Grandidierella japonica

A brackish water amphipod

Phylum: Arthropoda, Crustacea
Subphylum: Malacostraca
Order: Amphipoda, Gammaridea
Family: Aoridae

Description

Size: Males up to 22 mm in length, females 13 mm long (San Francisco Bay, Chapman and Dorman 1975; Myers 1981). The illustrated specimen (a male, from Coos Bay) is 10 mm in length (Fig. 1).

Color: Black head, mottled grey to grey brown body (Chapman and Dorman 1975) with distal parts of limbs white (Stephensen 1938; Chapman 2007). This specimen white (preserved in ETOH).

General Morphology: The body of amphipod crustaceans can be divided into three major regions. The **cephalon** (head) or cephalothorax includes antennules, antennae, mandibles, maxillae and maxillipeds (collectively the **mouthparts**). Posterior to the cephalon is the **pereon** (thorax) with seven pairs of pereopods attached to pereonites followed by the **pleon** (abdomen) with six pairs of pleopods. The first three sets of pleopods are generally used for swimming, while the last three are simpler and surround the telson at the animal posterior. The gammarid family Aoridae is characterized by separate urosome articles and a biramous third uropod. They also have a short (sometimes absent) rostrum, a long first antenna and a fleshy telson. *Grandidierella japonica* (see plate 262A, Chapman 2007), however, resembles the family Corophiidae more closely due to the uniramus uropod three (Chapman 2007).

Cephalon:

Rostrum:

Eyes: A single, oval-shaped, lateral eye (Kozloff 1974) that are black and medium in size (Stephensen 1938) (Fig. 1).

Antenna 1: The first antenna in males is more than ½ body length (Chapman and Dorman 1975) and is much shorter in females. The peduncle is with short accessory flagellum in both sexes (Fig. 1b). The male flagellum has 20 articles and is a little longer than peduncle. The female flagellum is equal to peduncle and consists of 18 articles (Stephensen 1938). Male antenna one longer than its antenna two (Barnard 1973), however female antennae are of equal size (Stephensen 1938) (female not figured).

Antenna 2: Length from ¾ of to longer than antenna one (Chapman and Dorman 1975) (see **antenna 1**). Spines present on peduncle articles 3–5. Male second antenna stout and flagellum with seven articles (Stephensen 1938). Female second antenna length in equal to antenna one and fifth article of peduncle with four strong spines. Female flagellum with six articles (not figured).

Mouthparts: Mandible with large molar, toothed lacinia mobilis, incisors and long 2-articled mandibular palp with third article setose. Maxilliped with 4-articled palp, article four claw-like and article two twice the length of one and two (Chapman and Dorman 1975). Outer maxilliped plates twice the length of inner plates.

Pereon:

Coxae: Reduced (Chapman and Dorman 1975), serially arranged and barely contiguous (Barnard 1973) (Fig. 1). Coxal plate one with a medial-ventral tooth (Chapman and Dorman 1975) (just slightly produced in illustrated specimen).

Gnathopod 1: Male gnathopod one is greatly enlarged, "carpochelate" (i.e. not filtering type) (*Grandidierella,* Barnard 1973; Chapman 2007). Articles two and five greatly enlarged and subequal (Chapman and Dorman 1975). Article two oval, article three small, article four small and elongate. Article five with sides parallel and with one enlarged tooth forming thumb and two smaller teeth (*Grandidierella*, Barnard 1975). Anterior edge of article five with 18–20 transverse fine ridges ("stridulating organs'', Stephensen 1938) and four spines (Figs. 1, 1a). Female gnathopod one is small, but larger than gnathopod two. Article two is setose and narrow (Stephensen 1938) (Fig. 5).

