
Eohaustorius estuarius

A sand-burrowing amphipod

Phylum: Arthropoda, Crustacea

Class: Multicrustacea, Malacostraca, Eumalacostraca

Order: Peracarida, Amphipoda, Amphilochidea,
Lysianassida, Haustoriidira

Family: Haustorioidea, Haustoriidae

Description

Size: Holotype is a female from Yaquina Bay, Oregon that is 4 mm in length. Paratypes are 2.0–4.5 mm in length (measured from the distal anterior end to the posterior telson) (Bosworth 1973). The illustrated specimens, collected from the lower Columbia River, were up to 6 mm long (Fig. 1).

Color: White, in life and in preservation (Bosworth 1973).

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 amphipod family Haustoriidae are abundant in clean, fine sand in estuaries or marine habitats where they swim and burrow upside-down (Chapman 2007).

Cephalon:

Rostrum: Short, visor-like and pointed (Fig. 2).

Eyes: Visible in live specimens (not once preserved). Bright white in anterior distal corners of head (Bosworth 1973). Ovoid in shape, with irregular indentations, not protruding above the surface. Eyes probably not compound (Fig. 2).

Antenna 1: Massive, setose and not geniculate (i.e. bent like a knee) (Fig. 2).

Antenna 2: Peduncle articles large and flat, very setose and with multiarticulate accessory flagellum (Fig. 3).

Mouthparts: Mandible with palp and always consisting of three articles (Haustoriidae, Barnard 1969). Palp with smooth molar (Fig. 4).

Pereon:

Coxae: Coxal plates one and two small and hidden beneath three and four (Fig. 1). Coxal margins rounded and not pointed.

Gnathopod 1: Small, feeble and simple with article five longer than six (Kozloff 1987) (Fig. 1).

Gnathopod 2: Feeble, small and minutely chelate (Barnard 1969) (Fig. 5).

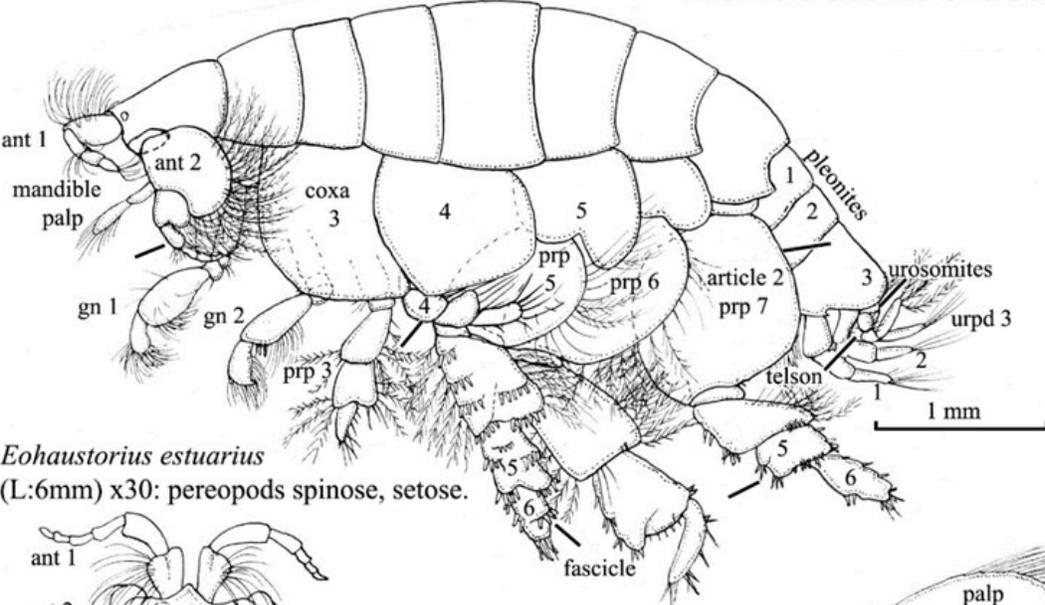
Pereopods 3 through 7: Pereopods lack dactyls (i.e. have only six articles), are furry and fringed with long bristles (*Eohaustorius*, Kozloff 1987). Pereopod four is smaller than pereopod three and is reversed and positioned like pereopods 5–7, not like 1–3 (Barnard 1969; 1975) (Fig. 1). Pereopod five with only one fascicle (bundle) of spines on posterior edge of article six and with articles five and six relatively equal in length (Bosworth 1973) (Fig. 1). Pereopod six like pereopod seven in length and general shape (i.e. not excessively long, Barnard 1975). Pereopod seven with posterior dorsal corner of article two smoothly rounded, without a cusp (arrow, Fig. 1) and with article five having two fascicles of spines on its anterior edge (Fig. 1).

Pleon:

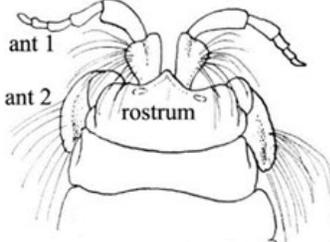
Pleonites: Third pleonites with a fine posterior fringe (Fig. 1).

