

NEW YORK FISH & AQUATIC INVERTEBRATE INVASIVENESS RANKING FORM

Scientific name: Bythotrephes cederstroemi (Bythotrephes longimanus)
 Common names: Spiny Water Flea
 Native distribution: Northern Europe and Asia
 Date assessed: 6/7/2013
 Assessors: E. Schwartzberg
 Reviewers: _____
 Date Approved: _____ Form version date: 3 January 2013

New York Invasiveness Rank: Very High (Relative Maximum Score >80.00)

Distribution and Invasiveness Rank (Obtain from PRISM invasiveness ranking form)		
Status of this species in each PRISM:	Current Distribution	PRISM Invasiveness Rank
1 Adirondack Park Invasive Program	Not Assessed	Not Assessed
2 Capital/Mohawk	Not Assessed	Not Assessed
3 Catskill Regional Invasive Species Partnership	Not Assessed	Not Assessed
4 Finger Lakes	Not Assessed	Not Assessed
5 Long Island Invasive Species Management Area	Not Assessed	Not Assessed
6 Lower Hudson	Not Assessed	Not Assessed
7 Saint Lawrence/Eastern Lake Ontario	Not Assessed	Not Assessed
8 Western New York	Not Assessed	Not Assessed

Invasiveness Ranking Summary (see details under appropriate sub-section)		Total (Total Answered*) Possible	Total
1	Ecological impact	30 (30)	23
2	Biological characteristic and dispersal ability	30 (30)	23
3	Ecological amplitude and distribution	30 (24)	24
4	Difficulty of control	10 (7)	5
	Outcome score	100 (91) ^b	75 ^a
	Relative maximum score †		82.42
	New York Invasiveness Rank §	Very High (Relative Maximum Score >80.00)	

* For questions answered “unknown” do not include point value in “Total Answered Points Possible.” If “Total Answered Points Possible” is less than 70.00 points, then the overall invasive rank should be listed as “Unknown.”

† Calculated as 100(a/b) to two decimal places.

§ Very High >80.00; High 70.00–80.00; Moderate 50.00–69.99; Low 40.00–49.99; Insignificant <40.00

A. DISTRIBUTION (KNOWN/POTENTIAL): Summarized from individual PRISM forms

A1.1. Has this species been documented in NY? (reliable source; voucher not required)		
<input checked="" type="checkbox"/>	Yes – continue to A1.2	
<input type="checkbox"/>	No – continue to A2.1; Yes <input type="checkbox"/> NA; Yes <input type="checkbox"/> USA	
A1.2. In which PRISMs is it known (see inset map)?		
<input checked="" type="checkbox"/>	Adirondack Park Invasive Program	
<input checked="" type="checkbox"/>	Capital/Mohawk	
<input type="checkbox"/>	Catskill Regional Invasive Species Partnership	
<input checked="" type="checkbox"/>	Finger Lakes	
<input type="checkbox"/>	Long Island Invasive Species Management Area	
<input type="checkbox"/>	Lower Hudson	
<input checked="" type="checkbox"/>	Saint Lawrence/Eastern Lake Ontario	

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<input checked="" type="checkbox"/>	Western New York
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Documentation:
Sources of information:
iMapInvasives 2013, Leibig et al. 2013.

- A2.0. Is this species listed on the Federal Injurious Fish and Wildlife list?
 Yes – the species will automatically be listed as Prohibited, no further assessment required.
 No – continue to A2.1

A2.1. What is the likelihood that this species will occur and persist given the climate in the following PRISMs?
 (obtain from PRISM invasiveness ranking form and/ or Climatch score)

- | | |
|-------------|------------------------------------------------|
| Very Likely | Adirondack Park Invasive Program |
| Very Likely | Capital/Mohawk |
| Very Likely | Catskill Regional Invasive Species Partnership |
| Very Likely | Finger Lakes |
| Very Likely | Long Island Invasive Species Management Area |
| Very Likely | Lower Hudson |
| Very Likely | Saint Lawrence/Eastern Lake Ontario |
| Very Likely | Western New York |

Documentation:
Sources of information (e.g.: distribution models, literature, expert opinions):
iMapInvasives 2013, Leibig et al. 2013.

