GLOBAL INVASIVE SPECIES DATABASE

FULL ACCOUNT FOR: ***Bythotrephes longimanus***

Bythotrephes longimanus 正體中文

System: Freshwater

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Branchiopoda	Diplostraca	Cercopagidae

Common name spiny water flea (English), Cederstroem-Blattflusskrebs (German), Eurasian spiny water flea (English), spiny waterflea (English)

Synonym *Bythotrephes cederstroemii* , Schodler, 1877

Similar species *Cercopagis pengoi*

Summary *Bythotrephes longimanus*, the spiny water flea, is a predatory cladoceran native to northern Europe and Asia. It was introduced to the North American Great Lakes through ballast water and has since spread to a number of inland lakes. *B. longimanus* competes directly for prey with juvenile and small fish along with predatory zooplankton. It can foul fishing lines and downrigger cables, and can have substantial impacts on zooplankton community structure.

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Species Description
The spiny water flea is a freshwater crustacean characterised by a well developed abdominal region (metasoma), a cauda continued into a long, thin caudal appendage, a head clearly delimited from the trunk and the ocular part of the head globular and filled with a large eye separated by a depression from the head shield. Adult *Bythotrephes* from the Great Lakes measure between about 1.5 and 5mm in length (excluding caudal spine). They are characterised by a long caudal tail spine that is barbed and can be up to 7mm in length (Rivier, 1998)

Notes
B. longimanus exhibits a high degree of morphological variability both throughout its range and seasonally within a locality. Until recently several different species were recognised, although these are now seen to be simply manifestations of the extreme polymorphism of *B. longimanus*. Currently, only the species *longimanus* is recognised in the genus *Bythotrephes* (Rivier, 1998). Initial reports of *Bythotrephes longimanus* in North America referred to the organism as *Bythotrephes cederstroemi*.

Lifecycle Stages
Sikes (2002) states that, \"Through parthenogenesis the spiny water flea can exhibit explosive population growth, but its ability to produce sexual eggs allows it to increase genetic variability as well as survive and disperse under adverse environmental conditions. Development time till primaparity (1st time mom) is not significantly different for the two modes of reproduction, averaging about 14 days. Sexually reproduced eggs can go into a semi-static metabolic condition called diapause. Through these sexual reproduced \"resting eggs\", the next generation of *B. longimanus* can overwinter and hatch usually when temperatures exceed 4ºC. The spiny water flea can survive a wide range of temperatures, but has lowest mortality between 5ºC and 30ºC. Its development time is temperature dependent and maximised between 20-25ºC without suffering higher mortality. Besides protection from winter conditions, many diapaused eggs can also survive passage through fish digestive tract. A female with a full clutch is double her usual weight . This fact causes increased predation on pregnant females above their conspicuous body with a single large eye and long tail spine and thereby further aids in dispersal.\"

Uses
Straile and Haelbich (2000) report that, \"Because of its large body size and conspicuousness, *B. longimanus* is a preferred prey of freshwater fish.\" In the Great Lakes it has been shown to be a preferred prey of alewife (*Alosa pseudoharengus*) (Pothoven and Vanderploeg, 2004; Mills *et al.* 1992) and lake herring (*Coregonus artedii*) (Coulas *et al.* 1998). However, it is probably not utilised by smaller fish (Barnhisel and Harvey, 1995).

Habitat Description
B. longimanus is a Palaearctic species, native to northern Europe and Asia (Rivier, 1998). Within both its native and introduced range, MacIsaac *et al.* (2000) have documented a preference for large, deep, clear lakes with relatively low summer bottom temperatures. Enz *et al.* (2001) hypothesised that its absence from shallow eutrophic lakes was due to a need for deep, oxygenated water to escape from fish predation.

Reproduction
B. longimanus can reproduce both by parthenogenetic (cloning) and gamogenetic (sexual) reproduction. Parthenogenetic reproduction occurs throughout the whole life cycle, while gamogenesis occurs at the end of a growing season and results in the formation of resting eggs capable of surviving unfavourable conditions (Rivier, 1998).

Nutrition
Crustaceans, and in particular cladocerans, appear to be preferred prey items *B. longimanus* (Schultz and Yurista, 1999), although copepods and rotifers are also apparently utilised (Schultz and Yurista, 1999; Vanderploeg *et al.* 1993). \"*B. longimanus* seizes prey with long arm-like antennae and hold them in place with its legs. One spiny water flea may consume as many as 20 prey organisms in a day\" (Berg, 1992).