Gnathopod 2: Male gnathopod two is simple and much smaller than gnathopod

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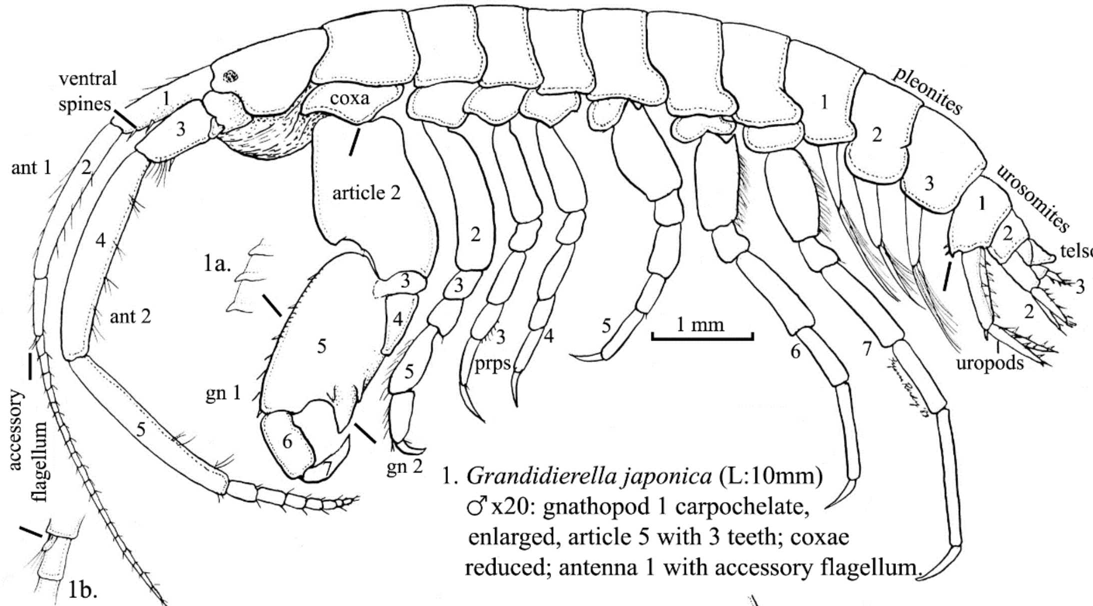
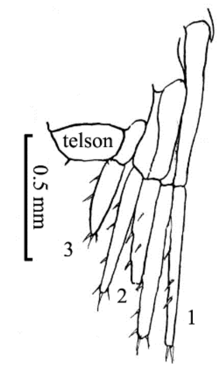
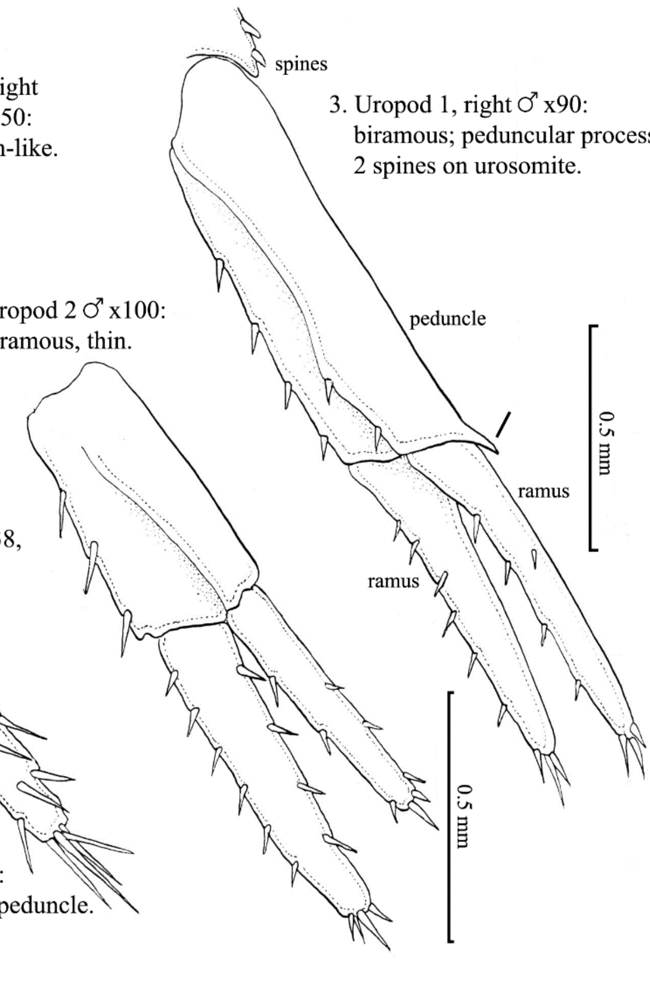