If the species does not occur and is not likely to survive and reproduce within any of the PRISMs, then stop here as there is no need to assess the species.

A2.2. What is the current distribution of the species in each PRISM? (obtain rank from PRISM invasiveness ranking forms)

	Distribution
Adirondack Park Invasive Program	Restricted
Capital/Mohawk	Restricted
Catskill Regional Invasive Species Partnership	Not Assessed
Finger Lakes	Restricted
Long Island Invasive Species Management Area	Not Assessed
Lower Hudson	Not Assessed
Saint Lawrence/Eastern Lake Ontario	Restricted
Western New York	Restricted

Documentation:
Sources of information:

A2.3. Describe the potential or known suitable habitats within New York. Natural habitats include all habitats not under active human management. Managed habitats are indicated with an asterisk.

- | | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Aquatic Habitats</p> <input checked="" type="checkbox"/> Marine
<input checked="" type="checkbox"/> Salt/ brackish waters
<input type="checkbox"/> Freshwater tidal
<input type="checkbox"/> Rivers/streams
<input checked="" type="checkbox"/> Natural lakes and ponds
<input type="checkbox"/> Vernal pools
<input checked="" type="checkbox"/> Reservoirs/ impoundments* | <p>Wetland Habitats</p> <input checked="" type="checkbox"/> Salt/brackish marshes
<input checked="" type="checkbox"/> Freshwater marshes
<input type="checkbox"/> Peatlands
<input type="checkbox"/> Shrub swamps
<input type="checkbox"/> Forested wetlands/riparian
<input type="checkbox"/> Ditches*
<input type="checkbox"/> Beaches/or coastal dunes | <p>Upland Habitats</p> <input type="checkbox"/> Cultivated*
<input type="checkbox"/> Grasslands/old fields
<input type="checkbox"/> Shrublands
<input type="checkbox"/> Forests/woodlands
<input type="checkbox"/> Alpine
<input type="checkbox"/> Roadsides*
<input type="checkbox"/> Cultural* |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Other potential or known suitable habitats within New York:

Documentation:
Sources of information:
GISD 2013.

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B. INVASIVENESS RANKING

1. ECOLOGICAL IMPACT

1.1. Impact on Ecosystem Processes and System-wide Parameters (e.g., water cycle, energy cycle, nutrient and mineral dynamics, light availability, or geomorphological changes (erosion and sedimentation rates).

- A. No perceivable impact on ecosystem processes based on research studies, or the absence of impact information if a species is widespread (>10 occurrences in minimally managed areas), has been well-studied (>10 reports/publications), and has been present in the northeast for >100 years. 0
- B. Influences ecosystem processes to a minor degree, has a perceivable but mild influence 3
- C. Significant alteration of ecosystem processes 7
- D. Major, possibly irreversible, alteration or disruption of ecosystem processes 10
- U. Unknown

Score 3

Documentation:

Identify ecosystem processes impacted (or if applicable, justify choosing answer A in the absence of impact information)
Affects trophic level dynamics of zooplankton (Strecker and Arnott 2008) and could affect ecosystem processes.
Sources of information:
Strecker and Arnott 2008.

1.2. Impact on Natural Habitat/ Community Composition

- A. No perceived impact; causes no apparent change in native populations 0
- B. Influences community composition (e.g., reduces the number of individuals of one or more native species in the community) 3
- C. Significantly alters community composition (e.g., produces a significant reduction in the population size of one or more native species in the community) 7
- D. Causes major alteration in community composition (e.g., results in the extirpation of one or several native species, reducing biodiversity or change the community composition towards species exotic to the natural community) 10
- U. Unknown

Score 10

Documentation:

Identify type of impact or alteration:
As a generalist predator, *B. cederstroemi* can negatively affect the species composition and abundance of other small zooplankton (Lehman 1991, Yan and Pawson 1997), affecting species richness (Yan et al. 2002). Also feeds on larger zooplankton (Schulz et al. 1998). Invasion of *B. cederstroemi* has been correlated with disappearance of species in Harp Lake (Yan and Pawson 1997).
Sources of information:
Lehman 1991, Yan and Pawson 1997, Schulz et al. 1998, Yan et al. 2002.

