**Table S4. Overview of the methods and indicators used to assess marine and coastal CES**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Cultural Ecosystem Services** | **Type of data** | **References** | **Type of Method** | **References** | **Quantification methods** | **References** | **Valuation methods** | **References** | **Mapping methods** | **References** | **Type of assessment** | **References** | **Indicators for quantification, valuation and/or mapping of CES** | **References** |
| **Recreation and leisure** | Primary | [1][2][3][4][5][6][7][8][9][10][11][12][13][14][15][16][17][18][19][20][21][22][23][24][25][26][27][28][29] | Quantitative | [1][30][2][31][9][32][11][13][16][20][21][22][26][27][33] | Questionnaire | [1][3][7][9][13][14][16][20][28] | Interview | [34][4][6][10][25] | GIS | [30][31][32][10][26] | Sociocultural | [1][3][4][5][6][7][35][12][14][15][16][21][22][23][25][28][29] | Quantification: no. of people visiting state and national parks | [30] |
| Secondary | [36][7][8][37][31][32][17][19][22][25][33] | Qualitative | [38][36][3][4][5][6][7][8][10][12][14][17][23][25][29] | Interview | [10][12][14][16] | Deliberative valuation | [1][7][13][14][20] | Expert opinion | [7][8][13] | Economic | [37][9][32][11][17][18][20][24][33] | Quantification: no. of respondents prefering water | [3] |
| Proxy | [34][30][38][2][39][36][32][11][35][13][14][22][24][26][27][28] | Mixed | [34][37][35][15][18][19][24][28] | Expert opinion | [36][19][22] | Contingent valuation | [9][32][18][24] | InVEST | [2][35] | Ecological  | [30][38][39][36] | Quantification: no. areas of suitable bathing temperature and climatic comfort for coastal tourism | [31] |
| - | Narrative-based | [30][31][21] | Questionnaire | [4][5][24] | Participatory | [19] | Sociocultural/ecological | [2][31][13][19][26] | Quantification: marine landscape (details on the type of substrate and marine habitats that scientists identified as of conservation importance; underwater objects (presence/absence: ship wreck, rock formation), sea life (presence/absence: large/specimen fish, grey/common seal, sea bird colony, octopus), access (accessible by: shore and boat; shore only, boat use prohibited; shore, boat, pier; site out at sea, only reachable by boat), other restrictions, vulnerable species protected, size of the protected area; travel distance | [9] |
| Images posted on image-hosting websites | [35] | Travel cost | [34][9][17] | Geo-tagged images posted on image-hosting websites | [20][23] | Sociocultural/economic | [34] [8][10] | Quantification: no. people traveling x admission price x emergy / money ratio for local province | [11] |
| Input-state-output | [11] | Perceptions survey | [38][12] | - | Ecological/economic | [27] | Quantification: photos of winter sports, hiking, trekking, climbing, riding, camping, kayaking and sport fishing | [35] |
| - | Expert opinion | [36][19] | - | Quantification: no. visitors / season; total activity days for each user-group; activity days per active diver for each of the regions multiplied by regional population; total no. of passengers undertaking wildlife viewing trips; annual no. of visitors to the Royal Society for the Protection of Birds marine reserves | [20] |
| Workshop | [8] | Quantification: coastal tourism – tourist population; quality improvement of resident environment for local population | [22] |
| Q-methodology | [15] | Valuation: importance score | [13] |
| Media archives and recordings | [25] | Valuation: WTP mean value per angler-day\* angler effort ; WTP to avoid loss in salmon catch/year/household | [32] |
| Images posted on image-hosting websites | [25] | Valuation: importance score | [14] |
| Choice experiment | [9] | Valuation: factor analysis of statements in questionnaires | [15] |
| Benefit transfer | [37]  | Valuation: bathing water quality – the average value of a day at the beach x the no. of beach visits | [40] |
| Market value | [33] | Valuation: Llikert-scale to rank importance | [24] |
| Maintenance cost | [27] | Valuation: WTP for maintaining CES | [24] |
