Ligia pallasii

A rock louse or shore isopod

Phylum: Arthropoda, Crustacea
Class: Malacostraca
Order: Isopoda, Oniscidea
Family: Ligiidae

Taxonomy: The genus *Ligia* was very briefly called *Ligyda* in the early 1900s. Since then, the genus has been split into four genera (*Geoligia*, *Megaligia*, *Nesoligia* and *Ligia*) based on morphological characters (e.g. antennulae, mouthparts, telson) (Jackson 1927). However, Van Name reduced these genera to subgeneric status and reinstated the genus *Ligia* in 1936 (Brusca 1980). Currently, these subgeneric names are rarely used and, instead, researchers refer to *Ligia pallasii* (e.g. Brusca et al. 2007).

Description

Size: To 35 mm in length (including uropods, which are 3 mm long) and approximately 11 mm wide (Brusca and Brusca 1978). The figured specimen (from Coos Bay) is 22 mm long.

Color: Mottled gray and often brown, with granular surface.

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 "iso-pod"). 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, *L. pallasii* groups among the former (see Fig. 3, Garthwaite and Lawson 1992; Brandt and Poore 2003; Plate 248C, Brusca et al. 2007). The suborder to which *L. pallasii* belongs, Oniscidea, is the largest isopod suborder and the only fully-terrestrial crustacean group (Brusca et al. 2007).

Cephalon: More than twice as wide as long with rounded anterior margin and without lobes (Fig. 1) (family Ligiidae, Brusca et al. 2007).

Rostrum:

Eyes: Large, round, composite, and close to lateral margin (Fig. 1) (Welton and Miller 1980). Separated in front by twice the length of the eye.

Antenna 1: First antennae are vestigial (Oniscidea, Brusca et al. 2007).

Antenna 2: Second antennae reach to middle of fourth thoracic segment (Fig. 1). The second antennae are with peduncles of five articles: the first two are short, the third is twice as long as the second, the fourth is 1½ x longer than the third, and the fifth 1½ x longer than the fourth (Welton and Miller 1980). The flagellum has 15 articles (Hatch 1947).

Mouthparts: In order from outside of buccal cavity: maxillipeds with palp of five articles (Fig. 8), second maxillae with two plumose processes on inner side of lobe (Fig. 5), first maxillae with three plumose processes on the inner lobe (Fig. 4), and the mandible with large, broad molar surfaces, and no palp (Fig. 3).

Pereon: First segment fused with head followed by seven free pereonites. Contains a tubular heart and cardiac ganglion consisting of six neurons (see Fig. 1, Sakurai and Wilkens 2003).

Pereonites: First four pereonites are subequal, last three are somewhat shorter along medial line and extend downward laterally. Epimera (flattened lateral extensions to pereonites) form broad plates, especially in males (Figs. 1, 4).

Pereopods: Seven pairs of delicate walking legs. Carpus and merus of first pair is swollen and not grooved (Hatch 1947).

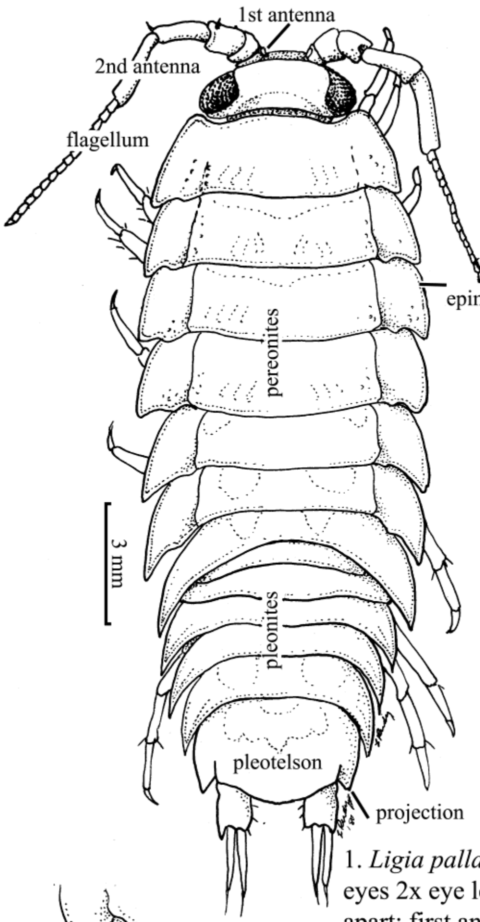
Pleon: Pleon as wide as thorax and with five free pleonites and a short pleotelson (Fig. 1).

