AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Coregonus albula*
Common name	vendace
Assessor	Ana Marić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Management of vendace (Coregonus albula (L.)) in the lakes of northwest Poland in the late twentieth and early twenty-first centuries. 2006. Przemysław Czerniejewski Wawrzyniec	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Management of vendace (Coregonus albula (L.)) in the lakes of northwest Poland in the late twentieth and early twenty-first centuries. 2006. Przemysław Czerniejewski Wawrzyniec	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	https://www.cabi.org/isc/datasheet/88207 invasive itself	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	Climach	High
5	2.02	What is the quality of the climate matching data?	Medium	https://www.cabi.org/isc/datasheet/88207	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	Identifying threats from introduced and translocated non-native freshwater fishes in neighbouring countries under current and future climatic conditions Tena Radočaj a, Ivan Špelić a, Lorenzo Vilizzi b, *, Meta Povž c, Marina Piria. 2021	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	https://www.cabi.org/isc/datasheet/88207#toriskOfIntroduction	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	https://www.cabi.org/isc/datasheet/88207#todistributionDatabase Table Romania	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	https://www.cabi.org/isc/datasheet/88207#todistributionDatabase Table	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	https://www.cabi.org/isc/datasheet/88207#toriskAndImpactFactors	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	https://www.cabi.org/isc/datasheet/88207#toriskAndImpactFactors	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	https://www.cabi.org/isc/datasheet/88207#toriskAndImpactFactors	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	https://www.cabi.org/isc/datasheet/88207#toriskAndImpactFactors	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	https://www.cabi.org/isc/datasheet/88207#toriskAndImpactFactors	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	https://www.cabi.org/isc/datasheet/88207#toriskAndImpactFactors	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	Yes	https://www.cabi.org/isc/datasheet/88207#toriskAndImpactFactors	High
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	https://www.cabi.org/isc/datasheet/88207#toriskAndImpactFactors	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	https://www.cabi.org/isc/datasheet/88207#toriskAndImpactFactors	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	https://www.cabi.org/isc/datasheet/88207#toriskAndImpactFactors	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	https://www.cabi.org/isc/datasheet/88207#toriskAndImpactFactors	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Invasion of vendace Coregonus albula in a subarctic watercourse PA Amundsen et al 1999	Very high
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	https://www.cabi.org/isc/datasheet/88207#todescription	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	Effects of temperature, swimming speed and body mass on standard and active metabolic rate in vendace (Coregonus albula) Jan Ohlberger, Georg Staaks & Franz Hölker 2007	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	https://www.cabi.org/isc/datasheet/88207#tobiologyAndEcology	High

25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	https://www.cabi.org/isc/datasheet/88207#tobiologyAndEcology	High
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	https://www.cabi.org/isc/datasheet/88207#tobiologyAndEcology	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	https://www.cabi.org/isc/datasheet/88207#tobiologyAndEcology	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Yes	Year-class fluctuations in vendace, Coregonus albula (Linnaeus): Who's got the upper hand in intraspecific competition? OT Sandlund et al 1991	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	https://www.cabi.org/isc/datasheet/88207#tohistoryOfIntroductionAndSpread	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	https://www.cabi.org/isc/datasheet/88207#tohistoryOfIntroductionAndSpread	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	https://www.cabi.org/isc/datasheet/88207#tohistoryOfIntroductionAndSpread	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	https://www.cabi.org/isc/datasheet/88207#tohistoryOfIntroductionAndSpread	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	https://www.cabi.org/isc/datasheet/88207#tobiologyAndEcology	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	https://www.cabi.org/isc/datasheet/88207#tobiologyAndEcology	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	https://www.cabi.org/isc/datasheet/88207#tobiologyAndEcology	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	https://www.cabi.org/isc/datasheet/88207#tobiologyAndEcology	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	https://www.cabi.org/isc/datasheet/88207#tobiologyAndEcology	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	https://www.cabi.org/isc/datasheet/88207#tobiologyAndEcology	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	https://www.cabi.org/isc/datasheet/88207#tobiologyAndEcology	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	https://www.cabi.org/isc/datasheet/88207#tobiologyAndEcology	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	https://www.cabi.org/isc/datasheet/88207#tobiologyAndEcology	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	https://www.cabi.org/isc/datasheet/88207#toriskAndImpactFactors	High
43	7.09	Is dispersal of the taxon density dependent?	Yes	https://www.cabi.org/isc/datasheet/88207#tobiologyAndEcology	Very high
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	https://www.cabi.org/isc/datasheet/88207#tobiologyAndEcology	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	https://www.cabi.org/isc/datasheet/88207#topreventionAndControl temperature	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	https://www.cabi.org/isc/datasheet/88207#topreventionAndControl	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	https://www.cabi.org/isc/datasheet/88207#toriskAndImpactFactors	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	https://www.cabi.org/isc/datasheet/88207#tobiologyAndEcology	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	https://www.cabi.org/isc/datasheet/88207#tonotesOnNaturalEnemies	High
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	https://www.cabi.org/isc/datasheet/88207#tonotesOnNaturalEnemies	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	https://www.cabi.org/isc/datasheet/88207#topreventionAndControl	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	https://www.cabi.org/isc/datasheet/88207#topreventionAndControl	Medium

53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	https://www.cabi.org/isc/datasheet/88207#topreventionAndControl	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	https://www.cabi.org/isc/datasheet/88207#topreventionAndControl	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	https://www.cabi.org/isc/datasheet/88207#topreventionAndControl	High

Statistics	
Scores	
BRA	**28.5**
BRA Outcome	**-**
BRA+CCA	**20.5**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**11.5**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*7.5*
B. Biology/Ecology	**17.0**
4. Undesirable (or persistence) traits	*5.0*
5. Resource exploitation	*7.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*1.0*
8. Tolerance attributes	*3.0*
C. Climate change	**-8.0**
9. Climate change	*-8.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**4**
Environmental	**5**
Species or population nuisance traits	**13**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.80**
BRA	**0.82**
CCA	**0.71**

Date and Time
24/05/2021 17:15:19

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Coregonus albula*
Common name	vendace
Assessor	Ivan Špelić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Manikowska-Ślepowrońska, B., Szydzik, B. & Jakubas, D. Determinants of the presence of conflict bird and mammal species at pond fisheries in western Poland. Aquat Ecol 50, 87–95 (2016). https://doi.org/10.1007/s10452-015-9554-z. Farmed but no info on how long.	Medium
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Harvested for human consumption, can be used for biological control and stocking (CABI 2019).	Medium
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	Coregonidae species are widely introduced but not quite invasive.	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Climatch 2020	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Climatch 2020	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	Froese, R. and D. Pauly. Editors. 2021. FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Intentional introduction for angling or aquaculture (CABI 2019).	Low
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Hungary (not established) (Froese & Pauly 2020).	Low
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Froese & Pauly 2020	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	U.S. Fish and Wildlife Service (2012): Vendace (Coregonus albula) Ecological Risk Screening Summary. Revised, September 2014 and July 2015	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Used in experimental aquaculture, no documented adverse impacts (U.S. Fish and Wildlife Service (2012): Vendace (Coregonus albula) Ecological Risk Screening Summary. Revised, September 2014 and July 2015).	High
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	Being an effective zooplanktivore, vendace may heavily reduce the zooplankton stock, in turn leading to reduced algal grazing by zooplankton (trophic cascade). This may aid eutrophication of the lake (CABI 2019).	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Except for effects related to fisheries and sport fishing, where employment can be created in rural areas, there are no obvious social impacts of vendace invasions (CABI 2019).	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (Froese & Pauly 2020).	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Depletion of zooplankton and impact on native planktivorous species (U.S. Fish and Wildlife Service (2012): Vendace (Coregonus albula) Ecological Risk Screening Summary. Revised, September 2014 and July 2015).	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No parasitic behaviour.	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Coldwater species that tolerates temperatures up to 22 degrees Celsius (CABI 2019).	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	Can lead to trophic cascade due to depletion of zooplankton (CABI 2019).	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	Increased eutrophication and abundance of algae (CABI 2019).	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	U.S. Fish and Wildlife Service (2012): Vendace (Coregonus albula) Ecological Risk Screening Summary. Revised, September 2014 and July 2015	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	U.S. Fish and Wildlife Service (2012): Vendace (Coregonus albula) Ecological Risk Screening Summary. Revised, September 2014 and July 2015	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Maximum size 48 cm and 1 kg (Froese & Pauly 2020).	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	Lacustrine and marine in open water (Froese & Pauly 2020).	High

24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Depletion of zooplankton causes eutrophication (CABI 2019).	Medium
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Not documented in literature.	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	Feeds on planktonic crustaceans (Froese & Pauly).	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	No data for calculation.	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Kottelat & Freyhof 2007	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	Only established in northern Europe (CABI 2019, https://www.gbif.org/species/2351027).	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No related species in Croatia (Kottelat & Freyhof 2007).	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Kottelat & Freyhof 2007.	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	U.S. Fish and Wildlife Service (2012): Vendace (Coregonus albula) Ecological Risk Screening Summary. Revised, September 2014 and July 2015	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Froese & Pauly 2020	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Froese & Pauly 2020	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Intentional introductions, used as bait	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	Personal opinion.	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No adaptations.	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Established only in northern Europe (CABI 2019), questionable natural reproduction in Croatia (personal opinion).	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	Established only in northern Europe (CABI 2019), questionable natural reproduction in Croatia (personal opinion).	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	There are spawning migrations in established populations, but no natural reproduction expected in Croatia (personal opinion).	Medium
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Even where spawning eggs are deposited on gravel or sand 3-10 m deep (Froese & Pauly 2020).	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Intentional introductions.	Very high
43	7.09	Is dispersal of the taxon density dependent?	No	Not documented in literature.	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Sensitive species, especially to low oxygen and high temperatures (CABI 2019).	High
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	CABI 2019	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Not applicable	Not allowed in Croatia.	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	If other water parameters are met (CABI 2019).	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Although it can tolerate brackish water with a relatively low salinity, natural spread between different watercourses is typically limited by the high salinity of estuary waters (CABI 2019).	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	Yes	Natural enemies of vendace are piscivorous fish, birds and mammals, typically those that are foraging in pelagic areas such as brown trout (Salmo trutta), loons (Gavidae) and cormorants (Phalacrocoracidae) (CABI 2019).	Very high
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Only pathway is introduction by human.	High

51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Cold water species, tolerates water up to about 20 degrees Celsius (CABI 2019; COMTE, L., BUISSON, L., DAUFRESNE, M. and GRENOUILLET, G. (2013), Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58: 625-639.	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Cold water species, tolerates water up to about 20 degrees Celsius (CABI 2019; COMTE, L., BUISSON, L., DAUFRESNE, M. and GRENOUILLET, G. (2013), Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58: 625-639.	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Cold water species, tolerates water up to about 20 degrees Celsius (CABI 2019; COMTE, L., BUISSON, L., DAUFRESNE, M. and GRENOUILLET, G. (2013), Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58: 625-639. https://doi.org/10.1111/fwb.12081). Unsuitablle habitats will cause stress and decrease food ingestion that represents most	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	Cold water species, tolerates water up to about 20 degrees Celsius (CABI 2019; COMTE, L., BUISSON, L., DAUFRESNE, M. and GRENOUILLET, G. (2013), Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58: 625-639. https://doi.org/10.1111/fwb.12081). Unsuitablle habitats will cause stress and decrease food ingestion that represents most	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	Cold water species, tolerates water up to about 20 degrees Celsius (CABI 2019; COMTE, L., BUISSON, L., DAUFRESNE, M. and GRENOUILLET, G. (2013), Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58: 625-639. https://doi.org/10.1111/fwb.12081). Unsuitablle habitats will cause stress and decrease food ingestion that represents most adverse impact and it is leading to eutrophication.	High

Statistics	
Scores	
BRA	**15.0**
BRA Outcome	**-**
BRA+CCA	**5.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**12.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*10.0*
B. Biology/Ecology	**3.0**
4. Undesirable (or persistence) traits	*6.0*
5. Resource exploitation	*0.0*
6. Reproduction	*0.0*
7. Dispersal mechanisms	*-3.0*
8. Tolerance attributes	*0.0*
C. Climate change	**-10.0**
9. Climate change	*-10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**7**
Environmental	**3**
Species or population nuisance traits	**-3**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.73**
BRA	**0.72**
CCA	**0.75**

Date and Time
19/05/2021 11:23:44

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Coregonus albula*
Common name	vendace
Assessor	Tamara Kanjuh
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	cabi.org	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	cabi.org	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	cabi.org	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	Dfa, Dfb (Köppen–Geiger climate classification system)	High
5	2.02	What is the quality of the climate matching data?	High	Köppen–Geiger climate classification system	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Document?	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Intentional stocking.	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Intentional stocking.	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	cabi.org	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	cabi.org	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	cabi.org	High
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	cabi.org	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	cabi.org	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (FishBase)	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	cabi.org	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	The taxon is not a parasite.	High
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	cabi.org	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	cabi.org	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	cabi.org	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	cabi.org	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	cabi.org	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	No information found.	High
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	cabi.org	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	cabi.org	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	cabi.org	High

5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	cabi.org	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	cabi.org	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	No information found.	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	cabi.org	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	cabi.org	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	cabi.org	High
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	cabi.org	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	cabi.org	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	"Vendace: Coregonus albula (L.)". NatureGate. Retrieved 2013-12-18.	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Intentional stocking.	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Intentional stocking.	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	cabi.org	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	cabi.org	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	cabi.org	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	cabi.org	Medium
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	cabi.org	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Intentional stocking.	High
43	7.09	Is dispersal of the taxon density dependent?	No	cabi.org	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	cabi.org	High
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	cabi.org	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	cabi.org	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	cabi.org	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	cabi.org	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	cabi.org	High
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Highly adaptable to different environments.	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	Highly adaptable to different environments.	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	Highly adaptable to different environments.	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Highly adaptable to different environments.	Medium

54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	Highly adaptable to different environments.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Highly adaptable to different environments.	Medium

Statistics	
Scores	
BRA	**32.0**
BRA Outcome	**-**
BRA+CCA	**32.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**10.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*5.0*
B. Biology/Ecology	**22.0**
4. Undesirable (or persistence) traits	*8.0*
5. Resource exploitation	*7.0*
6. Reproduction	*3.0*
7. Dispersal mechanisms	*1.0*
8. Tolerance attributes	*3.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**7**
Environmental	**11**
Species or population nuisance traits	**17**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.71**
BRA	**0.73**
CCA	**0.54**

Date and Time
03/06/2021 14:45:25

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Coregonus albula*
Common name	vendace
Assessor	Tena Radocaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Manikowska-Ślepowrońska, B., Szydzik, B. & Jakubas, D. Determinants of the presence of conflict bird and mammal species at pond fisheries in western Poland. Aquat Ecol 50, 87–95 (2016). https://doi.org/10.1007/s10452-015-9554-z. Farmed but no info on how long.	Medium
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	It is harvested for human consumption. (Freyhof, J. 2011. Coregonus albula. The IUCN Red List of Threatened Species 2011: e.T5360A97801719)	Medium
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	no	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	The similarity between climatic conditions RA area and native range is medium. I use climatch.	Medium
5	2.02	What is the quality of the climate matching data?	Medium	The quality of the climate matching data is medium.	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	Vendace is not present outside of captivity in the RA area.	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	Vendace can use >1 potential vectors to enter in the RA area; intentional: human impact, unintentional: natural spread via natural and manmade watercourses	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	No	The nearest area where the Vedance lives is Poland, I think in the near future the Vedanec won't be present in the RA area.	Low
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Præbel, K., Gjelland, K. Ø., Salonen, E., & Amundsen, P. A. (2013). Invasion genetics of vendace (Coregonus albula (L.)) in the I nari-P asvik watercourse: revealing the origin and expansion pattern of a rapid colonization event. Ecology and evolution, 3(5),	Medium
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	U.S. Fish and Wildlife Service (2012): Vendace (Coregonus albula) Ecological Risk Screening Summary. Revised, September 2014 and July 2015	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Vendace no has adverse impacts on aquaculture.	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	Vendace have been observed to reduce zooplankton diversity, resulting in smaller zooplankton species and smaller sizes of individual zooplankters (Bøhn and Amundsen,1998; Amundsen et al., 2009). Being an effective zooplanktivore, vendace may heavily reduce the zooplankton stock, in turn leading to reduced algal grazing by zooplankton (trophic cascade). (CABI, 2019)	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Except for effects related to fisheries and sport fishing, where employment can be created in rural areas, there are no obvious social impacts of vendace invasions (CABI 2019).	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (Froese & Pauly 2020)	Medium
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Strong effects from the vendace planktivory have been reported as reduced zooplankton diversity, reduced individual zooplankter size, and reduced zooplankton densities. This has resulted in lowered zooplankton availability for planktivorous fish, and to a large extent displaced native planktivores from the pelagic fish communities through exploitative competition. (CABI, 2019)	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Coldwater species that tolerates temperatures up to 22 degrees Celsius (CABI 2019).	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	Vendace maybe will disrupt food-web structure in the RA area. The presence of Vendace may result in a reduced availability of zooplankton for planktivorous fish and may adversely impact populations of native planktivore fish	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	Vendace maybe will have a negative impact on the economic outcome of fisheries for other species that could be negatively affected by the vendace invasion.	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Yes, the taxon may be a host or vector of known pests and infectious agents endemic to RA area. Because in every area exist infectious agents and pests.	Low

21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	It is possible, each fish can host or vector the disease, as such it can introduce the disease into the area where it occurs.	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Max length : 48.0 cm TL (Fishbase)	Medium
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	Lacustrine and marine in open water (Froese & Pauly 2020).	Low
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Depletion of zooplankton causes eutrophication (CABI 2019).	Medium
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Introduction to one area with low number of specimens wasn't succesful	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	Vendace not consume threatened of protected native taxa in the RA area.	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	not applicable	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Kottelat & Freyhof 2007	Low
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	Only established in northern Europe (CABI 2019)	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	no	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	no	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	no	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Vendace have high fecundity and many small eggs (80-300 egg per gram body mass). (CABI 2019)	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Spawns for the first time at 2-5 years (Freyhof, J. 2011. Coregonus albula. The IUCN Red List of Threatened Species 2011: e.T5360A97801719)	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	1.accidental introduction, 2.human-impact 3. natural spread via natural and manmade watercourses	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	All of these vectors/pathways can bring taxon in protected area.	Medium
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Freyhof, J. 2011. Coregonus albula. The IUCN Red List of Threatened Species 2011: e.T5360A97801719	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	Freyhof, J. 2011. Coregonus albula. The IUCN Red List of Threatened Species 2011: e.T5360A97801719	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	no	Low
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	There is a possibility of a high rate of spread of taxa. Eg. if a fertilized individual enters a new area by any means of expansion.	Low
43	7.09	Is dispersal of the taxon density dependent?	No	Personal opinion	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	personal opinion	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Sensitive	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Not applicable	It is not regulated in Croatia	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Dispersal downstream within a watercourse can be expected, even if the watercourse is regulated by dams. (CABI, 2019)	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Vendace is a freshwater fish species. Although it can tolerate brackish water with a relatively low salinity, natural spread between different watercourses is typically limited by the high salinity of estuary waters. (CABI, 2019)	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Silurus glanis, Northen pike, Brown trout	Medium
C. Climate change					

9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Only pathway is introduction by human	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Cold water species, tolerates water up to about 20 degrees Celsius (CABI 2019).	Low
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Cold water species, tolerates water up to about 20 degrees Celsius (CABI 2019).	Low
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Unsuitablle habitats will cause stress and decrease food ingestion that represents most adverse impact.	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	Unsuitablle habitats will cause stress and decrease food ingestion that represents most adverse impact.	Low
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	Unsuitablle habitats will cause stress and decrease food ingestion that represents most adverse impact and it is leading to eutrophication.	Low

Statistics	
Scores	
BRA	**14.5**
BRA Outcome	**-**
BRA+CCA	**4.5**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**10.5**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*7.5*
B. Biology/Ecology	**4.0**
4. Undesirable (or persistence) traits	*6.0*
5. Resource exploitation	*0.0*
6. Reproduction	*0.0*
7. Dispersal mechanisms	*-2.0*
8. Tolerance attributes	*0.0*
C. Climate change	**-10.0**
9. Climate change	*-10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**7**
Environmental	**3**
Species or population nuisance traits	**-2**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.38**
BRA	**0.39**
CCA	**0.29**

Date and Time
08/05/2020 07:53:26

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Coregonus lavaretus*
Common name	European whitefish
Assessor	Ana Marić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Effect of eye fluke infection on the growth of whitefish (Coregonus lavaretus) —An experimental approach Author links open overlay panelAnssiKarvonenaOttoSeppälä. 2008	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	https://www.iucnredlist.org/species/5369/174778292	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Coregonus albula	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Europe whitefish	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Logic	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Habekovic, D. (1972). Introdukcija Coregonusa -- ozimica u nase vode. Ribarstvo Jugoslavije, 28, 143.	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Habekovic, D. (1972). Introdukcija Coregonusa -- ozimica u nase vode. Ribarstvo Jugoslavije, 28, 143.	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Habekovic, D. (1972). Introdukcija Coregonusa -- ozimica u nase vode. Ribarstvo Jugoslavije, 28, 143.	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	FRESHWATER ALIEN FISH SPECIES INTRODUCED INTO CROATIA FOR AQUACULTURE AND CONSEQUENCES OF THEIR ESCAPES AND RELEASES IN INLAND WATERS Marina Piria1*, Divna Lukić1, Tatjana Boroša-Pecigoš 2016	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	Berg S., Jeppesen E., Søndergaard M., Mortensen E. (1994) Environmental effects of introducing whitefish, Coregonus lavaretus (L.), in Lake Ring. In: Mortensen E., Jeppesen E., Søndergaard M., Nielsen L.K. (eds) Nutrient Dynamics and Biological Structure in Shallow Freshwater and Brackish Lakes. Developments in Hydrobiology, vol 94. Springer, Dordrecht. https://doi.org/10.1007/978-94-017-2460-9_7	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Berg S., Jeppesen E., Søndergaard M., Mortensen E. (1994) Environmental effects of introducing whitefish, Coregonus lavaretus (L.), in Lake Ring. In: Mortensen E., Jeppesen E., Søndergaard M., Nielsen L.K. (eds) Nutrient Dynamics and Biological Structure in Shallow Freshwater and Brackish Lakes. Developments in Hydrobiology, vol 94. Springer, Dordrecht. https://doi.org/10.1007/978-94-017-2460-9_7	High
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	Berg S., Jeppesen E., Søndergaard M., Mortensen E. (1994) Environmental effects of introducing whitefish, Coregonus lavaretus (L.), in Lake Ring. In: Mortensen E., Jeppesen E., Søndergaard M., Nielsen L.K. (eds) Nutrient Dynamics and Biological Structure in Shallow Freshwater and Brackish Lakes. Developments in Hydrobiology, vol 94. Springer, Dordrecht. https://doi.org/10.1007/978-94-017-2460-9_7	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Berg S., Jeppesen E., Søndergaard M., Mortensen E. (1994) Environmental effects of introducing whitefish, Coregonus lavaretus (L.), in Lake Ring. In: Mortensen E., Jeppesen E., Søndergaard M., Nielsen L.K. (eds) Nutrient Dynamics and Biological Structure in Shallow Freshwater and Brackish Lakes. Developments in Hydrobiology, vol 94. Springer, Dordrecht. https://doi.org/10.1007/978-94-017-2460-9_7	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	https://www.iucnredlist.org/species/5369/174778292	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	Berg S., Jeppesen E., Søndergaard M., Mortensen E. (1994) Environmental effects of introducing whitefish, Coregonus lavaretus (L.), in Lake Ring. In: Mortensen E., Jeppesen E., Søndergaard M., Nielsen L.K. (eds) Nutrient Dynamics and Biological Structure in Shallow Freshwater and Brackish Lakes. Developments in Hydrobiology, vol 94. Springer, Dordrecht. https://doi.org/10.1007/978-94-017-2460-9_7	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	https://www.iucnredlist.org/species/5369/174778292	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Kottelat 2007	High

18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	Berg S., Jeppesen E., Søndergaard M., Mortensen E. (1994) Environmental effects of introducing whitefish, Coregonus lavaretus (L.), in Lake Ring. In: Mortensen E., Jeppesen E., Søndergaard M., Nielsen L.K. (eds) Nutrient Dynamics and Biological Structure in Shallow Freshwater and Brackish Lakes. Developments in Hydrobiology, vol 94. Springer, Dordrecht. https://doi.org/10.1007/978-94-017-2460-9_7	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	Habekovic, D. (1972). Introdukcija Coregonusa -- ozimica u nase vode. Ribarstvo Jugoslavije, 28, 143.	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	Habekovic, D. (1972). Introdukcija Coregonusa -- ozimica u nase vode. Ribarstvo Jugoslavije, 28, 143.	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Effect of eye fluke infection on the growth of whitefish (Coregonus lavaretus) —An experimental approach Author links open overlay panelAnssiKarvonenaOttoSeppälä. 2008	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	Kottelat 2007	High
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	https://www.fishbase.in/summary/Coregonus-lavaretus.html	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Berg S., Jeppesen E., Søndergaard M., Mortensen E. (1994) Environmental effects of introducing whitefish, Coregonus lavaretus (L.), in Lake Ring. In: Mortensen E., Jeppesen E., Søndergaard M., Nielsen L.K. (eds) Nutrient Dynamics and Biological Structure in Shallow Freshwater and Brackish Lakes. Developments in Hydrobiology, vol 94. Springer, Dordrecht. https://doi.org/10.1007/978-94-017-2460-9_7	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Berg S., Jeppesen E., Søndergaard M., Mortensen E. (1994) Environmental effects of introducing whitefish, Coregonus lavaretus (L.), in Lake Ring. In: Mortensen E., Jeppesen E., Søndergaard M., Nielsen L.K. (eds) Nutrient Dynamics and Biological Structure in Shallow Freshwater and Brackish Lakes. Developments in Hydrobiology, vol 94. Springer, Dordrecht. https://doi.org/10.1007/978-94-017-2460-9_7	High
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Berg S., Jeppesen E., Søndergaard M., Mortensen E. (1994) Environmental effects of introducing whitefish, Coregonus lavaretus (L.), in Lake Ring. In: Mortensen E., Jeppesen E., Søndergaard M., Nielsen L.K. (eds) Nutrient Dynamics and Biological Structure in Shallow Freshwater and Brackish Lakes. Developments in Hydrobiology, vol 94. Springer, Dordrecht. https://doi.org/10.1007/978-94-017-2460-9_7	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	Berg S., Jeppesen E., Søndergaard M., Mortensen E. (1994) Environmental effects of introducing whitefish, Coregonus lavaretus (L.), in Lake Ring. In: Mortensen E., Jeppesen E., Søndergaard M., Nielsen L.K. (eds) Nutrient Dynamics and Biological Structure in Shallow Freshwater and Brackish Lakes. Developments in Hydrobiology, vol 94. Springer, Dordrecht. https://doi.org/10.1007/978-94-017-2460-9_7	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Yes	Probably	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Habekovic, D. (1972). Introdukcija Coregonusa -- ozimica u nase vode. Ribarstvo Jugoslavije, 28, 143.	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	Habekovic, D. (1972). Introdukcija Coregonusa -- ozimica u nase vode. Ribarstvo Jugoslavije, 28, 143.	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	https://www.iucnredlist.org/species/5369/174778292	High
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	https://www.iucnredlist.org/species/5369/174778292	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	https://www.iucnredlist.org/species/5369/174778292	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	Planktivory and diet-overlap of densely rakered whitefish (Coregonus lavaretus (L.)) in a subarctic lake K. Kahilainen, E. Alajärvi, H. Lehtonen. 2005	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Habekovic, D. (1972). Introdukcija Coregonusa -- ozimica u nase vode. Ribarstvo Jugoslavije, 28, 143.	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Habekovic, D. (1972). Introdukcija Coregonusa -- ozimica u nase vode. Ribarstvo Jugoslavije, 28, 143.	Very high
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	Habekovic, D. (1972). Introdukcija Coregonusa -- ozimica u nase vode. Ribarstvo Jugoslavije, 28, 143.	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Habekovic, D. (1972). Introdukcija Coregonusa -- ozimica u nase vode. Ribarstvo Jugoslavije, 28, 143.	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Habekovic, D. (1972). Introdukcija Coregonusa -- ozimica u nase vode. Ribarstvo Jugoslavije, 28, 143.	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Habekovic, D. (1972). Introdukcija Coregonusa -- ozimica u nase vode. Ribarstvo Jugoslavije, 28, 143.	High

41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Habekovic, D. (1972). Introdukcija Coregonusa -- ozimica u nase vode. Ribarstvo Jugoslavije, 28, 143.	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	Habekovic, D. (1972). Introdukcija Coregonusa -- ozimica u nase vode. Ribarstvo Jugoslavije, 28, 143.	High
43	7.09	Is dispersal of the taxon density dependent?	Yes	Effects of Climatic and Density-Dependent Factors on Year-Class Strength of Coregonus lavaretus in Lake Constance Authors: Reiner Eckmann, Ursula Gaedke, and Hans Johst Wetzlar. 1988	Very high
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	https://www.fishbase.in/summary/Coregonus-lavaretus.html	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	https://www.luontoportti.com/suomi/en/kalat/whitefish	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	https://www.luontoportti.com/suomi/en/kalat/whitefish	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	https://www.luontoportti.com/suomi/en/kalat/whitefish	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	https://www.luontoportti.com/suomi/en/kalat/whitefish	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	https://www.luontoportti.com/suomi/en/kalat/whitefish	Very high
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Habekovic, D. (1972). Introdukcija Coregonusa -- ozimica u nase vode. Ribarstvo Jugoslavije, 28, 143.	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	Habekovic, D. (1972). Introdukcija Coregonusa -- ozimica u nase vode. Ribarstvo Jugoslavije, 28, 143.	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	Habekovic, D. (1972). Introdukcija Coregonusa -- ozimica u nase vode. Ribarstvo Jugoslavije, 28, 143.	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Habekovic, D. (1972). Introdukcija Coregonusa -- ozimica u nase vode. Ribarstvo Jugoslavije, 28, 143.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	Habekovic, D. (1972). Introdukcija Coregonusa -- ozimica u nase vode. Ribarstvo Jugoslavije, 28, 143.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	Habekovic, D. (1972). Introdukcija Coregonusa -- ozimica u nase vode. Ribarstvo Jugoslavije, 28, 143.	Medium

Statistics	
Scores	
BRA	**21.0**
BRA Outcome	**-**
BRA+CCA	**15.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**7.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*2.0*
B. Biology/Ecology	**14.0**
4. Undesirable (or persistence) traits	*5.0*
5. Resource exploitation	*7.0*
6. Reproduction	*2.0*
7. Dispersal mechanisms	*1.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**-6.0**
9. Climate change	*-6.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**2**
Environmental	**4**

Species or population nuisance traits	11

Thresholds	
BRA	-
BRA+CCA	-
Confidence	
BRA+CCA	0.77
BRA	0.79
CCA	0.63

Date and Time
25/05/2021 09:33:02

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Coregonus lavaretus*
Common name	European whitefish
Assessor	Ivan Špelić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Froese & Pauly 2020	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	No	Farmed for food and restocking, no harvesting	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	There is no invasive subspecies	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	Climatch 2020	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Climatch 2020	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	Not applicable	Already present (Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	Already present (Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Simonović, 2012	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Introductions to countries outside its native range have resulted in negative impacts for native species (Powan (Coregonus lavaretus) Ecological Risk Screening Summary, U.S. Fish and Wildlife Service, August 2012).	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	no documented evidence	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	The species is one of the most widely introduced fish species in northern Europe and has partially or completely displaced many native Arctic charr (Salvelinus alpinus) populations (Powan (Coregonus lavaretus) Ecological Risk Screening Summary, U.S. Fish and Wildlife Service, August 2012) probably decreasing	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	The species is one of the most widely introduced fish species in northern Europe and has partially or completely displaced many native Arctic charr (Salvelinus alpinus) populations (Powan (Coregonus lavaretus) Ecological Risk Screening Summary, U.S. Fish and Wildlife Service, August 2012) probably decreasing	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Jevtić, 1991	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	The species is one of the most widely introduced fish species in northern Europe and has partially or completely displaced many native Arctic charr (Salvelinus alpinus) (Powan (Coregonus lavaretus) Ecological Risk Screening Summary, U.S. Fish and Wildlife Service, August 2012).	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	Jevtić, 1991	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	This is a species living in clear, cold and well-oxygenated waters (Orban et al. 2006).	Very high
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	Foraging by introduced C. lavaretus can change the structure of the zooplankton community (Powan (Coregonus lavaretus) Ecological Risk Screening Summary, U.S. Fish and Wildlife	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	The main conclusion is that whitefish stocking of eutrophic lakes for commercial or other purposes may delay their recovery following nutrient load reduction, or even lead to enhanced eutrophication (Berg 1994).	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Skall et al. (2004)	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Skall et al. (2004)	High

22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	In introduced lake: 50 cm TL (Jevtić, 1991)	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Jevtić, 1991	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	It is written that there is no impact but without research (Jevtić, 1991)	Low
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Introduction to one area with low number of specimens wasn't succesful (Habeković, 1978)	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	Feeds on planktonic crustaceans (Froese & Pauly 2020).	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	No data for calculations.	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Jevtić, 1991	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Jevtić, 1991	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No related native taxa	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Jevtić, 1991	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Spawns in gravel, near shore, in shallow waterv(Froese & Pauly 2020).	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Jevtić, 1991 (30 000-50000)	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	1-4 years in literature (Froese & Pauly 2020).	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Intentional introductions for angling (Froese and Pauly 2020) Floods (Povž et al. 2015)	Low
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	Personal opinion	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No known adaptations	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Jevtić, 1991	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Næsje, T., Jonsson, B., and Sandlund, O. 1986. Drift of cisco and white-fish larvae in a Norwegian river. Transactions of the American Fisheries Society, 115: 37–41.	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	No documented data	Low
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Personal opinion	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Floods, introductions	Very high
43	7.09	Is dispersal of the taxon density dependent?	No	no documented data	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Personal opinion	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Very sensitive to changes in temperature (Povž et al. 2015).	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	not allowed in the region.	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Known to live in artificial reservoirs (Jevtić 1991).	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Coregonus lavaretus sensu lato can be found in different kinds of fresh-, brackish- and saltwater habitats (Papakostas, S., A. Vasemägi, J.-P. Vähä, M. Himberg, L. Peil et al., 2012 A proteomics approach reveals divergent molecular responses to salinity in populations of European whitefish (Coregonus lavaretus). Mol. Ecol. 21: 3516–3530.	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	Yes	Perch and pike (SAKSGÅRD, R., NÆSJE, T.F., SANDLUND O.T., UGEDAL, O. (2002): The effect of fish predators on whitefish (Coregonus lavaretus) habitat use in Lake Femund, a deep Norwegian Lake. – Arch. Hydrobiol. Spec. Issues Advanc. Limnol.	Very high
C. Climate change					

9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	Already present (Povže et al. 2015).	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	During the spawning season, water temperatures exceeding 8 °C, as are expected due to climate change, will likely cause a decline in whitefish reproductive success (Gillet 1991, Anneville et al. 2013).	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	During the spawning season, water temperatures exceeding 8 °C, as are expected due to climate change, will likely cause a decline in whitefish reproductive success (Gillet 1991, Anneville et al. 2013). Intentional releases may stay the same but natural recruitment may decrease.	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	No recorded impacts so no change expected.	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	No recorded impact so no change expected.	Low
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	No recorded impact so no change expected.	Low

Statistics	
Scores	
BRA	**20.5**
BRA Outcome	**-**
BRA+CCA	**16.5**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**11.5**
1. Domestication/Cultivation	*0.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*10.5*
B. Biology/Ecology	**9.0**
4. Undesirable (or persistence) traits	*6.0*
5. Resource exploitation	*0.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*-1.0*
8. Tolerance attributes	*3.0*
C. Climate change	**-4.0**
9. Climate change	*-4.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**10**
Environmental	**5**
Species or population nuisance traits	**5**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.75**
BRA	**0.79**
CCA	**0.46**

Date and Time
13/05/2021 20:49:03

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Coregonus lavaretus*
Common name	European whitefish
Assessor	Tamara Kanjuh
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	FishBase	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	FishBase	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No information found.	Medium
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Dfa, Dfb (Köppen–Geiger climate classification system)	High
5	2.02	What is the quality of the climate matching data?	High	Köppen–Geiger climate classification system	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Froese&Pauly (2015)	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Fisheries	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Fisheries, intentional stocking	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	No	cabi.org	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	No information found.	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No information found.	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	No information found.	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	cabi.org	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (FishBase)	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Sandlund et al. (2011)	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	The taxon is not a parasite.	High
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	cabi.org	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	Sandlund et al. (2011)	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	cabi.rs	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No information found.	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Skill et al. (2004); Brzuzan et al. (2007)	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	No information found.	Medium
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	cabi.org	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Eloranta et al. (2011); Berg et al. (1994)	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	No information found.	Medium

5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	fws.gov	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	fws.gov	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	No information found.	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	cabi.org	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No information found.	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Froese&Pauly (2015)	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	No information found.	Medium
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Froese&Pauly (2015)	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Similiar to other Coregonus.	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Intentional stocking.	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Intentional stocking.	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	Not known.	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	Eggs and larvae follow currents and drift downstream in rivers - similar to other Coregonus.	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Similar to other Coregonus.	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	No infom information found.	Medium
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	cabi.org	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Intentional stocking.	Medium
43	7.09	Is dispersal of the taxon density dependent?	No	No information found.	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	The taxon can not survive out of water.	High
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	cabi.org	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	No information found.	Medium
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	cabi.org	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	cabi.org	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	No information found.	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Adaptable to different environments - similat to other Coregonus.	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	Adaptable to different environments - similat to other Coregonus.	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	Adaptable to different environments - similat to other Coregonus.	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Adaptable to different environments - similat to other Coregonus.	Medium

54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	Adaptable to different environments - similat to other Coregonus.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Adaptable to different environments - similat to other Coregonus.	Medium

Statistics	
Scores	
BRA	**24.0**
BRA Outcome	**-**
BRA+CCA	**24.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**5.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*2.0*
B. Biology/Ecology	**19.0**
4. Undesirable (or persistence) traits	*7.0*
5. Resource exploitation	*7.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*1.0*
8. Tolerance attributes	*3.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**9**
Environmental	**9**
Species or population nuisance traits	**9**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.61**
BRA	**0.63**
CCA	**0.50**

Date and Time
03/06/2021 23:57:03

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Coregonus lavaretus*
Common name	European whitefish
Assessor	Tena Radocaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	No	Habeković 1978; succesfully introduced 1977 in Croatia.	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	This species is grown for human consummation and as a food source, whitefish is an appreciated and valuable freshwater fish species is caught in nature. (Vielma, J., Koskela, J., Ruohonen, K., Jokinen, I., & Kettunen, J. (2003). Optimal diet composition for European whitefish (Coregonus lavaretus): carbohydrate stress and immune parameter responses. Aquaculture, 225(1-4), 3-16.) (Orban, E., Masci, M., Nevigato, T., Di Lena, G., Casini, I., Caproni, R., & Rampacci, M. (2006). Nutritional quality and safety of whitefish (Coregonus lavaretus) from Italian lakes. Journal of Food Composition and Analysis, 19(6-7), 737-746.)	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	There is no invasive subspecies as I know; I didn't find any data	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	The similarity between climatic conditions RA area and native range is medium. I use climatch.	Medium
5	2.02	What is the quality of the climate matching data?	Medium	The quality of the climate matching data is medium.	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	This species is present outside of captivity in RA area	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	None	It is present in Croatia	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	not applicable	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Simonović, 2012	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	no documented evidence	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	no documented evidence	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	It is stated that in introduced area no negative impacts (Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.) but without any research	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Personal opinion	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	Also is stated that there is no competition with native species without research (Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.)	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Yes, this taxon is adapted on climate and environmental conditions, these species have self-sustaining populations in RA area. (Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26)	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	Maybe, it is possible there is a possibility that it will disrupt the nutritional structure, and reduce the abundance of benthic invertebrates.	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	My personal opinion is no	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Yes, the taxon may be a host or vector of known pests and infectious agents endemic to RA area. Because in every area exist infectious agents and pests.	Low

21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Whitefish are potential carriers of VHSV [viral haemorrhagic septicaemia virus] as they suffer only low mortality after infection but continue to carry virus,Bacterial kidney disease … Renibacterium salmoninarum. (Skall, H. F., T. E. Kjær, and N. J. Olesen. 2004. Investigation of wild caught whitefish, Coregonus lavaretus (L.), for infection with viral haemorrhagic septicaemia virus (VHSV) and experimental challenge of whitefish with VHSV. Journal of Fish Diseases 27(7):401-408.) (Rimaila-Pärnänen, E. 2002. First case of bacterial kidney disease (BKD) in whitefish (Coregonus lavaretus) in Finland. Bulletin of the European Association of Fish Pathologists 22(6):403-404.)	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	In introduced lake: 50 cm TL (Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.)	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	It is written that there is no impact but without research (Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.)	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Introduction to one area with low number of specimens wasn't succesful (Habeković, 1978)	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	It is possible that it consume endangered and protected native taxa in the RA area. If there are protected taxa in the RA area, the european whitefish will consume them, whether or not the taxon	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	not applicable	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	30 000-50000. (Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26).	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	In the second year of life it reaches sexual maturity. (Orban, E., Masci, M., Nevigato, T., Di Lena, G., Casini, I., Caproni, R., ... & Rampacci, M. (2006). Nutritional quality and safety of whitefish (Coregonus lavaretus) from Italian lakes. Journal of Food Composition and Analysis, 19(6-7), 737-746.)	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	1.accidental introduction, 2.human-mediated 3. natural spread via natural and manmade watercourses	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	This species is present in protected area in Croatia	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	personal opinion	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	No documented data	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Personal opinion	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	There is a possibility of a high rate of spread of taxa. Eg. if a fertilized individual enters a new area by any means of expansion.	Low
43	7.09	Is dispersal of the taxon density dependent?	No	no documented data	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Personal opinion	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Can't survive in extremes	Very high

46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Not applicable	No regulation in Croatia as I know	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Personal opinion	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Freshwater species	Very high
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	no known enemies in RA area	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	not applicable	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Considering climate change, population in the RA area is likely to decline, as this species does not tolerate high temperatures.	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	The risk of taxa spreading in the RA area is declining, currently this species in Croatia resides in only one reservoir, I believe that under the influence of climate change it will not spread further, but its number will decline due to differences in temperature.	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	no	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	Personal opinion, no impact	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	No impact	Medium

Statistics	
Scores	
BRA	**14.5**
BRA Outcome	**-**
BRA+CCA	**10.5**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**1.5**
1. Domestication/Cultivation	*0.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*1.5*
B. Biology/Ecology	**13.0**
4. Undesirable (or persistence) traits	*7.0*
5. Resource exploitation	*5.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*2.0*
8. Tolerance attributes	*-2.0*
C. Climate change	**-4.0**
9. Climate change	*-4.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**3**
Environmental	**8**
Species or population nuisance traits	**3**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.70**
BRA	**0.72**
CCA	**0.54**

Date and Time
01/06/2020 10:34:50

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Coregonus peled*
Common name	peled
Assessor	Ana Marić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Occurrence of Yersinia ruckeri infection in farmed whitefish, Coregonus peled Gmelin and Coregonus muksun Pallas, and Atlantic salmon, Salmo salar L., in northern Finland. Rintamaki et	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Habekovic. Introdukcija koregonusa u nase vode. 1972	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Coregonus albula	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	Russia north	High
5	2.02	What is the quality of the climate matching data?	Medium	Logical	Very high
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Habekovic. Introdukcija koregonusa u nase vode. 1972	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Habekovic. Introdukcija koregonusa u nase vode. 1972	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Habekovic. Introdukcija koregonusa u nase vode. 1972	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	FRESHWATER ALIEN FISH SPECIES INTRODUCED INTO CROATIA FOR AQUACULTURE AND CONSEQUENCES OF THEIR ESCAPES AND RELEASES IN INLAND WATERS Marina Piria1*, Divna Lukiæ1, Tatjana Boroša-Pecigoš. 2016	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Native vendace (Coregonus albula) and alien peled (C. peled): genetic comparison and introgressive hybridization. Borovikova, E et al. 2016 Introgressive hybridization of the introduced peled (Coregonus peled) with the native whitefish (Coregonus lavaretus) threatens indigenous coregonid populations: a case study. Author(s) : Luczynski, M. ; Mamcarz, A. ; Brzuzan, P. ; Demska-	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	https://www.luontoportti.com/suomi/en/kalat/peled	High
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	https://www.luontoportti.com/suomi/en/kalat/peled	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	https://www.luontoportti.com/suomi/en/kalat/peled	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	https://www.fishbase.se/summary/Coregonus-peled.html	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	https://www.fishbase.se/summary/Coregonus-peled.html	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	https://www.fishbase.se/summary/Coregonus-peled.html	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	https://www.luontoportti.com/suomi/en/kalat/peled	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	Ecological succession in mountain lake ecosystems of Southern Siberia after the introduction of the peled – Coregonus peled (Gmeli, 1778) V. K. Popkov. 2017	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	https://www.luontoportti.com/suomi/en/kalat/peled	Very high
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	The Long-Term Dynamics of Parasite Infection in Coregonids with Different Food Specializations A. L. Gavrilov & O. A. Gos'kova. 2018	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	The Long-Term Dynamics of Parasite Infection in Coregonids with Different Food Specializations A. L. Gavrilov & O. A. Gos'kova. 2018	Very high
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	https://www.luontoportti.com/suomi/en/kalat/peled	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Drift of Cisco and Whitefish Larvae in a Norwegian River Tor F. Næsje, Bror Jonsson, Odd T. Sandlund. 1986	High

24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	https://www.luontoportti.com/suomi/en/kalat/peled	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Relationship between annual variation in reservoir conditions and year-class strength of peled (Coregonus peled) and whitefish (C. lavaretus) Tapio Sutela1, Ahti Mutenia2 & Erno Salonen. 2002	High
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Ecological succession in mountain lake ecosystems of Southern Siberia after the introduction of the peled – Coregonus peled (Gmeli, 1778) V. K. Popkov. 2018	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	Ecological succession in mountain lake ecosystems of Southern Siberia after the introduction of the peled – Coregonus peled (Gmeli, 1778) V. K. Popkov. 2018	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Yes	Ecological succession in mountain lake ecosystems of Southern Siberia after the introduction of the peled – Coregonus peled (Gmeli, 1778) V. K. Popkov. 2018	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	FRESHWATER ALIEN FISH SPECIES INTRODUCED INTO CROATIA FOR AQUACULTURE AND CONSEQUENCES OF THEIR ESCAPES AND RELEASES IN INLAND WATERS Marina Piria1*, Divna Lukiæ1, Tatjana Boroša-Pecigoš2 1University. 2016	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Native vendace (Coregonus albula) and alien peled (C. peled): genetic comparison and introgressive hybridization. Borovikova, E et al. 2016 Introgressive hybridization of the introduced peled (Coregonus peled) with the native whitefish (Coregonus lavaretus) threatens indigenous coregonid populations: a case study. Author(s) : Luczynski, M. ; Mamcarz, A. ; Brzuzan, P. ; Demska-	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	https://www.fishbase.se/summary/Coregonus-peled.html	High
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	https://www.fishbase.se/summary/Coregonus-peled.html	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Relationship between annual variation in reservoir conditions and year-class strength of peled (Coregonus peled) and whitefish (C. lavaretus) Tapio Sutela1, Ahti Mutenia2 & Erno Salonen. 2002	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Ecological succession in mountain lake ecosystems of Southern Siberia after the introduction of the peled – Coregonus peled (Gmeli, 1778) V. K. Popkov. 2018	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Habekovic. Introdukcija koregonusa u nase vode. 1972	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Habekovic. Introdukcija koregonusa u nase vode. 1972	Very high
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	https://www.fishbase.se/summary/Coregonus-peled.html	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Habekovic. Introdukcija koregonusa u nase vode. 1972	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Habekovic. Introdukcija koregonusa u nase vode. 1972	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Habekovic. Introdukcija koregonusa u nase vode. 1972	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Habekovic. Introdukcija koregonusa u nase vode. 1972	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	https://www.luontoportti.com/suomi/en/kalat/peled	High
43	7.09	Is dispersal of the taxon density dependent?	Yes	Effects of Climatic and Density-Dependent Factors on Year-Class Strength of Coregonus lavaretus in Lake Constance. Reiner Eckmann, Ursula Gaedke, and Hans Johst Wetzlar. 1988	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	https://www.fishbase.se/summary/Coregonus-peled.html	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	https://www.luontoportti.com/suomi/en/kalat/peled Relationship between annual variation in reservoir conditions and year-class strength of peled (Coregonus peled) and whitefish (C. lavaretus) Tapio Sutela1, Ahti Mutenia2 & Erno Salonen. 2002	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	https://www.luontoportti.com/suomi/en/kalat/peled Relationship between annual variation in reservoir conditions and year-class strength of peled (Coregonus peled) and whitefish (C. lavaretus) Tapio Sutela1, Ahti Mutenia2 & Erno Salonen. 2002	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	https://www.luontoportti.com/suomi/en/kalat/peled	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	https://www.fishbase.se/summary/Coregonus-peled.html	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	https://www.fishbase.se/summary/Coregonus-peled.html	High
C. Climate change					
9. Climate change					

50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	FRESHWATER ALIEN FISH SPECIES INTRODUCED INTO CROATIA FOR AQUACULTURE AND CONSEQUENCES OF THEIR ESCAPES AND RELEASES IN INLAND WATERS Marina Piria1*, Divna Lukić1, Tatjana Boroša-Pecigoš 2016	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Coregonus peled, Northern Whitefish Assessment by: Freyhof, J. & Kottelat, M.. Red list	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Coregonus peled, Northern Whitefish Assessment by: Freyhof, J. & Kottelat, M.	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Coregonus peled, Northern Whitefish Assessment by: Freyhof, J. & Kottelat, M.	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	Coregonus peled, Northern Whitefish Assessment by: Freyhof, J. & Kottelat, M.	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Coregonus peled, Northern Whitefish Assessment by: Freyhof, J. & Kottelat, M.	High

Statistics	
Scores	
BRA	**23.5**
BRA Outcome	**-**
BRA+CCA	**19.5**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**9.5**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*4.5*
B. Biology/Ecology	**14.0**
4. Undesirable (or persistence) traits	*3.0*
5. Resource exploitation	*7.0*
6. Reproduction	*4.0*
7. Dispersal mechanisms	*1.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**-4.0**
9. Climate change	*-4.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**7**
Environmental	**7**
Species or population nuisance traits	**8**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.83**
BRA	**0.83**
CCA	**0.79**

Date and Time
24/05/2021 23:40:57

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Coregonus peled*
Common name	peled
Assessor	Ivan Špelić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Matousek, J., Stejskal, V., Prokesova, M., & Kouril, J. (2016). The effect of water temperature on growth parameters of intensively reared juvenile peled Coregonus peled . Aquaculture Research, 48(4), 1877–1884. doi:10.1111/are.13025	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	No	Harvested for food, stocked from farms (personal opinion).	Medium
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	Coregonidae are widely introduced but not considered as serious pests.	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	Climatch 2020	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Climatch 2020	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Introduced to Serbia (Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021))	Medium
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	Not applicable	Already present	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	Already present.	Medium
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Salonen, E. & Mutenia, A. 2007. Alien fish species in northern-most Finland. Riista- ja kalatalous – Tutkimuksia 2: 1 – 16(Report of the Finnish Game and Fisheries Research Institute).	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Popović, D., Szczepkowski, M., Heese, T., & Weglenski, P. (2015). Introgression of peled (Coregonus peled) into European whitefish (C. lavaretus) in Poland. Conservation Genetics, 17(2), 503–508. doi:10.1007/s10592-015-0786-1	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No reported adverse impacts, used in aquaculture (Matousek, J., Stejskal, V., Prokesova, M., & Kouril, J. (2016). The effect of water temperature on growth parameters of intensively reared juvenile peled Coregonus peled . Aquaculture Research, 48(4), 1877–1884. doi:10.1111/are.13025).	High
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	Salonen, E. & Mutenia, A. 2007. Alien fish species in northern-most Finland. Riista- ja kalatalous – Tutkimuksia 2: 1 – 16(Report of the Finnish Game and Fisheries Research Institute).	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Salonen, E. & Mutenia, A. 2007. Alien fish species in northern-most Finland. Riista- ja kalatalous – Tutkimuksia 2: 1 – 16(Report of the Finnish Game and Fisheries Research Institute).	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Potential pest but no direct harm to human health (Froese & Pauly 2020).	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Salonen, E. & Mutenia, A. 2007. Alien fish species in northern-most Finland. Riista- ja kalatalous – Tutkimuksia 2: 1 – 16(Report of the Finnish Game and Fisheries Research Institute).	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No parasitic behaviour.	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Coregonids need oligothrophic to mesotrophic waters, cool and well oxygenated. Lethal temperature for C. lavaretus is more or less 22°C with an optimum of less than 15°C. C. peled is more tolerant dealing with temperatures ranging from 0 to 28°C, but on the other hand recommends water temperature is below 25°C.	Very high
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	Not reported anywhere (Northern Whitefish (Coregonus peled) Ecological Risk Screening Summary. U.S. Fish and Wildlife Service, March 2011,;Revised, September 2014 and July 2015).	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	Northern Whitefish (Coregonus peled) Ecological Risk Screening Summary. U.S. Fish and Wildlife Service, March 2011,;Revised, September 2014 and July 2015.	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Enteric Redmouth Disease, Bacterial diseases (Froese & Pauly 2020).	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Enteric Redmouth Disease, Bacterial diseases (Froese & Pauly 2020).	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	50 cm, 5 kg max (Froese & Pauly 2020).	Very high