| Cognitive hierarchy model | [28] | Valuation: comparison between archival photos and modern-day photos (Flickr); comparison between historical interviews and modern-day interviews | [25] |
| - | Valuation: indispensability of CES according to a Likert-type scale | [28] |
| Valuation: recreation and ecotourism – income from tourism along the Yellow sea coast | [33] |
| Quantification/mapping: recreation and ecotourism – sum of no. nature recreation facilities (scenic view points, foot-paths, observation towers, bathing lakes, fishing areas, cycle paths, and associated amenities) per grid cell. Summed the points, the path lengths, and the area per grid cell of the different facilities and standardized the sums by ([value]/[mean])/[standard deviation]; summer cottages – sum of summer cottage area per grid; hunting – estimated roe deer density per grid cell from GPS registrations on roe deer killed in traffic | [41] |
| Valuation/mapping: relative value – the sum of the monetary, non-monetary or threat units assigned to the corresponding type of polygon (monetary, non-monetary, and threat) per interviewee | [42] |
| Mapping: spatial data on no. activities in a location: swimming at the beach, sea fishing, fishing village tourism, coastal visitors’ center, yachting, and scenic viewing | [2] |
| Mapping: density surface (points/ha) | [7] |
| Mapping: tourism – density of cultural tourist attractions; recreational navigation – intensity of recreational vessels’ navigation and anchorage | [43] |
| Mapping: no. and color of stickers from focus groups | [23] |
| **Aesthetic** | Primary | [44][2][3][4][45][5][7][8][9][10][12][46][16][18][23][24][25][28][29] | Quantitative | [30][2][7][9][16] | Questionnaire | [3][7][9][16] | Interview | [34][4][10][25] | GIS | [30][10][2][35] | Sociocultural | [44][3][4][5][7][35][12][16][23][25][28][29] | Quantification: level of "naturalness", computed via proximity to infrastructure and transport networks | [30] |
| Secondary | [36][7][8][37][25] | Qualitative | [44][38][36][3][4][45][5][8][10][12][23][25][29] | Interview | [10][12][16] | Contingent valuation | [9][18][24] | Expert opinion | [7][8] | Economic | [37][9][18][24] | Quantification: no scenic viewpoints | [2] |
| Proxy | [34][30][38][2][39][36][45][35][46][24][28] | Mixed | [34][37][35][46][18][24][28] | Expert opinion | [36] | Questionnaire | [4][5][24] | InVEST | [46] | Ecological  | [30][38][39][36][45][10] | Quantification: abundance of Red Data Book or nationally scarce invertebrates; plant biodiversity; vegetation structure, grass:forb ratio & flowering | [45] |
| - | Plant survey | [45] | Perceptions survey | [44][7][12] | Participatory | [23] | Sociocultural/ecological | [2] | Quantification: marine landscape (details on the type of substrate and marine habitats that scientists identified as of conservation importance; underwater objects (presence/absence: ship wreck, rock formation), sea life (presence/absence: large/specimen fish, grey/common seal, sea bird colony, octopus), access (accessible by: shore and boat; shore only, boat use prohibited; shore, boat, pier; site out at sea, only reachable by boat), other restrictions, vulnerable species protected, size of the protected area; travel distance | [9] |
| Images posted on image-hosting websites | [35] | Workshop | [38][8] | - | Sociocultural/economic | [34][8] | Quantification: photos of natural and urban landscapes | [35] |
| - | Choice experiment | [34][9] | Ecological/economic | [46] | Quantification: absence of salmon aquaculture net pens | [46] |
| Expert opinion | [36] | - | Valuation: Llikert-scale to rank importance | [24] |
| Media archives and recordings | [25] | Valuation: WTP for maintaining CES | [24] |
| Images posted on image-hosting websites | [25] | Valuation: indispensability of CES according to a Likert-type scale | [28] |
| Travel cost | [9] | Valuation/mapping: relative value – the sum of the monetary, non-monetary or threat units assigned to the corresponding type of polygon (monetary, non-monetary, and threat) per interviewee | [42] |