General Impacts
The invasion of *B. longimanus* into the Laurentian Great Lakes has resulted in substantial and sustained decreases in the populations of a number of (mostly cladoceran) native zooplankton species (Barbiero and Tuchman, 2004). Similar zooplankton community shifts have also been seen in Harp Lake, Ontario (Yan and Pawson, 1997). Given what is known of *B. longimanus*'s feeding habits (e.g., Schultz and Yurista, 1999), these impacts have presumably resulted from direct predation. The impacts of *B. longimanus* on fish community dynamics is unclear at present. While directly competing with small fish for food, *B. longimanus* is also utilised as food by some fish species (Coulas *et al.* 1998).
\"Surveys of Ontario anglers indicate that *B. longimanus* is widely regarded as a nuisance. With its long caudal process, it can foul fishing lines and downrigger cables, potentially resulting in the loss of hooked fish\" (Boudreau and Yan, 2004).

Management Info
Preventative measures: Ontario has initiated its own volunteer monitoring program for *B. longimanus*. Boudreau and Yan (2004) conducted an investigation to determine if the monitoring program was successful. The authors determined that, \"Volunteer monitoring programs not only benefit the parent or supporting organisation by helping carry out their mandates, they also serve a great purpose in educating the public. The best way to prevent the further spread of these organisms into Ontario's inland lakes is to educate the boaters that frequent the province's waterways.\"
Johnson (2003) has been promoting education and word of mouth in Wisconsin to prevent the further spread of the species within that state. Fliers have been posted in strategic locations, and Boaters are informed firsthand of precautions they should take in order to prevent the spread of *B. longimanus*.
Sikes (2002) states that, \"Personal management practices for boaters and anglers include cleaning of boating equipment with high-pressure water or heated water upwards of 104ºF. Also bait buckets should not be emptied into waters, instead empty on land. Visual inspection of rigging, fishing, and anchor lines as well as the props and hulls of boats can help limit *B. longimanus* spread. Boats should be allowed to dry for at least 5 days before transport between lakes, but because of *B. longimanus* resting eggs longer periods are recommended. Boats and trailers can be towed through carwashes if exposed to infected waters for long time periods.\"
Sikes (2002) reports that, \"Current management practices for the spiny water flea seek to limit its spread to other lakes. Predictions can be made on the invasion potential for surrounding areas using the vectors of transfer, namely humans. One main factor is the lakes proximity to major roads and lakes within 3.4 km show particular vulnerability.\" The author also reports that, \"The accidental introduction of ballast water invaders like *B. longimanus*, the zebra mussel, and others could possibly have been avoided by ships using open water ballast exchange practices.\"

Principal source: Sikes, 2002 Spiny Water Flea *Bythotrephes longimanus* Leydig 1860

Compiler: National Biological Information Infrastructure (NBII) & IUCN/SSC Invasive Species Specialist Group (ISSG)

Review: Richard P. Barbiero, Ph.D.\ Senior Environmental Scientist CSC Chicago USA

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ALIEN RANGE

[4] CANADA
[1] LAKE ERIE
[1] LAKE MICHIGAN
[1] LAKE SUPERIOR
[1] GREAT LAKES
[1] LAKE HURON
[1] LAKE MUSKOKA
[9] UNITED STATES

BIBLIOGRAPHY
48 references found for **Bythotrephes longimanus**

Managment information
Barnhisel, D.R. and H.A. Harvey, 1995. Size-Specific Fish Avoidance of the Spined Crustacean *Bythotrephes*: Field Support for Laboratory Predictions. Canadian Journal of Fisheries and Aquatic Sciences 52(4): 768-775