1. *Grandidierella japonica* (L:10mm) ♂x20: gnathopod 1 carpochelate, enlarged, article 5 with 3 teeth; coxae reduced; antenna 1 with accessory flagellum.

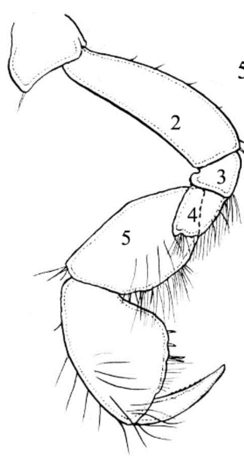


2. Telson and right uropods ♂x50: telson button-like.

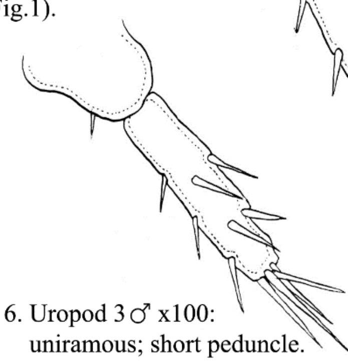


3. Uropod 1, right ♂x90: biramous; peduncular process; 2 spines on urosomite.

4. Uropod 2 ♂x100: biramous, thin.



5. Gnathopod 1♀: article 2 narrow (from Stephensen 1938, Fig.1).



6. Uropod 3♂ x100: uniramous; short peduncle.

one. Article two is twice the length of article five. Article three is short and dactyl is not chelate (Fig. 1). Female gnathopod two is setose, is smaller than gnathopod one and with article two about 2/3 length of male article two (Barnard 1973).

Pereopods 3 through 7: Simple, not prehensile (Barnard 1973) and increasing in length. A character of the Aoridae is a seventh pereopod that is longer than the sixth (see plate 269C, Chapman 2007) and the seventh pereopod in *G. japonica* is very long (Fig. 1). Female pereopods are with narrow second articles (Stephensen 1938).

Pleon:

Pleonites: Third pleonite is without dorsal tooth (Barnard 1975)

Urosomites: All three urosomites short (Fig. 1). The first uropod is biramous and longer than the second or third. The peduncle is with peduncular process and two anterolateral spines on urosomite (Barnard 1969) (Fig. 3). Second uropod is also biramous (*Grandidierella,* Barnard 1975) and with thin peduncle and long rami (Barnard 1975) (Fig. 4). The third uropod is uniramous, without hooked apical spine or long setae (Barnard 1975) (a defining character of *G. japonica*). It is not fleshy, blunt or elongate and the ramus is three times as long as the peduncle (Barnard 1973) (Fig. 6).

Epimera:

Telson: Telson uncleft and somewhat swollen (Kozloff 1974), with button-like morphology and medial groove (Chapman and Dorman 1975) (Figs. 1, 2).

Sexual Dimorphism: Male first gnathopod article two is expanded and article five is large, with parallel sides, teeth and stridulating organ. All features are lacking in females. Male antenna one is also longer than two and female antennae are equal.

