Limnoria tripunctata

A gribble

Phylum: Arthropoda, Crustacea

Class: Multicrustacea, Malacostraca, Eumalacostraca

Order: Peracarida, Isopoda, Limnoriidea

Family: Limnorioidea, Limnoriidae

Taxonomy: *Limnoria* was described in 1813 by Leach and has been placed in a variety of isopod families since (e.g. Asellidae), until Harger erected the family Limnoriidae for it, in 1880 (Menzies 1957). It was divided into two subgenera on the basis of boring substrate and associated mouthparts (Cookson 1991). *Limnoria Limnoria* were the wood-borers while *Limnoria Phycolimnoria* were the algae-borers (Menzies 1957; Brusca 1980). Thus, *Limnoria Limnoria tripunctata* is sometimes seen, although these subgeneric names are rarely used today (Cookson 1991; Brusca et al. 2007).

Description

Size: Limnoriids are small and *L. tripunctata* is no exception, reaching maximum lengths of 2.5 mm.

Color: Light tan, whitish and often encrusted with debris.

General Morphology: Isopod bodies are dorso-ventrally flattened and can be divided into a compact **cephalon**, with eyes, two **antennae** and **mouthparts**, and a **pereon** (thorax) with eight segments, each bearing similar **pereopods** (hence the name “isopod”). Posterior to the pereon is the **pleon**, or abdomen, with six segments, the last of which is fused with the telson (the **pleotelson**) (see Plate 231, Brusca et al. 2007). The Isopoda can be divided into two groups: ancestral (“short-tailed”) groups (i.e. suborders) that have short telsons and derived (“long-tailed”) groups with long telsons. Members of the Flabellifera, to which *L. tripunctata* belongs, fall into the long-tailed variety (see Fig. 86, Kozloff 1993). *Limnoria tripunctata* individuals are able to roll into a ball and are easily recognizable by their small size and wood-boring habits (Brusca 1980).

Cephalon: Smooth, rounded and modified for boring (Fig. 1).

Eyes: Lateral and anterior (Fig. 1).

Antenna 1: First antenna flagellum with four articles and peduncle with three (Fig. 3). Both antennae are reduced, separated at midline, and positioned in a nearly transverse line (Fig. 1).

Antenna 2: Second antenna flagellum with five articles (Fig. 4).

Mouthparts: Mandibles with file-like ridges (right) and rasping surface (left), but lack lacina mobilis and molar processes (Brusca 1980).

Rostrum:

Pereon:

Pereonites: Seven total segments, the first of which is widest (Figs. 1, 2) and coxal plates are present on pereonites 2–7 (Brusca 1980).

Pereopods: In mature females, leaf-like ooestegites are present at the base of each of first four pairs of legs and forms a brood pouch or marsupium (see Fig. 6, *Corophiurn spinicorne*, this guide).

Pleon:

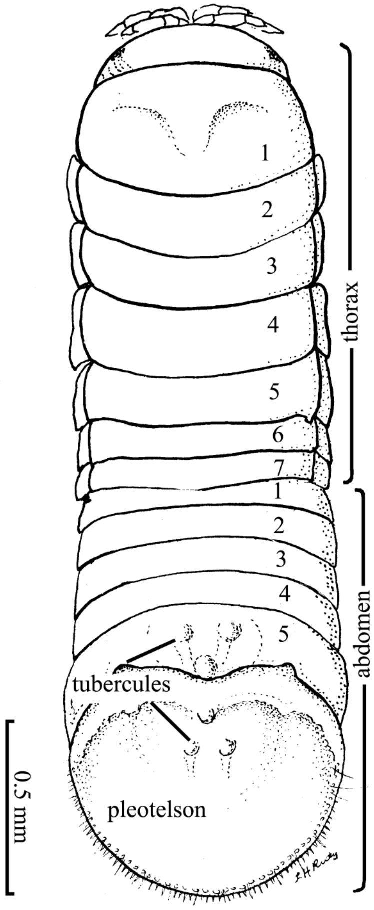
Pleonites: Five free pleonites with fifth somite bearing three tubercles (Fig. 1).

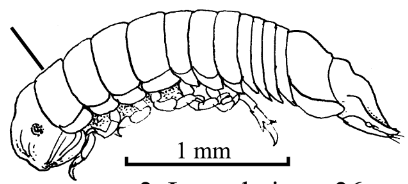
Pleopods:

Uropods: Uropod branches dissimilar, with short and claw-like exopod and long, apically blunt endopod (Fig. 6).

