Oregon Estuarine Invertebrates

2nd Edition (Summer 2013)

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This is a draft edition. Please email corrections to oimbref@uoregon.edu.

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Aequorea victoria (=A. aequorea)

A large common hydromedusa

Phylum: Cnidaria
Class: Hydrozoa
Order: Leptomedusae
Family: Aequoreidae

Description:

Medusa Stage:
Color—transparent aqua blue with whitish radial canals.
Size—up to 15 cm diameter (Hyman 1940c).
Bell—relatively flat, except when contracted in swimming; thick, gelatinous, large, rigid; with ring canal around margin and radial canals from mouth to margin (fig.1).
Radial Canals—about 60 around bell margin; (fig. 1, 2) simple, not branched in two (Kozloff 1974b). Gonads are suspended from radial canals. Excretory pores open at the canal bases near the tentacles (Hyman 1940c).
Gonads—not finger-like; attached to radial canals (fig. 1).
Tentacles—numerous (over 50) (Kozloff 1974a); hollow, not branched; on a single whorl around bell margin on ring canal (Rees and Hand 1975). Can be very long and extended. Have stinging bodies (nematocysts) for protection and food-gathering.
Mouth—part of tubular manubrium: large, surrounded by numerous frilled lips (fig. 2).
Velum—a flap of tissue, barely visible inside bell rim; used for swimming (fig. 1) (Hyman 1940c).
Hydroid stage (polypoid, or attached stage): Very small (fig. 3, 4, 5); simple or slightly branched colonies, with rarely more than two polyps; hydrocaulus (stem) up to 2.5 mm; hydranth with about 20 tentacles, a mouth, and a web with nematocysts. Some stems have gonophores (fig. 5) which release medusae. Tiny planular larvae, embryos from sexual products of the medusa, settle on their sides (fig. 3) and become new polyps (fig. 4, 5) (Strong 1925).

Possible Misidentifications:

Aequorea is very large for a hydroid medusa, and it is the only Leptomedusa with more than 24 radial canals (most have only four) (Rees and Hand 1975). The Scyphozoa, or true jellyfish, are large, have fringed mouth lobes, scalloped margins, no velum, and a complex pat-tern of radial canals (Rees and Hand 1975). Some have prominent, pendant oral arms. Very young *Aequorea*, up to 4 mm, can look very like *Polyorchis* in shape, even to lacking the numerous radial canals of the adult (Russell 1953).

Ecological Information:

Range—in many temperate waters, northern and southern hemispheres; well known in northwest: Puget Sound, British Columbia.
Local Distribution—Oregon bays and nearshore waters.
Habitat—medusae are found floating in the plankton, and often in harbors as well. The attached, or hydroid, forms are often encountered in the intertidal (Smith and Carlton 1975). Specific information on Aequorea hydroids is not available.
Salinity—collected at 30‰. Cannot tolerate unusual amounts of fresh water, as from storms (MacGinitie and MacGinitie 1949).
Temperature—a cold to temperate species.
Tidal level—medusae are found only floating; hydroids are intertidal.
Associates—small anemone *Bucidium aequorea* in some-times parasitic on lower side of *Aequorea* (Puget Sound) (MacGinitie and MacGinitie 1949).

Quantitative Information:

Weight—
Abundance—most common large medusa; it can occur in great numbers locally at the right time of year.

Life History Information:

Reproduction—an interesting life cycle, with a good example of alternation of generations: the attached, polypoid colony is delicate and plant-like. From the buds, medusae develop asexually and become free swimming. All medusae from a single colony are the same sex. Medusae discharge sperm or eggs into the water and the embryos produced become planula larvae which settle and develop into new polypoids.

Growth Rate—very fast, especially as compared to anemones (MacGinitie and MacGinitie 1949); egg to polyp (in lab), less than 6 days (Strong 1925).

Longevity—probably only a few months. Found April through September (Puget Sound); (medusae) (Kozloff 1974a).

Food—crustaceans and their larvae; polychaetes, ctenophores, medusae, cannery refuse. Feeding response mostly tactile (Hyman 1940c).

Predators—well protected by nematocysts (stinging cells). Giant sunfish (*Mola mola*) eat them, as do some nudibranchs.

Behavior—small polypoid stage needs well-sheltered place to attach. Usual stage seen in floating medusa (figs. 1, 2). Often high mortality after a storm or sudden presence of fresh water (MacGinitie and MacGinitie 1949). Medusa is luminescent when stimulated.

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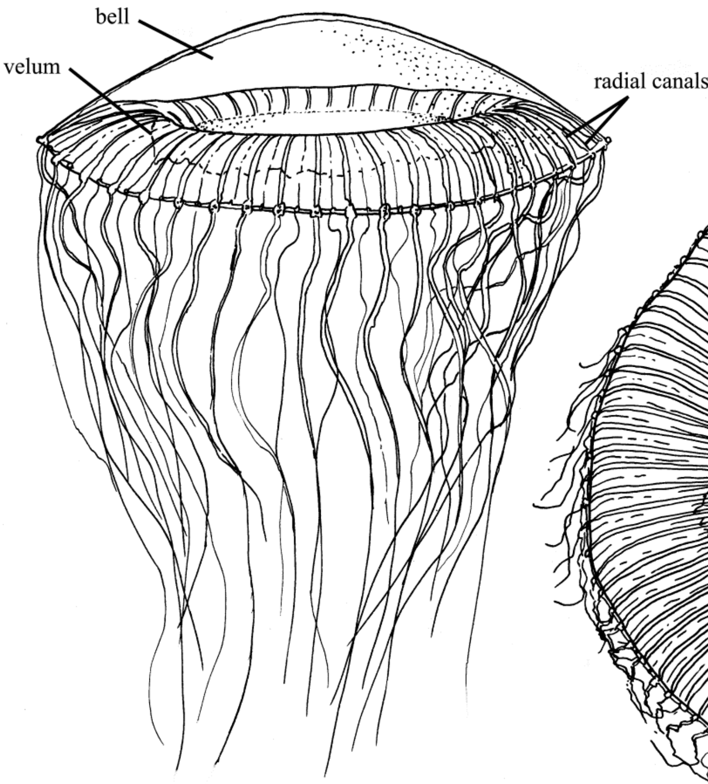
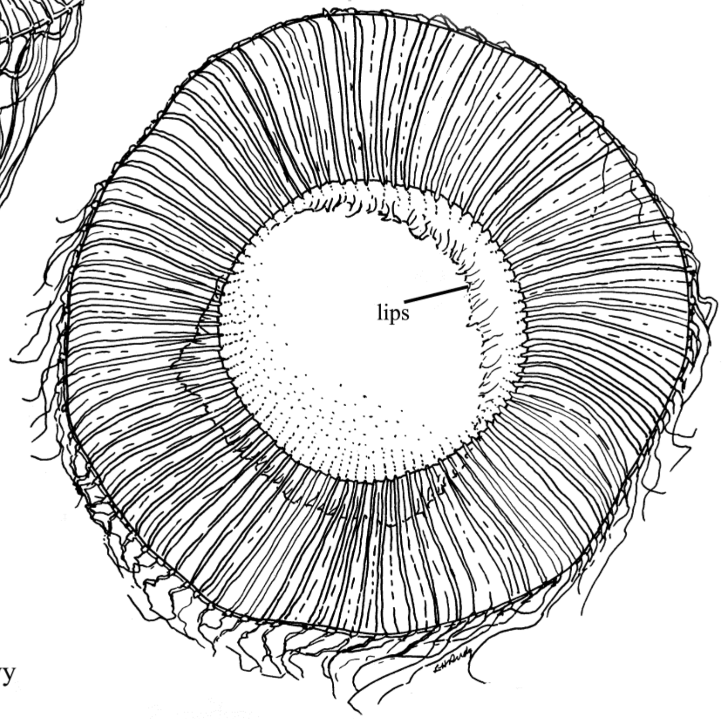
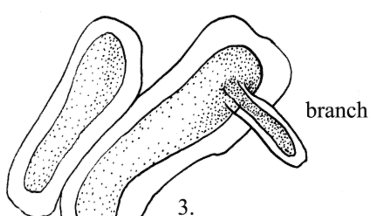
Aequorea victoria (*Aequorea aequorea*)



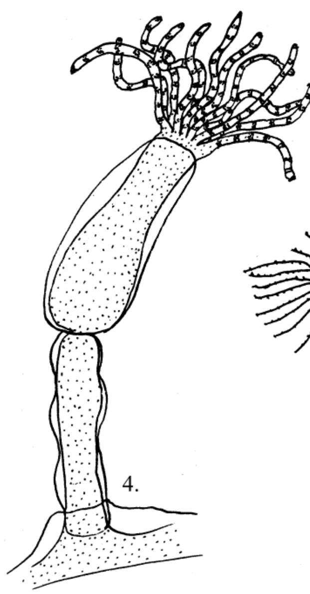
1. *Aequorea victoria* medusa: rather flat, heavy bell with about 60 radial canals; over 50 tentacles on ring canal; wide mouth; gonads along radial canals.



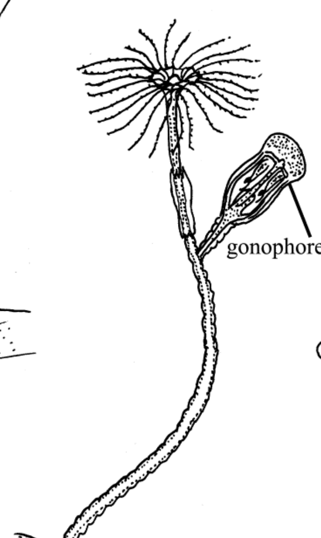
2. Medusa: dorsal view; mouth with fringed lips.



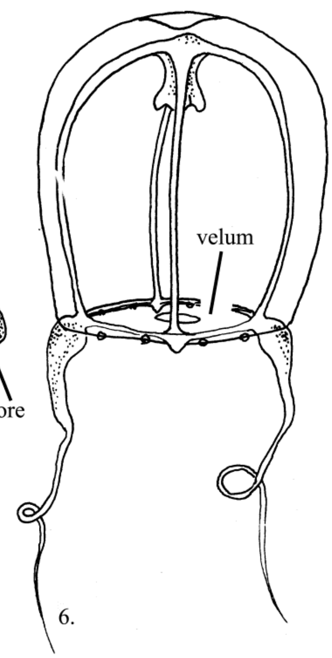
3. Planulae, 72 hrs: laterally attached; branch becomes polyp.



4. Hydranth



5. Single polyp (L:2mm): hydranth web has nematocysts.



6. Juvenile medusa

Anthopleura artemisia (=Evactis artemisia)

A burrowing anemone (Pickering in Dana, 1848)

Phylum: Cnidaria
Class: Anthozoa, Zoantharia
Order: Actiniaria
Tribe: Thenaria, Endomyaria
Family: Actiniidae

Description

Size—most around 25 mm diameter, 60-70 mm long; largest observed (California): 90 mm long, 25 mm column diameter (Hand 1955b). This specimen is 20 mm long, 25 mm crown diameter, 15 mm column diameter.
Color—oral disc can be red, brown, gray, black (solid or con-centric patterns); this specimen: brown disc, tan spots, light tan mouth. Tentacles brightly colored and/or patterned: red, white, black, blue, or orange; species *Artemisia* (Hand 1975). This specimen: "day glo" and pink tentacles, pink spots on oval disc. Column: top (distal) third black, brown, or gray shading to white or pink at proximal third (this specimen: gray). Verrucae on collar tend to be white-tipped (Hand 1955b). Mesentery insertions can be visible on bottom 3rd of column, showing as vertical white lines (not on this specimen). Acrorhagi white (fig. 2).
Shape—can be quite elongate (not figured); long column, with tubercules near top; slender, tapering tentacles; broad flat oral disc. Prominent collar and acrorhagi (spherules). *A. artemisia* can also contract into a crevice with only its crown showing. When contracted, it forms a low round-topped pillar (fig. 1) (Hand 1955b). Adherent shell and debris are typical of this solitary species.
Base—circular to irregular; well attached to substrate; often wider than column; no physa (bulb) at base.
Column—can extend to 5x diameter; well-developed collar; longitudinal rows of verrucae, especially on uppermost (distal) third of column (fig. 1), rarely any verrucae on proximal 3rd of column: species *Artemisia* (Hand 1975).
Collar (Parapet)—well-developed, separated from tentacles by deep fosse (groove) in which there are acrorhagi (spherules). Collar covered with compound verrucae (fig. 3).
Acrorhagi (Spherules)—round, hollow white in-conspicuous structures in fosse, just under tentacles (fig. 2, 3): genus *Anthopleura*; contain nematocysts (Hyman 1940c).

