Morphological, calorific and nutritive characteristics of 656 freshwater invertebrates taxa

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Abstract

Background

The Freshwater Animal Diversity Assessment (FADA) project estimated that freshwater animal species represent 9.5% of the 1.2 million species described. Knowing that freshwater represents only 0.01% of the earth's surface, these wetlands are suitable habitats for a great part of the world's total biodiversity. However, it has been shown that there is a lack of knowledge on these species, including freshwater invertebrates. Nevertheless, they play a key role in the majority of freshwater ecosystems and in their foodweb networks. Freshwater invertebrates are the food resource of many species, such as fish and birds. The knowledge of their morphological, energetic and nutritive characteristics allows a better understanding of their selection by predators (size, energy intake etc.), but also leads to the improvement of wetland management. Although information about freshwater invertebrates exists in literature, they are generally heterogeneous, dispersed and difficult to collect. To facilitate the accessibility of these data and, thus, optimise and accelerate research projects including freshwater invertebrates, we propose a literature review describing 14 morphological and nutritive characteristics (size, dry weight, gross energy, crude protein etc.) for 656 taxa of freshwater invertebrates.

New information

This dataset is a review from 104 publications from 1935 to 2020, compiling 14 characteristics when available (size, dry weight, gross energy, crude protein etc.) for 656 taxa of freshwater invertebrates.

Keywords

freshwater invertebrates, invertebrate biometry, gross energy, protein, lipid, fiber, nitrogen free extract, ash, water

Introduction

In twenty years, the estimated world's total number of species has increased from 3 to 30 million (May 1990) to between 3 and 100 million (May 2010). Currently, 1.2 million species have been listed, but it was estimated that about 86% of terrestrial species and 91% of oceanic species are still to be described (Mora et al. 2011). Invertebrates would represent 60% of known species and three quarters of new species identified each year (Chapman 2009). Occupying the majority of habitats, they could potentially represent a significant part of the global biomass (Ellwood and Foster 2004). They play a key role in most trophic webs (Vanni 2002, Hornung and Foote 2006, McCarthy et al. 2009) and some are even good indicators of the environmental quality (Stork and Eggleton 1992, Hodkinson and Jackson 2005).

Wetlands are amongst the most impacted environments by climate change (Dawson et al. 2003, Erwin 2009). They have particularly declined worldwide, losing at least 50% of their surface since the beginning of the 19th century (Finlayson et al. 1999, Davidson 2014, Gardner et al. 2015). However, some species depend directly on these habitats, such as fish (Gilinsky 1984, Diehl 1992, Garvey et al. 1994, Bouffard and Hanson 2006, McCarthy et al. 2009) or birds (e.g. Bolduc and Afton 2004, Taft and Haig 2005, Ma et al. 2010), particularly because of the available food resources, such as freshwater invertebrates (Covich et al. 1999). The links between freshwater invertebrates and waterbirds were examined (Goss-Custard 1977, Colwell and Landrum 1993, Lillie and Evrard 1994, Weber and Haig 1997, Brodmann and Reyer 1999, Elmberg et al. 2000, Halse et al. 2000, Arzel et al. 2009, Guareschi et al. 2015), but remain insufficiently explored (Sanders 2000, Prather et al. 2013). The lack of knowledge about freshwater invertebrate abundance and diversity is, therefore, an important issue for the conservation of the species living in these environments, but also for their habitats management (Vanni 2002). Knowing the species that contribute to this diversity, as well as their morphological characteristics, energetic value or nutritional composition (Fredrickson and Reid 1988, Zwarts and Blomert 1992, Davis and Smith 2001), would improve the understanding of the prey-predator interactions (Nudds and Bowlby 1984, Anderson and Smith 2000). For example, waterfowl feed on aquatic invertebrates and, consequently, the abundance, accessibility, size or even the energetic values of these foods affect the use of foraging habitats by waterfowl (Ma et al. 2010).

Invertebrates are very sensitive to environmental variations, included climate change (Lawrence and Soame 2004, Prather et al. 2013, Khamis et al. 2014) and affect finally ecosystem functions and associated ecosystem services (Lavelle et al. 2006, Prather et

al. 2013, Khamis et al. 2014). Some of them are also very sensitive to the water physico-chemical variations and are indicators of its quality, especially since beginning of anthropogenic pollution (Gaufin and Tarzwell 1952, Gaufin and Tarzwell 1956, Hellawell 1986, Dallinger 1994). Obtaining knowledge on freshwater invertebrates is, therefore, essential for the habitat and species conservation (Vicente 2010), but also to answer the global change (Strayer 2010, Collier et al. 2016).

Studies in literature were more specifically focused on knowledge of the orders and families, in particular, according to their stages of development (larvae, nymphs, adults) and their sizes, but it appears as still incomplete and insufficient (Vicente 2010, Strayer and Dudgeon 2010, Collier et al. 2016). If information exists, it is generally heterogeneous, scattered or restricted to local journals and, therefore, not widely distributed (Strayer 2006, Balian et al. 2008b, Strayer and Dudgeon 2010, Appeltans et al. 2012), especially when the interest is on other factors, such as the individuals weight, the energetic value or the nutritional composition (proteins, lipids etc.). Even if some books or publications have a high level of details (Cumminns and Wuycheck 1971, Nudds and Bowlby 1984, Anderson and Smith 2000, James et al. 2012), none includes all information about these physical, nutritive or energetic characteristics, placing limits to the progress of some studies. Indeed, the skills of researchers or managers do not always include know-how in taxa or species identification (Krieger 1992).

Thus, the available information in literature is generally uncommon (Strayer 2006, James et al. 2012) and/or difficult to collect (Krieger 1992). The solution for acquiring these data may be to characterise all the taxa detected and collected. However, this option raises problems related to the availability of technological tools, time (taxa collection, sorting and identification, when this skill is available, are long) (James et al. 2012) or financial (Krieger 1992, Strayer 2006) because of the human resources and the material to be mobilised. These points constitute obstacles to the progress of some studies or even points of renunciation.

In order to facilitate the accessibility of these data and, thus, promote research projects on the importance of freshwater invertebrates in wetland ecosystems, we propose a literature review of the main biological characteristics of all freshwater invertebretates available in literature up to 2020.

Geographic coverage

Description: This literature review concerns the worldwide freshwater wetlands (lakes, rivers, marshes, temporary and permanent ponds etc.).

Taxonomic coverage

Description: This dataset describes 656 taxa of freshwater invertebrates (Table 1).