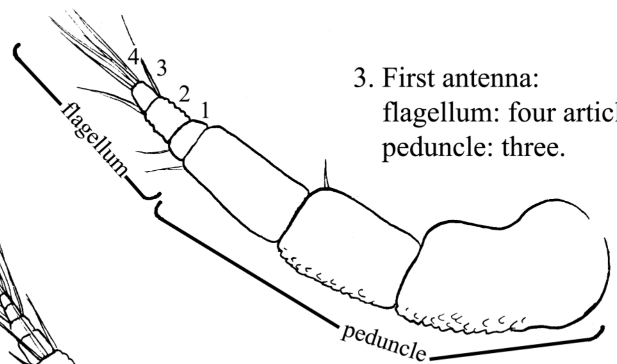
Pleotelson: Ornamented pleotelson with three anterior tubercles (“*tri-punctata*", Fig. 1) and tuberculate posterior and lateral borders (Fig. 5).

Limnoria tripunctata

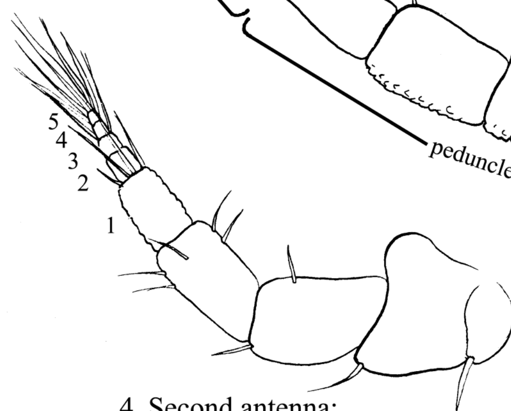




2. Lateral view x26:
eyes lateral; head rounded for boring;
first thoracic segment widest.

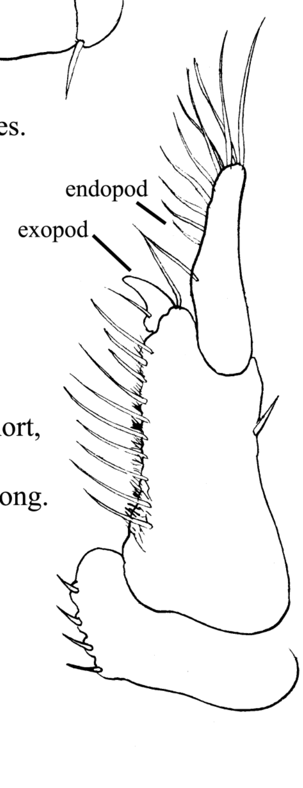


3. First antenna:
flagellum: four articles
peduncle: three.

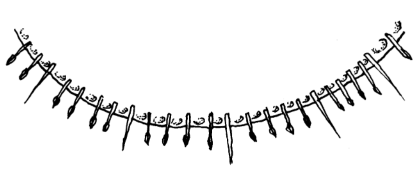


1. *Limnoria tripunctata* (L:2.5mm) x56:
head smooth; antennae reduced, transverse;
fifth abdominal somite: three tubercules;
telson: three tubercules.

4. Second antenna:
flagellum: five articles.



6. Uropod:
exopod short,
claw-like;
endopod long.



5: Pleotelson:distal border:
small tubercules.

Hiebert, T.C. 2015. *Limnoria tripunctata. In:* Oregon Estuarine Invertebrates: Rudys' Illustrated Guide to Common Species, 3rd ed. T.C. Hiebert, B.A. Butler and A.L. Shanks (eds.). University of Oregon Libraries and Oregon Institute of Marine Biology, Charleston, OR.

Sexual Dimorphism: Mature females are conspicuous with a marsupium (see **pereopods**) and males with modified posterior end of the seventh pereonite (see Fig. 1, Menzies 1972).

Possible Misidentifications

The order Isopoda contains 10,000 species, 1/2 of which are marine and comprise 10 suborders, with eight present from central California to Oregon (see Brusca et al. 2007). Among isopods with elongated telsons (with anuses and uropods that are subterminal), there are several groups (i.e. suborders) including the Valvifera, Anthuridea, Gnathiidea, Epicaridea and Flabellifera.

The Flabellifera is a large assemblage and contains 3,000 species with seven families occurring locally, threeof which are not present north of Point Conception, California (Brusca et al. 2007). Limnoriids are wood-boring species that are characterized by reduced uropods, small exopods, and a body that is less that 4 mm in length (see Brusca et al. 2007 for other distinguishing characters). This family comprises only four local species (70 described worldwide) and all are in the genus *Limnoria*.