Verrucae (Tubercules)—rounded, wart-like structures; adherent, collect shell, debris for protection; also contain cinclides (pores) (see fig. 4, *A. elegantissima*). Verrucae on collar (where they are compound, with 3-6 vesicles each (fig. 3); well-developed, in longitudinal rows on upper third of column, sparsely spaced and single in middle third of column; usually none on lowest third of column: species *Artemisia* (Hand 1955b). Verrucae near acrorhagi sometimes white-tipped.
Mesenteries—interior vertical partitions; up to 24 pairs in some adults; often irregular due to asexual longitudinal fission. Mesenterial insertions often visible on proximal third of column in elongated specimens, as white lines (not shown).
Nematocysts (Cnidae)—tiny stinging cells; many kinds, differing in size, distribution from other species (not shown).
Acontia—(thread-like defensive structures expelled through column wall); none.
Tentacles—numerous, slender, tapering; about 1/2 as long as oral disc diameter; rarely; more than 5 orders (Hand 1955b). Arrangement sometimes irregular due to longitudinal fission of animal.
Oral Disc—broad, usually flat, about 11/2 x column diameter when expanded. Radial lines (mesenterial insertions) (fig. 2). Open central area (tentacle-free) sometimes with radial pattern.
Lips—not ribbed; do not protrude above disc surface; usually with siphonglyphs (ciliate grooves) but can have 1 or 3. Mouth commonly an elongate slit (Fig. 2).

Possible Misidentifications

There are other more common estuarine anemones (*Metridium*, *Haliplanella*, etc.), but none of them have acrorhagi
inside the fosse at the collar edge, or adherent tubercules on the column. *Anthopleura* species have both of these, as well as a well-developed pedal disc (base), and a flat broad oral disc with a clear central area.

Anthopleura xanthogrammica is usually an open coast species, large, green solitary and unicolored; its column is completely covered with verrucae (they are not in rows). It is found occasionally in the lower reaches of the most marine estuaries.

Anthopleura elegantissima, the aggregating anemone, can be solitary, like *A. artemisia*, and is often found in like habitats, i.e. rock substrate with sand and mud over the rock. *A. elegantissima* has verrucae in longitudinal rows on the entire column, not just on the upper part; the column is green or whitish, not black or gray fading to pinkish. The tentacles in *elegantissima* are pink, white, purple, blueish or green, not brightly colored red, orange or patterned, as in *A. artemisia*. *A. elegantissima*, when solitary, is usually larger than *A. artemisia*, which never has symbiotic algae in its endoderm. *A. artemisia* is the only species of the genus whose verrucae do not extend down to the base.

Small *artemisia* can be confused with *Metridium* when contracted, for their bright tentacles are hidden and they are plain gray or greenish (Ricketts and Calvin 1971).

Ecological Information

Range—Alaska to southern California; possibly Japan (Hand 1955b).
Local Distribution—Coos Bay Pigeon Point.
Habitat—in estuaries, attached to a solid substrate, often in a crevice or pholad burrow; column often buried in mud or sand, with only crown exposed; withdraws into its burrow when disturbed or at low tide. Also on pilings, floats, and on open coast.
Salinity—collected at 30‰ salt.
Temperature—
Tidal Level—distribution centers around mean lower low water, but also found occasionally quite a bit higher (Hand 1955b).
Associates—

Quantitative Information

Weight—
Abundance—

Life History Information

Reproduction—sexual: separate sexes; gonads borne on directive mesenteries attached to siphonoglyphs; asexual reproduction by longitudinal fission.
Growth Rate—
Longevity—
Food—small crustaceans.
Predators—not one of the preferred foods of coelenterate predator *Aeolidia* (Waters 1975).
Behavior—retracts completely into "burrow" when disturbed.

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Anthopleura elegantissima

The aggregated anemone (Brandt, 1835)

Phylum: Cnidaria
Class: Anthozoa, Zoantharia
Order: Actiniaha
Tribe: Thenaria, Endomyaria
Family: Actiniidae

Description

Size—small to medium-sized: a large specimen about 65 mm diameter. Crown can be to 90 mm across (solitary specimens); aggregated individuals common size about 25-40 mm. Usually larger in bays than on open coast (Hand 1955b). This specimen is 35 mm high, 45 mm disc diameter.
Color—tentacles tipped with pink, purple or other colors; this specimen with white, green, maroon tentacles. Disc green with maroon radial lines (this specimen). Column usually green: genus *Anthopleura* (Hand 1975): green caused by symbiotic algae cells (Kozloff 1974a). Collar green, acrorhagi white (figs. 2, 3). Puget Sound forms often red and green (Ricketts and Calvin 1971).
Shape—strong collar, broad flat disc, slender pointed tentacles; column with longitudinal rows of tubercules, attached shell and debris. Body walls soft, thin (Morris et al 1980). Becomes a hemispheric glob when contracted (fig. 3).
Base—attached to substrate; well developed pedal disc. Genus *Anthopleura* Outline circular to very irregular: spp *elegantissima* (Hand 1955b). Base usually same diameter as column. No physa (bulb) at base.
Column—twice as high as diameter when extended; hemispherical when contracted. Entire column covered with round verrucae (tubercules) in longitudinal rows: species *elegantissima* (Hand 1975).
Verrucae—simple tubercules, adherent: collect gravel, shell, debris. Tubercules on collar are forked, compound (see *A. artemisia*, fig. 3). Verrucae in rows, not densely packed, become fewer toward base ("limbus") (Hand 1955b).
Collar (Parapet)—strong; well-developed fosse (groove) (fig. 2).
Acrorhagi (Spherules)—round, hollow bodies covered with nematocysts; inconspicuous at top of column just outside tentacles (fig. 2): genus *Anthopleura* (Hand 1955b).
Disc—broad, flat, with radiating lines (mesenterial insertions); large central area tentacle-free. Disc slightly wider than column, or of similar width.
Mouth—lips may be swollen or flush with surface of disc. Lips not ribbed.
Tentacles—more than 24; pointed; no oral inner ring of tentacles. Tentacles about ¼ as long as diameter of disc (fig. 3) usually more than 5 orders (rows) present.
Cinclides—(temporary or permanent pores at tips of verrucae): many, on column (fig. 4).
Mesenteries—vertical body partitions: from 6 in young specimens to more than 24 pairs in mature adults. Visible at high magnification as vertical lines on column, particularly near base. Can be irregular, due to asexual fission (not shown).
Acontia—(thread-like defensive structures expelled through column wall): none.
Nematocysts—several kinds, in tentacles, column, acrorhagi, actinopharynx and filaments (not shown); see *Metridium* (Hand 1955b).

Possible Misidentifications

The genus *Anthopleura* can be distinguished from other estuarine anemones (*Metridium*, *Haliplanella*, *Diadumene*) by their acrorhagi inside the fosse under the tentacles, and by the verrucae on their columns. *Anthopleura* always have a well-developed pedal disc and a flat, oral disc with a clear central area.

Two other species of *Anthopleura* occur here:

Anthopleura xanthogrammica is a large open coast species occasionally found in the most marine parts of our estuaries. It is very large, solitary (not aggregating), with uniformly colored disc and tentacles (not pink-tipped or with radial lines on the disc). The tentacles are in 6 or more rows (Morris et al

1980). Its verrucae completely cover the column (they are not in rows).

Anthopleura artemisia has tubercules on the upper 2/3 of its column only; the column is white or pink below and usually gray or black above; its tentacles are brightly colored and patterned (red in Coos Bay). *A. artemisia* is more likely to be found burrowing in a sandy or muddy substrate than *A. elegantissima*, which can live close by.

Other sand-dwelling anemones might include *Flosmaris*, a southern form, which is elongate and has a translucent or white column. Most other elongated or tube-dwelling forms, i.e. *Cerinatharia*, are not intertidal in our area.

Ecological Information

Range—Alaska to southern California.
Local Distribution—Coos Bay: Pigeon Point.
Habitat—on rocky substrates, often in full sun, where it aggregates in beds of up to 60 ft., 100,000 animals (Childress 1969). Often in sand, but attached to underlying rock. Can survive in polluted waters (Ricketts and Calvin 1971).
Salinity—collected at 30 ‰ salt.
Temperature—
Tidal Level—from 0 to +4.5 feet above mean lower low water level (Hand 1955b).
Associates—green algae (zoochlorellae) and dinoflagellates (zooxanthellae) in gut tissue; amphipod *Allogaussia* in digestive cavity.

Quantitative Information

Weight—
Abundance—most abundant anemone on coast; most abundant *Anthopleura* in Coos Bay (Ricketts and Calvin 1971).

Life History Information

Reproduction—sexual: spawning in September (San Francisco) (Morris et al 1980) Asexual: longitudinal fission, producing aggregations of "clones" common to this species (all are similar in coloration and sex) (Hand 1955b).
Growth Rate—
Longevity—reputed to be very long live; especially successful as an aquarium animal (Ricketts and Calvin 1971).
Food—largely crustaceans: copepods, amphipods, isopods (Morris et al 1980). Food preference seems to be genetically determined (Waters 1975).
Predators—seastars; nudibranch *Aeolidia papillosa* attacks the column (*ibid*).
Behavior—anemones at edges of clonal groups will "attack" neighboring (and different) clonal individuals with their acrorhagi, causing wounds; a corridor between clonal groups is thus maintained (Francis 1973b). Symbiotic green algae may aid anemone in modifying phototaxis (Buchsbaum 1968) and in averting starvation (Kozloff 1974a). Anemones, contract, inflate, expel nematocysts or detach and move when column attacked by nudibranch *Aeolidia papillosa* (Waters 1975).

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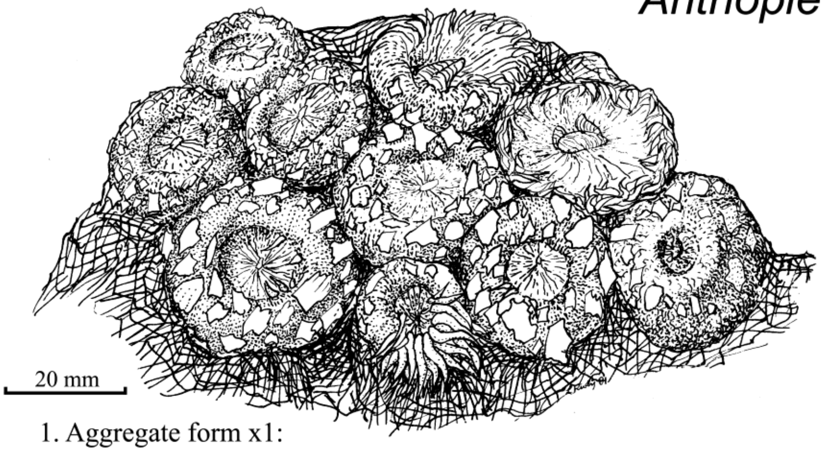
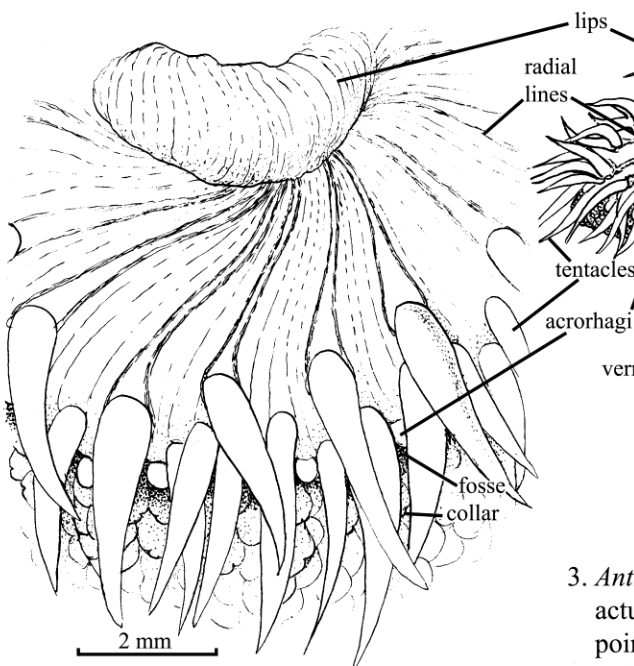
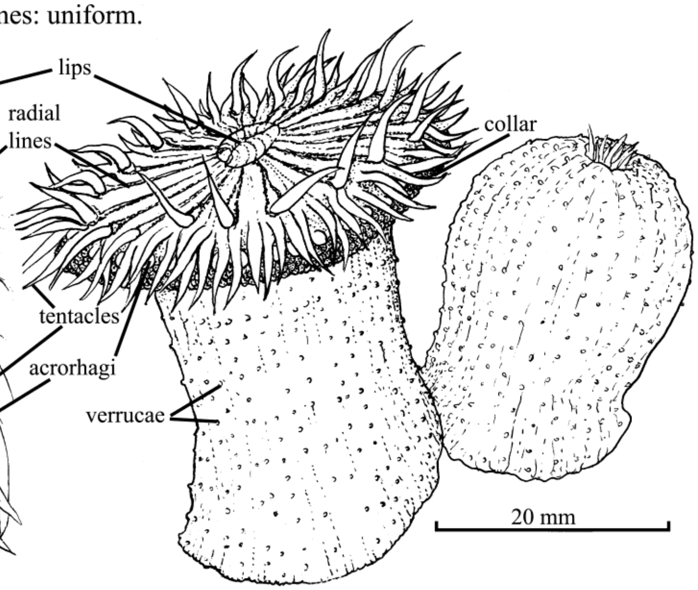
Anthopleura elegantissima



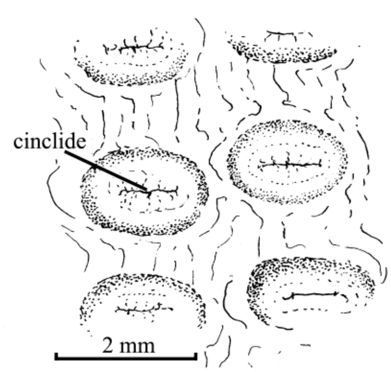
1. Aggregate form x1:
shell and debris adhere to verrucae; clones: uniform.