| Benefit transfer | [37] | Mapping: density surface (points/ha) | [7] |
| Cognitive hierarchy model | [28] | Mapping: no. and color of stickers from focus groups | [23] |
| **Cultural heritage and identity** | Primary | [44][4][5][6][7][8][10][36][7][8][47][12][14][16][18][21][23][24][25][48][27][28] | Quantitative | [44][7][16][21][27] | Interview | [6][10][47][12][14][16] | Interview | [34][4][10][47][25][48] | Participatory | [8][47][23] | Sociocultural | [44][4][5][6][7][35][12][14][16][21][23][25][48][28] | Quantification: photos of heritage, folklore, traditions, art and local workers (ranching, forestry, artisanal fishing, mining, and oil extraction) | [35] |
| Secondary | [34][38][36][25] | Qualitative | [38][36][4][5][6][8][10][12][14][23][25][48] | Questionnaire | [7][14][16] | Perceptions survey | [44][7][47][12] | GIS | [10][35] | Economic | [18][24] | Valuation: species visibility, species population size, anchovy availability | [4] |
| Proxy | [35][14][24][27][28] | Mixed | [34][47][35][18][24][28] | Expert opinion | [36] | Questionnaire | [4][5][24] | - | Ecological | [38][36] | Valuation: factor analysis of statements in questionnaires | [15] |
|  | Narrative-based | [21] | Workshop | [38][8] | Sociocultural/economic | [34][8][10][47] | Valuation/mapping: relative value – the sum of the monetary, non-monetary or threat units assigned to the corresponding type of polygon (monetary, non-monetary, and threat) per interviewee | [42] |
| Images posted on image-hosting website | [35] | Contingent valuation | [18][24] | Ecological/economic | [27] | Valuation: importance score | [14] |
| - | Expert opinion | [36] | - | Valuation: Llikert-scale to rank importance | [24] |
| Deliberative valuation | [14] | Valuation: WTP for maintaining CES | [24] |
| Media archives and recordings | [25] | Valuation: comparison between archival photos and modern-day photos (Flickr); comparison between historical interviews and modern-day interviews | [25] |
| Images posted on image-hosting websites | [25] | Valuation: indispensability of CES according to a Likert-type scale | [28] |
| Choice experiment | [34] | Mapping: density surface (points/ha) | [7] |
| Maintenance cost | [27] | Mapping: presence and intensity of the following traditional activities - venetian rowing, lugsail sailing, artisanal fishing, extensive aquaculture practices andcultivation of traditional crops | [43] |
| Cognitive hierarchy model | [28] | Mapping: no. and color of stickers from focus groups | [23] |
| **Spiritual, sacred and/or religious** | Primary | [44][49][5][6][7][10][36][7][47][12][14][15][16][18][21][23][25][28][29] | Quantitative | [7][16][21] | Interview | [6][10][12][14][16] | Perceptions survey | [44][7][47][12] | Participatory | [47][23] | Sociocultural | [44][4][5][6][7][35][12][14][16][21][23][25][48][28] | Valuation/mapping: relative value – the sum of the monetary, non-monetary or threat units assigned to the corresponding type of polygon (monetary, non-monetary, and threat) per interviewee | [42] |
| Secondary | [38][36][25] | Qualitative | [44][49][38][36][5][6][10][12][14][23][25][29] | Questionnaire | [49][7][14][16] | Interview | [10][47][25] | GIS | [10] | Economic | [18][24] | Valuation: importance score | [14] |
| Proxy | [14][28] | Mixed | [47][15][18][28] | Expert opinion | [36][47] | Expert opinion | [49][36] | - | Ecological | [38][36] | Valuation: factor analysis of statements in questionnaires | [15] |
|  | Narrative-based | [21] | Questionnaire | [5] | Sociocultural/economic | [34][8][10][47] | Valuation: indispensability of CES according to a Likert-type scale | [28] |
|  | Workshop | [38] | Ecological/economic | [27] | Mapping: density surface (points/ha) | [7] |
| Deliberative valuation | [14] |  | Mapping: no. and color of stickers from focus groups | [23] |
| Q-methodology | [15] |  |
| Media archives and recordings | [25] |
| Contingent valuation | [18] |
| Cognitive hierarchy model | [28] |
