Fishhook Waterflea - *Cercopagis pengoi*

The fishhook waterflea, a native of the Ponto-Caspian region, is a predatory zooplankton and a recent invader of the Laurentian Great Lakes and Finger Lakes regions.

Taxonomy

Phylum	▪ Arthropoda
Superclass	▪ Crustacea
Class	▪ Branchiopoda
Superorder	▪ Cladocera
Order	▪ Onychopoda
Family	▪ Cercopagidae

General Biology

Adult Morphology

- Body length of males (Figs. 1 and 2) can range from 0.8 to 1.6 mm
- Body length of females (Figs. 3 and 4) can range from 0.6 to 2.4 mm
- North American specimens are generally smaller than counterparts collected in their native region
- Caudal (i.e., tail) process may exceed the body length by more than 5 times (Fig. 5)
- Distinctive “loop” at the end of the caudal process (Fig. 6)
- Head is composed primarily of one large, compound eye
- Well-developed second pair of antennae (Fig. 7)
- Four pairs of thoracic legs with the first pair of legs 3 to 4 times the length of the second (Fig. 8)
- Males possess paired penes behind the last thoracic legs (Fig. 2) and toothed hook on the first pair of legs

Fig. 1 An adult *Cercopagis* male.[1]

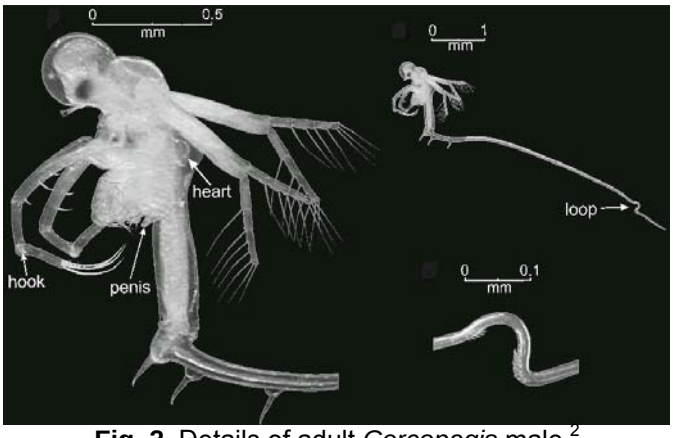

Fig. 2 Details of adult *Cercopagis* male.[2]

[1] Igor Grigorovich (University of Windsor)
[2] Igor Grigorovich (University of Windsor)

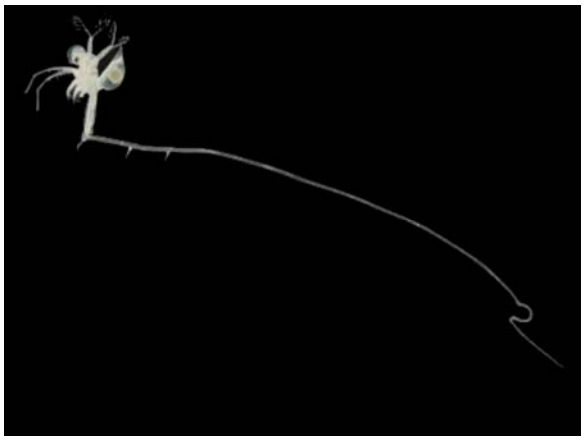

Fig. 3 An adult *Cercopagis* female.[3]

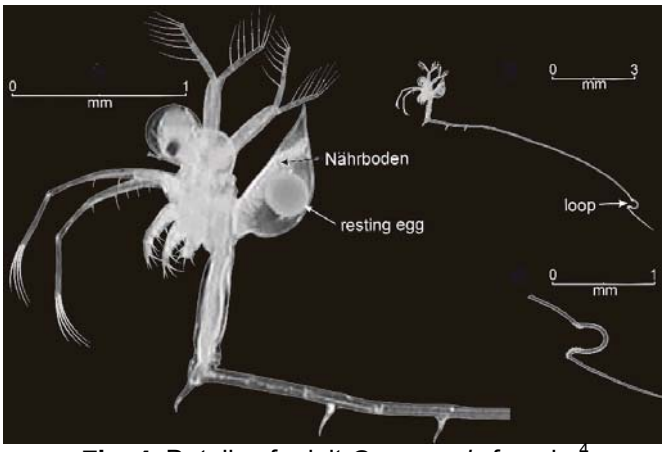

Fig. 4 Details of adult *Cercopagis* female.[4]