23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Lacustrine, fluvial and anadromous forms exist (Froese & Pauly 2020).	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Not mentioned as impact in literature.	Medium
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Introduced populations rely mostly on stocking (Salonen, E. & Mutenia, A. 2007. Alien fish species in northern-most Finland. Riista- ja kalatalous – Tutkimuksia 2: 1 – 16(Report of the Finnish Game and Fisheries Research Institute)(Malbrouck, C., P. Mergen and J.-C. Micha, 2005. Growth and diet of introduced coregonid fish Coregonus peled (Gmelin) and Coregonus lavaretus (L.) in two Belgian reservoir lakes. Appl. Ecol. Env. Res. 4(1):27-44.).	High
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	Feeds on zooplankton (mostly crustaceans), benthic animals (especially insect larvae and mussels, also algae) and insects from surface (Froese & Pauly 2020).	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	No data for calculation.	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	No information in literature.	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	No natural reproduction in most areas of introduction but probably possible if all conditions met (Salonen, E. & Mutenia, A. 2007. Alien fish species in northern-most Finland. Riista- ja kalatalous – Tutkimuksia 2: 1 – 16(Report of the Finnish Game and Fisheries Research Institute)(Malbrouck, C., P. Mergen and J.-C. Micha, 2005. Growth and diet of introduced coregonid fish Coregonus peled (Gmelin) and Coregonus lavaretus (L.) in two Belgian reservoir lakes. Appl. Ecol. Env. Res. 4(1):27-44.).	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No native Coregonidae in RA area (Kottelat & Freyhof 2007).	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Kottelat & Freyhof 2007	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	(Salonen, E. & Mutenia, A. 2007. Alien fish species in northern-most Finland. Riista- ja kalatalous – Tutkimuksia 2: 1 – 16(Report of the Finnish Game and Fisheries Research Institute)(Malbrouck, C., P. Mergen and J.-C. Micha, 2005. Growth and diet of introduced coregonid fish Coregonus peled (Gmelin) and Coregonus lavaretus (L.) in two Belgian reservoir lakes. Appl.	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Up to 105000 eggs per female (Froese & Pauly 2020).	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	In Russia (Froese & Pauly 2020).	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable habitats nearby)?	>1	Intentional introductions for angling (Northern Whitefish (Coregonus peled) Ecological Risk Screening Summary. U.S. Fish and Wildlife Service, March 2011,;Revised, September 2014 and July 2015.) Floods (Povž et al. 2015)	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	Personal opinion	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No adaptations.	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Eggs deposited on gravel or sand (Kottelat & Freyhof 2007).	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Larval drift in rivers (Bogdanov, V. D., & Bogdanova, E. N. (2012). Ecological aspects of larval drift in coregonids with long migration routes. Russian Journal of Ecology, 43(4), 315–322. doi:10.1134/s1067413612040042).	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Salonen, E. & Mutenia, A. 2007. Alien fish species in northern-most Finland. Riista- ja kalatalous – Tutkimuksia 2: 1 – 16(Report of the Finnish Game and Fisheries Research Institute	Medium
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Eggs deposited on gravel or sand (Kottelat & Freyhof 2007).	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Introductions and floods.	High
43	7.09	Is dispersal of the taxon density dependent?	No	No such information in literature.	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Sensitive species	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Malbrouck, C., P. Mergen and J.-C. Micha, 2005. Growth and diet of introduced coregonid fish Coregonus peled (Gmelin) and Coregonus lavaretus (L.) in two Belgian reservoir lakes. Appl. Ecol. Env. Res. 4(1):27-44.)	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	Not allowed in the region.	Very high

47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Introduced in reservoirs where it survives (Malbrouck, C., P. Mergen and J.-C. Micha, 2005. Growth and diet of introduced coregonid fish Coregonus peled (Gmelin) and Coregonus lavaretus (L.) in two Belgian reservoir lakes. Appl. Ecol. Env. Res. 4(1):27-	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Moskalenko, B.K. 1971. The whitefishes of Siberia. Pishchevaya Promyshlennost, Report SFWFR-TR-73-05, Moscow (translated from Russian in 1972 by R.M. Howland and G. Kavanagh, U.S. Department of the Interior, Division of Fishery Research, Washington, D.C., USA.	Very high
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Piscivorous fish and birds, otters (personal opinion).	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	Already present.	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Native in polar climate, increased temperatures will narrow its suitable habitats (personal opinion).	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Native in polar climate, increased temperatures will narrow its suitable habitats (personal opinion). Intentional releases may stay the same but natural recruitment may decrease.	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	No expected impact in current conditions, no impact expected under future conditions.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	No expected impact in current conditions, no impact expected under future conditions.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	No expected impact in current conditions, no impact expected under future conditions.	Medium

Statistics	
Scores	
BRA	**9.5**
BRA Outcome	**-**
BRA+CCA	**5.5**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**5.5**
1. Domestication/Cultivation	*0.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*4.5*
B. Biology/Ecology	**4.0**
4. Undesirable (or persistence) traits	*4.0*
5. Resource exploitation	*0.0*
6. Reproduction	*-1.0*
7. Dispersal mechanisms	*1.0*
8. Tolerance attributes	*0.0*
C. Climate change	**-4.0**
9. Climate change	*-4.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**7**
Environmental	**0**
Species or population nuisance traits	**2**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.70**
BRA	**0.72**
CCA	**0.50**

Date and Time
13/05/2021 20:49:30

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Coregonus peled*
Common name	peled
Assessor	Tamara Kanjuh
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Froese & Pauly (2015)	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Froese & Pauly (2015)	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No information found.	Medium
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Dfa, Dfb (Köppen–Geiger climate classification system)	High
5	2.02	What is the quality of the climate matching data?	High	Köppen–Geiger climate classification system	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	No information found.	Medium
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Fisheries	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	No	No information found.	Medium
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	No	No infrmation found.	Medium
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Witkowski & Grabowska (2012)	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No information found.	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	Similar to other Coregonus.	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No information found.	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (FishBase)	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	fws.gov	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	The taxon is not a parasite.	High
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Similar to other Coregonus.	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	fws.gov	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	Similar to other Coregonus.	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No information found.	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	FishBase	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	No information found.	Medium
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Similar to other Coregonus.	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	fws.gov	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	No information found.	Medium

5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	fws.gov	Medium
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	fws.gov	Medium
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	FishBase	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	No information found.	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Kirtiklis & Jankun (2006)	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	FishBase	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Not known.	Medium
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	cabi.org	Medium
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Similar to other Coregonus.	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Intentional stocking.	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Intentional stocking.	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	Not known.	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	Similar to other Coregonus.	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Similar to other Coregonus.	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	No information found.	Medium
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No information found.	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Intentional stocking.	High
43	7.09	Is dispersal of the taxon density dependent?	No	No information found.	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	The taxon can nit survive out of water.	High
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	Similar to other Coregonus.	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	Similar to other Coregonus.	Medium
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Similar to other Coregonus.	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Similar to other Coregonus.	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	FishBase	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Adaptable to different environments - similar to other Coregonus.	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	Adaptable to different environments - similar to other Coregonus.	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	Adaptable to different environments - similar to other Coregonus.	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Adaptable to different environments - similar to other Coregonus.	Medium

54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	Adaptable to different environments - similar to other Coregonus.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Adaptable to different environments - similar to other Coregonus.	Medium

Statistics	
Scores	
BRA	**30.0**
BRA Outcome	**-**
BRA+CCA	**30.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**10.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*8.0*
B. Biology/Ecology	**20.0**
4. Undesirable (or persistence) traits	*7.0*
5. Resource exploitation	*7.0*
6. Reproduction	*2.0*
7. Dispersal mechanisms	*1.0*
8. Tolerance attributes	*3.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**8**
Environmental	**13**
Species or population nuisance traits	**11**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.60**
BRA	**0.61**
CCA	**0.50**

Date and Time
04/06/2021 00:29:06

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Coregonus peled*
Common name	peled
Assessor	Tena Radocaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	No	Habeković, 1978, introduced	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	This species is grown for human consumption and Coregonus peled reared in intensive RAS. (Matousek, J., Prokesova, M., Novikava, K., Sebesta, R., Zuskova, E., & Stejskal, V. (2017). The effect of water oxygen saturation on growth and haematological profile of juvenile peled Coregonus peled (Gmelin). Aquaculture Research, 48(10), 5411-5417.)	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	The similarity between climatic conditions RA area and native range is medium. I use climatch.	Medium
5	2.02	What is the quality of the climate matching data?	Medium	The quality of the climatic matching data is medium.	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	This species is present outside of captivity in the RA area.	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	None	It is present in Croatia	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	not applicable	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Its importance increased with introduction to another countries such as Estonia, Lithuania, Latvia, Byelorussia, Poland, Germany, Finland, the Czech Republic, France and Japan. (Matousek, J., Prokesova, M., Novikava, K., Sebesta, R., Zuskova, E., & Stejskal, V. (2017). The effect of water oxygen saturation on growth and haematological profile of juvenile peled Coregonus peled (Gmelin). Aquaculture Research, 48(10), 5411-5417.)	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	Personal opinion	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Personal opinion	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	Personal opinion	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Personal opinion, I don't any data about that	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	no	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Yes, this taxon is adapted on climate and environmental conditions, these species have self-sustaining populations in RA area. (Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26)	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	Maybe, it is possible there is a possibility that it will disrupt the nutritional structure	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	no	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Yes, the taxon may be a host or vector of known pests and infectious agents endemic to RA area. Because in every area exist infectious agents and pests.	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Enteric Redmouth Disease, Bacterial diseases (Froese, R., and D. Pauly, editors. 2015. Coregonus peled (Gmelin, 1789). FishBase. Available: http://www.fishbase.org/summary/4687. July 2015)	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	Very high

23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Kottelat and Freyhof, 2007	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	High
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	It is possible that it consume endangered and protected native taxa in the RA area. If there are protected taxa in the RA area, the european whitefish will consume them, whether or not the taxon	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	not applicable	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	Personal opinion	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Personal opinion	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Personal opinion	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	Freyhof, J. & Kottelat, M. 2008. Coregonus peled . The IUCN Red List of Threatened Species 2008: e.T5374A11125006. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T5374A11125006.en. Downloaded on 05 February 2020.	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	1.accidental introduction, 2.human-mediated 3. natural spread via natural and manmade watercourses	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	It is present in protected area.	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	Personal opinion	Low
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Personal opinion	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	There is a possibility of a high rate of spread of taxa. Eg. if a fertilized individual enters a new area by any means of expansion.	Low
43	7.09	Is dispersal of the taxon density dependent?	No	Personal opinion	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Personal opinion	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Not applicable	Personal opinion	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Jevtić (1991) Izbor ozimice za otvorene i zatvorene vode. Ribarstvo Jugoslavije 46:14-26.	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Kotelat and Frayhof, 2007	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	Personal opinion	High
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	not apllicable	Very high

51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Considering climate change, population in the RA area is likely to decline, as this species does not tolerate high temperatures.	Low
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	The risk of taxa spreading in the RA area is declining, currently this species in Croatia resides in only one reservoir, I believe that under the influence of climate change it will not spread further, but its number will decline due to differences in temperature.	Low
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	no	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	No impact	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	There will be no impact on ecosystem	Low

Statistics	
Scores	
BRA	**10.5**
BRA Outcome	**-**
BRA+CCA	**6.5**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**1.5**
1. Domestication/Cultivation	*0.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*1.5*
B. Biology/Ecology	**9.0**
4. Undesirable (or persistence) traits	*7.0*
5. Resource exploitation	*5.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*-2.0*
8. Tolerance attributes	*-2.0*
C. Climate change	**-4.0**
9. Climate change	*-4.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**3**
Environmental	**7**
Species or population nuisance traits	**-1**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.66**
BRA	**0.69**
CCA	**0.42**

Date and Time
01/06/2020 11:50:54

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Hucho hucho*
Common name	huchen
Assessor	Ana Marić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Some notes to the farming and conservation of tile Danube salmon (Hucho hucho)* Mathias Jungwirth 1978 For conservation purposes, not easily reared.	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	NAredba o merama za ocuvanje i zastitu ribljeg fonda. "Službeni glasnik RS", br. 104/2009 Na osnovu člana 21. stav 2. Zakona o zaštiti i održivom korišćenju ribljeg fonda	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	European Red List of Freshwater Fishes. Freyhor and Brooks. 2011	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Same drainge basin, same range	Very high
5	2.02	What is the quality of the climate matching data?	High	Climach	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	http://www.politika.rs/sr/clanak/268003/Drugi-zivot-mladice	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Stocking	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Zaštita ihtiofaune i zakonska regulativa u Srbiji Stevan Maletin, Aleksandar Matić , Miroslav Ćirković Nikolina Milošević1 Željka Jurakić1	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	PAst and present of and perspectives for the DAnube huchen Hucho hucho in the Danube basin. Witkovski et al. 2013.	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	Past and present of and perspectives for the Danube huchen Hucho hucho in the Danube basin. Witkovski et al. 2013.	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Past and present of and perspectives for the Danube huchen Hucho hucho in the Danube basin. Witkovski et al. 2013.	Very high
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	Past and present of and perspectives for the Danube huchen Hucho hucho in the Danube basin. Witkovski et al. 2013.	Very high
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Past and present of and perspectives for the Danube huchen Hucho hucho in the Danube basin. Witkovski et al. 2013.	Very high
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Past and present of and perspectives for the Danube huchen Hucho hucho in the Danube basin. Witkovski et al. 2013.	Very high
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	Past and present of and perspectives for the Danube huchen Hucho hucho in the Danube basin. Witkovski et al. 2013.	Very high
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	Past and present of and perspectives for the Danube huchen Hucho hucho in the Danube basin. Witkovski et al. 2013.	Very high
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Connectivity Solution for huchen Hucho hucho (L.) in human-altered habitats. Simonovic et al. 2015	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	Past and present of and perspectives for the Danube huchen, Hucho hucho (L.), in the Danube basin Andrzej Witkowski, Aleksandar Bajiæ, Tomislav Treer, Aleksandar Hegediš, Saša Mariæ, Nikica Šprem, Marina Piria, Andrzej Kapusta. 2013	Very high
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp	High
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp	Very high

25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	The history of huchen in Poland-distribution, restoration and conservation. Witkovski et al. 2013	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	The history of huchen in Poland-distribution, restoration and conservation. Witkovski et al. 2013	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	The history of huchen in Poland-distribution, restoration and conservation. Witkovski et al. 2013	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Past and present of and perspectives for the Danube huchen, Hucho hucho (L.), in the Danube basin Andrzej Witkowski, Aleksandar Bajiæ, Tomislav Treer, Aleksandar Hegediš, Saša Mariæ, Nikica Šprem, Marina Piria, Andrzej Kapusta. 2013	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	http://www.politika.rs/sr/clanak/268003/Drugi-zivot-mladice	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	4	Some notes to the farming and conservation of tile Danube salmon (Hucho hucho)* Mathias Jungwirth 1978.	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Stocking.The history of huchen in Poland-distribution, restoration and conservation. Witkovski et al. 2013	Very high
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Past and present of and perspectives for the Danube huchen, Hucho hucho (L.), in the Danube basin Andrzej Witkowski, Aleksandar Bajiæ, Tomislav Treer, Aleksandar Hegediš, Saša Mariæ, Nikica Šprem, Marina Piria, Andrzej Kapusta. 2013	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp	Very high
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	The history of huchen in Poland-distribution, restoration and conservation. Witkovski et al. 2013	Very high
43	7.09	Is dispersal of the taxon density dependent?	No	The history of huchen in Poland-distribution, restoration and conservation. Witkovski et al. 2013	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	The history of huchen in Poland-distribution, restoration and conservation. Witkovski et al. 2013	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	The history of huchen in Poland-distribution, restoration and conservation. Witkovski et al. 2013	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Not applicable	European Red List of Freshwater Fishes. Freyhof and Brooks. 2011.	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	The history of huchen in Poland-distribution, restoration and conservation. Witkovski et al. 2013	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	The history of huchen in Poland-distribution, restoration and conservation. Witkovski et al. 2013	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	High
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Past and present of and perspectives for the Danube huchen, Hucho hucho (L.), in the Danube basin Andrzej Witkowski, Aleksandar Bajiæ, Tomislav Treer, Aleksandar Hegediš, Saša Mariæ, Nikica Šprem, Marina Piria, Andrzej Kapusta. 2013	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Past and present of and perspectives for the Danube huchen, Hucho hucho (L.), in the Danube basin Andrzej Witkowski, Aleksandar Bajiæ, Tomislav Treer, Aleksandar Hegediš, Saša Mariæ, Nikica Šprem, Marina Piria, Andrzej Kapusta. 2013	Very high

52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Past and present of and perspectives for the Danube huchen, Hucho hucho (L.), in the Danube basin Andrzej Witkowski, Aleksandar Bajiæ, Tomislav Treer, Aleksandar Hegediš, Saša Mariæ, Nikica Šprem, Marina Piria, Andrzej Kapusta. 2013	Very high
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Past and present of and perspectives for the Danube huchen, Hucho hucho (L.), in the Danube basin Andrzej Witkowski, Aleksandar Bajiæ, Tomislav Treer, Aleksandar Hegediš, Saša Mariæ, Nikica Šprem, Marina Piria, Andrzej Kapusta. 2013	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	Past and present of and perspectives for the Danube huchen, Hucho hucho (L.), in the Danube basin Andrzej Witkowski, Aleksandar Bajiæ, Tomislav Treer, Aleksandar Hegediš, Saša Mariæ, Nikica Šprem, Marina Piria, Andrzej Kapusta. 2013	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	Past and present of and perspectives for the Danube huchen, Hucho hucho (L.), in the Danube basin Andrzej Witkowski, Aleksandar Bajiæ, Tomislav Treer, Aleksandar Hegediš, Saša Mariæ, Nikica Šprem, Marina Piria, Andrzej Kapusta. 2013	High

Statistics	
Scores	
BRA	**6.0**
BRA Outcome	**-**
BRA+CCA	**-4.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**5.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*2.0*
B. Biology/Ecology	**1.0**
4. Undesirable (or persistence) traits	*2.0*
5. Resource exploitation	*5.0*
6. Reproduction	*-2.0*
7. Dispersal mechanisms	*0.0*
8. Tolerance attributes	*-4.0*
C. Climate change	**-10.0**
9. Climate change	*-10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**2**
Environmental	**2**
Species or population nuisance traits	**-6**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.88**
BRA	**0.88**
CCA	**0.83**

Date and Time
16/05/2021 18:30:57

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Hucho hucho*
Common name	huchen
Assessor	Ivan Špelić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	For stocking purposes (Muhamedagić S., Habibović E. 2013 – The State and Perspective of Danube huchen (Hucho hucho) in Bosnia and Herzegovina– Arch. Pol. Fish. 21: 155-160).	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	For stocking purposes (Muhamedagić S., Habibović E. 2013 – The State and Perspective of Danube huchen (Hucho hucho) in Bosnia and Herzegovina– Arch. Pol. Fish. 21: 155-160), personal	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No such species.	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Very high, within same country and basin.	Very high
5	2.02	What is the quality of the climate matching data?	#N/A	No climate analysis, within the same country and basin.	Very high
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Fishbase	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Introduction for angling (Holcik, J., 1984 Review on experiments with introduction and acclimatization of the huchen -Hucho hucho (Linnaeus, 1758) (Salmonidae). EIFAC Tech.Pap., (42)	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Present in all countries, translocation is possible (Holcik, J., 1984 Review on experiments with introduction and acclimatization of the huchen -Hucho hucho (Linnaeus, 1758) (Salmonidae). EIFAC Tech.Pap., (42) Vol.2:289–98).	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Holcik, J., 1984 Review on experiments with introduction and acclimatization of the huchen -Hucho hucho (Linnaeus, 1758) (Salmonidae). EIFAC Tech.Pap., (42) Vol.2:289–98; Witkowski, Andrzej, Goryczko, Krzysztof and Kowalewski, Mieczysław. "The history of huchen, Hucho hucho (L.), in Poland – distribution, restoration and conservation" Fisheries & Aquatic Life, vol.21, no.3, 2013, pp.161-168. https://doi.org/10.2478/aopf-2013-0013	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Holcik, J., 1984 Review on experiments with introduction and acclimatization of the huchen -Hucho hucho (Linnaeus, 1758) (Salmonidae). EIFAC Tech.Pap., (42) Vol.2:289–98	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No such reports.	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	There has been a documented negative impact associated with one of those populations, the decline of other large sport fish (https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Hucho-hucho_Final.pdf).	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Not listed in literature.	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Brown trout, grayling, nase (Holcik, J., 1984 Review on experiments with introduction and acclimatization of the huchen -Hucho hucho (Linnaeus, 1758) (Salmonidae). EIFAC Tech.Pap.,	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No parasitic behaviour.	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Very sensitive species: "The huchen may be transplanted into streams of the foot-hill zone with stony-gravel or gravel-sandy bottom, where the water temperature in summer months is not higher than 20°C, the dissolved oxygen does not fall below 8–9 mg/1, and the water is not polluted either by industrial, urban or agricultural waste. Those parts of a river where riffles alternate with bigger and deeper pools, where the flow is branched by islands, the banks are overgrown with shrubs and trees and interrupted by the mouths of tributaries are to be preferred. Reaches selected should be sufficiently long and the zone of the of foothill brooks with possible spawning grounds should be accessible. The overall length of a reach should be about 20 km" (Holcik, J., 1984 Review on experiments with introduction and acclimatization of the huchen -Hucho hucho (Linnaeus, 1758)	Very high
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	Not documented.	Medium

19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	Could impact the native fish species if established, but usually fail to establish natural populations where introduced (Holcik, J., 1984 Review on experiments with introduction and acclimatization of the huchen -Hucho hucho (Linnaeus, 1758) (Salmonidae). EIFAC Tech.Pap., (42) Vol.2:289–98).	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Susceptible to parasites and diseases (https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Hucho-hucho_Final.pdf).	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Susceptible to parasites and diseases (https://www.fws.gov/fisheries/ANS/erss/highrisk/ERSS-Hucho-hucho_Final.pdf).	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Max 150 cm and 52 kg (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	The huchen may be transplanted into streams of the foot-hill zone with stony-gravel or gravel-sandy bottom, where the water temperature in summer months is not higher than 20°C, the dissolved oxygen does not fall below 8–9 mg/1, and the water is not polluted either by industrial, urban or agricultural waste. Those parts of a river where riffles alternate with bigger and deeper pools, where the flow is branched by islands, the banks are overgrown with shrubs and trees and interrupted by the mouths of tributaries are to be preferred. Reaches selected should be sufficiently long and the zone of the of foothill brooks with possible spawning grounds should be accessible. The overall length of a reach should be about 20 km" (Holcik, J., 1984 Review on experiments with introduction and acclimatization of the huchen -Hucho hucho (Linnaeus, 1758) (Salmonidae). EIFAC	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Not documented.	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Not documented.	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Carnivore. Juveniles feed mainly on invertebrates and adults mostly on fishes, but also prey on amphibians, reptiles, small mammals and waterfowl (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	No data.	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Yes	Both sexes covered the eggs with substrate. They both defend the spawning site up to 2 weeks after spawning (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Attempts to introduce the huchen inside the original area of its distribution (transplantation), as in RA area, were more successful (Holcik, J., 1984 Review on experiments with introduction and acclimatization of the huchen -Hucho hucho (Linnaeus, 1758) (Salmonidae). EIFAC Tech.Pap., (42) Vol.2:289–98), taking that succesful introduction is possibility to spawn in the wild.	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No suitable native species to hybridize with.	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No such behavior or adaptations.	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	Small and shallow streams in upper reaches of tributaries, on gravelly bottom (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	1600-27000 eggs per female (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Medium
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Introductions for angling, self-dispersion in connected rivers (personal opinion).	Low
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Possibly, if stocked river is in a vicinity of the protected area and connected to other bodies of water within it (personal opinion).	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No such adaptations.	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Eggs are covered with gravel (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Huchen in France penetrated from Rhone tributary Usses to the main river (Holcik, J., 1984 Review on experiments with introduction and acclimatization of the huchen -Hucho hucho (Linnaeus, 1758) (Salmonidae). EIFAC Tech.Pap., (42)	High

40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Ptoamodromous, spawning migrations (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Parental care of the spawning site (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Drift, migrations, introductions.	High
43	7.09	Is dispersal of the taxon density dependent?	No	No documented evidence.	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Very sensitive species (personal communication).	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Very sensitive to pollution and water quality (Holcik, J., 1984 Review on experiments with introduction and acclimatization of the huchen -Hucho hucho (Linnaeus, 1758) (Salmonidae). EIFAC Tech.Pap., (42) Vol.2:289–98).	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Not applicable	Not allowed.	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	In spite of its great areas of distribution the huchen is now considered to be an endangered species because of the effects on stocks of increasing stream regulation and pollution (Holcik, J., 1984 Review on experiments with introduction and acclimatization of the huchen -Hucho hucho (Linnaeus, 1758) (Salmonidae). EIFAC Tech.Pap., (42) Vol.2:289–98)).	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Exclusively freshwater species.	Very high
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Piscivorous birds and mammals prey on smaller specimens (personal opinion).	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Translocation mediated by humans, no natural dispersion from current locations.	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Future conditions will impact flow regimes and temperatures wich have great influence on populations (Holcik, J., 1984 Review on experiments with introduction and acclimatization of the huchen -Hucho hucho (Linnaeus, 1758) (Salmonidae). EIFAC Tech.Pap., (42) Vol.2:289–98).	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Future conditions will impact flow regimes and temperatures, reducing the number of suitable habitats (personal opinion).	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Future conditions will impact flow regimes and temperatures wich have great influence on populations (Holcik, J., 1984 Review on experiments with introduction and acclimatization of the huchen -Hucho hucho (Linnaeus, 1758) (Salmonidae). EIFAC Tech.Pap., (42) Vol.2:289–98), potentially reducing the impact of the species.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	Future conditions will impact flow regimes and temperatures wich have great influence on populations (Holcik, J., 1984 Review on experiments with introduction and acclimatization of the huchen -Hucho hucho (Linnaeus, 1758) (Salmonidae). EIFAC Tech.Pap., (42) Vol.2:289–98), potentially reducing the impact of the species.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	Future conditions will impact flow regimes and temperatures wich have great influence on populations (Holcik, J., 1984 Review on experiments with introduction and acclimatization of the huchen -Hucho hucho (Linnaeus, 1758) (Salmonidae). EIFAC Tech.Pap., (42) Vol.2:289–98), potentially reducing the impact of the species.	Medium

Statistics	
Scores	
BRA	**9.0**
BRA Outcome	**-**
BRA+CCA	**-1.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**3.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*0.0*
B. Biology/Ecology	**6.0**
4. Undesirable (or persistence) traits	*3.0*
5. Resource exploitation	*5.0*
6. Reproduction	*0.0*
7. Dispersal mechanisms	*2.0*
8. Tolerance attributes	*-4.0*
C. Climate change	**-10.0**
9. Climate change	*-10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**

4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**4**
Environmental	**2**
Species or population nuisance traits	**-3**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.75**
BRA	**0.79**
CCA	**0.50**

Date and Time
18/05/2021 09:35:00

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Hucho hucho*
Common name	huchen
Assessor	Tamara Kanjuh
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Currently, Danube salmon populations are fragmented within the Danube drainage, with many being supported by artiβicial reproduction and stocking programs (Ihut et al., 2014).	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Fisheries: commercial; aquaculture: commercial; gamefish: yes (fishbase.de)	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No information found.	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Dfa, Dfb (Köppen–Geiger climate classification system)	High
5	2.02	What is the quality of the climate matching data?	High	Köppen–Geiger climate classification system	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Currently, Danube salmon populations are fragmented within the Danube drainage, with many being supported by artiβicial reproduction and stocking programs (Inhut et al., 2014).	Medium
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	Aquaculture, sportfishing, angling.	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	In Serbia the main river inhabited by huchen is the Drina and its tributaries. This river is 346 km long with an average discharge of 395 m3 s-1, 220 km of which flow through Serbia (Mijović-Magdić, 2007).	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	In one stretch of the Hornád River, Czechoslovakia, a transplanted and naturalized population of huchen had to be eradicated because the abundance of the brown trout and the grayling (Thymallus thymallus) significantly decreased (Skácel, 1976).	Low
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	In one stretch of the Hornád River, Czechoslovakia, a transplanted and naturalized population of huchen had to be eradicated because the abundance of the brown trout and the grayling (Thymallus thymallus) significantly decreased (Skácel, 1976).	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No information found.	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	No information flound.	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No information found.	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (fishbase.de)	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No information found.	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No information found.	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	The taxon is very sensitive to environmental conditions.	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No information found.	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No information found.	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No information found.	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No information found.	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	No informartion found.	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Over 3.5 m/s (Bănăduc, 2008).	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	No information found.	Low

25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	No information found.	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	No information found.	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	Danube huchen grows faster than the other species of salmonids early in its life cycle due to the early beginning of predatory feeding (Bastl and Kirka, 1958).	Medium
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	No parental care (fishbase.de)	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	The species were translocated in the Danube Basin into other rivers of the same basin.	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No information found.	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No information found.	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	No information found.	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	The number of eggs deposited depends on body (Ihut et al., 2014).	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	According to Ivaska. (1951) the females reach sexual maturity at the age of 5 years; other authors give 3 or 4 years.	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Intentional restocking.	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	No information found.	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No information found.	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	The dispersion of the taxon occurs as juvenil.	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	The dispersion of the taxon occurs as juvenil.	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	...pawning migrations can be restricted to just a few hundred meters (Ihut et al., 2014).	Medium
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No information found.	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Intentional restocking.	Low
43	7.09	Is dispersal of the taxon density dependent?	No	No information found.	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	The taxon cannot survive out of the water.	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	The taxon is very sensitive to environmental changes.	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	No information found.	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Excessive anthropogenic impacts like habitat destruction, irresponsible deforestation, pollution, poaching and dam construction, have led to significant reductions in population abundances (Cristea, 2007; Geist et al., 2009).	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	The taxon is very sensitive to environmental changes.	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	No	Mature H. hucho have no predators. Young and small individuals, when they arrive in waters which run relatively slowly, can become the prey of the pike (Esox lucius) (FAO, 1968).	High
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	The effects of climate change have been much discussed but presently, especially for the Balkan region, there is a lack of reference data or reliable models to make any serious prediction on the potential effects of climate on the species in the region (Fryhof et al.,2015). The taxon is very sensitive to environmental	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	The taxon is very sensitive to environmental changes.	Medium

52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	The taxon is very sensitive to environmental changes.	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	The taxon is very sensitive to environmental changes.	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	The taxon is very sensitive to environmental changes.	Low
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	The taxon is very sensitive to environmental changes.	Low

Statistics	
Scores	
BRA	**7.0**
BRA Outcome	**-**
BRA+CCA	**1.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**6.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*2.0*
B. Biology/Ecology	**1.0**
4. Undesirable (or persistence) traits	*0.0*
5. Resource exploitation	*2.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*0.0*
8. Tolerance attributes	*-2.0*
C. Climate change	**-6.0**
9. Climate change	*-6.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**4**
Environmental	**-4**
Species or population nuisance traits	**4**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.39**
BRA	**0.39**
CCA	**0.38**

Date and Time
30/05/2021 15:13:13

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Hucho hucho*
Common name	huchen
Assessor	Tena Radocaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Fisheries: commercial; aquaculture: commercial; gamefish: yes (Fishbase)	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	No	No	Low
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No invasive races, varieties, sub-taxa or congeners.	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	The similarity between climatic conditions RA area and native range is high. I use climatch.	Medium
5	2.02	What is the quality of the climate matching data?	High	Distribution Map and Climatch.	Very high
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	H. hucho is not present outside of captivity in the RA area.	Medium
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Stocking (U.S. Fish & Wildlife Service, April 2011 Revised, January 2019, February 2019 Web Version, 4/30/2019)	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	H. hucho is established in a neighbouring rivers. (Witkowski, A., Bajić, A., Treer, T., Hegediš, A., Marić, S., Šprem, N., ... & Kapusta, A. (2013). Past and present of and perspectives for the Danube huchen, Hucho hucho (L.), in the Danube basin. Fisheries & Aquatic Life, 21(3), 129-142).	Medium
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	In the 1950s it [H. hucho] was translocated for conservation purposes to some tributaries of the upper stretch of the Vistula River [Poland] where it established self-sustained populations (Witkowski 1996). Currently huchen is being stocked also into water courses of the Oder River catchment [Poland]. (Grabowska, J., J. Kotusz, and A. Witkowski. 2010. Alien invasive fish species in Polish waters: an overview. Folia Zoologica 59(1):73–85.)	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	In one stretch of the Hornád River, Czechoslovakia, a transplanted and naturalized population of huchen had to be eradicated because the abundance of the brown trout and the grayling (Thymallus thymallus) significantly decreased (Skácel, 1976) (U.S. Fish & Wildlife Service, April 2011 Revised, January 2019, February 2019 Web Version, 4/30/2019).	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No evidence	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	May have adverse impact on some native species (competition). (U.S. Fish & Wildlife Service, April 2011 Revised, January 2019, February 2019 Web Version, 4/30/2019).	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No evidence	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	H. hucho is harmless (Fishbase)	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No evidence	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	H. hucho is adaptable to climatic and other environmental conditions in the RA area. (Witkowski, A., Bajić, A., Treer, T., Hegediš, A., Marić, S., Šprem, N., ... & Kapusta, A. (2013). Past and present of and perspectives for the Danube huchen, Hucho hucho (L.), in the Danube basin. Fisheries & Aquatic Life, 21(3),	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	Competition (U.S. Fish & Wildlife Service, April 2011 Revised, January 2019, February 2019 Web Version, 4/30/2019).	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	(U.S. Fish & Wildlife Service, April 2011 Revised, January 2019, February 2019 Web Version, 4/30/2019).	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA area?	Yes	U.S. Fish & Wildlife Service, April 2011 Revised, January 2019, February 2019 Web Version, 4/30/2019 Infection with Gyrodactylus salaris is an OIE-reportable disease (OIE 2019). Popiołek et al. (2013) does not specify which species of Gyrodatcylus can infect Hucho hucho	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	According to CABI (2019), Hucho hucho can carry the following diseases: infectious pancreatic necrosis, Renibacterium salmoninarum, bacterial kidney disease, whirling disease and lernaeopdid infection of fish. (CABI, 2019)	Medium

22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Max length : 150 cm TL (Fishbase)	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Usually solitary, inhabits deeper regions of swift flowing streams with oxygen rich waters. (Fishbase)	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	No evidence	Low
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Fishbase	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Juveniles feed mainly on invertebrates and adults mostly on fishes, but also prey on amphibians, reptiles, small mammals and waterfowl (Fishbase)	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	Not applicable	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Yes	They both defend the spawning site up to 2 weeks after spawning. (Fishbase)	Low
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Witkowski, A., Bajić, A., Treer, T., Hegediš, A., Marić, S., Šprem, N., ... & Kapusta, A. (2013). Past and present of and perspectives for the Danube huchen, Hucho hucho (L.), in the Danube basin. Fisheries & Aquatic Life, 21(3), 129-142).	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No evidence	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	Spawns in very clean gravel in fast-flowing water, usually in small river tributaries. (Freyhof, J. & Kottelat, M. 2008. Hucho hucho. The IUCN Red List of Threatened Species)	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	No	Freyhof, J. & Kottelat, M. 2008. Hucho hucho. The IUCN Red List of Threatened Species	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	4	Males reproduce for the first time at 3-4 years and about 1 kg, females at 4-5 years and 2-3 kg (Freyhof, J. & Kottelat, M. 2008. Hucho hucho. The IUCN Red List of Threatened Species 2008)	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Human influence	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	No	Very high
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No adaptations	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Spawns on gravelly bottom where female makes a shallow hole where the eggs are laid and covered with gravel (Ref. 682). Both sexes covered the eggs with substrate. (Fishbase)	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Freyhof, J. & Kottelat, M. 2008. Hucho hucho. The IUCN Red List of Threatened Species 2008	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Sexually mature fish migrate upstream into smaller and shallower (0.3-1.5 m deep) streams (Ref. 26170), usually in upper reaches of tributaries (Fishbase)	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Fishbase	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	There is the possibility of a high rate of dispersal of taxa. E.g. when a fertilized individual enters a new area by some kind of dispersal.	Low
43	7.09	Is dispersal of the taxon density dependent?	No	No evidence	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	No, it sensitive species	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Usually solitary, inhabits deeper regions of swift flowing streams with oxygen rich waters. Adults are territorial but not solitary (Fishbase)	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	No	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Historically overfishing, pollution and dam construction caused the decline of the species. Currently the main the threats are hydropower stations which heavily regulate flow regime (which impacts upon their prey and habitat), and pollution in some countries (Bosnia and Croatia). (Freyhof, J. & Kottelat, M. 2008. Hucho hucho. The IUCN Red List of Threatened Species)	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Freshwater fish	Very high

49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Juvenile- catfish, zander, pike..	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	The risks of entry into the RA area is no change. Maybe because of human impact, but not because of climate change.	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Medium

Statistics	
Scores	
BRA	**15.0**
BRA Outcome	**-**
BRA+CCA	**5.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**10.0**
1. Domestication/Cultivation	*0.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*10.0*
B. Biology/Ecology	**5.0**
4. Undesirable (or persistence) traits	*6.0*
5. Resource exploitation	*5.0*
6. Reproduction	*-2.0*
7. Dispersal mechanisms	*0.0*
8. Tolerance attributes	*-4.0*
C. Climate change	**-10.0**
9. Climate change	*-10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**6**
Environmental	**6**
Species or population nuisance traits	**-6**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.60**
BRA	**0.62**
CCA	**0.50**

Date and Time
19/05/2021 12:32:12

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Oncorhynchus mykiss*
Common name	rainbow trout
Assessor	Ana Marić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp https://www.fishbase.se/summary/Oncorhynchus-	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Frimodt, C., 1995. Multilingual illustrated guide to the world's commercial coldwater fish. Fishing News Books, Osney Mead, Oxford, England. 215 p.	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	http://www.iucngisd.org/gisd/species.php?sc=103 invasive itself, does it count?	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	Climach	High
5	2.02	What is the quality of the climate matching data?	Low	Very unsure	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Risks to Stocks of Native Trout of the Genus Salmo (Actinopterygii: Salmoniformes: Salmonidae) of Serbia and Management for their Recovery. Lovili u Belosavcu	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	Stocking and escape from farms	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	A brief review of non-native freshwater fishes in Slovenia M. Povž, S. Šumer	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	A brief review of non-native freshwater fishes in Slovenia M. Povž, S. Šumer Invasions of rainbow trout and brown trout in Japan: A comparison of invasiveness and impact on native species Koh Hasegawa 2019	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	The impact of introduced brown and r bow trout on native fish: the case of Australasia TODD A. CROWL ~*, COLIN R. TOWNSEND and ANGUS R. MCINTOSH 1992....	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Check ref	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	Check	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	It was introduced intentionaly	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	No	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Invasions of rainbow trout and brown trout in Japan: A comparison of invasiveness and impact on native species Koh Hasegawa	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp	Very high
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	A handbook of global freshwater invasive species. Frencis. 2012	Very high
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Invasions of rainbow trout and brown trout in Japan: A comparison of invasiveness and impact on native species Koh Hasegawa.2019	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Invasions of rainbow trout and brown trout in Japan: A comparison of invasiveness and impact on native species Koh Hasegawa. 2019	Very high
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Invasions of rainbow trout and brown trout in Japan: A comparison of invasiveness and impact on native species Koh Hasegawa. 2002	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Invasions of rainbow trout and brown trout in Japan: A comparison of invasiveness and impact on native species Koh Hasegawa. 2002	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Invasions of rainbow trout and brown trout in Japan: A comparison of invasiveness and impact on native species Koh Hasegawa	Medium

25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Invasions of rainbow trout and brown trout in Japan: A comparison of invasiveness and impact on native species Koh Hasegawa. 2019.	High
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Invasions of rainbow trout and brown trout in Japan: A comparison of invasiveness and impact on native species Koh	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	Invasions of rainbow trout and brown trout in Japan: A comparison of invasiveness and impact on native species Koh Hasegawa.2019	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Yes	Invasions of rainbow trout and brown trout in Japan: A comparison of invasiveness and impact on native species Koh Hasegawa. 2019	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Kottelat 2007	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Slovenia check	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	No	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Kottekat 2007	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Kottelat 2007	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Escape stocking	Very high
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Espetially stocking	Very high
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Kottelat 2007	Very high
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Kottelat 2007	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Kottelat 2007	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Kottelat 2007	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Invasions of rainbow trout and brown trout in Japan: A comparison of invasiveness and impact on native species Koh Hasegawa 2019	Very high
43	7.09	Is dispersal of the taxon density dependent?	Yes	Probably, partial migratory	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Kottelat 2007	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Small-scale rainbow trout farming FAO 2011.	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	Recolonization by the mountain galaxias Galaxias olidus of a montane stream after the eradication of rainbow trout Oncorhynchus mykiss Mark Lintermans 2000	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	MAybe flood?	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Kottelat 2007	Very high
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Fish and mamals	Very high
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	Assessing the impact of a downscaled climate change simulation on the fish fauna in an Inner-Alpine River C. Matulla & S. Schmutz & A. Melcher & T. Gerersdorfer & P. Haas 2007	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	Assessing the impact of a downscaled climate change simulation on the fish fauna in an Inner-Alpine River C. Matulla & S. Schmutz & A. Melcher & T. Gerersdorfer & P. Haas 2007	Very high
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	Assessing the impact of a downscaled climate change simulation on the fish fauna in an Inner-Alpine River C. Matulla & S. Schmutz & A. Melcher & T. Gerersdorfer & P. Haas 2007	Very high

53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	Assessing the impact of a downscaled climate change simulation on the fish fauna in an Inner-Alpine River C. Matulla & S. Schmutz & A. Melcher & T. Gerersdorfer & P. Haas 2007	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	Assessing the impact of a downscaled climate change simulation on the fish fauna in an Inner-Alpine River C. Matulla & S. Schmutz & A. Melcher & T. Gerersdorfer & P. Haas 2007	Very high
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Assessing the impact of a downscaled climate change simulation on the fish fauna in an Inner-Alpine River C. Matulla & S. Schmutz & A. Melcher & T. Gerersdorfer & P. Haas 2007	High

Statistics	
Scores	
BRA	**37.0**
BRA Outcome	**-**
BRA+CCA	**47.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**12.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*6.0*
B. Biology/Ecology	**25.0**
4. Undesirable (or persistence) traits	*8.0*
5. Resource exploitation	*7.0*
6. Reproduction	*4.0*
7. Dispersal mechanisms	*3.0*
8. Tolerance attributes	*3.0*
C. Climate change	**10.0**
9. Climate change	*10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**11**
Environmental	**11**
Species or population nuisance traits	**30**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.90**
BRA	**0.90**
CCA	**0.92**

Date and Time
22/05/2021 00:51:42

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Oncorhynchus mykiss*
Common name	rainbow trout
Assessor	Ivan Špelić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	FAO	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	No	Not harvested but farmed and used for stocking (Stanković et al. 2015).	Medium
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Climatch	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Climatch	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Stanković et al. 2015	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	Not applicable	Already present (Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	Already present (Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary). Welcomme, R.L., 1988. International introductions of inland aquatic species. FAO Fish.	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Species used in aquaculture, there is an impact on biodiversity but no recognized socio-economic impact for Great Lakes (Fuller et al. 2020).	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Inhabits clear, cold waters. Not tolerating temperatures above 25 degrees Celzius and low oxygen levels (<5 mg/l) (Froese and Pauly 2019, CABI 2019).	Very high
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No information on such impact.	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	It can be beneficial for angling and aquaculture, no other impacts regonized (Jonsson, B. (2011): NOBANIS – Invasive Alien Species Fact Sheet – Oncorhynchus mykiss. – From: Online Database of the European Network on Invasive Alien Species – NOBANIS www.nobanis.org, Date of access x/x/201x.)	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA area?	Yes	Host to parasites (Stanković et al. 2015; Fuller, P., J. Larson, A. Fusaro, T.H. Makled, and M. Neilson, 2020, Oncorhynchus mykiss (Walbaum, 1792): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=910, Revision Date: 9/12/2019, Peer Review Date: 4/1/2016, Access Date: 2/11/2020	Very high

21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Host to parasites (Stanković et al. 2015; Fuller, P., J. Larson, A. Fusaro, T.H. Makled, and M. Neilson, 2020, Oncorhynchus mykiss (Walbaum, 1792): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=910, Revision Date: 9/12/2019, Peer Review Date: 4/1/2016, Access Date: 2/11/2020	Very high
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	The presence of live salmonids may have an even greater effect on nutrients in streams through the excretion of ammonium and soluable reactive phosphorus and their mechanical disturbance of the stream bottom during spawning runs (Ivan et al. 2011, Tiegs	Medium
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	High
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Anglers occasionally report the presence of olm remains in the gut of caught rainbow trout (Stanković et al. 2015).	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	No sufficient information to calculate.	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Kottelat & Freyhof 2007	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Stanković et al. 2015	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	Stanković et al. 2015	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Kottelat & Freyhof 2007	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	Reported not to establish breeding populations if the peak emergence of fry corresponds to flood season and cold summer temperatures and if temperature does not fall below 13°C (Kottelat & Freyhof 2007).	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Fecundity up to over 12000 eggs per female (Froese & Pauly 2019).	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Froese & Pauly 2019	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Restocking, ecsapes from farms, ilegal introductions	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	No restocking of protected areas with alien species, natural dispersion most unlikely because of the ecological demands of species.	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No adaptations (personal opinion)	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Eggs covered in gravel pit (Froese & Pauly 2019).	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Young fish move downstream at night, shortly after emergence (Froese & Pauly 2019).	Very high
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Mature individuals undertake short spawning migrations. Anadromous and lake forms may migrate long distances to spawning streams (Froese & Pauly 2019).	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No, eggs covered with gravel (Froese and Pauly 2019).	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Stocking.	Very high
43	7.09	Is dispersal of the taxon density dependent?	No	Personal opinion	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being considered.]	Yes	The rainbow trout is a hardy fish that is easy to spawn, fast growing, tolerant to a wide range of environments and handling (FAO). Rainbow trout is more temperature tolerant than native Salmonid species (Matulla et al. 2007). Better tolerance to temperature, oxygen levels and pH than other salmonids in	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	Not allowed	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Only one example found that the species tolerates deforestation (Lacy et al. 2018).	High

48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Froese & Pauly 2019	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Piscivorous birds and otters (personal opinion).	High
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	Already present (Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	Climate change will not dramatically alter the status of rainbow trout (predicted for USA) (Isaak et al. 2010).	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	Climate change will not dramatically alter the status of rainbow trout (predicted for USA) (Isaak et al. 2010).	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	Native salmonids may be at risk of losing habitat in favour of invaders like more tolerant rainbow trout (Matulla et a. 2007).	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	Species may possibly limit upward shifts of native Salmonids, brown trout and grayling, reducing their numbers which may have effects on ecosystem.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	Reduced numbers of grayling and brown trout may have adverse influence on salmonid sport fishing and loss in economic value (Matulla et al. 2007).	High

Statistics	
Scores	
BRA	**26.0**
BRA Outcome	**-**
BRA+CCA	**32.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**11.0**
1. Domestication/Cultivation	*0.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*10.0*
B. Biology/Ecology	**15.0**
4. Undesirable (or persistence) traits	*5.0*
5. Resource exploitation	*5.0*
6. Reproduction	*-1.0*
7. Dispersal mechanisms	*1.0*
8. Tolerance attributes	*5.0*
C. Climate change	**6.0**
9. Climate change	*6.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**10**
Environmental	**14**
Species or population nuisance traits	**11**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.85**
BRA	**0.87**
CCA	**0.67**

Date and Time
13/05/2021 20:49:49

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Oncorhynchus mykiss*
Common name	rainbow trout
Assessor	Tamara Kanjuh
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Rainbow trout have been cultured for hundred of years, and are the most widely farmed trout in the world (Hardy, 2002).	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	The rainbow trout has long been used for fish farming (Hardy, 2002).	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Robert J. Behnke (2002) listed 15 subspecies of rainbow trout.	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Dfa, Dfb (Köppen–Geiger climate classification system)	Medium
5	2.02	What is the quality of the climate matching data?	High	Köppen–Geiger climate classification system	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	The occurrence of a resident form of rainbow trout in the Danube is rare but pretty regular, especially in the proximity of Djerdap dam I and II (Nikčecić, et al., 2016).	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	Aquaculture, hunting, angling, sport fishing (Lemhardt et al., 2011).	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	No	There is no established population of rainbow trout in Serbian natural waters, its populations being associated with escapes from fish farms.	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	The highest abundance of suchpopulations was observed in the Alpine foothills of central Europe where naturalization is notlimited to modified waters less suitable for native salmonids but also occurs commonly inpristine and near-natural waters (Stanković et	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Native rainbow trout and other congeneric trout can suffer significant loss of genetic diversity and integrity due to hybridization with introduced hatchery populations (Pearse et al., 2010; Simmons et al., 2010; Finger et al., 2011).Rainbow trout can have a severe negative impact on other salmonid species through redd superimposition and competition for space and food (Scott&Irvine, 2000; Seiler and Keeley, 2009; Van Zwol et al., 2012b). Non-native rainbow trout can also affect congeneric trout species by predation or competition, or both (Stanković et al.,	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	Rainbow trout have been introduced throughout the world, negatively impacting species of native freshwater fishes and, therefore, native fisheries (https://animaldiversity.org/accounts/Oncorhynchus_mykiss/).	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	Rainbow trout have been introduced throughout the world, negatively impacting species of native freshwater fishes and, therefore, native fisheries (https://animaldiversity.org/accounts/Oncorhynchus_mykiss/).	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	Rainbow trout have been introduced throughout the world, negatively impacting species of native freshwater fishes and, therefore, native fisheries (https://animaldiversity.org/accounts/Oncorhynchus_mykiss/).	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	Yes	Potenitial pests (fishbase.se)	Medium
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Alongside hybridization, competition has been implicated in the extinction of the Alvord cutthroat trout (O. c. alvordensis) and in having a severe negative impact on several other cutthroat trout subspecies (Allendorf and Leary, 1988; Seiler and Keeley, 2009).	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	Yes	Introduction of salmonids into karstic waters of Adriatic Croatia represents a special problem as these waters host various endemic minnow-like fish, which are in danger of local and even total extinction due to predation by rainbow trout (Stanković et	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Forexample,O.mykisscan survive in waters between approximately 0.0 °C and 29.8 °C ,depending on the temperature history and strain of the fish being tested (Rodgers&Griffiths, 1983; Currie et al., 1998) and the rate of temperature change (Elliott&Elliott, 1995). However, within this temperature range for survival, or for any other variable,O.mykisshave a preferred range in which growth, reproduction and/or other physiologicalcharacteristics are optimised (Peterson&Meador, 1994).	Medium

18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	Reduction of rainbow trout densities led to compensatory responses in other components of the Castle Lake fish assemblage as brook trout and golden shiners increased in abundance. This compensation resulted in increased rates of vertebrate planktivory on daphnids within 2 yr after trout stocking was discontinued. Zooplankton shifts in response to discontinuance of trout stocking were more rapid, particularly an immediate increase in a previously rare invertebrate predator (Diacyclops thomasi) (Elser	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	Recreational fishing is a multifaceted activity with complex benefits for individuals and society (Liu et al., 2019).	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No information found.	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No information found.	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	No information found.	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	The study showed that the highest trout densities were found in the fastest flowing waters (based on volume throughput estimates of individual streams). The highest trout densities were recorded in water velocities of 45.6 – 76.0 cm*sec-1. However, trout have also been recorded in high abundance in water speeds exceeding 156-321 cm*sec-1 (Varley&Gresswell, 1988).	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Rainbow trout can have a severe negative impact on other salmonid species through redd superimposition and competition for space and food (Scott&Irvine, 2000; Seiler&Keeley, 2009; Van Zwol et al., 2012b).	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	The evidence for stronger dominance hierarchies in the 10 kg m−3 treatment, indicate that low as well as high stocking densities have the potential to adversely affect trout welfare (North et al., 2006).	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Introduction of salmonids into karstic waters of Adriatic Croatia represents a special problem as these waters host various endemic minnow-like fish, which are in danger of local and even total extinction due to predation by rainbow trout. This has already happened with the striped minnow (Telestes metohiensis) in the River Ljuta (Zupančič&Bogutskaya, 2002; Zupančič, 2008).	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information found.	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	There is no parental care of the nest or the eggs (Rainbow Trout - Lake Superior Streams, https://www.lakesuperiorstreams.org).	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Recent records on naturalized rainbow trout populations in Croatia are rare. MacCrimmon (1971) reported self-sustaining rainbow trout populations from the disappearing river systems of Gacka and Dretulja and in Plitvice Lakes, all in Lika County. Recently, a self-sustaining population was observed in the karstic disappearing river system Ljuta near Dubrovnik (Zupančič&Bogutskaya, 2002; Zupančič, 2008; unpublished personal observations), in River Jadro and Žrnovnica near Split, and in an artificial canal of the Drava near Prolog (Nikica Šprem, personal communication; unpublished personal observations).	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Native rainbow trout and other congeneric trout can suffer significant loss of genetic diversity and integrity due to hybridization with introduced hatchery populations (Pearse et al., 2010; Simmons et al., 2010; Finger et al., 2011). Such accounts are reported throughout the entire range of North American native trout. Hybridization has especially affected the inland resident redband trout of the Columbia, Sacramento and northern Great basins, the subspecies of the Kern River basin, Gila trout (Oncorhynchus gilae gilae) from Arizona and Apache trout (O. g. apache) from New Mexico, along with many subspecies of	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No information found.	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	Cover, defined as sheltered areas in a stream where trout can rest or hide from predators (i.e. snags, logs, undercut banks, large rocks, etc), was positively correlated with trout abundance. The best trout areas had in excess of 55% of the available area of the stream containing some form of cover. The most inadequate streams still had cover, but less than 10% of the area of a stream	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Female rainbow trout usually produce 2000 to 3000 4-to-5-millimetre eggs per kilogram of weight (Tyler et al., 1996). Range number of offspring 200 to 8000 (https://animaldiversity.org/accounts/Oncorhynchus_mykiss/).	Medium
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	As a result, temperature and food availability influence growth and maturation, causing age at maturity to vary; though it is usually 3-4 years (fao.org).	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Aquaculture, stocking for sport fisheries (Lenhardt et al., 2010).	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Through water connections.	Medium