Centre for Environment, Fisheries & Aquaculture Science (CEFAS)., 2008. Decision support tools-Identifying potentially invasive non-native marine and freshwater species: fish, invertebrates, amphibians.
Summary: The electronic tool kits made available on the Cefas page for free download are Crown Copyright (2007-2008). As such, these are freeware and may be freely distributed provided this notice is retained. No warranty, expressed or implied, is made and users should satisfy themselves as to the applicability of the results in any given circumstance. Toolkits available include 1) FISK- Freshwater Fish Invasiveness Scoring Kit (English and Spanish language version); 2) MFISK- Marine Fish Invasiveness Scoring Kit; 3) MI-ISK- Marine invertebrate Invasiveness Scoring Kit; 4) FI-ISK- Freshwater Invertebrate Invasiveness Scoring Kit and AmphISK- Amphibian Invasiveness Scoring Kit. These tool kits were developed by Cefas, with new VisualBasic and computational programming by Lorenzo Vilizzi, David Cooper, Andy South and Gordon H. Copp, based on VisualBasic code in the original Weed Risk Assessment (WRA) tool kit of P.C. Pheloung, P.A. Williams & S.R. Halloy (1999).
The decision support tools are available from:
http://cefas.defra.gov.uk/our-science/ecosystems-and-biodiversity/non-native-species/decision-support-tools.aspx [Accessed 13 October 2011]
The guidance document is available from http://www.cefas.co.uk/media/118009/fisk_guide_v2.pdf [Accessed 13 January 2009].
Dumitru, C., Sprules, W. G. and Yan, N. D. 2001. Impact of *Bythotrephes cederstroemi* on zooplankton assemblages of Harp Lake, Canada: an assessment based on predator consumption and prey production. Freshwater Biol. 46: 241-251.
Johnson, P. 2003. *Spiny Water Flease Invade Wisconsin*. University of Wisconsin.
Saksgard, R., and T. Hesthagen. 2004. *A 14-year study of habitat use and diet of brown trout (Salmo trutta) and Arctic charr (Salvelinus alpinus) in Lake Atnsjoen, a subalpine Norwegian lake.* Hydrobiologia-. 2004; 521(1-3): 187-199.
Sikes, B. A. 2002. *Spiny Water Flea (Bythotrephes longimanus (Leydig 1860)*. Institute for Biological Invasions, Invader of the Month.
USGS-NAS (Nonindigenous Aquatic Species Database). 2004. *Bythotrephes longimanus* . Center for Aquatic Resource Studies, Biological Resources Division of the Geological Survey, U. S. Department of the Interior.
Summary: Available from: http://nas.er.usgs.gov/queries/SpFactSheet.asp?SpeciesID=162 [Accessed 13 February 2006]
Vander Zanden, J., K.A. Wilson, J. M. Casselman, and N.D. Yan. 2004. Species introductions and their impacts in North American Shield lakes. In J.M. Gunn, R.J. Steedman and R.A. Ryder (eds). Boreal Shield watersheds: lake trout ecosystems in a changing environment. Lewis Publishers, Boca Raton, pp. 229-263
Summary: Introduced species impact in the North American Shield lakes.
Yan, N.D., R. Girard and S. Boudreau, 2002. An introduced predator (*Bythotrephes*) reduces zooplankton species richness. Ecology Letters 5: 481-485.
Summary: Spiny water flea invasion impact.

General information
Barbiero, R.P. and M.L. Tuchman, 2004. Changes in the crustacean communities of Lakes Michigan, Huron and Erie following the invasion of the predatory cladoceran *Bythotrephes longimanus*. Canadian Journal of Fisheries and Aquatic Sciences. 61(11): 2111-2125.
Berg, D. J. 1992. *The spiny water flea, Bythotrephes cederstroemi, Another unwelcome newcomer to the Great Lakes*. Ohio Sea Grant, College Program: FS-049.
Berg, D. J., D. W. Garton, H. J. MacIsaac, V. E. Panov, and I. V. Telesh. 2002. *Changes in genetic structure of North American Bythotrephes populations following invasion from Lake Ladoga, Russia.* Freshwater-Biology. 2002; 47(2): 275-282.
Boudreau, S. A., and N. D. Yan. 2003. *The differing crustacean zooplankton communities of Canadian Shield lakes with and without the nonindigenous zooplanktivore Bythotrephes longimanus.* Canadian-Journal-of-Fisheries-and-Aquatic-Sciences. 2003; 60(11): 1307-1313.
Boudreau, S. A., and N. D. Yan. 2004. *Auditing the Accuracy of a Volunteer-Based Surveillance Program for an Aquatic Invader, Bythotrephes.* Environmental Monitoring and Assessment, 91:17-26.
Brown, M. E., and D. K. Branstrator. 2004. *A 2001 survey of crustacean zooplankton in the western arm of Lake Superior.* Journal-of-Great-Lakes-Research. 2004; 30(1): 1-8.
Bungartz, B., and D. K. Branstrator. 2003. *Morphological changes in Daphnia mendotae in the chemical presence of Bythotrephes longimanus.* Archiv Fuer Hydrobiologie. 158(1). August 2003. 97-108.
Charalambidou, I., A. M. Ketelaars, and L. Santamaria. 2003. *Endozoochory by ducks: influence of developmental stage of Bythotephes diapause eggs on dispersal probability*. Diversity and Distributions, 9:367-374.
CONABIO. 2008. Sistema de informaci⌐n sobre especies invasoras en M⌐xico. Especies invasoras - Crust⌐ceos. Comisi⌐n Nacional para el Conocimiento y Uso de la Biodiversidad. Fecha de acceso.
Summary: English:
The species list sheet for the Mexican information system on invasive species currently provides information related to Scientific names, family, group and common names, as well as habitat, status of invasion in Mexico, pathways of introduction and links to other specialised websites. Some of the higher risk species already have a direct link to the alert page. It is important to notice that these lists are constantly being updated, please refer to the main page (http://www.conabio.gob.mx/invasoras/index.php/Portada), under the section Novedades for information on updates.
Invasive species - crustaceans is available from: http://www.conabio.gob.mx/invasoras/index.php/Especies_invasoras_-_Crust%C3%A1ceos [Accessed 30 July 2008]
Spanish:
La lista de especies del Sistema de informaci⌐n sobre especies invasoras de m⌐xico cuenta actualmente con informaci⌐n aceca de nombre cient⌐fico, familia, grupo y nombre com⌐n, as⌐ como h⌐bitat, estado de la invasi⌐n en M⌐xico, rutas de introducci⌐n y ligas a otros sitios especializados. Algunas de las especies de mayor riesgo ya tienen una liga directa a la p⌐gina de alertas. Es importante resaltar que estas listas se encuentran en constante proceso de actualizaci⌐n, por favor consulte la portada (http://www.conabio.gob.mx/invasoras/index.php/Portada), en la secci⌐n novedades, para conocer los cambios.
Especies invasoras - Crust⌐ceos is available from: http://www.conabio.gob.mx/invasoras/index.php/Especies_invasoras_-_Crust%C3%A1ceos [Accessed 30 July 2008]