2. Oral disc (part) x12:
radial lines from mouth to tentacles;
white marginal spherules inside collar.



3. *Anthopleura elegantissima* solitary form x2:
actual height 35 mm, crown width 45 mm; tentacles short, pointed, in about 5 rows, pink, green and white; collar green; collar green/white, with vertical rows of verrucae.



4. Verrucae (tubercules) x12

Diadumene lineata (=*Haliplanella luciae*)

A small piling anemone (Verrill, 1898)

Phylum: Cnidaria
Class: Anthozoa. Zoantharia
Order: Actiniaria
Family: Haliplanellidae

Description

Color—variable: usually green with vertical orange, white or yellow stripes, but can have a brownish or olive column: pink or orange gonads may be visible on the lower column; mesenteries appear as dark vertical lines; tentacles usually colorless, can be gray to light green with white flecks (nematocysts) (Hand 1955a); oral disc transparent, can appear dark because of dark interior: lips dark gray.
Size—largest, fully expanded: 31 mm high. 22 mm diameter, average (California): 15 mm high, 11 mm diameter (Hand 1955a).
Shape— tow and cylindrical with many fine long tentacles (fig. 1)
Base—distinct "pedal disc", circular, attached to substrate
Column—smooth, tapering, usually a low cylinder, with 4-48 (often 7-19) (Kozloff 1974a) vertical stripes: dark mesenteries showing through, surface smooth: "cinclides", portholes through which acontia can protrude, can be visible to naked eye; column often scarred by longitudinal fission (asexual reproduction) (Hand 1955a).
Capitulum—(top of column): separated from column by parapet (collar) (fig. 2); transparent, usually light green, without cinclides: tentacles around the even margin.
Parapet—collar (fig. 2): noticeable only when anemone is fully extended.
Mouth— dark; ribbed (corresponding to number of mesenteries); 0-3 siphonoglyphs (none figured).
Oral Disc—(area surrounding mouth, fig. 4): with radiating rows of white flecks on endocoels (Hand 1955a); margin plain, not frilled or lobed; large area of disc tentacle-free. (Endocoels are the spaces between the pairs of septa (fig. 4)).
Mesenteries—vertical internal partitions (usually 6 in this species) visible as dark vertical lines; usually more mesenteries distally than near base (Hand 1955a). Gonads appear as thickened bands on mesentery filaments.
Tentacles—up to 100: retractile, smooth, not capitate (knobbed): only one kind. No oral ring of tentacles; short and blunt when contracted. Typically with 2 pairs of "directives", close to the ends of mouth, but this can vary (Hand 1955a). Can have up to 18 "catch" tentacles, short, blunt and opaque, near mouth (Williams 1975b).
Acontia—threadlike defensive structures which are discharged through column wall when animal is disturbed.
Nematocysts—stinging organelles: several types present; 3 kinds on the acontia (fig. 5): Haliplanellidae (Hand 1955a).

Possible Misidentifications

Metridium senile, a large anemone also found on floating docks, is deeply frilled and lobed, with short tentacles.

The anemone most likely to be confused with *Diadumene lineata* is *Diadumene franciscana*, which can be cream to light green with white stripes. It has one pair of directive tentacles (expanded, long, retractible and pointing toward the mouth), and they are yellow at their bases (*D. lineata*'s are clear). *D. franciscana* usually has 2 siphonoglyphs, pink lips, a rough column, and often an irregular base. Its parapet is poorly developed compared to *D. lineata*'s. The Puget Sound *Diadumene* is not green but orange, yellowish, grayish, reddish, cream or brown. Other *Diadumene* species are not green (Hand 1975).

If the specimen is orange striped "it can only be [*D. lineata*]" (Hand 1955).

Ecological Information

Range—cosmopolitan: Europe; New England coasts; Asia; Pacific coast: Puget Sound

south to California: probably introduced from Asia with oyster spat (Carlton 1975).
Distribution— Oregon estuaries: Coos Bay: Charleston docks, South Slough.
Habitat—"on or under rocks or on pilings' in estuarine situations; never found on the outer coast (Hand 1955).
Salinity—"euryhaline" (Ricketts and Calvin 1971) adapts to variations in salinity.
Temperature—cold and temperate waters; "eurythermal"? also found in the Suez Canal and Pt. Aransas, Texas (Ricketts and Calvin 1971). Contraction and encystment can occur with exteme high temperatures (East Coast) (Williams 1975b).
Tidal Level— shallow waters.
Associates—*Metridium;* also found on *Mytiius edulis* with its accompanying fauna.

Quantitative Information
Weight—
Abundance—can completely cover surface of log or piling.

Life History Information
Reproduction—can be sexual or asexual, the latter by longitudinal fission of the column or pedal laceration (Morris et al 1980). Its success is largely due to its ability to colonize quickly (Hausmann 1919).
Growth Rate—
Longevity—
Food—small crustaceans and annelids (Hausmann 1919).
Predators—in San Francisco Bay, the opisthobranch mollusc *Trinchesia* sp. (Hand 1975).
Behavior—Catch tentacles, used only for stinging, not feeding, serve to keep anemones separate (Williams 1975b).

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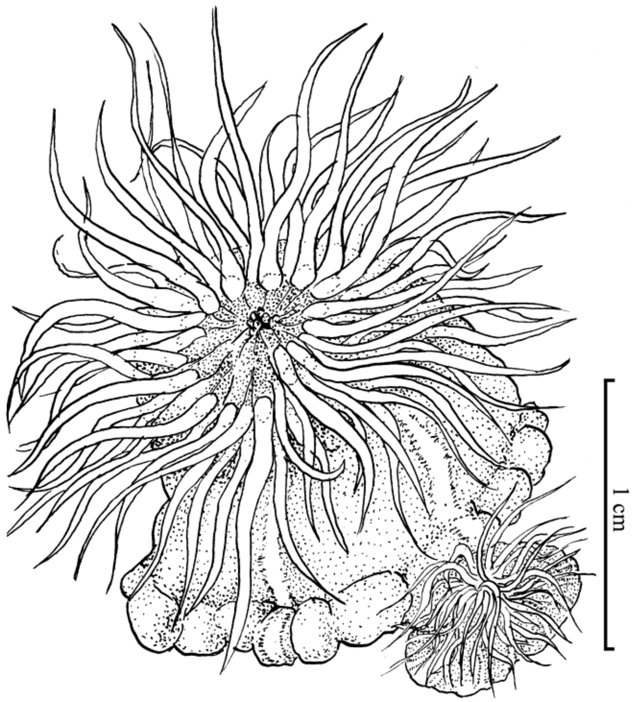
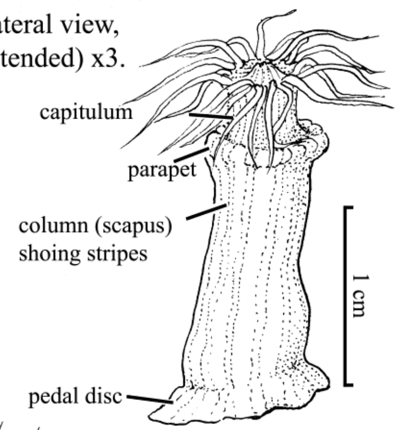
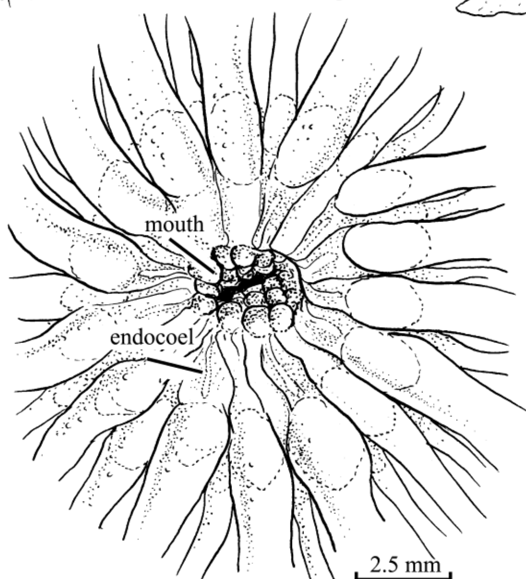
Diadumene lineata



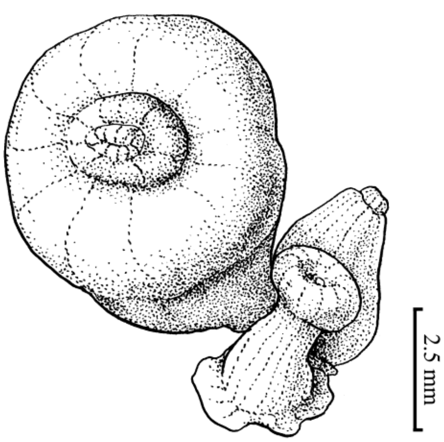
1. *Diadumene lineata* (H:1cm) x4.5:
up to 100 clear, tapered tentacles; low, cylindrical column attached to substrate; oral disc with tentacle-free area; column smooth, green, striped white, yellow or orange; margin not frilled or lobed.



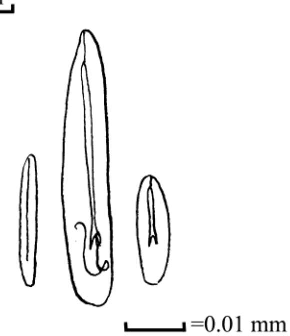
2. Small anemone (lateral view, extended) x3.



4. Oral disc x9:
radiating white endocoels; large tentacle-free area dark, ribbed mouth.



3. Contracted anemones x8:
tentacles completely retracted.



5. Nematocycts from acontia x1000 (Hand 1955).

Metridium senile fimbriatum

A piling anemone (Verrill, 1865)

Phylum: Cnidaria
Class: Anthozoa, Zonatharia
Order: Actinaria
Family: Metridiidae

Description

Color—white when young: adult can be brown, orange, tan. Because of asexual reproduction, all animals in one area may be same color
Size—piling specimens average about 5 cm (2 inches) in diameter (tentacles); can be up to 6 inches; subtidal animals can be "10 gallon" size (Ricketts and Calvin 1971).
Column—stout, compact in young specimens, often long in old ones; usually over 5 cm long; not striped (Perkins 1977). A parapet (collar) is seen beneath the crown of tentacles (fig. 2).
Base—flat, attached to hard surface
Tentacles— fine, short, not knobbed. Number of tentacles increases with age: old ones can have hundreds (Perkins 1977). Tentacles arranged in lappet-like groups or lobes(fig. 1) (*ibid*). Can have up to 18 "catch" tentacles, short, blunt and opaque, near mouth (Morris and Abbott et al 1980).
Oral Disc—very little tentacle-free area around mouth. Siphonoglyphs (ciliated grooves) vary from 0-3; one usual (Hand 1955).
Mesenteries—vertical body cavity partitions: 3-15 pairs: not visible, as animal is opaque.
Acontia—threadlike structures, found in lower part of mesenteries, which are discharged through lower column wall when animal is disturbed. They are probably used for defense (Hyman 1940).
Nematocysts—several kinds present (Hand 1955); (fig. 3a, b). Contain a toxin with a protein fraction, dialyzable material with aromatic amines.

Possible Misidentifications

Anthopleura artemesia, an estuarine anemone with a white stalk, can be confused with young *Metridium*. It lives in fine sand however, not on pilings, and when extended, its tentacles are pink or green, and heavy. The only other local species of *Metridium* is *M. exilis*, a small, open coast animal with fewer than 100 tentacles, and a yellow, orange or red column (Hand 1975). No other anemone

besides *M. senile* in the area has over 200 tentacles. *M.s. fimbriatum* is the name given the Pacific Ocean specimens (Hand 1955).