Taxa included:

Rank	Scientific Name
phylum	Annelida
subclass	Hirudinida
genus	*Haemopis*
family	Hirudinidae
genus	*Macrobdella*
family	Erpobdellidae
species	*Dina dubia*
genus	*Erpobdella*
species	*Erpobdella obscura*
species	*Erpobdella octoculata*
species	*Erpobdella punctata*
family	Glossiphoniidae
species	*Glossiphonia complanata*
species	*Helobdella stagnalis*
species	*Theromyzon rude*
family	Piscicolidae
subclass	Oligochaeta
family	Naididae
species	*Aulodrilus pigueti*
species	*Branchiodrilus semperi*
species	*Dero limosa*
genus	*Limnodrilus*
family	Opistocystidae
family	Tubificidae
genus	*Tubifex*
family	Lumbriculidae
species	*Lumbriculus variegatus*
species	*Stylodrilus heringianus*
class	Polychaeta
family	Nereidae

family	Hydrachnidiae
genus	*Limnochares*
subclass	Aranae
order	Anostraca
species	*Branchinecta paludosa*
species	*Streptocephalus sealii*
order	Diplostraca
suborder	Cladocera
species	*Acantholeberis curvirostris*
family	Bosminidae
genus	*Bosmina*
species	*Bosmina coregoni*
species	*Bosmina hagmanni*
species	*Bosmina longirostris*
species	*Bythotrephes longimanus*
family	Chydoridae
genus	*Alona*
species	*Alona affinis*
species	*Alona costata*
species	*Alona rectangula*
species	*Alonella exigua*
species	*Alonella nana*
species	*Chydorus sphaericus*
species	*Eurycercus lamellatus*
species	*Graptoleberis testudinaria*
species	*Leydigia leydigi*
species	*Pleuroxus aduncus*
species	*Acroperus harpae*
species	*Dunhevedia crassa*
family	Daphniidae
species	*Ceriodaphnia quadrangula*

species	*Ceriodaphnia reticulata*
species	*Ceriodaphnia silvestrii*
genus	*Daphnia*
species	*Daphnia ambigua*
species	*Daphnia cristata*
species	*Daphnia cucullata*
species	*Daphnia dubia*
species	*Daphnia galeata*
species	*Daphnia gessneri*
species	*Daphnia hyalina*
species	*Daphnia magna*
species	*Daphnia pulex*
species	*Diaphanosoma spinulosum*
species	*Moina dubia*
species	*Scapholeberis mucronata*
species	*Simocephalus vetulus*
species	*Holopedium gibberum*
family	Leptodoridae
species	*Leptodora kindtii*
species	*Leptodora kindtii*
species	*Moina macrocopa*
species	*Moina micrura*
species	*Moina mongolica*
species	*Polyphemus pediculus*
species	*Diaphanosoma brachyurum*
species	*Diaphanosoma pauscispinosum*
family	Cyzicidae
species	*Caenestheriella setosa*
family	Leptestheriidae
family	Lynceidae
species	*Lynceus brachyurus*

order	Notostraca
species	*Lepidurus couesii*
species	*Chirocephalopsis bundyi*
order	Amphipoda
genus	*Eogammarus*
species	*Chelicorophium curvispinum*
genus	*Corophium*
species	*Crangonyx gracilis*
species	*Crangonyx richmondensis*
species	*Gammaracanthus lacustris*
family	Gammaridae
genus	*Gammarus*
species	*Gammarus fasciatus*
species	*Gammarus fossarum*
species	*Gammarus lacustris*
species	*Gammarus pulex*
species	*Gammarus roeseli*
genus	*Hyalella*
species	*Hyalella azteca*
species	*Hyalella curvispina*
species	*Pallasiola quadrispinosa*
species	*Paracalliope fluviatilis*
family	Pontogammaridae
species	*Monoporeia affinis*
species	*Pontoporeia hoyi*
family	Talitridae
order	Decapoda
genus	*Aegla*
species	*Aegla neuquensis*
family	Astacidae
family	Cambaridae

species	*Faxonius virilis*
species	*Atyaephyra desmarestii*
species	*Macrobrachium rosenbergii*
species	*Palaemon lamarrie*
species	*Samastacus spinifrons*
genus	*Orconectes*
order	Isopoda
genus	*Gnorimosphaeroma*
family	Asellidae
genus	*Asellus*
species	*Asellus aquaticus*
species	*Caecidotea racovitzai*
species	*Lirceus lineatus*
species	*Proasellus meridianus*
family	Sphaeromatidae
species	*Austridotea annectens*
family	Mysidae
species	*Mysis relicta*
species	*Tenagomysis chiltoni*
subclass	Copepoda
species	*Limnocalanus macrurus*
species	*Acanthocyclops robustus*
species	*Mesocyclops ogunnus*
family	Diaptomidae
species	*Argyrodiaptomus azevedoi*
species	*Diaptomus arcticus*
species	*Diaptomus clavipes*
species	*Diaptomus leptopus*
species	*Diaptomus minutus*
species	*Diaptomus siciloides*
species	*Eudiaptomus gracilis*

species	*Eudiaptomus padanus*
species	*Heliodiaptomus cinctus*
species	*Notodiaptomus cearensis*
species	*Notodiaptomus evaldus*
species	*Notodiaptomus iheringi*
species	*Eurytemora affinis*
order	Cyclopoida
family	Cyclopidae
genus	*Cyclops*
species	*Cyclops abyssorum*
species	*Cyclops bicuspidatus*
species	*Macrocyclops albidus*
species	*Mesocyclops edax*
species	*Thermocyclops hyalinus*
order	Harpacticoida
class	Ostracoda
family	Cyprididae
species	*Stenocypris malcolmsonii*
order	Collembola
order	Coleoptera
family	Dytiscidae
species	*Agabus bifarius*
species	*Colymbetes sculptilis*
species	*Cybister tripunctatus*
genus	*Dytiscus*
species	*Dytiscus marginalis*
species	*Rhantus frontalis*
family	Gyrinidae
species	*Gyrinus maculiventris*
species	*Enochrus hamiltoni*
species	*Galerucella nymphaeae*

family	Curculionidae
family	Elmidae
species	*Ancronyx variegata*
genus	*Austrelmis*
species	*Macronychus glabratus*
genus	*Promoresia*
genus	*Stenelmis*
genus	*Optioservus*
family	Hydrophilidae
genus	*Cylomissus*
species	*Enochrus carinatus*
species	*Hydrophilus olivaceus*
species	*Tropisternus setiger*
genus	*Ectopria*
genus	*Psephenus*
species	*Anchytarsus bicolor*
genus	*Hydrocyphon*
order	Diptera
family	Athericidae
genus	*Atherix*
species	*Atherix ibis*
genus	*Dasyoma*
family	Dolichopodidae
family	Empididae
family	Ephydridae
family	Stratiomyiidae
genus	*Caloparyphus*
species	*Hedriodiscus truquii*
genus	*Stratiomys*
family	Syrphidae
genus	*Eristalis*