Coulas, R.A., H.J. MacIsaac, and W. Dunlop, 1998. Selective Predation on an Introduced Zooplankton (*Bythotrephes cederstroemi*) by Lake Herring (*Coregonus artedii*) in Harp Lake, Ontario. Freshwater Biology 40: 343-355
Dumitru, C., W. G. Sprules, and N. D. Yan. 2001. *Impact of Bythotrephes longimanus on zooplankton assemblages of Harp Lake, Canada: An assessment based on predator consumption and prey production.* Freshwater-Biology. 2001; 46(2): 241-251.
Eckmann, R., M. Becker, and M. Schmid. 2002. *Estimating food consumption by a heavily fished stock of zooplanktivorous Coregonus lavaretus.* Transactions-of-the-American-Fisheries-Society. 2002; 131(5): 946-955.
Environmental Education Network. 2004. *Systematic tree of organisms: Bythotrephes longimanus.*
Enz, C. A., C. Heller, R. Muller, and H. R. Burgi. 2001. *Investigations on fecundity of Bythotrephes longimanus in Lake Lucerne (Switzerland) and on Niche Segregation of Leptodora kindti and Bythotrephes longimanus in Swiss lakes.* Hydrobiologia-. 2001; (464): 143-151.
Hall, R. I. and Yan, N. D. 1997. Comparing annual population growth estimates of the exotic invader *Bythotrephes* from sediment vs. plankton records. Limnol. Oceanogr. 42:112-120.
Haugen, T. O., and T. A. Rygg. 1996. *Food- and habitat-segregation in sympatric grayling and brown trout*. Journal-of-Fish-Biology. 1996; 49(2): 301-318.
Ketelaars, H. A., A. J. Wagenvoort, R. F. Herbst, P. A. Van-Der-Salm, and G. A. De-Jonge-Pinkster. 1995. *Life history characteristics and distribution of Bythotrephes longimanus Leydig (Crustacea, Onychopoda) in the Biesbosch reservoirs.* Hydrobiologia-. 1995; 307(1-3): 239-251.
Ketelaars, H. A., and L. Gille. 1994. *Range extension of the predatory cladoceran Bythotrephes longimanus Leydig 1860 (Crustacea, Onychopoda) in western Europe.* Netherlands-Journal-of-Aquatic-Ecology. 1994; 28(2): 175-180.
Lurling, M. 2003. *The effect of substances from different zooplankton species and fish on the induction of defensive morphology in the green alga Scenedesmus obliquus.* Journal of Plankton Research. 25(8). August 2003. 979-989.
MacIsaac, H. J., Ketelaars, H. A. M., Grigorovich, I. A., Ramcharan, C. W. and Yan, N. D. 2000. Modeling *Bythotrephes longimanus* invasions in the Great Lakes basin based on its European distribution. Arch. Hydrobiol. 149: 1-21.
MacIssac, H. J., J. V. Borbely, J. R. Muirhead, and P. A. Graniero. 2004. *Backcasting and forecasting biological invasions of inland lakes*. Ecological-Applications. 2004; 14(3): 773-783
Maemets, A., M. Timm, and T. Noges. 1996. *Zooplankton of Lake Peipsi-Pihkva in 1909-1987*. Hydrobiologia-. 1996; 338(1-3): 105-112.
Manca, M., and D. Ruggiu. 1998. *Consequences of pelagic food-web changes during a long-term lake oligotrophication process.* Limnology-and-Oceanography. 1998; 43(6): 1368-1373.
Morrison, B. R.S. 1997. *Stomach contents of trout, Salmo trutta L., caught by angling on Loch Dee, an acid water in south-west Scotland PH16 5LB.* Fisheries-Management-and-Ecology. 1997; 4(3): 217-222.