Possible Misidentifications

The Aoridae are a family of gammarid amphipods that are tube-building suspension feeders found in marine and estuarine habitats. They are characterized by a short rostrum, long first antenna, gnathopod one larger than two (in males), a fleshy telson, a long seventh pereopod (longer than the sixth), distinctly separate urosome articles and a biramous uropod three. There are four aorid amphipod species that are not native to the northeastern Pacific coast (e.g. *Aoroides secundus, Microdeutopus gryllotapla*), one of which is *G. japonica*. At least two aorid genera that are quite similar to *Grandidierella: Paraoroides,* and *Aoroides* (family Aoridae). *Paraoroides* species have a uniramous third uropod (as in *G. Japonica),* but this ramus is only as long as the peduncle, not twice or three times as long (Barnard 1973). In *Paraoroides,* the first gnathopod is not carpochelate, but only slightly enlarged, the gnathopods are equal in size. The third article of the first antenna is not elongate, as it is in *G. japonica. Aoroides* species (six local) have an immensely merochelate male first gnathopod (Barnard 1975), quite different from that of *G. japonica.* Article four is elongate, article five is oval, but lacks teeth. The gnathopod is the filtering type, with long setae. The third uropods in this genus are biramous, not uniramous as in *Grandidierella. Aoroides columbiae* is a Pacific coast species. Other species of *Grandidierella* have not been recorded from our area, include a tropical species, *G. nottoni*, and four freshwater species. *Grandidierella japonica* closely resembles amphipods in the gamily Corophiidae (Chapman 2007)

The gammarid family Corophiidae is characterized by individuals that build U-shaped tubes in both soft sediments and on hard surfaces, sometimes forming dense aggregations. Species can be dramatically sexually dimorphic and, while males may be easier to identify with taxonomically relevant characters including the rostrum and peduncle of second antennae, most females can be reliably identified to species as well (Chapman 2007). Five corophiid genera occur locally, *Americorophium*, *Corophium*, *Crassicorophium*, *Laticorophium* and *Monocorophium*. The three common estuarine species in this guide (*A. brevis, A. salmonis, A. spinicorne*) were previously members of the genus *Corophium* (see Shoemaker 1949), but were transferred to the genus *Americorophium* in 1997 (Bousfield and Hoover 1997).

Other common gammarid families include the Ampithoidae, Cheluridae, Ischyroceridae, Podoceridae, and Isaeidae (for key see Chapman 2007). The Ampithoidae have a poorly recessed head (Barnard 1973) and a short third article on the peduncle of antenna one. At least one ramus of the third uropod in this family is very setose terminally and the third uropod also has curved hooks on the end of its stout ramus (Barnard 1975). The Ampithoidae have a thick, uncleft telson. In our area there are several species of *Ampithoe* including *A. lacertosa* and *A. valida*. The Cheluridae are a wood-boring group that utilize the holes in wood left by boring isopods family with a huge dorsal tooth on the third pleonite. The urosomites form a box-like structure, and the second uropods are "flabellate" (i.e. paddle-like). *Chelura terebrans* is an introduced species found on the Pacific coast and is the only cheluird species found in this region (Chapman 2007). The Ischyroceridae is another closely related family. Members have an unusual thorn-like rostrum and a rather cylindrical body. The telson is broad and short, and it is the second male gnathopod, not the first, in this family which is carpochelate. Ischyroceridae have hooks on the outer ramus of the third uropod (like Ampithoidae), but this ramus is short and slender, not stout. The inner ramus is also slender and void of setae. Local genera include *Cerapus, Ericthonius, Jassa, Ischyrocerus, Microjassa and Ruffojassa. Ericthonius* species have a body much like G. *japonica,* but the first male gnathopod is normal, and the second is carpochelate (the opposite is true for *Grandidierella).* At least two species occur in our area, *E. rubicornis (=E. hunteri)* and *E. brasiliensis.* In Podoceridae both gnathopods (especially the second) are large and subchelate. The first urosomite is very long, more than twice the length of the second. The genera *Podocerus, Dulichia,* and *Dyopedos* occur in our area. The Isaeidae are marine, tube building suspension feeders and include the common genus *Photis.* Characteristics of this group include a recessed head, and an elongate third article on the first antenna (like *G. japonica). Photis* species have elongate coxae and a normal first gnathopod, but an enlarged second gnathopod that is often highly sculptured. The third uropod has an elongate peduncle.