Ecological Information

Range—circumpolar, northern hemisphere; harbors and bays or Atlantic and Pacific Oceans; Pacific Coast: Sitka to Santa Barbara, California; type locality: San Francisco Bay (Hand 1955).
Local Distribution— protected pilings in larger Oregon estuaries: Coos Bay.
Habitat—likes bare, shaded pilings; can also attach to dead shells, tunicate *Styela*, kelp crab *Pugettia,* Barnacles (Ricketts and Calvin 1971).
Salinity—collected at 30‰, Coos Bay; at 27 ‰, Puget Sound (communication, R. Boomer) Tolerates brackish conditions: to 68% seawater in San Francisco Bay.
Temperature—temperate to cold waters (Hand 1955). Metabolic rate often positively correlated with temperature: acclimates well.
Tidal Level—can tolerate limited exposure found between 0.0 and -1.0 to low water on pilings, especially in summer (Kozloff 1974a). Flourishes well subtidally. even in deep water (to 60 fathoms). Most abundant at slightly above mean low low water Largest specimens are "well out from shore" (Hand 1955).
Associates—in Puget Sound: *Haliplanella luciae,* a Japanese anemone: on protected pilings, sea star *Pisaster*, tunicates *Styela, Dona*, and *Cnemidocarpa* (Ricketts and Calvin 1971).

Quantitative Information

Weight—

Abundance—"common on pilings, floats, and jetties of bays and harbors, as well as subtidally" (Hand 1975). Especially abundant in dark quiet corners.

Life History Information

Reproduction—sexual: oviparous, separate sexes, discharges eggs or sperm from mouth into water. Sperm have wedge shaped heads; eggs are pinkish, about 0.1 mm diameter; planular larvae settle as young anemones. Asexual reproduction: by "pedal laceration", small amount of tissue is left on substrate as anemone moves about; each small clump forms new anemone. Other asexual reproduction may be by "longitudinal fission", laceration, and budding (Hand 1955). Asexual re-production accounts for the often irregular siphonoglyphs and septa (mesenteries), which make *M. senile* a poor choice for lab use (Hyman 1940).
Growth Rate—
Longevity—survives well in small aquaria with running seawater.
Food—an active predator and carnivore, it eats very small organisms, unlike many anemones which manage larger prey (Kozloff 1974a). Also eats algae *Enteromorpha intestinalis* and *Desmarestia viridis* (Perkins 1977). Large specimens may be exclusively microplankton feeders while small ones closer to shore eat macrofood and perhaps some plankton (Hand 1955).
Predators—
Behavior—In dense groups of small animals, catch tentacles, used only for stinging, not feeding, serve to keep anemones separate (Morris and Abbott et al 1980). At low tide they can be seen on the sides of pilings hanging "fully relaxed and pendulous" (Ricketts and Calvin 1971).

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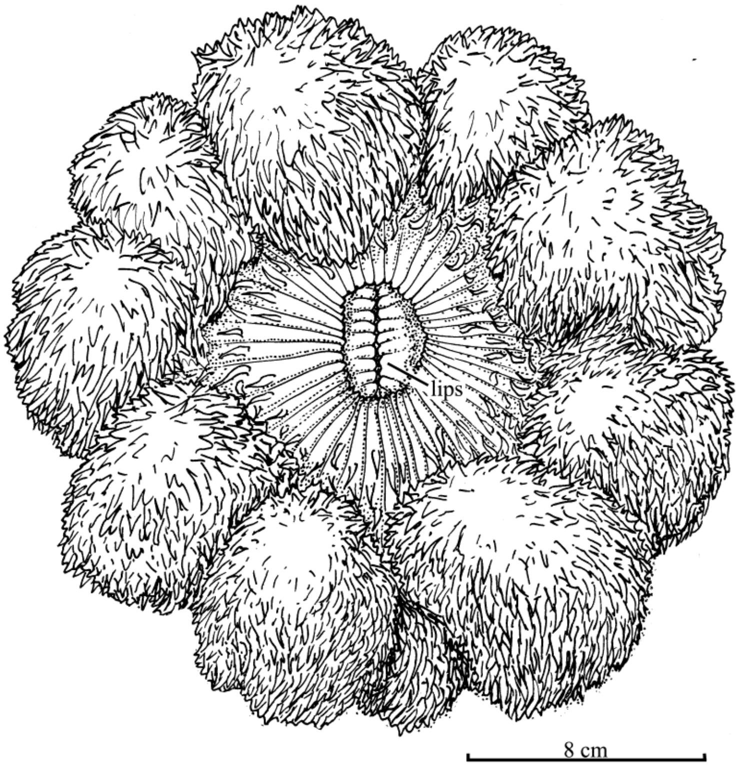
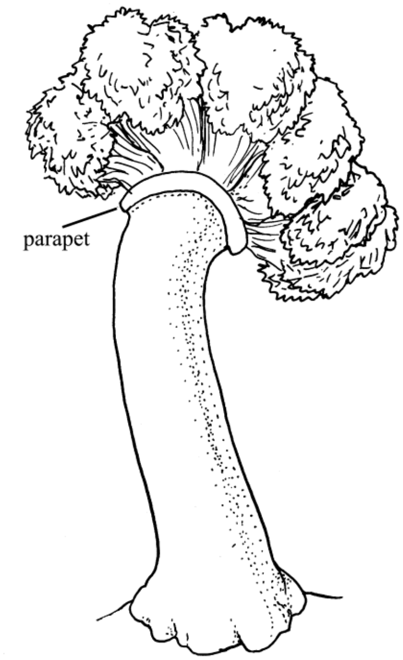
Metridium senile

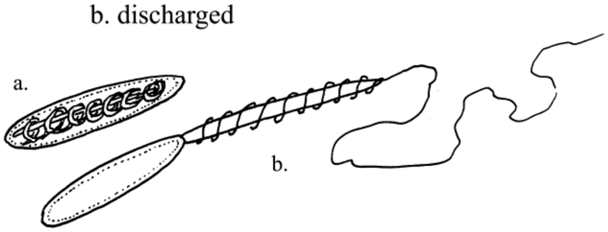


1. *Metridium senile* (dorsal view, D: 24cm): large subtidal specimen, many small tentacles in lobe-like groups; column stout, not striped; base flat, attached; oral disc with obvious lips.



2. Subtidal specimen (lateral view) x1

3. Nematocysts (generalized):
   a. undischarged
   b. discharged



4. Small piling specimen (D:6cm) x1

Nematostella vectensis

A solitary marsh anemone (Stephenson, 1935)

Phylum: Cnidaria
Class: Anthonthozoa, Zoantharia
Order: Actiniaria
Family: Edwardsiidae

Description

Color—white; transparent when expanded; internal color can depend on food.
Size—column (fig. 1) up to 15 mm long, can be up to 2.5 mm in diameter at base near bulb. Crown of tentacles up to 8 mm diameter. Column at tentacles' base about 4 mm (Hand 1957).
Shape—radially symmetrical, consisting of a tall cylinder and a crown of tentacles. Aberrant forms, i.e. two headed, tentacleless, are found as well (Williams 1976).
Tentacles—retractile, cylindrical, tapered, not "capitate": knobbed. Number 12-18, usually 16 (Stephenson 1935): can be as many as 204. 6-7 outer (exocoelic) tentacles longer than inner (endocoelic) ones, and are often reflexed down column; (they can be longer than column). Inner tentacles can be raised above the mouth (fig. 1), and can have white spots on their inner edges (Crowell 1946). Nematosomes can be seen moving inside the tentacles.
Column—long, cylindrical, worm-like, transparent. The eight mesenteries are visible through its walls.
Physa—a swollen, bulb-like burrowing structure at the base of the column (fig. 1), which replaces the pedal disc of other anemones. It is covered with rugae (ridges) which secrete mucus and aid in digging and climbing (Williams 1975).
Oral Disc—no inner ring of tentacles or siphonoglyphs, only a single ventral siphonoglyph (ibid).
Mesenteries—vertical partitions (eight in this species) below gullet, visible through column. Gonads appear as thickened bands on filaments (fig. 3) (Lindsay 1975). Eggs are produced from these filaments. The mesenteries can be green. brown, black, etc.; depending on food (Williams 1975).
Nematosomes—rather mysterious spherical, ciliated bodies, sometimes found in the coelenteron (digestive cavity) and in tentacles (fig. 2). Their function is not known.

Possible Misidentifications

This is the only species of the genus *Nematostella* known in the temperate northern hemisphere. *N. polaris*, a similar Arctic anemone, lives under conditions which *N. vectensis* could tolerate, but they are not believed to be the same species (Hand 1957). There is certainly no other very small, muddwelling burrowing anemone in our area which could be confused with *N. vectensis.*

Flosmaris grandis is another elongate, mud-burrowing, translucent anemone, but it is usually very large (to 46 cm), has over 24 tentacles, and instead of a physa, has a basal disc attached to something solid. *Diadumene* sp. are often long and pale. but have pigmentation of some sort and don't burrow. Only *N. vectensis* of these anemones has nematosomes.

Ecological Information

Distribution—north temperate shallow estuarine pools: England, New England, northern California. Type locality-Isle of Wight (where it probably doesn't exist now, due to destruction of habitat) (Williams 1975).
Range—in Oregon: five sites in Coos Bay: South Slough, near downtown Coos Bay, mouth of Coos River.
Habitat—soft muds of *Salicornia* marshes; pondweed masses (New England: *Ruppia, Cladophora, Chaetomorpha*, Coos Bay: in *Enteromorpha, Vaucheria*. Sensitive to pollution) (Williams 1976).
Salinity—can tolerate a wide range: from less than 50% seawater to over 100% in Coos Bay (Hand 1957). It has been found from 8 ‰ to 38 ‰: an osmoconformer, it is very adaptable to salinity changes (Inouye 1976).
Temperature—lives in a wide range (northern California): 0-30°C (Hand 1957). Has been

kept for long periods in the lab at 21-22 ° C (Inouye 1976). Coos Bay (South Slough) range 6-18°C (ibid).
Tidal Level—*Nematostella* is generally found in salt marsh tide pools above + 3 ft.
Associates—plants: *Distichlis, Salicornia, Enteromorpha. Vaucheria*, diatoms; invertebrates: nemerteans, polychaete larvae, harpacticoid copepods, ciliates, sphaeromid isopods, gammarid amphipods.

Life History Information

Reproduction—probably has separate sexes; gonads on mesenteries produce gametes; planula larvae settle as new polyps; no medusoid stage. Asexual reproduction also possible (by elongation of column, constriction, and breaking off of a transverse section) (Lindsay 1975). Animals found with developed gonads summer and fall (Williams 1976). Egg production can be induced in lab by lowering salinity (Lindsay 1975). Egg to planula: 3 days: to four knobbed juvenile, 5 days.
Growth rate—
Longevity—kept in lab for up to five years.
Food—like other anemones, it is an active predator, using tentacles with stinging nematocysts to capture prey. Diet largely snail *Hydrobia* (New England. Nova Scotia) (Frank 1978); harpacticoid copepods; only anemone known to eat insect larvae (*ibid*).
Predators—
Behavior—usually buried to tentacles, but also found extended over the mud. Can move by short. peristaltic-like movements, or by throwing itself (Lindsay 1975). Secretes mucus "tube" to protect its epidermis (Crowell 1946).

Quantitative Information

Weight—
Abundance—a rarely occurring animal, it can be very abundant over a small area where it does occur.

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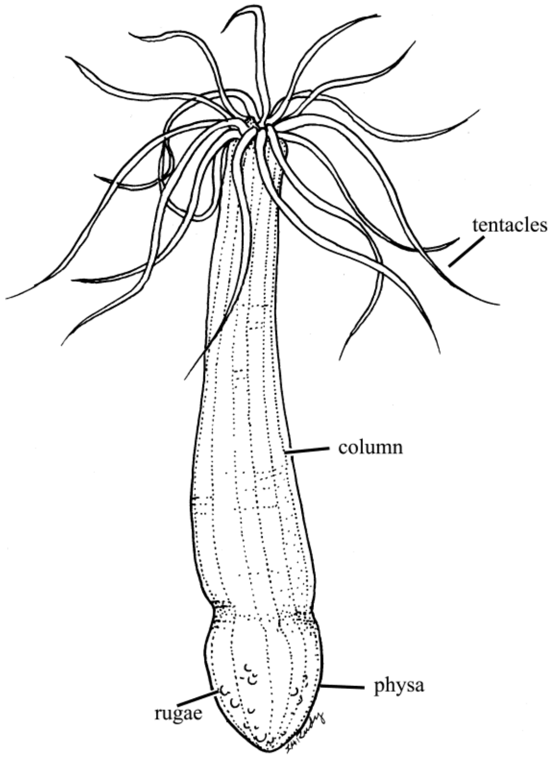
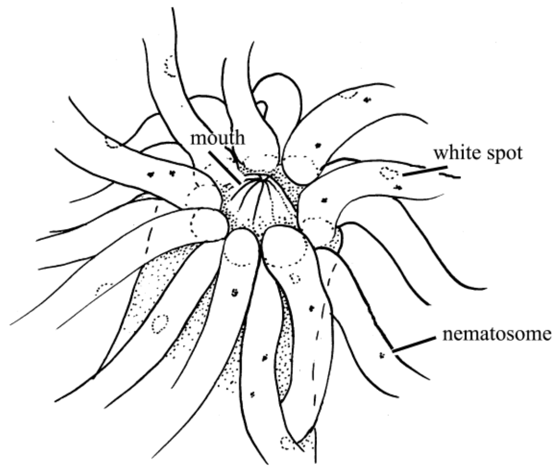
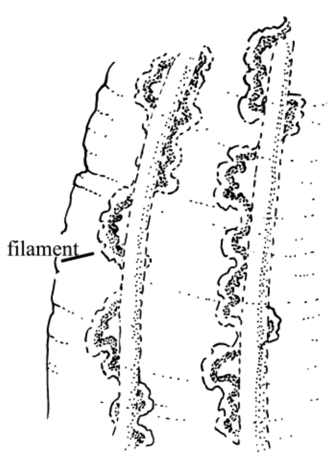
Nematostella vectensis



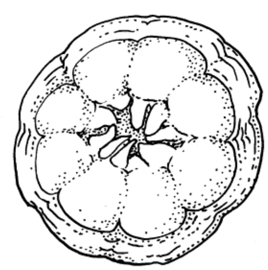
1. *Nematostella vectensis* x10:
cylindrical column; physa with rugae;12-18 transparent tentacles, white spotted; actual size 11 mm.