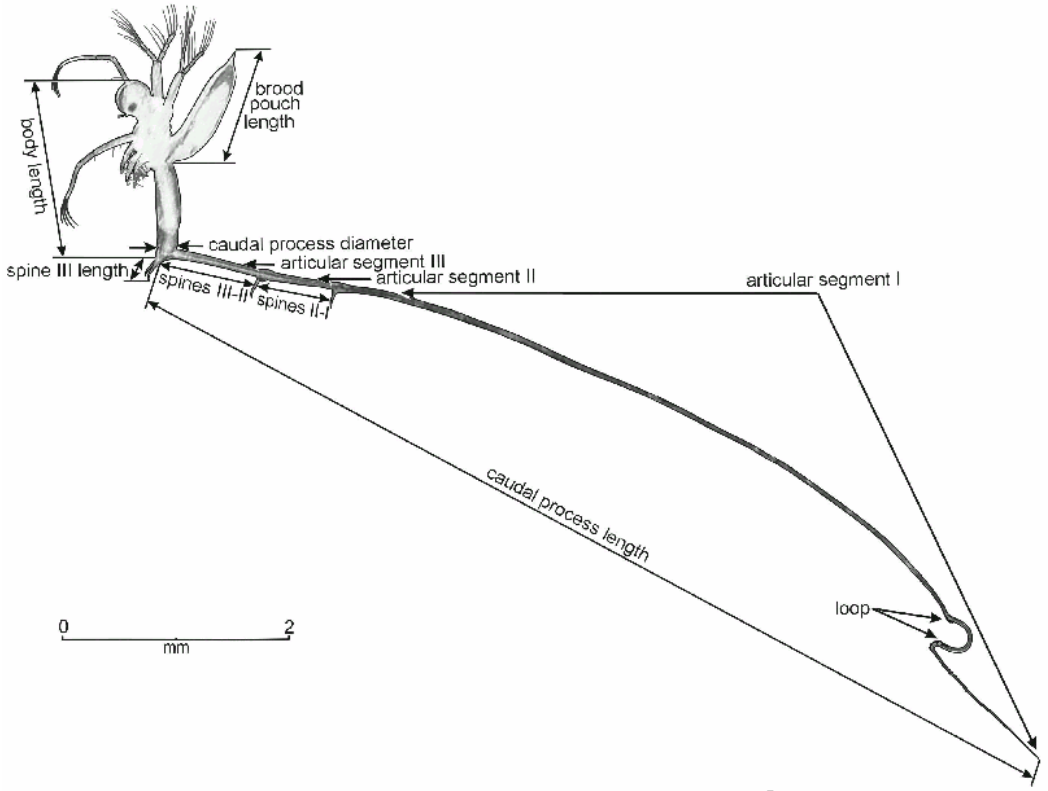

Fig. 5 Dimensions of the spiny waterflea.[5]

[3] Igor Grigorovich (University of Windsor)
[4] Igor Grigorovich (University of Windsor)
[5] Igor Grigorovich (University of Windsor)

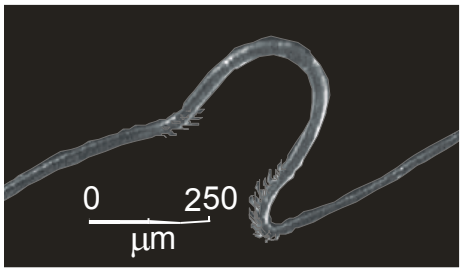

Fig. 6 The characteristic loop which occurs at the end of the caudal process.[6]

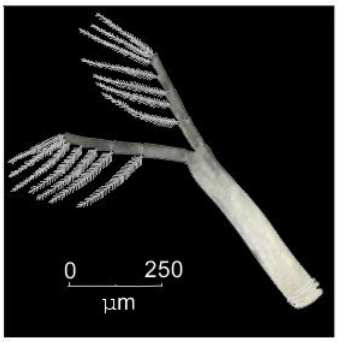

Fig. 7 Seven natatory setae on each branch of the antenna distinguish *Cercopagis* from *Bythotrephes*.[7]

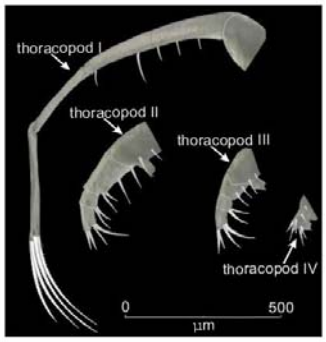

Fig. 8 One of the thoracic legs from each of the four pairs present on *Cercopagis*.[8]