Pleonites: First two pleonites narrow and without downwardly extending lateral edges, which mark last three segments (Fig. 1).

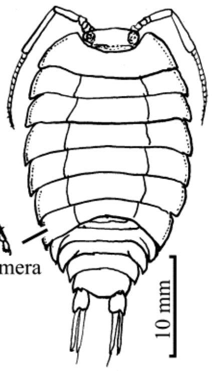
Pleopods: Paired breathing appendages beneath pleonites have whitish

Hiebert, T.C. 2015. *Ligia pallasii. 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.

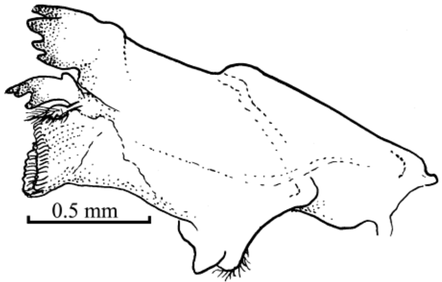
Ligia pallasii



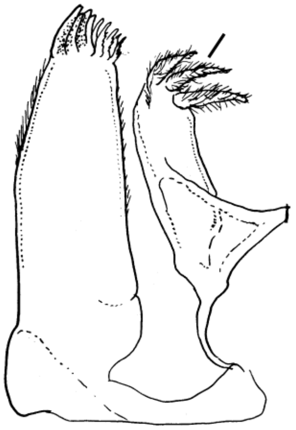
1. *Ligia pallasii* ♀ x8: eyes 2x eye length apart; first antennae vestigial; second: 15 articled flagellum; post-lateral pleotelson projections.



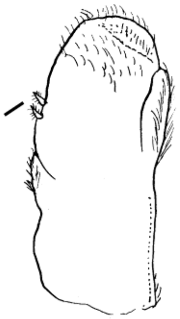
2. Male x2.



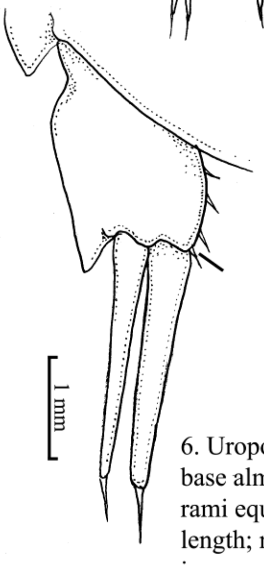
3. Mandible x50: no palp; broad molar surface.



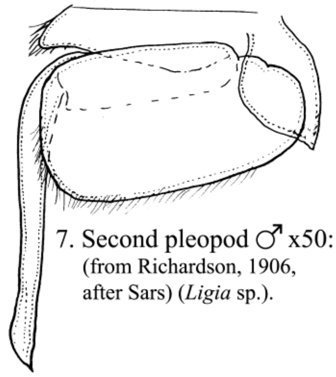
4. First maxilla x50: three plumose processes, inner lobe.



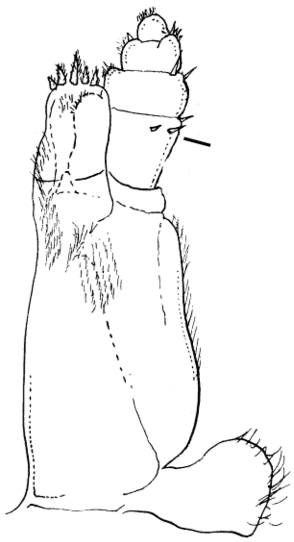
5. Second maxilla x50: two plumose processes.