family	Tabanidae
genus	*Chrysops*
genus	*Tabanus*
suborder	Nematocera
family	Blephariceridae
genus	*Edwardsina*
genus	*Blepharicera*
family	Ceratopogonidae
genus	*Palpomyia*
genus	*Chaoborus*
species	*Chaoborus flavicans*
family	Chironomidae
genus	*Ablabesmyia*
species	*Ablabesmyia pulchripennis*
genus	*Chironomus*
species	*Chironomus modestus*
species	*Chironomus plumosus*
species	*Chironomus tentans*
species	*Chironomus zealandicus*
genus	*Cladopelma*
genus	*Cladotanytarsus*
genus	*Coelotanypus*
genus	*Cricotopus*
genus	*Dicrotendipes*
species	*Dicrotendipes tenuiforceps*
species	*Endochironomus albipennis*
genus	*Glyptotendipes*
species	*Glyptotendipes barbipes*
species	*Heterotrissocladius grimshawi*
genus	*Metriocnemus*
species	*Microtendipes pedellus*

genus	*Pagastiella*
species	*Parakiefferiella nigra*
genus	*Paratrichocladius*
genus	*Paucispinigera*
species	*Phaenopsectra albescens*
genus	*Polypedilum*
species	*Polypedilum uncinatum*
genus	*Procladius*
genus	*Psectrocladius*
species	*Psectrocladius semicirculatus*
species	*Psectrotanypus dyari*
genus	*Tanytarsus*
species	*Tanytarsus lewisi*
genus	*Zavrelia*
family	Culicidae
species	*Aedes aegypti*
species	*Aedes canadensis*
species	*Culex pipiens*
family	Dixidae
genus	*Dixa*
family	Limoniidae
species	*Aphrophila neozelandica*
genus	Hexatoma
genus	*Lipsothrix*
genus	*Molophilus*
genus	*Dicranota*
genus	*Pedicia*
genus	Pilaria
family	Psychodidae
genus	*Clogmia*
genus	*Psychoda*

family	Sciaridae
family	Simuliidae
genus	*Austrosimulium*
genus	*Simulium*
family	Tipulidae
genus	*Hexatoma*
genus	*Tipula*
species	*Tipula abdominalis*
order	Ephemeroptera
genus	*Baetisca*
family	Caenidae
genus	*Caenis*
species	*Caenis diminuta*
species	*Caenis horaria*
species	*Caenis robusta*
family	Ephemerellidae
species	*Cincticostella nigra*
species	*Cincticostella orientalis*
genus	*Drunella*
species	*Drunella basalis*
genus	*Ephemerella*
species	*Ephemerella aurivillii*
species	*Eurylophella temporalis*
genus	*Serratella*
species	*Teloganopsis punctisetae*
family	Ephemeridae
genus	*Ephemera*
species	*Ephemera japonica*
species	*Ephemera strigata*
genus	*Blasturus*
genus	*Deleatidium*

species	*Habrophlebia vibrans*
genus	*Leptophlebia*
species	*Leptophlebia vespertina*
genus	*Meridialaris*
species	*Nousia bella*
genus	*Paraleptophlebia*
species	*Paraleptophlebia westoni*
species	*Penaphlebia chilensis*
genus	*Zephlebia*
species	*Ephoron album*
family	Potamanthidae
genus	*Tricorythodes*
genus	*Ameletus*
species	*Ameletopsis perscitus*
species	*Chiloporter eatoni*
family	Ametropodidae
family	Baetidae
genus	*Acentrella*
species	*Acentrella gnom*
species	*Baetiella japonica*
genus	*Baetis*
species	*Baetis thermicus*
genus	*Callibaetis*
species	*Centroptilum luteolum*
species	*Cloeon dipterum*
genus	*Heterocloeon*
genus	*Pseudocloeon*
species	*Coloburiscus humeralis*
family	Heptageniidae
genus	*Cinygmula*
genus	*Ecdyonurus*

species	*Ecdyonurus dispar*
genus	*Epeorus*
species	*Epeorus dispar*
species	*Epeorus ikanonis*
species	*Epeorus latifolium*
species	*Epeorus pleuralis*
genus	*Heptagenia*
species	*Kageronia fuscogrisea*
genus	*Leucrocuta*
species	*Maccaffertium meririvulanum*
genus	*Nixe*
genus	*Rhithrogena*
species	*Stenacron carolina*
species	*Stenacron interpunctatum*
genus	*Stenonema*
species	*Stenonema modestum*
genus	*Isonychia*
species	*Isonychia japonica*
genus	*Nesameletus*
genus	*Metamonius*
species	*Siphlonisca aerodromia*
genus	*Siphlonurus*
order	Hemiptera
species	*Aphelocheirus vittatus*
family	Belostomatidae
species	*Lethocerus deyrollei*
species	*Lethocerus indicus*
family	Corixidae
species	*Callicorixa audeni*
species	*Corisella mercenaria*
species	*Corixa punctata*

species	*Cymatia americana*
family	Gerridae
family	Nepidae
species	*Laccotrephes japonensis*
species	*Laccotrephes maculatus*
species	*Laccotrephes ruber*
family	Notonectidae
species	*Notonecta glauca*
species	*Notonecta kirbyi*
species	*Neoplea striola*
species	*Microvelia macgregori*
order	Hymenoptera
order	Lepidoptera
family	Pyralidae
genus	*Petrophila*
order	Megaloptera
family	Corydalidae
species	*Archichauliodes diversus*
species	*Corydalus cornutus*
species	*Nigronia serricornis*
species	*Parachauliodes continentalis*
species	*Protohermes grandis*
family	Sialidae
genus	*Sialis*
species	*Sialis aequalis*
species	*Sialis itasca*
species	*Sialis lutaria*
species	*Sialis velata*
order	Neuroptera
order	Odonata
suborder	Anisoptera

family	Aeshnidae
genus	*Aeshna*
species	*Aeshna interrupta*
species	*Cordulegaster maculata*
species	*Cordulia aenea*
genus	*Epitheca*
species	*Epitheca cynosura*
species	*Epitheca semiaquea*
species	*Neurocordulia molesta*
genus	*Dromogomphus*
family	Gomphidae
genus	*Gomphus*
species	*Lanthus vernalis*
species	*Megalogomphus superbus*
species	*Progomphus obscurus*
species	*Sieboldius albardae*
family	Libellulidae
species	*Celithemis fasciata*
species	*Crocothemis servilia*
species	*Erythemis simplicicollis*
species	*Ladona deplanata*
genus	*Libellula*
species	*Plathemis lydia*
genus	*Procordulia*
species	*Sympetrum internum*
suborder	Zygoptera
family	Calopterygidae
genus	*Calopteryx*
family	Coenargionidae
genus	*Argia*
species	*Argia vivida*