Urosomites: Segments two and three

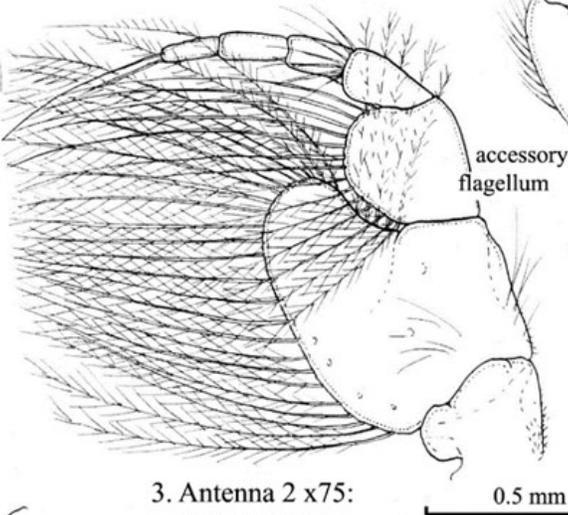
Eohaustorius estuarius



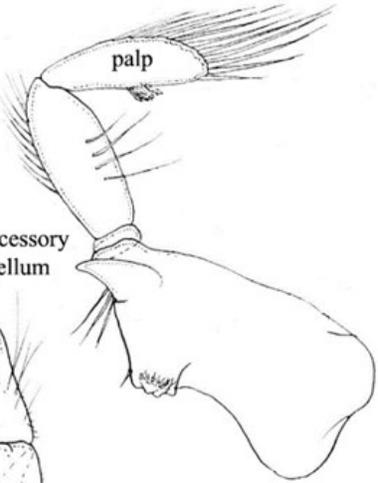
1. *Eohaustorius estuarius* (L:6mm) x30: pereopods spinose, setose.



2. Anterior (dorsal view) x30.



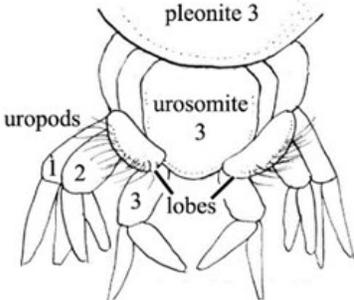
3. Antenna 2 x75: multiarticulate.



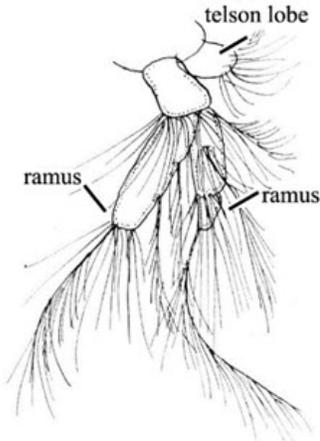
4. Left mandible x75.



5. Gnathopod 2 x75: dactyl minutely chelate.



6. Telson and uropods x30: telson lobes separated by urosomite; lobes setose.



7. Uropod 3 x75 two equal rami.

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not fused, but freely articulated (Kozloff 1987). Urosomites small and hidden beneath pleonites (Figs. 1, 6). Third uropods each with two rami of equal length (Barnard 1969) (Fig. 7).

Epimera:

Telson: Thin, flattened, setose lobes that are widely separated at bases by urosomites (Haustoriidae, Barnard 1975) (Fig. 6).

Sexual Dimorphism: No obvious differences between males and females (Bosworth 1973).

Possible Misidentifications

The Phoxocephalidae and Haustoriidae are morphologically similar gammarid amphipod families. Unlike the latter, Phoxocephalidae have very dissimilar pereopods six and seven: six is long and seven has a broad second article (see *Eobrolgus spinosus*). In the phoxocephalids, the fourth pereopod is not reversed as in the Haustoriidae, and although the rostrum is visor-like, it is much longer.

The Haustoriidae have feeble gnathopods, a mandible with a 3-articled palp, and spinose and setose pereopods. There are many genera in the family, but *Eohaustorius* is the only genus in which all the pereopods (3–7) lack dactyls (Barnard 1969). It is also the only genus of the family found in (and restricted to) the northern Pacific (Barnard 1969), where there are six species (Chapman 2007).

