NOBANIS - Marine invasive species in Nordic waters - Fact Sheet

Gammarus tigrinus

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Species description

Species name
Gammarus tigrinus, Sexton, 1939 – an amphipod

Synonyms
None

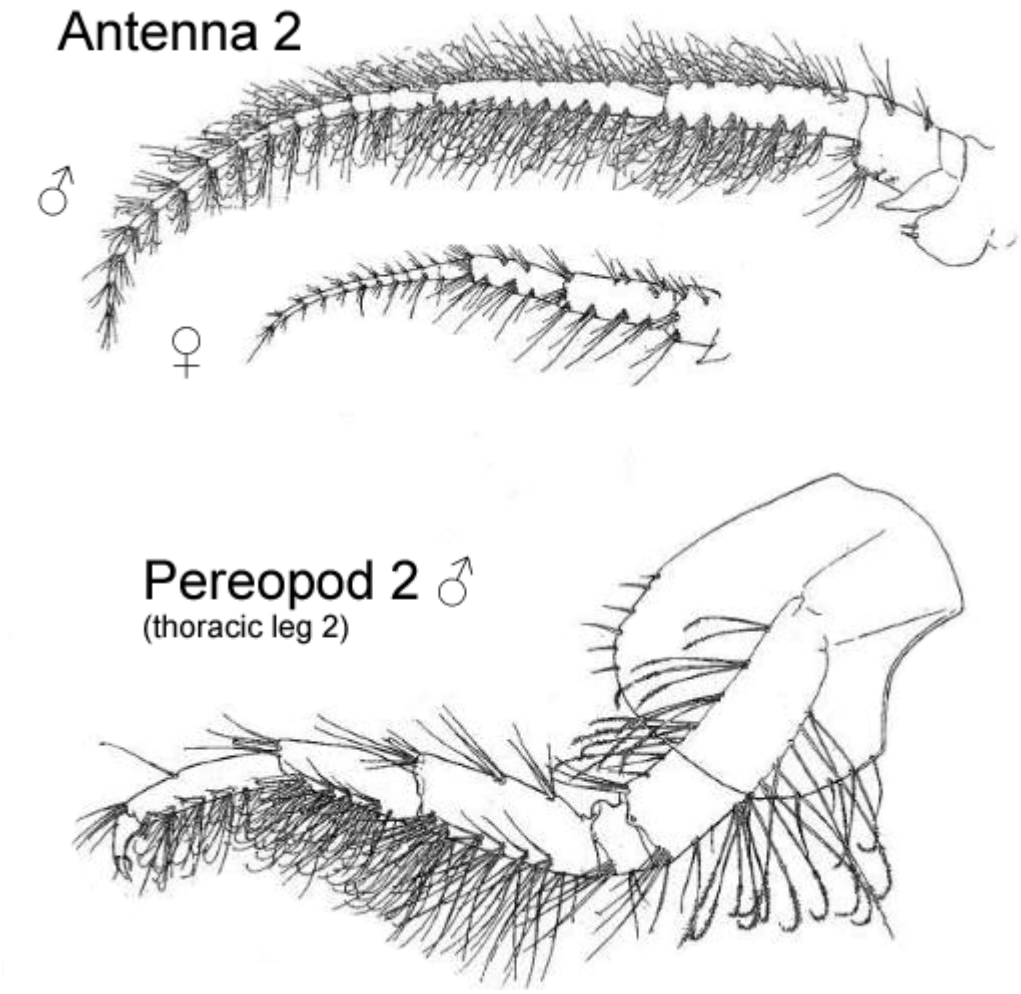
Common names
Tigermärle (SE); Gefleckter Flussflohkrebs, Getigerter Bachflohkrebs (DE); Kielz tygrys (PL); Leväkatka (FI); Tijgervlokreeft (NL).

Gammarus tigrinus, preserved specimen (colour pattern disappeared).

Gammarus tigrinus, preserved specimen (colour pattern disappeared) with "hairy antennae".

Identification

Many species of *Gammarus* and related genera (*Chaetogammarus, Dikerogammarus, Echinogammarus, Obesogammarus, Pontogammarus*) look alike macroscopically and identification to species level requires microscopic examination. Male *G. tigrinus* is characterized by having a dense “fur” of long, “curly” setae on antennae 2 and pereopods (Sexton, 1939; Grigorovich et al., 2005), though the curling may be absent during winter months. Uropod 3 is long and setose. The females are not as hairy. Males are only slightly bigger than females (♂ 12-14 mm, ♀ 10-12 mm). Body of living adult animals usually has characteristic dark transverse bands (“tiger-stripes”). Several native and introduced gammarid species occur in the same general area as *G. tigrinus* (see Ecology below).



Gammarus tigrinus drawings of setae on antennae and legs of male. Drawing of female antenna for comparison (from Sexton 1939).