species	*Coenagrion angulatum*
species	*Coenagrion resolutum*
species	*Enallagma boreale*
genus	*Ischnura*
species	*Ischnura elegans*
genus	*Xanthocnemis*
family	Lestidae
species	*Lestes congener*
species	*Lestes disjunctus*
species	*Lestes dryas*
species	*Lestes malabaricus*
species	*Lestes rectangularis*
order	Orthoptera
order	Plecoptera
species	*Austroperla cyrene*
species	*Klapopteryx kuscheli*
species	*Stenoperla prasina*
species	*Antarctoperla michaelseni*
species	*Aubertoperla illiesi*
species	*Limnoperla jaffueli*
species	*Notoperla archiplatae*
species	*Notoperlopsis femina*
species	*Potamoperla myrmidon*
species	*Senzilloides panguipulli*
genus	*Zelandobius*
genus	*Zelandoperla*
genus	*Allocapnia*
species	*Allocapnia rickeri*
family	Chloroperlidae
genus	*Sweltsa*
genus	*Leuctra*

family	Nemouridae
genus	*Amphinemura*
species	*Amphinemura delosa*
species	*Amphinemura wui*
species	*Prostoia completa*
genus	*Tallaperla*
genus	*Acroneuria*
species	*Acroneuria abnormis*
species	*Acroneuria evoluta*
species	*Agnetina capitata*
species	*Beloneuria georgiana*
genus	*Caroperla*
species	*Eccoptura xanthenes*
species	*Kamimuria uenoi*
species	*Kempnyela genualis*
genus	*Kiotina*
genus	*Neoperla*
species	*Neoperla clymene*
genus	*Paragnetina*
species	*Paragnetina kansensis*
genus	*Perla*
genus	*Perlesta*
species	*Perlesta placida*
species	*Perlinella drymo*
species	*Pictetoperla gayi*
family	Perlodidae
species	*Clioperla clio*
genus	*Isogenus*
genus	*Isoperla*
species	*Isoperla bilineata*
species	*Isoperla namata*

species	*Isoperla signata*
species	*Malirekus hastatus*
genus	*Perlodes*
genus	*Stavsolus*
species	*Pteronarcys dorsata*
species	*Pteronarcys scotti*
genus	*Strophopteryx*
species	*Strophopteryx limata*
genus	*Taeniopteryx*
species	*Taeniopteryx lita*
order	Trichoptera
family	Ecnomidae
species	*Ecnomus tenellus*
family	Hydropsychidae
genus	*Aoteapsyche*
genus	*Cheumatopsyche*
species	*Cheumatopsyche infascia*
genus	*Hydropsyche*
species	*Hydropsyche albicephala*
species	*Hydropsyche dissimulata*
species	*Hydropsyche elissoma*
species	*Hydropsyche pellucidula*
species	*Hydropsyche sparna*
species	*Hydropsyche incommoda*
species	*Macronema pseudoneura*
species	*Macrostemum carolina*
genus	*Smicridea*
genus	*Chimarra*
genus	*Dolophilodes*
family	Polycentropodidae
genus	*Cyrnus*

species	*Cyrnus crenaticornis*
species	*Cyrnus flavidus*
species	*Cyrnus trimaculatus*
genus	*Neureclipsis*
genus	*Polycentropus*
species	*Polycentropus flavomaculatus*
family	Psychomyiidae
species	*Lype diversa*
species	*Tinodes waeneri*
species	*Stenopsyche marmorata*
species	*Stenopsyche sauteri*
genus	*Brachycentrus*
species	*Brachycentrus etowahensis*
genus	*Micrasema*
species	*Micrasema quadriloba*
genus	*Phylloicus*
species	*Olinga feredayi*
genus	*Pycnocentrodes*
species	*Goera japonica*
genus	*Helicopsyche*
genus	*Lepidostoma*
family	Leptoceridae
genus	*Athripsodes*
species	*Athripsodes aterrimus*
genus	*Ceraclea*
species	*Mystacides longicornis*
species	*Mystacides nigra*
genus	*Nectopsyche*
genus	*Oecetis*
species	*Triaenodes tardus*
family	Limnephilidae

genus	*Anabolia*
species	*Anabolia bimaculata*
species	*Anabolia furcata*
species	*Dicosmoecus jozankeanus*
species	*Hydatophylax festivus*
species	*Ironoquia parvula*
genus	*Limnephilus*
species	*Limnephilus janus*
species	*Limnephilus rhombicus*
species	*Philarctus quaeris*
species	*Potamophylax cingulatus*
species	*Pycnopsyche guttifera*
species	*Pycnopsyche lepida*
species	*Pycnopsyche luculenta*
species	*Pycnopsyche scabripennis*
species	*Molanna angustata*
genus	*Psilotreta*
family	Phryganeidae
species	*Agrypnia obsoleta*
genus	*Phryganea*
species	*Phryganea cinerea*
genus	*Ptilostomis*
family	Sericostomatidae
species	*Agarodes libalis*
species	*Fattigia pele*
species	*Parasericostoma ovale*
genus	*Glossosoma*
species	*Glossosoma altaicum*
species	*Glossosoma nigrior*
species	*Glossosoma ussuricum*
family	Hydrobiosidae

genus	*Neoatopsyche*
genus	*Rheochorema*
genus	*Cailloma*
family	Hydroptilidae
genus	*Hydroptila*
genus	*Orthotrichia*
genus	*Oxyethira*
genus	*Paroxyethira*
family	Rhyacophilidae
genus	*Rhyacophila*
species	*Rhyacophila kawamurae*
species	*Rhyacophila vao*
family	Corbiculidae
species	*Dreissena polymorpha*
family	Sphaeriidae
genus	*Pisidium*
species	*Pisidium casertanum*
family	Hyriidae
family	Unionidae
species	*Anodonta cataracta*
species	*Elliptio complanata*
species	*Leptodea ochracea*
species	*Parreysia favidens*
species	*Parreysia khadakvaslaensis*
class	Gastropoda
family	Viviparidae
species	*Bellamya dissimilis*
family	Amnicolidae
species	*Amnicola stenothyroides*
family	Bithyniidae
species	*Bithynia tentaculata*

family	Hydrobiidae
species	*Potamopyrgus antipodarum*
family	Bithyniidae
species	*Elimia cahawbensis*
species	*Elimia carinifera*
species	*Elimia fascinans*
species	*Elimia variata*
species	*Pleurocera canaliculatum*
family	Thiaridae
species	*Melanoides tuberculata*
family	Valvatidae
species	*Valvata cristata*
species	*Succinea ovalis*
family	Acroloxidae
species	*Chilina gibbosa*
species	*Chilina patagonica*
family	Lymnaeidae
species	*Lymnaea stagnalis*
species	*Radix peregra*
family	Physidae
family	Planorbidae
genus	*Ancylus*
species	*Anisus vortex*
genus	*Gyraulus*
species	*Gyraulus albus*
species	Gyraulus crista
species	*Hippeutis complanatus*
species	*Planorbis indicus*
phylum	Platyhelminthes
class	Rhabditophora
order	Tricladida

species	*Dendrocoelum lacteum*
species	*Cura foremanii*
species	*Dugesia tigrina*
genus	*Girardia*
species	*Girardia tigrina*
species	*Polycelis nigra*

Temporal coverage

Notes: The oldest publication was published in 1935 and the most recent in 2020.