37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No information found.	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	No information found.	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Other than these established populations, adults have been frequently captured during many years in streams all along the estuary. Given that no reproduction has been detected in these rivers, captures are believed to be composed of vagrant fish	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Rainbow trout populations in Lake Constance should receive special attention as they exhibit migratory behavior. Individuals leave the lake and migrate upstream for spawning where, presumably, they compete with brown trout for spawning grounds (Peter, 1997; Dußling&Berg, 2001).	Medium
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No information found.	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Expansion for sport fishing.	Medium
43	7.09	Is dispersal of the taxon density dependent?	Yes	The evidence for stronger dominance hierarchies in the 10 kg m−3 treatment, indicate that low as well as high stocking densities have the potential to adversely affect trout welfare	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	It cannot survive out of the water.	High
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being considered.]	No	Oxygen concentration has been identified as the critical factor for the survival of O.mykiss from spawning to hatching (Rubin 1998). Although O.mykiss have been recorded in a range of dissolved oxygen levels (2.6 - 8.6 mg.L-1 (Thurston et al., 1981), <1.0 - 5.0 mg.L-1 (Matthews&Berg 1997)), sub-lethal effects have been recorded in O.mykiss and other salmonids at moderate levels of dissolved oxygen. For example, the distribution of adult O.mykiss was observed to be restricted to areas where dissolved oxygen concentrations were above 2.5 mg.L-1 (Rowe&Chisnall 1995).	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	Although some areas still intentionally stock rainbow trout, other areas are attempting to cut down on rainbow trout numbers. There are two main methods to remove the fish: fish traps and electro-fishing. Electro-fishing only stuns the fish, so it has the added benefit of allowing scientists to monitor populations of other fish while also removing rainbow trout. These methods are currently employed by rangers at the Grand Canyon National Park, where they're attempting to remove non-native trout to help the recovery of the native humpback chub (http://www.invasivespeciesinitiative.com/rainbow-trout).	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	No information found.	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	In terms of a tolerance range to salinity, both O.mykiss and S.trutta appear to be able to cope with salinities between 0 - 35 ‰ (Molony, 2001).	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	Yes	The rainbow trout is prey for larger fish, fish eating birds, including herons and kingfishers, and mammals (https://www.chesapeakebay.net/discover/field-guide/entry/rainbow_trout)	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Warming of rivers can be assumed to affect these populations by exceeding temperature preference and tolerance limits (Matulla et al., 2007).	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Warming of rivers can be assumed to affect these populations by exceeding temperature preference and tolerance limits (Matulla et al., 2007).	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Warming of rivers can be assumed to affect these populations by exceeding temperature preference and tolerance limits (Matulla et al., 2007).	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Warming of rivers can be assumed to affect these populations by exceeding temperature preference and tolerance limits (Matulla et al., 2007).	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	Warming of rivers can be assumed to affect these populations by exceeding temperature preference and tolerance limits (Matulla et al., 2007).	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	Warming of rivers can be assumed to affect these populations by exceeding temperature preference and tolerance limits (Matulla et al., 2007).	Medium

Statistics	
Scores	
BRA	**38.0**
BRA Outcome	**-**
BRA+CCA	**26.0**
BRA+CCA Outcome	**-**

Score partition	
A. Biogeography/Historical	**24.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*18.0*
B. Biology/Ecology	**14.0**
4. Undesirable (or persistence) traits	*8.0*
5. Resource exploitation	*5.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*3.0*
8. Tolerance attributes	*-3.0*
C. Climate change	**-12.0**
9. Climate change	*-12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**17**
Environmental	**8**
Species or population nuisance traits	**6**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.63**
BRA	**0.64**
CCA	**0.50**

Date and Time
28/05/2021 08:59:34

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Oncorhynchus mykiss*
Common name	rainbow trout
Assessor	Tena Radocaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Rainbow trout is most important trout species in croatia aquaculture (90 %)	Medium
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	High
5	2.02	What is the quality of the climate matching data?	High	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary). plus climatch	Very high
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	R. trout is present in Croatia	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	None	R. trout is present in Croatia	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	not applicable	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary). Welcomme, R.L., 1988. International introductions of inland aquatic species. FAO Fish.	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	R. trout adapted on climate and another environmental condition in RA area, it has developed self-sustaining populations in Croatia	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	Maybe, there is a possibility that the taxon will impair the nutritional structure and function of the ecosystem in the RA area. Becasue of that Rainbow trout are known to have damaged native species populations (through competition and predation). (Hasegawa, K. Invasions of rainbow trout and brown trout in Japan: A comparison of invasiveness and impact on native species. Ecology of Freshwater Fish.)	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	The taxon will not adversely affect ecosystem services in the RA area. There is no recorded negative impact on aquaculture.	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Yes, the taxon may be a host or vector of known pests and infectious agents endemic to RA area. Because in every area exist infectious agents and pests.	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Rainbow trout were infected concomitantly with Argulus coregoni and Flavobacterium columnare (Bandilla, M., Valtonen, E. T., Suomalainen, L. R., Aphalo, P. J., & Hakalahti, T. (2006). A link between ectoparasite infection and susceptibility to bacterial disease in rainbow trout. International journal for parasitology,	High

22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	High
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	The diet sometimes includes native salmonids and other fish species. It is possible that it consume endangered and protected native taxa in the RA area. If there are protected taxa in the RA area will consume them, whether or not the taxon is endangered.	Medium
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	not applicable	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	No	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable habitats nearby)?	>1	1. anglers for recreational fishing 2. flooding 3. natural spread via natural and manmade watercourses (Hasegawa, K. Invasions of rainbow trout and brown trout in Japan: A comparison of invasiveness and impact on native species. Ecology of Freshwater	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	This species is present in protect area.	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	There is a possibility of a high rate of spread of taxa. Eg. if a fertilized individual enters a new area by any means of expansion.	Medium
43	7.09	Is dispersal of the taxon density dependent?	No	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Not applicable	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	High

48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	No	Baruš V. and Oliva O. 1995. Fauna of the Czech and Slovak Republics. Volume 28/2. Fishes - Osteichthyes. Academia, Praha. (in Czech with English summary).	Very high
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	not applicable	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	The risk of a taxon becoming domesticated is increasing. Rainbow trout (Oncorhynchus mykiss), is better adapted to higher water temperatures. Matulla, C., Schmutz, S., Melcher, A., Gerersdorfer, T., & Haas, P. (2007). Assessing the impact of a downscaled climate change simulation on the fish fauna in an Inner-Alpine River. International journal of biometeorology, 52(2), 127-137.	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	The risk of distribution of this taxon is increased. Matulla, C., Schmutz, S., Melcher, A., Gerersdorfer, T., & Haas, P. (2007). Assessing the impact of a downscaled climate change simulation on the fish fauna in an Inner-Alpine River. International journal of biometeorology, 52(2), 127-137.	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	Increase	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	Rainbow trout are known to have damaged native species populations (through competition and predation). Matulla, C., Schmutz, S., Melcher, A., Gerersdorfer, T., & Haas, P. (2007). Assessing the impact of a downscaled climate change simulation on the fish fauna in an Inner-Alpine River. International journal of	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	Matulla, C., Schmutz, S., Melcher, A., Gerersdorfer, T., & Haas, P. (2007). Assessing the impact of a downscaled climate change simulation on the fish fauna in an Inner-Alpine River. International journal of biometeorology, 52(2), 127-137.	Medium

Statistics	
Scores	
BRA	**38.0**
BRA Outcome	**-**
BRA+CCA	**48.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**20.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*18.0*
B. Biology/Ecology	**18.0**
4. Undesirable (or persistence) traits	*8.0*
5. Resource exploitation	*5.0*
6. Reproduction	*0.0*
7. Dispersal mechanisms	*2.0*
8. Tolerance attributes	*3.0*
C. Climate change	**10.0**
9. Climate change	*10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**19**
Environmental	**16**
Species or population nuisance traits	**16**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.83**
BRA	**0.86**
CCA	**0.58**

Date and Time
02/06/2020 09:54:41

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Oncorhynchus tshawytscha*
Common name	chinook salmon
Assessor	Ana Marić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Genetic Variation within and Between Domesticated Chinook Salmon, Oncorhynchus tshawytscha, Strains and their Progenitor Populations Ji Eun Kim, Ruth E. Withler, Carol Ritland & Kimberly	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Genetic Variation within and Between Domesticated Chinook Salmon, Oncorhynchus tshawytscha, Strains and their Progenitor Populations Ji Eun Kim, Ruth E. Withler, Carol Ritland & Kimberly M. Cheng. 2004 https://www.fisheries.noaa.gov/species/chinook-	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	https://www.cabi.org/isc/datasheet/71815#toidentity incasive itself? and rainbow trout	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	Koppen Geiger climate system	High
5	2.02	What is the quality of the climate matching data?	Medium	climach 11/26 in 5 in target region, 10-8-5-3-1 in source region of 653	Very high
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	Identifying threats from introduced a 1 nd translocated non-native freshwater fishes in neighbouring countries under current and future climatic conditions Tena Radočaj a, Ivan Špelić a, Lorenzo Vilizzi b, *, Meta Povž c, Marina Piria. 2021	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Stocking	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	No	Identifying threats from introduced a 1 nd translocated non-native freshwater fishes in neighbouring countries under current and future climatic conditions Tena Radočaj a, Ivan Špelić a, Lorenzo Vilizzi b, *, Meta Povž c, Marina Piria 2021	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Impacts of Introduced and Translocated Freshwater Fishes in Australia A.H. ARTHINGTON. 1989	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Impacts of Introduced and Translocated Freshwater Fishes in Australia A.H. ARTHINGTON 1989. Center for Catchment and In-st ream Research.	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Establishment of Chinook salmon (Oncorhynchus tshawytscha) in Pacific basins of southern South America and its potential ecosystem implications. DORIS SOTO1, 2, IVÁN ARISMENDI1, CECILIA DI PRINZIO3 & FERNANDO JARA 2007	Very high
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	https://www.fishbase.se/summary/Oncorhynchus-tshawytscha.html Establishment of Chinook salmon (Oncorhynchus tshawytscha) in Pacific basins of southern South America and its potential ecosystem implications. DORIS SOTO1, 2, IVÁN ARISMENDI1, CECILIA DI PRINZIO3 & FERNANDO JARA	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Establishment of Chinook salmon (Oncorhynchus tshawytscha) in Pacific basins of southern South America and its potential ecosystem implications. DORIS SOTO1, 2, IVÁN ARISMENDI1, CECILIA DI PRINZIO3 & FERNANDO JARA 2007	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	https://www.fishbase.se/summary/Oncorhynchus-tshawytscha.html	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Impacts of Introduced and Translocated Freshwater Fishes in Australia A.H. ARTHINGTON Center for Catchment and In-st ream Research. 1989	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	https://www.fishbase.se/summary/Oncorhynchus-tshawytscha.html	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	https://www.cabi.org/isc/datasheet/71815#toclimate	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	Impacts of Introduced and Translocated Freshwater Fishes in Australia A.H. ARTHINGTON Center for Catchment and In-st ream Research. 1989	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	https://www.cabi.org/isc/datasheet/71815#toclimate	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Marine netpen farming leads to infections with some unusual parasites Author links open overlay panelMichael LKent 2000	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Marine netpen farming leads to infections with some unusual parasites Author links open overlay panelMichael LKent	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	https://www.cabi.org/isc/datasheet/71815#topathwayCauses	Very high

23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	https://www.cabi.org/isc/datasheet/71815#towaterTolerances	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	https://www.fishbase.se/summary/Oncorhynchus-tshawytscha.html	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	https://www.cabi.org/isc/datasheet/71815#tonaturalEnemies	High
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	https://www.cabi.org/isc/datasheet/71815#tonaturalEnemies https://www.fishbase.se/summary/Oncorhynchus-	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	Impacts of Introduced and Translocated Freshwater Fishes in Australia A.H. ARTHINGTON Center for Catchment and In-st ream Research. 1989	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Yes	Changes in Size and Age of Chinook Salmon Oncorhynchus tshawytscha Returning to Alaska Bert Lewis ,W. Stewart Grant,Richard E. Brenner,Toshihide Hamazaki. 2015	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	As O, mykiss is	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	https://www.cabi.org/isc/datasheet/71815#tonaturalEnemies	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	https://www.cabi.org/isc/datasheet/71815#tonaturalEnemies	High
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	https://www.cabi.org/isc/datasheet/71815#toriskAndImpactFactors	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	https://www.cabi.org/isc/datasheet/71815#toriskAndImpactFactors	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	https://www.fisheries.noaa.gov/species/chinook-salmon	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Most probably stocking	Very high
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Stocing protected area	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	https://www.fisheries.noaa.gov/species/chinook-salmon	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	https://www.fishbase.se/summary/Oncorhynchus-tshawytscha.html	Very high
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	https://www.fishbase.se/summary/Oncorhynchus-tshawytscha.html	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	https://www.fishbase.se/summary/Oncorhynchus-tshawytscha.html	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	https://www.fishbase.se/summary/Oncorhynchus-tshawytscha.html	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	https://www.cabi.org/isc/datasheet/71815#toriskAndImpactFactors	High
43	7.09	Is dispersal of the taxon density dependent?	Yes	The Interplay between Climate Variability and Density Dependence in the Population Viability of Chinook Salmon RICHARD W. ZABEL,* MARK D. SCHEUERELL, MICHETTF M. McCLURE, AND JOHN G. WILLIAMS. 2006	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	https://www.cabi.org/isc/datasheet/71815#toriskAndImpactFactors	High
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	https://www.cabi.org/isc/datasheet/71815#toriskAndImpactFactors oxygen, amonia...	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	https://www.cabi.org/isc/datasheet/71815#toriskAndImpactFactors	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	https://www.cabi.org/isc/datasheet/71815#toriskAndImpactFactors	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	https://www.fishbase.se/summary/Oncorhynchus-tshawytscha.html	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	https://www.cabi.org/isc/datasheet/71815#tonaturalEnemies	Very high
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Stocking	Very high

51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Potential climate change impacts on thermal habitats of Pacific salmon (Oncorhynchus spp.) in the North Pacific Ocean and adjacent seas Omar I. Abdul-Aziz, Nathan J. Mantua, and Katherine W. Myers. 2010	Very high
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	Potential climate change impacts on thermal habitats of Pacific salmon (Oncorhynchus spp.) in the North Pacific Ocean and adjacent seas Omar I. Abdul-Aziz, Nathan J. Mantua, and Katherine W. Myers. 2010	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Potential climate change impacts on thermal habitats of Pacific salmon (Oncorhynchus spp.) in the North Pacific Ocean and adjacent seas Omar I. Abdul-Aziz, Nathan J. Mantua, and Katherine W. Myers. 2010	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	Potential climate change impacts on thermal habitats of Pacific salmon (Oncorhynchus spp.) in the North Pacific Ocean and adjacent seas Omar I. Abdul-Aziz, Nathan J. Mantua, and Katherine W. Myers. 2010	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	Potential climate change impacts on thermal habitats of Pacific salmon (Oncorhynchus spp.) in the North Pacific Ocean and adjacent seas Omar I. Abdul-Aziz, Nathan J. Mantua, and Katherine W. Myers. 2010	High

Statistics	
Scores	
BRA	**26.5**
BRA Outcome	**-**
BRA+CCA	**18.5**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**8.5**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*4.5*
B. Biology/Ecology	**18.0**
4. Undesirable (or persistence) traits	*7.0*
5. Resource exploitation	*7.0*
6. Reproduction	*4.0*
7. Dispersal mechanisms	*1.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**-8.0**
9. Climate change	*-8.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**4**
Environmental	**3**
Species or population nuisance traits	**13**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.85**
BRA	**0.85**
CCA	**0.83**

Date and Time
23/05/2021 16:37:28

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Oncorhynchus tshawytscha*
Common name	chinook salmon
Assessor	Ivan Špelić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Species Fact Sheet: Oncorhynchus tshawytscha (Walbaum, 1792). FAO. Archived from the original on 3 April 2020.	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Maybe for restocking (personal opinion).	Low
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	O. mykiss (CABI 2019).	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Climatch 2020	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Climatch 2020	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	Escape from aquaculture, introduced for angling (CABI 2019).	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	No	Not established in Europe (Froese & Pauly 2020).	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Fuller, P., G. Jacobs, M. Cannister, J. Larson, and A. Fusaro, 2020, Oncorhynchus tshawytscha (Walbaum in Artedi, 1792): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=920, Revision Date: 12/20/2019, Peer Review Date: 6/26/2014, Access Date: 4/28/2020	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Fuller, P., G. Jacobs, M. Cannister, J. Larson, and A. Fusaro, 2020, Oncorhynchus tshawytscha (Walbaum in Artedi, 1792): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=920, Revision Date: 12/20/2019, Peer Review Date: 6/26/2014, Access Date: 4/28/2020	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Farmed and no adverse impacts (Species Fact Sheet: Oncorhynchus tshawytscha (Walbaum, 1792). FAO. Archived from the original on 3 April 2020.).	High
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	No examples in introduced areas.	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Positive impact on sportfishing (Scott, C. 2003. "Oncorhynchus tshawytscha" (On-line), Animal Diversity Web. Accessed April 28, 2020 at https://animaldiversity.org/accounts/Oncorhynchus_tshawytscha/)	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Potential pest but no direct risk (Froese & Pauly 2020).	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Fuller, P., G. Jacobs, M. Cannister, J. Larson, and A. Fusaro, 2020, Oncorhynchus tshawytscha (Walbaum in Artedi, 1792): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=920, Revision Date: 12/20/2019, Peer Review Date: 6/26/2014, Access Date: 4/28/2020	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No parasitic behaviour.	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	The freshwater streams are relatively deep with course gravel. The water must be cool, under 14 C for maximum survival, and fast flowing (Scott, C. 2003. "Oncorhynchus tshawytscha" (On-line), Animal Diversity Web. Accessed April 28, 2020 at https://animaldiversity.org/accounts/Oncorhynchus_tshawytscha/)	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	CABI 2019 listed altered trophic level as invasion outcome but there is no documented evidence. In Great Lakes caused a substantial loss of forage fish (Fuller, P., G. Jacobs, M. Cannister, J. Larson, and A. Fusaro, 2020, Oncorhynchus tshawytscha (Walbaum in Artedi, 1792): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=920, Revision Date: 12/20/2019, Peer Review Date: 6/26/2014, Access Date: 4/28/2020).	Medium

19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No examples of such imapacts in invaded areas.	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA area?	Yes	Rauque, C., Viozzi, G., Flores, V., Vega, R., Waicheim, A., & Salgado-Maldonado, G. (2018). Helminth parasites of alien freshwater fishes in Patagonia (Argentina). International journal for parasitology. Parasites and wildlife, 7(3), 369–379. https://doi.org/10.1016/j.ijppaw.2018.09.008	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Rauque, C., Viozzi, G., Flores, V., Vega, R., Waicheim, A., & Salgado-Maldonado, G. (2018). Helminth parasites of alien freshwater fishes in Patagonia (Argentina). International journal for parasitology. Parasites and wildlife, 7(3), 369–379. https://doi.org/10.1016/j.ijppaw.2018.09.008	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	150 cm, 61 kg (Froese & Pauly 2020).	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Streams, lakes, sea (Froese & Pauly 2020).	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Supply of marine derived nutrients to headwaters (Soto D, Arismendi I, Di Prinzio C, Jara F (2007) Establishment of Chinook Salmon (Oncorhynchus tshawytscha) in Pacific basins of Southern South America and its potential ecosystem implications. Rev Chil Hist Nat 80:81–98), but this is not likely for Slovenia (personal	Medium
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Establishments of populations in new areas are very rare (CABI 2019).	High
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Food in streams is mainly terrestrial insects and small crustaceans; adults prey on fish in the sea (Froese & Pauly 2020). Landlocked populations in great lakes feed on fish (Fuller, P., G. Jacobs, M. Cannister, J. Larson, and A. Fusaro, 2020, Oncorhynchus tshawytscha (Walbaum in Artedi, 1792): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=920, Revision Date: 12/20/2019, Peer Review Date: 6/26/2014, Access	Medium
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	No obtained data for calculation.	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Froese & Pauly 2020	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	Never established in Europe despite continuous effort through history (Crawford SS, Muir AM (2008) Global introductions of salmon and trout in the genus Oncorhynchus: 1870–2007. Reviews in Fish Biology and Fisheries 18: 313– 344.).	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No related native taxa (Kottelat & Freyhof 2007).	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No reports in literature.	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	Anadromous spawner, needs specific habitats. Freshwater streams, estuaries, and the open ocean are all important habitats. The freshwater streams are relatively deep with course gravel. The water must be cool, under 14 C for maximum survival, and fast flowing. There are landlocked populations in Great Lakes but they also migrate to connected streams to spawn (Scott, C. 2003. "Oncorhynchus tshawytscha" (On-line), Animal Diversity Web. Accessed April 28, 2020 at https://animaldiversity.org/accounts/Oncorhynchus_tshawytscha/; Fuller, P., G. Jacobs, M. Cannister, J. Larson, and A. Fusaro, 2020, Oncorhynchus tshawytscha (Walbaum in Artedi, 1792): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=920, Revision Date: 12/20/2019, Peer Review Date: 6/26/2014, Access Date: 4/28/2020)	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Max 13,600 eggs per female (Froese & Pauly 2020).	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Varies from 2-7 (Froese & Pauly 2020).	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Introductions for angling.	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	Personal opinion.	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No adaptations.	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Almost certainly it will not establish a viable population due to non optimum conditions (Crawford SS, Muir AM (2008) Global introductions of salmon and trout in the genus Oncorhynchus: 1870–2007. Reviews in Fish Biology and Fisheries 18: 313– 344).	Very high

39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	Almost certainly it will not spawn in RA area due to non optimum conditions (Crawford SS, Muir AM (2008) Global introductions of salmon and trout in the genus Oncorhynchus: 1870–2007. Reviews in Fish Biology and Fisheries 18: 313– 344).	Very high
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	Anadromous spawners (potamodromous in Great Lakes) but no so far no suitable conditions for natural spawning in Europe (Crawford SS, Muir AM (2008) Global introductions of salmon and trout in the genus Oncorhynchus: 1870–2007. Reviews in Fish Biology and Fisheries 18: 313– 344).	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Almost certainly it will not spawn in RA area due to non optimum conditions (Crawford SS, Muir AM (2008) Global introductions of salmon and trout in the genus Oncorhynchus: 1870–2007. Reviews in Fish Biology and Fisheries 18: 313– 344).	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Introductions	Medium
43	7.09	Is dispersal of the taxon density dependent?	No	In streams only during spawning and while smoltifying (Froese & Pauly 2020).	Very high
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Probably sensitive as other Salmonids (personal opinion).	Medium
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	CABI 2019	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	Not allowed.	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Needs rivers without obstacles to reach spawning streams (COSEWIC 2006. COSEWIC assessment and status report on the chinook salmon Oncorhynchus tshawytscha (Okanagan population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 41 pp.	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Anadromous species (Froese & Pauly 2020).	Very high
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	Yes	Piscivorous fish and birds (Scott, C. 2003. "Oncorhynchus tshawytscha" (On-line), Animal Diversity Web. Accessed April 28, 2020 at https://animaldiversity.org/accounts/Oncorhynchus_tshawytscha/)	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Only pathway is introduction by man.	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	Almost certainly not able to establish viable population (Crawford SS, Muir AM (2008) Global introductions of salmon and trout in the genus Oncorhynchus: 1870–2007. Reviews in Fish Biology and Fisheries 18: 313– 344), it is a cold water species so no change with climate change.	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	Almost certainly not able to establish viable population (Crawford SS, Muir AM (2008) Global introductions of salmon and trout in the genus Oncorhynchus: 1870–2007. Reviews in Fish Biology and Fisheries 18: 313– 344), it is a cold water species so no change with climate change.	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Potential stocked specimens would be stressed under predicted increase in temperature because it is a cold water species (Myrick, C.A., and J.J. Cech, Jr. 2001. Temperature effects on Chinook salmon and steelhead: a review focusing on California's Central Valley populations. Bay-Delta Modeling Forum Technical	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	Potential stocked specimens would be stressed under predicted increase in temperature because it is a cold water species (Myrick, C.A., and J.J. Cech, Jr. 2001. Temperature effects on Chinook salmon and steelhead: a review focusing on California's Central Valley populations. Bay-Delta Modeling Forum Technical	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Predicted impact is not certain even in this conditions so no change.	Medium

Statistics	
Scores	
BRA	**14.0**
BRA Outcome	**-**
BRA+CCA	**10.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**11.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*6.0*
B. Biology/Ecology	**3.0**
4. Undesirable (or persistence) traits	*5.0*
5. Resource exploitation	*5.0*
6. Reproduction	*-2.0*
7. Dispersal mechanisms	*-4.0*
8. Tolerance attributes	*-1.0*

C. Climate change	**-4.0**
9. Climate change	*-4.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**9**
Environmental	**2**
Species or population nuisance traits	**1**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.76**
BRA	**0.77**
CCA	**0.71**

Date and Time
12/05/2021 08:02:54

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Oncorhynchus tshawytscha*
Common name	chinook salmon
Assessor	Tamara Kanjuh
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	The world's largest producer and market supplier of the Chinook salmon is New Zealand ("Aquaculture New Zealand Industry Overview". Retrieved September 20, 2011.)	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	"Fisheries and Aquaculture Department Statistics". Food and Agriculture Organization of the United Nations. Retrieved 2012-09-	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	cabi.org	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	Dfa, Dfb (Köppen–Geiger climate classification system)	High
5	2.02	What is the quality of the climate matching data?	High	Köppen–Geiger climate classification system	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Document???	Medium
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Intentional stocking, aquaculture	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Intentional stocking	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	No	No information found.	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	cabi.org	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	cabi.org	High
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	cabi.org	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	cabi.org	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	Yes	Potential pests (FishBase)	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	cabi.org	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	The taxon is not a parasite.	High
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	cabi.org	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	cabi.org	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	cabi.org	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No information found.	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	cabi.org	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	Not in captivity.	High
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	cabi.org	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	cabi.org	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	cabi.org	High

5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	cabi.org	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	cabi.org	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	cabi.org	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	No information found.	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	cabi.org	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	Yes	cabi.org	High
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	cabi.org	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	cabi.org	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	6	"CHINOOK SALMON FACTSBlue Face Baby". Pacific States Marine Fisheries Commission. 2010-03-05. Retrieved 2010-03-05. 1996-12-16	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Intentional stocking.	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Intentional stocking.	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	cabi.org	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	cabi.org	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	cabi.org	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	cabi.org	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	cabi.org	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Intentional stocking.	High
43	7.09	Is dispersal of the taxon density dependent?	No	No information found.	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	cabi.org	High
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	cabi.org	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	No information found.	Medium
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	cabi.org	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	cabi.org	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	cabi.org	High
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	cabi.org	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	cabi.org	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	cabi.org	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	cabi.org	High

54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	cabi.org	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	cabi.org	High

Statistics	
Scores	
BRA	**25.0**
BRA Outcome	**-**
BRA+CCA	**25.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**3.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*0.0*
B. Biology/Ecology	**22.0**
4. Undesirable (or persistence) traits	*8.0*
5. Resource exploitation	*7.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*1.0*
8. Tolerance attributes	*5.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**7**
Environmental	**9**
Species or population nuisance traits	**12**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.73**
BRA	**0.73**
CCA	**0.75**

Date and Time
03/06/2021 13:06:30

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Oncorhynchus tshawytscha*
Common name	chinook salmon
Assessor	Tena Radocaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Species Fact Sheet: Oncorhynchus tshawytscha (Walbaum, 1792). FAO. Archived from the original on 3 April 2020.	Medium
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	No	Personal opinion	Low
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Oncorhynchus mykiss (CABI 2019).	Medium
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	The similarity between climatic conditions RA area and native range is high. I use climatch.	Medium
5	2.02	What is the quality of the climate matching data?	Medium	The quality of the climate matching data is medium.	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	Chinook salmon is not present outside of captivity in the RA area	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	Escape from aquaculture, introduced for angling (CABI 2019)	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	No	Chinook salmon not established in Europe (Froese & Pauly 2020).	Medium
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Fuller, P., G. Jacobs, M. Cannister, J. Larson, and A. Fusaro, 2020, Oncorhynchus tshawytscha (Walbaum in Artedi, 1792): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=920, Revision Date: 12/20/2019, Peer Review Date: 6/26/2014, Access Date: 5/18/2020	Medium
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Fuller, P., G. Jacobs, M. Cannister, J. Larson, and A. Fusaro, 2020, Oncorhynchus tshawytscha (Walbaum in Artedi, 1792): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=920, Revision Date: 12/20/2019, Peer Review Date: 6/26/2014, Access Date: 5/18/2020	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Farmed and no adverse impacts (Species Fact Sheet: Oncorhynchus tshawytscha (Walbaum, 1792). FAO. Archived from the original on 3 April 2020.).	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	no data available	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Personal opinion	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Chinook salmon is harmless (Fishbase)	Medium
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Fuller, P., G. Jacobs, M. Cannister, J. Larson, and A. Fusaro, 2020, Oncorhynchus tshawytscha (Walbaum in Artedi, 1792): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=920, Revision Date: 12/20/2019, Peer Review Date: 6/26/2014, Access Date: 5/18/2020	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	The freshwater streams are relatively deep with course gravel. The water must be cool, under 14 C for maximum survival, and fast flowing (Scott, C. 2003. "Oncorhynchus tshawytscha" (On-line), Animal Diversity Web. Accessed May, 18, 2020 at https://animaldiversity.org/accounts/Oncorhynchus_tshawytscha/)	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	The taxon can will is no effect on the food-web structure/function in the aquatic ecosystem.	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	The taxon will not have an adverse impact on ecosystem services in the RA area.	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Yes, the taxon may be a host or vector of known pests and infectious agents endemic to RA area. Because in every area exist infectious agents and pests.	Medium

21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Rauque, C., Viozzi, G., Flores, V., Vega, R., Waicheim, A., & Salgado-Maldonado, G. (2018). Helminth parasites of alien freshwater fishes in Patagonia (Argentina). International journal for parasitology. Parasites and wildlife, 7(3), 369–379	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Max length : 150 cm TL (Fishbase)	Medium
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Froese & Pauly 2020	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Supply of marine derived nutrients to headwaters (Soto D, Arismendi I, Di Prinzio C, Jara F (2007) Establishment of Chinook Salmon (Oncorhynchus tshawytscha) in Pacific basins of Southern South America and its potential ecosystem implications. Rev Chil Hist Nat 80:81–98	Medium
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Establishments of populations in new areas are very rare (CABI 2019).	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	It is possible that it consume endangered and protected native taxa in the RA area. If there are protected taxa in the RA area will consume them, whether or not the taxon is endangered.	Medium
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	not applicable	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Froese & Pauly 2020	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	Chinook salmon can't produce viable gametes in the RA area. (Crawford SS, Muir AM (2008) Global introductions of salmon and trout in the genus Oncorhynchus: 1870–2007. Reviews in Fish Biology and Fisheries 18: 313– 344)	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	Walbaum in Artedi, 1792): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=920, Revision Date: 12/20/2019, Peer Review Date: 6/26/2014, Access Date: 5/18/2020	Medium
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Froese & Pauly 2020	Medium
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Spawns for the first time at 2-7 years. (Froese & Pauly 2020)	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Fishing (CABI, 2019)	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	That vector/pathway can't bring taxon in protected area.	Medium
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No adaptations	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Crawford SS, Muir AM (2008) Global introductions of salmon and trout in the genus Oncorhynchus: 1870–2007. Reviews in Fish Biology and Fisheries 18: 313– 344	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	Crawford SS, Muir AM (2008) Global introductions of salmon and trout in the genus Oncorhynchus: 1870–2007. Reviews in Fish Biology and Fisheries 18: 313– 344	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	Crawford SS, Muir AM (2008) Global introductions of salmon and trout in the genus Oncorhynchus: 1870–2007. Reviews in Fish Biology and Fisheries 18: 313– 344	Medium
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Crawford SS, Muir AM (2008) Global introductions of salmon and trout in the genus Oncorhynchus: 1870–2007. Reviews in Fish Biology and Fisheries 18: 313– 344	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	There is a possibility of a high rate of spread of taxa. Eg. if a fertilized individual enters a new area by any means of expansion.	Low
43	7.09	Is dispersal of the taxon density dependent?	No	Personal opinion	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Personal opinion	Medium
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Personal opinion	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Not applicable	It is not regulated in Croatia	Very high

47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	COSEWIC 2006. COSEWIC assessment and status report on the chinook salmon Oncorhynchus tshawytscha (Okanagan population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 41 pp.	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Anadromous species (Froese & Pauly 2020)	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Piscivorous fish and birds	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	The risks of entry into the RA area is no change. Maybe because of human impact, but not because of climate change.	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	Crawford SS, Muir AM (2008) Global introductions of salmon and trout in the genus Oncorhynchus: 1870–2007. Reviews in Fish Biology and Fisheries 18: 313– 344), it is a cold water species so no change with climate change	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	Crawford SS, Muir AM (2008) Global introductions of salmon and trout in the genus Oncorhynchus: 1870–2007. Reviews in Fish Biology and Fisheries 18: 313– 344), it is a cold water species so no change with climate change	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Future potential impacts on biodiversity and ecological status will not change.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	The future potential impacts on ecosystem structure and function will not change.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	The future potential impacts on ecosystem services and socio-economic factors will not change.	Medium

Statistics	
Scores	
BRA	**12.0**
BRA Outcome	**-**
BRA+CCA	**12.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**9.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*6.0*
B. Biology/Ecology	**3.0**
4. Undesirable (or persistence) traits	*5.0*
5. Resource exploitation	*5.0*
6. Reproduction	*-2.0*
7. Dispersal mechanisms	*-4.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**7**
Environmental	**6**
Species or population nuisance traits	**1**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.47**
BRA	**0.47**
CCA	**0.50**

Date and Time
18/05/2020 08:05:37

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo labrax*
Common name	Black Sea salmon
Assessor	Ana Marić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	1. http://aquatres.scientificwebjournals.com/en/download/article-file/1265953. Chemical composition of the Black Sea trout (Salmo labrax Pallas, 1814): A comparative study. 2020. Ekrem Cem Çankırılıgil , Nermin Berik, 2. Variation in the Timing of Spawning of the Black Sea Brown Trout Salmo trutta labrax Pallas under Artificial and Natural Conditions. 2011. A. A. Makhrova, V. S. Artamonovaa, V. S. Sumarokovb, A. N. Pashkovb, S. I. Reshetnikovb, M. V. Ganchenkoc, and S. A. Kulvand	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Naredbao merama za ocuvanje i zastitu ribljeg fonda. 2009.	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	A handbook of freshwater invasive species. Robert A. Francis. 2012.	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Dfb.. KG climate	Very high
5	2.02	What is the quality of the climate matching data?	High	https://climatch.cp1.agriculture.gov.au/climatch.jsp 4 light green	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	DIVERSITY OF BROWN TROUT, SALMO TRUTTA (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE), IN THE DANUBE RIVER BASIN OF CROATIA REVEALED BY MITOCHONDRIAL DNA Tamara KANJUH 1*, Ana MARIĆ1, Marina PIRIA2, Ivan ŠPELIĆ2, Ivana MAGUIRE3, and Predrag SIMONOVIĆ. The taxon is not in captivity, but yet not in Adriatic basin in RA area.	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Intentional unprofessional stocking.	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	BROWN TROUT'S POPULATIONS GENETIC DIVERSITY USING MITOCHONDRIAL MARKERS IN RELATIVELY SIMILAR GEOGRAPHICAL AND ECOLOGICAL CONDITIONS – A CARPATHIAN CASE STUDY Gina-Oana POPA *, Miad KHALAF **, Andreea DUDU ***, Angela CURTEAN-BĂNĂDUC ****, Doru BĂNĂDUC *****, Sergiu Emil GEORGESCU ***** and Marieta COSTACHE******* 2013.	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Genetic variation among trout in the River Neretva basin, Bosnia and Herzegovina 2006. A. RAZPET, S. SUSˇ NIK, T. JUG AND A. SNOJ* Diversity of Brown trout Salmo cf. trutta in the River Danube Basin of Western Balkans as Assessed from the Structure of Their Mitochondrial Control Region Haplotypes1 2017. P. Simonovića, *, A. Tošića, D. Škraba Jurlinaa, V. Nikolića, M. Piriab, T. Tomlianovićb, N. Špremb, D. Mrdakc, D. Miloševićc, A.	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp. https://www.fishbase.de/summary/Salmo-	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	https://www.fishbase.de/summary/Salmo-labrax.html Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	Very high
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp. Not evaluated elsewhere. But are there any consequences of stocking in 19th century? Diversity of Brown trout Salmo cf. trutta in the River Danube Basin of Western Balkans as Assessed from the Structure of Their Mitochondrial Control Region Haplotypes1 P. Simonovića, *, A. Tošića, D. Škraba Jurlinaa, V. Nikolića, M. Piriab, T. Tomlianovićb, N. Špremb, D.	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Not toxic.	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Genetic variation among trout in the River Neretva basin, Bosnia and Herzegovina. 2006. A. RAZPET, S. SUSˇ NIK, T. JUG AND A. SNOJ*	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	Not a parasite.	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 p	Very high

18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	Salmonids are top predators. S. trutta, its relative is one of 100 most invasive species	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	Mostly impacts other species and congeneras. A Handbook of Global Freshwater Invasive Species. Frencis. 2012	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Close relative to S. trutta and other salmonids so probably yes	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	Basins are in close proximity so probably no.	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Not applicable	Not in captivity.	High
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	https://dergipark.org.tr/en/download/article-file/141678 TJFAS	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Salmo trutta changes productivity in intorduced streams but DA is not that competitive?	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Tosic et al. 2016.	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Feeds on invertebrates, fish and crustaceans: Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 p	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	For S. trutta RIP is:	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Yes	Characteristics of the Hatchery-Reared Black Sea Salmon Salmo trutta labrax. 2007. V. Ya. Nikandrov and N. I. Shindavina For S. trutta deffinitly	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Genetic variation among trout in the River Neretva basin, Bosnia and Herzegovina A. RAZPET, S. SUSi NIK, T. JUG AND A. SNOJ*	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Genetic variation among trout in the River Neretva basin, Bosnia and Herzegovina A. RAZPET, S. SUSi NIK, T. JUG AND A. SNOJ*	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Characteristics of the Hatchery-Reared Black Sea Salmon Salmo trutta labrax. 2007 V. Ya. Nikandrov and N. I. Shindavina	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	No specialist incubators.	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Fecundity and egg size of three salmonid species (Oncorhynchus mykiss, Salmo labrax, Salvelinus fontinalis) cultured at the same farm condition in north-eastern, Turkey. Author(s) : SerezlİI, R. ; Guzel, S. ; Kocabas, M. 2010	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Characteristics of the Hatchery-Reared Black Sea Salmon Salmo trutta labrax. 2007. V. Ya. Nikandrov and N. I. Shindavina	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Unprofesional stocking	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Genetic variation among trout in the River Neretva basin, Bosnia and Herzegovina. 2007 A. RAZPET, S. SUSˇ NIK, T. JUG AND A. SNOJ*	Very high
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No such adaptation.	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	Very high
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Eggs dont have attaching adaptation.	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	If intention it can be very rapid.	High
43	7.09	Is dispersal of the taxon density dependent?	Yes	Partial migratority is	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Salmonids are very sensitive to reduced oxigen levels	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High

46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	No efficant pisticides for eradication.	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Maybe floods?	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Same as for S.trutta. S. obtusirostis...	Very high
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Same latitude for both basins. Professional judgement.	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	Professional judgement.	Very high
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	Professional judgement.	Very high
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Professional judgement.	Very high
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	Professional judgement.	Very high
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Professional judgement.	Very high

Statistics	
Scores	
BRA	**23.0**
BRA Outcome	**-**
BRA+CCA	**23.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**7.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*2.0*
B. Biology/Ecology	**16.0**
4. Undesirable (or persistence) traits	*4.0*
5. Resource exploitation	*7.0*
6. Reproduction	*4.0*
7. Dispersal mechanisms	*2.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**5**
Environmental	**7**
Species or population nuisance traits	**14**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.86**
BRA	**0.84**
CCA	**1.00**

Date and Time
12/05/2021 20:02:04

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo labrax*
Common name	Black Sea salmon
Assessor	Ivan Špelić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Reared in hatcheries (Nikandrov, V.Y., Shindavina, N.I., 2007. Characteristics of the hatchery-reared Black Sea salmon Salmo trutta labrax. Journal of Ichthyology 47, 184–193.. doi:10.1134/s0032945207020063; Ramazan Serezli, Senol Guzel and Mehmet Kocabas, 2010. Fecundity and Egg Size of Three Salmonid Species (Oncorhynchus mykiss, Salmo labrax, Salvelinus fontinalis) Cultured at the Same Farm Condition in North-Eastern. Turkey. Journal of Animal and Veterinary	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Nikandrov, V.Y., Shindavina, N.I., 2007. Characteristics of the hatchery-reared Black Sea salmon Salmo trutta labrax. Journal of Ichthyology 47, 184–193.. doi:10.1134/s0032945207020063	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Salmo trutta complex in general (CABI).	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Low	Estimated using Climatch, low number of points in the target area, only 6.	Low
5	2.02	What is the quality of the climate matching data?	Low	Estimated using Climatch, low number of points in the target area, only 6.	Very high
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Gacka river in Croatia (debatable if introduced or native as a consequence of historical hydrologic changes) (Jadan, M., Čož-Rakovac, R., Topić Popović, N., & Strunjak-Perović, I. (2007). Presence of unexpected phylogenetic lineages of brown trout Salmo trutta L. in Gacka River, Croatia. Aquaculture Research, 38(15), 1682–1685. doi:10.1111/j.1365-2109.2007.01832.x).	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	Not applicable	Already present (Jadan, M., Čož-Rakovac, R., Topić Popović, N., & Strunjak-Perović, I. (2007). Presence of unexpected phylogenetic lineages of brown trout Salmo trutta L. in Gacka River, Croatia. Aquaculture Research, 38(15), 1682–1685. doi:10.1111/j.1365-2109.2007.01832.x).	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	Already present (Jadan, M., Čož-Rakovac, R., Topić Popović, N., & Strunjak-Perović, I. (2007). Presence of unexpected phylogenetic lineages of brown trout Salmo trutta L. in Gacka River, Croatia. Aquaculture Research, 38(15), 1682–1685. doi:10.1111/j.1365-2109.2007.01832.x).	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Gacka river (debatable) (Jadan, M., Čož-Rakovac, R., Topić Popović, N., & Strunjak-Perović, I. (2007). Presence of unexpected phylogenetic lineages of brown trout Salmo trutta L. in Gacka River, Croatia. Aquaculture Research, 38(15), 1682–1685. doi:10.1111/j.1365-2109.2007.01832.x).	Medium
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	Not documented.	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Not documented	High
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	Not documented.	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Not documented.	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (Sa-a, Pascualita in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	If biology and ecology are presumably similar to other invasive Salmo trutta lineages (belonging to the same brown trout complex). Salmo trutta has been implicated in reducing native fish populations (especially other salmonids) through predation, displacement, and food competition; S. trutta introductions may have eliminated or reduced several Plecoptera and Trichoptera species in streams in Victoria, Australia (CABI, 2021. Salmo trutta[original text by Sunil Siriwardena]. In: Invasive Species Compendium. Wallingford, UK: CAB International.	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No parasitic behaviour (Kotellat & Freyhof 2008).	Very high

17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	For Salmo trutta: they prefer cold, well-oxygenated upland waters although their tolerance limits are lower than those of rainbow trout and favors large streams in the mountainous areas with adequate cover in the form of submerged rocks, undercut banks, and overhanging vegetation (Froese, R. and D. Pauly. Editors. 2019.FishBase. World Wide Web electronic publication. www.fishbase.org, (12/2019). Salmo labrax is distributed along the coasts of the Black and Azov Seas, and also in the rivers emptying into the seas (Lațiu, C., Cocan, D., Uiuiu, P., Ihuț, A., Nicula, S.A., Constantinescu, R., Mireșan, V., 2020. The Black Sea Trout, Salmo labrax Pallas, 1814 (Pisces: Salmonidae) in Romanian Waters. Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Animal Science and Biotechnologies 77, 9.. doi:10.15835/buasvmcn-asb:2020.0017)	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	Nystrom, P.; McIntosh, A. R. (2003): Are impacts of an exotic predator on a stream food web influenced by disturbance history? Oecologia (2003) 136:279–288. DOI 10.1007/s00442-003-1250-3 (for Salmo trutta).	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	For Salmo trutta: brown trout have been implicated in reducing native fish populations (especially other salmonids) through predation, displacement, food competition and hybridization (Global Invasive Species Database (2020) Species profile: Salmo trutta. Downloaded from http://www.iucngisd.org/gisd/speciesname/Salmo+trutta on 25-	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA area?	Yes	Salmo trutta is susceptible to pathogens and parasites (Cultured Aquatic Species Information Programme. Salmo trutta. Cultured Aquatic Species Information Programme. Text by Vandeputte, M. & Labbé, L. In: FAO Fisheries Division [online]. Rome. Updated . [Cited 24 May 2021].), so most likely S. labrax is also susceptible as a part of brown trout complex.	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Salmo trutta is susceptible to pathogens and parasites (Cultured Aquatic Species Information Programme. Salmo trutta. Cultured Aquatic Species Information Programme. Text by Vandeputte, M. & Labbé, L. In: FAO Fisheries Division [online]. Rome. Updated . [Cited 24 May 2021].), so most likely S. labrax is also susceptible as a part of brown trout complex.	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	80 cm (Sa-a, Pascualita in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	There are anadromous, lacustrine and resident forms. At the sea, it occurs along coasts at depths of up to 50 m. Undertakes migration to hill streams. Resident part of populations live in streams and uppermost reaches with fast current, cold clear water and stone or gravel bottom (Sa-a, Pascualita in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Resident populations live in habitats with hard substrate, ecology does not imply such impacts (Sa-a, Pascualita in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)) and it was never documented.	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	No evidence, resilience very Low, minimum population doubling time more than 14 years (Sa-a, Pascualita in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Small specimens feed on aquatic and terrestrial invertebrates, while adults feed on invertebrates and fish (Lațiu, C., Cocan, D., Uiuiu, P., Ihuț, A., Nicula, S.A., Constantinescu, R., Mireșan, V., 2020. The Black Sea Trout, Salmo labrax Pallas, 1814 (Pisces: Salmonidae) in Romanian Waters. Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Animal Science and Biotechnologies 77, 9.. doi:10.15835/buasvmcn-	Medium
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	No data for calculation.	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	No evidence, not documented for brown trout complex.	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Established a self-sustainable population in the Gacka river in Croatia (debatable if introduced or native and consequence of historical hydrologic changes) (Jadan, M., Čož-Rakovac, R., Topić Popović, N., & Strunjak-Perović, I. (2007). Presence of unexpected phylogenetic lineages of brown trout Salmo trutta L. in Gacka River, Croatia. Aquaculture Research, 38(15), 1682–1685. doi:10.1111/j.1365-2109.2007.01832.x).	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Buj I, Ivić L, Raguz L, Caleta M, Marčić Z, Duplić A, Zanella D, Tomašić A, Horvatić S, Karlović R and Mustafić P (2019). Trouts in karstic watersheds – diversity, origin and perspective. Front. Mar. Sci. Conference Abstract: XVI European Congress of Ichthyology. doi: 10.3389/conf.fmars.2019.07.00114	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Not documented (Nikandrov, V.Y., Shindavina, N.I., 2007. Characteristics of the hatchery-reared Black Sea salmon Salmo trutta labrax. Journal of Ichthyology 47, 184–193.. doi:10.1134/s0032945207020063).	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	Spawns in upper reaches of streams with fast current (Sa-a, Pascualita in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (	High

33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	680-15014 eggs per female (Nikandrov, V.Y., Shindavina, N.I., 2007. Characteristics of the hatchery-reared Black Sea salmon Salmo trutta labrax. Journal of Ichthyology 47, 184–193.. doi:10.1134/s0032945207020063).	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Females are mature at 2 years (Nikandrov, V.Y., Shindavina, N.I., 2007. Characteristics of the hatchery-reared Black Sea salmon Salmo trutta labrax. Journal of Ichthyology 47, 184–193.. doi:10.1134/s0032945207020063).	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Uncontrolled introductions by anglers (personal opinion).	Low
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	If introduced to streams connected to water bodies within protected areas.	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No such adaptations.	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	No data for spawning substrate for this species but other species from brown trout complex deposit eggs in redds between gravel (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021))	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	The fry stay near to the redd until they are 5-7 cm long (Aksungur, M., Zengin, M., Tabak, İ., Aksungur, N., & Alkan, A. (2011). Migration Characteristics of the Black Sea Trout (Salmo trutta labrax, Pallas, 1814) in the Eastern Black Sea Coasts and Streams. Turkish Journal of Fisheries and Aquatic Sciences, 11, 623-630. http://doi.org/10.4194/1303-2712-v11_4_17).	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Undertakes migration to hill streams. Resident part of populations live in streams and uppermost reaches with fast current, cold clear water and stone or gravel bottom. Spawns in upper reaches with fast current (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No data for spawning substrate for this species but other species from brown trout complex deposit eggs in redds between gravel (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021))	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Uncontrolled introductions by anglers (personal opinion).	Low
43	7.09	Is dispersal of the taxon density dependent?	No	Not documented.	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Personal observation.	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	No specific info but closely related Salmo trutta requires cold, well oxygenated upland waters (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	Not allowed in the RA area.	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Damming hinders most returning adults to reach spawning sites (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication.	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Anadromous (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Piscivorous fish, birds and mammals (personal observation, personal communication).	Very high
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	Already present.	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Trout (brown trout complex) are cold-water fish, they are particularly vulnerable to the effects of global warming, including increasing water temperatures and decreasing flow rates, future changes will reduce the number of potential habitats, especially in the Mediterranean, because of the future water scarcity conditions (Carosi, A., Ghetti, L., Padula, R., Lorenzoni, M., 2020. Population status and ecology of the Salmo trutta complex in an Italian river basin under multiple anthropogenic pressures. Ecology and Evolution 10, 7320–7333.. doi:10.1002/ece3.6457).	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Trout (brown trout complex) are cold-water fish, they are particularly vulnerable to the effects of global warming, including increasing water temperatures and decreasing flow rates, future changes will reduce the number of potential habitats, especially in the Mediterranean, because of the future water scarcity conditions (Carosi, A., Ghetti, L., Padula, R., Lorenzoni, M., 2020. Population status and ecology of the Salmo trutta complex in an Italian river basin under multiple anthropogenic pressures. Ecology and Evolution 10, 7320–7333.. doi:10.1002/ece3.6457).	Medium

53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Trout (brown trout complex) are cold-water fish, they are particularly vulnerable to the effects of global warming, including increasing water temperatures and decreasing flow rates, future changes will impact the populations of trout, especially in the Mediterranean, because of the future water scarcity conditions (Carosi, A., Ghetti, L., Padula, R., Lorenzoni, M., 2020. Population status and ecology of the Salmo trutta complex in an Italian river basin under multiple anthropogenic pressures. Ecology and Evolution 10, 7320–7333.. doi:10.1002/ece3.6457). As waters warm, cold water species with lower "thermal niches" become competitively disadvantaged with respect to other species for which the warmer temperatures are optimal (Magnuson, J.J., L.B. Crowder, and P.A. Medvick. 1979. Temperature as an ecological	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	Trout (brown trout complex) are cold-water fish, they are particularly vulnerable to the effects of global warming, including increasing water temperatures and decreasing flow rates, future changes will impact the populations of trout, especially in the Mediterranean, because of the future water scarcity conditions (Carosi, A., Ghetti, L., Padula, R., Lorenzoni, M., 2020. Population status and ecology of the Salmo trutta complex in an Italian river basin under multiple anthropogenic pressures. Ecology and Evolution 10, 7320–7333.. doi:10.1002/ece3.6457). As waters warm, cold water species with lower "thermal niches" become competitively disadvantaged with respect to other species for which the warmer temperatures are optimal (Magnuson, J.J., L.B. Crowder, and P.A. Medvick. 1979. Temperature as an ecological	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Trout (brown trout complex) are cold-water fish, they are particularly vulnerable to the effects of global warming, including increasing water temperatures and decreasing flow rates, future changes will impact the populations of trout, especially in the Mediterranean, because of the future water scarcity conditions (Carosi, A., Ghetti, L., Padula, R., Lorenzoni, M., 2020. Population status and ecology of the Salmo trutta complex in an Italian river basin under multiple anthropogenic pressures. Ecology and Evolution 10, 7320–7333.. doi:10.1002/ece3.6457). As waters warm, cold water species with lower "thermal niches" become competitively disadvantaged with respect to other species for which the warmer temperatures are optimal (Magnuson, J.J., L.B. Crowder, and P.A. Medvick. 1979. Temperature as an ecological resource. Amer. Zool. 19:331-343.). In this case, adverse impact is recognized as reducing the number of native fish species, especially other Salmonids. With future conditions, both native and introduced Salmonids are predicted to experience reductions in suitable habitats so relative impact will not change (personal	Low

Statistics	
Scores	
BRA	**17.0**
BRA Outcome	**-**
BRA+CCA	**9.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**7.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*2.0*
B. Biology/Ecology	**10.0**
4. Undesirable (or persistence) traits	*6.0*
5. Resource exploitation	*5.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*-1.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**-8.0**
9. Climate change	*-8.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**5**
Environmental	**4**
Species or population nuisance traits	**3**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.69**
BRA	**0.71**
CCA	**0.54**

Date and Time
27/05/2021 23:33:49

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo labrax*
Common name	Black Sea salmon
Assessor	Tamara Kanjuh
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	For conserving the unique representative of salmonids—the Black Sea salmon Salmo trutta labrax—its hatchery rearing was initiated in 1998 at the Adler trout hatchery farm (Northern Caucasia) (Nikandrov&Shindavina, 2007).	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	For conserving the unique representative of salmonids—the Black Sea salmon Salmo trutta labrax—its hatchery rearing was initiated in 1998 at the Adler trout hatchery farm (Northern Caucasia) (Nikandrov&Shindavina, 2007).	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No information found.	Medium
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Dfa, Dfb (Köppen–Geiger climate classification system)	High
5	2.02	What is the quality of the climate matching data?	High	Köppen–Geiger climate classification system	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Translocated to the Adriatic basin.	Medium
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Intentional stocking.	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Translocated in Adriatic basin.	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	No	No information found.	Low
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Food competition, hybridization	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No information found.	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	No informtion found.	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No information found.	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (https://www.fishbase.de/summary/Salmo-labrax.html)	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No information found.	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	The taxon is not a parasite.	Medium
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	The taxon is sensitive to environmental conditions.	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No information found.	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No information found.	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No information found.	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No information found.	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	No information found.	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	The taxon is sensitive to environmental conditions.	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	No information found.	Low