Eohaustorius is the only genus in the family Haustoriidae that occurs exclusively on Pacific coasts (from Russia to Mexico, Slattery 1985; Bousfield and Hoover 1995). Six species in the genus have been found in Oregon and four were described by Bosworth in 1973 (*Eohaustorius brevicuspis*, *E. sawyeri*, *E. washingtonianus* and *E. estuarius*). *Eohaustorius brevicuspis* and *E. sawyeri* inhabit only the open coast (Bosworth 1973). *Eohaustorius brevicuspis*

was described from Lost Creek Beach, south of Newport, Oregon (Bosworth 1973). It has a small cusp on the dorsal posterior margin of article two of pereopod seven and it has only two fascicles of spines on the posterior edge of article six or pereopod seven. This species is found high in the intertidal, from +0.6 to 3.6 meters MLLW, and never in brackish water (Bosworth 1973). *Eohaustorius sawyeri*, often found with *E. brevicuspis*, lacks the cusp on the seventh pereopod and has instead a bulge on the posterior edge of the second article (of the seventh pereopod). The posterior edge of the sixth article of pereopod seven has four fascicles of spines. This species is subtidal, marine and found from MLLW down to -0.76 meters. It has not been found in estuarine conditions (Bosworth 1973). The species most likely to be confused with *E. estuarius*, and which is also found occasionally in the more marine portions of estuaries, is *E. washingtonianus*. Described from Puget Sound, it has also been found in Coos Bay, Yaquina Bay, and in the lower Columbia River. This species can be larger than *E. estuarius*, to 8 mm long (Kozloff 1993). It has a prominent crescent-shaped cusp on the dorsal posterior edge of article two of pereopod seven and there are three fascicles of spines on the posterior edge of article six, pereopod five. In the Newport area (e.g. Yaquina Bay), it overlaps with *E. brevicuspis* intertidally, and with *E. sawyeri* subtidally, being found from -0.76 to +1.22 meters (Bosworth 1973). *Eohaustorius sencillus* has a first gnathopod with a sixth article that is swollen and has an apical spine. The seventh article on gnathopod one is quite long. This species lacks the cusp on article two of pereopod seven (as does *E. estuarius*). *Eohaustorius sencillus* is found commonly from Monterey Bay, California (Barnard 1962) to southern California. *Eohaustorius barnardi* is a subtidal species that occurs in fine sand, and is 5 mm in length (Chapman 2007).

Ecological Information

Range: Type locality is Yaquina Bay, OR (Bosworth 1973) and known range includes the entire northeastern Pacific (Chapman 2007).

Local Distribution: Local distribution at several Coos Bay sites, including the North Bend Airport extension site. Additional sites in Oregon include Yaquina Bay (near the Hatfield Marine Science Center) and lower Columbia River.

Habitat: Burrows in relatively clean, medium sized sand with a fairly high proportion of organic material. An estuarine species, it is found on open coast only where there is freshwater runoff (Bosworth 1973).

Eohaustorius estuarius is a common species used in toxicity testing (e.g. Kohn et al. 1994; Kravitz et al. 1999; Hecht and Boese 2002; Kuo et al. 2010; Greenstein et al. 2013; Ernst et al. 2014). It is the primary species used in the San Francisco Bay Estuary Regional Monitoring Program where it has been tested for sensitivity to a wide variety of toxins including copper, fluoranthene, chlorpyrifos, permethrin, bifenthrin and cypermethrin, the latter four toxins eliciting the most sensitive response (Anderson et al. 2008). *Eohaustorius estuarius* also exhibited a dramatic, short-term population decline following exposure to carbaryl, an oyster farming pesticide (Dumbauld et al. 2001).

Salinity: Brackish water (e.g. salinity at type locality ranges from 1–25).

Temperature:

Tidal Level: Intertidal and subtidal (up to 7 meters deep, Bosworth 1973; Chapman 2007). Some small permanent populations occur in high intertidal if freshwater stream runoff occurs (Bosworth 1973).

Associates: Does not overlap with habitats of other Oregon *Eohaustorius* species, where *E. estuarius* is found in brackish water, *E. brevicuspis* occurs mid-intertidally

and *E. washingtonianus* and *E. sawyeri* are found in the lower intertidal (Bosworth 1973).

Abundance: Densest at intertidal heights (Bosworth 1973).

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 chamber and create a water flow by moving their pleopods to irrigate embryos. 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 *E. estuarius*, however Slattery (1985) followed the reproduction of the congener *E. sencillus* from Monterey Bay, California, where mating occurs in the fall and ovigerous females can be found year round, with peaks in winter months. Brood sizes range from 3–6 eggs and egg sizes within the brood are 430 μm and, upon hatching, are 800–900 μm (Slattery 1985).

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: Sexual maturity is reached after 2–3 molts in local species of the families Haustoriidae (e.g. *E. sencillus*) and Phoxocephalidae (e.g. *Rhepoxynius fatigans*, *R. abronius*) (Slattery 1985).

Longevity: The longevity of *E. estuarius* is not directly known, but local species in the families Haustoriidae (e.g. *E. sencillus*) and Phoxocephalidae (e.g. *Rhepoxynius fatigans*, *R. abronius*) are on an annual cycle (Slattery 1985).

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 (Ruppert et al. 2004).

Food:

Predators: Fish, shorebirds.

Behavior: Phoxocephalid and haustoriid species tend to be very mobile and efficient burrowers (Slattery 1985) and *E. estuarius* is a strong digger, with an impressive armament of spines and setae used for digging.

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