Usage licence

Usage licence: Creative Commons Public Domain Waiver (CC-Zero)

Data resources

Data package title: Freshwater invertebrates characteristics data

Number of data sets: 1

Data set name: Freshwater invertebrates characteristics data

Data format: .txt

Description: This dataset describes 14 characteristics (size, dry weight, gross energy, crude protein etc.) for 656 taxa of freshwater invertebrates (Suppl. material 1). Headers corresponding to variable names are included as the first row in the data file. Each characteristic is subdivided into two categories, "value" corresponding to the value of the variable with sometimes a note corresponding to the comment associated with the value ("WS" for "with shell" and "SR" for "shell removed") and "reference" corresponding to the literature reference (Suppl. material 2). The datasets are deposited in Dryad (doi:10.5061/dryad.j3tx95xfg).

Column label	Column description
ID	Unique number corresponding to a described taxa
Phylum	Identification of taxa (Phylum)
Subphylum	Identification of taxa (Subphylum)
Class	Identification of taxa (Class)
Subclass	Identification of taxa (Subclass)

Order	Identification of taxa (Order)
Suborder	Identification of taxa (Suborder)
Family	Identification of taxa (Familly)
Genus	Identification of taxa (Genus)
Species	Identification of taxa (Genus + Species)
Taxa	Identification of taxa (Taxa)
LifeStage	The life stage of the taxa, i.e. "Larvae", "Larvae I", "Larvae II", "Larvae III", "Larvae IV", "Larvae V", "Larvae VI", "Nymph", "Pupae" or "Adult".
TL (value)	Total length in millimetres
HW/SW (value)	Head width / Shell width in millimetres
BL/SL (value)	Body length / Shell length in millimetres
WW (value)	Wet weight in milligrams
DW (value)	Dry weight in milligrams
GE-WW (value)	Gross energy in cal/g of wet weight
GE-DW (value)	Gross energy in cal/g of dry weight
GE-AFDW (value)	Gross energy in cal/g of ash free dry weight
Protein (value)	Crude protein in % of aggregate dry weight
Lipid (value)	Crude lipid in % of aggregate dry weight
Fibre (value)	Crude fibre in % of aggregate dry weight
NFE (value)	Nitrogen Free Extract in % of aggregate dry weight
Ash (value)	Ash in % of aggregate dry weight
Water (value)	Water in % of aggregate dry weight

Additional information

Steps of database building

1. **Classification and characteristics of freshwater invertebrates:** A literature review of the different morphological, calorific and nutritive characteristics of freshwater invertebrates was established. They were classified from phylum to species from three manuals of references (Balian et al. 2008a, Thorp and Covich 2009, Thorp and Rogers 2011). In this review, 104 scientific publications were

used and 14 criteria were described: total length, head width or shell width, body length or shell length, wet weight, dry weight, gross energy of wet weight, gross energy of dry weight, gross energy of ash free dry weight, crude protein, crude lipid, crude fibre, nitrogen free extract, proportion of ash and water.

2. **Referencing and retranscription of literature values:** Publications presenting original data or non-published data from another study were cited. Within publications, the values of the different criteria were represented heterogeneously (e.g. different measure units, taxonomic level). Due to this heterogeneity, all values were transformed to obtain a homogeneous set of measurement units and taxonomic level (i.e. µm in mm, µg in mg, kcal/g in cal/g, J/g in cal/g (1 J = 0.239006 cal), kJ/g in cal/g).

Prospects for use

Scientific literature shows that abundance of food resource is one of the first things that the animal ecologists measure when they want to understand the species they are studying, whether it is individual behaviour, reproduction or even population dynamics (Newton 1998). Thus, estimates of biomass or the calorific equivalent of freshwater organisms are necessary in the study of the food ecology of fish, amphibians or even birds. For example, the availability of food is often considered to be a fundamental factor affecting the migration and reproduction of animals, especially birds. For example, Anatidae conventionally have a diet dominated by seeds and plant matter in winter, but aquatic invertebrates dominate in spring and summer (Krapu and Reinecke 1994). Thus, the annual migration of Anatidae between the wintering and breeding site is often explained by the exploitation of abundant food resources at higher latitudes to increase breeding success (Berthold et al. 2003). In addition, many scientists agree that migration is programmed according to local peaks of food abundance at successive stopover sites in order to feed during migration and prepare for reproduction (Ankney et al. 1991, Drent and Daan 2002). After prenuptial migration, the majority of surface ducks must efficiently replenish fat and protein stores because egg formation and incubation are expensive processes (Alisauskas and Ankney 1992). Consequently, the abundance of food appears to be a decisive factor in the choice of breeding habitat (Pöysä et al. 2000). For all these reasons, the abundance, biomass and nutritional value of invertebrates are essential in studying habitat choice, reproductive success and annual cycles of dabbling ducks (Batt et al. 1992). In addition, prey size is essential to understand the food ecology of the organisms studied. For example, the Northern Shoveler has a spatula-shaped beak made up of many lamellae. This physical characteristic allows it to select only small prey, giving it a specific food niche. Thus, it is important to know the size of the prey available in order to understand the use of a site by this species.

The abundance, biomass and nutritional value of freshwater invertebrates are, therefore, essential in the study of predatory of freshwater invertebrates (Towers et al. 1994). The most common method for determining the wet or dry weight of aquatic invertebrates is to directly weigh individual specimens (Smock 1980). However, this approach often takes time and is prone to error if individuals were fixed (Downing 1984). Indeed, preservative

often modifies the fresh mass of conserved invertebrates (Johnston and Cunjak 1999). The dry mass measurement has the disadvantage of rendering the sample unusable for further examination following the drying process (Towers et al. 1994). In this case, a table synthesising the biometric and calorific data of freshwater invertebrates is a real benefit for the ecologist. Indeed, this table will allow freshwater ecologists to estimate biomass, energy and size class of freshwater invertebrates at survey sites quickly and economically.