Limnoria algarum, bores in algal holdfasts, not wood, and is the only species with a simple incisor mandibular process, lacking a file that is present in the other three, wood-boring, species. *Limnoria lignorum* has a pleotelson with dorsal surface that forms a Y-shaped keel at the base while *L. quadripuntcata* and *L. tripunctata* have pleotelsons with symmetrically arranged anterior tubercles. The two latter species can be differentiated (as their names suggest) by the number of tubercles present, four in *L. quadripuntcata* and three in *L. tripunctata* (Brusca et al. 2007).

Ecological Information

Range: Type locality is San Diego, California. Known range from Atlantic and Pacific coasts in temperate and tropical waters and capable of interbreeding over large geographic distances (Menzies 1972) within a temperature range of 15–30˚C (44˚ to 12° N) (Beckman and Menzies 1960). *Limnoria tripunctata* is a well-established species in European coastal waters (Borges et al. 2014).

Local Distribution: Oregon distribution in upper bays including Coos, Yaquina, Tillamook estuaries.

Habitat: Docks and pilings, chiefly in bays and estuaries, where it burrows into wood, whether it is floating or submerged (Johnson and Menzies 1956). The wood serves as both food and protection. *Limnoria tripunctata* is even undeterred by creosote preserved wood (Menzies 1951; Ricketts and Calvin 1952; Borges et al. 2014) (see also **Food**). Within the wood, burrows are equal in diameter throughout and have smooth walls (Sleeter and Coull 1973). Bite marks left on wood by *Limnoria* species are distinct and measure 50 –80 µm in diameter and tunnels reach depths of 2 cm (Pitman et al. 1997). They can completely bury themselves within wood in 4–6 days, but remain close to the wood surface (Ricketts and Calvin 1952).

Salinity: A stenohaline species (Borges et al. 2014) that tolerates salinity and oxygen fluctuations as individuals occur in warm, often salty upper bays. The ideal salinity range is 30–34 (in the lab, Borges et al. 2009), but individuals tolerate salinities from 12 to 48 (Menzies 1972). Other *Limnoria* species (e.g. *L. lignorum*) can't tolerate low salinity (15) or dissolved oxygen content below 1.6 ppm. *Limnoria tripunctata* can stand periodic oxygen depletion, however, (Menzies 1957) and has been observed at salinities of 12 near San Francisco, California, and can survive at salinities between 10–18. However, even *L. tripunctata* cannot survive exposure to freshwater for greater than one day (Menzies 1957).

Temperature: Temperature range from 15° to 30°C (Beckman and Menzies 1960; Menzies 1972; Borges et al. 2009). Highest reproductive rates were observed between 20–25˚C, reproduction is impaired below 10° C and egg production takes twice as long at 15˚C than at 20˚C (Menzies 1957, 1972).

Tidal Level: A shallow water species, *L. tripunctata* occurs from the water surface to 18 meters deep. Individuals prefer lower depths when surface salinity is low or tidal fluctuation is great. Individuals tend to prefer estuary benthos, and commonly occur at the bases of pilings.

Associates: *Limnoria* burrows can be inhabited by the commensal isopod, *Caecijaera;* the sphaeromatid isopod, *Gnorimosphaeroma;* the amphipod, *Chelura;* and the copepod *Donsiella* (Menzies 1957), none of which are borers. The boring mollusk, *Teredo,* can also co-occur in wood where *Limnoria* burrows. After 4–6 months submerged (suspended 1–4 meters above the bottom), untreated wood with *L. tripunctata* developed a community consisting of turbellarians, nematodes, the archiannelid *Dinophilus;* the polychaete *Polydora;* the tanaid, *Leptochelia savignyi;* copepods and amphipods (Sleeter and Coull 1973). The heterotrich ciliate *Microfolliculina limnoriae,* attaches to the dorsal surface of the pleotelson (up to four individuals per single *L. tripunctata*). The presence of this obligate ciliate may reduce feeding rate and negatively affect swimming, suggesting that this relationship is a form of ectoparasitism (Delgery et al. 2006).

Abundance: The small size of individuals in this genus allows for hundreds to co-occur in a single square inch of wood.