Identification

Distinguishing Characteristics

- Similar in appearance to the spiny waterflea *Bythotrephes* (Fig. 9), but with the following differences:
  - Presence (*Cercopagis*) and absence (*Bythotrephes*) of the loop on the caudal process
  - Presence (*Bythotrephes*) and absence (*Cercopagis*) of gnathobasic process on the thoracopod
  - *Cercopagis* have seven setae on each ramus of the antennae whereas *Bythotrephes* have eight on the outer ramus of antennae and seven on the inner (Fig. 7)
  - Morphology of the penes differ between genera (*Cercopagis* – long, smooth; *Bythotrephes* – shorter, containing minute setae)
  - Dorsal brood pouch of *Cercopagis* is pointed at apex in instar III females (Fig. 9)

[6] Igor Grigorovich (University of Windsor)
[7] Igor Grigorovich (University of Windsor)
[8] Igor Grigorovich (University of Windsor)

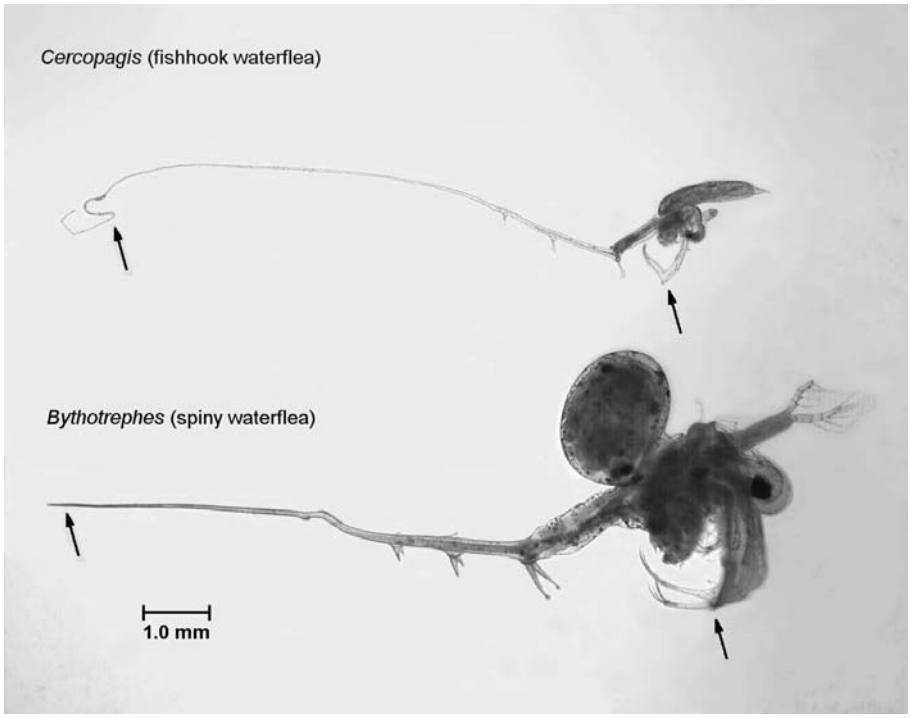

Fig. 9 Arrows indicate key morphological differences between *Cercopagis* and *Bythotrephes*: Presence of loop in caudal process of *Cercopagis* and differences in the appearance of the thoracic legs.[9]

Life Cycle

- *Cercopagis* grows allomentrically (i.e., increases in body length exceed increases in caudal process length between molts)
- Shape and size of the dorsal brood pouch varies between instars (i.e., developmental stages of growth)
- Resting eggs (produced by sexual females) and embryos (produced by parthenogenetic females) develop in dorsal brood pouch
- Resting eggs remain dormant over the winter
- Parthenogenetic females reproduce at instars I through III
- Sexual females reproduce at instars II and III
- *Cercopagis ossiani* (Fig. 10) is believed to be a vernal, morphologically distinct generation of *C. pengoi* (emerging only from resting eggs) although further research is needed to define its taxonomic status

Reproduction

- Monocyclic
- Mainly parthenogenetic throughout growth season
- Sexual reproduction during late growth season (as water temperature declines); sexual females are reproductive only at instars II and III, producing 1-4 resting eggs
- Parthenogenetic females produce between 1 and 24 embryos; average clutch size decreases gradually from instar I to instar III and from early to late stage of brood development