However, it is important to note that there is variation in calorific values due to the collection season, the diet of the organisms and the sex of the individuals (Arzel et al. 2009). In addition, there is variation in individual values because the measurements taken almost always include the intestinal contents of the organisms or because females carrying eggs should have the highest values for a given species (Cumminns 1967). Given the errors that environmentalists face, it might be more realistic to use a median or overall calorific value. For the taxon studied, this value is, thus, easily obtainable thanks to this table. Indeed, the comparison of values for the same species obtained in different laboratories should allow problems due to seasonal differences, habitat and diet to be overcome (Johnston and Cunjak 1999).

References

- Alisauskas R, Ankney CD (1992) Spring Habitat Use and Diets of Midcontinent Adult Lesser Snow Geese. The Journal of Wildlife Management 56 (1): 43-54. https://doi.org/10.2307/3808789
- Anderson JT, Smith LM (2000) Invertebrate response to moist-soil management of playa wetlands. Ecological Applications 10 (2): 550-558. https://doi.org/10.2307/2641114
- Ankney CD, Afton A, Alisauskas R (1991) The Role of Nutrient Reserves in Limiting Waterfowl Reproduction. The Condor 93 (4): 1029-1032. https://doi.org/10.2307/3247743
- Appeltans W, Ahyong S, Anderson G, Angel M, Artois T, Bailly N, Bamber R, Barber A, Bartsch I, Berta A, Błażewicz-Paszkowycz M, Bock P, Boxshall G, Boyko C, Brandão S, Bray R, Bruce N, Cairns S, Chan T, Cheng L, Collins A, Cribb T, Curini-Galletti M, Dahdouh-Guebas F, Davie PF, Dawson M, De Clerck O, Decock W, De Grave S, de Voogd N, Domning D, Emig C, Erséus C, Eschmeyer W, Fauchald K, Fautin D, Feist S, Fransen CJ, Furuya H, Garcia-Alvarez O, Gerken S, Gibson D, Gittenberger A, Gofas S, Gómez-Daglio L, Gordon D, Guiry M, Hernandez F, Hoeksema B, Hopcroft R, Jaume D, Kirk P, Koedam N, Koenemann S, Kolb J, Kristensen R, Kroh A, Lambert G, Lazarus D, Lemaitre R, Longshaw M, Lowry J, Macpherson E, Madin L, Mah C, Mapstone G, McLaughlin P, Mees J, Meland K, Messing C, Mills C, Molodtsova T, Mooi R, Neuhaus B, Ng PL, Nielsen C, Norenburg J, Opresko D, Osawa M, Paulay G, Perrin W, Pilger J, Poore GB, Pugh P, Read G, Reimer J, Rius M, Rocha R, Saiz-Salinas J, Scarabino V, Schierwater B, Schmidt-Rhaesa A, Schnabel K, Schotte M, Schuchert P, Schwabe E, Segers H, Self-Sullivan C, Shenkar N, Siegel V, Sterrer W, Stöhr S, Swalla B, Tasker M, Thuesen E, Timm T, Todaro A, Turon X, Tyler S, Uetz P, van der Land J, Vanhoorne B, van Ofwegen L, van Soest RM, Vanaverbeke J, Walker-Smith G, Walter C, Warren A,

Williams G, Wilson S, Costello M (2012) The magnitude of global marine species diversity. Current Biology 22 (23): 2189-2202. https://doi.org/10.1016/j.cub.2012.09.036

- Arzel C, Elmberg J, Guillemain M, Lepley M, Bosca F, Legagneux P, Nogues J (2009) A flyway perspective on food resource abundance in a long-distance migrant, the Eurasian teal (*Anas crecca*). Journal of Ornithology 150 (1): 61-73. https://doi.org/10.1007/s10336-008-0318-6
- Balian EV, Lévêque C, Segers H, Martens K (2008a) Freshwater animal diversity assessment. Edition 1. Springer Netherlands https://doi.org/10.1007/978-1-4020-8259-7
- Balian EV, Segers H, Lévèque C, Martens K (2008b) The freshwater animal diversity assessment: an overview of the results. Hydrobiologia 595 (1): 627-637. https://doi.org/10.1007/s10750-007-9246-3
- Batt BJ, Anderson M, Afton A (1992) Ecology and Management of Breeding Waterfowl. Minne ed. edition. University of Minnesota Press, 664 pp. [ISBN 978-0-8166-6832-8]
- Berthold P, Gwinner E, Sonnenschein E (2003) Avian Migration. Springer-Verlag, Berlin Heidelberg, 610 pp. [ISBN 978-3-540-43408-5] https://doi.org/10.1007/978-3-662-05957-9
- Bolduc F, Afton AD (2004) Relationships between wintering waterbirds and invertebrates, sediments and hydrology of coastal marsh ponds. Waterbirds: The International Journal of Waterbird Biology 27 (3): 333-341. https://doi.org/10.1675/1524-4695(2004)027[0333:RBWWAI]2.0.CO;2
- Bouffard S, Hanson M (2006) Fish in waterfowl marshes: waterfowl managers' perspective. Wildlife Society Bulletin (1973-2006) 25 (1): 146-157. URL: http://www.jstor.org/stable/3783297
- Brodmann P, Reyer H (1999) Nestling provisioning in water pipits (*Anthus spinoletta*): Do parents go for specific nutrients or profitable prey? Oecologia 120 (4): 506-514. https://doi.org/10.1007/s004420050884
- Chapman A (2009) Numbers of living species in Australia and the World. Australia Government - Department of the Environment, Water, Heritage and the Arts. URL: https://www.environment.gov.au/science/abrs/publications/other/numbers-living-species/contents
- Collier K, Probert PK, Jeffries M (2016) Conservation of aquatic invertebrates: concerns, challenges and conundrums: Conservation of aquatic invertebrates. Aquatic Conservation: Marine and Freshwater Ecosystems 26 (5): 817-837. https://doi.org/10.1002/aqc.2710
- Colwell MA, Landrum SL (1993) Nonrandom shorebird distribution and fine-scale variation in prey abundance. Condor 95 (1): 94-103. https://doi.org/10.2307/1369390
- Covich AP, Palmer MA, Crowl TA (1999) The role of benthic invertebrate species in freshwater ecosystem. BioScience 49 (2): 119-127. https://doi.org/10.2307/1313537
- Cumminns KW (1967) Calorific Equivalents for Studies in Ecological Energetics. University of Pittsburgh, 52 pp. https://doi.org/10.1080/05384680.1971.11903918
- Cumminns KW, Wuycheck JC (1971) Caloric equivalents for investigations in ecological energetics. International Association of Theoretical and Applied Limnology1-158. https://doi.org/10.1080/05384680.1971.11903918
- Dallinger R (1994) Invertebrate organisms as biological indicators of heavy metal pollution. Applied Biochemistry and Biotechnology 48 (1): 27-31. https://doi.org/10.1007/BF02825356

