Hemimysis anomala

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Scientific Name: *Hemimysis anomala* G. O. Sars, 1907

Common Name: bloody-red mysid (shrimp)

Taxonomy: Available through ITIS

Identification: This freshwater shrimp can be ivory-yellow in color or translucent, but exhibits pigmented red chromatophores in the carapax and telson (Janas and Wysocki 2005; Salemaa and Hietalahti 1993). The intensity of coloration changes with the contraction or expansion of the chromatophores in response to light and temperature conditions; in shaded areas, individuals tend to have a deeper red color (Ketelaars et al. 1999; Pothoven et al. 2007; Salemaa and Hietalahti 1993). Juveniles are more translucent than adults (Ketelaars et al. 1999). Preserved individuals may lose their color. *H. anomala* is distinguishable from other mysid species (including the Great Lakes' native opossum shrimp *Mysis diluviana*) by its blunt telson (tail) with a long spine at both corners; by contrast, *M. diluviana* has a forked telson (Holdich et al. 2006; Ketelaars et al. 1999; Salemaa and Hietalahti 1993).

Size: Mature individuals range from 6 to 13 mm in length (Borcherding et al. 2006; Janas and Wysocki 2005; Salemaa and Hietalahti 1993). Females are slightly larger than males. In southern Lake Michigan basin, females average 7 mm in length (Pothoven et al. 2007).

Native Range: *H. anomala* is native to freshwater margins of the Black Sea, the Azov Sea and the eastern Caspian Sea. It has historically occurred in the lower reaches of the Don, Danube, Dnieper and Dniester rivers.

Nonindigenous Occurrences: *H. anomala* was reported for the first time in 2006 from two disjunct regions in the Great Lakes: southeastern Lake Ontario at Nine Mile Point near Oswego, New York, in May 2006 (J. Wyda 2007, personal communication); and from a channel connecting Muskegon Lake to Lake Michigan in November 2006 (Pothoven et al. 2007). Specimens resembling *H. anomala* have also been found in the stomach contents of a white perch collected near Port Dover, Lake Erie in August 2006 (T. MacDougall, Ontario Ministry of Natural Resources, pers. comm.). The species is probably present at other locations in the Great Lakes basin, but has escaped detection.

Means of Introduction: *H. anomala* was very likely introduced to the Great Lakes via ballast water release from transoceanic ships.

Status: The presence of juveniles and reproductive females within a dense population suggests that *H. anomala* is well established near Muskegon Lake in southern Lake Michigan (Pothoven et al. 2007) and at Nine Mile Point in Lake Ontario (J. Wyda, pers. comm.). A population density of 0.5 ± 0.1 individuals/L recorded at the Lake Michigan site (Pothoven et al. 2007) is already within the range found in some European reservoirs invaded by *H. anomala*, and is higher than maximum densities recorded for several other mysids (Ketelaars et al. 1999).

Ecology: Most mysid species are found in marine environments, but about 3% (25 species) inhabit fresh to brackish water. *Hemimysis anomala* is a brackish-water mysid able to adapt to freshwater environments (Pienimäki and Leppäkoski 2004; Jażdżewski et al. 2005). It tolerates salinity concentrations of 0–19 ppm (Bij de Vaate et al. 2002; Borcherding et al. 2006) and prefers water temperatures of 9–20ºC. Populations may survive temperatures of 0ºC over winter, but not without substantial mortality (Borcherding et al. 2006).

This species is normally found in lentic waters, although it has successfully established in European rivers (bij de Vaate et al. 2002; Holdich et al. 2006). Individuals remain near profundal sediments during the day, migrate in swarms to the upper water column at twilight, then return to the profundal zone at dawn (Borcherding et al. 2006; Janas and Wysocki 2005). Only males tend to undergo these migrations. Juvenile *H. anomala* often inhabit different positions (usually higher) in the water column than adults, possibly to avoid cannibalism (Ketelaars et al. 1999). Being more transparent, juveniles may be less at risk of fish predation than adults. The adults are fast swimmers, moving at several centimeters per second when alarmed (Borcherding et al. 2006). Bloody-red mysids have been collected at depths ranging from 0.5 m to 50 m, although they generally inhabit 6 m to 10 m depths (Salemaa and Hietalahti 1993). They favor rocky substrate (Janas and Wysocki 2005), are less abundant on soft sediments, and are usually scarce in areas of dense vegetation or high siltation (Pothoven et al. 2007). They generally avoid areas where other mysid species are found (Salemaa and Hietalahti 1993). Their tendency to aggregate creates locally dense swarms up to several square meters in area (Dumont 2006).

H. anomala breeds from April to September/October. Sexual maturity occurs in <45 days. Females become ovigerous at 8–9ºC and produce 2 to 4 broods per year. Brood size is correlated with female length and ranges from 6 to 70 embryos per individual (Ketelaars et al. 1999; Salemaa and Hietalahti 1993; Borcherding et al. 2006). Extremely high densities of *H. anomala* (up to >6 ind/L) have been recorded in some invaded European reservoirs (Ketelaars et al. 1999).