[9] Adapted from http://www.seagrant.wisc.edu/outreach/nis/images/cerco1.jpg

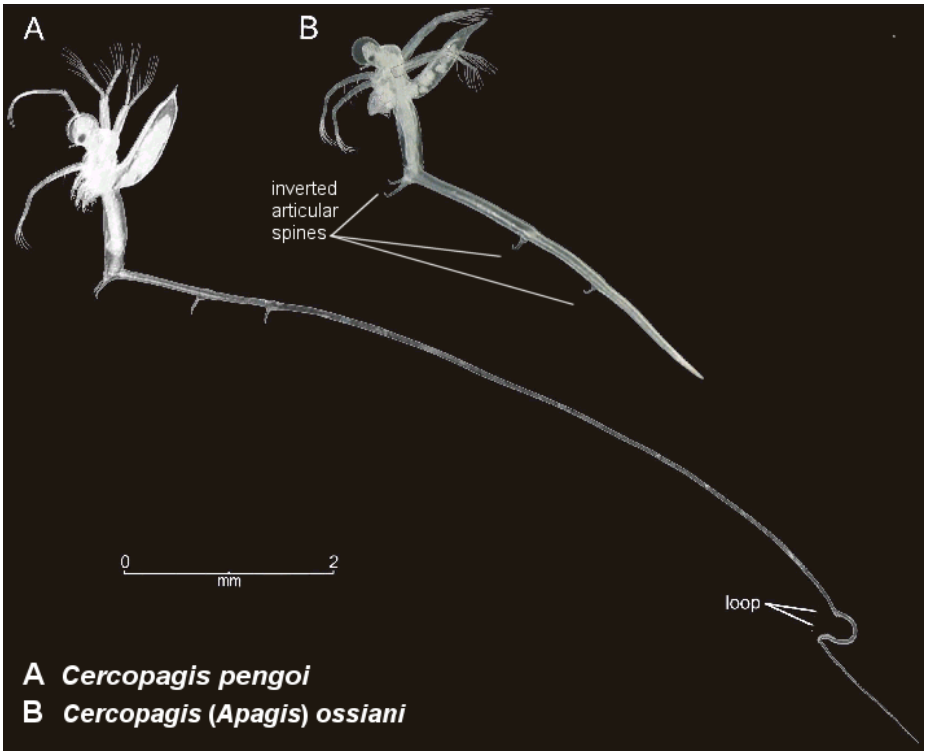

Fig. 10 The absence/presence of the caudal loop and the orientation of the anticular spines distinguish *Cercopagis pengoi* (A) and *Cercopagis ossiani* (B).[10]

Habitat Characteristics

Preferred Environment
- Naturally occurs in fresh and brackish waters
- Prefers to inhabit pelagic zone

Temperature
- Occurs at water temperatures between 8°C and 29°C, although population maxima observed between 18°C and 24°C

Salinity
- Euryhaline
- Resting eggs are capable of tolerating inhospitable conditions (e.g., inside ballast tanks)
- In native range are found to be more abundant at lower salinities (less than 10 ppt)

Distribution

Native Range
- Caspian Sea, Azov Sea, Aral Sea, estuarine regions of Black Sea

North American Distribution
- See Fig. 11

Probable Means of Introduction
- Ballast water discharged by transatlantic ships originating from Eastern Europe

[10] Igor Grigorovich (University of Windsor)