1.3. Impact on other species or species groups, including cumulative impact of this species on other organisms in the community it invades. (e.g., interferes with native predator/ prey dynamics; injurious components/ spines; reduction in spawning; hybridizes with a native species; hosts a non-native disease which impacts a native species)

- A. Negligible perceived impact 0
- B. Minor impact (e.g. impacts 1 species, <20% population decline, limited host damage) 3
- C. Moderate impact (e.g. impacts 2-3 species and/ or 20-29% population decline of any 1 species, kills host in 2-5 years, ,) 7

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- D. Severe impact on other species or species groups (e.g. impacts >3 species and/ or ≥30% population decline of any 1 species, kills host within 2 years, extirpation) 10
- U. Unknown

Score

10

Documentation:

Identify type of impact or alteration:

Competes with planktivorous larval fish for zooplankton food sources (Liebig 2013) and affect zooplankton community (Branstrator 1995, Lehman 1991, Barbiero and Tuchman 2004). Invasion of *B. cederstroemi* has been correlated with disappearance of species in Harp Lake (Yan and Pawson 1997).

Sources of information:

Lehman 1991, Branstrator 1995, Yan and Pawson 1997, Liebig 2013, Barbiero and Tuchman 2004.

Total Possible

30

Section One Total

23

2. BIOLOGICAL CHARACTERISTICS AND DISPERSAL ABILITY

2.1. Mode and rate of reproduction (provisional thresholds, more investigation needed)

- A. No reproduction (e.g. sterile with no sexual or asexual reproduction) 0
- B. Limited reproduction (e.g., intrinsic rate of increase <10%, low fecundity, complete one life cycle) 1
- C. Moderate reproduction (e.g., intrinsic rate of increase between 10-30%, moderate fecundity, complete 2-3 life cycles) 2
- D. Abundant reproduction (e.g., intrinsic rate of increase >30%, parthenogenesis, large egg masses, complete > 3 life cycles) 4
- U. Unknown

Score

4

Documentation:

Describe key reproductive characteristics:

Can reproduce sexually or asexually (Liebig 2013) and produce resting eggs (Evans 1988).

Sources of information:

Evans, 1988, Liebig 2013.

2.2. Migratory behavior

- A. Always migratory in its native range 0
- B. Non-migratory or facultative migrant in its native range 2
- U. Unknown

Score

2

Documentation:

Describe migratory behavior:

Non-migratory.

Sources of information:

2.3. Biological potential for colonization by long-distance dispersal/ movement (e.g., veligers, resting stage eggs, glochidia)

- A. No long-distance dispersal/ movement mechanisms 0
- B. Adaptations exist for long-distance dispersal, but studies report that most individuals (90%) establish territories within 5 miles of natal origin or within a distance twice the home range of the typical individual, and tend not to cross major barriers such as dams and watershed divides 1
- C. Adaptations exist for long-distance dispersal, movement and evidence that offspring often disperse greater than 5 miles of natal origin or greater than twice the home range of typical 2

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individual and will cross major barriers such as dams and watershed divides

U. Unknown

Score

Documentation:

Identify dispersal mechanisms:

Resting stage eggs are produced, cited as possible means of introduction into U.S. (Evans 1988).

Sources of information:

Evans 1988.

2.4. Practical potential to be spread by human activities, both directly and indirectly – possible vectors include: commercial bait sales, deliberate illegal stocking, aquaria releases, boat trailers, canals, ballast water exchange, live food trade, rehabilitation, pest control industry, aquaculture escapes, etc.)