Life-History Information

Reproduction: Most isopods have separate sexes (i.e. dioecious, Brusca and Iverson 1985) (although protogynous and protandric species are known, Araujo et al. 2004; Boyko and Wolff 2014). Reproduction proceeds by copulation and internal fertilization where eggs are deposited within a few hours after copulation and brooded within the female marsupium (Brusca and Iverson 1985). The biphasic molting of isopods allows for copulation; the posterior portion of the body molts and individuals mate, then the anterior portion, which holds the brood pouch, molts (Sadro 2001). Embryonic development proceeds within the brood chamber and is direct with individuals hatching as manca larvae that resemble small adults, with no larval stage (Boyko and Wolff 2014). *Limnoria* species exhibit low fecundity, iteroparity and direct development (Menzies 1972) and females in the genus only carry an average of about 9–10 eggs and breeding occurs year-round (Ricketts and Calvin 1952). Adult *L. tripunctata* occur and copulate as pairs within tunnels (see Fig. 2, Menzies 1972) and eggs require 2–4 weeks for development (Borges et al. 2014). Females can produce up to three broods per year, and the number of gravid females in a single population is highest when water temperatures are between 17 and 19˚C (Johnson and Menzies 1956). Locally, peak breeding time for *L. tripunctata* is from April to May (Friday Harbor, WA, Welton and Miller 1980) and the average number of eggs per female is 22 (Welton and Miller 1980). Development time from egg deposition to hatching is 17 days (at 20 °C), 15 days (at 22° C), 13 days (at 26°C), 11 days (at 30°C but numbers greatly reduced) (Eltringham 1967).

Larva: Since most isopods are direct developing, they lack a definite larval stage. Instead this young developmental stage resembles small adults (e.g. Fig. 40.1, Boyko and Wolff 2014). Most isopods develop from embryo to a manca larva, consisting of three stages. Manca larvae are recognizable by lacking the seventh pair of pereopods, but otherwise resemble small adults. They usually hatch from the female marsupium at the second stage and the molt from second to third manca produces the seventh pair of pereopods and sexual characteristics (Boyko and Wolff 2014). Isopod development and larval morphology can vary between groups (e.g. Gnathiidae, Cryptoniscoidea, Bopyroidae, Cymothoidae, Oniscoidea) (see Boyko and Wolff 2014). Parasitic isopods, for example, have larvae that are morphologically dissimilar from adults (Sadro 2001). Isopod larvae are not common members of the plankton, with parasitic larvae most likely to be observed. Occasionally, suspended benthic juveniles or pelagic species are collected in plankton samples, but these can be differentiated from larvae by their larger size (Sadro 2001). Newly hatched *Limnoria* larvae do not swim, but develop this trait over time (Ricketts and Calvin 1952).

Juvenile:

Longevity: There is some evidence that individuals leave their burrows and dig separate "tombs" into which they settle to die (Sleeter and Coull 1973).

Growth Rate: Growth among isopods 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 autonomized (Kuris et al. 2007), however, isopods do not autotomize limbs as readily as other groups (Brusca and Iverson 1985). Compared to other arthropods, isopods exhibit a unique biphasic molting, in which the posterior 1/2 of the body molts before the anterior 1/2 (Brusca et al. 2007). Intermolt period is 25 days in *L. tripunctata,* but decreases with time and age of individual (Ria Formosa, Portugal, Delgery et al. 2006). See Fig. 4 Johnson and Menzies 1956 for plot of seasonal chart of growth rate.

Food: *Limnoria tripunctata* is an economically significant species due to its ability to alter wooden structures by burrowing and ingesting wood (e.g. Fig. 1 Menzies 1957). They use wood as their primary carbon source by producing lignocellulose digesting enzymes (Borges et al. 2014) and, interestingly, have digestive systems void of the microorganisms that aid in digestion of wood and cellulose among other metazoans (Boyle and Mitchell 1978; Sleeter et al. 1978). However, epiphytic bacteria ingested with wood may serve as nutritionally beneficial to species with nitrogen-poor wood diets (Zachary and Colwell 1979; Zachary et al. 1983; Cragg et al. 1999). Digestion occurs rapidly (8 minutes total, Ricketts and Calvin 1952). The wood-boring ability of limnoriids has instigated research toward alternative structures that deter boring (e.g. Borges et al. 2009; Cragg et al. 1999). *Limnoria tripunctata* is apparently undeterred by creosote preserved wood (Menzies 1951) and populations that ingest creosote wood appear to possess a microbial gut flora unlike those that ingest untreated wood (Zachary and Colwell 1979; Zachary et al. 1983). *Limnoria tripunctata* may represent a resistant strain of gribble, which developed in response to creosote (Welton and Miller 1980). Furthermore, *L. tripunctata* is also reported to tunnel into wood treated with copper chrome arsenic (Pitman et al. 1997).

Predators: Isopods play a significant role as intermediate food web links, like amphipods, (e.g. see *Americorophium salmonis*, this guide) that are consumed by more than 20 species of marine fish (Welton and Miller 1980; cabezon, Best and Stachowicz 2012), whales (Brusca et al. 2007) and other invertebrates (e.g. polychaete worms, Reish 1954; Brusca 1980).

Behavior: Dispersal between wood habitats occurs by swimming and crawling in young adults. In *Teredo* species, dispersal is by larvae only, adults burrow but do not swim or crawl.

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