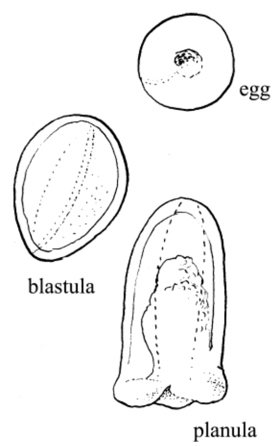
2. Crown of tentacles x30:
usually 16 white-spotted tentacles; nematosomes visible; mouth cone-shaped.



3. Menenteries (seen through column wall) x30: 8 vertical partitions; filaments contain eggs.

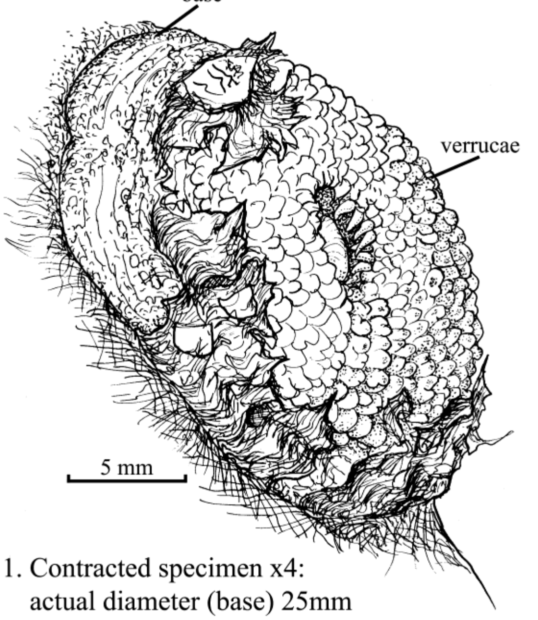


4. Dorsal view,
tentacles retracted x40.

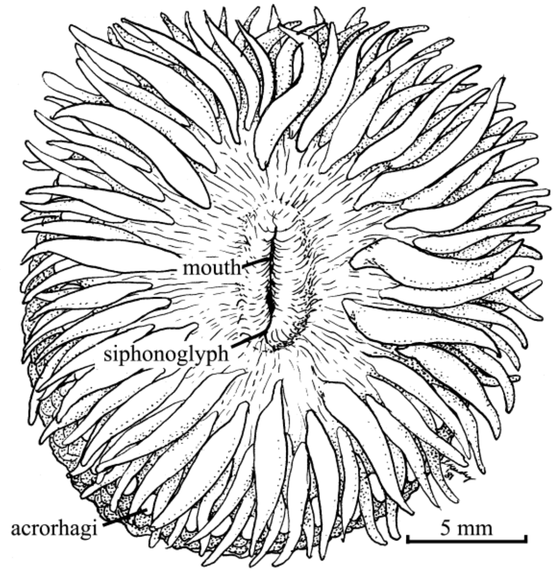


5. Development

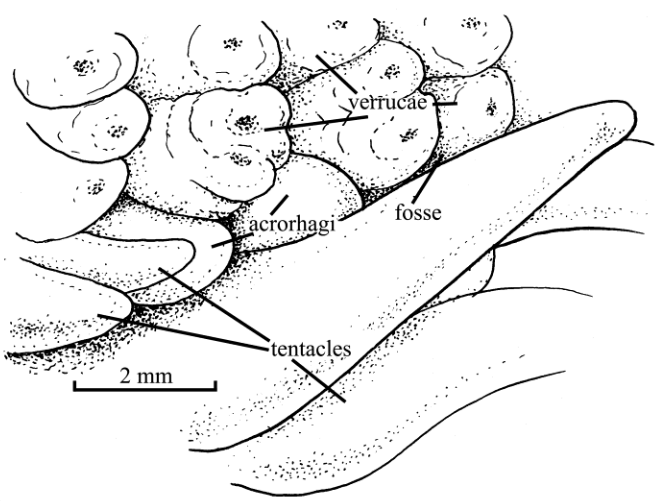
Anthopleura artemisia



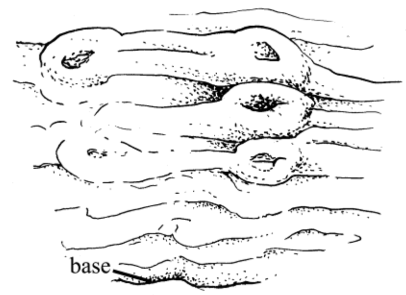
1. Contracted specimen x4:
   actual diameter (base) 25mm
   algae, shell adhere to verrucae on upper third, sand particles near base; column gray; many verrucae on upper third, sparse on middle third, none near base.



2. *Anthopleura artemisia* crown x4:
   width 25 mm; brightly colored tentacles, slender, tapering, about 5 rows; broad oral disc; lips not grooved, mouth a long slit; 1-3 siphonoglyphs. acrorhagi: round, white, under tentacles.



3. Verrucae, acrorhagi (collar) x12:
   verrucae compound; acrorhagi round, white, in single row in fosse under tentacles.



4. Verrucae, mid-column x12:
   simple, sparsely spaced; none near base.

Obelia longissima

A floating dock hydroid   Pallas, 1766

Phylum: Cnidaria
Class: Hydrozoa
Order: Hydroida, Leptomedusae
Family: Campanularidae

Description

Hydroid (polypoid form)

Color—transparent white when young, main stems "horn" colored; old, mature colonies look dirty.

Size—colony can be up to 60 cm (Rees and Hand 1975) (fig. 1).

Gonotheca—medusae-producing buds (fig. 2c) also called "gonangia" (Ricketts and Calvin 1971); axillary, ie. grow out of the angle between the stem and the hydrotheca; "ovate, smooth, with raised central aperture" (Parker et al. 1951).

Hydrothecae—bell-like, large, and deep; margin toothed; borne on long, ringed "pedicels" (fig. 2d, f).

Stems—thread-like, many-branched, ringed at joints, branches alternate, stalks short, (fig. 2).

Medusa (sometimes called *O. lucifera*)

Color—clear; some color at tentacle bases, on mouth, gonads.

Size—when "new", .5 mm; grows to 5 mm (Cornelius 1975); full size. 2.5-6 mm.

Bell—very thin, flat; small stomach, no peduncle, rudimentary velum (fig. 3); mouth with four lips.

Radial Canals—four; straight; each containing globular gonads (fig. 3).

Ring Canal—narrow; with eight statocysts (balance structures); no ocelli (fig. 3).

Tentacles—numerous, solid, short; 20-24 in newly hatched medusae; 46-90 in "*O. Lucifera*" (Russell 1953).

Possible Misidentifications

There are two very closely related species of *Obelia*: (fig. 4)

O. geniculata has a central zig zag stem, thickened at the joints; its hydrothecae are rather conical, slightly longer than wide, with plain margins and borne on short stalks with 4-6 rings; its gonothecae are axillary (in the joint), urn-shaped, with a raised center, and attached by a short stalk with 3-4 rings (fig. 4a).

O. dichotoma has slender, nearly straight, and irregularly branched, annulated stems; its branches are often long, giving a "whitish, fuzzy appearance" (Kozloff 1974a); the colony can be up to 2 cm (Cornelius 1975). Its hydrothecae are alternate, broad, bell-shaped, the tops are many sided, with slightly sinuated margins; its gonothecae are axillar, slender, smooth, widening from the base, and ending in a "raised, somewhat conical aperture" (Russell 1953) (fig. 4b).

Other hydroids which have stalks, and thecae within which their hydranths can be retracted (fig. 2b) include those of the famrues Campanulinidae and Phialellidae (Rees and Hand 1975), which are very small and have tubular thecae with a pointed operculum. Other Campanularidae (bell-shaped hydrothecae) include *Phialidium sp.* and *Campanularia sp*. both of which have colonies of less than 2 cm in height, and are rarely branched.

The genus most closely related to *Obelia* is *Gonothyraea*, which does not release free medusae, but retains them within the gonotheca.

Cornelius has preferred *O. longissima* to *Obelia bidentata* Clark, the Atlantic species (Cornelius 1975).

Ecological Information

Distribution—worldwide (*Obelia* sp.); *O. longissima*: Alaska to San Pedro, California.

Range—all three closely related species (*O. geniculata*, *O. dictotoma*) are found in northern California and Puget Sound; other species may be present as well, some of them introduced (Rees and Hand 1975).

Habitat—hydroids like docks, kelp, and floats in bays; healthy colonies are found on exposed pilings, particularly where water is clean and fast-moving. Medusae are found floating, probably not far from their hydroid parents. They probably are not light

dependent for vertical distribution (Parker and Haswell 1951).
Salinity—collected at 30 ‰; an Atlantic species, *O. bidentata* was found to have a wide distribution across the estuarine gradient, down to 0.5 ‰; *O. dichotoma* was found down to 12 ‰ (Cornelius 1975).
Temperature—found in cold temperate waters; settling may occur in cooler temperatures during the year (Standing 1976).
Tidal Level—most abundant in middle intertidal and just below.
Associates—caprellid amphipods, garnmarid amphipods, asellote isopods, copepods, diatoms, sea slug *Eubranchus*, nudibranchs *Dendronotus frondosus*, *Phidiana crassicornis* (Bodega Bay), pycnogonid *Halosoma veridintestinale*; with medusa: pycnogonid larvae of *Anaphia* (England). Barnacle larvae cannot settle where *Obelia* growth is heavy (Standing 1976).

Quantitative Information
Weight—
Abundance—particularly common in harbors in northern California (Rees and Hand 1975), and in British Columbia (Ricketts and Calvin 1971).

Life History Information
Reproduction—like other Hydroida, *Obelia* has both a sexual reproduction and an asexual one. The medusae are producers of eggs and sperm the larvae of which settle and become hydroids. The production of medusae by the hydroid is apparently tied to lunar periodicity: to the third week of the moon (Elmhirst, 1925, in Russell) (Russell 1953). The complete life cycle (swimming larvae to hydroid colony discharging medusae): takes one month (MacGinitie and MacGinitie 1949). Lab reared medusae are sexually mature six days after emergence (Russell 1953). *Obelia* are present all year, but are most numerous in spring to late summer. Settling of *O. dichotoma* (northern California) found in May, June, not in July (ibid). Another worker (Boyd in Standing) (Standing 1976) found settling in winter, spring and early summer, corresponding to low water temperatures. Budding, release of medusae only below 12 ° C (lab) (Morris et al. 1980).Asexual reproduction, budding by the hydroid to form medusae, is the other stage of duplication.
Growth Rate—several generations possible in a year; *O. dichotoma* grow to 2.5 mm in 19 days (from 1 mm): Browne in Russell (Russell 1953). Growth: direct correlation with temperatures of 8-20° C (Morris et al. 1980).
Longevity—about one month (complete life cycle).
Food— crustaceans and their larvae, arrowworm *Sagitta* (England), young fish.
Predators—Opisthobranch *Eubranchus* eats hydroid buds (Kozloff 1974a)
Behavior—medusa noted for quick movements; often found inverted (fig. 3).