25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	It has anadromous and potamodromous forms (Cărăușu, 1952; Svetovidov, 1984; Vasilieva, 2003; Kottelat&Freyhof, 2007).	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Parrs and resident adults feed on aquatic and terrestrial invertebrates. Anadromous and large lacustrine individuals prey mostly on fish and large crustaceans (K&F, 2007).	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information found.	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	No parental care.	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	No information found.	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Hybridization with S.trutta (Kottelat&Fryhof, 2007).	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No information found.	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	No information found.	Medium
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Presumably like other salmonids.	Medium
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	4	Presumably like other salmonids.	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Intentional stocking.	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Intentional stocking.	Medium
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	Not known.	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Not as eggs, but could as juveniles.	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Not as eggs, but could as juveniles.	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	No information found.	Low
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No information found.	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Intentional translocations.	Medium
43	7.09	Is dispersal of the taxon density dependent?	No	No information found.	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	The taxon does not survive out of water.	High
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	The taxon is sensitive to environmental changes.	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	No information found.	Medium
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	The taxon is sensitive to environmental changes.	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	The taxon is sensitive to environmental changes.	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	As for other salmonids.	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	The taxon is sensitive to environmental changes.	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	The taxon is sensitive to environmental changes.	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	The taxon is sensitive to environmental changes.	Medium

53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	The taxon is sensitive to environmental changes.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	The taxon is sensitive to environmental changes.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	The taxon is sensitive to environmental changes.	Medium

Statistics	
Scores	
BRA	**6.0**
BRA Outcome	**-**
BRA+CCA	**-6.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**5.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*2.0*
B. Biology/Ecology	**1.0**
4. Undesirable (or persistence) traits	*0.0*
5. Resource exploitation	*5.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*-1.0*
8. Tolerance attributes	*-4.0*
C. Climate change	**-12.0**
9. Climate change	*-12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**7**
Environmental	**2**
Species or population nuisance traits	**-12**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.47**
BRA	**0.46**
CCA	**0.50**

Date and Time
02/06/2021 15:16:40

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo labrax*
Common name	Black Sea salmon
Assessor	Tena Radocaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Midilli, A., Kucuk, H., & Dincer, I. (2012). Environmental and sustainability aspects of a recirculating aquaculture system. Environmental Progress & Sustainable Energy, 31(4), 604-611.	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	It is harvested for human consumption, and for sport fishing. (Freyhof, J. 2013. Salmo labrax. The IUCN Red List of Threatened Species 2013)	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Salmo trutta (Fishbase)	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	The similarity between climatic conditions RA area and native range is high. I use climatch.	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Distribution Map of IUCN and Climatch	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	S. labrax is present outside of captivity in the RA area. (Buj, I., Raguž, L., Marčić, Z., Ćaleta, M., Duplić, A., Zanella, D., ... & Karlović, R. (2021). Plitvice Lakes National park harbors ancient, yet endangered diversity of trout (genus Salmo). Journal of	Medium
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	Not applicable	S. labrax is present in the RA area.	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	S. labrax is present in the RA area.	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Buj, I., Raguž, L., Marčić, Z., Ćaleta, M., Duplić, A., Zanella, D., ... & Karlović, R. (2021). Plitvice Lakes National park harbors ancient, yet endangered diversity of trout (genus Salmo). Journal of Applied Ichthyology, 37(1), 20-37.	Low
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	No evidence, but probably they compete with native fish species.	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No evidence	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	Maybe can reducing native fish populations (especially other salmonids) through predation, displacement, and food competition	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No evidence	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	S. labrax is harmless (Fishbase)	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No evidence	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No	Medium
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Buj, I., Raguž, L., Marčić, Z., Ćaleta, M., Duplić, A., Zanella, D., ... & Karlović, R. (2021). Plitvice Lakes National park harbors ancient, yet endangered diversity of trout (genus Salmo). Journal of Applied Ichthyology, 37(1), 20-37.	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No evidence (May In some places, trout populations have outgrown native fish populations so rapidly that native fish have been forced out).	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	S. labrax no adverse impacts in the RA area.	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA area?	Yes	Savas, H., Altinok, I., Cakmak, E., & Firidin, S. (2006). Isolation of Renibacterium salmoninarum from cultured Black Sea salmon (Salmo trutta labrax): first report in Turkey. BULLETIN-EUROPEAN ASSOCIATION OF FISH PATHOLOGISTS, 26(6), 238.	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Savas, H., Altinok, I., Cakmak, E., & Firidin, S. (2006). Isolation of Renibacterium salmoninarum from cultured Black Sea salmon (Salmo trutta labrax): first report in Turkey. BULLETIN-EUROPEAN ASSOCIATION OF FISH PATHOLOGISTS, 26(6), 238.	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	80.0 cm SL (Fishbase)	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Resident part of populations in streams and uppermost reaches with fast current, cold clear water and stone or gravel bottom. (Freyhof, J. 2013. Salmo labrax. The IUCN Red List of Threatened	High

24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	No evidence	Low
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Freyhof, J. 2013. Salmo labrax. The IUCN Red List of Threatened Species 2013	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Parrs and resident adults feed on aquatic and terrestrial invertebrates. Anadromous and large lacustrine individuals prey mostly on fish and large crustaceans. (Fishbase)	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	Not applicable	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Fishbase	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Buj, I., Raguž, L., Marčić, Z., Ćaleta, M., Duplić, A., Zanella, D., ... & Karlović, R. (2021). Plitvice Lakes National park harbors ancient, yet endangered diversity of trout (genus Salmo). Journal of Applied Ichthyology, 37(1), 20-37.	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	LAȚIU, C., COCAN, D., UIUIU, P., IHUȚ, A., NICULA, S. A., CONSTANTINESCU, R., & MIREȘAN, V. (2020). The Black Sea Trout, Salmo labrax Pallas, 1814 (Pisces: Salmonidae) in Romanian Waters. Bulletin UASVM Animal Science and	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No evidence	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	Resident part of populations in streams and uppermost reaches with fast current, cold clear water and stone or gravel bottom. Spawns in upper reaches with fast current (Freyhof, J. 2013. Salmo labrax. The IUCN Red List of Threatened Species 2013)	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	No	Fishbase	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	between 2 and 4 years old (Cakmak, E., Firidin, S., Duzgunes, Z. D., & Parlak, R. (2019). The age-dependent reproductive performance of 4th generation Black Sea Trout (Salmo labrax Pallas, 1814) Females. Turkish Journal of Fisheries and Aquatic	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	1. human influence 2. natural spread via natural and manmade watercourses	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Buj, I., Raguž, L., Marčić, Z., Ćaleta, M., Duplić, A., Zanella, D., ... & Karlović, R. (2021). Plitvice Lakes National park harbors ancient, yet endangered diversity of trout (genus Salmo). Journal of Applied Ichthyology, 37(1), 20-37.	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	Fishbase	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Freyhof, J. 2013. Salmo labrax. The IUCN Red List of Threatened Species 2013	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Freyhof, J. 2013. Salmo labrax. The IUCN Red List of Threatened Species 2013	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Fishbase	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Freyhof, J. 2013. Salmo labrax. The IUCN Red List of Threatened Species 2013	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	There is the possibility of a high rate of dispersal of taxa. E.g. when a fertilized individual enters a new area by some kind of dispersal.	Low
43	7.09	Is dispersal of the taxon density dependent?	No	No	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin	Medium
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	damming, most returning adults are unable to reach spawning sites. The resident populations are less impacted by the dams (Freyhof, J. 2013. Salmo labrax. The IUCN Red List of Threatened	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	17 (Cakmak, E., Firidin, S., Duzgunes, Z. D., & Parlak, R. (2019). The age-dependent reproductive performance of 4th generation Black Sea Trout (Salmo labrax Pallas, 1814) Females. Turkish Journal of Fisheries and Aquatic Sciences, 19(6), 496-502).	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Catfish, Zander...	Medium
C. Climate change					
9. Climate change					

50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	S. labrax is present in the RA area.	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Low
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Low
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Low
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Low

Statistics	
Scores	
BRA	**17.5**
BRA Outcome	**-**
BRA+CCA	**13.5**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**6.5**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*1.5*
B. Biology/Ecology	**11.0**
4. Undesirable (or persistence) traits	*5.0*
5. Resource exploitation	*5.0*
6. Reproduction	*0.0*
7. Dispersal mechanisms	*2.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**-4.0**
9. Climate change	*-4.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**6**
Environmental	**6**
Species or population nuisance traits	**6**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.55**
BRA	**0.57**
CCA	**0.38**

Date and Time
19/05/2021 12:31:27

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo letnica*
Common name	Ohrid trout
Assessor	Ana Marić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	http://www.fao.org/fishery/countrysector/naso_macedonia/en	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Historical demography of brown trout (Salmo trutta) in the Adriatic drainage including the putative S. letnica endemic to Lake Ohrid. Simona Susnik a,b, Ales˘ Snoj b, Iain F. Wilson c, Danilo Mrdak d, Steven Weiss. 2007.	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	A handbook of aquatic freshwater species. Francis 2012.	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	19	Very high
5	2.02	What is the quality of the climate matching data?	Medium	Climach - no adequate points.	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Deterioration of the fish-species assemblage due to the human impact and the pike introduction as a measure for restoration of the Vlasinsko Reservoir (Serbia, Yugoslavia). Simonovic. 2000.	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Stocking. Deterioration of the fish-species assemblage due to the human impact and the pike introduction as a measure for restoration of the Vlasinsko Reservoir (Serbia, Yugoslavia).	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Lake Ohrid is in close proximity. Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Deterioration of the fish-species assemblage due to the human impact and the pike introduction as a measure for restoration of the Vlasinsko Reservoir (Serbia, Yugoslavia). Simonovic. 2000.	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	Deterioration of the fish-species assemblage due to the human impact and the pike introduction as a measure for restoration of the Vlasinsko Reservoir (Serbia, Yugoslavia). Simonovic. 2000.	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Deterioration of the fish-species assemblage due to the human impact and the pike introduction as a measure for restoration of the Vlasinsko Reservoir (Serbia, Yugoslavia). Simonovic. 2000.	Very high
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	Deterioration of the fish-species assemblage due to the human impact and the pike introduction as a measure for restoration of the Vlasinsko Reservoir (Serbia, Yugoslavia). Simonovic. 2000.	Very high
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Deterioration of the fish-species assemblage due to the human impact and the pike introduction as a measure for restoration of the Vlasinsko Reservoir (Serbia, Yugoslavia). Simonovic. 2000.	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Deterioration of the fish-species assemblage due to the human impact and the pike introduction as a measure for restoration of the Vlasinsko Reservoir (Serbia, Yugoslavia). Simonovic. 2000.	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	Caarnivorus. Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Deterioration of the fish-species assemblage due to the human impact and the pike introduction as a measure for restoration of the Vlasinsko Reservoir (Serbia, Yugoslavia). Simonovic. 2000.	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	Deterioration of the fish-species assemblage due to the human impact and the pike introduction as a measure for restoration of the Vlasinsko Reservoir (Serbia, Yugoslavia). Simonovic. 2000.	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	Deterioration of the fish-species assemblage due to the human impact and the pike introduction as a measure for restoration of the Vlasinsko Reservoir (Serbia, Yugoslavia). Simonovic. 2000.	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Deterioration of the fish-species assemblage due to the human impact and the pike introduction as a measure for restoration of the Vlasinsko Reservoir (Serbia, Yugoslavia). Simonovic. 2000.	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	Occurrence of parasitic ciliates (Protozoa) on perch (Perca fluviatilis) in Lake Vlasinsko Vera P. Nikolic & Predrag D. Simonovic. 1996	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High

23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	http://solair.eunet.rs/~vlaxym/Vlasinsko%20jezero.htm	High
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Deterioration of the fish-species assemblage due to the human impact and the pike introduction as a measure for restoration of the Vlasinsko Reservoir (Serbia, Yugoslavia). Simonovic. 2000.	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	http://solair.eunet.rs/~vlaxym/Vlasinsko%20jezero.htm	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Yes	No data.	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	http://solair.eunet.rs/~vlaxym/Vlasinsko%20jezero.htm	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Historical demography of brown trout (Salmo trutta) in the Adriatic drainage including the putative S. letnica endemic to Lake Ohrid Simona Susˇnik a,b, Alesˇ Snoj b, Iain F. Wilson c, Danilo Mrdak d, Steven Weiss a. 2007	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	High
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	6	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Stocking. Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	Very high
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	Deterioration of the fish-species assemblage due to the human impact and the pike introduction as a measure for restoration of the Vlasinsko Reservoir (Serbia, Yugoslavia). Simonovic. 2000.	Very high
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	Very high
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No attachable structures	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	http://solair.eunet.rs/~vlaxym/Vlasinsko%20jezero.htm	High
43	7.09	Is dispersal of the taxon density dependent?	No	http://solair.eunet.rs/~vlaxym/Vlasinsko%20jezero.htm	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	THE IMPACT OF ENVIRONMENTAL CONDITIONS ON GROWTH AND DEVELOPMENT OF SALMO LETNICA SMOLT Viola Prifti1 & Arefi Cake 2017	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	THE IMPACT OF ENVIRONMENTAL CONDITIONS ON GROWTH AND DEVELOPMENT OF SALMO LETNICA SMOLT Viola Prifti1 & Arefi Cake2	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Not applicable	THE IMPACT OF ENVIRONMENTAL CONDITIONS ON GROWTH AND DEVELOPMENT OF SALMO LETNICA SMOLT Viola Prifti1 & Arefi Cake2	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	CHANGES IN THE SPAWNING ECOLOGY OF THE LAKE OHRID TROUT, Salmo letnica (Karaman) Zoran SPIRKOVSKI	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Probably, anadromous relatives	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	Yes	Deterioration of the fish-species assemblage due to the human impact and the pike introduction as a measure for restoration of the Vlasinsko Reservoir (Serbia, Yugoslavia). Simonovic. 2000.	High
C. Climate change					
9. Climate change					

50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	CHANGES IN THE SPAWNING ECOLOGY OF THE LAKE OHRID TROUT, Salmo letnica (Karaman) Zoran SPIRKOVSKI	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	CHANGES IN THE SPAWNING ECOLOGY OF THE LAKE OHRID TROUT, Salmo letnica (Karaman) Zoran SPIRKOVSKI	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	CHANGES IN THE SPAWNING ECOLOGY OF THE LAKE OHRID TROUT, Salmo letnica (Karaman) Zoran SPIRKOVSKI	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	CHANGES IN THE SPAWNING ECOLOGY OF THE LAKE OHRID TROUT, Salmo letnica (Karaman) Zoran SPIRKOVSKI	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	CHANGES IN THE SPAWNING ECOLOGY OF THE LAKE OHRID TROUT, Salmo letnica (Karaman) Zoran SPIRKOVSKI	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	CHANGES IN THE SPAWNING ECOLOGY OF THE LAKE OHRID TROUT, Salmo letnica (Karaman) Zoran SPIRKOVSKI	High

Statistics	
Scores	
BRA	**18.0**
BRA Outcome	**-**
BRA+CCA	**8.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**7.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*2.0*
B. Biology/Ecology	**11.0**
4. Undesirable (or persistence) traits	*5.0*
5. Resource exploitation	*5.0*
6. Reproduction	*3.0*
7. Dispersal mechanisms	*-1.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**-10.0**
9. Climate change	*-10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**2**
Environmental	**2**
Species or population nuisance traits	**5**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.82**
BRA	**0.83**
CCA	**0.75**

Date and Time
15/05/2021 19:47:19

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo letnica*
Common name	Ohrid trout
Assessor	Ivan Špelić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	National Aquaculture Sector Overview. Albania. National Aquaculture Sector Overview Fact Sheets. Text by Cobani, M. In: FAO Fisheries Division [online]. Rome. Updated . [Cited 5 May	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Fuller, P. and Daniel, W.M., 2021, Salmo letnica (Karaman, 1924): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Harvested for aquaculture purposes (Gainesville, FL, https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=925, Revision Date: 7/11/2019, Peer Review Date: 7/11/2019, Access Date: 5/5/2021)	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Salmo trutta (CABI, fishbase).	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Climatch software, calculated as in https://dpipwe.tas.gov.au/Documents/Risk%20assessment%20methodology_wildlife%20imports%20August%202017.pdf	Low
5	2.02	What is the quality of the climate matching data?	Low	No meteorological stations near lake Ohrid, based on two stations in vicinity (Climatch).	Very high
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Vlasinsko lake in Serbia, no recent evidence of establishment (https://www.fws.gov/fisheries/ans/erss/uncertainrisk/ERSS-Salmo-letnica-final-May2018.pdf).	Low
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	Not applicable	Already present.	Low
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	Already present.	Low
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Fuller (2018) shows an established population of S. letnica at Pathfinder Reservoir in Natrona County, Wyoming (https://www.fws.gov/fisheries/ans/erss/uncertainrisk/ERSS-Salmo-letnica-final-May2018.pdf)	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Hybridization with native species (Zenetos, A., M.-A. Pancucci-Papadopoulou, S. Zogaris, E. Papastergiadou, L. Vardakas, K. Aligizaki, and A. N. Economou. 2009. Aquatic alien species in Greece (2009): tracking sources, patterns and effects on the ecosystem. Journal of Biological ResearchThessaloniki 12:135-	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	The impacts of this species are currently unknown, as no studies have been done to determine how it has affected ecosystems in the invaded range (Fuller, P. and Daniel, W.M., 2021, Salmo letnica (Karaman, 1924): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=925, Revision Date: 7/11/2019, Peer Review Date: 7/11/2019, Access Date: 5/17/2021).	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	The impacts of this species are currently unknown, as no studies have been done to determine how it has affected ecosystems in the invaded range (Fuller, P. and Daniel, W.M., 2021, Salmo letnica (Karaman, 1924): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=925, Revision Date: 7/11/2019, Peer Review Date: 7/11/2019, Access Date: 5/17/2021).	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	The impacts of this species are currently unknown, as no studies have been done to determine how it has affected ecosystems in the invaded range (Fuller, P. and Daniel, W.M., 2021, Salmo letnica (Karaman, 1924): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=925, Revision Date: 7/11/2019, Peer Review Date: 7/11/2019, Access Date: 5/17/2021).	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	The impacts of this species are currently unknown, as no studies have been done to determine how it has affected ecosystems in the invaded range (Fuller, P. and Daniel, W.M., 2021, Salmo letnica (Karaman, 1924): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=925, Revision Date: 7/11/2019, Peer Review Date: 7/11/2019, Access Date: 5/17/2021).	Low

16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No parasitic behaviour (Kottelat & Freyhof 2008).	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Not much data, only lacustrine forms, probably not tolerant to high temperatures as most salmonids.	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	No	The impacts of this species are currently unknown, as no studies have been done to determine how it has affected ecosystems in the invaded range (Fuller, P. and Daniel, W.M., 2021, Salmo letnica (Karaman, 1924): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=925, Revision Date: 7/11/2019, Peer Review Date: 7/11/2019, Access Date: 5/17/2021).	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	The impacts of this species are currently unknown, as no studies have been done to determine how it has affected ecosystems in the invaded range (Fuller, P. and Daniel, W.M., 2021, Salmo letnica (Karaman, 1924): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=925, Revision Date: 7/11/2019, Peer Review Date: 7/11/2019, Access Date: 5/17/2021).	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Susceptible to parasites: https://www.fws.gov/fisheries/ans/erss/uncertainrisk/ERSS-Salmo-letnica-final-May2018.pdf	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Susceptible to parasites: https://www.fws.gov/fisheries/ans/erss/uncertainrisk/ERSS-Salmo-letnica-final-May2018.pdf	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	76 cm, 6,5 kg (Torres, Armi G. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021))	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	Only lacustrine forms (Torres, Armi G. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021).	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	The impacts of this species are currently unknown, as no studies have been done to determine how it has affected ecosystems in the invaded range (Fuller, P. and Daniel, W.M., 2021, Salmo letnica (Karaman, 1924): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=925, Revision Date: 7/11/2019, Peer Review Date: 7/11/2019, Access Date: 5/17/2021).	Low
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Low resilience and high vulnerability (Torres, Armi G. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021).	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Adults feed on zooplankton and fish (Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.).	Medium
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	No data for calculation.	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Yes	Janković, D. and M. Raspopović (1960). Ohridska pastrmka (Salmo letnica typicus K.) pod promenjenim uslovima u Vlasinskom baražnom jezeru. Archives of Biological Sciences, 12,	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Janković, D. and M. Raspopović (1960). Ohridska pastrmka (Salmo letnica typicus K.) pod promenjenim uslovima u Vlasinskom baražnom jezeru. Archives of Biological Sciences, 12,	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Hybrids with congeners found in Greece (Zenetos, A., M.-A. Pancucci-Papadopoulou, S. Zogaris, E. Papastergiadou, L. Vardakas, K. Aligizaki, and A. N. Economou. 2009. Aquatic alien species in Greece (2009): tracking sources, patterns and effects on the ecosystem. Journal of Biological ResearchThessaloniki	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No records for this species or congeners.	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Spawns in littoral and sublittoral areas (Kottelat, M., and J. Freyhof. 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.).	Medium
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	2500-3900 eggs per female (Janković, D. and M. Raspopović (1960). Ohridska pastrmka (Salmo letnica typicus K.) pod promenjenim uslovima u Vlasinskom baražnom jezeru. Archives of Biological Sciences, 12, 117-122.).	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	2-3 years in Vlasinsko lake where introduced, 5-6 years in native area (Janković, D. and M. Raspopović (1960). Ohridska pastrmka (Salmo letnica typicus K.) pod promenjenim uslovima u Vlasinskom baražnom jezeru. Archives of Biological Sciences, 12,	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Introduction for angling purposes.	Low
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	No further dispersions in the last 60 years.	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No such adaptations.	Very high

38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	No evidence, no historical examples on self-dispersion.	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	No evidence, no historical examples on self-dispersion.	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	Migrations within lake (could it be interpreted as migration?)	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No evidence, no historical examples on such dispersion.	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Not applicable	No such dispersal.	Very high
43	7.09	Is dispersal of the taxon density dependent?	No	No evidence on any historical dispersal except human	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Vulnerable species (Fishbase), sensitive as other congeners.	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being considered.]	No	High vulnerability (fishbase). The Ohrid trout faces extinction in its native lakes due to pollution (Fuller, P. and Daniel, W.M., 2021, Salmo letnica (Karaman, 1924): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=925, Revision Date: 7/11/2019, Peer Review Date: 7/11/2019, Access Date: 5/17/2021).	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Not applicable	Not allowed.	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Threatened by habitat destruction (https://www.fws.gov/fisheries/ans/erss/uncertainrisk/ERSS-Salmo-letnica-final-May2018.pdf), vulnerable.	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	No info, sensitive lacustrine species.	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Piscivorous mammals and birds (personal opinion).	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	No self-dispersion noted, only indrotuction by human.	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	Not as sensitive to high temperatures, critical thermal maximum set at 29 deg. Celsius (Mackey, T., C.T. Hasler, and E.C. Enders. 2019. Summary of Temperature Metrics for Aquatic Invasive Fish Species in the Prairie Region. Can. Tech. Rep. Fish. Aquat. Sci.	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	Dispersion dependent on human introductions in suitable lacustrine habitats. Not as sensitive to high temperatures, critical thermal maximum set at 29 deg. Celsius (Mackey, T., C.T. Hasler, and E.C. Enders. 2019. Summary of Temperature Metrics for Aquatic Invasive Fish Species in the Prairie Region. Can. Tech. Rep. Fish. Aquat. Sci. 3308: viii + 62 p.)	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	No recognized impacts, so no change expected.	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	No recognized impacts, so no change expected.	Low
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	No recognized impacts, so no change expected.	Low

Statistics	
Scores	
BRA	**13.0**
BRA Outcome	**-**
BRA+CCA	**13.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**11.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*6.0*
B. Biology/Ecology	**2.0**
4. Undesirable (or persistence) traits	*2.0*
5. Resource exploitation	*5.0*
6. Reproduction	*4.0*
7. Dispersal mechanisms	*-5.0*
8. Tolerance attributes	*-4.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*

2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**8**
Environmental	**5**
Species or population nuisance traits	**1**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.61**
BRA	**0.63**
CCA	**0.46**

Date and Time
17/05/2021 12:56:09

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo letnica*
Common name	Ohrid trout
Assessor	Tamara Kanjuh
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Fisheries: commercial; aquaculture: commercial; gamefish: yes (Froese&Pauly, 2017)	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Fisheries: commercial; aquaculture: commercial; gamefish: yes (Froese&Pauly, 2017)	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No information found.	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Dfa, Dfb (Köppen–Geiger climate classification system)	High
5	2.02	What is the quality of the climate matching data?	High	Köppen–Geiger climate classification system	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Lake Ohrid trout, Salmo letnica (Karaman, 1924), was heavily and repeatedly stocked from a hatchery into the Vlasina Lake in Southern Serbia in 1950s and 1960s […] (Janković&Raspopović	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Intentional stocking.	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	The lake Vlasina (Piria et al., 2017)	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	No	Since the late 1960s, roe was reintroduced almost every year, since it seems that this species did not naturalize in the reservoir, despite its fast growth and great yield (Piria et al., 2017).	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	[…] the main problem is the risk of hybridization with the native Prespa trout Salmo peristericus Karaman, 1938 (Perdikaris et al., 2010).	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No information found.	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	No information found.	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No informtion found.	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (Froese&Pauly, 2017)	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	[…] the introduction of Salmo trutta and Salmo letnica to Greek freshwaters (where different Salmo species exist) has resulted in harmful hybridizations that may prove detrimental to the native trout species in the long term (Crivelli et al., 1997; Economou et	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No information found.	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	No information found.	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No information found.	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No information found.	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No information found.	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No information found.	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	No information found.	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	No information found.	Low
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	No information found.	Low

25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	No information found.	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	No information found.	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information found.	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	No information found.	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	It is not known whether this species hybridizes with the native brown trout, but from the regular roe imports over a long-term period, it appears that letnica trout were feral there and diminished after the cessation of reservoir stocking (Piria et al.,	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	[…] the introduction of Salmo trutta and Salmo letnica to Greek freshwaters (where different Salmo species exist) has resulted in harmful hybridizations that may prove detrimental to the native trout species in the long term (Crivelli et al., 1997; Economou et al., 2007). Also, it is not known whether this species hybridizes with the native brown trout in Vlasinsko jezero (Piria et al., 2017).	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No information found.	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	No information found.	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	No	No information found.	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	5	Attains first sexual maturity at 5-6 years (Froese&Pauly, 2017).	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Intentional stocking.	Low
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Introduction to Vlasina lake (Piria et al., 2017).	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No information found.	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	No information found.	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Dispersion as juvenile.	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	Non-migratory species.	Low
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No information found.	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Intentional stocking.	Low
43	7.09	Is dispersal of the taxon density dependent?	No	No information found.	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	The taxon cannot survive out of the water.	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	The taxon is sensitive to environmental changes.	Low
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	No information found.	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Threatened by habitat destruction, overfishing and introduction of new species (Crivelli, 1996).	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	The taxon is sensitive to environmental conditions.	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	No information found.	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	The taxon is sensitive to environmental changes.	Low
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	The taxon is sensitive to environmental changes.	Low

52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	The taxon is sensitive to environmental changes.	Low
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	The taxon is sensitive to environmental changes.	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	The taxon is sensitive to environmental changes.	Low
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	The taxon is sensitive to environmental changes.	Low

Statistics	
Scores	
BRA	**0.0**
BRA Outcome	**-**
BRA+CCA	**0.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**5.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*2.0*
B. Biology/Ecology	**-5.0**
4. Undesirable (or persistence) traits	*0.0*
5. Resource exploitation	*0.0*
6. Reproduction	*-2.0*
7. Dispersal mechanisms	*-1.0*
8. Tolerance attributes	*-2.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**9**
Environmental	**1**
Species or population nuisance traits	**-7**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.36**
BRA	**0.38**
CCA	**0.25**

Date and Time
31/05/2021 20:51:48

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo letnica*
Common name	Ohrid trout
Assessor	Tena Radocaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Fisheries: commercial; aquaculture: commercial; gamefish: yes (Fishbase)	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	gamefish: yes (Fishbase)	Low
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Salmo trutta	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	The similarity between climatic conditions RA area and native range is medium. I use climatch.	Very high
5	2.02	What is the quality of the climate matching data?	Medium	Distribution Map of IUCN and Climatch	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	S. letnica is present outside of captivity in the RA area. (Piria et al., 2018)	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	Not applicable	S. letnica is present in the RA area.	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	S. letnica is present in the RA area.	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Greece (Perdikaris, C., Gouva, E., & Paschos, I. (2010). Alien fish and crayfish species in Hellenic freshwaters and aquaculture. Reviews in Aquaculture, 2(3), 111-120).	Medium
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	No evidence, but probably they compete with native fish species.	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No evidence	High
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	No evidence	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No evidence	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	Yes	S. letnica is harmless (Fishbase)	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No evidence	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	S. macedonicus will be adaptable to climatic and other environmental conditions. (Kanjuh, T., Tomić, S., Marić, A., Jurlina, D. Š., Nikolić, V., & Simonović, P. Trout Salmo spp.(Salmoniformes: Salmonidae) Molecular Diversity in Streams on the Southern Slopes of the Stara Planina Mts. in Serbia)	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No evidence	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	S. letnica no adverse impacts in the RA area.	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA area?	Yes	Blazhekovikj-Dimovska, D., Stojanovski, S., & Hristovski, N. (2013). PARASITE FAUNA OF ENDEMIC FISHES (Salmo letnica Karaman, 1924 and Salmo ohridanus Steindachner 1892) FROM LAKE OHRID (MACEDONIA). Natura Montenegrina, 12(3-4), 761-	Very high
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Blazhekovikj-Dimovska, D., Stojanovski, S., & Hristovski, N. (2013). PARASITE FAUNA OF ENDEMIC FISHES (Salmo letnica Karaman, 1924 and Salmo ohridanus Steindachner 1892) FROM LAKE OHRID (MACEDONIA). Natura Montenegrina, 12(3-4), 761-	Very high
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Max length : 76.0 cm TL (Fishbase)	Medium
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	Inhabits lakes. (Fishbase)	Low
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	No evidence	Low

25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	No evidence	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Adults prey fish, mainly Alburnus scoranza. (Fishbase)	Medium
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	Not applicable	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	No evidence	Low
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Piria et al., 2018	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	The risk of hybridization with the native Prespa trout Salmo peristericus (Perdikaris, C., Gouva, E., & Paschos, I. (2010). Alien fish and crayfish species in Hellenic freshwaters and aquaculture. Reviews in Aquaculture, 2(3), 111-120).	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No evidence	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	No evidence	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	No	U.S. Fish and Wildlife Service, May 2011 Revised, October 2017, May 2018 Web Version, 5/17/2018	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	5	Attains first sexual maturity at 5-6 years (Fishbase)	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	1. human influence 2. natural spread via natural and manmade watercourses	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Human influence	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No adaptions	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	No	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin.	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin.	Low
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No evidence	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	There is the possibility of a high rate of dispersal of taxa. E.g. when a fertilized individual enters a new area by some kind of dispersal.	Medium
43	7.09	Is dispersal of the taxon density dependent?	No	No evidence	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	No	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Sensitive species	Low
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	No evidence	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	habitat destruction (Fishabse)	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Freshwater fish	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Catfish, Zander, Pike..	High
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	S. letnica is present in the RA area.	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Medium

53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Medium

Statistics	
Scores	
BRA	**16.5**
BRA Outcome	**-**
BRA+CCA	**12.5**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**6.5**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*1.5*
B. Biology/Ecology	**10.0**
4. Undesirable (or persistence) traits	*6.0*
5. Resource exploitation	*5.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*2.0*
8. Tolerance attributes	*-4.0*
C. Climate change	**-4.0**
9. Climate change	*-4.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**6**
Environmental	**7**
Species or population nuisance traits	**4**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.50**
BRA	**0.49**
CCA	**0.58**

Date and Time
19/05/2021 12:29:45

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo macedonicus*
Common name	Macedonian trout
Assessor	Ana Marić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Aleksandar SAVESKI, Tatjana KALEVSKA,Viktorija STAMATOVSKA, Dragan DAMJANOVSKI, 2017. CHEMICAL COMPOSITION AND ENERGY VALUE IN THE MEAT OF THE MACEDONIAN AND OHRID TROUT. Journal of Faculty of Food Engineering, Ştefan cel Mare University of Suceava, Romania Volume XVI, Issue 1- 2017, pag. 40 - 46	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	http://www.fao.org/fishery/countrysector/naso_macedonia/en in FYRM http://extwprlegs1.fao.org/docs/pdf/srb153883.pdf u Srbiji moze preko 25cm	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	http://www.iucngisd.org/gisd/100_worst.php A handbook of global freshwater invasive speies. 2012. Robert A. Francis	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Dfb, Csb and Bsk in FYRM. Dfb is the same for all analysed countries.From 22 stations selected 11 are in same climate region (orange), five in red and 2,2,2, in light orange, yellow and light green. 16 matches are in FYRM near Kumanovo, 6 near Skopje and none near Strumica using Climatch.	High
5	2.02	What is the quality of the climate matching data?	Medium	DAta from Climatch were used	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Predrag SIMONOVIĆ, Zoran VIDOVIĆ, Ana TOŠIĆ, Dubravka ŠKRABA, Jelena ČANAK-ATLAGIĆ, and Vera NIKOLIĆ. 2015. RISKS TO STOCKS OF NATIVE TROUT OF THE GENUS SALMO (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE) OF SERBIA AND ANAGEMENT FOR THEIR RECOVERY	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Intentional, unproffesional stocking	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	No	RISKS TO STOCKS OF NATIVE TROUT OF THE GENUS SALMO (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE) OF SERBIA AND MANAGEMENT FOR THEIR RECOVERY Predrag SIMONOVIÆ1*, Zoran VIDOVIÆ2, Ana TOŠIÆ1, Dubravka ŠKRABA1, Jelena ÈANAK-ATLAGIÆ1, and Vera NIKOLIc 2015	Low
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Predrag SIMONOVIĆ, Zoran VIDOVIĆ, Ana TOŠIĆ, Dubravka ŠKRABA, Jelena ČANAK-ATLAGIĆ, and Vera NIKOLIĆ. 2015. RISKS TO STOCKS OF NATIVE TROUT OF THE GENUS SALMO (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE) OF SERBIA AND MANAGEMENT FOR THEIR RECOVERY	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	RISKS TO STOCKS OF NATIVE TROUT OF THE GENUS SALMO (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE) OF SERBIA AND MANAGEMENT FOR THEIR RECOVERY Predrag SIMONOVIÆ1*, Zoran VIDOVIÆ2, Ana TOŠIÆ1, Dubravka ŠKRABA1, Jelena ÈANAK-ATLAGIÆ1, and Vera NIKOLIÆ1	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	RISKS TO STOCKS OF NATIVE TROUT OF THE GENUS SALMO (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE) OF SERBIA AND MANAGEMENT FOR THEIR RECOVERY Predrag SIMONOVIÆ1*, Zoran VIDOVIÆ2, Ana TOŠIÆ1, Dubravka ŠKRABA1, Jelena ÈANAK-ATLAGIÆ1, and Vera NIKOLIÆ1 2015	High
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	RISKS TO STOCKS OF NATIVE TROUT OF THE GENUS SALMO (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE) OF SERBIA AND MANAGEMENT FOR THEIR RECOVERY Predrag SIMONOVIÆ1*, Zoran VIDOVIÆ2, Ana TOŠIÆ1, Dubravka ŠKRABA1, Jelena ÈANAK-ATLAGIÆ1, and Vera NIKOLIÆ1 2015	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	RISKS TO STOCKS OF NATIVE TROUT OF THE GENUS SALMO (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE) OF SERBIA AND MANAGEMENT FOR THEIR RECOVERY Predrag SIMONOVIÆ1*, Zoran VIDOVIÆ2, Ana TOŠIÆ1, Dubravka ŠKRABA1, Jelena ÈANAK-ATLAGIÆ1, and Vera NIKOLIÆ1	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	RISKS TO STOCKS OF NATIVE TROUT OF THE GENUS SALMO (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE) OF SERBIA AND MANAGEMENT FOR THEIR RECOVERY Predrag SIMONOVIÆ1*, Zoran VIDOVIÆ2, Ana TOŠIÆ1, Dubravka ŠKRABA1, Jelena ÈANAK-ATLAGIÆ1, and Vera NIKOLIÆ1 2015	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	Not a parasite but it is a predator.	High
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Since its relatives are very adaptable.	Medium

18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	Macedonian trout is top predator in native ecosystem.	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	RISKS TO STOCKS OF NATIVE TROUT OF THE GENUS SALMO (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE) OF SERBIA AND MANAGEMENT FOR THEIR RECOVERY Predrag SIMONOVIÆ1*, Zoran VIDOVIÆ2, Ana TOŠIÆ1, Dubravka ŠKRABA1, Jelena ÈANAK-ATLAGIÆ1, and Vera NIKOLIÆ1 2015. Its relatives are.	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Is is similar to her relatives in RA area.	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Probably.	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	Larger fish can easily escape from fish farms, but there are no fish farms of AdSalmo in Serbia. RISKS TO STOCKS OF NATIVE TROUT OF THE GENUS SALMO (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE) OF SERBIA AND MANAGEMENT FOR THEIR RECOVERY Predrag SIMONOVIÆ1*, Zoran VIDOVIÆ2, Ana TOŠIÆ1, Dubravka ŠKRABA1, Jelena ÈANAK-ATLAGIÆ1, and Vera NIKOLIÆ1 2015	High
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	MANAGEMENT FOR THEIR RECOVERY Predrag SIMONOVIÆ1*, Zoran VIDOVIÆ2, Ana TOŠIÆ1, Dubravka ŠKRABA1, Jelena ÈANAK-ATLAGIÆ1, and Vera NIKOLIÆ1 2015. Her relatives are.	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No data for RIP calculation. Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	Medium
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Yes	https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1095-8649.2009.02380.x za S. trutta i S. salar	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	RISKS TO STOCKS OF NATIVE TROUT OF THE GENUS SALMO (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE) OF SERBIA AND MANAGEMENT FOR THEIR RECOVERY	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	RISKS TO STOCKS OF NATIVE TROUT OF THE GENUS SALMO (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE) OF SERBIA AND MANAGEMENT FOR THEIR RECOVERY	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Da li je ovde potrebna referenca? Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	S obzirom na spoljašnje oplodjenje jeste. Nije precizirano koji je to broj jaja. Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	https://www.researchgate.net/profile/J-Labee-Lund/publication/237183660_Variation_within_and_between_Rivers_in_Adult_Size_and_Sea_Age_at_Maturity_of_Anadromous_Brown_Trout_Salmo_trutta/links/5677c0d308ae502c99d525e2/Variation-within-and-between-Rivers-in-Adult-Size-and-Sea-Age-at-Maturity-of-Anadromous-Brown-Trout-Salmo-trutta.pdf 2-3 years kottelat and Freyhof za S. trutta	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	By unprofesional stocking?	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Probably SSSI.	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No such structures.	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Maybe, but in the associated streams.	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	S. trutta has migratory individuas and s. macedonicus perhapes	Medium
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Her eggs can only be eaten.	High

42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	If dispersed by humen is likely to be rapid	High
43	7.09	Is dispersal of the taxon density dependent?	Yes	Probably, partial mygratory behaviour in brown trout is density dependent.	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Brown trout wont survive these conditions.	High
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Trout preferes cold, fast and oxigenated water, but we have seen it in different streams, as well	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	It is very difficult with fish species.	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Probably floods can spread some individuals. Check	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Some populations of S. trutta are partly migratory, probably it stands for macedonicus as well.	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	Yes	Other fish species can eat trout eggs. Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	Very high
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Probably since macedonian trout prefers a little warmer climate.	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Increase	She is estabiliseh already, a little more similar climate can only increase establishement	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	Dispersal would be the same - human influenced.	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Higher	If she establish population as a top predator it could impact biodiversity more.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Higher	Same as for the previous question.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Higher	It could impact fisheries	Medium

Statistics	
Scores	
BRA	**23.0**
BRA Outcome	**-**
BRA+CCA	**31.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**7.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*2.0*
B. Biology/Ecology	**16.0**
4. Undesirable (or persistence) traits	*6.0*
5. Resource exploitation	*5.0*
6. Reproduction	*4.0*
7. Dispersal mechanisms	*2.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**8.0**
9. Climate change	*8.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**7**
Environmental	**11**
Species or population nuisance traits	**16**

Thresholds	
BRA	-
BRA+CCA	-
Confidence	
BRA+CCA	0.69
BRA	0.71
CCA	0.50

Date and Time
16/05/2021 21:45:56

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo macedonicus*
Common name	Macedonian trout
Assessor	Ivan Špelić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	https://sgp.undp.org/spacial-itemid-projects-landing-page/spacial-itemid-project-search-results/spacial-itemid-project-detailpage.html?view=projectdetail&id=15129	Medium
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	For restocking purposes, as brood stock (https://sgp.undp.org/spacial-itemid-projects-landing-page/spacial-itemid-project-search-results/spacial-itemid-project-detailpage.html?view=projectdetail&id=15129).	Medium
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Salmo trutta (CABI).	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Climatch, low number of source points (only three).	Low
5	2.02	What is the quality of the climate matching data?	Low	Climatch, low number of source points (only three).	Very high
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	River Jerma in Serbia (Danube basin) (Simonović, P., 2015. Risks to stocks of native trout of the genus Salmo (Actinopterygii: Salmoniformes: Salmonidae) of Serbia and management for their recovery. Acta Ichthyologica et Piscatoria 45, 161–173.. doi:10.3750/aip2015.45.2.06).	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	Not applicable	Already present (Škraba Jurlina, D., Marić, A., Mrdak, D., Kanjuh, T., Špelić, I., Nikolić, V., Piria, M., Simonović, P., 2020. Alternative Life-History in Native Trout (Salmo spp.) Suppresses the Invasive Effect of Alien Trout Strains Introduced Into Streams in the Western Part of the Balkans. Frontiers in Ecology and Evolution 8.. doi:10.3389/fevo.2020.00188; Simonović, P., 2015. Risks to stocks of native trout of the genus Salmo (Actinopterygii: Salmoniformes: Salmonidae) of Serbia and management for their recovery. Acta Ichthyologica et Piscatoria 45, 161–173..	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	Already present (Škraba Jurlina, D., Marić, A., Mrdak, D., Kanjuh, T., Špelić, I., Nikolić, V., Piria, M., Simonović, P., 2020. Alternative Life-History in Native Trout (Salmo spp.) Suppresses the Invasive Effect of Alien Trout Strains Introduced Into Streams in the Western Part of the Balkans. Frontiers in Ecology and Evolution 8.. doi:10.3389/fevo.2020.00188; Simonović, P., 2015. Risks to stocks of native trout of the genus Salmo (Actinopterygii: Salmoniformes: Salmonidae) of Serbia and management for their recovery. Acta Ichthyologica et Piscatoria 45, 161–173..	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Jerma river in Serbia (Škraba Jurlina, D., Marić, A., Mrdak, D., Kanjuh, T., Špelić, I., Nikolić, V., Piria, M., Simonović, P., 2020. Alternative Life-History in Native Trout (Salmo spp.) Suppresses the Invasive Effect of Alien Trout Strains Introduced Into Streams in the Western Part of the Balkans. Frontiers in Ecology and Evolution 8.. doi:10.3389/fevo.2020.00188; Simonović, P., 2015. Risks to stocks of native trout of the genus Salmo (Actinopterygii: Salmoniformes: Salmonidae) of Serbia and management for their recovery. Acta Ichthyologica et Piscatoria 45, 161–173..	Medium
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Hybridization with native species (Škraba Jurlina, D., Marić, A., Mrdak, D., Kanjuh, T., Špelić, I., Nikolić, V., Piria, M., Simonović, P., 2020. Alternative Life-History in Native Trout (Salmo spp.) Suppresses the Invasive Effect of Alien Trout Strains Introduced Into Streams in the Western Part of the Balkans. Frontiers in Ecology and Evolution 8.. doi:10.3389/fevo.2020.00188).	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No documented evidence.	High
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	No documented impacts.	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No documented impacts.	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (Torres, Armi G. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high

15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Biology and ecology are presumably similar to other invasive Salmo trutta lineages (belonging to the same brown trout complex). Salmo trutta has been implicated in reducing native fish populations (especially other salmonids) through predation, displacement, and food competition; S. trutta introductions may have eliminated or reduced several Plecoptera and Trichoptera species in streams in Victoria, Australia (CABI, 2021. Salmo trutta[original text by Sunil Siriwardena]. In: Invasive Species Compendium. Wallingford, UK: CAB International.	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No parasitic behavior within genus.	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	For Salmo trutta from the same species complex: they prefer cold, well-oxygenated upland waters although their tolerance limits are lower than those of rainbow trout and favors large streams in the mountainous areas with adequate cover in the form of submerged rocks, undercut banks, and overhanging vegetation (Froese, R. and D. Pauly. Editors. 2019.FishBase. World Wide Web electronic publication. www.fishbase.org, (12/2019). Salmo macedonicus is present only in upper Vardar drainage in Macedonia and in Jerma river in Serbia where it was introduced (Torres, Armi G. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021); Simonović, P., 2015. Risks to stocks of native trout of the genus Salmo (Actinopterygii: Salmoniformes: Salmonidae) of Serbia and management for their recovery. Acta Ichthyologica et Piscatoria 45, 161–173. doi:10.3750/aip2015.45.2.06)	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	Nystrom, P.; McIntosh, A. R. (2003): Are impacts of an exotic predator on a stream food web influenced by disturbance history? Oecologia (2003) 136:279–288. DOI 10.1007/s00442-003-1250-3 (for Salmo trutta in the same species complex).	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	For Salmo trutta from the same species complex: brown trout have been implicated in reducing native fish populations (especially other salmonids), which could be more attractive for fishing, through predation, displacement, food competition and hybridization (Global Invasive Species Database (2020) Species profile: Salmo trutta. Downloaded from http://www.iucngisd.org/gisd/speciesname/Salmo+trutta on 25-02-2020).	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA area?	Yes	Salmo trutta is susceptible to pathogens and parasites (Cultured Aquatic Species Information Programme. Salmo trutta. Cultured Aquatic Species Information Programme. Text by Vandeputte, M. & Labbé, L. In: FAO Fisheries Division [online]. Rome. Updated . [Cited 24 May 2021].), so most likely S. macedonicus is also susceptible as a part of the brown trout complex.	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Salmo trutta is susceptible to pathogens and parasites (Cultured Aquatic Species Information Programme. Salmo trutta. Cultured Aquatic Species Information Programme. Text by Vandeputte, M. & Labbé, L. In: FAO Fisheries Division [online]. Rome. Updated . [Cited 24 May 2021].), so most likely S. macedonicus is also susceptible as a part of the brown trout complex.	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Size to 40 cm (Torres, Armi G. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	Inhabits stretches with swift water, rapids and small waterfalls (Torres, Armi G. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Lives in habitats usually associated with hard substrate, ecology does not imply such impacts (Torres, Armi G. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)) and it was never	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Not documented.	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	No information on diet. As a part of the brown trout complex, smaller specimens most likely feed on invertebrates and larger	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	No data for calculation.	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	No such observations within Salmo trutta complex.	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Established in river Jerma in Serbia (Simonović, P., 2015. Risks to stocks of native trout of the genus Salmo (Actinopterygii: Salmoniformes: Salmonidae) of Serbia and management for their recovery. Acta Ichthyologica et Piscatoria 45, 161–173.. doi:10.3750/aip2015.45.2.06; Škraba Jurlina, D., Marić, A., Mrdak, D., Kanjuh, T., Špelić, I., Nikolić, V., Piria, M., Simonović, P., 2020. Alternative Life-History in Native Trout (Salmo spp.) Suppresses the Invasive Effect of Alien Trout Strains Introduced Into Streams in the Western Part of the Balkans. Frontiers in Ecology and Evolution 8.. doi:10.3389/fevo.2020.00188).	Very high

30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Simonović, P., 2015. Risks to stocks of native trout of the genus Salmo (Actinopterygii: Salmoniformes: Salmonidae) of Serbia and management for their recovery. Acta Ichthyologica et Piscatoria 45, 161–173.. doi:10.3750/aip2015.45.2.06; Škraba Jurlina, D., Marić, A., Mrdak, D., Kanjuh, T., Špelić, I., Nikolić, V., Piria, M., Simonović, P., 2020. Alternative Life-History in Native Trout (Salmo spp.) Suppresses the Invasive Effect of Alien Trout Strains Introduced Into Streams in the Western Part of the Balkans. Frontiers in Ecology and Evolution 8..	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No such observations within Salmo trutta complex.	High
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	No information for this species, most likely similar to S. trutta from the same complex: Spawns in rivers and streams with swift current, usually characterized by downward movement of water into gravel (Froese & Pauly 2019).	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Similar to other taxons of the brown trout complex.	Medium
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	No information, other taxons in brown trout complex are usually mature in 1-2 years.	Low
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable habitats nearby)?	One	Introduction for angling (stocking) (Kanjuh T., S. Tomić, A. Marić, D. Š. Jurlina, V. Nikolić & P. Simonović 2021. Trout Salmo spp. (Salmoniformes: Salmonidae) Molecular Diversity in Streams on the Southern Slopes of the Stara Planina Mts. in Serbia. Acta Zool. Bulg., in press).	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	For years present just in one river in Serbia with occasional occurences in rivers downstream (Kanjuh T., S. Tomić, A. Marić, D. Š. Jurlina, V. Nikolić & P. Simonović 2021. Trout Salmo spp. (Salmoniformes: Salmonidae) Molecular Diversity in Streams on the Southern Slopes of the Stara Planina Mts. in Serbia. Acta Zool. Bulg., in press).	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No adaptations.	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Not documented, other taxons in the brown trout complex deposit eggs in redds between gravel.	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Present in Jerma, spreading in the River Nišava downstream and entering into large tributaries such as the River Temštica (personal observations), with the occasional reports of catches even in the city of Niš, more than 100 km downstream (Kanjuh T., S. Tomić, A. Marić, D. Š. Jurlina, V. Nikolić & P. Simonović 2021. Trout Salmo spp. (Salmoniformes: Salmonidae) Molecular Diversity in Streams on the Southern Slopes of the Stara Planina Mts. in Serbia. Acta Zool. Bulg., in press). Not certain if it is the	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	No evidence, resident life history (Kottelat & Freyhof 2008).	Medium
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Not documented, other taxons in the brown trout complex deposit eggs in redds between gravel.	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Stocking, natural dispersal.	High
43	7.09	Is dispersal of the taxon density dependent?	Yes	Present in Jerma, spreading in the River Nišava downstream and entering into large tributaries such as the River Temštica (personal observations), with the occasional reports of catches even in the city of Niš, more than 100 km downstream (Kanjuh T., S. Tomić, A. Marić, D. Š. Jurlina, V. Nikolić & P. Simonović 2021. Trout Salmo spp. (Salmoniformes: Salmonidae) Molecular Diversity in Streams on the Southern Slopes of the Stara Planina Mts. in Serbia. Acta Zool. Bulg., in press). Not certain if it is the result of density dependent dispersion.	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Sensitive species, most likely similar to other taxons in brown trout complex.	High
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	No specific info but closely related Salmo trutta requires cold, well oxygenated upland waters (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	Not allowed in RA area.	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Crivelli, A.J. 2006. Salmo macedonicus. The IUCN Red List of Threatened Species 2006: e.T61361A12467912. https://dx.doi.org/10.2305/IUCN.UK.2006.RLTS.T61361A12467912.en. Downloaded on 28 May 2021.	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Only freshwater resident population (Kottelat & Freyhof 2008).	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Piscivorous birds, fish and mammals are known predators of trouts.	High
C. Climate change					
9. Climate change					

50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	Already present.	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Trout (brown trout complex) are cold-water fish, they are particularly vulnerable to the effects of global warming, including increasing water temperatures and decreasing flow rates, future changes will reduce the number of potential habitats because of the future water scarcity conditions (Carosi, A., Ghetti, L., Padula, R., Lorenzoni, M., 2020. Population status and ecology of the Salmo trutta complex in an Italian river basin under multiple anthropogenic pressures. Ecology and Evolution 10, 7320–7333..	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Trout (brown trout complex) are cold-water fish, they are particularly vulnerable to the effects of global warming, including increasing water temperatures and decreasing flow rates, future changes will reduce the number of potential habitats because of the future water scarcity conditions (Carosi, A., Ghetti, L., Padula, R., Lorenzoni, M., 2020. Population status and ecology of the Salmo trutta complex in an Italian river basin under multiple anthropogenic pressures. Ecology and Evolution 10, 7320–7333..	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Trout (brown trout complex) are cold-water fish, they are particularly vulnerable to the effects of global warming, including increasing water temperatures and decreasing flow rates, future changes will impact the populations of trout because of the future water scarcity conditions (Carosi, A., Ghetti, L., Padula, R., Lorenzoni, M., 2020. Population status and ecology of the Salmo trutta complex in an Italian river basin under multiple anthropogenic pressures. Ecology and Evolution 10, 7320–7333.. doi:10.1002/ece3.6457). As waters warm, cold water species with lower "thermal niches" become competitively disadvantaged with respect to other species for which the warmer temperatures are optimal (Magnuson, J.J., L.B. Crowder, and P.A. Medvick. 1979. Temperature as an ecological resource. Amer. Zool. 19:331-343.)	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	Trout (brown trout complex) are cold-water fish, they are particularly vulnerable to the effects of global warming, including increasing water temperatures and decreasing flow rates, future changes will impact the populations of trout because of the future water scarcity conditions (Carosi, A., Ghetti, L., Padula, R., Lorenzoni, M., 2020. Population status and ecology of the Salmo trutta complex in an Italian river basin under multiple anthropogenic pressures. Ecology and Evolution 10, 7320–7333.. doi:10.1002/ece3.6457). As waters warm, cold water species with lower "thermal niches" become competitively disadvantaged with respect to other species for which the warmer temperatures are optimal (Magnuson, J.J., L.B. Crowder, and P.A. Medvick. 1979. Temperature as an ecological resource. Amer. Zool. 19:331-343.)	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Trout (brown trout complex) are cold-water fish, they are particularly vulnerable to the effects of global warming, including increasing water temperatures and decreasing flow rates, future changes will impact the populations of trout, because of the future water scarcity conditions (Carosi, A., Ghetti, L., Padula, R., Lorenzoni, M., 2020. Population status and ecology of the Salmo trutta complex in an Italian river basin under multiple anthropogenic pressures. Ecology and Evolution 10, 7320–7333.. doi:10.1002/ece3.6457). As waters warm, cold water species with lower "thermal niches" become competitively disadvantaged with respect to other species for which the warmer temperatures are optimal (Magnuson, J.J., L.B. Crowder, and P.A. Medvick. 1979. Temperature as an ecological resource. Amer. Zool. 19:331-343.). In this case, adverse impact is recognized as reducing the number of native fish species, especially other Salmonids. With future conditions, both native and introduced Salmonids are predicted to experience reductions in suitable habitats so relative impact will	Low