- Davidson N (2014) How much wetland has the world lost? Long-term and recent trends in global wetland area. Marine and Freshwater Research 65 (10). https://doi.org/10.1071/MF14173
- Davis CA, Smith LM (2001) Foraging strategies and niche dynamics of coexisting shorebirds at stopover sites in the Southern Great Plains. The Auk 118: 484-495. https://doi.org/10.1642/0004-8038(2001)118[0484:FSANDO]2.0.CO;2
- Dawson T, Berry P, Kampa E (2003) Climate change impacts on freshwater wetland habitats. Journal for Nature Conservation 11 (1): 25-30. https://doi.org/10.1078/1617-1381-00031
- Diehl S (1992) Fish predation and benthic community structure: The role of omnivory and habitat complexity. Ecology 73 (5): 1646-1661. https://doi.org/10.2307/1940017
- Downing JA (1984) Sampling the Benthos of Standing Waters. In: Downing JA (Ed.) A Manual on Methods for the Assessment of Secondary Productivity. Blackwell, Oxford, 43 pp. https://doi.org/10.1002/iroh.19720570426
- Drent RH, Daan S (2002) The Prudent Parent: Energetic Adjustments in Avian Breeding. Ardea 38-90: 225-252. https://doi.org/10.5253/arde.v68.p225
- Ellwood MF, Foster W (2004) Doubling the estimate of invertebrate biomass in a rainforest canopy. Nature 429 (6991): 549-551. https://doi.org/10.1038/nature02560
- Elmberg J, Sjöberg K, Pöysä H, Nummi P (2000) Abundance-distribution relationships on interacting trophic levels: the case of lake-nesting waterfowl and dytiscid water beetles. Journal of Biogeography 27 (4): 821-827. https://doi.org/10.1046/j.1365-2699.2000.00445.x
- Erwin K (2009) Wetlands and global climate change: the role of wetland restoration in a changing world. Wetlands Ecology and Management 17 (1): 71-84. https://doi.org/10.1007/s11273-008-9119-1
- Finlayson CM, Davidson NC, Spiers AG, Stevenson NJ (1999) Global wetland inventory - current status and future priorities. Marine and Freshwater Research 50 (8). https://doi.org/10.1071/MF99098
- Fredrickson LH, Reid FA (1988) Nutritional values of waterfowl foods. In: Cross DH (Ed.) Waterfowl management handbook. Fish and Wildlife Leaflet, 13. U.S. Fish and Wildlife Service, 273 pp. URL: https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1034&context=icwdmwfm
- Gardner RC, Barchiesi S, Beltrame C, Finlayson CM, Galewski T, Harrison I, Paganini M, Perennou C, Pritchard DE, Rosenqvist A, Walpole M (2015) State of the world's wetlands and their services to people: A compilation of recent analyses. https://doi.org/10.2139/ssrn.2589447
- Garvey J, Stein R, Thomas H (1994) Assessing how fish predation and interspecific prey competition influence a crayfish assemblage. Ecology 75 (2): 532-547. https://doi.org/10.2307/1939556
- Gaufin AR, Tarzwell CM (1952) Aquatic invertebrates as indicators of stream pollution. Public Health Reports (1896-1970) 67 (1). https://doi.org/10.2307/4587981
- Gaufin AR, Tarzwell CM (1956) Aquatic macro-invertebrate communities as indicators of organic pollution in Lytle Creek. Sewage and Industrial Wastes 28 (7): 906-924. https://doi.org/10.2307/25033111
- Gilinsky E (1984) The role of fish predation and spatial heterogeneity in determining benthic community structure. Ecology 65 (2): 455-468. https://doi.org/10.2307/1941408

- Goss-Custard JD (1977) Optimal foraging and the size selection of worms by redshank, *Tringa totanus*, in the field. Animal Behaviour 25: 10-29. https://doi.org/10.1016/0003-3472(77)90063-X
- Guareschi S, Abellán P, Laini A, Green AJ, Sánchez-Zapata JA, Velasco J, Millán A (2015) Cross-taxon congruence in wetlands: Assessing the value of waterbirds as surrogates of macroinvertebrate biodiversity in Mediterranean Ramsar sites. Ecological Indicators 49: 204-215. https://doi.org/10.1016/j.ecolind.2014.10.012
- Halse SA, Shiel RJ, Storey AW, Edward DH, Lansbury I, Cale DJ, Harvey MS (2000) Aquatic invertebrates and waterbirds of wetlands and rivers of the southern Carnarvon Basin, Western Australia. Records of the Western Australian Museum, Supplement 60 (1). https://doi.org/10.18195/issn.0313-122x.61.2000.217-265
- Hellawell JM (Ed.) (1986) Biological indicators of freshwater pollution and environmental management. Springer Netherlands, 546 pp. https://doi.org/10.1007/978-94-009-4315-5
- Hodkinson I, Jackson J (2005) Terrestrial and aquatic invertebrates as bioindicators for environmental monitoring, with particular reference to mountain ecosystems. Environmental Management 35 (5): 649-666. https://doi.org/10.1007/s00267-004-0211-x
- Hornung J, Foote AL (2006) Aquatic invertebrate responses to fish presence and vegetation complexity in Western Boreal wetlands, with implications for Waterbird productivity. Wetlands 26 (1): 1-12. https://doi.org/10.1672/0277-5212(2006)26[1:AIRTFP]2.0.CO;2
- James D, Csargo I, Von Eschen A, Thul M, Baker J, Hayer C, Howell J, Krause J, Letvin A, Chipps S (2012) A generalized model for estimating the energy density of invertebrates. Freshwater Science 31 (1): 69-77. https://doi.org/10.1899/11-057.1
- Johnston T, Cunjak R (1999) Dry mass-length relationships for benthic insects: a review with new data from Catamaran Brook, New Brunswick, Canada. Freshwater Biology 41 (4): 653-674. https://doi.org/10.1046/j.1365-2427.1999.00400.x
- Khamis K, Hannah DM, Brown LE, Tiberti R, Milner AM (2014) The use of invertebrates as indicators of environmental change in alpine rivers and lakes. Science of the Total Environment 493: 1242-1254. https://doi.org/10.1016/j.scitotenv.2014.02.126
- Krapu GL, Reinecke KJ (1994) Foraging ecology and nutrition. In: Krapu GL, Reinecke KJ (Eds) Ecology and Management of Breeding Waterfowl. University of Minnesota Press, 29 pp. https://doi.org/10.2307/3809573
- Krieger K (1992) The ecology of invertebrates in great lakes coastal wetlands: Current knowledge and research needs. Journal of Great Lakes Research 18 (4): 634-650. https://doi.org/10.1016/S0380-1330(92)71327-6
- Lavelle P, Decaëns T, Aubert M, Barot S, Blouin M, Bureau F, Margerie P, Mora P, Rossi J- (2006) Soil invertebrates and ecosystem services. European Journal of Soil Biology 42: 3-15. https://doi.org/10.1016/j.ejsobi.2006.10.002
- Lawrence A, Soame J (2004) The effects of climate change on the reproduction of coastal invertebrates: Climate change and invertebrate reproduction. Ibis 146: 29-39. https://doi.org/10.1111/j.1474-919X.2004.00325.x
- Lillie RA, Evrard JO (1994) Influence of macroinvertebrates and macrophytes on waterfowl utilization of wetlands in the Prairie Pothole Region of northwestern Wisconsin. Hydrobiologia 279 (1): 235-246. https://doi.org/10.1007/BF00027857
- May RM (1990) How many species? Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences 330 (1257): 293-304. https://doi.org/10.1098/rstb.1990.0200