| **Educational** | Primary | [6][7][8][10][47][12][16][18][21][23][24][25][27] | Quantitative | [7][16][21][27][33] | Interview | [10][47][12] | Interview | [6][10][47][16][25] | Participatory | [8][47][23] | Sociocultural | [6][7][12][16][21][23][25] | Valuation/mapping: relative value – the sum of the monetary, non-monetary or threat units assigned to the corresponding type of polygon (monetary, non-monetary, and threat) per interviewee | [42] |
| Secondary | [36][7][8][25][33] | Qualitative | [38][36][6][8][10][12][23][25] | Questionnaire | [7] | Perceptions survey | [7][47][12] | GIS | [10] | Economic | [18][24][33] | Valuation: Llikert-scale to rank importance | [24] |
| Proxy | [38][36][24][27] | Mixed | [47][18][24] | Narrative-based | [21] | Questionnaire | [16][24] | - | Ecological | [38][36] | Valuation: WTP for maintaining CES | [24] |
| - | Workshop | [38][8] |  | Sociocultural/economic | [8][10][47] | Valuation: comparison between archival photos and modern-day photos (Flickr); comparison between historical interviews and modern-day interviews | [25] |
| Contingent valuation | [18][24] | Ecological/economic | [27] | Valuation: RMB yuan/yr) = no. i education level, i present graduate students, college students, secondary vocational education students, and researchers (person) x energy transformity of i education level (sej/person/yr) / ration of energy to GDP (sej/$) x exchange rate of dollar - RMB yuan | [33] |
| Media archives and recordings | [25] | - | Mapping: density surface (points/ha) | [7] |
| Images posted on image-hosting websites | [25] | Mapping: frequency of excursions withenvironmental education purpose | [43] |
| Maintenance cost | [27] | Mapping: no. and color of stickers from focus groups | [23] |
| Market value | [33] |  |  |
| **Inspiration for culture, art and design** | Primary | [44][50][4][6][8][10][36][8][47][12][18][21][23][25][27][29] | Quantitative | [50][21][27] | Interview | [10][47][12] | Interview | [4][10][47][25] | Participatory | [8][47][23] | Sociocultural | [44][4][6][12][21][23][25][29] | Valuation: value of songs ($) x the number of dowloads | [50] |
| Secondary | [36][25] | Qualitative | [44][36][4][6][8][10][12][23][25][29] | Narrative-based | [21] | Perceptions survey | [44][47][12] | GIS | [10] | Economic | [50][18] | Valuation/mapping: relative value – the sum of the monetary, non-monetary or threat units assigned to the corresponding type of polygon (monetary, non-monetary, and threat) per interviewee | [42] |
| Proxy | [27] | Mixed | [47][18] | Expert opinion | [36] | Questionnaire | [4] | - | Ecological | [36] | Valuation: comparison between archival photos and modern-day photos (Flickr); comparison between historical interviews and modern-day interviews | [25] |
| - | Market value | [50] | Expert opinion | [36] | Sociocultural/economic | [8][10][47] | Mapping: no. and color of stickers from focus groups | [23] |
| - | Workshop | [8] | Ecological/economic | [27] | - |
| Media archives and recordings | [25] | - |
| Images posted on image-hosting websites | [25] |
| Contingent valuation | [18] |
| Maintenance cost | [27] |
| **Sense of place** | Primary | [44][3][5][6][8][10][15][18][23][25][26][48][27][29] | Quantitative | [3][27] | Questionnaire | [3][5] | Interview | [6][10][25][48] | Participatory | [8][23] | Sociocultural | [3][5][6][15][23][25][48][29] | Valuation/mapping: relative value – the sum of the monetary, non-monetary or threat units assigned to the corresponding type of polygon (monetary, non-monetary, and threat) per interviewee | [42] |
| Secondary | [8][25][26] | Qualitative | [44][5][6][8][10][23][25][26][48][29] | Interview | [10] | Workshop | [8] | GIS | [10][26] | Economic | [18] | Valuation: comparison between archival photos and modern-day photos (Flickr); comparison between historical interviews and modern-day interviews | [25] |
| Proxy | [27] | Mixed | [15][18] | - | Perceptions survey | [44] | - | Sociocultural/economic | [8][10] | Quantification/mapping: the conservation area per grid cell | [41] |
| - | Q-methodology | [15] | Sociocultural/ecological | [26] | Mapping: no. and color of stickers from focus groups | [23] |