Nauwerck, A. 1995. *The Danubian bleak, Chalcalburnus chalcoides mento (Agassiz), and its food in Lake Mondsee (Upper Austria)*. Limnologica-. 1995; 25(2): 91-103.
Parker, S. L., L. G. Rudstam, E. L. Mills, and D. w. Einhouse. 2001. *Retention of Bythotrephes spines in the stomachs of eastern Lake Erie rainbow smelt.* Transactions-of-the-American-Fisheries-Society. 2001; 130(5): 988-994.
Pothoven, S. A., and Vanderploeg, H. A. 2004. Diet and prey selection of alewives in Lake Michigan: seasonal, depth, and interannual patterns. Trans. Am. Fish. Soc. 133: 1068-1077.
Rivier I. K, 1998. The predatory Cladocera (Onychopoda: Podonidae, Polyphemidae, Cercopagidae) and Leptodorida of the World. Guides to the Identification of the Micro-Invertebrates of the Continental Waters of the World, Backhuys Publishing, Leiden 13: 213 pp.
Schulz, K. L., and Yurista, P. M., 1999. Implications of an invertebrate predator s (*Bythotrephes cederstroemi*) atypical effects on a pelagic zooplankton community. Hydrobiologia 380: 179-193.
Straile, D. 2000. Life History And Multiple Antipredator Defenses Of An Invertebrate Pelagic Predator, Bythotrephes Longimanus. Ecology January 2000 Issue.
Straile, D., and A. Haelbich. 2000. *Life history and multiple antipredator defenses of an invertebrate pelagic predator, Bythotrephes longimanus.* Ecology-(Washington-D-C). 2000; 81(1): 150-163.
Therriault, T. W., Grigorovich, I. A., Kane, D. D., Haas, E. M., Culver, D. A., and MacIsaac, H. J., 2002. Range expansion of the exotic zooplankter *Cercopagis pengoi* (Ostroumov) into western Lake Erie and Muskegon Lake. J. Great Lakes Res. 28: 698-701.
Vanderploeg, H. A., Liebig, J. R., and Omair, M., 1993. *Bythotrephes* predation on Great Lakes zooplankton measured by an *in situ* method - implications for zooplankton community structure. 1993. Arch. Hydrobiol. 127: 1-8.
Winfield, I. J., C. W. Bean, and D. P. Hewitt. 2002. *The relationship between spatial distribution and diet of Arctic charr, Salvelinus alpinus, in Loch Ness, U.K.* Environmental-Biology-of-Fishes. 2002; 64(1-3): 63-73.
Yan, N. D., A. Blukacz, W. G. Sprules, P. K. Kindy, D. Hackett, R. E. Girar, and B. J. Clark. 2001. *Changes in zooplankton and the phenology of the spiny water flea, Bythotrephes, following its invasion of Harp Lake, Ontario, Canada.* Canadian Journal of Fisheries and Aquatic Sciences. 2001; 58(12): 2341-2350.
Yan, N. D. and Pawson, T. W. 1998. Variation in size and abundance of the exotic invader *Bythotrephes cederstroemi* in Harp Lake, Canada. Hydrobiologia 361:157-168.
Yan, N.D., and T.W. Pawson., 1997. Changes in the crustacean zooplankton community of Harp Lake, Canada, following invasion by *Bythotrephes cederstroemi*, Freshwater Biology 37: 409-425
Yan, N.D., and T.W. Pawson., 1998. Seasonal Variation in the Size and Abundance of the Invading *Bythotrephes* in Harp Lake, Ontario, Canada Hydrobiologia 361: 157-168
Yan, N. D., Dunlop, W., Pawson, T. W. and Mackay, L. E. 1992. *Bythotrephes cederstroemi* (Schoedler) in Muskoka lakes: first records of the European invader in inland lakes in Canada. Can. J. Fish. Aquat. Sci. 49: 422-426.