Statistics	
Scores	
BRA	**18.0**
BRA Outcome	**-**
BRA+CCA	**10.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**11.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*6.0*
B. Biology/Ecology	**7.0**
4. Undesirable (or persistence) traits	*5.0*
5. Resource exploitation	*5.0*
6. Reproduction	*2.0*
7. Dispersal mechanisms	*-1.0*
8. Tolerance attributes	*-4.0*
C. Climate change	**-8.0**
9. Climate change	*-8.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*

5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**9**
Environmental	**3**
Species or population nuisance traits	**0**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.63**
BRA	**0.64**
CCA	**0.54**

Date and Time
28/05/2021 13:25:22

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo macedonicus*
Common name	Macedonian trout
Assessor	Tamara Kanjuh
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	At the beginning the Macedonia fishery was present in freshwater lakes, but after the Second World War, there was a fast development of the aquaculture (Hristovski&Stevanovski, 2005).	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	At the beginning the Macedonia fishery was present in freshwater lakes, but after the Second World War, there was a fast development of the aquaculture (Hristovski&Stevanovski, 2005).	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No information found.	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Dfa, Dfb (Köppen–Geiger climate classification system)	Medium
5	2.02	What is the quality of the climate matching data?	High	Köppen–Geiger climate classification system	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Macedonian trout of the AD haplogroup were recorded exclusively in the River Jerma, which strongly suggests their allochthonous character (Simonović et al., 2021).	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Aquaculture (Simonović et al., 2015)	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Jerma River (Simonović et al., 2021)	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	River Jerma (Simonović et al., 2021)	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Possible hybridization with native taxa.	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No information found.	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	No information found.	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No information found.	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	No information found.	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Possible through competition for food, habitat occupation...	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No information found.	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	No information found.	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No information found.	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No information found.	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No information found.	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No information found.	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	No information found.	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	No information found.	Low
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	No information found.	Low

25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	The current ecosystem status of the Macedonian trout in the River Jerma is that it naturalised and revealed the strong invasive character (Simonović et al., 2015).	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	No information found.	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information found.	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	No information found.	Low
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	The current ecosystem status of the Macedonian trout in the River Jerma is that it naturalised and revealed the strong invasive character (Simonović et al., 2015).	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Introduction of the tentative Macedonian trout Salmo macedonicus of the AD lineage was also detected in a native population of the tentative S. labrax. In almost all recipient nonmigratory trout populations, a cross-breeding between native and introduced trout was detected by heterozygosity in either only the LDH-C nuclear locus or the LDH-C and specific microsatellite loci (Škraba et al.,	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No information found.	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	No information found.	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	No	No information found.	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	As there is no exact data, it is assumed that, like other members of the genus Salmo, the range of age at sexual or reproductive maturity is 1 to 10 years (animaldiversity.org)	Low
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Intentional restocking, escape from aquaculture, spreading through water body connections (Simonović et al., 2021).	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	No information found.	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No information found.	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	No information found.	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	... spreading in the River Nišava downstream and entering into large tributaries such as the River Temštica (personal observations), with the occasional reports of catches even in the city of Niš, more than 100 km downstream (Simonović et al.,	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	No information found.	Low
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No information found.	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Escape from aquaculture.	Low
43	7.09	Is dispersal of the taxon density dependent?	No	No information found.	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	No information found.	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	As no information is available, it is assumed that like most species of the genus Salmonidae, S. macedonicus sensitive to water quality and requires cold, clean, well oxygenated water.	Low
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	No information found.	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	No information found.	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	No information found.	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	No information found.	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Similar to other species of the Salmonidae family, S. macedonicus does not tolerate extreme changes and is particularly sensitive to water temperature and oxygen saturation.	Low
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	Similar to other species of the Salmonidae family, S. macedonicus does not tolerate extreme changes and is particularly sensitive to water temperature and oxygen saturation.	Low

52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	Similar to other species of the Salmonidae family, S. macedonicus does not tolerate extreme changes and is particularly sensitive to water temperature and oxygen saturation.	Low
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Similar to other species of the Salmonidae family, S. macedonicus does not tolerate extreme changes and is particularly sensitive to water temperature and oxygen saturation.	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	Similar to other species of the Salmonidae family, S. macedonicus does not tolerate extreme changes and is particularly sensitive to water temperature and oxygen saturation.	Low
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Similar to other species of the Salmonidae family, S. macedonicus does not tolerate extreme changes and is particularly sensitive to water temperature and oxygen saturation.	Low

Statistics	
Scores	
BRA	**9.0**
BRA Outcome	**-**
BRA+CCA	**9.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**9.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*6.0*
B. Biology/Ecology	**0.0**
4. Undesirable (or persistence) traits	*1.0*
5. Resource exploitation	*0.0*
6. Reproduction	*2.0*
7. Dispersal mechanisms	*-1.0*
8. Tolerance attributes	*-2.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**10**
Environmental	**0**
Species or population nuisance traits	**2**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.35**
BRA	**0.37**
CCA	**0.25**

Date and Time
28/05/2021 09:07:01

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo macedonicus*
Common name	Macedonian trout
Assessor	Tena Radocaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	No	No evidence	Low
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Probably (angling)	Low
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Salmo trutta (Fishbase)	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	The similarity between climatic conditions RA area and native range is high. I use climatch.	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Distribution Map and Climatch	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	S. macedonicus is not present in the RA area.	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	Stocking and waterways	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Kanjuh, T., Tomić, S., Marić, A., Jurlina, D. Š., Nikolić, V., & Simonović, P. Trout Salmo spp.(Salmoniformes: Salmonidae) Molecular Diversity in Streams on the Southern Slopes of the Stara Planina Mts. in Serbia.	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Kanjuh, T., Tomić, S., Marić, A., Jurlina, D. Š., Nikolić, V., & Simonović, P. Trout Salmo spp.(Salmoniformes: Salmonidae) Molecular Diversity in Streams on the Southern Slopes of the	Low
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	No evidence, but probably they compete with native fish species.	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No evidence	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	Competition (no evidence)	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No evidence	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	S. macedonicus is harmless	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No evidence	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	S. macedonicus will be adaptable to climatic and other environmental conditions. (Kanjuh, T., Tomić, S., Marić, A., Jurlina, D. Š., Nikolić, V., & Simonović, P. Trout Salmo spp.(Salmoniformes: Salmonidae) Molecular Diversity in Streams on the Southern Slopes of the Stara Planina Mts. in Serbia)	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	Competition with native species	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	S. macedonicus no adverse impacts in the RA area.	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Yes, the taxon may be a host or vector of known pests and infectious agents endemic to RA area. Because in every area exist infectious agents and pests.	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Yes, the taxon may be a host or vector of known pests and infectious agents endemic to RA area. Because in every area exist infectious agents and pests.	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	40.0 cm SL (Fishbase)	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Inhabits stretches with swift water, rapids and small waterfalls (Fishbase)	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	No evidence	Low

25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	No evidence	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	No evidence (personal opinion-yes)	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	Not applicable	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	No evidence	Low
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	S. macedonicus can produce viable gamete in the RA area.	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No evidence	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	No	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	No	No evidence	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	2?	Low
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	1. human influence 2. natural spread via natural and manmade watercourses	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Human influence	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No adaptions	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	No evidence	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Probably yes	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Yes	Low
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	There is the possibility of a high rate of dispersal of taxa. E.g. when a fertilized individual enters a new area by some kind of dispersal.	Low
43	7.09	Is dispersal of the taxon density dependent?	Yes	No evidence	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Sensitive species	High
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Personal opinion	Low
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	No evidence	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Future habitat loss, water abstraction, and water pollution. (Crivelli, A.J. 2006. Salmo macedonicus. The IUCN Red List of Threatened Species 2006)	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Freshwater fish	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Catfish, Zander, Pike..	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Low
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Low

53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Low
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Low

Statistics	
Scores	
BRA	**14.0**
BRA Outcome	**-**
BRA+CCA	**10.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**5.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*2.0*
B. Biology/Ecology	**9.0**
4. Undesirable (or persistence) traits	*5.0*
5. Resource exploitation	*5.0*
6. Reproduction	*0.0*
7. Dispersal mechanisms	*3.0*
8. Tolerance attributes	*-4.0*
C. Climate change	**-4.0**
9. Climate change	*-4.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**4**
Environmental	**6**
Species or population nuisance traits	**4**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.39**
BRA	**0.40**
CCA	**0.29**

Date and Time
19/05/2021 12:30:19

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo obtusirostris*
Common name	soft-muzzled trout
Assessor	Ana Marić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	http://www.musicar.rs/vrste-riba-koje-se-gaje-u-ribnjacima/ Artificial breeding of Neretva softmouth trout (Salmo obtusirostris oxyrhincus Heckel, 1851). Handžar, D. ; Jažić, A. ; Spasojević, P. 2015 but maybenot for 20 generations?	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Službene novine Federacije BiH", br. 63/05 PRAVILNIK O NAČINU, ALATIMA I SREDSTVIMA KOJIMA SE OBAVLJA RIBOLOV	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	A handbook of global freshwater invasive species. Frencis. 2012.	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Its the same latitude and area.	High
5	2.02	What is the quality of the climate matching data?	High	https://climatch.cp1.agriculture.gov.au/climatch.jsp	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	ZRnovnica	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	Stocking and escape from fish farms.	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Genetic variation among trout in the River Neretva basin, Bosnia and Herzegovina A. RAZPET, S. SUSˇ NIK, T. JUG AND A. SNOJ. 2006	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Genetic composition of the Jadro softmouth trout following translocation into a new habitat. Alesˇ Snoj Æ Andrej Razpet Æ Tea Tomljanovic ÆTomislav Treer Æ Simona Susnik. 2007	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	Genetic composition of the Jadro softmouth trout following translocation into a new habitat. Alesˇ Snoj,Andrej Razpet, Tea Tomljanovic, Tomislav Treer,imona Susnik. 2007	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Genetic composition of the Jadro softmouth trout following translocation into a new habitat. Alesˇ Snoj,Andrej Razpet, Tea Tomljanovic, Tomislav Treer,imona Susnik. 2007	Very high
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	Genetic composition of the Jadro softmouth trout following translocation into a new habitat. Alesˇ Snoj,Andrej Razpet, Tea Tomljanovic, Tomislav Treer,imona Susnik. 2007	Very high
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Genetic composition of the Jadro softmouth trout following translocation into a new habitat. Alesˇ Snoj,Andrej Razpet, Tea Tomljanovic, Tomislav Treer,imona Susnik. 2007	Very high
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Handbook of European Freshwater Fishes. 2007. Kottelat and Freyhof	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	Genetic composition of the Jadro softmouth trout following translocation into a new habitat. Alesˇ Snoj,Andrej Razpet, Tea Tomljanovic, Tomislav Treer,imona Susnik. 2007	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	Handbook of European Freshwater Fishes. 2007. Kottelat and Freyhof	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Note on the growth of endemic soft muzzled trout Salmothymus obtusirostris translocated into Dalmatian river. Treer et al. 2003	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	Genetic composition of the Jadro softmouth trout following translocation into a new habitat. Alesˇ Snoj,Andrej Razpet, Tea Tomljanovic, Tomislav Treer,imona Susnik. 2007	Very high
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	Genetic composition of the Jadro softmouth trout following translocation into a new habitat. Alesˇ Snoj,Andrej Razpet, Tea Tomljanovic, Tomislav Treer,imona Susnik. 2007	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Handbook of European Freshwater Fishes. 2007. Kottelat and Freyhof	Very high
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	It is the very close, practicly same area	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	From farms.	High
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	Ecologically acceptable flows definition for the Žrnovnica River (Croatia) Ognjen Bonacci Mladen Kerovec Tanja Roje-Bonacci... 1998	High

24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Ecologically acceptable flows definition for the Žrnovnica River (Croatia) Ognjen Bonacci Mladen Kerovec Tanja Roje-Bonacci... 1998	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Genetic composition of the Jadro softmouth trout following translocation into a new habitat. Alesˇ Snoj,Andrej Razpet, Tea Tomljanovic, Tomislav Treer,imona Susnik. 2007	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Handbook of European Freshwater Fishes. 2007. Kottelat and Freyhof	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	Genetic composition of the Jadro softmouth trout following translocation into a new habitat. Alesˇ Snoj,Andrej Razpet, Tea Tomljanovic, Tomislav Treer,imona Susnik. 2007	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	No data	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Treer, T., Aničić, I., Safner, R., Odak, T. & Piria, M. (2003): Note on the growth of endemic soft-muzzled trout Salmothymus obtusirostris translocated into a Dalmatian river. Biologia, Bratislava, section Zoology 58, 999–1001	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Genetic composition of the Jadro softmouth trout following translocation into a new habitat. Alesˇ Snoj,Andrej Razpet, Tea Tomljanovic, Tomislav Treer,imona Susnik. 2007	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Handbook of European Freshwater Fishes. 2007. Kottelat and Freyhof	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Handbook of European Freshwater Fishes. 2007. Kottelat and Freyhof	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Handbook of European Freshwater Fishes. 2007. Kottelat and Freyhof	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Handbook of European Freshwater Fishes. 2007. Kottelat and Freyhof	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Stocking,escape	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Its near the sea area	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	Handbook of European Freshwater Fishes. 2007. Kottelat and Freyhof	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Spawning behaviour and the softmouth trout dilemma. 2014. Manu Esteve, Deborah Ann McLennan, John Andrew Zablocki, Gašper Pustovrh, Ignacio Doadrio	Very high
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Spawning behaviour and the softmouth trout dilemma. 2014. Manu Esteve, Deborah Ann McLennan, John Andrew Zablocki, Gašper Pustovrh, Ignacio Doadrio	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Note on the growth of endemic soft muzzled trout Salmothymus obtusirostris translocated into Dalmatian river. Treer et al. 2003	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	can only eat them	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	Genetic composition of the Jadro softmouth trout following translocation into a new habitat. Alesˇ Snoj,Andrej Razpet, Tea Tomljanovic, Tomislav Treer,imona Susnik. 2007	High
43	7.09	Is dispersal of the taxon density dependent?	No	Genetic composition of the Jadro softmouth trout following translocation into a new habitat. Alesˇ Snoj,Andrej Razpet, Tea Tomljanovic, Tomislav Treer,imona Susnik. 2007	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Ecologically acceptable flows definition for the Žrnovnica River (Croatia) Ognjen Bonacci Mladen Kerovec Tanja Roje-Bonacci... 1998	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Ecologically acceptable flows definition for the Žrnovnica River (Croatia) Ognjen Bonacci Mladen Kerovec Tanja Roje-Bonacci... 1998	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Not applicable	Endagered	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Ecologically acceptable flows definition for the Žrnovnica River (Croatia) Ognjen Bonacci Mladen Kerovec Tanja Roje-Bonacci...	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Ecologically acceptable flows definition for the Žrnovnica River (Croatia) Ognjen Bonacci Mladen Kerovec Tanja Roje-Bonacci... 1998 anadromous relatives	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Egg eaters and mamals	Very high
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Ecologically acceptable flows definition for the Žrnovnica River (Croatia) Ognjen Bonacci Mladen Kerovec Tanja Roje-Bonacci... 1998	Very high

51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Ecologically acceptable flows definition for the Žrnovnica River (Croatia) Ognjen Bonacci Mladen Kerovec Tanja Roje-Bonacci... 1998	Very high
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Ecologically acceptable flows definition for the Žrnovnica River (Croatia) Ognjen Bonacci Mladen Kerovec Tanja Roje-Bonacci... 1998	Very high
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Ecologically acceptable flows definition for the Žrnovnica River (Croatia) Ognjen Bonacci Mladen Kerovec Tanja Roje-Bonacci... 1998	Very high
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	Ecologically acceptable flows definition for the Žrnovnica River (Croatia) Ognjen Bonacci Mladen Kerovec Tanja Roje-Bonacci... 1998	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	Ecologically acceptable flows definition for the Žrnovnica River (Croatia) Ognjen Bonacci Mladen Kerovec Tanja Roje-Bonacci... 1998	Very high

Statistics	
Scores	
BRA	**20.0**
BRA Outcome	**-**
BRA+CCA	**10.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**8.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*2.0*
B. Biology/Ecology	**12.0**
4. Undesirable (or persistence) traits	*4.0*
5. Resource exploitation	*5.0*
6. Reproduction	*3.0*
7. Dispersal mechanisms	*1.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**-10.0**
9. Climate change	*-10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**4**
Environmental	**4**
Species or population nuisance traits	**6**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.88**
BRA	**0.87**
CCA	**0.96**

Date and Time
15/05/2021 11:25:16

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo obtusirostris*
Common name	soft-muzzled trout
Assessor	Ivan Špelić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	There is a project of artificial spawning of one subspecies,ongoing for 13 years (http://moreikrs.hr/projekti-detalji/A/1).	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	For artificial spawning (http://moreikrs.hr/projekti-detalji/A/1).	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Salmo trutta (CABI).	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Same country and same basin (Adriatic basin in Croatia).	Very high
5	2.02	What is the quality of the climate matching data?	High	Within the same region and basin.	Very high
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224. Preuzeto s https://hrcak.srce.hr/128484	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	Not applicable	Already present.	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	Already present.	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	River Žrnovnica in Croatia (Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224. Preuzeto s	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	There was no fish present prior to stocking of Žrnovnica (Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224. Preuzeto s https://hrcak.srce.hr/128484).	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No recorded adverse impacts on aquaculture in the area.	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	Positive impacts because it is attractive species for angling (pers. comm.).	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No adverse impact (Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224. Preuzeto s https://hrcak.srce.hr/128484).	Very high
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (Cruz, Tess in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	Not documented for any species.	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No parasitic behaviour.	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Sensitive to water temperatures over 20 deg Celsius, low oxygen levels and pollution (Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224. Preuzeto s https://hrcak.srce.hr/128484).	Very high
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	Not documented in literature.	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	Not documented in introduced area, not likely due to species ecology.	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Most likely susceptible to parasites and pathogens as other congeners (personal opinion).	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Most likely susceptible to parasites and pathogens as other congeners (Szczembara, A. 2011. "Gyrodactylus salaris" (On-line), Animal Diversity Web. Accessed May 19, 2021 at https://animaldiversity.org/accounts/Gyrodactylus_salaris/, personal opinion).).	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Size to 70 cm (Cruz, Tess in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high

23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	Found only in flowing water with temperature lower than 20 deg C and high oxygen levels (Cruz, Tess in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021); Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224. Preuzeto s	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Not likely due to species ecology and preffered habitat (Cruz, Tess in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021); Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224. Preuzeto s https://hrcak.srce.hr/128484).	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Not documented, sensitive and usually restocked to maintain populations in some areas (http://moreikrs.hr/projekti-detalji/A/1).	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	Not likely, feeds on invertebrates (Cruz, Tess in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021))	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	No data.	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	No such adaptations or behaviours documented.	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Already stablished and spawning in Žrnovnica river where it is translocated (Cruz, Tess in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Hybridizing with brown trout in Žrnovnica, so most likely able to hybridize with all lineages of brown trout (Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224. Preuzeto s	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No such adaptations described in literature.	High
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	Gravel substrate in highly oxygenated streams (Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224. Preuzeto s	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Fecundity of Neretva lineage was determined to be 2000 eggs per female (CEPF FINAL PROJECT COMPLETION REPORT: Education of the public on sustainable water use and the protection of endemic fish in the Neretva River Valley. https://www.cepf.net/sites/default/files/sg60922-final-report.pdf).	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224. Preuzeto s https://hrcak.srce.hr/128484	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Introductions for angling (personal opinion).	Low
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	Already present as native in suitable habitats in some protected areas (Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224. Preuzeto s https://hrcak.srce.hr/128484), not expected to be introduced in protected areas far from native range.	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No such adaptations.	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Eggs deposited in redd on gravel supstrate (Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224. Preuzeto s	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	Very restricted distribution, no documented dispersion except when introduced by human (Žrnovnica) (Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224. Preuzeto s	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	Non-migratory (Cruz, Tess in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Eggs deposited in redds on gravel substrate (Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224. Preuzeto s	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Introductions for angling.	Very high
43	7.09	Is dispersal of the taxon density dependent?	No	Very restricted distribution, no documented dispersion except when introduced by human (Žrnovnica) (Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224. Preuzeto s	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Sensitive species as most Salmonids.	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Sensitive to any kind of pollution (Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224. Preuzeto s https://hrcak.srce.hr/128484).	Very high

46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Not applicable	Not allowed.	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Endangered because of the habitat degradation, embakment and fragmentation (Very restricted distribution, no documented dispersion except when introduced by human (Žrnovnica) (Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224. Preuzeto s https://hrcak.srce.hr/128484).).	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Only freshwater (Very restricted distribution, no documented dispersion except when introduced by human (Žrnovnica) (Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224. Preuzeto s https://hrcak.srce.hr/128484).).	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Piscivorous birds and mammals (otters) (personal opinion).	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	Already present.	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Temperatures over 20 deg. Celsius are lethal (Very restricted distribution, no documented dispersion except when introduced by human (Žrnovnica) (Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224. Preuzeto s https://hrcak.srce.hr/128484).). Predicted decrease in suitable habitats for freshwater species (COMTE, L., BUISSON, L., DAUFRESNE, M. and GRENOUILLET, G. (2013), Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58: 625-639. https://doi.org/10.1111/fwb.12081).	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Temperatures over 20 deg. Celsius are lethal (Very restricted distribution, no documented dispersion except when introduced by human (Žrnovnica) (Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224. Preuzeto s https://hrcak.srce.hr/128484).). Predicted decrease in suitable habitats for freshwater species (COMTE, L., BUISSON, L., DAUFRESNE, M. and GRENOUILLET, G. (2013), Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58: 625-639. https://doi.org/10.1111/fwb.12081).	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	No recognized impact so no possible change expected under less suitable climatic conditions.	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	No recognized impact so no possible change expected under less suitable climatic conditions.	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	No recognized impact so no possible change expected under less suitable climatic conditions.	High

Statistics	
Scores	
BRA	**2.0**
BRA Outcome	**-**
BRA+CCA	**-2.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**7.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*2.0*
B. Biology/Ecology	**-5.0**
4. Undesirable (or persistence) traits	*2.0*
5. Resource exploitation	*0.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*-4.0*
8. Tolerance attributes	*-4.0*
C. Climate change	**-4.0**
9. Climate change	*-4.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**5**
Environmental	**0**

Species or population nuisance traits	-5

Thresholds	
BRA	-
BRA+CCA	-
Confidence	
BRA+CCA	0.78
BRA	0.78
CCA	0.79

Date and Time
21/05/2021 23:24:21

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo obtusirostris*
Common name	soft-muzzled trout
Assessor	Tamara Kanjuh
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Fisheries: commercial; gamefish: yes (fishbase.in) This only gregarious trout in the Adriatic Sea drainage area of Montenegro is of the yet unknown potential for fish farming, which is necessary to investigate (Mrdak et al., 2012).	Medium
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Fisheries: commercial; gamefish: yes (fishbase.in)	Medium
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No information found.	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Dfa, Dfb (Köppen–Geiger climate classification system)	High
5	2.02	What is the quality of the climate matching data?	High	Köppen–Geiger climate classification system	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	River Žrnovnica (Kottelat&Freyhof, 2007)	Medium
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Intentional introduction (Treer et al., 2005)	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Introduced and established from Jardo to Žrnovnica drainages (Croatia) around 1960 (Kottelat&Freyhof, 2007; Treer et al., 2005).	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Introduced and established from Jardo to Žrnovnica drainages (Croatia) around 1960 (Kottelat&Freyhof, 2007; Treer et al.,	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	No information found.	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No information found.	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	No information found.	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No information found.	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (fishbase.in)	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No information found.	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No information found.	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	As the result of the very limited distribution and endangerments in its native river Jadro (Povrž et al., 1990; Mrakovčić et al., 1995), which flows through the suburb of the biggest Dalmatian city, this subspecies was sometimes considered extinct (Crivelli, 1995). However, the remains of the population are still present in the upper part of the river .	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No information found.	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No information found.	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No information found.	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No information found.	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	No information found.	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	The River Žrnovnica has high flows and water quality so that it is used for drinking water (Bonacci et al., 1998).	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	No information found.	Low

25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	However, following the rumors that there is still soft-muzzled trout in the Zeta River, we managed to find one population at the locality of the village of Tunjevo (N 42◦37' 912''; E 019◦01' 016'') that was still the only one known and with the ultimately small number of specimens (Sušnik et al. 2007)	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	No information found.	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information found.	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	No information found.	Low
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Established in River Žrnovnica (Kottelat&Freyhof, 2007)	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	Neighbour-Joining Tree of individuals showed strong soft-muzzled genotype grouping among all samples and no hybrids among soft-muzzled and other trout genotypes (Mrdak et al., 2012).	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No information found.	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	No information found.	Medium
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	No	No information found.	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	Following the example of other species of the genus Salmo.	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Intentional restocking (Treer et al., 2005)	Low
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	No information found.	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No information found.	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Dispersion could occur in the juvenile stage.	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Dispersion could occur in the juvenile stage.	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	Non-migratory (fishbase.in)	Low
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No information found.	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Intentional restocking (Treer et al., 2005)	Medium
43	7.09	Is dispersal of the taxon density dependent?	No	No information found.	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	The taxon cannot live out of the water.	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	The taxon is very sensitive to environmental changes.	Low
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	No information found.	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	The taxon is very sensitive to environmental changes.	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	The taxon is very sensitive to environmental changes.	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	No information found.	Low
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	The taxon is very sensitive to environmental changes.	Low
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	The taxon is very sensitive to environmental changes.	Low
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	The taxon is very sensitive to environmental changes.	Low

53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	The taxon is very sensitive to environmental changes.	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	The taxon is very sensitive to environmental changes.	Low
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	The taxon is very sensitive to environmental changes.	Low

Statistics	
Scores	
BRA	**2.0**
BRA Outcome	**-**
BRA+CCA	**2.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**5.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*2.0*
B. Biology/Ecology	**-3.0**
4. Undesirable (or persistence) traits	*1.0*
5. Resource exploitation	*0.0*
6. Reproduction	*0.0*
7. Dispersal mechanisms	*-2.0*
8. Tolerance attributes	*-2.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**5**
Environmental	**0**
Species or population nuisance traits	**-1**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.35**
BRA	**0.36**
CCA	**0.25**

Date and Time
31/05/2021 00:13:04

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo obtusirostris*
Common name	soft-muzzled trout
Assessor	Tena Radocaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Fisheries: commercial; gamefish: yes (Fishbase)	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Fishbase	Medium
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Salmo trutta (Fishbase)	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	The similarity between climatic conditions RA area and native range is high. I use climatch.	High
5	2.02	What is the quality of the climate matching data?	Medium	Climatch	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	Not applicable	S. obtusirostris is present in the RA area.	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	S. obtusirostris is present in the RA area.	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	River Žrnovnica in Croatia (Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224.	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	No evidence	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No evidence	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	No evidence	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No evidence	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No evidence	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No evidence	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224.	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No evidence	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No evidence	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Yes, the taxon may be a host or vector of known pests and infectious agents endemic to RA area. Because in every area exist infectious agents and pests.	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Yes, the taxon may be a host or vector of known pests and infectious agents endemic to RA area. Because in every area exist infectious agents and pests.	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	70.0 cm SL (Fishbase)	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp	Low
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp	Low

25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	Not applicable	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Hybridizing with brown trout in Žrnovnica, (Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224).	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No evidence	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	Gravel substrate in highly oxygenated streams (Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224.	Medium
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224.	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224.	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Human influence	Very high
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	No	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No adaptations	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224.	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224.	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224.	Low
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224.	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224.	Medium
43	7.09	Is dispersal of the taxon density dependent?	No	Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224.	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224.	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224.	Low
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	Not applicable	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224.	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Tomljanović, T. (2014). Endemska mekousna pastrva solinka (Salmo obtusirostris salonitana). Tusculum, 7 (1), 215-224.	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Catfish, Pike..	High
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	It is present in the RA area	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Low
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Low

53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Comte, L., Buisson, L., Daufresne, M., & Grenouillet, G. (2013). Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58(4), 625-639.	Medium

Statistics	
Scores	
BRA	**2.0**
BRA Outcome	**-**
BRA+CCA	**-2.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**7.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*2.0*
B. Biology/Ecology	**-5.0**
4. Undesirable (or persistence) traits	*2.0*
5. Resource exploitation	*0.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*-4.0*
8. Tolerance attributes	*-4.0*
C. Climate change	**-4.0**
9. Climate change	*-4.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**5**
Environmental	**0**
Species or population nuisance traits	**-5**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.50**
BRA	**0.49**
CCA	**0.50**

Date and Time
02/06/2021 07:39:34

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo salar*
Common name	Atlantic salmon
Assessor	Ana Marić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	A handbook of global freshwater invasive species. Frencis. 2012. Salmo trutta	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	There is a wide range of native dispersal of S.salar 35-70 lat but only small variations in water temperature. 11 in yellow no 5 in target region, 14 matcher, 5 of 23 with high compatibility	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Climach used, Worldclim sample available points - 23 target points selected.	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	Horizon species	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Intentional - aquaculture	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	No	In 1986 S.salar was experimentaly aquacultured. not succesful.	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	The contribution of Atlantic salmon (Salmo salar L.) enhancement to a sustainable resource. 1997 J. A. Ritter	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	no, it is rather contra. One species with two biologies: Atlantic salmon (Salmo salar) in the wild and in aquaculture 1998 Mart R.	High
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	Environmental issues in Chilean salmon farming: a reviewRenato A. Qui~nones1,2, Marcelo Fuentes2, Rodrigo M. Montes1, Doris Soto1and Jorge Le□on-Mu~noz. 2019.	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Environmental issues in Chilean salmon farming: a reviewRenato A. Qui~nones1,2, Marcelo Fuentes2, Rodrigo M. Montes1, Doris Soto1and Jorge Le□on-Mu~noz. 2019	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	Incidence and impacts of escaped farmed Atlantic salmon Salmo salar in nature Eva B. Thorstad, Ian A. Fleming, Philip McGinnity, Doris Soto, Vidar Wennevik & Fred Whoriskey. 2008.	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	Not a parasite.	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	Incidence and impacts of escaped farmed Atlantic salmon Salmo salar in nature Eva B. Thorstad, Ian A. Fleming, Philip McGinnity, Doris Soto, Vidar Wennevik & Fred Whoriskey. 2008.	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	The contribution of Atlantic salmon (Salmo salar L.) enhancement to a sustainable resource. 1997. J. A. Ritter	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Ecology of Atlantic Salmon and Brown Trout. jonsson and jonsson. 2011	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Ecology of Atlantic Salmon and Brown Trout. jonsson and jonsson. 2011	Very high
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Stream channel experiments on downstream movement of recently emerged trout, Salmo trutta L. and salmon, S. salar L.—I. Effect of four different water velocity treatments upon dispersal rate. D. T. Crisp M. A. Hurley. 1991.	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High

25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Incidence and impacts of escaped farmed Atlantic salmon Salmo salar in nature Eva B. Thorstad, Ian A. Fleming, Philip McGinnity, Doris Soto, Vidar Wennevik & Fred Whoriskey. 2008.	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	Incidence and impacts of escaped farmed Atlantic salmon Salmo salar in nature Eva B. Thorstad, Ian A. Fleming, Philip McGinnity, Doris Soto, Vidar Wennevik & Fred Whoriskey. 2008. at juvenile	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Yes	Life history variation and growth rate thresholds for maturity in Atlantic salmon, Salmo salar. Jeffrey A. Hutchings and Megan E.B. Jones. 1997. Ecology of Atlantic Salmon and Brown Trout. jonsson and jonsson. 2011	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	There is climate overlap so probably yes.	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	High
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Ecology of Atlantic Salmon and Brown Trout. jonsson and jonsson. 2011	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Life history variation and growth rate thresholds for maturity in Atlantic salmon, Salmo salar. Jeffrey A. Hutchings and Megan E.B. Jones. 1998	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Intentional stocking and unintentional escape from fish farms	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Probably, S.salar is anadromous fish.	Medium
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No such structures.	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Stream channel experiments on downstream movement of recently emerged trout, Salmo trutta L. and salmon, S. salar L.—I. Effect of four different water velocity treatments upon dispersal rate. D. T. Crisp M. A. Hurley. 1991.	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Stream channel experiments on downstream movement of recently emerged trout, Salmo trutta L. and salmon, S. salar L.—I. Effect of four different water velocity treatments upon dispersal rate. D. T. Crisp M. A. Hurley. 1991. Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	More likely to be eaten.	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Intentional and unintentional.	High
43	7.09	Is dispersal of the taxon density dependent?	Yes	Ecology of Atlantic Salmon and Brown Trout. jonsson and jonsson. 2011	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Very sensitive to reduced oxigen levels. Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	There is no selective ichtiocid. Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Anadromous species. Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	Yes	Probably egg eaters and some mamals. Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	Very high
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Ecology of Atlantic Salmon and Brown Trout. jonsson and jonsson. 2011	Medium

51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	Ecology of Atlantic Salmon and Brown Trout. jonsson and jonsson. 2011	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	Ecology of Atlantic Salmon and Brown Trout. jonsson and jonsson. 2011	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Ecology of Atlantic Salmon and Brown Trout. jonsson and jonsson. 2011	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	Ecology of Atlantic Salmon and Brown Trout. jonsson and jonsson. 2011	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Ecology of Atlantic Salmon and Brown Trout. jonsson and jonsson. 2011	High

Statistics	
Scores	
BRA	**28.5**
BRA Outcome	**-**
BRA+CCA	**26.5**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**11.5**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*7.5*
B. Biology/Ecology	**17.0**
4. Undesirable (or persistence) traits	*4.0*
5. Resource exploitation	*7.0*
6. Reproduction	*4.0*
7. Dispersal mechanisms	*3.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**-2.0**
9. Climate change	*-2.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**8**
Environmental	**10**
Species or population nuisance traits	**12**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.81**
BRA	**0.83**
CCA	**0.67**

Date and Time
13/05/2021 15:00:53

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo salar*
Common name	Atlantic salmon
Assessor	Ivan Špelić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Cultured Aquatic Species Information Programme. Salmo salar. Cultured Aquatic Species Information Programme. Text by Jones, M. In: FAO Fisheries Division [online]. Rome. Updated . [Cited 19 May 2021].	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	No	Wild salmon is harvested for consumption (Liu, Y., Olaf Olaussen, J., & Skonhoft, A. (2011). Wild and farmed salmon in Norway—A review. Marine Policy, 35(3), 413–418. doi:10.1016/j.marpol.2010.11.007), broodstock in aquaculture are selected from already farmed stock (Cultured Aquatic Species Information Programme. Salmo salar. Cultured Aquatic Species Information Programme. Text by Jones, M. In: FAO Fisheries Division [online]. Rome. Updated . [Cited 19 May 2021].).	Medium
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Salmo trutta (CABI).	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	Climatch, using methodology in https://dpipwe.tas.gov.au/Documents/Risk%20assessment%20methodology_wildlife%20imports%20August%202017.pdf	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Climatch	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Drava in Croatia (Piria, M., Simonović, P., Kalogianni, E., Vardakas, L., Koutsikos, N., Zanella, D., Ristovska, M., Apostolou, Apostolos, Adrović, Avdul, Mrdak, D. & Tarkan. Ali Serhan et al. (2018) Alien freshwater fish species in the Balkans— Vectors and pathways of introduction. Fish and fisheries, 19, 138-169.) but unconfirmed in recent times.	Low
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	Not applicable	Already listed as present in Croatia, but a while ago and not recently confirmed (Piria, M., Simonović, P., Kalogianni, E., Vardakas, L., Koutsikos, N., Zanella, D., Ristovska, M., Apostolou, Apostolos, Adrović, Avdul, Mrdak, D. & Tarkan. Ali Serhan et al. (2018) Alien freshwater fish species in the Balkans— Vectors and pathways of introduction. Fish and fisheries, 19, 138-169.).	Low
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	Already listed as present in Croatia, but a while ago and not recently confirmed (Piria, M., Simonović, P., Kalogianni, E., Vardakas, L., Koutsikos, N., Zanella, D., Ristovska, M., Apostolou, Apostolos, Adrović, Avdul, Mrdak, D. & Tarkan. Ali Serhan et al. (2018) Alien freshwater fish species in the Balkans— Vectors and pathways of introduction. Fish and fisheries, 19, 138-169.).	Low
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	CABI, Fuller, P., M. Neilson, K. Dettloff, A. Fusaro, and R. Sturtevant, 2021, Salmo salar Linnaeus, 1758: U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=926, Revision Date: 9/12/2019, Peer Review Date: 1/26/2016, Access Date: 5/19/2021	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Fuller, P., M. Neilson, K. Dettloff, A. Fusaro, and R. Sturtevant, 2021, Salmo salar Linnaeus, 1758: U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=926, Revision Date: 9/12/2019, Peer Review Date: 1/26/2016, Access Date: 5/19/2021	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	Fuller, P., M. Neilson, K. Dettloff, A. Fusaro, and R. Sturtevant, 2021, Salmo salar Linnaeus, 1758: U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=926, Revision Date: 9/12/2019, Peer Review Date: 1/26/2016, Access Date: 5/19/2021	High
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	Positive economic/livelihood impact (CABI, 2021. Salmo salar [original text by Sunil Siriwardena]. In: Invasive Species Compendium. Wallingford, UK: CAB International.	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Positive economic/livelihood impact (CABI, 2021. Salmo salar [original text by Sunil Siriwardena]. In: Invasive Species Compendium. Wallingford, UK: CAB International.	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high

15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	There was documented competition between salmon and both steelhead trout and rainbow trout (Fuller, P., M. Neilson, K. Dettloff, A. Fusaro, and R. Sturtevant, 2021, Salmo salar Linnaeus, 1758: U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=926, Revision Date: 9/12/2019, Peer Review Date: 1/26/2016, Access Date: 5/19/2021) but not with native species of the RA area.	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No parasitic behaviour.	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Temperate; 2°C - 9°C; found in rivers where temperature rises above 10° C for about 3 months per year and does not exceed 20° C for more than a few weeks in summer (preferred temperatures 4-12°C) (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No evidence for similar impacts.	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No documented adverse impacts in any area ((CABI, 2021. Salmo salar [original text by Sunil Siriwardena]. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc.)).	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA area?	Yes	Susceptible to pathogens and parasites (Global Invasive Species Database (2021) Species profile: Salmo salar. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=376 on 21-05-2021.; CABI, 2021. Salmo salar [original text by Sunil Siriwardena]. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc.)	Very high
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Susceptible to pathogens and parasites (Global Invasive Species Database (2021) Species profile: Salmo salar. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=376 on 21-05-2021.; CABI, 2021. Salmo salar [original text by Sunil Siriwardena]. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc.)	Very high
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	150 cm, 46,8 kg (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Lacustrine (landlocked) and riverine populations (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Possible for this species in aquaculture but not documented for introductions in the wild (Global Invasive Species Database (2021) Species profile: Salmo salar. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=376 on 21-05-	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Not documented.	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Juveniles feed mainly on aquatic insects, mollusks, crustaceans and fish; adults at sea feed on squids, shrimps, and fish (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	No data.	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Renzi, V. 1999. "Salmo salar" (On-line), Animal Diversity Web. Accessed May 21, 2021 at https://animaldiversity.org/accounts/Salmo_salar/	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	The likelihood of S. salar establishing reproducing populations in introduced habitats is extremely low. Over 130 attempts to introduce Atlantic salmon across 32 states in the United States, over 60 attempts in British Columbia, Canada, several attempts in Tasmania, and numerous attempts in Chile have all failed (Global Invasive Species Database (2021) Species profile: Salmo salar. Downloaded from	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	Hybridizes with brown trouts but it is very unlikely for S. salar to establish a spawning population in the RA area (Global Invasive Species Database (2021) Species profile: Salmo salar. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=376 on 21-05-	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Not documented in literature.	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	Spawning migration into freshwater lasts from June to November. Spawns at 6-10°C in gravel river areas far upstream with moderate to fast-flowing, well-oxygenated waters and a succession of riffles and pools. The female selects a site where the gravel is of the right size and of sufficient depth (0.1 to 0.3 m) and water depth is around 0.5-3 m (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	No	Not expected to spawn in the RA area (Global Invasive Species Database (2021) Species profile: Salmo salar. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=376 on 21-05-	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)	High
7. Dispersal mechanisms					

35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Escape from aquaculture (not yet allowed but in the process), introduction for angling (not likely).	Low
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	If situated near streams entering protected areas.	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No such adaptations.	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Fertilized eggs sink into the redd and are covered with a layer of gravel (0.1-0.3 m) (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	At the southern end of their range, many reach a length of 12-15 cm, transform into smolts and are ready for migration in spring of the first year after hatching (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Anadromous (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Fertilized eggs sink into the redd and are covered with a layer of gravel (0.1-0.3 m) (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Introductions, escapes.	Low
43	7.09	Is dispersal of the taxon density dependent?	No	Not documented, migratory species.	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Not documented, sensitive species.	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Sensitive to pollution, coldwater species (Renzi, V. 1999. "Salmo salar" (On-line), Animal Diversity Web. Accessed May 21, 2021 at https://animaldiversity.org/accounts/Salmo_salar/).	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	Not allowed.	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Habitat destruction, denial of access to spawning grounds by dams and other obstructions are causing declinig numbers (Renzi, V. 1999. "Salmo salar" (On-line), Animal Diversity Web. Accessed May 21, 2021 at	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Anadromous (Luna, Susan M. in Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)).	Very high
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Piscivore fish and mammals (CABI).	High
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	Already present (?).	Low
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	The likelihood of S. salar establishing reproducing populations in introduced habitats is extremely low. Over 130 attempts to introduce Atlantic salmon across 32 states in the United States, over 60 attempts in British Columbia, Canada, several attempts in Tasmania, and numerous attempts in Chile have all failed. Most likely not able to establish viable populations even under current conditions (Global Invasive Species Database (2021) Species profile: Salmo salar. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=376 on 21-05-	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	Possible dispersal mediated by human, not under influence of climate change.	Low
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Decreased activity and increased mortality in southern areas of native distribution (Jonsson, B., Jonsson, N., 2009. A review of the likely effects of climate change on anadromous Atlantic salmonSalmo salarand brown trout Salmo trutta, with particular reference to water temperature and flow. Journal of Fish Biology 75, 2381–2447.. doi:10.1111/j.1095-8649.2009.02380.x) so this effects could only be emphasized in RA area if introduced.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	Decreased activity and increased mortality in southern areas of native distribution (Jonsson, B., Jonsson, N., 2009. A review of the likely effects of climate change on anadromous Atlantic salmonSalmo salarand brown trout Salmo trutta, with particular reference to water temperature and flow. Journal of Fish Biology 75, 2381–2447.. doi:10.1111/j.1095-8649.2009.02380.x) so this effects could only be emphasized in RA area if introduced.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	No likely impacts under current conditions (CABI) so no change expected (personal opinion).	Medium

Statistics

Scores	
BRA	**16.5**
BRA Outcome	**-**
BRA+CCA	**12.5**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**10.5**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*7.5*
B. Biology/Ecology	**6.0**
4. Undesirable (or persistence) traits	*3.0*
5. Resource exploitation	*5.0*
6. Reproduction	*-3.0*
7. Dispersal mechanisms	*2.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**-4.0**
9. Climate change	*-4.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**10**
Environmental	**2**
Species or population nuisance traits	**5**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.70**
BRA	**0.73**
CCA	**0.42**

Date and Time
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AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo salar*
Common name	Atlantic salmon
Assessor	Tamara Kanjuh
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Since the early 1970s, and for more than 12 generations, Atlantic salmon have been subject to domestication and directional selection for economically important traits (Perry WB et al., 2019).	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Atlantic salmon is hunted in the wild for commercial and recreational purposes (https://www.fisheries.noaa.gov/species/atlantic-salmon-	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Commonly expressed concerns surrounding escaped Atlantic salmon include competition with native salmon, predation, disease transfer, hybridization, and colonization (https://wdfw.wa.gov/species-habitats/invasive/salmo-	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	Dfa, Dfb (Köppen–Geiger climate classification system)	Medium
5	2.02	What is the quality of the climate matching data?	High	Köppen–Geiger climate classification system	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Krka estaury, Drava and Sava River (Piria et al., 2016).	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Aquaculture (Piria et al., 2016).	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Krka estaury, Drava and Sava River (Piria et al., 2016).	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	...successful seed introduction and naturalization were reported in the upper parts of the River Krka in central Slovenia (Stanković et al., 2015).	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Concerns have been raised over the negative impacts of its farming on native fish populations and the surrounding environment. Transmission of disease and hybridization with wild populations are of particular concern (cabi.org). Jonsson and Jonsson (2006) concluded that as a result of ecological interaction and through density-dependent mechanisms, cultured fish may displace wild conspecifics to some extent, increase their mortality, and decrease their growth rate, adult size, reproductive output,	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	Rapid increases in production have led to falling prices, which in turn have put increasing pressures on producers to limit costs. Significant future expansion of the industry may rely on the development of offshore sites, since most of the available suitable inshore sites are already in use, and because of increasing antagonism towards, and regulation over, further expansion in sheltered areas	Very high
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	No information found.	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No information found.	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	No information found.	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Effect on wild fish of escapees, through the spread of diseases, competition for food, space, and breeding partners, and genetic introgression. Transmission of ectoparasites (especially sea lice, which are species of copepod in the genera Lepeophtheirus and Caligus) from farmed fish to wild fish causing increased mortality in the latter, especially of migrating smolts (https://www.cabi.org/isc/datasheet/65307#tosummaryOfInvasiveness).	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No information found.	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Species with complex life cycles where habitat requirements change through ontogeny are particularly susceptible to climate change owing to the multiple climate-related drivers at each life stage (see Graham and Harrod 2009 and examples within). This is particularly relevant for anadromous salmonids, where the complexity of their life cycle means that the fish will be affected by multiple climate-related drivers at each life stage in both	Medium

18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	No	Escaped farmed salmon occur on feeding grounds in the Atlantic Ocean and seem to consume similar food resources as wild salmon. It is unlikely that availability of food in the Atlantic Ocean limits Atlantic salmon production, and food competition from escaped farmed salmon is unlikely to be strong (Thorstad et al.,	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	Local nutrient pollution into water systems from waste feed/faeces. Local chemical pollution through use of chemical treatments (https://www.cabi.org/isc/datasheet/65307#tosummaryOfInvasive	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Transmission of disease wild populations are of particular concern (https://www.cabi.org/isc/datasheet/65307#tosummaryOfInvasiveness).	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Pancreas disease caused by toga-like virus affects farm-reared Atlantic salmon, Salmo salar L., smolts during their first year at sea. It has caused mortality rates of 10±50% of the yearly smolt input in Ireland (Wheatley, 1994; Menzies et al., 1996), with up to 10% of survivors failing to grow.	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	No informatin found.	Medium
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	The taxon has the ability to use different types of habitats (Jonsson&Jonsson, 2009; Solstorm et al., 2015).	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Escaped farmed salmon occur on feeding grounds in the Atlantic Ocean and seem to consume similar food resources as wild salmon. It is unlikely that availability of food in the Atlantic Ocean limits Atlantic salmon production, and food competition from escaped farmed salmon is unlikely to be strong (Thorstad et al.,	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Growth rate of young-of-the-year (YOY) Atlantic salmon (Salmo salar) in low-density rivers was substantial better relative to YOY captured in normal density rivers (Vae, 2015).	High
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	No information found.	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	Escaped farmed salmon occur on feeding grounds in the Atlantic Ocean and seem to consume similar food resources as wild salmon. It is unlikely that availability of food in the Atlantic Ocean limits Atlantic salmon production, and food competition from escaped farmed salmon is unlikely to be strong (Thorstad, 2008).	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	There is no parental investment beyond spawning (https://animaldiversity.org/accounts/Salmo_salar/).	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	No information found.	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Brown trout coexist with Atlantic salmon in many watersheds throughout their distribution range. Evidence from rivers in Norway and Scotland suggest that escaped farmed salmon hybridize with brown trout more frequently than their wild conspecifics (Youngson et al. 1993, Hindar & Balstad 1994).	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No information found.	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Atlantic salmon have similar environmental conditions as other salmonid species to maintain optimal health (Novak, 2014).	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Salmo salar is an iteroparous species. Female fecundity varies considerably both within and among salmon populations, as both egg number and size increase with body size (reviewed in Fleming [1996]). However, relative fecundity (i.e. eggs per kilogram body weight) varies much less (typically 1 200-2 000) and inversely with fish size (i.e. smaller fish have more eggs per kg than larger	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	Atlantic salmon show high diversity in age of maturity and may mature as parr, one- to five-sea-winter fish, and in rare instances, at older sea ages (Klemetsen et al., 2003).	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Agriculture and sport fishing.	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Krka River (Piria et al., 2016).	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No information found.	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	No information found.	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Natural dispersal of the taxon could occur in the juvenile stage (OESD, 2017).	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	No information found.	Low
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No information found.	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Sport fishing.	Low

43	7.09	Is dispersal of the taxon density dependent?	No	No information found.	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	No information found.	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Atlantic salmon require a minimum dissolved oxygen saturation level of 6mg/l. Dissolved oxygen below this threshold level result in depressed respiration (Novak, 2014).	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	No information found.	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	No information found.	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Atlantic salmon is anadromus species (https://www.cabi.org/isc/datasheet/65307).	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Birds, fish, mammals (OESD, 2017).	High
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	The changes would not play a role in the introduction of taxa into RA.	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Indirectly climate affects populations through, effects on their competitors, pathogens, predators and water quality, and has consequences for population viability and geographical distributions (Lehodey et al., 2006).	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Indirectly climate affects populations through, effects on their competitors, pathogens, predators and water quality, and has consequences for population viability and geographical distributions (Lehodey et al., 2006).	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	No impact on ecosystem funtion.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	No impact on ecosystem services.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	No impact on ecosystem services.	Medium

Statistics	
Scores	
BRA	**16.0**
BRA Outcome	**-**
BRA+CCA	**10.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**10.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*5.0*
B. Biology/Ecology	**6.0**
4. Undesirable (or persistence) traits	*5.0*
5. Resource exploitation	*0.0*
6. Reproduction	*2.0*
7. Dispersal mechanisms	*0.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**-6.0**
9. Climate change	*-6.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**10**
Environmental	**2**
Species or population nuisance traits	**2**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.61**
BRA	**0.63**

CCA	0.50

Date and Time
28/05/2021 16:45:47

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo salar*
Common name	Atlantic salmon
Assessor	Tena Radocaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Fisheries: highly commercial; aquaculture: commercial; gamefish: yes (Fishbase)	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	The Atlantic salmon is renowned among game fishermen and is a highly prized food fish. (Renzi, V. 1999. "Salmo salar" (On-line), Animal Diversity Web)	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	The similarity between climatic conditions RA area and native range is medium. I use climatch.	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Distribution Map and Climatch	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Piria, M., Simonović, P., Kalogianni, E., Vardakas, L., Koutsikos, N., Zanella, D., ... & Joy, M. K. (2018). Alien freshwater fish species in the Balkans—Vectors and pathways of introduction. Fish and fisheries, 19(1), 138-169.	Low
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	Not applicable	It is present	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	It is present	Low
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Introductions for angling and escapes from culture have led to the establishment of wild populations in the north-east Pacific, Chile, Argentina and New Zealand (CABI, 2019)	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	S. salar that escape can wreak havoc on wild populations by spreading disease and parasites to, competing with, and hybridizing with native salmon and other fish. (Global Invasive Species Database (2021) Species profile: Salmo salar)	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No evidence	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	Competition with native species; S. salar compete with wild populations and other native fishes for resources. (Global Invasive Species Database (2021) Species profile: Salmo salar)	Very high
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	It is also a highly desirable sport fish by anglers (FAO, 2009).	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (Fishbase)	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No evidence	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No evidence	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	S. salar will be adaptable to climatic and other environmental conditions	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	No information for the RA area, generally S. salar that escape can wreak havoc on wild populations by spreading disease and parasites to, competing with, and hybridizing with native salmon and other fish. (Global Invasive Species Database (2021) Species profile: Salmo salar)	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	It will be a highly desirable sport fish for anglers (FAO, 2009).	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Marcos-López, M., & Rodger, H. D. (2020). Amoebic gill disease and host response in Atlantic salmon (Salmo salar L.): A review. Parasite immunology, 42(8), e12766.	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Marcos-López, M., & Rodger, H. D. (2020). Amoebic gill disease and host response in Atlantic salmon (Salmo salar L.): A review. Parasite immunology, 42(8), e12766.	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	150 cm TL (Fishbase)	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Occurs in lakes and rocky runs and pools of small to large rivers (Fishbase)	Low

24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	No evidence	Low
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	No evidence	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Juveniles feed mainly on aquatic insects, mollusks, crustaceans and fish; adults at sea feed on squids, shrimps, and fish (Fishbase)	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	Not applicable	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	There is no parental investment beyond spawning. (Renzi, V. 1999. "Salmo salar" (On-line), Animal Diversity Web)	Low
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Spawning migration into freshwater lasts from June to November. Spawns at 6-10°C (Fishbase). Natural reproduction (Fishbase)	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Scribner, K. T., Page, K. S., & Bartron, M. L. (2000). Hybridization in freshwater fishes: a review of case studies and cytonuclear methods of biological inference. Reviews in Fish Biology and Fisheries, 10(3), 293-323.	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No information	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	Requires specific temp and substrate for spawning	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	No	On average, a female deposits 700-800 eggs per pound of her body weight (Global Invasive Species Database (2021) Species profile: Salmo salar)	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Species needs at least 2–3 years before reproducing. Z 1.4 - 4.4 years www.fishbase.org	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	1. Escape from fish farm 2. Intentional release	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	No	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No adaptations	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	The female then covers the eggs with gravel, using the same method used to create the redd. The eggs are buried in gravel at a depth of about 12.7 to 25.4cm. (Global Invasive Species Database (2021) Species profile: Salmo salar.)	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Renzi, V. 1999. "Salmo salar" (On-line), Animal Diversity Web)	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Migratory species (Fishbase)	Medium
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Fishbase	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Stocking, escape from fish farm	Medium
43	7.09	Is dispersal of the taxon density dependent?	No	No evidence	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Global Invasive Species Database (2021) Species profile: Salmo salar	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Sensitive species (Global Invasive Species Database (2021) Species profile: Salmo salar)	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	No	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Global Invasive Species Database (2021) Species profile: Salmo salar	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Global Invasive Species Database (2021) Species profile: Salmo salar	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Catfish, pike..	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Increase	Human influence	Low