- | | | |
|----|---------------------------------------------------------------------------------------------------------------------------|---|
| A. | Does not occur | 0 |
| B. | Low (human dispersal to new areas occurs almost exclusively by direct means and is infrequent or inefficient) | 1 |
| C. | Moderate (human dispersal to new areas occurs by direct and indirect means to a moderate extent) | 2 |
| D. | High (opportunities for human dispersal to new areas by direct and indirect means are numerous, frequent, and successful) | 4 |
| U. | Unknown | |

Score

Documentation:

Identify dispersal mechanisms:

Introduction into United States is speculative, possibly by means of attachment of resting eggs to mud-covered boots and fishing tackle (Evans 1988). Also potential spread via ship ballast water (Liebig 2013).

Sources of information:

Evans 1988, Liebig 2013.

2.5. Non-living chemical and physical characteristics that increase competitive advantage (e.g., tolerance to various extremes, pH, DO, temperature, desiccation, fill vacant niche, charismatic species)

- | | | |
|----|---------------------------------------------------------------------------|---|
| A. | Possesses no characteristics that increase competitive advantage | 0 |
| B. | Possesses one characteristic that increases competitive advantage | 4 |
| C. | Possesses two or more characteristics that increase competitive advantage | 8 |
| U. | Unknown | |

Score

Documentation:

Evidence of competitive ability:

Some evidence of thermal tolerance, but overall, none that show a clear competitive advantage.

Sources of information:

Garton et al. 1990.

2.6. Biological characteristics that increase competitive advantage (e.g., high fecundity, generalist/ broad niche space, highly evolved defense mechanisms, behavioral adaptations, piscivorous, etc.)

- | | | |
|----|---------------------------------------------------------------------------|---|
| A. | Possesses no characteristics that increase competitive advantage | 0 |
| B. | Possesses one characteristic that increases competitive advantage | 4 |
| C. | Possesses two or more characteristics that increase competitive advantage | 8 |
| U. | Unknown | |

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Documentation:

Evidence of competitive ability:

Spines serve as a defense against small fish (Barnhisel 1991, Straile 2000). Generalist predator (Liebig 2013).

Sources of information:

Barnhisel 1991, Straile 2000, Liebig 2013.

2.7. Other species in the family and/ or genus invasive in New York or elsewhere?

- | | | |
|----|---------|---|
| A. | No | 0 |
| B. | Yes | 2 |
| U. | Unknown | |

Score

Documentation:

Identify species:

Bythotrephes longimanus, Cercopagis pengoi

Total Possible	<input style="width: 50px;" type="text" value="30"/>
Section Two Total	<input style="width: 50px;" type="text" value="23"/>

3. ECOLOGICAL AMPLITUDE AND DISTRIBUTION

3.1. Current introduced distribution in the northern latitudes of USA and southern latitude of Canada (e.g., between 35 and 55 degrees).

- | | | |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| A. | Not known from the northern US or southern Canada. | 0 |
| B. | Established as a non-native in 1 northern USA state and/or southern Canadian province. | 1 |
| C. | Established as a non-native in 2 or 3 northern USA states and/or southern Canadian provinces. | 2 |
| D. | Established as a non-native in 4 or more northern USA states and/or southern Canadian provinces, and/or categorized as a problem species (e.g., “Invasive”) in 1 northern state or southern Canadian province. | 3 |
| U. | Unknown | |

Score

Documentation:

Identify states and provinces:

NY, MI, MN, OH, PA, WI,

Sources of information:

- See known introduced range at www.usda.gov, and update with information from states and Canadian provinces.

Liebig 2013, GISD 2013.