- May RM (2010) Tropical arthropod species, more or less? Science 329 (5987): 41-42. https://doi.org/10.1126/science.1191058
- Ma Z, Cai Y, Li B, Chen J (2010) Managing wetland habitats for waterbirds: an international perspective. Wetlands 30 (1): 15-27. https://doi.org/10.1007/s13157-009-0001-6
- McCarthy S, Duda J, Emlen J, Hodgson G, Beauchamp D (2009) Linking habitat quality with trophic performance of steelhead along forest gradients in the South Fork Trinity River Watershed, California. Transactions of the American Fisheries Society 138 (3): 506-521. https://doi.org/10.1577/T08-053.1
- Mora C, Tittensor D, Adl S, Simpson AB, Worm B (2011) How many species are there on earth and in the ocean? PLOS Biology 9 (8). https://doi.org/10.1371/journal.pbio.1001127
- Newton I (1998) Population limitation in birds. Academic Press, London, 597 pp. [ISBN 978-0-12-517365-0] https://doi.org/10.1016/B978-0-12-517365-0.X5000-5
- Nudds TD, Bowlby JN (1984) Predator–prey size relationships in North American dabbling ducks. Canadian Journal of Zoology 62 (10): 2002-2008. https://doi.org/10.1139/z84-293
- Pöysä H, Elmberg J, Sjöberg K, Nummi P (2000) Nesting mallards (Anas platyrhynchos) forecast brood-stage food limitation when selecting habitat: experimental evidence. Oecologia 122 (4): 582-586. https://doi.org/10.1007/PL00008858
- Prather C, Pelini S, Laws A, Rivest E, Woltz M, Bloch C, Del Toro I, Ho C, Kominoski J, Newbold TAS, Parsons S, Joern A (2013) Invertebrates, ecosystem services and climate change: Invertebrates, ecosystems and climate change. Biological Reviews 88 (2): 327-348. https://doi.org/10.1111/brv.12002
- Sanders MD (2000) Enhancing food supplies for waders: inconsistent effects of substratum manipulations on aquatic invertebrate biomass. Journal of Applied Ecology 37 (1): 66-76. https://doi.org/10.1046/j.1365-2664.2000.00469.x
- Smock L (1980) Relationships between body size and biomass of aquatic insects. Freshwater Biology 10 (4): 375-383. https://doi.org/10.1111/j.1365-2427.1980.tb01211.x
- Stork N, Eggleton P (1992) Invertebrates as determinants and indicators of soil quality. American Journal of Alternative Agriculture 7 (1-2). https://doi.org/10.1017/S0889189300004446
- Strayer D (2006) Challenges for freshwater invertebrate conservation. Journal of the North American Benthological Society 25 (2): 271-287. https://doi.org/10.1899/0887-3593(2006)25[271:CFFIC]2.0.CO;2
- Strayer D (2010) Alien species in fresh waters: ecological effects, interactions with other stressors, and prospects for the future. Freshwater Biology 55: 152-174. https://doi.org/10.1111/j.1365-2427.2009.02380.x
- Strayer D, Dudgeon D (2010) Freshwater biodiversity conservation: recent progress and future challenges. Journal of the North American Benthological Society 29 (1): 344-358. https://doi.org/10.1899/08-171.1
- Taft O, Haig S (2005) The value of agricultural wetlands as invertebrate resources for wintering shorebirds. Agriculture, Ecosystems & Environment 110: 249-256. https://doi.org/10.1016/j.agee.2005.04.012
- Thorp JH, Covich AP (2009) Ecology and classification of North American freshwater invertebrates. Third. Elsevier https://doi.org/10.1016/C2009-0-02669-5
- Thorp JH, Rogers DC (2011) Field guide to freshwater invertebrates of North America. Elsevier https://doi.org/10.1016/C2009-0-61804-3

- Towers DJ, Henderson IM, Veltman CJ (1994) Predicting dry weight of New Zealand aquatic macroinvertebrates from linear dimensions. New Zealand Journal of Marine and Freshwater Research 28 (2): 159-166. https://doi.org/10.1080/00288330.1994.9516604
- Vanni M (2002) Nutrient cycling by animals in freshwater ecosystems. Annual Review of Ecology and Systematics 33 (1): 341-370. https://doi.org/10.1146/annurev.ecolsys.33.010802.150519
- Vicente F (2010) Micro-invertebrates conservation: forgotten biodiversity. Biodiversity and Conservation 19 (13): 3629-3634. https://doi.org/10.1007/s10531-010-9898-6
- Weber LM, Haig SM (1997) Shorebird–prey interactions in South Carolina coastal soft sediments. Canadian Journal of Zoology 75 (2): 245-252. https://doi.org/10.1139/z97-031
- Zwarts L, Blomert A (1992) Why knot *Calidris canutus* take medium-sized *Macoma balthica* when six prey species are available. Marine Ecology Progress Series 83: 113-128. https://doi.org/10.3354/meps083113

Table 1.

Number of described taxa.

Phylum	Subphylum	Class	Subclass	Order	Suborder	Familly	Genus	Species
Annelida	-	Clitellata	2	2	3	10	14	14
-	-	Polychaeta	1	1	1	1	0	-
Arthropoda	Chelicerata	1	2	1	1	2	1	-
-	Crustacea	4	4	12	10	44	66	98
-	Hexapoda	2	1	13	15	98	325	209
Mollusca	-	Bivalvia	2	2	-	5	6	7
-	-	Gastropoda	3	6	1	14	17	21
Plathelminthes	-	1	1	1	1	3	5	5

Supplementary materials

Suppl. material 1: Freshwater invertebrates characteristics data

Authors: Moreau A
Data type: Morphological, calorific and nutritive
Download file (174.05 kb)

Suppl. material 2: Reference code

Authors: Moreau A
Data type: References
Download file (21.41 kb)