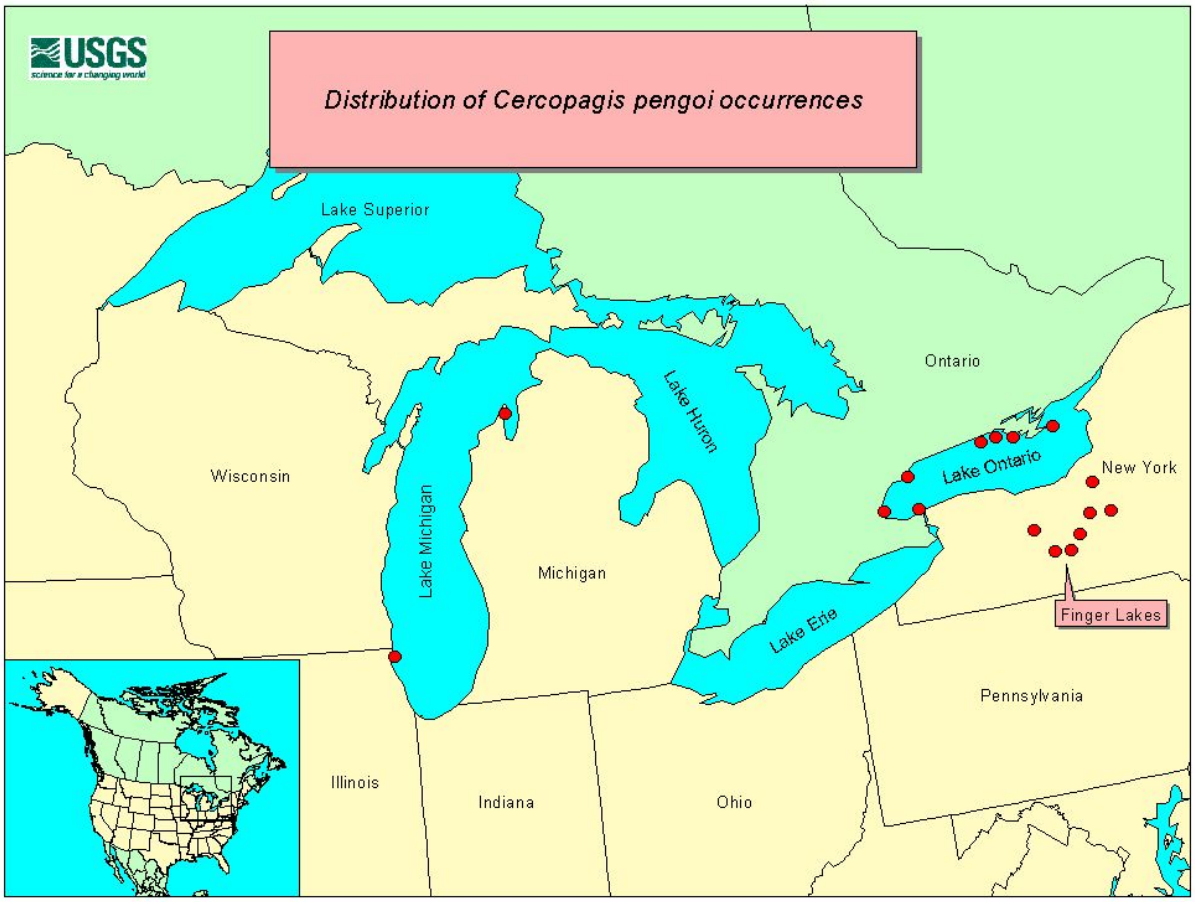

Fig. 7 North American distribution of the fishhook waterflea. Since production of this map[11], *C. pengoi* has been also documented in western Lake Erie, the Detroit River, and Muskegon Lake, Michigan.

Diet

- Consume various zooplankton (e.g., *Daphnia*, *Ceriodaphnia*, and *Leptodora*) at a rate of up to 16 individuals per day

Impacts

Negative

- Competes with planktivorous invertebrates and vertebrates for food
- Has potential to affect small and juvenile fish populations
- Has potential to impact native plankton assemblages including carniverous onychopods
- Presence of *Cercopagis* has the potential to affect the abundance and condition of predatory fish (e.g., herring, smelt)
- Interference with angler activities (i.e., fouling fishing lines and trawls)
- Presence results in economic losses at fish farms

[11] http://nas.er.usgs.gov/crustaceans/images/pengoimap.jpg

Positive

- Although not all zooplanktivorous fish prefer to consume *Cercopagis*, some of the larger species do

Management

Control Measures

- Do not release bait or bait water into waterbody or transport from one waterbody to another
- Following good containment measures is important in controlling the spread of adult *Cercopagis*, but resting eggs are capable of surviving desiccation and freezing (even for periods of several years) and therefore:
  - Rinsing boat and equipment with hot water (>40°C), high-pressure water spray, or drying boat and equipment for at least 5 days before re-entering waterbody will help to control the spread of adult *Cercopagis*
  - Thoroughly draining and cleaning motor; bilge, transom, and live wells; bait buckets; and fishing apparatus and gear will help to control the spread of adult *Cercopagis* and resting eggs

Literature

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Web Sites

http://venus.uwindsor.ca/courses/biology/macisaac/pages/cercopagis.htm
Comparative Biology of the Predatory Cladoceran *Cercopagis pengoi* from Lake Ontario, Baltic Sea, and Caspian Sea

http://www.seagrant.wisc.edu/outreach/nis/fishhook.html
Invasive Waterfleas by the University of Wisconsin Sea Grant Institute

http://nas.er.usgs.gov/fishes/accounts/gobiidae/ne_melan.html
United States Geological Survey Non Indigenous Aquatic Species

http://www.protectyourwaters.net
Stop Aquatic Hitchhikers

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