Ecological Information

Range: *Grandidierella japonica* is native to Abasiri River, Hokkaido, Japan, from which it was introduced to U.S. Pacific harbors with *Crassostrea* (commercial oyster), Tomales, Bolinas, and San Francisco, California, possibly as early as 1928 (Chapman and Dorman 1975). Current distribution includes the Fraser River, Canada, Bahia San Quintin, Hawaii, England and Australia in addition to the northeast Pacific (Chapman 2007). For west coast invasion history, see Fig. 1, Pilgrim et al. 2013. Genetic barcoding data suggests two cryptic *G. japonica* species – both present in San Francisco Bay with one expanding northward and the other southward (Pilgrim et al. 2013).

Local Distribution: Coos Bay sites include the South Slough and North Bend Airport (Gonor 1979).

Habitat: Burrows in mud bottoms of bays and estuaries where individuals build U-shaped tubes, in which pairs can often be found (Chapman and Dorman 1975). Males also found out of tubes and in tide pools at low tide. *Grandidierella japonica* is sensitive to a variety of pollutants and is a common subject of toxicity tests (e.g. Nipper et al. 1989).

Salinity: Brackish water in Japan and introduced into Oregon and California estuaries (Chapman and Dorman 1975). Unique osmoregulatory tissue of the coxal gills allow *G. japonica* to exist in a wide variety of salinities (Kikuchi and Matsumasa 1993).

Temperature:

Tidal Level: Intertidal to 10 meters (Chapman 2007). Collected at +1.5 meters MLLW in South Slough.

Associates: Introduced with *Crassostrea.* In South Slough, associates include the algae, *Enteromorpha* sp., the amphipod, *Ampithoe valida,* and sacoglossan, *Aplysiopsis smithi.* California associates include polychaetes, *Harmothoe* sp., *Heteromastus* sp., *Capitella* sp., *Neanthes* sp., *Streblospio* sp., molluscs, *Mya* sp., *Cryptomya* sp., *Macoma* sp., barnacles, *B. improvisus,* isopods, *Gnorimosphaeroma lutea,* amphipods, *Photis* sp., *Corophium* sp., *Allorchestes* sp., *Ampithoe* sp., *Anisogammarus* sp. and the anemone *Haliplanella* sp. (Chapman and Dorman 1975).

Abundance: Can be present in great numbers seasonally. Third most common amphipod at North Bend Airport site (Gonor

1979). South Slough, abundances of 27 individuals per m^2 reported (Posey 1985).

Life-History Information

Reproduction: Most amphipods have separate sexes with some sex determination correlated with environmental conditions (Straude 1987). Females brood embryos in an external thoracic brood chamber and irrigate embryos with water produced by pleopod movement. Development within this brood chamber is direct and individuals hatch as juveniles that resemble small adults, with no larval stage. Little is known about the reproduction and development in *G. japonica* (but see Wang et al. 2009, in Chinese).
Larva: Since most amphipods are direct developing, they lack a definite larval stage. Instead this young developmental stage resembles small adults (e.g. Fig. 39.1, Wolff 2014).
Juvenile:
Longevity:
Growth Rate: Amphipod growth occurs in conjunction with molting where the exoskeleton is shed and replaced. Post-molt individuals will have soft shells as the cuticle gradually hardens. During a molt, arthropods have the ability to regenerate limbs that were previously autotomized (Kuris et al. 2007).
Food: Detritivore that feeds on epiphytes and suspended particles. Also known to be a predator of amphipods and can be cannabalistic (Chapman 2007).
Predators: The benthic carnivorous fish *Clevelandia ios, Hypsopsetta guttulata, Gillichthys mirabilis, Fundulus parvipinnis* (Tijuana estuary, West et al. 2003).
Behavior: Builds U-shaped tubes which protrude from the mud (Chapman and Dorman 1975) and modify native habitats (Pilgrim et al. 2013).

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