Gammarus duebeni Liljeborg, 1852, see: http://species-identification.org/species.php?species_group=crustacea&id=333
Gammarus tigrinus see: http://species-identification.org/species.php?species_group=crustacea&id=341
Gammarus zaddachi Sexton, 1912, see: http://species-identification.org/species.php?species_group=crustacea&id=342

Distribution

Native area
Oligo- (0.5-5(7.5) ppt) and mesohaline (5(7.5)-18 ppt) brackish waters of eastern North America from St. Lawrence River estuary to Florida (Nijssen & Stock, 1966; Kelly et al., 2006a).

Introduced area
Anecdotal information that it was brought to Europe with naval vessels during World War I has often been repeated, but so far never documented (Costello, 1993; Bailey et al., 2006). The first documented European record is from the UK in 1931 when it was described as a new species (Sexton, 1939; Pinkster et al., 1977). Molecular studies have shown that the English and Northern Ireland populations come from different source populations (Kelly et al., 2006b). It was introduced intentionally from England to the heavily polluted German rivers Weser and Werra in 1957 because the native gammarids had disappeared. It reproduced and spread to other inland waters in Germany. In 1964 *G. tigrinus* was found abundantly in the Netherlands where it caused nuisance to fisheries in the IJselmeer (Nijssen & Stock, 1966; Pinkster et al., 1977). The first introduction into the Netherlands appears to originate from a semi-intentional release in 1960 by a scientist, who had imported specimens for laboratory experiments from Northern Ireland; because they had not reproduced in the laboratory, he assumed that they would not be able to reproduce in the wild either (Nijssen & Stock, 1966). Although ballast water has also been suggested as a possible vector, the Northern Ireland origin of the Dutch population has been confirmed by molecular studies (Pinkster et al., 1992; Kelly et al., 2006b). Its spread in the Netherlands has been followed over the years, and it appears that a second invasion from German rivers took place around 1991 (Pinkster et al., 1992). In Belgium the first record is from 1995 near Antwerp (Kerckhof et al., 2007). It was first found in Brittany, France in 2005, although it had been present in various rivers since 1991. It is currently spreading at a slow rate at the Atlantic coast of France (Piscart et al., 2008). In the Baltic Sea the earliest record is from the Schlei Fjord, Germany in the westernmost most part where it was recorded in 1975 (Bulnheim, 1976). The next records are likewise from the German Baltic coast in 1994 (Zettler, 1995). In the same year it was also recorded from Polish waters, in the Szczecin and Vistula Lagoons (Jaźdźewski & Konopacka, 2000), though apparently it had been present in freshwaters since 1988 (Normant et al., 2007). In 2003 it was found in the Gulf of Finland (Pienemäki et al., 2004) and Gulf of Riga (Herkul & Kotta, 2007), and in 2004 in the Curonian Lagoon (Daunys & Zettler, 2006). Its occurrence in the American Great Lakes, where it was first found in 2001, is also considered an introduction by human interference (Grigorovich et al., 2005; Kelly et al., 2006b), possibly from Europe (Kipp, 2007). It has not yet been observed in Swedish (Främmande arter, 2006), Danish or Norwegian waters.

Ecology

Gammarus tigrinus is highly euryhaline. In its native area it lives in brackish water of salinities from 4 to 20 ppt (Kelly et al., 2006b). In its introduced area it lives in freshwater in many rivers, though ionic content may be elevated due to pollution (Koop & Grieshaber, 2000; Grabowski et al., 2007), and up to 7 ppt in the southern Baltic Sea (Normant et al., 2007). Upper temperature tolerance is 32-34° C (Kipp, 2007). It is also relatively tolerant to low oxygen concentrations, high alkalinity and eutrophication (Chambers, 1977; Koop & Grieshaber, 2000; Kipp, 2007). Population densities may be extremely high, more than 20,000 individuals per m² (Chambers, 1977). *G. tigrinus* may act as a herbivore (Normant et al., 2007; Orav-Kotta et al., 2009), although predatory behavior, especially in connection with interspecific aggression, has also been observed (MacNeil & Prenter, 2000).
Native species of *Gammarus* show different, but somewhat overlapping, preferences for salinity, depth, tidal influence and substrate (Fenchel & Kolding, 1979; Pinkster et al., 1992), but are generally able to coexist, often by being reproductively active at different times of year (Kolding & Fenchel, 1979; MacNeil & Prenter, 2000). *G. tigrinus* also competes with other gammarids and

even mysids with highly variable results ranging from total displacement of native species to total displacement of the invader (Pinkster et al., 1977, 1992; MacNeil & Prenter, 2000; Bailey et al., 2006; Grabowski et al., 2006; Packalén et al., 2008; Piscart et al., 2008). Several species of fish, including perch, stickleback and eel, feed on *G. tigrinus* (Daunys & Zettler, 2006). *G. tigrinus* has been shown to be second intermediate host for a native digenean, *Maritrema subdolum* Jägerskiöld, 1909 (Rolbiecki & Normant, 2005). Molecular studies have identified multiple introductions to Europe (Kelly et al., 2006b)