| Media archives and recordings | [25] | Ecological/economic | [27] | - |
| Images posted on image-hosting websites | [25] | - |
| Contingent valuation | [18] |
| Maintenance cost | [27] |
| **Social relations** | Primary | [51][49][6][10][12][18][27] | Quantitative | [27] | Interview | [51][10][52][12] | Interview | [6][10] | GIS | [10] | Sociocultural | [6][12] | Quantification: Trust, community involvement, social cohesion - no. people from each village attending inter-village meetings | [51][52] |
| Secondary | [36] | Qualitative | [49][36][6][10][12] | Questionnaire | [49] | Expert opinion | [49][36] | - | Economic | [18] | Valuation/mapping: relative value – the sum of the monetary, non-monetary or threat units assigned to the corresponding type of polygon (monetary, non-monetary, and threat) per interviewee | [42] |
| Proxy | [36][52][27] | Mixed | [51][52][18] | Focus group | [52] | Contingent valuation | [52][18] | Ecological | [36] | - |
| - | Expert opinion | [36] | Choice experiment | [51][52] | Sociocultural/economic | [51][10][52] |
| - | Perceptions survey | [12] | Sociocultural/ecological | [49] |
| Ranking and rating | [51] | Ecological/economic | [27] |
| Maintenance cost | [27] |  |  |
| **Scientific** | Primary | [10][11][12][16][22] | Quantitative | [11][16][22][33] | Interview | [10][12][16] | Interview | [10] | GIS | [10] | Sociocultural | [12][16][22] | Quantification: no. pages published about yellow river x the emergy transformity of paper | [11] |
| Secondary | [22][33] | Qualitative | [38][10][12] | Questionnaire | [16] | Workshop | [38] | - | Economic | [11][33] | Quantification: no. published papers | [22] |
| Proxy | [38][11][22] |  |  | Expert opinion | [22] | Perceptions survey | [12] | Ecological | [38] | Valuation: RMB yuan/yr) = no. pages research papers in Chinese) + ( no. pages research papers in English)) x solar transformaty of research paper (sej/page) / ration of energy to GDP (sej/$) x exchange rate of dollar - RMB yuan | [33] |
| - | Input-state-output | [11] | Market value | [33] | Sociocultural/economic | [10] | - |
| **Existence** | Primary | [26][27] | Quantitative | [27] | Images posted on image-hosting website | [35] | Workshop | [38] | GIS | [35][26] | Sociocultural | [35] | Quantification: photos of individual species of flora and fauna, both native and allochthonous | [35] |
| Secondary | [37] | Qualitative | [38][26] | - | Maintenance cost | [27] | - | Economic | [37] | Quantification/mapping: nature Appreciation: no. of sightings of species per grid cell submitted by people via the nature observation portal Fugle og Natur (www.fugleognatur.dk) | [41] |
| Proxy | [38][35][27] | Mixed | [37][35] | Benefit transfer | [37] | Ecological | [38] | - |
| - | - | Sociocultural/ecological | [26] |
| Ecological/economic | [27] |
| **Bequest** | Primary | [6][47][21] | Quantitative | [21] | Interview | [47][52] | Interview | [6][47] | - | - | Sociocultural | [6][21] | Quantification: no. future generations able to live as Vezo (the "fishing people") | [52] |
| Proxy | [52] | Qualitative | [6] | Focus group | [52] | Perceptions survey | [47] | Expert opinion | [19] | Sociocultural/economic | [47][52] | - |
| - | Mixed | [47][52] | Narrative-based | [21] | Contingent valuation | [52] | Participatory | [23] | Sociocultural | [12][23] |
| - | Choice experiment | [52] | - |  | Sociocultural/ecological | [49][19] |  |
| **Intellectual and representative interactions (group)** | Primary | [49][12][19][23] | Qualitative | [49][12][23] | Questionnaire | [49] | Expert opinion | [49][19] | Expert opinion | [19] | Sociocultural | [12][23] | Mapping: no. and color of stickers from focus groups | [23] |
| Secondary | [19] | Mixed | [19] | Interview | [12] | Perceptions survey | [12] | Participatory | [23] | Sociocultural/ecological | [49][19] | - |
|  |  |  |  | Expert opinion | [19] | - | - |
| **Services to ecosystems** | Primary | [53] | Qualitative | [53] | Narratives and descriptions of field observations | [53] | - | Sociocultural | [53] | - |

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