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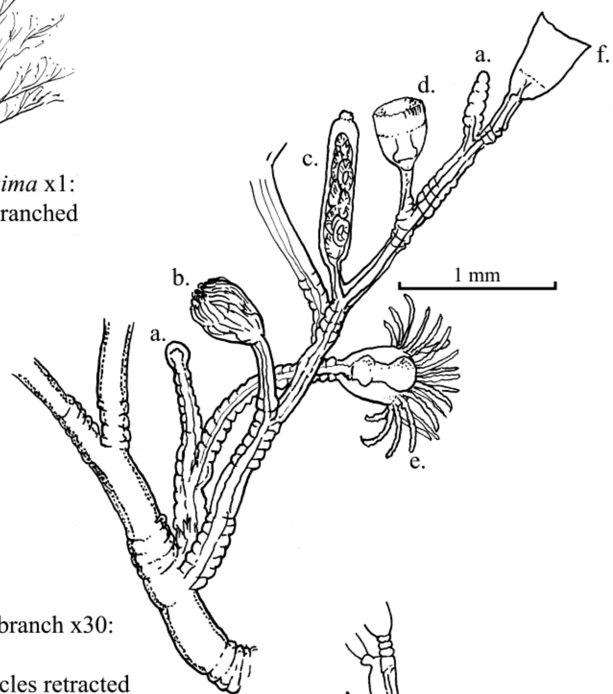
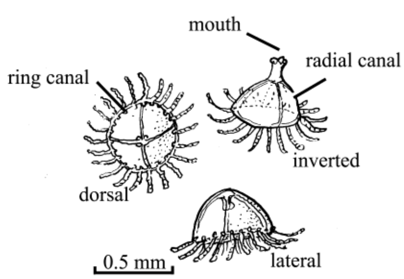
Obelia longissima

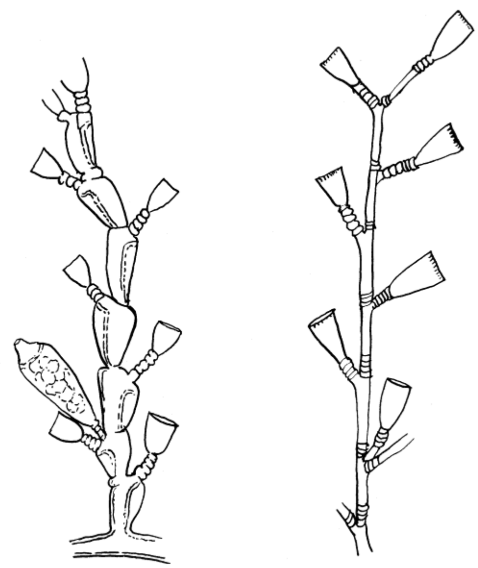
1. *Obelia longissima* x1: white, many-branched colonies.



2. Closeup, single branch x30:
   a. buds
   b. hydranth, tentacles retracted
   c. gonotheca, showing medusae buds
   d. hydrotheca (covering young polyp)
   e. hydranth, tentacles extended
   f. empty hydrotheca



3. Medusae x30: actual diameter 0.5 mm.



a. *O. geniculata* b. *O. dichotoma*

4. Other species (from Russell 1953, after Hincks 1868)

Pinauay crocea (*Tubularia crocea*)

A floating dock hydroid (Agassiz, 1862)

Phylum: Cnidaria
Class: Hydrozoa
Order: Hydroida, Anthomedusa
Family: Tubularidae

Description

Color—stem (hydrocaulus) white to light tan: feeding tentacles (proximal and distal) transparent white; gonophores light pink and dark coral: manubrium pale yellow-orange.
Size—colony in large bushy clusters to 15 cm; stems to 2 cm long; "flowers" (hydranth) up to 1 cm when extended. "largest athecate hydroid" (genus), Puget Sound (Kozloff 1974a).
Stem—(hydrocaulus) unbranched, crooked, covered with fine "hairs" (diatoms).
Hydranth—without theca: suborder Anthomedusa (fig. 2). (Theca is present in Leptomedusan hydroids).
Tentacles—filiform (thread-like), simple, in two whorls: proximal-long, extended feeding tentacles at the base of the hydranth, and distal-short, tentacles usually contracted around mouth (figs. 2, 3). Usually close to the same number of distal and proximal tentacles: species *crocea*. Older specimens have more tentacles than do young ones, which will have only 10 proximal tentacles when "new".
Mouth—(manubrium); simple, circular; on a cone (fig. 3).
Gonophores—"abortive medusae", or gonomedusae: in clusters on stalks (racemes) between the two whorls of tentacles. Within the gonophores develop the planulae which become tentaculate, crawling larvae, the actinulae (fig. 5) (Kozloff 1974a).
Actinula—larval stage which attaches to substrate and be-comes new polyp. Up to 10 capitate (knobbed) tentacles containing nematocysts; visible inside are manubrium, distal tentacle buds (fig. 5). In *T. larnyx,* tentacles can vary from 6 to 13. Most have 10 (Pyefinch and Downing 1949).

Possible Misidentifications

The other common local species, *Pinauay marina*, is a small, solitary athecate hydroid of the outer coast. Its stalk is usually about 2.5 cm. long, it has fewer distal tentacles than proximal ones, and it is less showy than *T. crocea*, as it does not occur in clumps as the latter does. It does live in estuarine habitats in Puget Sound (Kozloff 1974a).

Other athecate (without a cup-like theca) hydroids often have some capitate (knobbed) tentacles as adults, ie. Cladonema, *Hydrocoryne.* Of those with only threadlike tentacles, some like *Hydractinia* and *Eudendrium* have only a single whorl of tentacles, not two whorls as in Pinauay. Others, such as *Turritopsis* and *Clava* have tentacles in scattered patterns rather than in whorls (Rees and Hand 1975).

Other Pacific species of *Pinauay* in the literature, but about which there is little information, are *T. prolifer* and *T larynx* (England) (Pyefinch and Downing 1949).

Ecological Information

Range—north temperate seas, Atlantic and Pacific (introduced to the Pacific from the Atlantic) (Rees and Hand 1975).
Local Distribution—Oregon and California estuaries. Coos Bay: South Slough, Charleston, Fossil Point. *T. marina* seems to be a more northern species.
Habitat—likes cold water with good movement; often found on undersides of floating docks. Not bothered by strong light (Mackie 1966). One of the invertebrate organisms most resistant to such poisons as copper (Barnes in Pyefinch and Downing 1949).
Salinity—collected at 30 ‰.
Temperature—responds badly to warm water in lab: loses hydranths. Regression occurs with summer temperatures (Mackie 1966).
Tidal Level—low intertidal; subtidal to 40m (Morris et al. 1980).
Associates—suctorian protozoans, diatoms (especially in fall, darkening stems) (Pyefinch and Downing 1949); caprellid and tube-building amphipods, isopods, copepods, mussels. A pycnogonid, *Anoplodactylus*

erectus, is parasitic in the digestive tract of *Pinauay* in southern California, distending the polyps abnormally (Rees and Russell 1937). Some amphipods (Stenothoe) are immune to *Pinauay's* nematocysts (Mackie 1966). The colonial *Pinauay* and its substrate constitute a rich microecosystem on the floating docks.

Quantitative Information

Weight—

Abundance—colonies can be quite dense under the right conditions of water and movement.

Life History Information

Reproduction— sexual colonies dioecious. Asexual: new hydranths can grow from stolons (subsurface runners); sexual: actinulae, formed in gonophores, correspond to the medusae stage in other hydroids; these produce eggs and sperm while still attached to hydranth, then crawl away and attach to substrate and form new polyps. There is no swimming stage. One polyp can produce over 100 gonomedusae (not simultaneously) (Miller 1976). The gonomedusae most distal on the racemes (stalks) mature soonest (Mackie 1966). Mature male gonomedusae are white. The immature have a red stripes. Each polyp is sexually separate: clusters of polyps will be grouped in the colony by sex because of asexual reproduction from stolons. Release mechanisms for spawning and larvae release are not known (Miller 1976), but possibly could be due to a change in light intensity and in water speed (Pyefinch and Downing 1949). In one area, only one species of *Pinauay* will be sexually active at a time (Miller 1976).

Growth rate—two weeks to maturity; 6-8 days from ripe female gonads to liberation of viable actinulae (Mackie 1966). Settlement of actinulae to first generation of new larvae takes 24 days (Pyefinch and Downing 1949). Stolon growth rate: a steady 1 mm/day (Mackie 1966). Settlement of actinulae begins after about 24 hours (Pyefinch and Downing 1949). Easily grown in the lab.

Longevity—

Food—copepods, chaetognaths, portunid zooae, small mysids. siphonophores, eudoxids, salps; rejects pteropods, pycnogonids.

Predators— pycnogonids; nudibranchs Cratena and Dendronotus feed on polyps (England) (Pyefinch and Downing 1949).

Behavior—most unusual is the actinula stage. "The colony is the unit, not the polyp" (Pyefinch and Downing 1949).

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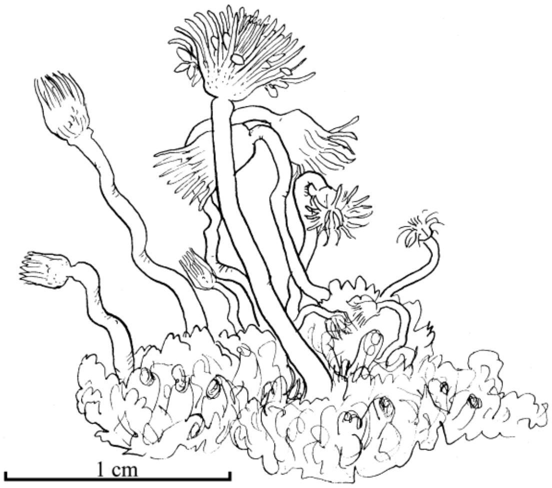
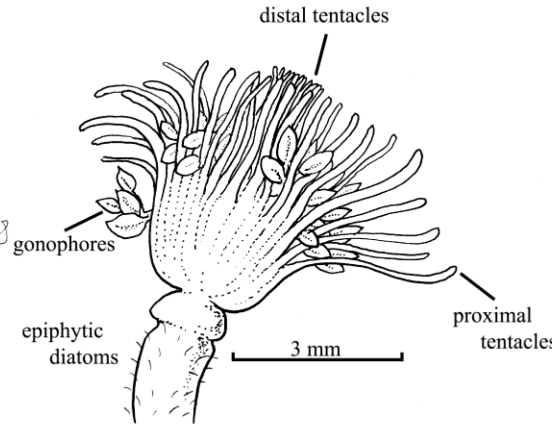
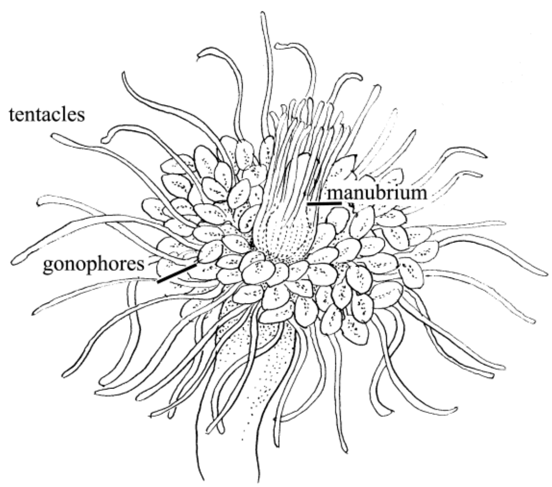
Pinauay crocea



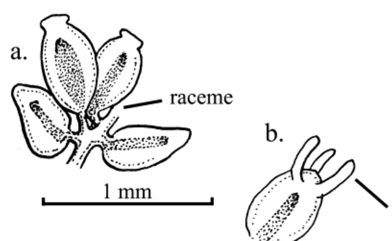
1. *Pinauay crocea* colony x4:
actual polyp height c. 2 cm.



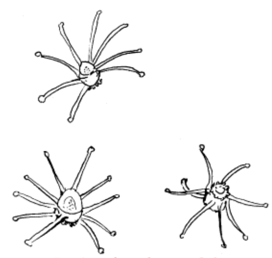
2. Hydranth x10:
actual diameter 3mm
two whorls of tentacles, distal and
proximal; gonophores between whorls.



3. Hydranth, extended x10



4. Gonophores x30:
a. showing racemes (stems)
b. with developing marginal lappets.



5. Actinulae x30

Polyorchis penicillatus

A bell-shaped hydromedusa (Eschscholtz, 1829)

Phylum: Cnidaria
Class: Hydrozoa
Order: Hydroida,Anthomedusae
Family: Polyorchidae

Description –Medusa

Color—transparent white with purple eyespots; gonads and other organs variable (yellow brown to purple) (Ricketts and Calvin 1971).
Size—taller than wide: to 60 mm high, 40 mm wide (Kozloff 1974a); averages over 25 mm wide (Ricketts and Calvin 1971).
Bell—higher than wide; thin, delicate, not gelatinous.
Manubrium—extends from short, pronounced gelatinous gastric peduncle (fig. 1); as long as bell cavity; with four oral lips densely set with nematocysts which form a distinct marginal band (fig. 1).
Radial Canals—four, each with 15-25 pairs of short diverticula (blind side branches), (fig. 1) (Kramp 1961).
Gonads—four to eleven (average: eight); sausage shaped, hanging from each radial canal as it joins manubrium (fig. 1). They produce either eggs or sperm.
Tentacles—up to 160, in a single whorl along bell margin on ring canal; not in clusters. Number of tentacles increases rapidly with age (Skogsberg 1948).
Ring Canal—simple, contains tentacles; ocelli on extensions at bases of tentacles (fig. 2).
Ocelli—pigmented eyespots suspended from ring canal; "abaxial": not on canal (fig. 2).
Nematocysts—stinging organelles (fig. 4) found on manubrium, each containing a poison sac and a stinging thread. Produced by cnidoblast, specialized cells (fig. 3).
Hydroid—unknown.