51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	In contrast to rainbow trout, the thermal acclimation response of Atlantic salmon is more limited. The long-term consequence is that climate change will continue to decimate wild populations of this species. (Hittle, K. A., Kwon, E. S., & Coughlin, D. J. (2021). Climate change and anadromous fish: How does thermal acclimation affect the mechanics of the myotomal muscle of the Atlantic salmon, Salmo salar?. Journal of Experimental Zoology Part A: Ecological and Integrative Physiology).	Low
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	In contrast to rainbow trout, the thermal acclimation response of Atlantic salmon is more limited. The long-term consequence is that climate change will continue to decimate wild populations of this species. (Hittle, K. A., Kwon, E. S., & Coughlin, D. J. (2021). Climate change and anadromous fish: How does thermal acclimation affect the mechanics of the myotomal muscle of the Atlantic salmon, Salmo salar?. Journal of Experimental Zoology Part A: Ecological and Integrative Physiology).	Low
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	In contrast to rainbow trout, the thermal acclimation response of Atlantic salmon is more limited. The long-term consequence is that climate change will continue to decimate wild populations of this species. (Hittle, K. A., Kwon, E. S., & Coughlin, D. J. (2021). Climate change and anadromous fish: How does thermal acclimation affect the mechanics of the myotomal muscle of the Atlantic salmon, Salmo salar?. Journal of Experimental Zoology Part A: Ecological and Integrative Physiology).	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	In contrast to rainbow trout, the thermal acclimation response of Atlantic salmon is more limited. The long-term consequence is that climate change will continue to decimate wild populations of this species. (Hittle, K. A., Kwon, E. S., & Coughlin, D. J. (2021). Climate change and anadromous fish: How does thermal acclimation affect the mechanics of the myotomal muscle of the Atlantic salmon, Salmo salar?. Journal of Experimental Zoology Part A: Ecological and Integrative Physiology).	Low
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	In contrast to rainbow trout, the thermal acclimation response of Atlantic salmon is more limited. The long-term consequence is that climate change will continue to decimate wild populations of this species. (Hittle, K. A., Kwon, E. S., & Coughlin, D. J. (2021). Climate change and anadromous fish: How does thermal acclimation affect the mechanics of the myotomal muscle of the Atlantic salmon, Salmo salar?. Journal of Experimental Zoology Part A: Ecological and Integrative Physiology).	Low

Statistics	
Scores	
BRA	**21.5**
BRA Outcome	**-**
BRA+CCA	**13.5**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**10.5**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*7.5*
B. Biology/Ecology	**11.0**
4. Undesirable (or persistence) traits	*6.0*
5. Resource exploitation	*5.0*
6. Reproduction	*0.0*
7. Dispersal mechanisms	*1.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**-8.0**
9. Climate change	*-8.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**7**
Environmental	**5**
Species or population nuisance traits	**5**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.45**
BRA	**0.47**
CCA	**0.25**

Date and Time
01/06/2021 18:19:51

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo trutta*
Common name	brown trout
Assessor	Ana Marić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	https://www.researchgate.net/publication/319344554_Diversity_of_brown_trout_Salmo_cf_trutta_in_the_River_Danube_basin_of_Western_Balkans_as_assessed_from_the_structure_of_their_mitochondrial_Control_Region_haplotypes	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Effects of stocking on the genetic structure of Effects of stocking on the genetic structure of brown trout, Salmo trutta, in Central Europe Effects of stocking on the genetic structure of brown trout, Salmo trutta, in Central Europeinferred from mitochondrial and nuclear DNA markers 2012. Kohout et al.	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	Its invasive itself, other taxons are introduced no invasive*	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	Near Bratislava 8, and France 6, 11 points in orange (Climatch)	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Climatch +personal assesment	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Risks to Stocks of Native Trout of the Genus Salmo (Actinîpterygii: Salmoniformes: Salmonidae) of Serbia and Management for their Recovery	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	Stocking and escape fom fish ponds.	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	https://www.researchgate.net/publication/344114601_Diversity_of_brown_trout_Salmo_trutta_Actinopterygii_Salmoniformes_Salmonidae_in_the_Danube_River_basin_of_Croatia_revealed_by_mitochondrial_DNA	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	INVASION BIOLOGY AND ECOLOGICAL IMPACTS OF INVASION BIOLOGY AND ECOLOGICAL IMPACTS OF BROWN TROUT Salmo trutta IN NEW ZEALAND Colin R. Townsend	Medium
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	INVASION BIOLOGY AND ECOLOGICAL IMPACTS OF INVASION BIOLOGY AND ECOLOGICAL IMPACTS OF BROWN TROUT Salmo trutta IN NEW ZEALAND Colin R. Townsend	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	A handbook of global freshwater invasive species. Francis. 2012	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	A handbook of global freshwater invasive species. Francis. 2012	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	A handbook of global freshwater invasive species. Francis. 2012	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Not toxic.	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	A handbook of global freshwater invasive species. Francis. 2012	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	Not a parasite.	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	A review of the likely effects of climate change on anadromous Atlantic salmon Salmo salar and brown trout A review of the likely effects of climate change on anadromous Atlantic salmon Salmo salar and brown troutSalmo trutta, with particular reference to water temperature and flow. Jonsson and Jonsson 2009	Very high
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	A handbook of global freshwater invasive species. Francis. 2012	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	A handbook of global freshwater invasive species. Francis. 2012	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	INVASION BIOLOGY AND ECOLOGICAL IMPACTS OF BROWN TROUT Salmo trutta IN NEW ZEALAND. Colin R. Townsend 1996.	Very high
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	INVASION BIOLOGY AND ECOLOGICAL IMPACTS OF BROWN TROUT Salmo trutta IN NEW ZEALAND. Colin R. Townsend 1996.	Very high
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	INVASION BIOLOGY AND ECOLOGICAL IMPACTS OF BROWN TROUT Salmo trutta IN NEW ZEALAND. Colin R. Townsend 1996.	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Ecology of brown trout and atlantic salmon. Jonsson and Jonsson 2011.	Very high

24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	A handbook of global freshwater invasive species. Francis. 2012	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Haplotype diversity of brown trout Salmo trutta (L.) in the broader Iron Gate area. 2016. Ana TOŠIĆ1,*, Dubravka ŠKRABA1, Vera NIKOLIĆ1, Jelena ČANAK ATLAGIĆ2, Danilo MRDAK3, Predrag SIMONOVIĆ1	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	A handbook of global freshwater invasive species. Francis. 2012	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	A handbook of global freshwater invasive species. Francis. 2012,	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Yes	A review of the likely effects of climate change on anadromous Atlantic salmon Salmo salar and brown trout A review of the likely effects of climate change on anadromous Atlantic salmon Salmo salar and brown trout Salmo trutta, with particular reference to water temperature and flow. 2009. Jonsson and Jonsson.	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	INVASION BIOLOGY AND ECOLOGICAL IMPACTS OF BROWN TROUT Salmo trutta IN NEW ZEALAND. 1996. Colin R. Townsend	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	A handbook of global freshwater invasive species. Francis. 2012 Ecology of brown trout and atlantic salmon. Jonsson and Jonsson 2011. IUCN: Salmo trutta, Brown Trout Assessment by: Freyhof, J.	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Personal assesment	High
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Vertebrate. Non dependent of another taxon.	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	INVASION BIOLOGY AND ECOLOGICAL IMPACTS OF BROWN TROUT Salmo trutta IN NEW ZEALAND. 1996. Colin R. Townsend	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	The IUCN Red List of Threatened Species™ ISSN 2307-8235 (online) IUCN 2008: T19861A9050312, Salmo trutta, Brown Trout Assessment by: Freyhof, J.	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Stocking and aquaculture	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Maybe in Croatia for MPA In Serbia: Haplotype diversity of brown trout Salmo trutta (L.) in the broader Iron Gate area Ana TOŠIÆ1,*, Dubravka ŠKRABA1, Vera NIKOLIÆ1, Jelena ÈANAK ATLAGIÆ2, Danilo MRDAK3, Predrag SIMONOVIÆ1	Medium
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No such adaptation.	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	no evidance for no.	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	INVASION BIOLOGY AND ECOLOGICAL IMPACTS OF BROWN TROUT Salmo trutta IN NEW ZEALAND. 1996. Colin R. Townsend	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Brown Trout (Salmo trutta): A Technical Conservation Assessment. Laura Belica1 with life cycle model by David	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	They will probably eat them.	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	INVASION BIOLOGY AND ECOLOGICAL IMPACTS OF BROWN TROUT Salmo trutta IN NEW ZEALAND. 1996. Colin R. Townsend	High
43	7.09	Is dispersal of the taxon density dependent?	Yes	Somewhat, partal migratority. Ecology of brown trout and atlantic salmon. Jonsson and Jonsson 2011.	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Brown trout can stand only few minutes out of the water.	High
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being considered.]	No	Ecology of brown trout and atlantic salmon. Jonsson and Jonsson 2011. But can tolerate some chemicals Arsenic accumulationinafreshwaterfishlivinginacontaminated riverofCorsica,France. 2009.Julia-LaurenceCulioli a, , SergeCalendini b, ChristopheMori a, AntoineOrsini a	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	A handbook of global freshwater invasive species. Francis. 2012 Cant be eradicated but less numbered	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Personal assesment. MAybe tolarate (Arsenic). IUCN red list	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	yes, some individuals are anadromous. Ecology of brown trout and atlantic salmon. Jonsson and Jonsson 2011.	Very high
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	Yes	Other fishes eat trout eggs. Lutra and Mustela. https://deepblue.lib.umich.edu/bitstream/handle/2027.42/141891/tafs0239.pdf?sequence=1	Medium
C. Climate change					
9. Climate change					

50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Personal assesment	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	Professional judgement	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	Prof. judgement	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Prof. judgement	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	Prof judgement	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	RA and their water habitats are not under big climaic change pressure.	Medium

Statistics	
Scores	
BRA	**37.5**
BRA Outcome	**-**
BRA+CCA	**33.5**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**14.5**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*10.5*
B. Biology/Ecology	**23.0**
4. Undesirable (or persistence) traits	*10.0*
5. Resource exploitation	*7.0*
6. Reproduction	*4.0*
7. Dispersal mechanisms	*3.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**-4.0**
9. Climate change	*-4.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**13**
Environmental	**8**
Species or population nuisance traits	**18**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.76**
BRA	**0.79**
CCA	**0.50**

Date and Time
10/05/2021 13:24:48

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo trutta*
Common name	brown trout
Assessor	Ivan Špelić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	For restocking of natural waters (angling) (Cultured Aquatic Species Information Programme. Salmo trutta. Cultured Aquatic Species Information Programme. Text by Vandeputte, M. & Labbé, L. In: FAO Fisheries and Aquaculture Department [online]. Rome. Updated 1 January 2012. [Cited 25 February 2020].)	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Restocking purposes (personal opinion).	Low
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No such information.	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Climatch 2020.	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Climatch 2020.	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Freyhof, J. 2011. Salmo trutta . The IUCN Red List of Threatened Species 2011: e.T19861A9050312. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T19861A9050312. en. Downloaded on 25 February 2020., Froese, R. and D. Pauly. Editors. 2019.FishBase. World Wide Web electronic publication. www.fishbase.org, (12/2019)	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	Not applicable	Already present (IUCN 2011).	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	Already present (IUCN 2011).	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	IUCN 2011, Global Invasive Species Database (2020) Species profile: Salmo trutta. Downloaded from http://www.iucngisd.org/gisd/speciesname/Salmo+trutta on 25-02-2020.	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Brown trout have been implicated in reducing native fish populations (especially other salmonids) through predation, displacement, food competition and hybridization (Global Invasive Species Database (2020) Species profile: Salmo trutta. Downloaded from http://www.iucngisd.org/gisd/speciesname/Salmo+trutta on 25-	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Farmed, no adverse impact (FAO rome 2005).	Very high
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	Brown trout have been implicated in reducing native fish populations (especially other salmonids) through predation, displacement, food competition and hybridization (Global Invasive Species Database (2020) Species profile: Salmo trutta. Downloaded from http://www.iucngisd.org/gisd/speciesname/Salmo+trutta on 25-	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	Brown trout have been implicated in reducing native fish populations (especially other salmonids) through predation, displacement, food competition and hybridization (Global Invasive Species Database (2020) Species profile: Salmo trutta. Downloaded from http://www.iucngisd.org/gisd/speciesname/Salmo+trutta on 25-02-2020). Reducing numbers of maybe more attractive native	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	No risk for human health, listed as potential pest (Froese, R. and D. Pauly. Editors. 2019.FishBase. World Wide Web electronic publication. www.fishbase.org, (12/2019).	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Brown trout have been implicated in reducing native fish populations (especially other salmonids) through predation, displacement, food competition and hybridization (Global Invasive Species Database (2020) Species profile: Salmo trutta. Downloaded from http://www.iucngisd.org/gisd/speciesname/Salmo+trutta on 25-	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No such information	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	They prefer cold, well-oxygenated upland waters although their tolerance limits are lower than those of rainbow trout and favors large streams in the mountainous areas with adequate cover in the form of submerged rocks, undercut banks, and overhanging vegetation (Froese, R. and D. Pauly. Editors. 2019.FishBase. World Wide Web electronic publication. www.fishbase.org, (	Very high

18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	Nystrom, P.; McIntosh, A. R. (2003): Are impacts of an exotic predator on a stream food web influenced by disturbance history? Oecologia (2003) 136:279–288. DOI 10.1007/s00442-003-1250-3	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	Brown trout have been implicated in reducing native fish populations (especially other salmonids) through predation, displacement, food competition and hybridization (Global Invasive Species Database (2020) Species profile: Salmo trutta. Downloaded from http://www.iucngisd.org/gisd/speciesname/Salmo+trutta on 25-02-2020). Hybridization with maybe more attractive native species Salmo marmoratus (A. Razpet , S. Marić , T. Parapot , V. Nikolić & P. Simonović (2007) Re-evaluation of Salmo data by Gridelli ()—description of stocking, hybridization and repopulation in the River Soča basin, Italian Journal of Zoology, 74:1, 63-70.	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA area?	Yes	Taxon is affected by several bacterial diseases. They are highly sensitive to furunculosis and BKD and may also moderately suffer from yersiniosis, rainbow trout fry syndrome and vibriosis. They also suffer from fungal and parasitic infections (FAO Rome 2005).	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Taxon is affected by several bacterial diseases. They are highly sensitive to furunculosis and BKD and may also moderately suffer from yersiniosis, rainbow trout fry syndrome and vibriosis. They also suffer from fungal and parasitic infections (FAO Rome 2005).	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Common length to 72 cm (Froese & Pauly 2019).	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Found in streams, ponds, rivers and lakes (Froese & Pauly 2019).	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Lives in habitats with mostly hard substrate (rock, gravel), prefers clear water (Froese & Pauly 2019).	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	No evidence	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Juveniles feed mainly on aquatic and terrestrial insects; adults on mollusks, crustaceans and small fish (Froese & Pauly 2019) which may include threatened or protected taxa.	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	No sufficient data for calculation.	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Spawning behaviour and life history well known, no such adaptations.	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	IUCN 2011	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	A. Razpet , S. Marić , T. Parapot , V. Nikolić & P. Simonović (2007) Re-evaluation of Salmo data by Gridelli ()—description of stocking, hybridization and repopulation in the River Soča basin, Italian Journal of Zoology, 74:1, 63-70, DOI:	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Well known	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	Spawns in rivers and streams with swift current, usually characterized by downward movement of water into gravel (Froese & Pauly 2019).	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Each female produces about 10.000 eggs (Froese & Pauly 2019).	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	FAO Rome 2005	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Restocking - angling purposes Escape from aquaculture	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	May happen with restocking, altough native stock is used more and more.	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No such adaptations.	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	Yes	Eggs covered with sand and gravel (Froese & Pauly 2019) but drift is recorded (Elliott, J.M. 1976: The downstream drifting of eggs of brown trout, Salmo trutta L. Journal of Fish Biology 45-50)	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Downstream drift (Lechner, A., Keckeis, H. & Humphries, P. Patterns and processes in the drift of early developmental stages of fish in rivers: a review. Rev Fish Biol Fisheries 26, 471–489 (2016). https://doi.org/10.1007/s11160-016-9437-y)	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Spawning migrations are common (Froese & Pauly 2019, Kottelat & Freyhof 2007).	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Eggs in redd covered with sand or gravel (Kottelat & Freyhoff 2007).	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Stocking, escape from aquaculture (personal opinion).	High

43	7.09	Is dispersal of the taxon density dependent?	No	Migrations occure even without increase in density (Shry Samuel J., McCallum Erin S., Alanärä Anders, Persson Lo, Hellström Gustav (2019): Energetic Status Modulates Facultative Migration in Brown Trout (Salmo trutta) Differentially by Age and Spatial Scale. Frontiers in Ecology and Evolution. 7. 411.	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Personal opinion, communication with anglers.	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being considered.]	No	Vulerable to low oxygen levels and pollution (Freyhof, J. 2011. Salmo trutta . The IUCN Red List of Threatened Species 2011: e.T19861A9050312. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T19861A9050312.en. Downloaded on 25 February 2020).	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	Not allowed	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Personal opinion	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Some populations are anadromous (Kottelat & Freyhof 2007, Froese & Pauly 2019).	Very high
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Otters, piscivorous birds (personal communication).	High
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	Already present (IUCN 2011)	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Predicted climatic effects are depletion of populations, increased threats of parasites, increased probability of droughts which has negative effects on populations (Jonsson, B.; Jonsson, N. (2009): A review of the likely effects of climate change on anadromous Atlantic salmon Salmo salar and brown trout Salmo trutta, with particular reference to water temperature and flow. Journal of Fish Biology 75, 2381–2447)	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Predicted climatic effects are depletion of populations, increased threats of parasites, increased probability of droughts which has negative effects on populations (Jonsson, B.; Jonsson, N. (2009): A review of the likely effects of climate change on anadromous Atlantic salmon Salmo salar and brown trout Salmo trutta, with particular reference to water temperature and flow. Journal of Fish Biology 75, 2381–2447)	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Predicted climatic effects are depletion of populations, increased threats of parasites, increased probability of droughts which has negative effects on populations (Jonsson, B.; Jonsson, N. (2009): A review of the likely effects of climate change on anadromous Atlantic salmon Salmo salar and brown trout Salmo trutta, with particular reference to water temperature and flow. Journal of Fish Biology 75, 2381–2447)	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	Predicted climatic effects are depletion of populations, increased threats of parasites, increased probability of droughts which has negative effects on populations (Jonsson, B.; Jonsson, N. (2009): A review of the likely effects of climate change on anadromous Atlantic salmon Salmo salar and brown trout Salmo trutta, with particular reference to water temperature and flow. Journal of Fish Biology 75, 2381–2447)	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Both populations of native salmonids and brown trout will decrease equally, so no magnified adverse impact is expected (personal opinion).	Low

Statistics	
Scores	
BRA	**33.0**
BRA Outcome	**-**
BRA+CCA	**25.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**17.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*14.0*
B. Biology/Ecology	**16.0**
4. Undesirable (or persistence) traits	*6.0*
5. Resource exploitation	*5.0*
6. Reproduction	*2.0*
7. Dispersal mechanisms	*4.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**-8.0**
9. Climate change	*-8.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*

5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**14**
Environmental	**8**
Species or population nuisance traits	**7**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.80**
BRA	**0.82**
CCA	**0.71**

Date and Time
13/05/2021 20:50:43

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo trutta*
Common name	brown trout
Assessor	Tamara Kanjuh
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	The stocking of nonindigenous brown trout has been very extensive in Central Europe. It was initiated during the Austrian-Hungarian Empire in the 19th Century. For example, in 1862, eggs of brown trout were transported from Salzburg (Danube basin) to Nedošin (North Sea basin), where the stock was set up (http://www.vackuvchovpstruhu.estranky.cz) (Kohout et al.,	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Brown trout is important for commercial fisheries and the species is a very popular target for angling. In several European countries it is one of the most important species for sport fisheries (Laikre	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Brown trout (which includes almost all of its morphs and phylogenetic lineages) have been introduced into streams, rivers, reservoirs, and lakes and have been able to form self-sustaining populations in all of these environments (Belica, 2007).	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Low	Dfa, Dfb (Köppen–Geiger climate classification system)	Medium
5	2.02	What is the quality of the climate matching data?	High	Köppen–Geiger climate classification system	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Una River (Škraba et al., 2017), Kupčina River (Kanjuh et al., 2020)	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	Taxon has been traditionally introduced via stocking programs. Fishfarm brown trout that are often formed from allochthonous or hybrid fish stocks are often deliberately released into natural waters and mixed with indigenous populations (Allendorf et al., 2001). Random restocking with farmed trout of non-native origin (Taggart&Ferguson, 1986). Bucket biologists have also been known to further propagate invasions (Burrill, 2014).	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	The presence of taxa has already been detected in the RA area (Simonović et al., 2017).	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	The rapid naturalization of brown trout and their success in forming selfsustaining populations throughout North America have been attributed in part to the increased genetic diversity of the mixed forms that were introduced (Behnke 2002).	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	The taxon hybridizes with native Danube trout, leading to the loss of intraspecific variability, following the introduction of alien strains and a change in genetic composition of native brown trout stock of Danube lineage (Simonović et al., 2014).	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No information found.	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	No information found.	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No information found.	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	Yes	Potential pests (https://www.fishbase.se/summary/Salmo-trutta.html)	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	The taxon can suppress the native phylogenetic lineage (Apostolidis et al., 1997; Piria et al., 2019).	Very high
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No information found.	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	The taxon is sensitive to changes in habitat conditions, so in the first place the water temperature must be optimal (Burrill, 2014).	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No information found.	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	Such difference in feeding strategy between brown trout of different lineages implies that brown trout of the AT lineage could be more attractive for fly fishing (Piria et al., 2019).	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No information found.	Low

21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	No information found.	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	No information found.	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	The taxon is sensitive to changes in habitat conditions (Burrell, 2014).	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	The diet of the taxon may affect food availability (Piria et al., 2019).	Medium
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	No information found.	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	No information found.	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	Due to their diet, they can affect the availability of prey (Piria et al., 2019).	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Yes	Parental care is certainly part of the taxon's life cycle (https://animaldiversity.org/accounts/Salmo_trutta/).	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Reproduction is uninterrupted, as well as hybridization with native taxa (Marić et al., 2006; Simonović et al., 2017; Kanjuh et al.,	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Restriction fragment length polymorphism, RFLP analysis showed that hybridization with the native Da lineage occurs (Tošić et al. 2016; Škraba et al., 2017). Reproduction is uninterrupted, as well as hybridization with native taxa (Marić et al., 2006; Simonović et al., 2017; Kanjuh et al., 2020)	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No information found.	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	The taxon requires a gravelly spawning ground most often in fast waters (Simonović, 2001; Klemetsen, 1967; Sneider, 2000).	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	The female lays from 500 to 30,000 eggs (Simonović, 2001).	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	The taxon becomes fully mature after 2-3 years (Somme 1941).	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable habitats nearby)?	>1	Fishfarm specimens that are often formed from allochthonous or hybrid fish stocks are often deliberately released into natural waters and mixed with indigenous populations. Another pathway is random restocking in order to increase the number of fishery exploited populations (Allendorf et al., 2001). Introduction for sport fishing (Piria et al., 2017).	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Đerdap National Park (Tošić et al., 2016).	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No information found.	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Natural spread of taxa by watercourse as juvenile.	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	Natural spread of taxa by watercourse as juvenile.	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	During the pre-spawning period, in early summer, brown trout were found to travel an average of 348 meters a day. During spawning they moved an average of 160 meters (Burrill, 2014).	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No information found.	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Escape from fish farm, introduction for sport fishing.	Low
43	7.09	Is dispersal of the taxon density dependent?	No	No information found.	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	The taxon cannot survive for a long period of time out of the water.	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	The taxon is very sensitive to changes in habitat conditions, especially temperature and oxygen saturation.	Low
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	Management proposals are still under development.	Medium

47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Anthropogenic impact is the most important factor endangering the taxon, both directly under the influence of fishing and restocking, and indirectly through the destruction of habitats that it inhabits (Crisp, 2000).	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	The brown trout is well-known for its highly flexible life-cycle (Hansen, 2002).	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Humans, otters (https://animaldiversity.org/accounts/Salmo_trutta/).	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	The egg stage would be clearly the most vulnerable life stage to any increase in temperature as a result of climate change. In a longterm study of a juvenile anadromous S. trutta population, summer drought led to increased mortality, especially for 1+ year fish (Elliott et al., 1997).	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	The egg stage would be clearly the most vulnerable life stage to any increase in temperature as a result of climate change. In a longterm study of a juvenile anadromous S. trutta population, summer drought led to increased mortality, especially for 1+ year fish (Elliott et al., 1997).	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	The egg stage would be clearly the most vulnerable life stage to any increase in temperature as a result of climate change. In a longterm study of a juvenile anadromous S. trutta population, summer drought led to increased mortality, especially for 1+ year fish (Elliott et al., 1997).	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	The egg stage would be clearly the most vulnerable life stage to any increase in temperature as a result of climate change. In a longterm study of a juvenile anadromous S. trutta population, summer drought led to increased mortality, especially for 1+ year fish (Elliott et al., 1997).	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	The egg stage would be clearly the most vulnerable life stage to any increase in temperature as a result of climate change. In a longterm study of a juvenile anadromous S. trutta population, summer drought led to increased mortality, especially for 1+ year fish (Elliott et al., 1997).	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	The egg stage would be clearly the most vulnerable life stage to any increase in temperature as a result of climate change. In a longterm study of a juvenile anadromous S. trutta population, summer drought led to increased mortality, especially for 1+ year fish (Elliott et al., 1997).	Medium

Statistics	
Scores	
BRA	**18.5**
BRA Outcome	**-**
BRA+CCA	**12.5**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**7.5**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*1.5*
B. Biology/Ecology	**11.0**
4. Undesirable (or persistence) traits	*4.0*
5. Resource exploitation	*2.0*
6. Reproduction	*2.0*
7. Dispersal mechanisms	*0.0*
8. Tolerance attributes	*3.0*
C. Climate change	**-6.0**
9. Climate change	*-6.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**8**
Environmental	**3**
Species or population nuisance traits	**7**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.57**
BRA	**0.58**
CCA	**0.50**

Date and Time
28/05/2021 09:06:41

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salmo trutta*
Common name	brown trout
Assessor	Tena Radocaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	For angling purpose in almost all karstic rivers in mediteranean area. Together with atlantic form	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	primarily bred and stocked for recreational fishing (Global Invasive Species Database (2020) Species profile: Salmo trutta. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=78 on 06-03-2020.)	Medium
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	atlantic haplotip	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	The similarity between climatic conditions RA area and native range is high. I use climatch.	Very high
5	2.02	What is the quality of the climate matching data?	High	The quality of the climate matching data is high.	Very high
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Salmo trutta is present outside in captivity in the RA area.	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	None	S.trutta is present in RA area	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	S.trutta is present in RA area	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	The species is found in Iceland and on the northwest coast of Europe, along the Mediterranean and south to India. S. trutta has been introduced to appropriate streams all over the world (Animal Diversity Web, 2004) and today is found in rivers, lakes and coastal areas (Nova Scotia, 2004). (CABI)	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	They compete with native trout and other fish species, but they are not known to have been the cause of any species' extinction (Animal Diversity Web, 2004). (CABI)	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	no data	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	Salmo trutta has been implicated in reducing native fish populations (especially other salmonids) through predation, displacement, and food competition (Taylor et al., 1984). Another negative effect is their contribution to the lamprey population in many rivers. The increased lamprey populations since S. trutta were introduced have been considered as a negative impact on biodiversity (Animal Diversity Web, 2004). (CABI)	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No data, personal opinion	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	no	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Where brown trout have been introduced, they have had detrimental impacts on native fauna, and in many systems in North America, they have displaced or completely replaced native salmonids (Behnke 2002) Where brown trout have been introduced, they have had detrimental impacts on native fauna, and in many systems in North America, they have displaced or completely replaced native salmonids (Behnke 2002). 8Belica, L. (2007, April 26). Brown Trout (Salmo trutta): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/ browntrout.pdf	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	no	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Brown trout are well adapted for many environments, as has been demonstrated by their successful introduction to suitable cold-water systems worldwide. (Belica, L. (2007, April 26). Brown Trout (Salmo trutta): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/ browntrout.pdf [date of access].)	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	It may have a similar impact in the RA area (no data- personal opinion), as this species is found in many locations, encountering other native and introduced trout. In some places, brown trout populations have outgrown indigenous fish populations so rapidly that native fish have been forced out (Behnke 2002).	Low

19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No impact on ecosystem services in RA area.	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Yes, the taxon may be a host or vector of known pests and infectious agents endemic to RA area. Because in every area exist infectious agents and pests.	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Some diseases that affect brown trout include a range of gill ectoparasites (documented by Schisler et al. 1999), plestophera and epitheliocytis parasites (as reported by Kershner 1995 and cited by Schrank 2004), and bacterial diseases such as furunculosis (caused by Aeromonas salmonicida), enteric redmouth (caused by Yersinia ruckeri), and bacterial kidney disease (caused by Renibacterium salmoninarum) (Mitchum 1982). 8Belica, L. (2007, April 26). Brown Trout (Salmo trutta): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/ browntrout.pdf	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	It can grow to a standard length of 140 cm (Muus and Dahlström, 1967) (CABI)	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	approximately 8 cm per s [0.26 ft. per s] and (up to 60 to 70 cm per s [2.0 to 2.3 ft. per s])	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Belica, L. (2007, April 26). Brown Trout (Salmo trutta): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/browntrout.pdf [date of access].)	Low
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	no	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	It is possible that it consume endangered and protected native taxa in the RA area. If there are protected taxa in the RA area will consume them, whether or not the taxon is endangered.	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	NOT APPLICABLE	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Belica, L. (2007, April 26). Brown Trout (Salmo trutta): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/browntrout.pdf [date of access].)	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Yes	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Hibidization with eg. Salmo marmoratus, Salmo obtusirostris in Jadro river (Snoj, A., Razpet, A., Tomljanović, T., Treer, T., & Sušnik, S. (2007). Genetic composition of the Jadro softmouth trout following translocation into a new habitat. Conservation	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	(Belica, L. (2007, April 26). Brown Trout (Salmo trutta): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/browntrout.pdf [date of access].)	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	no (Belica, L. (2007, April 26). Brown Trout (Salmo trutta): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/browntrout.pdf [date of access].)	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	No	No (Freyhof, J. 2011. Salmo trutta . The IUCN Red List of Threatened Species 2011)	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Resident trouts usually spawn for the first time at 2-3 years. (Freyhof, J. 2011. Salmo trutta . The IUCN Red List of Threatened Species 2011.)	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	1. human impact 2. flooding 3. natural spread via natural and manmade watercourses	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Some of the vectors may introduce a taxon into the protected area.	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	Freyhof, J. 2011. Salmo trutta . The IUCN Red List of Threatened Species 2011	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Freyhof, J. 2011. Salmo trutta . The IUCN Red List of Threatened Species 2011	Very high
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	(Freyhof, J. 2013. Salmo trutta. The IUCN Red List of Threatened Species 2013: e.T19861A9050312. http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T19861A9050312.en)	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	yes, (Freyhof, J. 2013. Salmo trutta. The IUCN Red List of Threatened Species 2013: e.T19861A9050312. http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T19861A9050312.e	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	The taxon no to be dispersed with propagules or eggs in the RA area by other animals.	Very high

42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	There is a possibility of a high rate of spread of taxa. Eg. if a fertilized individual enters a new area by any means of expansion.	Low
43	7.09	Is dispersal of the taxon density dependent?	Yes	yes	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	no	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	The taxon no tolerant of a wide range of water quality.	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Not applicable	It is not regulated in Croatia	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Freyhof, J. 2011. Salmo trutta . The IUCN Red List of Threatened Species 2011	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Freyhof, J. 2011. Salmo trutta . The IUCN Red List of Threatened Species 2011	Very high
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Esox lucius (CABI)	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	not applicable	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	The risks of establishment S.trutta is decreased. Reason for that is increased temperatures because its catch has dramatically declined in several parts of Europe. (Réalis-Doyelle, E., Pasquet, A., De Charleroy, D., Fontaine, P., & Teletchea, F. (2016). Strong Effects of Temperature on the Early Life Stages of a Cold Stenothermal Fish Species, Brown Trout (Salmo trutta L.). PloS one, 11(5), e0155487.	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	The risk of spread in the RA area is reduced. Temperatures are a major problem therefore. (Réalis-Doyelle, E., Pasquet, A., De Charleroy, D., Fontaine, P., & Teletchea, F. (2016). Strong Effects of Temperature on the Early Life Stages of a Cold Stenothermal Fish Species, Brown Trout (Salmo trutta L.). PloS one, 11(5), e0155487. https://doi.org/10.1371/journal.pone.0155487)	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Lower (Réalis-Doyelle, E., Pasquet, A., De Charleroy, D., Fontaine, P., & Teletchea, F. (2016). Strong Effects of Temperature on the Early Life Stages of a Cold Stenothermal Fish Species, Brown Trout (Salmo trutta L.). PloS one, 11(5), e0155487. https://doi.org/10.1371/journal.pone.0155487)	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	It is likely to have a negative impact on the ecosystem and system functioning, regardless of the assumed population decline.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	No change, the same situation	Medium

Statistics	
Scores	
BRA	**28.0**
BRA Outcome	**-**
BRA+CCA	**22.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**14.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*10.0*
B. Biology/Ecology	**14.0**
4. Undesirable (or persistence) traits	*8.0*
5. Resource exploitation	*5.0*
6. Reproduction	*2.0*
7. Dispersal mechanisms	*3.0*
8. Tolerance attributes	*-4.0*
C. Climate change	**-6.0**
9. Climate change	*-6.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	

Commercial	**9**
Environmental	**10**
Species or population nuisance traits	**6**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.70**
BRA	**0.72**
CCA	**0.54**

Date and Time
02/06/2020 09:13:47

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salvelinus alpinus*
Common name	Arctic charr
Assessor	Ana Marić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Environmental conditions required for intensive farming of Arctic charr (Salvelinus alpinus (L.)) Bjørn-Steinar Sæther, Sten Ivar Siikavuopio & Malcolm Jobling. 2016 Status of arctic charr (Salvelinus alpinus) farming in Norway, Sweden and Iceland B. -S. Sæther, S. I. Siikavuopio, H. Thorarensen & E. Brännäs. 2013	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Status of arctic charr (Salvelinus alpinus) farming in Norway, Sweden and Iceland B. -S. Sæther, S. I. Siikavuopio, H. Thorarensen & E. Brännäs	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	S. fontinalis	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	FRESHWATER ALIEN FISH SPECIES INTRODUCED INTO CROATIA FOR AQUACULTURE AND CONSEQUENCES OF THEIR ESCAPES AND RELEASES IN INLAND WATERS Marina Piria1*, Divna Lukić1, Tatjana Boroša-Pecigoš2. 2016	High
5	2.02	What is the quality of the climate matching data?	Medium	FRESHWATER ALIEN FISH SPECIES INTRODUCED INTO CROATIA FOR AQUACULTURE AND CONSEQUENCES OF THEIR ESCAPES AND RELEASES IN INLAND WATERS Marina Piria1*, Divna Lukić1, Tatjana Boroša-Pecigoš2	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	RISKS TO STOCKS OF NATIVE TROUT OF THE GENUS SALMO (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE) OF SERBIA AND MANAGEMENT FOR THEIR RECOVERY Predrag SIMONOVIĆ1*, Zoran VIDOVIĆ2, Ana TOŠIĆ1, Dubravka ŠKRABA1, Jelena ČANAK-ATLAGIĆ1, and Vera NIKOLIĆ. 2015	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	RISKS TO STOCKS OF NATIVE TROUT OF THE GENUS SALMO (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE) OF SERBIA AND MANAGEMENT FOR THEIR RECOVERY Predrag SIMONOVIĆ1*, Zoran VIDOVIĆ2, Ana TOŠIĆ1, Dubravka ŠKRABA1, Jelena ČANAK-ATLAGIĆ1, and Vera NIKOLIĆ. 2015 stocking	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	FRESHWATER ALIEN FISH SPECIES INTRODUCED INTO CROATIA FOR AQUACULTURE AND CONSEQUENCES OF THEIR ESCAPES AND RELEASES IN INLAND WATERS Marina Piria1*, Divna Lukić1, Tatjana Boroša-Pecigoš. 2016	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	FRESHWATER ALIEN FISH SPECIES INTRODUCED INTO CROATIA FOR AQUACULTURE AND CONSEQUENCES OF THEIR ESCAPES AND RELEASES IN INLAND WATERS Marina Piria1*, Divna Lukić1, Tatjana Boroša-Pecigoš. 2016	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	RISKS TO STOCKS OF NATIVE TROUT OF THE GENUS SALMO (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE) OF SERBIA AND MANAGEMENT FOR THEIR RECOVERY Predrag SIMONOVIĆ1*, Zoran VIDOVIĆ2, Ana TOŠIĆ1, Dubravka ŠKRABA1, Jelena ČANAK-ATLAGIĆ1, and Vera NIKOLIĆ. 2015 stocking	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	RISKS TO STOCKS OF NATIVE TROUT OF THE GENUS SALMO (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE) OF SERBIA AND MANAGEMENT FOR THEIR RECOVERY Predrag SIMONOVIĆ1*, Zoran VIDOVIĆ2, Ana TOŠIĆ1, Dubravka ŠKRABA1, Jelena ČANAK-ATLAGIĆ1, and Vera NIKOLIĆ. 2015 stocking	High
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	RISKS TO STOCKS OF NATIVE TROUT OF THE GENUS SALMO (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE) OF SERBIA AND MANAGEMENT FOR THEIR RECOVERY Predrag SIMONOVIĆ1*, Zoran VIDOVIĆ2, Ana TOŠIĆ1, Dubravka ŠKRABA1, Jelena ČANAK-ATLAGIĆ1, and Vera NIKOLIĆ. 2015 stocking	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	RISKS TO STOCKS OF NATIVE TROUT OF THE GENUS SALMO (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE) OF SERBIA AND MANAGEMENT FOR THEIR RECOVERY Predrag SIMONOVIĆ1*, Zoran VIDOVIĆ2, Ana TOŠIĆ1, Dubravka ŠKRABA1, Jelena ČANAK-ATLAGIĆ1, and Vera NIKOLIĆ. 2015 stocking	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	RISKS TO STOCKS OF NATIVE TROUT OF THE GENUS SALMO (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE) OF SERBIA AND MANAGEMENT FOR THEIR RECOVERY Predrag SIMONOVIĆ1*, Zoran VIDOVIĆ2, Ana TOŠIĆ1, Dubravka ŠKRABA1, Jelena ČANAK-ATLAGIĆ1, and Vera NIKOLIĆ. 2015 stocking	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	https://www.luontoportti.com/suomi/en/kalat/arctic-char	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	https://www.luontoportti.com/suomi/en/kalat/arctic-char	High

17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Environmental conditions required for intensive farming of Arctic charr (Salvelinus alpinus (L.)) Bjørn-Steinar Sæther, Sten Ivar Siikavuopio & Malcolm Jobling . 2016	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	No	RISKS TO STOCKS OF NATIVE TROUT OF THE GENUS SALMO (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE) OF SERBIA AND MANAGEMENT FOR THEIR RECOVERY Predrag SIMONOVIĆ1*, Zoran VIDOVIĆ2, Ana TOŠIĆ1, Dubravka ŠKRABA1, Jelena ČANAK-ATLAGIĆ1, and Vera NIKOLIĆ. 2015	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	RISKS TO STOCKS OF NATIVE TROUT OF THE GENUS SALMO (ACTINOPTERYGII: SALMONIFORMES: SALMONIDAE) OF SERBIA AND MANAGEMENT FOR THEIR RECOVERY Predrag SIMONOVIĆ1*, Zoran VIDOVIĆ2, Ana TOŠIĆ1, Dubravka ŠKRABA1, Jelena ČANAK-ATLAGIĆ1, and Vera NIKOLIĆ. 2015 stocking	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	AS S. fontinalis	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Parasites as indicators of individual feeding specialization in Arctic charr during winter in northern Norway R Knudsen et al. 2016	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	FRESHWATER ALIEN FISH SPECIES INTRODUCED INTO CROATIA FOR AQUACULTURE AND CONSEQUENCES OF THEIR ESCAPES AND RELEASES IN INLAND WATERS Marina Piria1*, Divna Lukić1, Tatjana Boroša-Pecigoš 2016	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Simonovic. Risks to stocks. 2015	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	High
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Stocking Simonovic et al. Risks to stocks. 2015	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	FRESHWATER ALIEN FISH SPECIES INTRODUCED INTO CROATIA FOR AQUACULTURE AND CONSEQUENCES OF THEIR ESCAPES AND RELEASES IN INLAND WATERS Marina Piria1*, Divna Lukić1, Tatjana Boroša-Pecigoš 2016	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	https://www.luontoportti.com/suomi/en/kalat/arctic-char	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	https://www.luontoportti.com/suomi/en/kalat/arctic-char	Medium
43	7.09	Is dispersal of the taxon density dependent?	Yes	Density-dependent diel activity in stream-dwelling Arctic charr Salvelinus alpinus A Fingerle, N Larranaga et al. 2016	High
8. Tolerance attributes					

44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	https://www.luontoportti.com/suomi/en/kalat/arctic-char	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	https://www.luontoportti.com/suomi/en/kalat/arctic-char	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	Very high
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp. salmonid egg eaters, mammals	Very high
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High

Statistics	
Scores	
BRA	**15.5**
BRA Outcome	**-**
BRA+CCA	**11.5**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**6.5**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*1.5*
B. Biology/Ecology	**9.0**
4. Undesirable (or persistence) traits	*0.0*
5. Resource exploitation	*7.0*
6. Reproduction	*2.0*
7. Dispersal mechanisms	*1.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**-4.0**
9. Climate change	*-4.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**4**
Environmental	**4**
Species or population nuisance traits	**6**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.78**
BRA	**0.79**
CCA	**0.71**

Date and Time
26/05/2021 16:49:41

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salvelinus alpinus*
Common name	Arctic charr
Assessor	Ivan Špelić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	S. alpinus has been commercially farmed since the early 90ths and today, the total production is 3000, 2300 and 700 tonnes/year in Iceland, Sweden and Norway, respectively. (4) (PDF) Arctic charr farming. Available from: https://www.researchgate.net/publication/277835864_Arctic_charr_farming [accessed Mar 04 2020].	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	No	Restocking is done with farmed fish (Savari et al. 2017).	Low
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Salvelinus fontinalis (CABI 2019).	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Climatch 2020	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Climatch 2020	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Lenhardt, M., Markovic, G., Hegedis, A. et al. Non-native and translocated fish species in Serbia and their impact on the native ichthyofauna. Rev Fish Biol Fisheries 21, 407–421 (2011).	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	Not applicable	Already present.	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	Already present.	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Welcomme, R.L., 1988. International introductions of inland aquatic species. FAO Fish. Tech. Pap. No. 294. 318: 115–119.	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	U.S. Fish & Wildlife Service, Web Version, 1/31/2019: Arctic Char (Salvelinus alpinus). Ecological Risk Screening Summary	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Farmed in aquaculture (Froese & Pauly 2020), no adverse impact.	High
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	There are no known negative impacts of arctic char on humans (Flack, M. 2019. "Salvelinus alpinus" (On-line), Animal Diversity Web. Accessed May 04, 2020 at https://animaldiversity.org/accounts/Salvelinus_alpinus/).	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	There are no known negative impacts of arctic char on humans (Flack, M. 2019. "Salvelinus alpinus" (On-line), Animal Diversity Web. Accessed May 04, 2020 at https://animaldiversity.org/accounts/Salvelinus_alpinus/).	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (Froese & Pauly 2020).	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	It is typically found in cool or cold lakes with depauperate fish communities. In alpine or northern lakes, it is often the only fish species (U.S. Fish & Wildlife Service, Web Version, 1/31/2019: Arctic Char (Salvelinus alpinus). Ecological Risk Screening Summary). The impacts of this species are currently unknown (Pam Fuller, and Matt Neilson, 2020, Salvelinus alpinus (Linnaeus, 1758): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=935, Revision Date: 4/30/2012, Peer Review Date: 4/30/2012, Access	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No parasitic behaviour.	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Occurs in the sea along coasts, estuaries, rivers, and lakes with cold, clear water (Froese & Pauly 2020).	Very high
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	U.S. Fish & Wildlife Service, Web Version, 1/31/2019: Arctic Char (Salvelinus alpinus). Ecological Risk Screening Summary	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	There are no known negative impacts of arctic char on humans (Flack, M. 2019. "Salvelinus alpinus" (On-line), Animal Diversity Web. Accessed May 04, 2020 at https://animaldiversity.org/accounts/Salvelinus_alpinus/).	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	U.S. Fish & Wildlife Service, Web Version, 1/31/2019: Arctic Char (Salvelinus alpinus). Ecological Risk Screening Summary	High

21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	U.S. Fish & Wildlife Service, Web Version, 1/31/2019: Arctic Char (Salvelinus alpinus). Ecological Risk Screening Summary	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Maximum size 107 cm and 15 KG (Froese & Pauly 2020).	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Occurs in the sea along coasts, estuaries, rivers, and lakes with cold, clear water (Froese & Pauly 2020).	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Typical environment of the charr is oligotrophic and ultraoligotrophic lakes (U.S. Fish & Wildlife Service, Web Version, 1/31/2019: Arctic Char (Salvelinus alpinus). Ecological Risk Screening Summary).	Low
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	No, minimum population doubling time 4.5 - 14 years (Froese & Pauly 2020).	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Flack, M. 2019. "Salvelinus alpinus" (On-line), Animal Diversity Web. Accessed May 04, 2020 at https://animaldiversity.org/accounts/Salvelinus_alpinus/	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	No data for calculation.	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Froese & Pauly 2020.	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Lenhardt, M., Markovic, G., Hegedis, A. et al. Non-native and translocated fish species in Serbia and their impact on the native ichthyofauna. Rev Fish Biol Fisheries 21, 407–421 (2011).	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	Hybridization with Salmo trutta is possible in hatcheries but survival is low. No hybridization reported in nature (Hisar SA, Yanik T, Hisar O (2003). Hatchery and growth performance of trout pure breeds, Salvelinus alpinus and Salmo trutta fario, and their hybrid. The Israeli J. Aquaculture – Bamidgeh, 55(3): 154-	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Froese & Pauly 2020	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Froese & Pauly 2020.	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Max 8065 eggs per female (Froese & Pauly 2020).	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	Minimum 3 years (Froese & Pauly 2020).	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Stocking for angling (U.S. Fish & Wildlife Service, Web Version, 1/31/2019: Arctic Char (Salvelinus alpinus). Ecological Risk Screening Summary).	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	Personal opinion.	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No adaptations.	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Could probably be established only in lakes (no current to disperse eggs), eggs covered in gravel (Froese & Pauly 2020, Flack, M. 2019. "Salvelinus alpinus" (On-line), Animal Diversity Web. Accessed May 04, 2020 at	Medium
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	Could probably be established only in lakes (no current to disperse juveniles).	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	Migration in anadromous populations (Froese & Pauly 2020), highly unlikely in RA area.	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Eggs covered in redd (Froese & Pauly 2020).	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Stocking.	High
43	7.09	Is dispersal of the taxon density dependent?	No	Not documented.	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Sensitive species (temperature and oxygen) (Froese & Pauly 2020).	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Extremely sensitive to water pollution (Froese & Pauly 2020).	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	Not allowed.	Very high

47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Typical environment of the charr is oligotrophic and ultraoligotrophic lakes (U.S. Fish & Wildlife Service, Web Version, 1/31/2019: Arctic Char (Salvelinus alpinus). Ecological Risk Screening Summary). Any type of human disturbance usually results in eutrophication (reservoirs, pollution).	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Anadromous species (Froese & Pauly 2020).	Very high
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Piscivorous birds, otters (personal opinion).	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	Already present.	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	James D. Reist , Michael Power & J. Brian Dempson (2013): Arctic charr (Salvelinus alpinus): a case studyof the importance of understanding biodiversity and taxonomic issues in northern fishes, Biodiversity, 14:1, 45-56	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	James D. Reist , Michael Power & J. Brian Dempson (2013): Arctic charr (Salvelinus alpinus): a case studyof the importance of understanding biodiversity and taxonomic issues in northern fishes, Biodiversity, 14:1, 45-56	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	James D. Reist , Michael Power & J. Brian Dempson (2013): Arctic charr (Salvelinus alpinus): a case studyof the importance of understanding biodiversity and taxonomic issues in northern fishes, Biodiversity, 14:1, 45-56	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	James D. Reist , Michael Power & J. Brian Dempson (2013): Arctic charr (Salvelinus alpinus): a case studyof the importance of understanding biodiversity and taxonomic issues in northern fishes, Biodiversity, 14:1, 45-56	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	No predicted impact in current conditions, no change under future conditions.	High

Statistics	
Scores	
BRA	**14.0**
BRA Outcome	**-**
BRA+CCA	**6.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**9.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*6.0*
B. Biology/Ecology	**5.0**
4. Undesirable (or persistence) traits	*4.0*
5. Resource exploitation	*5.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*-4.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**-8.0**
9. Climate change	*-8.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**7**
Environmental	**2**
Species or population nuisance traits	**-1**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.71**
BRA	**0.71**
CCA	**0.75**

Date and Time
13/05/2021 20:51:02

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salvelinus alpinus*
Common name	Arctic charr
Assessor	Tamara Kanjuh
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	The first known introduction of charr in the Balkans likely dates back to 1928, when Salvelinus sp. from Italy was introduced to Krnsko Lake in Slovenia. The second introduction to Slovenia from Austria oc-curred in 1943 in Bohinj Lake for sport fishing purposes (Povž&Ocvirk, 1990).	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Salvelinus alpinus is used for commercial purposes (https://www.fishbase.de/summary/Salvelinus-alpinus.html)	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No information found.	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Low	Dfa, Dfb (Köppen–Geiger climate classification system)	Medium
5	2.02	What is the quality of the climate matching data?	High	Köppen–Geiger climate classification system	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	The Serbian literature refers to S. alpinus as an introduced species, first in Kokin Brod reservoir in 1943, then later in Vlasina Lake (Simonović, 2006).	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Aquaculture (Piria et al., 2017)	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	The taxon is found in the RA region (Piria et al., 2017)	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	There are allegations that charr is very well adapted to environmental conditions in RA (Vuković&Kosorić)	Medium
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Due to the diet, they can affect the availability of prey (Klementsen et al., 2003).	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No information found.	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	No information found.	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No information found.	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	There are no known negative impacts of arctic char on humans (Freyhof&Kottelat, 2008).	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	Food competition.	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	Arctic char are motile and natatorial (https://animaldiversity.org/accounts/Salvelinus_alpinus/#09E5637A-B5CA-11E8-A12E-005056AB59D3).	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Although there is some evidence for thermal adaptation to very low temperatures in cold rivers (mean annual temperature <6·5◦C), there is no corresponding adaptation to increasing temperature, even in a hot geothermal river. When water temperatures exceed 22–28◦C for S. salar, 22–25◦C for S. trutta and 22–23◦C for S. alpinus, the fishes will soon die unless they can move to cooler water. Deep pools with cooler water near the bottom serve as refugia in streams and rivers and should be maintained or even created when scarce (Elliot et al., 2010)	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	In 10 Norwegian charr lakes, Langeland (1978) found that charr selected cladocerans above copepods and that increasing predation had negative effects on large cladocerans and also affected the size of two important prey species.	Very high
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No information found.	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No information found.	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No information found.	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	No information found.	Low

23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	The study of Grnbaum et al. (2008) showed that the use of a higher water velocity immediately after hatching is associated with a significant increase in growth.	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	In a 6-year experimental study in one lake, Langeland (1982) found that predation from charr changed the zooplankton community from large- to smallsized species. The predation also affected body size and the production of resting eggs in cladocerans negatively (Klementsen et al., 2003).	Very high
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	No information found.	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	No information found.	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	In addition to the diet, there is a possibility that the taxon will use the available resources to the detriment of native species (Klementsen et al., 2003)	Medium
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	No parental involvement (https://animaldiversity.org/accounts/Salvelinus_alpinus/).	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	The literature points out that the taxon is adapted to the conditions in RA (Vukovič&Kosorić)	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Salvelinus aplinus x Salmo trutta (Chevassus, 1979).	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No information found.	Medium
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	No information found.	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Range number of offspring: 2,500 to 8,500 (https://animaldiversity.org/accounts/Salvelinus_alpinus/)	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	4	Sexual maturity in arctic char ranges from 4 years to 10 years old, usually when they reach around 500-600 mm in length (https://animaldiversity.org/accounts/Salvelinus_alpinus/#4D908FB0-CA64-11E8-AE5C-005056AB59D3)	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Aquaculture, sport fishing (Piria et al., 2017)	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	One of the first places where the taxon was introduced in Serbia is Kokin Brod, which belongs to the Uvac Special Nature Reserve (Piria et al., 2017)	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No information found.	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	No information found.	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	The dispersal could occur in the juvenile stages (Janjua et al., 2010).	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Anadromus and semi-anadromus, fluviatile-lacustrine and dwarf stocks are known (Kottelat&Freyhof, 2007)	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No information found.	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Literary references indicate the release of the taxon into the water by anglers or his escape from the farm (Piria et al., 2017 - D.Jelić, personal communication)	Very high
43	7.09	Is dispersal of the taxon density dependent?	No	Characteristics that make these species suitable for commercial farming in cold-water recirculating aquaculture systems include tolerance of S. alpinus to high density culture (Prokešova et al.,	Very high
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	No information found.	Medium
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	Dong et al. (2011) reviewed that hyperoxia may enhance food intake, feed conversion efficiency, growth performance, survival, and tolerance to ammonia.	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	No information found.	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	No information found.	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	The taxon includes anadromus and semi-anadromus species (Kottelat&Freyhof, 2007)	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	Yes	Humans (https://animaldiversity.org/accounts/Salvelinus_alpinus/#4D908FB0-CA64-11E8-AE5C-005056AB59D3)	Medium
C. Climate change					
9. Climate change					