3.2. Current introduced distribution of the species in natural areas in the eight New York State PRISMs (Partnerships for Regional Invasive Species Management)

- | | | |
|----|-----------------------------------|---|
| A. | Established in none of the PRISMs | 0 |
| B. | Established in 1 PRISM | 1 |
| C. | Established in 2 or 3 PRISMs | 3 |
| D. | Established in 4 or more PRISMs | 5 |
| U. | Unknown | |

Score

Documentation:

Describe distribution:

Present in SLELO, Finger Lakes, Western New York, APIPP, Capital/Mohawk.

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Sources of information:
Liebig 2013, iMapInvasives 2013.

3.3. Number of known, or potential (each individual possessed by a vendor or consumer), individual releases and/ or release events

- A. None 0
- B. Few releases (e.g., <10 annually). 2
- C. Regular, small scale releases (e.g., 10-99 annually). 4
- D. Multiple, large scale (e.g., ≥ 100 annually). 6
- U. Unknown

Score

Documentation:
Describe known or potential releases:

Sources of information:

3.4. Current introduced population density, or distance to known occurrence, in northern USA and/ or southern Canada.

- A. No known populations established. 0
- B. Low to moderate population density (e.g., $\leq 1/4$ to $< 1/2$ native population density) with few other invasives present and/ or documented in 1 or more non-adjacent state/ province and/ or 1 unconnected waterbody. 1
- C. High or irruptive population density (e.g., $\geq 1/2$ native population density) with numerous other invasives present and/ or documented in 1 or more adjacent state/ province and/ or 1 connected waterbody. 2
- U. Unknown

Score

Documentation:
Describe population density:
Present in more than one adjacent state.
Sources of information:
GISD 2013, Liebig 2013.

3.5. Number of habitats the species may invade

- A. Not known to invade any natural habitats given at A2.3. 0
- B. Known to occur in 2 or 3 of the habitats given at A2.3, with at least 1 or 2 natural habitat(s). 2
- C. Known to occur in 4 or more of the habitats given at A2.3, with at least 3 natural habitats. 3
- U. Unknown.

Score

Documentation:
Identify type of habitats where it occurs and degree/type of impacts:
Marine, lakes, wetlands, brackish water.
Sources of information:
GISD 2013.

3.6. Role of anthropogenic (human related) and natural disturbance in establishment (e.g. water level management, man-made structures, high vehicle traffic, major storm events, etc).

- A. Requires anthropogenic disturbances to establish. 0

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- B. May occasionally establish in undisturbed areas but can readily establish in areas with natural or anthropogenic disturbances. 2
- C. Can establish independent of any known natural or anthropogenic disturbances. 3
- U. Unknown.

Score 3

Documentation:
Identify type of disturbance:

Sources of information:

3.7. Climate in native range (e.g., med. to high, ≥ 5 , Climatch score; within 35 to 55 degree latitude; etc.)

- A. Native range does not include climates similar to New York (e.g., <10%). 0
- B. Native range possibly includes climates similar to portions of New York (e.g., 10-29%). 4
- C. Native range includes climates similar to those in New York (e.g., $\geq 30\%$). 8
- U. Unknown.

Score 8

Documentation:
Describe known climate similarities:
43/48 stations in NY score 5 or greater using Climatch.
Sources of information:
ADAFF 2013.

Total Possible	24
Section Three Total	24

4. DIFFICULTY OF CONTROL

4.1. Re-establishment potential, nearby propagule source, known vectors of re-introduction (e.g. biological supplies, pets, aquaria, aquaculture facilities, connecting waters/ corridors, mechanized transportation, live wells, etc.)

- A. No known vectors/ propagule source for re-establishment following removal. 0
- B. Possible re-establishment from 1 vector/ propagule source following removal and/ or viable <24 hours. 1
- C. Likely to re-establish from 2-3 vectors/ propagule sources following removal and/ or viable 2-7 days. 2
- D. Strong potential for re-establishment from 4 or more vectors/ propagule sources following removal and/or viable >7 days. 3
- U. Unknown.

Score 2

Documentation:
Identify source/ vectors:
Ballast water, fishing equipment and recreational boating (GISD 2013). Possibly dispersed via the digestive tracts of migrating birds, however less likely.
Sources of information:
GISD 2013.