Possible Misidentifications

Several other Polyorchidae occur in our area: *P. montereyensis*, a small (to 40 mm high) species with up to 45 gonads on each canal, has 25-30 pairs of lateral diverticula and up to about 80 tentacles (Skogsberg 1948). *P. haplus* is very small (15-20 mm high), has 20-25 gonads on each canal, and only knob-like diverticula on its radial canals.

It has up to 24 tentacles (*ibid.*). *Scrippsia pacifica*, the largest of the family, is 75 mm high, with a long peduncle reaching halfway down the bell, numerous gonads, and about 256 tentacles in 7 'cycles', some attached on the bell above the radial canal.

Other tall, bell-shaped medusae are either very small (like new *Aequorea*), or have greatly different tentacles or manubrium*: ie. Coryne, "Sarsia"*, etc.

Ecological Information

Distribution—California to Hawaii (Mayer 1910); northwest waters (Kramp 1961): type locality probably San Francisco Bay.
Range—in plankton in bays, seasonally, in Oregon.
Habitat—medusae: floating in plankton near the surface: often found in bays, around docks, in summer and into fall. San Francisco Bay: December-April. Polypoid stage: a single hydroid colony was growing on a sponge on the upper surface of the rock scallop *Hinnites giganteus*, in 15 m. of water off Vancouver Island. (Brinkmann-Voss 1977).
Salinity—collected in full seawater: 30 ‰ (medusa).
Temperature—found from cold waters (Vancouver) and temperate waters (San Francisco). A specimen from the Gulf of California is considered doubtful (Skogsberg 1948).
Tidal Level—Throughout water column.
Associates—

Quantitative Information

Weight—
Abundance—the most common large Anthomedusa in our area.

Life History Information

Reproduction—like other Hydrozoans, *Polyorchis* has a two-layered reproductive cycle, involving both asexual and sexual processes. Efforts to raise *Polyorchis* in the lab have produced planula larvae; these would not settle, however (authors). A single colony *of P. penicillatus* has been described (Brinkmann-Voss 1977).
Growth rate—
Longevity—
Food—
Predators— Aequorea.

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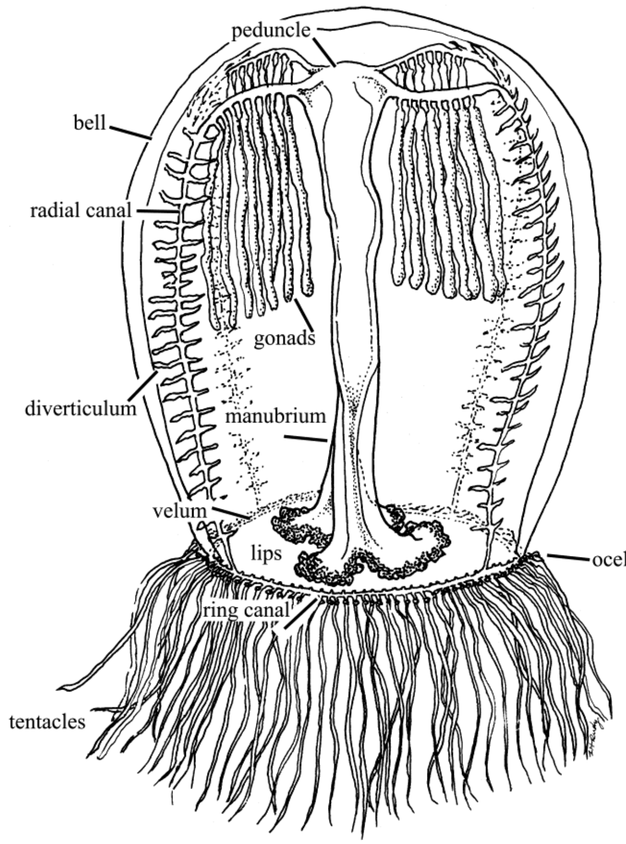
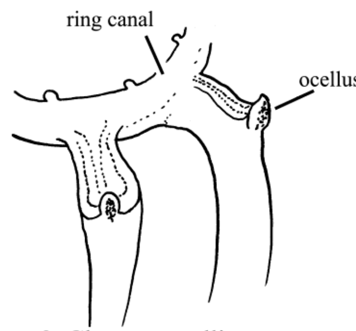
Polyorchis penicillatus



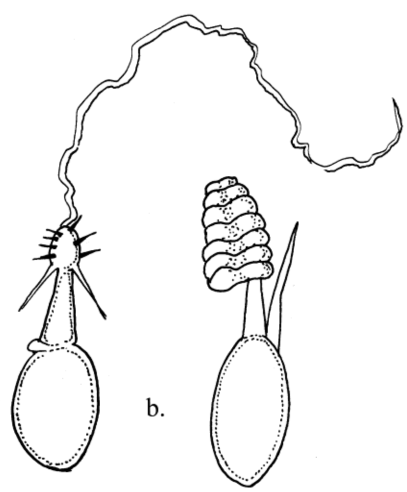


2. Closeup, ocelli

1. *Polyorchis penicillatus* x2:
actual size of bell 5 cm high four radial canals, each with 15-25 pairs diverticula; long manubrium; nematocyst-banded lips; 4-11 sausage-shaped gonads; up to 160 tentacles on ring canal.

3. Cnidoblast

a.



b.

4. Generalized nematocysts:
a. undischarged
b. exploded

Amphiporus imparispinosus

Griffin, 1898

Phylum: Nemertea (Rhynchocoela)
Class: Enopla
Order: Hoplonemertea, Monostylitera
Family: Amphiporidae

Description

Color—solid. opaque white; sometimes pale reddish or yellowish tinge, or pale yellow, flesh-colored; brain area pinkish, intestinal canal brownish tinge (Coe 1905).
Size—mature at about 25 mm; usually 25-50 mm; very slender (Coe 1905).
Head—not strongly differentiated from rest of body.
Ocelli—many, small; in 2 groups on each side of the head anterior to brain: also an elongated anterior group of 6-15 ocelli along the margin, and a posterior, internal group of about the same number, (but it can be up to 30); fewer in younger animals (fig. 2).
Mouth—anterior to brain: class Enopla; opens into proboscis pore (not figured) (Correa 1964).
Proboscis—very long: contained within sheath (rhynchocoel) almost as long as body: genus *Amphiporus*; armed with one stylet: suborder: Monostylifera, in which the proximal end of the basal segment is rounded and wide (fig. 3); with 3 pouches of accessory stylets (Correa 1964). (The proboscis must be everted or the worm dissected to see the stylet and pouches.)
Body—soft, elongate, non-segmented: Nemertea; long and slender, especially for the family Amphiporidae; slightly flattened posteriorly (fig. 1); no caudal cirrus (tail).

Possible Misidentifications

Other Hoplonemerteans (free-living Enoplans without a sucker disc at the posterior), with a central proboscis stylet (suborder *Monostylifera)*, can be divided into five families (Coe 1940). The Ototyphlonemertidae have no ocelli; the Emplectonometatidae have a short proboscis, usually numerous ocelli, and the mouth and proboscis pore usually united; the Prosorhochmidae have a very long, slender proboscis and usually 2 pairs of large ocelli. The Tetrastemmatidae usually have 4 ocelli. Most Amphiporidae are relatively short and broad; *A. imparispinosus* is unusual in this respect (Coe 1940).

There are as many as 17 species of *Amphiporus* in the Pacific Northwest; (5 are included in the Puget Sound keys). *A. formidabilis* is the only other slender species, and it has 6-12 pouches of accessory stylets, not 2-3. It is also much larger than *A. imparispinosus*: 10-30 cm (Haderlie 1975). The other 3 species are rather stout and more strongly colored: *A. rubellus* is a uniform red or orange with no pattern and 10-20 ocelli on each side of its heads.

A. punctulatus is a dark brown, irregularly blotched on its dorsal surface, and with a lighter head marked with 2 dark spots.

A. bimaculatus gets its name from the same sort of strong spots (which are not ocelli) on its light-colored head. Its general coloration is homogenous, not blotchy as in *A. punctulatus. A.bimaculatus* secretes great quantities of mucus when disturbed (Morris et al 1980).

A variety of *A. imparispinosus* (A. i. similis, Coe, 1905) varies only by having 2 pouches of accessory stylets not 3 (Coe 1940). It is often found with the typical form.

Because of the many identifying characteristics which are internal and not visible, it is sometimes very difficult to distinguish among Nemerteans without dissecting them. Ways in which the worms flatten, contract, and coil are useful as aids to identification of live specimens.

Ecological Information

Range—northeastern Pacific from Siberia, Bering Sea, south to Ensenada, Mexico; found at very many collection sites: genus rare in the tropics (Coe 1940).

Local Distribution— Coos Bay: several stations in South Slough;
Habitat—"among algae. mussels, and other growths on rocks and piles": can be on very exposed surfswept shores also under stones, among shells in red alga *Corallina vancouveriensis*" (Coe 1940).
Salinity—
Temperature—latitudinal range would indicate a wide temperature toleration; ie. 50-70°F (San Pedro, Calif.) to just above freezing (Bering Strait).
Tidal Level—intertidal and below: down to 50 m (Correa 1964).
Associates—

Quantitative Information
Weight—
Abundance—one of the most common *Amphiporus* species (Morris et al 1980).

Life History Information
Reproduction—dioecious (separate sexes) (Coe 1905). Some Hoplonemertes are hermaphroditic: eggs and sperm released at same time.
Growth Rate—
Longevity—
Food—predatory, killing prey with armed proboscis; secretes a toxic slime (Bacq 1937) which kills prey before ingestion (Jennings and Gibson 1969).
Predators—
Behavior—can't swim or roll up spirally: genus *Amphiporus* (Coe 1905).

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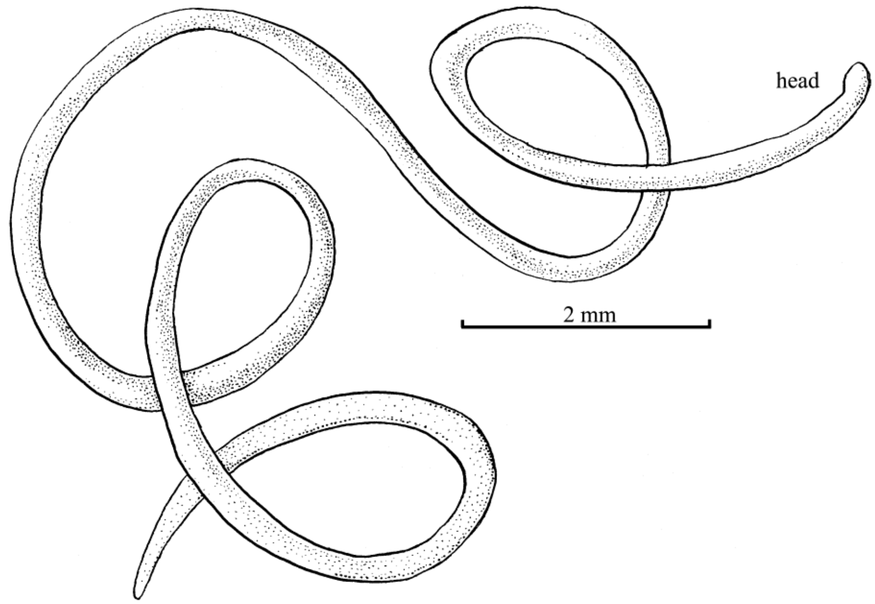
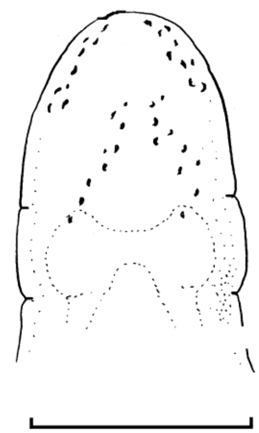
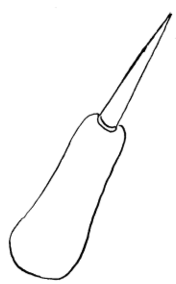
Amphiporus imparispinosus



1. *Amphiporus imparispinosus* (L:30 mm) x20:
body long and slender, head not set off from body; solid color, whitish; dark intestinal area; no caudal cirrus.