50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	There are no significant differences Elliot et al., 2010).	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	There are no significant differences Elliot et al., 2010).	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	There are no significant differences Elliot et al., 2010).	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	There are no significant differences Elliot et al., 2010).	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	There are no significant differences Elliot et al., 2010).	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	There are no significant differences (Elliot et al., 2010).	Medium

Statistics	
Scores	
BRA	**13.5**
BRA Outcome	**-**
BRA+CCA	**11.5**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**4.5**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*1.5*
B. Biology/Ecology	**9.0**
4. Undesirable (or persistence) traits	*2.0*
5. Resource exploitation	*2.0*
6. Reproduction	*2.0*
7. Dispersal mechanisms	*2.0*
8. Tolerance attributes	*1.0*
C. Climate change	**-2.0**
9. Climate change	*-2.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**5**
Environmental	**3**
Species or population nuisance traits	**8**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.56**
BRA	**0.57**
CCA	**0.50**

Date and Time
28/05/2021 09:06:26

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salvelinus alpinus*
Common name	Arctic charr
Assessor	Tena Radocaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland. This species introduced only in Croatia; Knin fish farm	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	S.alpinus used for human consumption. (Kapetanović, D., Vardić, I., Valić, D., & Teskeredžˇić, E. (2010). Furunculosis in cultured Arctic charr (Salvelinus alpinus) in Croatia. Aquaculture research, 41(10), e719-e721.)	Low
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland. I use climatch. The similarity between climatic conditions RA area and native	High
5	2.02	What is the quality of the climate matching data?	High	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland. The quality of the climate matching data is high.	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	In Croatia, arctic charr Salvelinus alpinus (Linnaeus, 1758) was introduced from Bohinj Lake to Kozjak Lake (one of the Plitvice Lakes) in 1963 (Pažur 1970). Later, anglers released arctic charr in several inland waters, including the Ruda River in the 1980s (Josip Budinski, pers. comm.), or specimens escaped from farms, though the distribution of this species has not yet been revised (D. Jelić, pers. comm.). 8Pofuk, M., Zanella, D., & Piria, M. (2017). An overview of the translocated native and non-native fish species in Croatia: pathways, impacts and management. Management of biological invasions, 8(3), 425.)	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	None	This species is present in Croatia	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	This species is present in Croatia	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	no data	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	This species adaptable in terms of climatic and other environmental conditions.	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No data	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	no data	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Yes, the taxon may be a host or vector of known pests and infectious agents endemic to RA area. Because in every area exist infectious agents and pests.	Low

21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Furunculosis, caused by Aeromonas salmonicida, is probably themost abundant disease in European aquaculture. Crane and Hyatt (2011) report that Salvelinus alpinus can be infected with infectious salmon anemia virus. According to Froese and Pauly (2018b), Salvelinus alpinus is a host for Abothrium crissum, Caligus elongatus, Diphyllobothrium dendriticum, D. ditremum, D. salvelini. 8Froese, R., and D. Pauly, editors. 2018a. Salvelinus alpinus (Linnaeus, 1758). FishBase. Available: https://www.fishbase.de/summary/Salvelinus-alpinus.html.	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	It is possible that it consume endangered and protected native taxa in the RA area. If there are protected taxa in the RA area will consume them, whether or not the taxon is endangered.	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	not applicable	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	1. human impact 2. flooding 3. natural spread via natural and manmade watercourses	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	No any of this vectors/pathways bring the taxon in close proximity in the protected areas.	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	There is a possibility of a high rate of spread of taxa. Eg. if a fertilized individual enters a new area by any means of expansion.	Low
43	7.09	Is dispersal of the taxon density dependent?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Not applicable	No regulation in Croatia	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	High

48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	No	Brown trout and Pikeperch (Vilhunen, S., & Hirvonen, H. (2003). Innate antipredator responses of Arctic charr (Salvelinus alpinus) depend on predator species and their diet. Behavioral Ecology and Sociobiology, 55(1), 1-10.)	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	not applicable	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	The risks of establishment S.alpinus is decreased. Reason for that is increased temperatures because its catch has dramatically declined in several parts of Europe. (Elliott, J., & Elliott, J. A. (2010). Temperature requirements of Atlantic salmon Salmo salar, brown trout Salmo trutta and Arctic charr Salvelinus alpinus: predicting the effects of climate change. Journal of fish biology,	Low
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	The risk of spread in the RA area is reduced. Temperatures are a major problem therefore. (Elliott, J., & Elliott, J. A. (2010). Temperature requirements of Atlantic salmon Salmo salar, brown trout Salmo trutta and Arctic charr Salvelinus alpinus: predicting the effects of climate change. Journal of fish biology, 77(8), 1793-	Low
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Decrease (Elliott, J., & Elliott, J. A. (2010). Temperature requirements of Atlantic salmon Salmo salar, brown trout Salmo trutta and Arctic charr Salvelinus alpinus: predicting the effects of climate change. Journal of fish biology, 77(8), 1793-1817.)	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	It is likely to no have impact on the ecosystem and system functioning. (Elliott, J., & Elliott, J. A. (2010). Temperature requirements of Atlantic salmon Salmo salar, brown trout Salmo trutta and Arctic charr Salvelinus alpinus: predicting the effects of climate change. Journal of fish biology, 77(8), 1793-1817.)	Low
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Elliott, J., & Elliott, J. A. (2010). Temperature requirements of Atlantic salmon Salmo salar, brown trout Salmo trutta and Arctic charr Salvelinus alpinus: predicting the effects of climate change. Journal of fish biology, 77(8), 1793-1817.	Low

Statistics	
Scores	
BRA	**28.0**
BRA Outcome	**-**
BRA+CCA	**22.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**16.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*14.0*
B. Biology/Ecology	**12.0**
4. Undesirable (or persistence) traits	*7.0*
5. Resource exploitation	*5.0*
6. Reproduction	*0.0*
7. Dispersal mechanisms	*-1.0*
8. Tolerance attributes	*1.0*
C. Climate change	**-6.0**
9. Climate change	*-6.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**13**
Environmental	**7**
Species or population nuisance traits	**4**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.65**
BRA	**0.69**
CCA	**0.38**

Date and Time
02/06/2020 09:09:48

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salvelinus fontinalis*
Common name	brook trout
Assessor	Ana Marić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	World Distribution of Brook Trout, Salaelinus fontinalis Hucu R. MecCnIMMoN and J. Scorr Campbell 1969	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	https://www.cabi.org/isc/datasheet/65325#tosummaryOfInvasiveness	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	https://www.cabi.org/isc/datasheet/65325#tosummaryOfInvasiveness	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	Proffesional estimation	High
5	2.02	What is the quality of the climate matching data?	Medium	https://www.cabi.org/isc/datasheet/65325#tosummaryOfInvasiveness	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	FRESHWATER ALIEN FISH SPECIES INTRODUCED INTO CROATIA FOR AQUACULTURE AND CONSEQUENCES OF THEIR ESCAPES AND RELEASES IN INLAND WATERS Marina Piria1*, Divna Lukić1, Tatjana Boroša-Pecigoš2. 2016	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Stocking	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	FRESHWATER ALIEN FISH SPECIES INTRODUCED INTO CROATIA FOR AQUACULTURE AND CONSEQUENCES OF THEIR ESCAPES AND RELEASES IN INLAND WATERS Marina Piria1*, Divna Lukić1, Tatjana Boroša-Pecigoš. 2016 https://www.cabi.org/isc/datasheet/65325#todistributionDatabaseTable	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	https://www.cabi.org/isc/datasheet/65325#todistributionDatabaseTable	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	https://www.cabi.org/isc/datasheet/65325#toriskAndImpactFactors	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	https://www.cabi.org/isc/datasheet/65325#toriskAndImpactFactors	High
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	https://www.cabi.org/isc/datasheet/65325#toriskAndImpactFactors	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	https://www.cabi.org/isc/datasheet/65325#toriskAndImpactFactors	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	https://www.fishbase.se/summary/Salvelinus-fontinalis.html	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	https://www.cabi.org/isc/datasheet/65325#toriskAndImpactFactors	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	https://www.fishbase.se/summary/Salvelinus-fontinalis.html	High
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	https://www.cabi.org/isc/datasheet/65325#toriskAndImpactFactors	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	https://www.cabi.org/isc/datasheet/65325#toriskAndImpactFactors	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	Fechney LR, 1988. The summer diet of brook trout (Salvelinus fontinalis) in a South Island high-country stream. New Zealand Journal of Marine and Freshwater Research, 22(2):163-168	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	https://www.cabi.org/isc/datasheet/65325#tosummaryOfInvasiveness	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	https://www.cabi.org/isc/datasheet/65325#tosummaryOfInvasiveness	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	https://www.fishbase.se/summary/Salvelinus-fontinalis.html	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	The Behavior of Juvenile Atlantic Salmon (Salmo salar) and Brook Trout (Salvelinus fontinalis) with Regard to Temperature and to Water Velocity R. John Gibson . 2011	Medium

24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	https://www.cabi.org/isc/datasheet/65325#touses	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Hierarchical analysis of relationships between brook trout (Salvelinus fontinalis) density and stream habitat features. Rodriguez. 2007	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	https://www.cabi.org/isc/datasheet/65325#tobiologyAndEcology	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	https://www.cabi.org/isc/datasheet/65325#toriskAndImpactFactors	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Yes	Kottelat. 2007	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	FRESHWATER ALIEN FISH SPECIES INTRODUCED INTO CROATIA FOR AQUACULTURE AND CONSEQUENCES OF THEIR ESCAPES AND RELEASES IN INLAND WATERS Marina Piria1*, Divna Lukić1, Tatjana Boroša-Pecigoš. 2016	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Cucherousset, Julien and Aymes, J. C. and Poulet, Nicolas and Santoul, Frédéric and Céréghino, Régis. Do native brown trout and non-native brook trout interact reproductively? (2008) Naturwissenschaften, vol. 95 (n° 7). pp. 647-654. ISSN 1432-1904	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Cucherousset, Julien and Aymes, J. C. and Poulet, Nicolas and Santoul, Frédéric and Céréghino, Régis. Do native brown trout and non-native brook trout interact reproductively? (2008) Naturwissenschaften, vol. 95 (n° 7). pp. 647-654. ISSN 1432-1904	High
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	https://www.cabi.org/isc/datasheet/65325#tobiologyAndEcology	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	https://www.cabi.org/isc/datasheet/65325#tobiologyAndEcology	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	1	Kottelat. 2007	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	https://www.cabi.org/isc/datasheet/65325#toriskAndImpactFactors	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	FRESHWATER ALIEN FISH SPECIES INTRODUCED INTO CROATIA FOR AQUACULTURE AND CONSEQUENCES OF THEIR ESCAPES AND RELEASES IN INLAND WATERS Marina Piria1*, Divna Lukić1, Tatjana Boroša-Pecigoš2. 2016	Very high
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	Kottelat. 2007	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Kottelat. 2007	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Kottelat. 2007	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Kottelat. 2007	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Kottelat. 2007	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	https://www.cabi.org/isc/datasheet/65325#toriskAndImpactFactors	High
43	7.09	Is dispersal of the taxon density dependent?	Yes	Density-dependent individual growth and size dynamics of central Appalachian brook trout (Salvelinus fontinalis) RM Utz, KJ Hartman. 2009	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Kottelat. 2007	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	https://www.cabi.org/isc/datasheet/65325#towaterTolerances oxygen	High
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	https://www.cabi.org/isc/datasheet/65325#topreventionAndControl	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	https://www.cabi.org/isc/datasheet/65325#topreventionAndControl	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	https://www.cabi.org/isc/datasheet/65325#towaterTolerances	Very high
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	https://www.cabi.org/isc/datasheet/65325#tonaturalEnemies	Very high
C. Climate change					
9. Climate change					

50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	https://www.cabi.org/isc/datasheet/65325#tonaturalEnemies	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	https://www.cabi.org/isc/datasheet/65325#toclimate	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	https://www.cabi.org/isc/datasheet/65325#toclimate	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	https://www.cabi.org/isc/datasheet/65325#toclimate	High
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	https://www.cabi.org/isc/datasheet/65325#toclimate	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	https://www.cabi.org/isc/datasheet/65325#toclimate	High

Statistics	
Scores	
BRA	**35.5**
BRA Outcome	**-**
BRA+CCA	**35.5**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**12.5**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*7.5*
B. Biology/Ecology	**23.0**
4. Undesirable (or persistence) traits	*9.0*
5. Resource exploitation	*7.0*
6. Reproduction	*5.0*
7. Dispersal mechanisms	*3.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**9**
Environmental	**12**
Species or population nuisance traits	**19**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.79**
BRA	**0.80**
CCA	**0.67**

Date and Time
26/05/2021 16:08:00

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salvelinus fontinalis*
Common name	brook trout
Assessor	Ivan Špelić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Froese & Pauly 2020	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	No	Restocking of open waters with farmed fish (Povž et al. 2015)	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	Kottelat, M. & Freyhof, J. 2007. Handbook of European Freshwater Fishes. Kottelat, Cornol and Freyhof, Berlin, xiv + 646 pp.	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Climatch 2020	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Climatch 2020	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Lenhardt, M., Markovic, G., Hegedis, A., Maletin, S., Cirkovic, M., Markovic, Z., 2011. Non-native and translocated fish species in Serbia and their impact on the native ichthyofauna. Reviews in Fish Biology and Fisheries 21, 407–421.. doi:10.1007/s11160-010-	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	Not applicable	Already present (Lenhardt, M., Markovic, G., Hegedis, A., Maletin, S., Cirkovic, M., Markovic, Z., 2011. Non-native and translocated fish species in Serbia and their impact on the native ichthyofauna. Reviews in Fish Biology and Fisheries 21, 407–421.. doi:10.1007/s11160-010-9180-8).	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	Already present (Lenhardt, M., Markovic, G., Hegedis, A., Maletin, S., Cirkovic, M., Markovic, Z., 2011. Non-native and translocated fish species in Serbia and their impact on the native ichthyofauna. Reviews in Fish Biology and Fisheries 21, 407–421.. doi:10.1007/s11160-010-9180-8).	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Kottelat, M. & Freyhof, J. 2007. Handbook of European Freshwater Fishes. Kottelat, Cornol and Freyhof, Berlin, xiv + 646 pp	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Global Invasive Species Database (2020) Species profile: Salvelinus fontinalis. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=1226 on 04-03-	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Global Invasive Species Database (2020) Species profile: Salvelinus fontinalis. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=1226 on 04-03-	High
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	S. fontinalis is said to modify nutrient cycling in lakes through its grazing of zooplankton, which in cases of drinking-water reservoirs could have adverse implications for environmental	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Brook trout are extremely popular in aquaculture and angling. Most of their introductions have been because of this. They are an important food source and socio-economic resource. Also, they are commonly used as experimentation test individuals (Global Invasive Species Database (2020) Species profile: Salvelinus fontinalis. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=1226 on 04-03-	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Kottelat, M. & Freyhof, J. 2007. Handbook of European Freshwater Fishes. Kottelat, Cornol and Freyhof, Berlin, xiv + 646 pp	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Brook trout have been found to compete with, displace, or replace many fish species throughout the world (Global Invasive Species Database (2020) Species profile: Salvelinus fontinalis. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=1226 on 04-03-	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Occurs in clear, cool, well-oxygenated creeks, small to medium rivers, and lakes (Froese & Pauly 2020).	Very high
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	Impacts include top down cascading trophic interactions resulting in modifications of benthic zooplankton, macroinvertebrates, and algal communities. Global Invasive Species Database (2020) Species profile: Salvelinus fontinalis. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=1226 on 04-03-	High

19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	Impacts include predation and population reduction of amphibians to the point of endangerment; and top down cascading trophic interactions resulting in modifications of benthic zooplankton, macroinvertebrates, and algal communities. Global Invasive Species Database (2020) Species profile: Salvelinus fontinalis. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=1226 on 04-03-	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	CABI 2010	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	CABI 2010	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Inhabits streams and lakes. Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland. CABI 2010.	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	No information	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Predates on amphibians an fish. Global Invasive Species Database (2020) Species profile: Salvelinus fontinalis. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=1226 on 04-03-	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	No sufficient data for calculations.	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Lenhardt, M., Markovic, G., Hegedis, A., Maletin, S., Cirkovic, M., Markovic, Z., 2011. Non-native and translocated fish species in Serbia and their impact on the native ichthyofauna. Reviews in Fish Biology and Fisheries 21, 407–421.. doi:10.1007/s11160-010-	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland. (with S. trutta)	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Up to 5000 eggs per female (Froese & Pauly 2020).	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Restocking, escape from aquaculture (CABI 2010)	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Personal opinion	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No adaptations	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Drift (personal opinion)	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Personal opinion	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Restocking, escape from aquaculture	High
43	7.09	Is dispersal of the taxon density dependent?	No	Personal opinion	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Sensitive as other salmonids	Very high

45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Occurs in clear, cool, well-oxygenated habitats (Froese & Pauly 2020).	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	Not allowed.	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Occurs in clear, cool, well-oxygenated habitats	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	Yes	Natural enemies of S. fontinalis include larger fish, piscivorous birds (including mergansers and kingfishers), and mammals such as otters and bears. CABI 2010.	Very high
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	Already present (Lenhardt, M., Markovic, G., Hegedis, A., Maletin, S., Cirkovic, M., Markovic, Z., 2011. Non-native and translocated fish species in Serbia and their impact on the native ichthyofauna. Reviews in Fish Biology and Fisheries 21, 407–421.. doi:10.1007/s11160-010-9180-8).	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	The subject of thermal tolerance among coldwater fishes has been widely documentedand is often cited as the single most important abiotic factor limiting the distribution,growth and survival of species like brook trout (Argent et al. 2013). Cold-water habitats and associated obligate species are particularly vulnerable to potential impacts of climate change (Merriam et al. 2017). Authors agree that climate change will not affect native populations as negative as thought before.	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	The subject of thermal tolerance among coldwater fishes has been widely documentedand is often cited as the single most important abiotic factor limiting the distribution,growth and survival of species like brook trout (Argent et al. 2013). Cold-water habitats and associated obligate species are particularly vulnerable to potential impacts of climate change (Merriam et al. 2017). Authors agree that climate change will not affect native populations as negative as thought before.	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	All populations of cold water species will probably decline (Lower impact i unfavourable conditions for cold-water species (COMTE, L., BUISSON, L., DAUFRESNE, M. and GRENOUILLET, G. (2013), Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58: 625-639. https://doi.org/10.1111/fwb.12081).) so relative impact would presumably be the same on those species.	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	Less impact on zooplankton communities under predicted less favourable conditions for coldwater species (Lower impact i unfavourable conditions for cold-water species (COMTE, L., BUISSON, L., DAUFRESNE, M. and GRENOUILLET, G. (2013), Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58: 625-639. https://doi.org/10.1111/fwb.12081).)	Low
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	Less impact on zooplankton communities under predicted less favourable conditions for coldwater species (Lower impact i unfavourable conditions for cold-water species (COMTE, L., BUISSON, L., DAUFRESNE, M. and GRENOUILLET, G. (2013), Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58: 625-639. https://doi.org/10.1111/fwb.12081).)	Low

Statistics	
Scores	
BRA	**26.0**
BRA Outcome	**-**
BRA+CCA	**18.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**11.0**
1. Domestication/Cultivation	*0.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*10.0*
B. Biology/Ecology	**15.0**
4. Undesirable (or persistence) traits	*6.0*
5. Resource exploitation	*5.0*
6. Reproduction	*3.0*
7. Dispersal mechanisms	*2.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**-8.0**
9. Climate change	*-8.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*

C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**6**
Environmental	**10**
Species or population nuisance traits	**6**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.79**
BRA	**0.82**
CCA	**0.54**

Date and Time
19/05/2021 11:37:31

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salvelinus fontinalis*
Common name	brook trout
Assessor	Tamara Kanjuh
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Culture and transport of brook trout began in the 1850s and was initially done to enhance populations in its native range (Karas, 1997).	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Brook trout are also raised commercially and sold to angling organisations or groups to stock their own lakes or ponds. There are businesses that hold a "U-fish license", where the public can come fish at their lake or pond and buy the fish that they catch (https://en.wikipedia.org/wiki/Brook_trout#cite_note-34)	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Salvelinus fontinalis is an invasive species that threatens native amphibians and fish, as well as the ecology of lakes and streams (Dunham et al., 2002)	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Low	Dfa, Dfb (Köppen–Geiger climate classification system)	Medium
5	2.02	What is the quality of the climate matching data?	High	Köppen–Geiger climate classification system	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Brook trout regulary escape from fish farm into streams (Simonović et al., 2015).	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	>1	Aquaculture (Piria et al., 2017), sport fishing (Lenhardt et al., 2011)	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	The taxson is successfully reared in the Vrla fishpond - Surdulica (Simonovic2001).	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	No	Alien salmonids do not reproduce naturally in most of the Balkan waters (Piria et al., 2017)	Low
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Brook trout exert similar competitive pressures that result in reductions and displacements of fishes around the globe, such as; golden trout (Oncorhynchus aguabonita), brown trout (Salmo trutta), and dolly vardon (Salvelinus malma), the last two have also been known to hybridize (ISSG). Brook trout have also been theorized to have prevented the establishment of populations of stocked grayling (Thymallus thymallus) due to their aggressive nature (Fuller and Neilson, 2014).	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No information found.	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	No information found.	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	Negative economic effects may be incurred through the brook trout's detrimental effects on native fish populations. If the non-native brook trout is causing a decline in a more valuable native species the economic benefits they bring may be offset by the economic losses suffered from the loss of the more valuable	Very high
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	No information found.	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Introductions may lead to replacement of native salmonids (e.g. brown trout, Salmo trutta) (cabi.org)	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No information found.	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Compared to other members of the salmonidae family brook trout are the least specialized in their habitat demands and as such can tolerate a wide variety of environmental conditions. Brook trout are equally at home in small streams, larger rivers, beaver ponds, large lakes, estuaries, and coastal marine environments (Karas,	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	Recent evidence from France provides information on both dietary overlap (Cucherousset et al., 2007) and reproductive interference (Cucherousset et al., 2008) of introduced S. fontinalis with native Salmo trutta. This indicates that the diet of the two species overlaps to an extent greater than expected, based on stable isotope signatures (Cucherousset et al., 2007).	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No information found.	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No information found.	Low

21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No information found.	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	No information found.	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	When living in rivers and streams, brook trout like to stay in areas of moderate flow, such as just above or below a set of rapids (Karas, 1997).	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	No information found.	Low
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	No information found.	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	No information found.	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information found.	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	No information found.	Low
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	The alien salmonids do not reproduce naturally in most of the Balkan waters (Piria et al., 2017).	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Introduced S. fontinalis may be having detrimental effects on native Salmo trutta reproductionthrough subtle hybridization behaviour, which was manifested by consistent spatial and temporal overlap in redd sites and spawning periods, mixed-species spawning groups, inter-specific subordinate males, and the occurrence of natural (tiger trout) hybrids (Cucherousset et	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No information found.	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	Primarily, brook trout require cool, clear, and clean waters to survive (Karas, 1997).	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	The eggs are large, 3.5–5.0 mm in diameter, with the number deposited depending on the size of the female, varying from 100 for a 144 mm TL female to 5000 eggs for a 565 mm TL female	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	S. fontinalis reach sexual maturity after two to four years (cabi.org).	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	The primary pathway of introduction for the brook trout is intentional stocking for the enhancement of sport fishing opportunities, than escapes from hatcheries (Jansson, 2013;	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	As Salvelinus fontinalis was introduced into the river Vlasina, it is very close to spreading in the Landscape Of Outstanding Features "Vlasina".	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No information found.	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	No information found.	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Young of the year washed downstream by water, adults naturally dispersed through migration (cabi.org)	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Some populations of brook trout also display a life history similar to that of anadromy, but instead of migrating out to sea they migrate from their natal streams to large bodies of freshwater such as the Great Lakes (Karas, 1997).	Medium
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No information found.	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Intentional dispersal due to water enrichment due to sport fishing.	Medium
43	7.09	Is dispersal of the taxon density dependent?	Yes	Brook trout will migrate when space and resources become limited (Karas, 1997)	Very high
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	No information found.	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being considered.]	No	The most importantly factor influencing the establishment of brook trout populations is temperature (Karas, 1997). If the introduced waters have temperatures outside of their optimum range, establishment of a selfsustaining population will be extremely difficult if not impossible (Seitz, 2014).	Medium

46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	This is typically done by physical means such as, trapping, netting, and electrofishing and most likely has to be performed at regular intervals to keep abundances down (Britton et al., 2011). There has also been recent attempts at controlling populations using "daughterless technology" which involves the release of genetically engineered fish that produce a biased sex ratio towards males when they mate (Britton et al., 2011; Idaho F&G). This will hopefully reduce the population's ability to reproduce and result in negative population growth rates (Britton et al., 2011;	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	No information found.	Low
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	No information found.	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	Yes	Natural enemies of S. fontinalis include larger fish, piscivorous birds (including mergansers and kingfishers), and mammals such as otters and bears (cabi.org).	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Studies have shown that an increase in temperature leads to an increase in S.fontinalis mortality of all age stages. In contrast, extreme low summer flows reduced survival of large fish, but only in small tributaries, and had no significant effects on fish in smaller size classes in any location (CL Xu et al., 2010).	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Studies have shown that an increase in temperature leads to an increase in S.fontinalis mortality of all age stages. In contrast, extreme low summer flows reduced survival of large fish, but only in small tributaries, and had no significant effects on fish in smaller size classes in any location (CL Xu et al., 2010).	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Studies have shown that an increase in temperature leads to an increase in S.fontinalis mortality of all age stages. In contrast, extreme low summer flows reduced survival of large fish, but only in small tributaries, and had no significant effects on fish in smaller size classes in any location (CL Xu et al., 2010).	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Studies have shown that an increase in temperature leads to an increase in S.fontinalis mortality of all age stages. In contrast, extreme low summer flows reduced survival of large fish, but only in small tributaries, and had no significant effects on fish in smaller size classes in any location (CL Xu et al., 2010).	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	Studies have shown that an increase in temperature leads to an increase in S.fontinalis mortality of all age stages. In contrast, extreme low summer flows reduced survival of large fish, but only in small tributaries, and had no significant effects on fish in smaller size classes in any location (CL Xu et al., 2010).	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	Studies have shown that an increase in temperature leads to an increase in S.fontinalis mortality of all age stages. In contrast, extreme low summer flows reduced survival of large fish, but only in small tributaries, and had no significant effects on fish in smaller size classes in any location (CL Xu et al., 2010).	Medium

Statistics	
Scores	
BRA	**7.0**
BRA Outcome	**-**
BRA+CCA	**-3.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**6.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*2.0*
3. Invasive elsewhere	*0.0*
B. Biology/Ecology	**1.0**
4. Undesirable (or persistence) traits	*4.0*
5. Resource exploitation	*0.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*2.0*
8. Tolerance attributes	*-6.0*
C. Climate change	**-10.0**
9. Climate change	*-10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**7**
Environmental	**-3**
Species or population nuisance traits	**-3**

Thresholds	
BRA	**-**
BRA+CCA	**-**

Confidence	
BRA+CCA	0.52
BRA	0.53
CCA	0.50

Date and Time
28/05/2021 09:08:57

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salvelinus fontinalis*
Common name	brook trout
Assessor	Tena Radocaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Kottelat, M. & Freyhof, J. 2007. Handbook of European Freshwater Fishes. Kottelat, Cornol and Freyhof, Berlin, xiv + 646 pp.	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	In aquaculture, but not in Croatia	Low
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	Kottelat, M. & Freyhof, J. 2007. Handbook of European Freshwater Fishes. Kottelat, Cornol and Freyhof, Berlin, xiv + 646 pp.	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Kottelat, M. & Freyhof, J. 2007. Handbook of European Freshwater Fishes. Kottelat, Cornol and Freyhof, Berlin, xiv + 646 pp. The similarity between climatic conditions RA area and native range is high. I use climatch	Very high
5	2.02	What is the quality of the climate matching data?	High	Kottelat, M. & Freyhof, J. 2007. Handbook of European Freshwater Fishes. Kottelat, Cornol and Freyhof, Berlin, xiv + 646 pp. The quality of the climate matching data is high.	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	S. fontinalis is present outside of captivity in the RA area	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	None	S. fontinalis is present in the RA area	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	S. fontinalis is present in the RA area	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Kottelat, M. & Freyhof, J. 2007. Handbook of European Freshwater Fishes. Kottelat, Cornol and Freyhof, Berlin, xiv + 646 pp	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Kottelat, M. & Freyhof, J. 2007. Handbook of European Freshwater Fishes. Kottelat, Cornol and Freyhof, Berlin, xiv + 646 pp	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	Kottelat, M. & Freyhof, J. 2007. Handbook of European Freshwater Fishes. Kottelat, Cornol and Freyhof, Berlin, xiv + 646 pp	High
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	Kottelat, M. & Freyhof, J. 2007. Handbook of European Freshwater Fishes. Kottelat, Cornol and Freyhof, Berlin, xiv + 646 pp	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	S. fontinalis is mainly used for sports fisheries, so there is an economic benefit for individual fishermen as well as the creation of jobs in the aquaculture industry. In addition to the value of S. fontinalis for individual fishermen, recreational fishing and tourism may create a demand not only for food, accommodation and transportation, but also for related recreational activities such as camping, boating, canoeing, etc. (CABI)	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Kottelat, M. & Freyhof, J. 2007. Handbook of European Freshwater Fishes. Kottelat, Cornol and Freyhof, Berlin, xiv + 646 pp	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	This species adaptable in terms of climatic and other environmental conditions.	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	Maybe, they can influence on food-web structure/function in aquatic ecosystem.	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	no data for Croatia	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Yes, the taxon may be a host or vector of known pests and infectious agents endemic to RA area. Because in every area exist infectious agents and pests.	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Pathogenic bacterium Renibacterium salmoninarum causes kidney disease with high mortality rate and considerable economic losses in salmonid farming. Infections caused by Flavobacterium columnare are much-feared bacterioses, which have economically significant mortality. (Vardić, I., Kapetanović, D., Vailć, D., Kurtović, B., Teskeredžić, Z., & Teskeredžić, E. (2007). DETECTION OF RENIBACTERIUM SALMONINARUM IN TISSUE OF BROOK TROUT (SALVELINUS FONTINALIS) BY NESTED RT–PCR. Croatian Journal of Fisheries, 65(1), 15-24.)	Low

22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	It is possible that it consume endangered and protected native taxa in the RA area. If there are protected taxa in the RA area will consume them, whether or not the taxon is endangered.	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	not applicable	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland. (with S. trutta)	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	1. Young of the year wash downstream by water, adults naturally disperse through migration. 2. Introduced for angling 3. flooding	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	No any of this vectors/pathways bring the taxon in close proximity in the protected areas.	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	There is a possibility of a high rate of spread of taxa. Eg. if a fertilized individual enters a new area by any means of expansion.	Low
43	7.09	Is dispersal of the taxon density dependent?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Not applicable	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Natural enemies of S. fontinalis include larger fish, piscivorous birds (including mergansers and kingfishers) (CABI)	Medium
C. Climate change					
9. Climate change					

50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	not applicable	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	The risks of establishment S.trutta is decreased. Reason for that is increased temperatures because its catch has dramatically declined in several parts of Europe. (Trumbo, B., Hudy, M., Smith, E. P., Kim, D. Y., Wiggins, B. A., Nislow, K. H., & Dolloff, C. A. (2010, September). Sensitivity and vulnerability of brook trout populations to climate change. In Wild trout X: conserving wild trout. Wild Trout Symposium, West Yellowstone, Montana (pp. 62-	Low
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Effects of climate change could be particularly profound for wild trout and aquatic ecosystems. The biology of salmonids is largely dependent on temperature and flow.The risk of spread in the RA area is reduced. Temperatures are a major problem therefore. (Trumbo, B., Hudy, M., Smith, E. P., Kim, D. Y., Wiggins, B. A., Nislow, K. H., & Dolloff, C. A. (2010, September). Sensitivity and vulnerability of brook trout populations to climate change. In Wild trout X: conserving wild trout. Wild Trout Symposium, West Yellowstone, Montana (pp. 62-68)	Low
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Lower (Trumbo, B., Hudy, M., Smith, E. P., Kim, D. Y., Wiggins, B. A., Nislow, K. H., & Dolloff, C. A. (2010, September). Sensitivity and vulnerability of brook trout populations to climate change. In Wild trout X: conserving wild trout. Wild Trout Symposium, West Yellowstone, Montana (pp. 62-68)	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	It is likely to no have impact on the ecosystem and system functioning. 8Trumbo, B., Hudy, M., Smith, E. P., Kim, D. Y., Wiggins, B. A., Nislow, K. H., & Dolloff, C. A. (2010, September). Sensitivity and vulnerability of brook trout populations to climate change. In Wild trout X: conserving wild trout. Wild Trout Symposium, West Yellowstone, Montana (pp. 62-68)	Low
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Trumbo, B., Hudy, M., Smith, E. P., Kim, D. Y., Wiggins, B. A., Nislow, K. H., & Dolloff, C. A. (2010, September). Sensitivity and vulnerability of brook trout populations to climate change. In Wild trout X: conserving wild trout. Wild Trout Symposium, West Yellowstone, Montana (pp. 62-68)	Low

Statistics	
Scores	
BRA	**28.0**
BRA Outcome	**-**
BRA+CCA	**20.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**16.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*14.0*
B. Biology/Ecology	**12.0**
4. Undesirable (or persistence) traits	*7.0*
5. Resource exploitation	*5.0*
6. Reproduction	*2.0*
7. Dispersal mechanisms	*-1.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**-8.0**
9. Climate change	*-8.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**13**
Environmental	**5**
Species or population nuisance traits	**4**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.71**
BRA	**0.75**
CCA	**0.38**

Date and Time
02/06/2020 09:06:41

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salvelinus namaycush*
Common name	lake charr
Assessor	Ana Marić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	RESULTS OF LAKE TROUT STOCKINGS IN FINLAND 1957–81 A. Mutenia.1984	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	RESULTS OF LAKE TROUT STOCKINGS IN FINLAND 1957–81 A. Mutenia.1984	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	S. fontinalis	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	Cf tolerate	High
5	2.02	What is the quality of the climate matching data?	Medium	No comment	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	Horzont species	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Stocking. https://www.cabi.org/isc/datasheet/65327#tosummaryOfInvasiven	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	No	https://www.cabi.org/isc/datasheet/65327#tointroductions	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	https://www.cabi.org/isc/datasheet/65327#tointroductions	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	https://www.cabi.org/isc/datasheet/65327#toriskAndImpactFactors	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	https://www.cabi.org/isc/datasheet/65327#toriskAndImpactFactors	High
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	https://www.cabi.org/isc/datasheet/65327#toriskAndImpactFactors	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	https://www.cabi.org/isc/datasheet/65327#toriskAndImpactFactors	Very high
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	https://www.cabi.org/isc/datasheet/65327#toriskAndImpactFactors	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	https://www.cabi.org/isc/datasheet/65327#toclimate	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	https://www.cabi.org/isc/datasheet/65327#toriskAndImpactFactors	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	Yes	https://www.cabi.org/isc/datasheet/65327#tointroductions	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	https://www.cabi.org/isc/datasheet/65327#toimpactSocial	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	https://www.cabi.org/isc/datasheet/65327#toimpactSocial	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	https://www.cabi.org/isc/datasheet/65327#todescription	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Importance of rearing-unit design and stocking density to the behavior, growth and metabolism of lake trout (Salvelinus namaycush) Author links open overlay panelRobert MRossaBarnaby JWatten. 1998	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	https://www.cabi.org/isc/datasheet/65327#towaterTolerances	Medium

25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	https://www.cabi.org/isc/datasheet/65327#todistributionDatabaseTable	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	https://www.cabi.org/isc/datasheet/65327#todistributionDatabaseTable	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	https://www.cabi.org/isc/datasheet/65327#todistributionDatabaseTable	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Yes	Life history differences parallel environmental differences among North American lake trout (Salvelinus namaycush) populations Jenni L. McDermid, Brian J. Shuter, and Nigel P. Lester. 2009	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	https://www.cabi.org/isc/datasheet/65325#tohistoryOfIntroductionAndSpread S. fontinais is	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Survival, growth and sexual maturation of the tiger trout hybrid (Salmo trutta ♀ × Salvelinus fontinalis ♂) Author links open overlay panelJean MarieBlanc1BernardChevassus2 1986.	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	https://www.cabi.org/isc/datasheet/65327#todistributionDatabaseTable	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	https://www.fishbase.se/summary/Salvelinus-namaycush.html	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	6	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	https://www.cabi.org/isc/datasheet/65327#toriskOfIntroduction stocking	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Depends on stocking activities	Very high
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp	Very high
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	https://www.cabi.org/isc/datasheet/65327#toriskOfIntroduction	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	https://www.cabi.org/isc/datasheet/65325#tohistoryOfIntroductionAndSpread S. fontinalis wasnt rapid, depends on stocking	Very high
43	7.09	Is dispersal of the taxon density dependent?	No	Effectiveness of lake trout (Salvelinus namaycush) suppression in Lake Pend Oreille, Idaho: 2006–2016 Andrew M. Dux, Michael J. Hansen, Matthew P. Corsi, Nicholas C. Wahl, James P. Fredericks, Charles E. Corsi, Daniel J. Schill & Ned J. Horner. 2019	Very high
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Importance of rearing-unit design and stocking density to the behavior, growth and metabolism of lake trout (Salvelinus namaycush) Author links open overlay panelRobert MRossaBarnaby JWatten. 1998	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Acute and chronic toxicity of nitrate to early life stages of lake trout (Salvelinus namaycush) and lake whitefish (Coregonus clupeaformis) Michael D. McGurk, François Landry, Armando Tang, Chris C. Hanks Nitrate	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	https://www.cabi.org/isc/datasheet/65327#topreventionAndControl	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	https://www.cabi.org/isc/datasheet/65327#toriskAndImpactFactors	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Variation in salinity tolerance, gill Na+/K+-ATPase, Na+/K+/2Cl− cotransporter and mitochondria-rich cell distribution in three salmonids Salvelinus namaycush, Salvelinus fontinalis and Salmo salar Junya Hiroi* and Stephen D. McCormick. 2007	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	https://www.cabi.org/isc/datasheet/65327#tonaturalEnemies	High
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	https://www.cabi.org/isc/datasheet/65327#toriskAndImpactFactors	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Non-native fishes and climate change: predicting species responses to warming temperatures in a temperate region J. R. BRITTON*, J. CUCHEROUSSET*, G. D. DAVIES*, †, M. J. GODARD‡ AND G. H. COPP* 2010	Very high

52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Non-native fishes and climate change: predicting species responses to warming temperatures in a temperate region J. R. BRITTON*, J. CUCHEROUSSET*, G. D. DAVIES*, †, M. J. GODARD‡ AND G. H. COPP* 2010	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Non-native fishes and climate change: predicting species responses to warming temperatures in a temperate region J. R. BRITTON*, J. CUCHEROUSSET*, G. D. DAVIES*, †, M. J. GODARD‡ AND G. H. COPP* 2010	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	Non-native fishes and climate change: predicting species responses to warming temperatures in a temperate region J. R. BRITTON*, J. CUCHEROUSSET*, G. D. DAVIES*, †, M. J. GODARD‡ AND G. H. COPP* 2010	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Non-native fishes and climate change: predicting species responses to warming temperatures in a temperate region J. R. BRITTON*, J. CUCHEROUSSET*, G. D. DAVIES*, †, M. J. GODARD‡ AND G. H. COPP* 2010	High

Statistics	
Scores	
BRA	**30.5**
BRA Outcome	**-**
BRA+CCA	**24.5**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**14.5**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*10.5*
B. Biology/Ecology	**16.0**
4. Undesirable (or persistence) traits	*7.0*
5. Resource exploitation	*7.0*
6. Reproduction	*3.0*
7. Dispersal mechanisms	*0.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**-6.0**
9. Climate change	*-6.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**9**
Environmental	**9**
Species or population nuisance traits	**8**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.85**
BRA	**0.86**
CCA	**0.79**

Date and Time
24/05/2021 11:11:40

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salvelinus namaycush*
Common name	lake charr
Assessor	Ivan Špelić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Ackefors, H. (1982). Aquaculture: A New Industry in Sweden. Ambio, 11(6), 362-365. Retrieved April 22, 2020, from www.jstor.org/stable/4312841	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Morissette, O. , Sirois, P. , Lester, N. P. , Wilson, C. C. , & Bernatchez, L. (2018). Supplementation stocking of Lake Trout (Salvelinus namaycush) in small boreal lakes: Ecotypes influence on growth and condition. PLoS ONE, 13, e0200599	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Salvelinus fontinalis	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	Climatch 2020	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Climatch 2020	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	Povž et al. 2018	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Introduction for angling (CABI 2019).	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Austria, Italy (Froese & Pauly 2020).	Medium
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	CABI 2019, Froese & Pauly 2020	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Global Invasive Species Database (2020) Species profile: Salvelinus namaycush. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=1363 on 22-04-	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Rarely used in aquaculture (Fisheries and Aquaculture Department. Introduced Species Fact Sheets. In: FAO Fisheries and Aquaculture Department [online]. Rome. Updated 17 March 2017. [Cited 22 April 2020]), no documented impacts.	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	Pam Fuller, and Matt Neilson, 2020, Salvelinus namaycush (Walbaum in Artedi, 1792): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=942, Revision Date: 11/12/2019, Peer Review Date: 2/2/2016, Access Date: 4/22/2020	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	Pam Fuller, and Matt Neilson, 2020, Salvelinus namaycush (Walbaum in Artedi, 1792): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=942, Revision Date: 11/12/2019, Peer Review Date: 2/2/2016, Access Date: 4/22/2020	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (Froese & Pauly 2020).	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Pam Fuller, and Matt Neilson, 2020, Salvelinus namaycush (Walbaum in Artedi, 1792): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=942, Revision Date: 11/12/2019, Peer Review Date: 2/2/2016, Access Date: 4/22/2020	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No parasitic behaviour.	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Lake trout are a cold-water species requiring relatively high concentrations of dissolved oxygen for survival. Lake trout are the only major native sport fish adapted to the deep, cold water of oligotrophic (low-nutrient) lakes. At the southern range of the species, lake trout require deep water refugia, where preferred temperature ranges and oxygen levels exist (Lenart, S. 2001. "Salvelinus namaycush" (On-line), Animal Diversity Web. Accessed April 22, 2020 at https://animaldiversity.org/accounts/Salvelinus_namaycush/).	Very high

18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	No	Only established in few lakes in Europe (some Alpine and Scandinavian lakes); adverse impact of this type only documented in North America, not in Europe. Crossman, E. J. (1995). Introduction of the Lake Trout (Salvelinus namaycush) in Areas Outside its Native Distribution: A Review. Journal of Great Lakes Research, 21, 17–29. doi:10.1016/s0380-1330(95)71081-4. Eloranta, A. P., Nieminen, P., & Kahilainen, K. K. (2014). Trophic interactions between introduced lake trout (Salvelinus namaycush) and native Arctic charr (S. alpinus) in a large Fennoscandian subarctic lake. Ecology of Freshwater Fish, 24(2).	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	Only established in few lakes in Europe (some Alpine and Scandinavian lakes); adverse impact of this type only documented in North America, not in Europe. Crossman, E. J. (1995). Introduction of the Lake Trout (Salvelinus namaycush) in Areas Outside its Native Distribution: A Review. Journal of Great Lakes Research, 21, 17–29. doi:10.1016/s0380-1330(95)71081-4. Eloranta, A. P., Nieminen, P., & Kahilainen, K. K. (2014). Trophic interactions between introduced lake trout (Salvelinus namaycush) and native Arctic charr (S. alpinus) in a large Fennoscandian subarctic lake. Ecology of Freshwater Fish, 24(2).	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Froese & Pauly 2020	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Froese & Pauly 2020	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	150 cm, 32 kg (Froese & Pauly 2020).	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Occurs in shallow and deep waters of northern lakes and streams (Froese & Pauly 2020).	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Not documented in literature.	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Not documented.	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Feeds on plankton, insects and fishes (Kottelat & Freyhof 2008).	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	No data for calculation.	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Yes	Research has indicated that environmental factors, such as lake size and dissolved solid concentrations, may play a role in the age of first maturity and overall repoductive success of the lake trout (Lenart, S. 2001. "Salvelinus namaycush" (On-line), Animal Diversity Web. Accessed April 22, 2020 at https://animaldiversity.org/accounts/Salvelinus_namaycush/).	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	Established in some high altitude lakes in Pyrenees, north Italy and Scandinavia. In lakes of Alps (France, Switzerland) apparently survives only by stocking (Kottelat & Freyhof 2008).	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No related species in RA area (Kottelat & Freyhof 2008).	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Froese & Pauly 2020	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	David T. Callaghan, Paul J. Blanchfield, Peter A. Cott (2016): Lake trout (Salvelinus namaycush) spawning habitat in a northern lake: The role of wind and physical characteristics on habitat quality. Journal of Great Lakes Research, Volume 42, Issue 2, 2016, Pages	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	18000 eggs per female (Froese & Pauly 2020). Sometimes they don't spawn every year to conserve energy (David T. Callaghan, Paul J. Blanchfield, Peter A. Cott, Lake trout (Salvelinus namaycush) spawning habitat in a northern lake: The role of wind and physical characteristics on habitat quality. Journal of Great Lakes Research, Volume 42, Issue 2, 2016, Pages 299-307).	Medium
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	3 years is minimum, mostly between 5 and 7 (Froese & Pauly 2020).	Low
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Introductions for angling, no spawning in wild is expected (personal opinion).	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	Personal opinion.	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No adaptations.	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Probably no possible reproduction in RA area, even if introduced to adequate habitats similar to Alpine lakes in Switzerland and France (Kottelat & Freyhof 2008).	Medium

39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	Probably no possible reproduction in RA area, even if introduced to adequate habitats similar to Alpine lakes in Switzerland and France (Kottelat & Freyhof 2008).	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	Probably no possible reproduction in RA area, even if introduced to adequate habitats similar to Alpine lakes in Switzerland and France (Kottelat & Freyhof 2008).	Medium
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Probably no possible reproduction in RA area, even if introduced to adequate habitats similar to Alpine lakes in Switzerland and France (Kottelat & Freyhof 2008).	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Introduction for angling.	Very high
43	7.09	Is dispersal of the taxon density dependent?	No	Not documented in literature.	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Sensitive species, not tolerant to low oxygen levels (Lenart, S. 2001. "Salvelinus namaycush" (On-line), Animal Diversity Web. Accessed April 22, 2020 at https://animaldiversity.org/accounts/Salvelinus_namaycush/).	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being considered.]	No	Needs cold water (below 13 deg Celsius) and high concentration of dissloved oxygen (Global Invasive Species Database (2020) Species profile: Salvelinus namaycush. Downloaded from http://www.iucngisd.org/gisd/species.php?sc=1363 on 22-04-2020.; Lenart, S. 2001. "Salvelinus namaycush" (On-line), Animal Diversity Web. Accessed April 22, 2020 at https://animaldiversity.org/accounts/Salvelinus_namaycush/).	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Not applicable	Not allowed in Slovenia.	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Can survive in reservoirs if conditions are met (Pam Fuller, and Matt Neilson, 2020, Salvelinus namaycush (Walbaum in Artedi, 1792): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=942, Revision Date: 11/12/2019, Peer Review Date: 2/2/2016, Access Date: 4/22/2020).	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Muir, A.M., Hansen, M.J., Bronte, C.R. and Krueger, C.C. (2016), If Arctic charr Salvelinus alpinus is 'the most diverse vertebrate', what is the lake charr Salvelinus namaycush?. Fish Fish, 17: 1194-1207. doi:10.1111/faf.12114	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Otters, piscivorous birds, maybe piscivorous fish if present in the habitat (personal opinion).	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Only path is introduction my man so no change expected.	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Needs temperatures under 13 degrees Celsius and high oxygen levels, those habitats will decrease (COMTE, L., BUISSON, L., DAUFRESNE, M. and GRENOUILLET, G. (2013), Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58: 625-639.	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Needs temperatures under 13 degrees Celsius and high oxygen levels, those habitats will decrease (COMTE, L., BUISSON, L., DAUFRESNE, M. and GRENOUILLET, G. (2013), Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58: 625-639.	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Lower impact i unfavourable conditions for cold-water species (COMTE, L., BUISSON, L., DAUFRESNE, M. and GRENOUILLET, G. (2013), Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58: 625-639. https://doi.org/10.1111/fwb.12081).	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	Lower impact i unfavourable conditions for cold-water species (COMTE, L., BUISSON, L., DAUFRESNE, M. and GRENOUILLET, G. (2013), Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58: 625-639. https://doi.org/10.1111/fwb.12081).	Low
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	Lower impact i unfavourable conditions for cold-water species (COMTE, L., BUISSON, L., DAUFRESNE, M. and GRENOUILLET, G. (2013), Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58: 625-639. https://doi.org/10.1111/fwb.12081).	Low

Statistics	
Scores	
BRA	**22.0**
BRA Outcome	**-**
BRA+CCA	**12.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**18.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*14.0*
B. Biology/Ecology	**4.0**
4. Undesirable (or persistence) traits	*4.0*
5. Resource exploitation	*5.0*
6. Reproduction	*-1.0*
7. Dispersal mechanisms	*-4.0*

8. Tolerance attributes	*0.0*
C. Climate change	**-10.0**
9. Climate change	*-10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**10**
Environmental	**5**
Species or population nuisance traits	**-2**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.69**
BRA	**0.72**
CCA	**0.42**

Date and Time
19/05/2021 11:38:25

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salvelinus namaycush*
Common name	lake charr
Assessor	Tamara Kanjuh
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Success of the stocked fish has varied depending on the area (https://animaldiversity.org/accounts/Salvelinus_namaycush/).	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Often caught by fishers (Billard, 1997).	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	Did not find information about invasive ones.	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	Dfa, Dfb (Köppen–Geiger climate classification system)	High
5	2.02	What is the quality of the climate matching data?	High	Köppen–Geiger climate classification system	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Radočaj et al. (2021)	Medium
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Stocking: Salvelinus namaycush is primarily bred and stocked for recreational fisheries worldwide (Fuller, 2007).	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Radočaj et al. (2021)	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	No	No information found.	Medium
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Radočaj et al. (2021)	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	Yes	Radočaj et al. (2021)	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	Radočaj et al. (2021)	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	Radočaj et al. (2021)	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (FishBase)	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	It can happen due to food competition, space occupation, hybridization.	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	The taxon is not a parasite.	High
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Sensitive to environmental conditions.	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	Radočaj et al. (2021)	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No information found.	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No information found.	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No information found.	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	Not in captivity.	Medium
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Radočaj et al. (2021)	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Radočaj et al. (2021)	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	No information found.	Low

5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Radočaj et al. (2021)	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information found.	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	No information found.	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Radočaj et al. (2021)	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	Not native, but yes with Salvelinus fontinalis (Nova Scotia Fisheries and Aquaculture, Inland Fisheries Division, 2007).	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Kottelat&Freyhof (2007)	High
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Kottelat&Freyhof (2007)	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Kottelat&Freyhof (2007)	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	5	Age at maturity varies widely from around 5 years in southern areas of its native range to more than 20 years in northern areas (cabi.org).	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Intentional stockong.	Very high
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Intentional stocking.	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	Kottelat&Feryhof (2007)	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	The dispersal of Salvelinus namaycush downstream and into new tributaries through regular stocking upstream is bound to occur (Hesthagen&Sandlund, 2007).	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	The dispersal of Salvelinus namaycush downstream and into new tributaries through regular stocking upstream is bound to occur (Hesthagen&Sandlund, 2007).	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	In large water bodies such as the Great Lakes, S. namaycush may migrate up to 300 km (186 mi) to their spawning grounds.	Medium
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Kottelat&Freyhof, 2007	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Intentional stocking.	High
43	7.09	Is dispersal of the taxon density dependent?	No	No information found.	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Can not survive out of water.	High
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Sensitive to environmental conditions.	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Yes	Preventative measures: Hewitt et al. (2006); Copp et al. (2005) and physical measures: Kaeding et al. (1996)	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Salvelinus namaycush are particularly susceptible to pollution, including but not limited to insecticides (FishBase, 2008).	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Sensitive to environmental conditions.	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Like other salmonids.	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Sensitive to environmental conditions.	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Sensitive to environmental conditions.	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Sensitive to environmental conditions.	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Sensitive to environmental conditions.	Medium

54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	Sensitive to environmental conditions.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	Sensitive to environmental conditions.	Medium

Statistics	
Scores	
BRA	**12.0**
BRA Outcome	**-**
BRA+CCA	**0.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**9.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*6.0*
B. Biology/Ecology	**3.0**
4. Undesirable (or persistence) traits	*3.0*
5. Resource exploitation	*5.0*
6. Reproduction	*0.0*
7. Dispersal mechanisms	*1.0*
8. Tolerance attributes	*-6.0*
C. Climate change	**-12.0**
9. Climate change	*-12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**9**
Environmental	**6**
Species or population nuisance traits	**-12**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.61**
BRA	**0.63**
CCA	**0.50**