4.2. Status of monitoring and/ or management protocols for species

- A. Standardized protocols appropriate to New York State are available. 0
- B. Scientific protocols are available from other countries, regions or states. 1
- C. No known protocols exist. 2
- U. Unknown

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Score

2

Documentation:

Describe protocols:

Sources of information:

4.3. Status of monitoring and/ or management resources (e.g. tools, manpower, travel, traps, lures, ID keys, taxonomic specialists, etc.)

- | | | |
|----|---------------------------------------------------------------------------------|---|
| A. | Established resources are available including commercial and/ or research tools | 0 |
| B. | Monitoring resources may be available (e.g. partnerships, NGOs, etc) | 1 |
| C. | No known monitoring resources are available | 2 |
| U. | Unknown | |

Score

1

Documentation:

Describe resources:

Identification tools and minimal management resources do exist (Berg 1991, Anon 2005, Haney 2013). Monitoring is being done in all of the Great Lakes (EPA 2012). Identification key available for related species (Crosier and Molloy, n.d.).

Sources of information:

Berg 1991, Anon 2005, EPA 2012, Haney 2013, Crosier and Molloy, n.d.

4.4. Level of effort required

- | | | |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| A. | Management is not required. (e.g., species does not persist without repeated human mediated action.) | 0 |
| B. | Management is relatively easy and inexpensive; invasive species can be maintained at low abundance causing little or no ecological harm. (e.g., 10 or fewer person-hours of manual effort can eradicate a local infestation in 1 year.) | 1 |
| C. | Management requires a major short-term investment, and is logistically and politically challenging; eradication is difficult, but possible. (e.g., 100 or fewer person-hours/year of manual effort, or up to 10 person-hours/ year for 2-5 years to suppress a local infestation.) | 2 |
| D. | Management requires a major investment and is logistically and politically difficult; eradication may be impossible. (e.g., more than 100 person-hours/ year of manual effort, or more than 10 person hours/year for more than 5 years to suppress a local infestation.) | 3 |
| U. | Unknown | |

Score

U

Documentation:

Identify types of control methods and time required:

Sources of information:

Total Possible	<table border="1" style="display: inline-table;"><tr><td style="width: 50px; text-align: center;">7</td></tr></table>	7
7		
Section Four Total	<table border="1" style="display: inline-table;"><tr><td style="width: 50px; text-align: center;">5</td></tr></table>	5
5		

Total for 4 sections Possible	<table border="1" style="display: inline-table;"><tr><td style="width: 50px; text-align: center;">91</td></tr></table>	91
91		
Total for 4 sections	<table border="1" style="display: inline-table;"><tr><td style="width: 50px; text-align: center;">75</td></tr></table>	75
75		

C. STATUS OF GENETIC VARIANTS AND HYBRIDS:

At the present time there is no protocol or criteria for assessing the invasiveness of genetic variants independent of the species to which they belong. Such a protocol is needed, and individuals with the

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appropriate expertise should address this issue in the future. Such a protocol will likely require data on cultivar fertility and identification in both experimental and natural settings.

Genetic variants of the species known to exist:

Hybrids (crosses between different parent species) should be assessed individually and separately from the parent species wherever taxonomically possible, since their invasiveness may differ from that of the parent species. An exception should be made if the taxonomy of the species and hybrids are uncertain, and species and hybrids can not be clearly distinguished in the field. In such cases it is not feasible to distinguish species and hybrids, and they can only be assessed as a single unit.