6. Uropod x20: base almost square; rami equal, 2x base length; no process on inner margin.



7. Second pleopod ♂ x50: (from Richardson, 1906, after Sars) (*Ligia* sp.).



8. Maxilliped x50: palp: five articles.

tissue. Male genitalia, paired but not fused, is present on second pleopods (Fig. 7).
Uropods: Terminal and styliform, with bases about as long as wide. No process at inner distal margin of basal joint (Fig. 6), uropod rami equal and about twice the length of the peduncle (less than $^1/_2$ total body length, *Ligia,* Hatch 1947).
Pleotelson: Rounded on middle of posterior edge and postero-lateral projections not quite as long as middle (Fig. 1).
Sexual Dimorphism: Males with penial processes on second **pleopods**, and with wide epimera (Fig. 2). Females, when ovigerous, with oöstegites. Mature males are larger and broader than females (Carefoot 1973a, but see Kozloff 1993).

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 small, short telsons, there are several groups (i.e. suborders) including Phreatoicidea, Asellota, Microcerberidea, Calabozoidea and Oniscidea.

The monophyletic Oniscidea (previously part of the paraphyletic Scyphacidae, see Holdrich et al. 1984 in Schmidt 2000, 2002) is a fully-terrestrial group composed of 4,000 described species, with 22 known locally (among 10 families, Schmidt 2002; Brusca et al. 2007). Members are characterized by seven pereonites, the first not fused with the head, seven pairs of pereopods, male penes on the sternum of pereonite seven, a pleotelson that does not curve dorsally, vestigal (or very small) antennules and a pleon with five free pleonites (Brusca et al. 2007). The first and second pleopods are also elongated in males for copulation, many species have a water conducting system and some have respiratory structures on pleopods called pseudotracheae. The Oniscidea can be divided into three major ecological groups: the runners (slender bodies with long pereopods, the clingers (broad bodies with short pereopods) and the rollers (convex bodies that roll into balls) (Schmalfuss 1984 in Brusca et al. 2007). *Ligia pallasii* are fast runners (Brusca 1980).

The Ligiidae are usually littoral, they can swim, but in our area are restricted to the upper littoral (spray) zone (Hatch 1947). They have terminal uropods that are conspicuous dorsally, flagellum antenna with more than 10 articles and eyes with more than 50 ommatidia each (Brusca et al. 2007). The Ligiidae can further be distinguished from the other oniscidean families by having more than four articles in the flagellum of the second antennae, and by their lack of anterolateral head lobes. This family is represented by four local species, two in the genus *Ligia*, including *L. occidentalis* and *L. pallasii* and two in the genus *Ligidium*, including *L. gracile* and *L. lactum*. The former genus is semi-terrestrial and occurs in higher intertidal marine habitats, while the two latter species occur in riparian habitats (Brusca 1980; Brusca et al. 2007). *Ligidium* species have uropods with processes at the inner distal margin, to articulate the endopod (*Ligia* species do not). The genus *Ligia* is characterized by a pleotelson that bears posterolateral projections (see Fig. 1) and a uropod that has endo- and exopod insertions at the same level (*Ligidium* species lack these projections) (Brusca et al. 2007).

The species closest to *L. pallasii* on the northeastern Pacific shore is *Ligia occidentalis*, an inhabitant mostly of rocky outer shores, which, like *L. pallasii,* is often found near fresh-water seeps (Wilson 1970). It can tolerate greater extremes of dryness than *L. pallasii*. The two species can be distinguished morphologically. *Ligia occidentalis* is narrower than *L. pallasii*, being over twice as long as wide and its eyes that are closer together, about one eye's length apart (Garthwaite and Lawson1992). Furthermore, its uropod bases are several times longer than broad (*L. pallasii*'s are almost square) (Brusca et al. 2007). Its second antennal flagella are longer, extending to the sixth thoracic segment, and contain 29 articles, not 15. This species occurs on rocky shores, from Oregon south (Brusca et al. 2007).

Ecological Information

Range: Known range includes western Aleutians south to Santa Cruz, California (Welton and Miller 1980). Across this range, there are three distinct clades (mitochondrial COI sequence data) and, within those clades, lower latitudes show greater divergence than those at northern latitudes (Eberl 2013).