Date and Time
02/06/2021 21:42:47

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salvelinus namaycush*
Common name	lake charr
Assessor	Tena Radocaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Ackefors, H. (1982). Aquaculture: A New Industry in Sweden. Ambio, 11(6), 362-365.	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Morissette, O. , Sirois, P. , Lester, N. P. , Wilson, C. C. , & Bernatchez, L. (2018). Supplementation stocking of Lake Trout (Salvelinus namaycush) in small boreal lakes: Ecotypes influence on growth and condition. PLoS ONE, 13, e0200599	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Salvelinus fontinalis	Medium
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	The similarity between climatic conditions RA area and native range is high. I use climatch.	Medium
5	2.02	What is the quality of the climate matching data?	Medium	The quality of the climate matching data is medium.	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	Lake trout is not present outside of captivity in the RA area.	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	One potential vectors: recreational fisheries. (CABI, 2019)	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Lake trout established populations on the Northern Italy (several localities). (Bianco, P. G., & Ketmaier, V. (2001). Anthropogenic changes in the freshwater fish fauna of Italy, with reference to the central region and Barbus graellsii, a newly established alien species of Iberian origin. Journal of Fish Biology, 59, 190-208.)	Medium
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Lake trout have self-sustaining populations in Norwegian freshwaters and Northern Italy. Lake trout were released in 1971 into two small lakes. (Hesthagen, T., & Sandlund, O. T. (2007). Non-native freshwater fishes in Norway: history, consequences and perspectives. Journal of Fish Biology, 71, 173-183.) (Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.)	Medium
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Lake Trout stocking is associated with declines of toads in the Alps and of salamanders Euproctis sp. in the Pyrenees. (Lobón-Cerviá, J., Esteve, M., Berrebi, P., Duchi, A., Lorenzoni, M., & Young, K. A. (2019). Trout and char of central and Southern Europe and Northern Africa. Trout and char of the world. Bethesda, Maryland: American Fisheries Society.)	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Rarely used in aquaculture (Fisheries and Aquaculture Department. Introduced Species Fact Sheets. In: FAO Fisheries and Aquaculture Department [online]. Rome. Updated 17 March 2017. [Cited 22 April 2020]), no documented impacts.	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	Yes	The introduction of the invasive trout species Salvelinus namaycush has had detrimental effects on native biodiversity worldwide. Many various species of fish are affected not only by competition but by predation as well (Fuller, 2007). (GISD, 2009)	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	Yes	Pam Fuller, and Matt Neilson, 2020, Salvelinus namaycush (Walbaum in Artedi, 1792): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=942, Revision Date: 11/12/2019, Peer Review Date	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Lake trout is harmless for human health (Fishbase)	Low
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Pam Fuller, and Matt Neilson, 2020, Salvelinus namaycush (Walbaum in Artedi, 1792): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=942, Revision Date: 11/12/2019, Peer Review Date	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No	Medium
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Lake trout use habitat: temperate; 4°C - 13°C, it is not enough to survive in Croatia. (Fishbase- Michigan Department of Natural Resources, 2019. Lake trout. https://www.michigan.gov/dnr/0,8817,7-350-	Low
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	Because, it not survive in RA area	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	The taxon will not have an adverse impact on ecosystem services in the RA area.	Low

20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Yes, the taxon may be a host or vector of known pests and infectious agents endemic to RA area. Because in every area exist infectious agents and pests.	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Salmonid Herpesvirus-3, commonly known as the Epizootic Epitheliotropic Disease virus (EEDV), causes a disease of lake trout (Salvelinus namaycush) that has killed millions of fish over the past several decades. (Faisal, M., Purbayu, M., Shavalier, M. A., Marsh, T. L., & Loch, T. P. (2019). Shedding of the Salmonid Herpesvirus-3 by Infected Lake Trout (Salvelinus namaycush).	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Size up 10 about 1000 mm SL. usually 350-450 mm SL. (Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.)	Medium
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	Occurs in shallow and deep waters of northern lakes and streams (Froese & Pauly 2020).	Low
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	no data available	Low
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	no data available	Medium
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	It is possible that it consume endangered and protected native taxa in the RA area. If there are protected taxa in the RA area will consume them, whether or not the taxon is endangered.	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	not applicable	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Yes	Lenart, S. 2001. "Salvelinus namaycush" (On-line), Animal Diversity Web. Accessed May 15, 2020 at https://animaldiversity.org/accounts/Salvelinus_namaycush/	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	Established in some high altitude lakes in Pyrenees, north Italy and Scandinavia. In lakes of Alps (France, Switzerland) apparently survives only by stocking (Kottelat & Freyhof 2008).	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	David T. Callaghan, Paul J. Blanchfield, Peter A. Cott (2016): Lake trout (Salvelinus namaycush) spawning habitat in a northern lake: The role of wind and physical characteristics on habitat quality. Journal of Great Lakes Research, Volume 42, Issue 2, 2016, Pages	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	David T. Callaghan, Paul J. Blanchfield, Peter A. Cott, Lake trout (Salvelinus namaycush) spawning habitat in a northern lake: The role of wind and physical characteristics on habitat quality. Journal of Great Lakes Research, Volume 42, Issue 2, 2016, Pages 299-	Medium
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	6	Spawns for the first time at 6-7 years. (Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.)	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Two potential vectors: natural dispersal and recreational fisheries.	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	That vector/pathway can't bring taxon in protected area.	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No adaptations.	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Probably no possible reproduction in RA area, even if introduced to adequate habitats similar to Alpine lakes in Switzerland and France (Kottelat & Freyhof 2008).	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	Probably no possible reproduction in RA area, even if introduced to adequate habitats similar to Alpine lakes in Switzerland and France (Kottelat & Freyhof 2008).	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	Probably no possible reproduction in RA area, even if introduced to adequate habitats similar to Alpine lakes in Switzerland and France (Kottelat & Freyhof 2008).	Low
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Probably no possible reproduction in RA area, even if introduced to adequate habitats similar to Alpine lakes in Switzerland and France (Kottelat & Freyhof 2008).	Medium
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	There is a possibility of a high rate of spread of taxa. Eg. if a fertilized individual enters a new area by any means of expansion.	Low
43	7.09	Is dispersal of the taxon density dependent?	No	no data available	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Sensitive species, not tolerant to low oxygen levels	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	S. namaycush prefers temperatures below 13°C and is rarely found in lakes with pH less than 5.2 (Global Invasive Species Database (2020) Species profile: Salvelinus namaycush. Downloaded from	Low

46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Not applicable	It is not regulated in Croatia	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	Yes	Pam Fuller, and Matt Neilson, 2020, Salvelinus namaycush (Walbaum in Artedi, 1792): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=942, Revision Date: 11/12/2019, Peer Review Date: 2/2/2016, Access Date: 4/22/2020).	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Muir, A.M., Hansen, M.J., Bronte, C.R. and Krueger, C.C. (2016), If Arctic charr Salvelinus alpinus is 'the most diverse vertebrate', what is the lake charr Salvelinus namaycush?. Fish Fish, 17: 1194-1207. doi:10.1111/faf.12114	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Otters, piscivorous birds..	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	The risk of entering the RA area does not change. The risk may be increased due to recreational fishing (human impact), but not due to climate change.	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Cold water species, tolerates water up to about 13 degrees Celsius (Fishbase)	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Cold water species, tolerates water up to about 13 degrees Celsius (Fishbase)	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Future potential impacts on biodiversity and ecological status will lower.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	The future potential impacts on ecosystem structure and function will lower.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	The future potential impacts on ecosystem services and socio-economic factors will lower.	Medium

Statistics	
Scores	
BRA	**21.0**
BRA Outcome	**-**
BRA+CCA	**11.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**18.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*14.0*
B. Biology/Ecology	**3.0**
4. Undesirable (or persistence) traits	*3.0*
5. Resource exploitation	*5.0*
6. Reproduction	*-2.0*
7. Dispersal mechanisms	*-3.0*
8. Tolerance attributes	*0.0*
C. Climate change	**-10.0**
9. Climate change	*-10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**11**
Environmental	**5**
Species or population nuisance traits	**-3**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.44**
BRA	**0.43**
CCA	**0.50**

Date and Time
15/05/2020 14:02:35

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salvelinus umbla*
Common name	Alpine charr
Assessor	Ana Marić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	No	Differences in immune components of blood, spleen and head kidney between diploid and auto- and allotriploid Salmonidae Author links open overlay panelFranzLahnsteiner. 2020	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	Salvelinus fontinalis Identifying threats from introduced and translocated non-native freshwater fishes in neighbouring countries under current and future climatic conditions Tena Radočaj a, Ivan Špelić a, Lorenzo Vilizzi b, *, Meta Povž c, Marina	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	Only few high altitude lakes in target area	High
5	2.02	What is the quality of the climate matching data?	Medium	Climatch	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	Identifying threats from introduced and translocated non-native freshwater fishes in neighbouring countries under current and future climatic conditions Tena Radočaj a, Ivan Špelić a, Lorenzo Vilizzi b, *, Meta Povž c, Marina Piria. 2021	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Stocking	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018 Is it likely to enter? Horizont species	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	Very high
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	Very high
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	High
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	High
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	https://www.fishbase.se/summary/Salvelinus-umbla.html	High

23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Key factors explaining critical swimming speed in freshwater fish: a review and statistical analysis for Iberian species Carlos Cano-Barbacil, Johannes Radinger, María Argudo, Francesc Rubio-Gracia, Anna Vila-Gispert & Emili García-Berthou 2020	Medium
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	Very high
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	High
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018 fishbase	Very high
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Yes	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Non-native Freshwater Fishes in Slovenia Meta Povž. 2017	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Salmo x Salvelinus	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	https://www.fishbase.se/summary/Salvelinus-umbla.html	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	https://www.fishbase.se/summary/Salvelinus-umbla.html	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	https://www.fishbase.se/summary/Salvelinus-umbla.html	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Kottelat. 2007	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Stocking	Very high
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Stocking	Very high
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	https://www.fishbase.se/summary/Salvelinus-umbla.html	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	https://www.fishbase.se/summary/Salvelinus-umbla.html	Very high
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	https://www.fishbase.se/summary/Salvelinus-umbla.html by stocking yes	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	https://www.fishbase.se/summary/Salvelinus-umbla.html yes by stocking	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	https://www.fishbase.se/summary/Salvelinus-umbla.html	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	High
43	7.09	Is dispersal of the taxon density dependent?	No	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Not applicable	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	High
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Salvelinus fontinalis is	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA area?	Yes	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	Very high
C. Climate change					
9. Climate change					

50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	Very high
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	No change	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	Very high
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	Very high
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	Trout and Char of Central and Southern Europe and Northern Africa Javier Lobón-Cerviá, Manu Esteve, Patrick Berrebi, Antonino Duchi, Massimo Lorenzoni, Kyle A. Young. 2018	High

Statistics	
Scores	
BRA	**14.5**
BRA Outcome	**-**
BRA+CCA	**8.5**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**3.5**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*1.5*
B. Biology/Ecology	**11.0**
4. Undesirable (or persistence) traits	*2.0*
5. Resource exploitation	*7.0*
6. Reproduction	*3.0*
7. Dispersal mechanisms	*0.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**-6.0**
9. Climate change	*-6.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**-1**
Environmental	**4**
Species or population nuisance traits	**7**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.85**
BRA	**0.84**
CCA	**0.92**

Date and Time
24/05/2021 15:36:09

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salvelinus umbla*
Common name	Alpine charr
Assessor	Ivan Špelić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	For stocking programs (Kottelat & Freyhof 2007).	Medium
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Restocking of lakes (Kottelat & Freyhof 2007).	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	Yes	S. fontinalis (CABI 2019)	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Low	Climatch 2020	Medium
5	2.02	What is the quality of the climate matching data?	Medium	Climatch 2020	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	Lenhardt, M., Markovic, G., Hegedis, A., Maletin, S., Cirkovic, M., Markovic, Z., 2011. Non-native and translocated fish species in Serbia and their impact on the native ichthyofauna. Reviews in Fish Biology and Fisheries 21, 407–421.. doi:10.1007/s11160-010-	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Introduction for angling.	Low
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Slovenia (Povž 2018).	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Povž et al. 2018	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	Usually introduced to lakes without any fish species (Schabetsberger, R., Luger, M.S., Drozdowski, G., Jagsch, A., 2009. Only the small survive: monitoring long-term changes in the zooplankton community of an Alpine lake after fish introduction. Biological Invasions.. doi:10.1007/s10530-008-9341-	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Usually introduced to lakes without any fish species (Schabetsberger, R., Luger, M.S., Drozdowski, G., Jagsch, A., 2009. Only the small survive: monitoring long-term changes in the zooplankton community of an Alpine lake after fish introduction. Biological Invasions.. doi:10.1007/s10530-008-9341-	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	Usually introduced to lakes without any fish species (Schabetsberger, R., Luger, M.S., Drozdowski, G., Jagsch, A., 2009. Only the small survive: monitoring long-term changes in the zooplankton community of an Alpine lake after fish introduction. Biological Invasions.. doi:10.1007/s10530-008-9341-	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Usually introduced to lakes without any fish species (Schabetsberger, R., Luger, M.S., Drozdowski, G., Jagsch, A., 2009. Only the small survive: monitoring long-term changes in the zooplankton community of an Alpine lake after fish introduction. Biological Invasions.. doi:10.1007/s10530-008-9341-	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (Froese & Pauly).	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Adverse impact on large zooplankton (Schabetsberger, R., Luger, M.S., Drozdowski, G., Jagsch, A., 2009. Only the small survive: monitoring long-term changes in the zooplankton community of an Alpine lake after fish introduction. Biological Invasions.. doi:10.1007/s10530-008-9341-z).	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No parasitic behaviour.	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Limited to deep, cold lakes (Povž et al. 2015).	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA area?	Yes	Depletes large zooplankton (Schabetsberger, R., Luger, M.S., Drozdowski, G., Jagsch, A., 2009. Only the small survive: monitoring long-term changes in the zooplankton community of an Alpine lake after fish introduction. Biological Invasions.. doi:10.1007/s10530-008-9341-z).	Medium
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	Usually introduced to lakes without other fish species to improve fishing (Aparicio, E., 2015. First record of a self-sustaining population of Alpine charr Salvelinus umbla (Linnaeus, 1758) (Actinopterygii, Salmonidae) in Spain. Graellsia..	Medium

20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA area?	Yes	Achleitner, D., Gassner, H., & Schabetsberger, R. (2009). "Global worming": first record of an epidemic ofTriaenophorus crassusin a population of Arctic charrSalvelinus umbla. Journal of Fish Biology, 74(4), 961–966. doi:10.1111/j.1095-8649.2008.02166.x	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Achleitner, D., Gassner, H., & Schabetsberger, R. (2009). "Global worming": first record of an epidemic ofTriaenophorus crassusin a population of Arctic charrSalvelinus umbla. Journal of Fish Biology, 74(4), 961–966. doi:10.1111/j.1095-8649.2008.02166.x	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Maximum length 110 cm (Povž et al. 2015).	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	This species rarely thrives in running waters (Aparicio, E., 2015. First record of a self-sustaining population of Alpine charr Salvelinus umbla (Linnaeus, 1758) (Actinopterygii, Salmonidae) in Spain. Graellsia.. doi:10.3989/graellsia.2015.v71.147).	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Lives in oligotrophic lakes, no behaviour to reduce habitat quality (Freyhof, J. & Kottelat, M. 2008. Salvelinus umbla. The IUCN Red List of Threatened Species 2008: e.T135426A4127943. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T135426A4127943.en. Downloaded on 07 May 2020.).	Very high
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Resilience low, minimum population doubling time 4.5 - 14 years (Froese & Pauly 2020). Usually maintained by stocking.	High
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Preys on crustaceans, insects and benthic fauna; a few individuals develop as large piscivores (Kottelat & Freyhof 2007).	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	No data for calculation.	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Kottelat & Freyhof 2007.	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	Needs deep lakes to spawn. Spawns on pebble to stone bottom on steep slopes, at depths of 30-120 m (Kottelat & Freyhof 2007). Reproduction in Alpine lakes.	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No documented hybrids in the wild with native species of RA area	Medium
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Kottelat & Freyhof 2007	High
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	Needs deep lakes to spawn. Spawns on pebble to stone bottom on steep slopes, at depths of 30-120 m (Kottelat & Freyhof 2007).	Medium
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Up to 7300 eggs per female (Povž et al. 2015).	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	2-3 years (Kottelat & Freyhof 2007).	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Stocking for angling (Povž et al. 2018).	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Personal opinion (some protected areas with lakes, e.g. Plitvice lakes).	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No adaptations.	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Even if spawning, eggs are deposited in deep part of lakes (Kottelat & Freyhof 2007).	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	No spawning expected.	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	No spawning expected.	Low
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Even if spawning, eggs are deposited in deep part of lakes (Kottelat & Freyhof 2007).	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Introductions, escapes.	High
43	7.09	Is dispersal of the taxon density dependent?	No	Not documented.	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Not likely for any Salmonidae species.	High
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being considered.]	No	Inhabits pristine Alpine lakes, very sensitive to eutrophication (Freyhof, J. & Kottelat, M. 2008. Salvelinus umbla. The IUCN Red List of Threatened Species 2008: e.T135426A4127943. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T135426A4127943.en. Downloaded on 07 May 2020.).	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	Not allowed	Very high

47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Freyhof, J. & Kottelat, M. 2008. Salvelinus umbla. The IUCN Red List of Threatened Species 2008: e.T135426A4127943. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T135426A4127943.en. Downloaded on 07 May 2020.	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Only landlocked populations in lakes (Freyhof, J. & Kottelat, M. 2008. Salvelinus umbla. The IUCN Red List of Threatened Species 2008: e.T135426A4127943. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T135426A4127943.en. Downloaded on 07 May 2020.).	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Probably otters and piscivorous birds (personal opinion).	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Only pathway is human introduction, not influenced by climate.	Low
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Restricted to cold water habitats (Aparicio, E., 2015. First record of a self-sustaining population of Alpine charr Salvelinus umbla (Linnaeus, 1758) (Actinopterygii, Salmonidae) in Spain. Graellsia.. doi:10.3989/graellsia.2015.v71.147). Jonsson, T., Setzer, M., 2015. A freshwater predator hit twice by the effects of warming across trophic levels. Nature Communications.. doi:10.1038/ncomms6992. Suitable habitats will decrase (Less impact on zooplanktpn communities under predicted less favourable conditions for coldwater species (Lower impact i unfavourable conditions for cold-water species (COMTE, L., BUISSON, L., DAUFRESNE, M. and GRENOUILLET, G. (2013), Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58: 625-639. https://doi.org/10.1111/fwb.12081).))	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Restricted to cold water habitats (Aparicio, E., 2015. First record of a self-sustaining population of Alpine charr Salvelinus umbla (Linnaeus, 1758) (Actinopterygii, Salmonidae) in Spain. Graellsia.. doi:10.3989/graellsia.2015.v71.147). Jonsson, T., Setzer, M., 2015. A freshwater predator hit twice by the effects of warming across trophic levels. Nature Communications.. doi:10.1038/ncomms6992. Suitable habitats will decrase (Less impact on zooplanktpn communities under predicted less favourable conditions for coldwater species (Lower impact i unfavourable conditions for cold-water species (COMTE, L., BUISSON, L., DAUFRESNE, M. and GRENOUILLET, G. (2013), Climate-induced changes in the distribution of freshwater fish: observed and predicted trends. Freshwater Biology, 58: 625-639. https://doi.org/10.1111/fwb.12081).))	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Restricted to cold water habitats (Aparicio, E., 2015. First record of a self-sustaining population of Alpine charr Salvelinus umbla (Linnaeus, 1758) (Actinopterygii, Salmonidae) in Spain. Graellsia.. doi:10.3989/graellsia.2015.v71.147). Jonsson, T., Setzer, M., 2015. A freshwater predator hit twice by the effects of warming across trophic levels. Nature Communications.. doi:10.1038/ncomms6992. Decreased possible impact on plankton	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	Restricted to cold water habitats (Aparicio, E., 2015. First record of a self-sustaining population of Alpine charr Salvelinus umbla (Linnaeus, 1758) (Actinopterygii, Salmonidae) in Spain. Graellsia.. doi:10.3989/graellsia.2015.v71.147). Jonsson, T., Setzer, M., 2015. A freshwater predator hit twice by the effects of warming across trophic levels. Nature Communications.. doi:10.1038/ncomms6992. Decreased possible impact on plankton	Low
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	So far no adverse impact, no change expected.	Medium

Statistics	
Scores	
BRA	**6.0**
BRA Outcome	**-**
BRA+CCA	**-2.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**5.0**
1. Domestication/Cultivation	*4.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*1.0*
B. Biology/Ecology	**1.0**
4. Undesirable (or persistence) traits	*4.0*
5. Resource exploitation	*5.0*
6. Reproduction	*-2.0*
7. Dispersal mechanisms	*-2.0*
8. Tolerance attributes	*-4.0*
C. Climate change	**-8.0**
9. Climate change	*-8.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*

5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**5**
Environmental	**3**
Species or population nuisance traits	**-7**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.65**
BRA	**0.67**
CCA	**0.46**

Date and Time
19/05/2021 11:39:58

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salvelinus umbla*
Common name	Alpine charr
Assessor	Tamara Kanjuh
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	cabi.org	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	cabi.org	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No information found.	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	Dfa, Dfb (Köppen–Geiger climate classification system)	High
5	2.02	What is the quality of the climate matching data?	High	Köppen–Geiger climate classification system	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Radočaj et al. (2021)	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Intentional stocking.	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	Radočaj et al. (2021)	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Established populations (Simonović, 2001; Aparicio, 2015)	High
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Established populations (Simonović, 2001)	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Not known.	Medium
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	Not known.	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Not known.	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (FishBase)	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Established populations (Simonović, 2001)	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	The taxon is not a parasite.	High
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	Established populations (Simonović, 2001)	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	Yes	Established populations (Simonović, 2001)	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No information found.	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No information found.	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No information found.	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	No information found.	Medium
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Established populations (Simonović, 2001)	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	Yes	Established populations (Simonović, 2001)	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Established populations (Simonović, 2001)	High

5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Established populations (Simonović, 2001)	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information found.	Medium
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Kottelat&Freyhof (2007)	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Established populations (Simonović, 2001)	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	Kottelat&Freyhof (2007)	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Kottelat&Freyhof (2007)	High
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Kottelat&Freyhof (2007)	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Kottelat&Freyhof (2007)	High
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	5	Similar to other salmonids.	Medium
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Intentional stocking.	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Intentional stocking.	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	Kottelat&Freyhof (2007)	High
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Not known.	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Could disperse as juveniles.	Medium
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	Kottelat&Freyhof (2007)	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Kottelat&Feeyhof (2007)	High
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Intentional stocking.	High
43	7.09	Is dispersal of the taxon density dependent?	No	No information found.	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Kottelat&Freyhof (2007)	High
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	The taxon is sensitive to enviromental conditions.	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	No information found.	Medium
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	The taxon is sensitive to enviromental conditions.	Medium
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	The taxon is sensitive to enviromental conditions.	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	As other salmonids.	High
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	The taxon is sensitive to enviromental conditions.	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	The taxon is sensitive to enviromental conditions.	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	The taxon is sensitive to enviromental conditions.	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	The taxon is sensitive to enviromental conditions.	Medium

54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	The taxon is sensitive to enviromental conditions.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	The taxon is sensitive to enviromental conditions.	Medium

Statistics	
Scores	
BRA	**12.0**
BRA Outcome	**-**
BRA+CCA	**0.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**6.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*3.0*
B. Biology/Ecology	**6.0**
4. Undesirable (or persistence) traits	*6.0*
5. Resource exploitation	*5.0*
6. Reproduction	*0.0*
7. Dispersal mechanisms	*-1.0*
8. Tolerance attributes	*-4.0*
C. Climate change	**-12.0**
9. Climate change	*-12.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**5**
Environmental	**4**
Species or population nuisance traits	**-6**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.64**
BRA	**0.65**
CCA	**0.50**

Date and Time
03/06/2021 11:46:49

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Salvelinus umbla*
Common name	Alpine charr
Assessor	Tena Radocaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	In Switzerland, Alpine Char supports important recreational and commercial fisheries and char are economically and culturally important in mountainous areas of France. (Lobón-Cerviá, J., Esteve, M., Berrebi, P., Duchi, A., Lorenzoni, M., & Young, K. A. (2019). Trout and char of central and Southern Europe and Northern Africa. Trout and char of the world. Bethesda, Maryland:	Medium
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	In Switzerland, Alpine Char supports important recreational and commercial fisheries and it is a popular food in homes and restaurants. (Lobón-Cerviá, J., Esteve, M., Berrebi, P., Duchi, A., Lorenzoni, M., & Young, K. A. (2019). Trout and char of central and Southern Europe and Northern Africa. Trout and char of the world. Bethesda, Maryland: American Fisheries Society.)	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	No	Low
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	The similarity between climatic conditions RA area and native range is high. I use climatch.	Medium
5	2.02	What is the quality of the climate matching data?	Medium	The quality of the climate matching data is medium.	Medium
6	2.03	Is the taxon already present outside of captivity in the RA area?	No	Salvelinus umbla is not present outside of captivity in the RA area.	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Sport fishing (Povž, M. (2017). Non-native freshwater fishes in Slovenia. Acta Zoologica Bulgarica, 9, 105-110.)	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	It established in Slovenia (Povž, M. (2017). Non-native freshwater fishes in Slovenia. Acta Zoologica Bulgarica, 9, 105-110.)	Medium
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Spain (Aparicio, E. (2015). First record of a self-sustaining population of Alpine charr Salvelinus umbla (Linnaeus. 1758)(Actinopterygii, Salmonidae) in Spain. Graellsia, 71(2),	Low
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Schabetsberger, R., Luger, M. S., Drozdowski, G., & Jagsch, A. (2009). Only the small survive: monitoring long-term changes in the zooplankton community of an Alpine lake after fish introduction. Biological Invasions, 11(6), 1335-1345.)	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	no data available	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	no data available	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	no data available	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Salvelinus umbla is harmless (Fishbase)	Medium
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Nine years after stocking of fertile charr, the two calanoids had virtually disappeared, and Daphnia rosea had notably declined in abundance. (Schabetsberger, R., Luger, M. S., Drozdowski, G., & Jagsch, A. (2009). Only the small survive: monitoring long-term changes in the zooplankton community of an Alpine lake after fish introduction. Biological Invasions, 11(6), 1335-1345.)	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Although is similarity climatic conditions natural range and RA area is high, this species won't survive in RA area because of high temperatures in RA area. S. umbla lives in high altitude lakes and deep lakes in glacial valleys.	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	S.umbla does not disrupt food-web structure or function in the aquatic ecosystem in the RA area.	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	The taxon does not have an adverse impact on ecosystem services in the RA area.	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Yes, the taxon may be a host or vector of known pests and infectious agents endemic to RA area. Because in every area exist infectious agents and pests.	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Achleitner, D., Gassner, H., & Schabetsberger, R. (2009). 'Global worming': first record of an epidemic of Triaenophorus crassus in a population of Arctic charr Salvelinus umbla. Journal of Fish Biology, 74(4), 961-966.	Medium

22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Max length : 75.0 cm SL (Fishbase)	Medium
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	S.umbla inhabit of northern lakes (Freyhof, J. & Kottelat, M. 2008. Salvelinus umbla. The IUCN Red List of Threatened Species 2008: e.T135426A4127943)	Low
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	no data available	Low
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	no data available	Low
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	It is possible that it consume endangered and protected native taxa in the RA area. If there are protected taxa in the RA area will consume them, whether or not the taxon is endangered. Preys on crustaceans, insects and benthic fauna; a few individuals develop as large piscivores (Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp)	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	Not applicable	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Personal opinion	Low
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	No	The species is found in many Alpine and sub-Alpine lakes in France, Switzerland, Germany, Italy and Austria. (Freyhof, J. & Kottelat, M. 2008. Salvelinus umbla. The IUCN Red List of Threatened Species 2008: e.T135426A4127943)	Low
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	Kottelat, M. and J. Freyhof 2007 Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland.	Low
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Personal opinion	Low
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Personal opinion	Low
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	Spawns for the first time at 2-3 years. (Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.)	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Release for sport fishing, self- reproduction (Povž, M. (2017). Non-native freshwater fishes in Slovenia. Acta Zoologica Bulgarica, 9, 105-110.)	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	No	No	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No adaptations.	Medium
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Freyhof, J. & Kottelat, M. 2008. Salvelinus umbla. The IUCN Red List of Threatened Species 2008: e.T135426A4127943	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	Freyhof, J. & Kottelat, M. 2008. Salvelinus umbla. The IUCN Red List of Threatened Species 2008: e.T135426A4127943)	Low
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	No	Freyhof, J. & Kottelat, M. 2008. Salvelinus umbla. The IUCN Red List of Threatened Species 2008: e.T135426A4127943	Low
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Freyhof, J. & Kottelat, M. 2008. Salvelinus umbla. The IUCN Red List of Threatened Species 2008: e.T135426A4127943)	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	There is a possibility of a high rate of spread of taxa. Eg. if a fertilized individual enters a new area by any means of expansion.	Low
43	7.09	Is dispersal of the taxon density dependent?	No	Personal opinion	Low
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Personal opinion	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Sensitive species (personal opinion)	Low
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Not applicable	It is not regulated in Croatia	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	(Freyhof, J. & Kottelat, M. 2008. Salvelinus umbla. The IUCN Red List of Threatened Species 2008: e.T135426A4127943)	Medium

48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Freshwater fish (Zavod za ribištvo Slovenije. BiosWeb. [online], Ljubljana, Zavod za ribištvo Slovenije, 2014, [Posodobljeno 21.05.2020], [Citirano 21.05.2020], Salvelinus umbla, http://www.biosweb.org/index.php?task=taxonsheet&tid=2773, Dostopno na spletnem naslovu: <www.biosweb.org>, ISSN 2350-4757)	Medium
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Otters, piscivorous birds..	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	The risk of entering the RA area does not change. The risk may be increased due to recreational fishing (human impact), but not due to climate change.	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Jonsson, T., & Setzer, M. (2015). A freshwater predator hit twice by the effects of warming across trophic levels. Nature Communications, 6(1), 1-9.	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Jonsson, T., & Setzer, M. (2015). A freshwater predator hit twice by the effects of warming across trophic levels. Nature Communications, 6(1), 1-9.	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Future potential impacts on biodiversity and ecological status will not change.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	The future potential impacts on ecosystem structure and function will not change.	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	The future potential impacts on ecosystem services and socio-economic factors will not change.	Medium

Statistics	
Scores	
BRA	**9.0**
BRA Outcome	**-**
BRA+CCA	**5.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**8.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*6.0*
B. Biology/Ecology	**1.0**
4. Undesirable (or persistence) traits	*3.0*
5. Resource exploitation	*5.0*
6. Reproduction	*0.0*
7. Dispersal mechanisms	*-3.0*
8. Tolerance attributes	*-4.0*
C. Climate change	**-4.0**
9. Climate change	*-4.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**9**
Environmental	**5**
Species or population nuisance traits	**-7**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.40**
BRA	**0.39**
CCA	**0.50**

Date and Time
21/05/2020 09:56:08

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Thymallus thymallus*
Common name	grayling
Assessor	Ana Marić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Distribution of Pseudomonas fluorescens and Aeromonas hydrophila Bacteria in a Recirculating Aquaculture System during Farming of European Grayling (Thymallus thymallus L.) Broodstock Iwona Goła´s 1,* , Mariusz Szmyt , Jacek Potorski 1, Michał Łopata 3 Anna Gotkowska-Płachta 1 and Katarzyna Gli ´nska-Lewczuk 2019. Yes for brroodstock not easily Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management.	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Naredba o merama za očuvanje i zaštitu ribljeg fonda "Službeni glasnik RS", br. 104/2009 Na osnovu člana 21. stav 2. Zakona o zaštiti i održivom korišćenju ribljeg fonda	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	https://climatch.cp1.agriculture.gov.au/climatch.jsp	High
5	2.02	What is the quality of the climate matching data?	Medium	https://climatch.cp1.agriculture.gov.au/climatch.jsp	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Genetic differentiation of European grayling (Thymallus thymallus) populations in Serbia, based on mitochondrial and nuclear DNA analyses Saša Marić1*, Andrej Razpet2, Vera Nikolić1, Predrag Simonović1 2011	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Intentional, stocking	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	National Aquaculture Sector Overview Slovenia.2005. Food and Agriculture Organization of the United Nations for a world without hunger	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its native range?	Yes	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	High
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	Very high
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem services?	No	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	Very high
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	High
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	High
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	High

20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA area?	Yes	Reservoir hosts for Gyrodactylus salaris may play a more significant role in epidemics than previously thought Giuseppe Paladini1*, Haakon Hansen2, Chris F Williams3, Nick GH Taylor4, Olga L Rubio-Mejía1, Scott J Denholm5, Sigurd Hytterød1, James E Bron1 and Andrew P Shinn 2014 Distribution of Pseudomonas fluorescens and Aeromonas hydrophila Bacteria in a Recirculating Aquaculture System during Farming of European Grayling (Thymallus thymallus L.) Broodstock Iwona Goła´s 1,* , Mariusz Szmyt , Jacek Potorski 1, Michał Łopata 3 Anna Gotkowska-Płachta	High
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Distribution of Pseudomonas fluorescens and Aeromonas hydrophila Bacteria in a Recirculating Aquaculture System during Farming of European Grayling (Thymallus thymallus L.) Broodstock Iwona Goła´s 1,* , Mariusz Szmyt , Jacek Potorski 1, Michał Łopata 3 Anna Gotkowska-Płachta 1 and Katarzyna Gli	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	High
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	Very high
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	High
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	High
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp. Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	High
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	High
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	One	Stocking. Hatcheries escape?	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Genetic differentiation of European grayling (Thymallus thymallus) populations in Serbia, based on mitochondrial and nuclear DNA analyses Saša Marić1*, Andrej Razpet2, Vera Nikolić1, Predrag Simonović1 2011	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof, Berlin. 646 pp.	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	No	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	High
43	7.09	Is dispersal of the taxon density dependent?	Yes	REF	Medium
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	Very high

45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Not applicable	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	Yes	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	High
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Kottelat, M. and J. Freyhof, 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol and Freyhof,	Very high
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	High
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	High
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	Genetic caracterisation of European grayling populations (Thymallus thymallus): Implications for conservation and management. Bernhard Gum. 2006.	High

Statistics	
Scores	
BRA	**12.5**
BRA Outcome	**-**
BRA+CCA	**8.5**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**4.5**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*1.5*
B. Biology/Ecology	**8.0**
4. Undesirable (or persistence) traits	*3.0*
5. Resource exploitation	*5.0*
6. Reproduction	*2.0*
7. Dispersal mechanisms	*-1.0*
8. Tolerance attributes	*-1.0*
C. Climate change	**-4.0**
9. Climate change	*-4.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**4**
Environmental	**6**
Species or population nuisance traits	**1**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.82**
BRA	**0.83**
CCA	**0.71**

Date and Time
17/05/2021 00:14:57

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Thymallus thymallus*
Common name	grayling
Assessor	Ivan Špelić
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Farming for restocking (FAO)	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Farmed and sold live for restocking of open waters (FAO)	Very high
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	Personal opinion	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	Climatch 2020	Low
5	2.02	What is the quality of the climate matching data?	Low	Climatch 2020	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	Cetina with tributaries (personal observation).	Very high
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	Not applicable	Already present	Very high
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	Already present	Very high
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	easily reproduce in new areas (personal data)	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	Yes	Hybridizing with native endemic subspecies (Horvath et al. 2014)	Very high
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	in this areas there is no such activities	Very high
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	Yes	Reducing population of endemic subspecies (Horvath et al 2014)	High
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	Similar angling suitability as native lineage.	Medium
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless (Froese & Pauly 2019)	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	Yes	Native lineage of grayling (Horvath et al 2014)	High
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No examples	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Very sensitive to pollution (Froese & Pauly 2019), cool water species and needs high oxygen levels.	Very high
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No such examples,	High
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	Suitable for angling, no known adverse impacts.	Medium
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Susceptible to pathogens (Grayling (Thymallus thymallus) Ecological Risk Screening Summary. U.S. Fish & Wildlife Service, February 2015. Revised, March 2017, April 2017. Web Version,	Medium
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	Could bring some pathogens when stocked from fish farms (personal opinion), proved to be a vector of Gyrodactylus salaris parasite (Paladini et al. 2014).	Medium
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	Grows to 60 cm and 6,7 kg (Froese & Pauly 2019).	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	Inhabits fast flowing rivers, in Scandinavia it occurs in clear lakes (Froese & Pauly 2019).	Very high
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	No data available but sensitive to pollution and inhabits localities with stone or hard sand bottom (Froese & Pauly 2019).	High
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	No	No data, forms schools, gregarious (Froese & Pauly 2019).	Very high

5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	Yes	No records on possible or actual impacts of introductions (Ecological Risk Screening Summary. U.S. Fish & Wildlife Service, February 2015. Revised, March 2017, April 2017. Web Version, 6/25/2018).	Medium
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	No data for calculation.	Very high
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Males defending terrritories at spawning site but leave after spawning and do not guard the eggs (Ingram et al. 2000).	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	Personal observation.	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	No	No native species to hybridise with (Kottelat & Freyhof 2007).	Very high
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No such data	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	Breeds in shallow stretches, usually 20-40 cm deep, or riffles, with moderate current of about 0.5 m/s and clean gravel bottom (Froese & Pauly 2019).	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Female grayling can lay between 421 – 36,000 eggs per breeding season (Peter Jørgen Tønnessen Haddeland, 2012 MSc thesis)	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	kottelat and Freyhof	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Stocking (Horvath et al. 2014), floods (personal opinion).	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	Krka National park	Medium
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No adaptations.	Very high
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	They dig redds and have sticky eggs (Everard & Knight 2013).	High
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Dokk 2015	Very high
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Ovidio et al. 2004	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No data	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	Stocking, drift	Very high
43	7.09	Is dispersal of the taxon density dependent?	No	No data to support this	Very high
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	Very sensitive species (personal data).	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Sensitive to pollution (Froese & Pauly 2019).	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	Not allowed	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	Population reduction caused by anthropogenic damage to biotopes (Ovidio et al. 2004).	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	Unable to tolerate higher saline waters (Blair et al. 2016).	Very high
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	Yes	Piscivorous birds, predatory fish (pike), otters.	High
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	Already present.	Very high
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	Significant reductions in suitable range for grayling under future climate predictions were demonstrated for UK (Huml et al. 2019). Similar can be expected for the RA area.	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	Significant reductions in suitable range for grayling under future climate predictions were demonstrated for UK (Huml et al. 2019). Similar can be expected for the RA area.	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	Impact already virtually non existant (after hybridization with native lineage) - personal opinion.	Medium

54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	No records on possible or actual impacts of introductions (Ecological Risk Screening Summary. U.S. Fish & Wildlife Service, February 2015. Revised, March 2017, April 2017. Web Version, 6/25/2018).	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	No change	No records on possible or actual impacts of introductions (Ecological Risk Screening Summary. U.S. Fish & Wildlife Service, February 2015. Revised, March 2017, April 2017. Web Version, 6/25/2018).	Medium

Statistics	
Scores	
BRA	**19.0**
BRA Outcome	**-**
BRA+CCA	**15.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**13.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*10.0*
B. Biology/Ecology	**6.0**
4. Undesirable (or persistence) traits	*4.0*
5. Resource exploitation	*5.0*
6. Reproduction	*-1.0*
7. Dispersal mechanisms	*2.0*
8. Tolerance attributes	*-4.0*
C. Climate change	**-4.0**
9. Climate change	*-4.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**10**
Environmental	**10**
Species or population nuisance traits	**-1**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.85**
BRA	**0.88**
CCA	**0.58**

Date and Time
25/05/2021 23:50:10

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Thymallus thymallus*
Common name	grayling
Assessor	Tamara Kanjuh
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	Thymallus thymallus is reared for re-stocking and for feeding purposes. It is a highly appreciated species for sports fishing in northern Europe, where several initiatives have been undertaken for conservation of endangered populations. Its breeding in aquaculture relies mostly on wild parents, and many aspects of its rearing remain undisclosed	High
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	Due to their agreeable taste and attractive form, the grayling species are valued as food and game fishes, and they are occasionally seen in public aquaria	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	In recent years, an increasing number of studies report severe declines in population sizes (Uiblein et al., 2005).	High
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	Medium	Dfa, Dfb (Köppen–Geiger climate classification system)	Medium
5	2.02	What is the quality of the climate matching data?	High	Köppen–Geiger climate classification system	High
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	European grayling was introduced to the Skadar Lake drainage area in the 1960s (Drecun, 1962; Knežević, 1981) and is present in the inland waters of Montenegro (Morača River) and may also be present in Skadar Lake (Talevski et al., 2009).	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	One	Sport fishing.	Medium
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Yes	European grayling was introduced to the Skadar Lake drainage area in the 1960s (Drecun, 1962; Knežević, 1981) and is present in the inland waters of Montenegro (Morača River) and may also be present in Skadar Lake (Talevski et al., 2009).	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	No	No information found.	Low
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	No information found.	Low
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	No information found.	Low
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	No information found.	Low
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	No information found.	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	Harmless to human (fishbase.se)	High
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	No information found.	Low
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	No information found.	Low
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	No	Grayling make an ideal indicator species of habitat quality and climate change and, even in comparison with other salmonids, shows high sensitivity to high temperature (Ibbotson et al., 2001; Jonsson&Jonsson, 2009).	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	No information found.	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	No information found.	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	No	No information found.	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	No	No information found.	Low
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	No	No information found.	Low
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	Yes	In general, a moderate velocity is required at spawning sites, ranging from 20-90cm/s (Gonczi, 1989; Sempeski&Gaudin, 1995a).	High

24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	No information found.	Low
25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	It has been found that density dependent mortality occurred at the highest levels of parent stock (Clark, 1992) High stocking density has also been found to increase downstream dispersion from a site (Cowx, 1994).	High
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	No information found.	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	No	No information found.	Low
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	No	Grayling belong to a group of lithophils which hide their brood under gravel and do not guard the deposited eggs (Balon, 1975).	Medium
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	No information found.	Medium
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	Marić et al. (2012) point out that their results (STRUCTURE and DAS) support observation of wide spread introgression of grayling in the Soča River basin (Sušnik et al., 2004) and are also congruent with the results of wild male genotyping being annually performed in a frame of Adriatic grayling action plan (Jesenšek&Šumer, 2004), which have revealed only hybrid individuals with varying proportion of parental alleles (D.	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	No information found.	Low
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	Yes	Very sensitive to water quality, requires clean cold water (Kottelat&Freyhof, 2007).	High
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Depending on the size of the female, she may lay between 1,500 and 30,000 eggs (animaldiversity.org)	Medium
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	3	Spawnes for the first time 2-3 years (Kottelat&Freyhof, 2007).	High
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	Stocking, sport fishing, angling (Piria et al., 2017).	High
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	European grayling was introduced to the Skadar Lake drainage area in the 1960s (Drecun, 1962; Knežević, 1981) and is present in the inland waters of Montenegro (Morača River) and may also be present in Skadar Lake (Talevski et al., 2009).	High
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	No information found.	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	No information found.	Low
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Proportions of stocked grayling juveniles recaptured by electric fishing in the fast-flowing section of the experimental stream (the rapids) were 9.9%, 46.7% and 16.6% after the first, second and third stocking, respectively (Carlstein&Eriksson, 1995).	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Adults make short spawning migrations (Kottelat&Freyhof, 2007).	High
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	No information found.	Low
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	No	No information found.	Low
43	7.09	Is dispersal of the taxon density dependent?	Yes	It has been found that density dependent mortality occurred at the highest levels of parent stock (Clark, 1992) High stocking density has also been found to increase downstream dispersion from a site (Cowx, 1994).	High
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	No information found.	Low
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	Yes	They are in addition able to tolerate low oxygen tension of between 1.4 mg/L at 8°C to 1.8 mg/L at 20°C (Feldmuth&Erilcsen, 1978).	Medium
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	No	No information found.	Low
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	During the second half of the 20th century, a decline in the number of its populations has been observed, primarily because of the construction of hydroenergetic objects, intensified fishing and inadequate protection (Janković, 2010).	High
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	No information found.	Low
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	No information found.	Low
C. Climate change					

9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	No change	European grayling, even in comparison with other salmonids, shows high sensitivity to high temperature (Ibbotson et al., 2001; Jonsson&Jonsson, 2009) and exhibits narrow water quality requirements (Oberdorffet al., 2002; Uiblein et al., 2001).	Medium
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	No change	European grayling, even in comparison with other salmonids, shows high sensitivity to high temperature (Ibbotson et al., 2001; Jonsson&Jonsson, 2009) and exhibits narrow water quality requirements (Oberdorffet al., 2002; Uiblein et al., 2001).	Medium
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Increase	European grayling, even in comparison with other salmonids, shows high sensitivity to high temperature (Ibbotson et al., 2001; Jonsson&Jonsson, 2009) and exhibits narrow water quality requirements (Oberdorffet al., 2002; Uiblein et al., 2001).	Medium
53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	No change	European grayling, even in comparison with other salmonids, shows high sensitivity to high temperature (Ibbotson et al., 2001; Jonsson&Jonsson, 2009) and exhibits narrow water quality requirements (Oberdorffet al., 2002; Uiblein et al., 2001).	Medium
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	No change	European grayling, even in comparison with other salmonids, shows high sensitivity to high temperature (Ibbotson et al., 2001; Jonsson&Jonsson, 2009) and exhibits narrow water quality requirements (Oberdorffet al., 2002; Uiblein et al., 2001).	Medium
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	European grayling, even in comparison with other salmonids, shows high sensitivity to high temperature (Ibbotson et al., 2001; Jonsson&Jonsson, 2009) and exhibits narrow water quality requirements (Oberdorffet al., 2002; Uiblein et al., 2001).	Medium

Statistics	
Scores	
BRA	**5.0**
BRA Outcome	**-**
BRA+CCA	**5.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**1.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*1.0*
3. Invasive elsewhere	*-2.0*
B. Biology/Ecology	**4.0**
4. Undesirable (or persistence) traits	*1.0*
5. Resource exploitation	*0.0*
6. Reproduction	*1.0*
7. Dispersal mechanisms	*2.0*
8. Tolerance attributes	*0.0*
C. Climate change	**0.0**
9. Climate change	*0.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**3**
Environmental	**1**
Species or population nuisance traits	**4**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.47**
BRA	**0.47**
CCA	**0.50**

Date and Time
28/05/2021 09:07:18

AS-ISK v2

Taxon and Assessor details	
Category	Fishes and Lampreys (freshwater)
Taxon name	*Thymallus thymallus*
Common name	grayling
Assessor	Tena Radocaj
Risk screening context	
Reason and socio-economic benefits	
Risk assessment area	Danube & Adriatic basins BA, HR, ME, RS
Taxonomy	
Native range	
Introduced range	
URL	

			Response	Justification (references and/or other information)	Confidence
A. Biogeography/Historical					
1. Domestication/Cultivation					
1	1.01	Has the taxon been the subject of domestication (or cultivation) for at least 20 generations?	Yes	In karstic rivers Cetina and Gacka	Very high
2	1.02	Is the taxon harvested in the wild and likely to be sold or used in its live form?	Yes	The Thymallus t. is grown on for human consumption in Slovenia. (FAO)	High
3	1.03	Does the taxon have invasive races, varieties, sub-taxa or congeners?	No	no	Very high
2. Climate, distribution and introduction risk					
4	2.01	How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range?	High	The similarity between climatic conditions RA area and native range is high. I use climatch.	Very high
5	2.02	What is the quality of the climate matching data?	High	The quality of the climate matching data is medium.	Very high
6	2.03	Is the taxon already present outside of captivity in the RA area?	Yes	It is present outside of captivity in the RA area.	High
7	2.04	How many potential vectors could the taxon use to enter in the RA area?	None	It is present in the RA area.	High
8	2.05	Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)?	Not applicable	It is present in the RA area.	High
3. Invasive elsewhere					
9	3.01	Has the taxon become naturalised (established viable populations) outside its	Yes	Introduced over most of southern and central Finland, established viable populations. (IUCN)	Very high
10	3.02	In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa?	No	no data available	Medium
11	3.03	In the taxon's introduced range, are there known adverse impacts to aquaculture?	No	in this areas there is no such activities	Very high
12	3.04	In the taxon's introduced range, are there known adverse impacts to ecosystem	No	no data	Medium
13	3.05	In the taxon's introduced range, are there known adverse socio-economic impacts?	No	no data	Low
B. Biology/Ecology					
4. Undesirable (or persistence) traits					
14	4.01	Is it likely that the taxon will be poisonous or pose other risks to human health?	No	no	Very high
15	4.02	Is it likely that the taxon will smother one or more native taxa (that are not threatened or protected)?	No	no data	Medium
16	4.03	Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area?	No	no	Very high
17	4.04	Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area?	Yes	The taxon is adaptable of climatic and other environmental conditions.	Medium
18	4.05	Is the taxon likely to disrupt food-web structure/function in aquatic ecosystems if it has invaded or is likely to invade the RA	No	The taxon not disrupt food-web structure/function in aquatic ecosystem in the RA area. Personal opinion- no data	Low
19	4.06	Is the taxon likely to exert adverse impacts on ecosystem services in the RA area?	No	The taxon no impacts on ecosystem services in the RA area.	Low
20	4.07	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA	Yes	Yes, the taxon may be a host or vector of known pests and infectious agents endemic to RA area. Because in every area exist infectious agents and pests.	Low
21	4.08	Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area?	Yes	The ability of T. thymallus to carry an infection for long periods increases the potential transfer of G. salaris to other susceptible hosts. (Paladini, G., Hansen, H., Williams, C. F., Taylor, N. G., Rubio-Mejía, O. L., Denholm, S. J., ... & Shinn, A. P. (2014). Reservoir hosts for Gyrodactylus salaris may play a more significant role in epidemics than previously thought. Parasites &	High
22	4.09	Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity?	Yes	large fish	Very high
23	4.10	Is the taxon capable of sustaining itself in a range of water velocity conditions (e.g. versatile in habitat use)?	No	usually live in running waters but there is lacustrine populations too	High
24	4.11	Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa?	No	no data available	High

25	4.12	Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)?	Yes	Population crash with expolatation eg. angling	Very high
5. Resource exploitation					
26	5.01	Is the taxon likely to consume threatened or protected native taxa in the RA area?	No	Thymallus t. not consume threatened of protected native taxa in the RA area.	Low
27	5.02	Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area?	Not applicable	not applicable	High
6. Reproduction					
28	6.01	Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions?	Yes	Males defending terrritories at spawning site	Very high
29	6.02	Is the taxon likely to produce viable gametes or propagules (in the RA area)?	Yes	yes	Very high
30	6.03	Is the taxon likely to hybridise naturally with native taxa?	Yes	In Slovakia and Czech republic was introduced T. baicalensis and they produce hybrids	High
31	6.04	Is the taxon likely to be hermaphroditic or to display asexual reproduction?	No	no	Very high
32	6.05	Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle?	No	no	Very high
33	6.06	Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)?	Yes	Female grayling can lay between 421 – 36,000 eggs per breeding season (Peter Jørgen Tønnessen Haddeland, 2012 MSc thesis)	Very high
34	6.07	How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction?	2	kottelat and Freyhof	Very high
7. Dispersal mechanisms					
35	7.01	How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable	>1	1. human impact (fishing) 2. flooding 3. followed by natural spread via natural and manmade watercourses	Medium
36	7.02	Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. MCZ, MPA, SSSI)?	Yes	All of this vectors/pathways bring taxon in protected areas.	Low
37	7.03	Does the taxon have a means of actively attaching itself to hard substrata (e.g. ship hulls, pilings, buoys) such that it enhances the likelihood of dispersal?	No	no	Low
38	7.04	Is natural dispersal of the taxon likely to occur as eggs (for animals) or as propagules (for plants: seeds, spores) in the RA area?	No	They have nests	Very high
39	7.05	Is natural dispersal of the taxon likely to occur as larvae/juveniles (for animals) or as fragments/seedlings (for plants) in the RA area?	Yes	Larvae live in open water below surface	High
40	7.06	Are older life stages of the taxon likely to migrate in the RA area for reproduction?	Yes	Adults makes short spawning migrations	Very high
41	7.07	Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals?	No	no	Very high
42	7.08	Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be	Yes	There is a possibility of a high rate of spread of taxa. Eg. if a fertilized individual enters a new area by any means of expansion.	Low
43	7.09	Is dispersal of the taxon density dependent?	No	no	Very high
8. Tolerance attributes					
44	8.01	Is the taxon able to withstand being out of water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle?	No	very sensitive	Very high
45	8.02	Is the taxon tolerant of a wide range of water quality conditions relevant to that taxon? [In the Justification field, indicate the relevant water quality variable(s) being	No	Very sensitive to pollution	Very high
46	8.03	Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means?	Not applicable	no regulation	Very high
47	8.04	Is the taxon likely to tolerate or benefit from environmental/human disturbance?	No	no	Very high
48	8.05	Is the taxon able to tolerate salinity levels that are higher or lower than those found in its usual environment?	No	only freshwater	Very high
49	8.06	Are there effective natural enemies (predators) of the taxon present in the RA	No	Cormorants are present there and probably their pressure are high	Medium
C. Climate change					
9. Climate change					
50	9.01	Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change?	Not applicable	not applicable	High
51	9.02	Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change?	Decrease	The risks of establishing self-sustaining populations are in decrease. Grayling show high sensitivity to high temperature (Ibbotson et al. 2001; Jonsson and Jonsson 2009).	High
52	9.03	Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change?	Decrease	The risks of dispersal within the RA area is decreased. Under conditions of climate change, the projections for 2050 predict predominantly a significant loss of high suitability habitat for Thymallus thymallus.	Medium

53	9.04	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status?	Lower	Future potential impacts on biodiversity/ecological status is lower.	Low
54	9.05	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function?	Lower	The future potential impacts on ecosystem structure or function is lower.	Low
55	9.06	Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors?	Lower	Future potential impacts on ecosystem services/socio-economic factors is lower.	Low

Statistics	
Scores	
BRA	**13.0**
BRA Outcome	**-**
BRA+CCA	**3.0**
BRA+CCA Outcome	**-**
Score partition	
A. Biogeography/Historical	**4.0**
1. Domestication/Cultivation	*2.0*
2. Climate, distribution and introduction risk	*0.0*
3. Invasive elsewhere	*2.0*
B. Biology/Ecology	**9.0**
4. Undesirable (or persistence) traits	*5.0*
5. Resource exploitation	*0.0*
6. Reproduction	*4.0*
7. Dispersal mechanisms	*2.0*
8. Tolerance attributes	*-2.0*
C. Climate change	**-10.0**
9. Climate change	*-10.0*
Answered Questions	
Total	***55***
A. Biogeography/Historical	**13**
1. Domestication/Cultivation	*3*
2. Climate, distribution and introduction risk	*5*
3. Invasive elsewhere	*5*
B. Biology/Ecology	**36**
4. Undesirable (or persistence) traits	*12*
5. Resource exploitation	*2*
6. Reproduction	*7*
7. Dispersal mechanisms	*9*
8. Tolerance attributes	*6*
C. Climate change	**6**
9. Climate change	*6*
Sectors affected	
Commercial	**3**
Environmental	**-3**
Species or population nuisance traits	**6**

Thresholds	
BRA	**-**
BRA+CCA	**-**
Confidence	
BRA+CCA	**0.73**
BRA	**0.77**
CCA	**0.46**

Date and Time
02/06/2020 08:54:27