H. anomala is an opportunistic omnivore that feeds primarily on zooplankton, particularly cladocerans, but also consumes detritus (plant and animal remains), phytoplankton (particularly green algae and diatoms), and insect larvae, and is occasionally cannibalistic (Ketelaars et al. 1999; Borcherding et al. 2006; Dumont 2006). Younger individuals (< 4mm total length) feed mainly on phytoplankton. The proportion of zooplankton consumed in the mysid's diet increases with its body size (Borcherding et al. 2006). A bloody-red mysid feeds using its thoracic limbs, either by capturing prey with its endopods or by removing food particles from its body that are filtered from incoming currents by its exopods (Borcherding et al. 2006; Ketelaars et al. 1999).

Impact of Introduction

A) Realized: There are no recorded impacts yet associated with the recent introduction of this species to the Great Lakes.

B) Potential:
Ponto-Caspian mysids differ from the North American mysid *Mysis diluviana* by their adaptation to warmer temperatures (Bondarenko and Yablonskaya 1979). Therefore, *H. anomala* could become abundant in many areas of the Great Lakes that are currently devoid of mysids. Judging by its impacts in some European reservoirs (Ketelaars et al. 1999), *H. anomala* may reduce zooplankton biomass and diversity in these areas, with cladocerans, rotifers and ostracods being most affected. *H. anomala* may compete with, or prey upon, other invertebrate predators, such as *Bythotrephes longimanus* and *Leptodora kindti*. Its omnivory may also reduce local phytoplankton, if small-sized juvenile mysids are abundant (Ketelaars et al. 1999); however, phytoplankton biomass typically increases (sometimes doubling) in lakes following mysid invasions (Borcherding et al. 2006). *Hemimysis* feeds rapidly, even at low prey densities, and its fecal pellets may alter the local physico-chemical environment (Ketelaars et al. 1999; Olenin and Leppäkoski 1999; Pienimäki and Leppäkoski 2004).

Hemimysis anomala is considered a high-energy food source due to its lipid content, which can increase growth rates for planktivores (Borcherding et al. 2006). In some lakes, mysid (*Mysis* spp.) introductions have preceded the increased growth of salmonids, whereas in other lakes they are associated with rapid declines in abundance and productivity of pelagic fishes (Lasenby et al. 1986; Langeland et al. 1991; Spencer et al. 1991). A mysid introduction can also increase the biomagnification of contaminants in piscivores, through a lengthening of the food chain; for example, concentrations of polychlorinated biphenyls and mercury in fishes have been shown to be higher in lakes containing mysids than in mysid-free lakes (cf. Rasmussen et al. 1990; Cabana et al. 1994). Furthermore, through direct transmission and indirect effects on the food web, introduced mysids may cause increased parasitism by nematodes, cestodes and acanthocephalans in fishes (Lasenby et al. 1986; Northcote 1991).

Remarks: This Ponto-Caspian species was predicted to invade the Great Lakes because of its likelihood of surviving transport in ship ballast water and because it has an extensive recent invasion history in Europe (Ricciardi and Rasmussen 1998). It was intentionally stocked in reservoirs of the Dnieper and Volga Rivers during the 1950s and '60s (Mordukhai-Boltovskoi 1979; Bubinas 1980; Pligin and Yemel'yanova 1989; Komarova 1991). It was discovered in the Baltic Sea in the Gulf of Finland in 1992 and subsequently spread 200 km along the coast (Salemaa and Hietalahti 1993; Lundberg and Svensson 2004). It was recorded in the Rhine River in 1997 (Borcherding et al. 2006), the Netherlands by 1998, Belgium by 1999, and the United Kingdom by 2004 (Holdich et al. 2006). Some of these introductions likely occurred via ballast water release, whereas most dispersal occurred through canals (bij de Vaate et al. 2002; Salemaa and Hietalahti

1993). *H. anomala* is considered to be more invasive than several other Ponto-Caspian mysids currently expanding their ranges in Europe (Wittmann 2006).

The port at Muskegon is not a high-traffic area for shipping; therefore, the population in Lake Michigan probably reflects an introduction from another invaded site in the Great Lakes. *H. anomala*'s relatively low fecundity (Ketelaars et al. 1999) suggests that it may have been present in the Great Lakes a few years before being discovered. Monitoring of this species is made difficult by its nocturnal behavior and because of its rapid swimming and response to stimuli. Specialized benthic traps are useful for sampling cryptic populations (Borcherding et al. 2006). It may be detected at night by shining a bright light on calm water, which will cause individuals to rapidly disperse. During daylight hours, swarms may hide in the shade provided by rock crevices, boulders, piers and jetties.

Voucher Specimens: Canadian Museum of Nature, Ottawa CMNC 2007-0001

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Other Resources:

Group: Crustaceans - shrimp

Lake(s): Lake Michigan Drainage, Lake Ontario

Genus: *Hemimysis*

Species: *anomala*

Common Name: bloody-red mysid (shrimp)

Status: Established

Freshwater/Marine: All

Pathway: Shipping

Exotic/Transplant: Exotic

Citation: Rebekah M. Kipp and Anthony Ricciardi. 2007. *Hemimysis anomala*. Factsheet, Great Lakes Aquatic Nonindigenous Species Information System (GLANSIS), NOAA.