Hybrids of uncertain origin known to exist:

References for species assessment:

- Anon 2005. Spiny fishhook and water fleas.
<http://www.in.gov/dnr/files/spiny_and_fishhook_water_flea.pdf>; [Accessed on Jun 7, 2013].
- Australian Department of Agriculture, Fisheries, and Forestry (ADAFF). 2013. Climatch Mapping Tool.
<<http://adl.brs.gov.au:8080/Climatch/climatch.jsp>>; [Accessed on June 7, 2013].
- Barbiero, R. P., & Tuchman, M. L. (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.
- Barnhisel, D. R. (1991). The caudal appendage of the cladoceran *Bythotrephes cederstroemi* as defense against young fish. *Journal of Plankton Research*, 13(3), 529-537.
- Berg, D. J. (1991). The spiny water flea, *Bythotrephes longimanus*: An unwelcome species to the Great Lakes. University of Miami. OHSU-FS-049.
- Branstrator, D. K. (1995). Ecological Interactions Between *Bythotrephes cederstroemi* and *Leptodora kindtii* and the Implications for Species Replacement in Lake Michigan. *Journal of Great Lakes Research*, 21(4), 670-679.
- Crosier and Molloy, n.d. Fishhook Waterflea - *Cercopagis pengoi*
<http://el.erdc.usace.army.mil/ansrp/cercopagis_pengoi.pdf>; [Accessed on May 28, 2013].
- Environmental Protection Agency (EPA) 2012. *Cercopagis pengoi*.
<<http://www.epa.gov/glnpo/monitoring/biology/exotics/cercopagis.html>>; [Accessed on June 7, 2013].
- Evans, M. S. (1988). *Bythotrephes Cederstroemi*: its New Appearance in Lake Michigan. *Journal of Great Lakes Research*, 14(2), 234-240.
- Garton, D. W., Berg, D. J., & Fletcher, R. J. (1990). Thermal tolerances of the predatory cladocerans *Bythotrephes cederstroemi* and *Leptodora kindtii*: relationship to seasonal abundance in western Lake Erie. *Canadian Journal of Fisheries and Aquatic Sciences*, 47(4), 731-738.
- Global Invasive Species Database (GISD) 2013. *Oreochromis aureus*.
<<http://www.issg.org/database/species/ecology.asp?si=151&fr=1&sts=sss>>; [Accessed on June 7, 2013].
- Haney, J.F. et al. "An-Image-based Key to the Zooplankton of North America" version 5.0 released 2013. University of New Hampshire Center for Freshwater Biology. <cfb.unh.edu>; [Accessed on June 7, 2013].
- iMapInvasives: An Online Mapping Tool for Invasive Species Locations. 2013. <iMapInvasives.org>; [Accessed on June 7, 2013].
- Lehman, J. T. (1991). Causes and Consequences of Cladoceran Dynamics in Lake Michigan: Implications of Species Invasion by *Bythotrephes*. *Journal of Great Lakes Research*, 17(4), 437-445.

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- Schulz, K. L., & Yurista, P. M. (1998). Implications of an invertebrate predator's (*Bythotrephes cederstroemi*) atypical effects on a pelagic zooplankton community. *Hydrobiologia*, 380(1-3), 179-193.
- Straile, D., & Hälbich, A. (2000). Life history and multiple antipredator defenses of an invertebrate pelagic predator, *Bythotrephes longimanus*. *Ecology*, 81(1), 150-163.
- Strecker, A. L., & Arnott, S. E. (2008). Invasive predator, *Bythotrephes*, has varied effects on ecosystem function in freshwater lakes. *Ecosystems*, 11(3), 490-503.
- Yan, N., & Pawson, T. (1997). Changes in the crustacean zooplankton community of Harp Lake, Canada, following invasion by *Bythotrephes cederstroemi*. *Freshwater Biology*, 37(2), 409-425.
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Citation: The New York Fish & Aquatic Invertebrate Invasiveness Ranking Form is an adaptation of the New York Plant Invasiveness Ranking Form. The original plant form may be cited as: Jordan, M.J., G. Moore and T.W. Weldy. 2008. Invasiveness ranking system for non-native plants of New York. Unpublished. The Nature Conservancy, Cold Spring Harbor, NY; Brooklyn Botanic Garden, Brooklyn, NY; The Nature Conservancy, Albany, NY.

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