Local Distribution: Oregon sites include estuaries at Coos and Depoe Bay and Florence, as well as outer shores (Hatch 1947).

Habitat: Outer shore in deep crevices, under ledges, and near freshwater seepage. Estuarine habitats in hard-packed beaches, pilings, docks, as well as rocks. Individuals cannot tolerate extreme wetting or drying for extended periods and are often found in cool, moist conditions (Wilson 1970), preferring shaded rocky cliffs and caves (Ricketts and Calvin 1952; Eberl 2012) along the open coast (Garthwaite and Lawson 1992). Young individuals prefer moist macroalgae, particularly *Enteromorpha* (Carefoot 1979). Phylogenetically, isopods in the genus *Ligia* are thought to be in evolutionary transition from sea to land environments. Thus, they have a variety of unique physiological traits associated with each habitat (Wilson 1970; Zimmer 2002). The composition of respiratory proteins, hemocyanin present in *L. pallasii* have been described (see Terwilliger 1982).

Salinity: Found in full salt water habitats, but near fresh water seeps. Individuals can osmoregulate well and are found in areas of variable salinity (Wilson 1970). *Ligia pallasii* has been the subject of some toxicity research (e.g. Carefoot 1990a, b).

Temperature: Does not tolerate extended heat or drying, lives permanently in cool moist habitats (Wilson 1970).

Tidal Level: Individuals reported living on cliffs that are 1.5–6 meters above tide level in Moss Beach, California. In estuarine beaches of South Slough in Coos Bay, individuals are found at about 1.5 meters.

Associates: Beach wrack and wood debris associates include isopods *Limnoria*, and amphipods *Orchestia* and *Orchestoidea*. *Ligia* species *L. pallasii* and *L. occidentalis* both host mycoplasma-like symbionts that are believed to have aided in the sea to land transition among the Oniscidea (Eberl 2010).

Abundance: *Ligia pallasii* is the most common *Ligia* species on extreme northern California coast (Brusca and Brusca 1978). Abundant along the open coast from Alaska to San Francisco, California (Kozloff 1993).

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). Gravid *L. pallasii* females have been observed year-round (Ecola State Park, Oregon to Ventura California, Eberl 2012). Females are found with young in early spring through summer (April to May) in Coos Bay and females with broods were collected in July in Mora, Washington (Ricketts and Calvin 1952). The average brood size is 48 ±11 (Carefoot 1973a; Welton and Miller 1980).

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, and parasitic larvae are 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).

Juvenile: Young individuals are approximately 2–5 mm in length after release from the female brood pouch (Carefoot 1979). Individuals reach sexual maturity after one year (Carefoot 1973a).

Longevity: 1.5–2 years (Carefoot 1973a; Welton and Miller 1980).

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). The hemolymph ion composition of *L. pallasii* has been documented throughout several molting stages and concentrations of Ca2+ and K+ changed most significantly over the course of a a molt (Siegler et al. 2000).

Food: A scavenger, feeding mostly on decayed algal material as well as animal detritus (Kozloff 1993; Brusca and Brusca 1978). Individuals showed preference to aged and decaying beach wrack over fresh macroalgae of the same species (Pennings et al. 2000). Food gathering is restricted to cool, humid periods (Wilson 1970) and includes diatoms, insect larvae and macro algae (e.g. *Ulva* sp., *Nereocystis leutkeana*) (Carefoot 1973b). With a daily energy budget of about 14 J per 250 mg per isopod, *L. pallasii* individuals require at least 11 mg of seaweed to survive, which takes about 35 minutes to ingest (Carefoot et al. 2003).

Predators: Birds, humans (e.g. for fish bait) and *Pachygrapsus crassipes* (Welton and Miller 1980). 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) and whales (Brusca et al. 2007).

Behavior: Uropod rami are dipped into pools to obtain moisture for gills (pleopods) (Brusca and Brusca 1978). The energy budget of *L. pallasii* can be divided as follows: 0.56 J for resting, 1.36 J for feeding, 1.31 J for running, 0.96 J for molting and 0.57 J per 250 mg per individual per hour for brood-carrying (Carefoot et al. 2003

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