Reproduction
Breeding has been studied in detail by Chambers (1977). Sexual maturity is reached at a small size, egg-bearing females of only slightly more than 4 mm have been observed. This size is reached in 40 days at 10° C, 32 days at 15° C and 27 days at 20° C (Pinkster, 1975). The number of eggs in a brood depends on the size of the female. The maximum number of eggs recorded in a brood is 95, and the mean brood size is about 20 (Grabowski et al., 2007). Males grasp females in a characteristic pre-copula pose, and hold on until spawning takes place. Overwintering animals may copulate in winter, and egg-bearing females have been found in early spring at a water temperature of 2° C, although it has been claimed that *Gammarus tigrinus* cannot reproduce below a temperature of 5° C (Pinkster et al., 1992). Brooding time is 20 days at 10° C (Pinkster, 1975), 16 days at 13° C and 9 days at 21° C, and there are three spawning peaks (July, August, October) per year. Life span has been calculated to be about 2 months depending on temperature; overwintering animals live for several months. Presumably one female can have several consecutive broods per season. Native species grow and mature more slowly and carry fewer eggs (Pinkster, 1975; Chambers, 1977), but other non-indigenous species also have high fecundity and short generation times (Grabowski et al., 2007).

Impacts

Gammarus tigrinus is able to outcompete many native gammarids in oligohaline waters. In Vistula Lagoon in the southern Baltic Sea, the native gammarids G. duebeni and G. zaddachi have been replaced by non-native species, predominantly G. tigrinus (Grabowski et al., 2006; Surowiec & Dobrzycka-Krahel, 2008). In any case the original amphipod fauna has been drastically changed in several places in northern Europe (Pinkster et al., 1992; Jazdzewski et al., 2004; Zettler, 2008). Life-history traits, such as early maturation, large brood size, short generation time have been identified as possible reasons for the competitive superiority of G. tigrinus (Pinkster et al., 1977; Costello, 1993), though multivariate analyses showed that tolerance to changing salinity and pollution were better indicators for separating invasive and native species (Devin & Beisel, 2007; Grabowski et al., 2007). Parasitism, both in native and invasive species, may also be involved in determining competitive success (MacNeil et al., 2003a,b), whereas differences in microhabitat preference and diel activity patterns have been demonstrated in cases of coexistence (MacNeil & Prenter, 2000; van Riel et al., 2007). G. tigrinus is intermediate host for the eel parasite Paratenuisentis ambiguus (Van Cleave, 1921), in Germany, but as only laboratory reared amphipods were introduced from England to Germany, it is unlikely that the acanthocephalan parasite was brought to Germany with the amphipod (Taraschewski et al., 1987). The parasite has recently been found in eels in Polish coastal waters (Morozińska-Gogol, 2008), and may also occur in other localities within the introduced range of G. tigrinus. When occurring in high densities, G. tigrinus has had damaging effects on fishing gear and trapped fish (Pinkster et al., 1977).

Other non-indigenous gammarid amphipods in Nordic waters

Several other non-indigenous species of gammarid amphipods occur in freshwaters of northern Europe. Some of these species are tolerant of low salinities, and have been found in oligohaline waters of the Baltic Sea. However, these will not be dealt with specifically in this project. Below a list is given with links to further information.

Crangonyx pseudogracilis Bousfield, 1958. Native area: North America. Invasive distribution: Freshwaters of the U.K. No on-line description available.

Dikerogammarus haemobaphes (Eichwald, 1841). Native area: Ponto-Caspian. See: http://www.corpi.ku.lt/nemo/directory_details.php?sp_name=Dikerogammarus+haemobaphes

Dikerogammarus villosus (Sowinski, 1894). Native area: Ponto-Caspian. See: http://el.erdc.usace.army.mil/ansrp/dikerogammarus_villosus.pdf and http://www.frammandearter.se/0/2english/pdf/Dikerogammarus_villosus.pdf

Echinogammarus ischnus (Stebbing, 1899) (syn.: *Chaetogammarus ischnus*). Native area: Black Sea. See: http://el.erdc.usace.army.mil/ansrp/echinogammarus_ischnus.pdf and http://nlbif.eti.uva.nl/bis/amphipoda.php?menuentry=soorten&id=57

Gmelinoides fasciatus (Stebbing, 1899). Native area: Baikal Lake; intentionally introduced to several lakes in Russia. Now also in Gulf of Finland (Panov & Berezina, 2002). No on-line description available.

Obesogammarus crassus (G.O. Sars, 1894). Native area : Ponto-Caspian. See: http://aliensinbelarus.com/en/obesogammarus-crassus-sars-1894.html

Pontogammarus robustoides (G.O. Sars, 1894). Native area: Ponto-Caspian. See : http://www.nobanis.org/files/factsheets/Pontogammarus_robustoides.pdf and http://www.corpi.ku.lt/nemo/directory_details.php?sp_name=Pontogammarus+robustoides

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