2. Head x35:
ocelli grouped along anterior margin, interior (Coe, 1905).



3. Stylet and base (proboscis) x200:
basal segment rounded (Coe, 1905).

Carinoma mutabilis

A ribbon worm (Griffin, 1898)

Phylum: Nemertea (Rhynchocoela)
Class: Anopla
Order: Paleonemertea
Family: Carinomidae

Description

Color—homogeneous (dorsal and ventral the same); anterior a solid white mottled with brown pigment (Kozloff 1974a): head milk white, not translucent: intestinal region cream or brownish; internal organs show as transverse dark lines: dark yellow or orange in the male, reddish in the female (fig. 1).
Size—great variation: from 2.5 cm to 50 cm; few over 20 cm on the California coast, and average size much less; largest diameter: 3-5 mm (Coe 1905).
Head—shape changes constantly; can be rounded or emarginate: is wider than neck, and not distinctly marked off from the body. No ocelli, no cephalic grooves: order Paleonemertes.
Mouth—just behind brain: class Anopla.
Proboscis—no stylets (can be seen only when proboscis is everted): pore (opening to rhynchocoel) almost terminal.
Body—soft, elongate, nonsegmented: phylum Nemertea. Thickened, rounded anteriorly; very flattened posteriorly (fig. 1) and slightly from behind head; tends to coil posteriorly: no caudal cirrus (tail) (Coe 1905).

Possible Misidentifications

C. mutabilis is the only species of its family on the Pacific coast. The Tubulanidae, another primitive nemertean family. are similar in having no ocelli or cephalic grooves: they however, do not flatten posteriorly as does *Tubulanus polymorphus*.

There are no other free-living, solidly colored nemerteans lacking caudal cirrus, ocelli and cephalic grooves in the northwest. One Heteronemertean which might cause confusion is *Baseodiscus punnetti*, which has many very minute eyespots, and slight, oblique cephalic grooves; it can retract its head, however, which *Carinoma* cannot, and it doesn't flatten posteriorly.

One of the difficulties of identifying nemerteans is that they are differentiated partly by interior muscle layer arrangements which are not visible superficially.

Ecological Information

Range—worldwide (Europe, New England, Magellan Straits): genus *Carinoma*, but only 3 species. This species: from British Columbia to Gulf of California.
Local Distribution—in Coos Bay, several stations: South Slough, Pony Slough, North Spit.
Habitat—sand, sandy mud, clay (Haderlie 1975), wharf pilings (Griffin 1898).
Salinity—
Temperature—latitudinal range would indicate a wide temperature toleration.
Tidal Level—intertidal and below (to 40 m) (Correa 1964).
Associates-

Quantitative Information

Weight—
Abundance—

Life History Information

Reproduction— sexually mature in August, California and Puget Sound (Coe 1905). Dioecious (separate sexes); many eggs released at once, fertilized by male sperm.
Growth Rate—
Longevity—
Food— a predator, capturing prey with eversible proboscis.
Predators—
Behavior—

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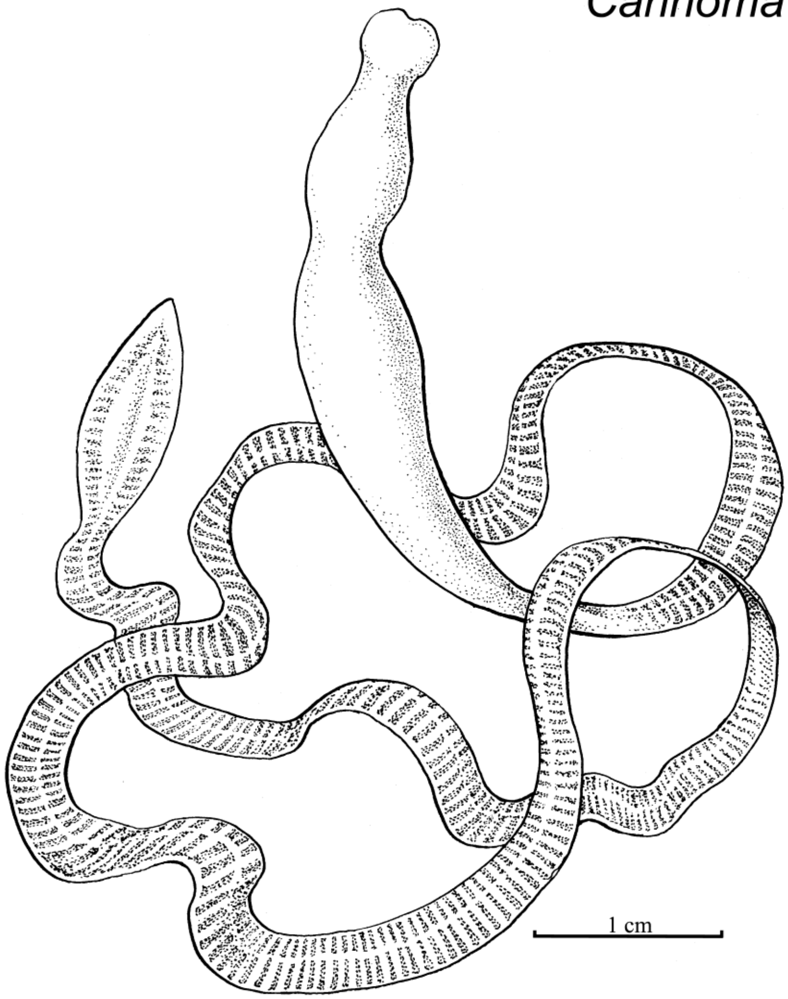
Carinoma mutabilis



1. *Carinoma mutabilis* (L:27cm) x3:
head changes shape constantly; no ocelli or cephalic grooves; internal organs show as transverse lines; body thickened anteriorly, flattened posteriorl, coiled (Coe, 1940).

Cerebratulus californiensis

A ribbon worm (Coe, 1905)

Phylum: Nemertea (Rhynchocoela)
Class: Anopla
Order: Heteronemertea
Family: Lineidae

Description

Color—pale orange, posterior with transverse white stripes, white head and tail areas. Can vary to yellow or brown.
Size—to 1 m or more, this specimen 3.5 cm.
Head—with deep cephalic grooves (fig. 1), no eyes; medium sized proboscis with sticky surface.
Body—anterior, firm, rounded; posterior with transverse stripes. flat, ribbon-like, sharp edged for swimming.
Caudal Cirrus—thin, tail-like appendage (fig. 1). Easily lost in collecting.

Possible Misidentifications

Among Nemerteans which are slender, free-living and without strong pigment patterns or contrasting dorsal and ventral surfaces, only *Micrura alaskensis* has cephalic grooves and a caudal cirrus. But it lacks the flattened posterior section for swimming, and its cephalic grooves are shallow, its head pointed, and it has no transverse bands. Several other species of *Cerebratulus* exist, especially farther north (Kozloff 1974b), but they are all large, dark in color, and only one, *C. montgomeryi* has the white tipped head of *C. californiensis*.

Ecological Information

Range—Gulf of California to Puget Sound.
Distribution—several stations South Slough of Coos Bay.
Habitat: Substrate—“sand and mudflats of bays and harbors” (Haderlies 1975). “sand of exposed beach” mud or sand (Kozloff 1974a); South Slough of Coos Bay: mud, chips.
Salinity—
Tidal Level—mid-tide or lower.
Associates— polychaetes, tanaidaceans (*Leptochelia*), amphipods.

Quantitative Information

Weight—
Abundance—

Life History Information

Reproduction—mature sexually July, Monterey (Coe 1940): some nemerteans are noted for regeneration from one small piece into a new, small worm (MacGinitie and MacGinitie 1949). Development includes a larval stage.
Longevity—
Growth rate—
Predators—
Food—preys on polychaetes

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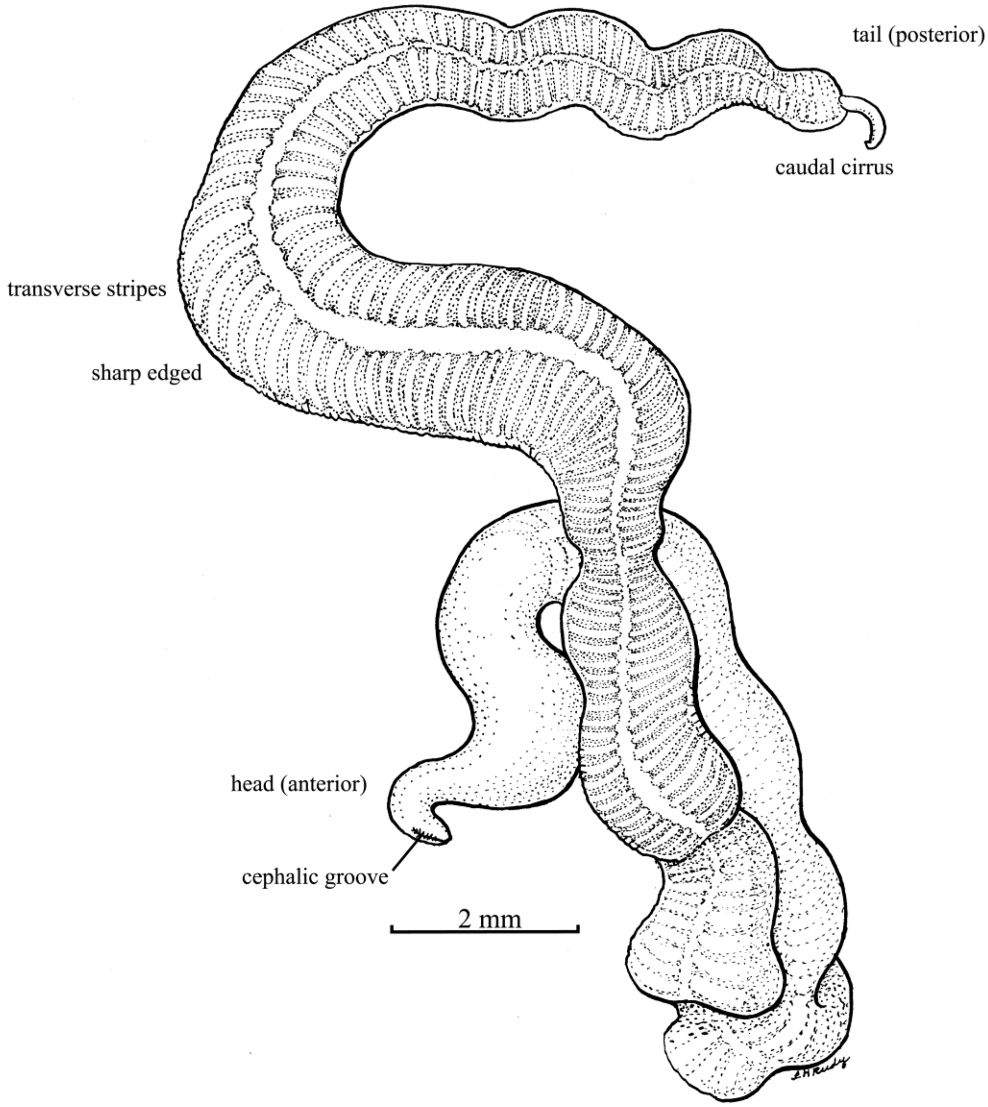
Cerebratulus californiensis



1. *Cerebratulus californiensis* x15:
pale orange with white stripes, head and tail.

Lineus sp. (=*Lineus ruber*)

(O.F. Muller, 1771)

Phylum: Nemertea (Rhynchocoela)
Class: Anopla
Order: Heteronemertea
Family: Lineidae

Description

Color—solid, no pattern; reddish brown, dark brown, or greenish brown, commonly paler ventrally.
Size—large for a nemertean: to 20 cm; "about 8 cm" long, 1 mm wide (Correa 1964). Mature at 10 cm (Green 1968).
Head—deep cephalic grooves: order Heteronemertea; head slightly wider than body, oval, snake-like (Haderlie 1975).
Ocelli—rows of 4-8 small ocelli (eyespots) on each side of the head; (4-5) (Correa 1964).
Proboscis—very long, unarmed (with stylets): class Anopla: not visible coiled inside cavity (rhynchocoel), and everted to catch prey.
Body—soft, contractile, non-segmented: phylum Nemertea; elongate, without a posterior sucker or a caudal cirrus (tail); contracts by thickening and shortening, doesn't coil: *Lineus* sp..

Possible Misidentifications

Lineus sp. is the only member of its genus known from Coos Bay. Several other species do occur in the northwest:

L. rubescens, a small (10-15 mm) species from Puget Sound, usually has only 2-4 eyespots on each side of its head, and white spots at the tip of the head above and below (Kozloff 1974a): it is pinkish, some-times with a blue tinge: it is not included in the primary California key (Haderlie 1975).

L. vegetus, known to have extraordinary regenerative abilities; can be red like *Lineus* sp. (or green, or brown) (Kozloff 1974a); can have faint light lateral longitudinal lines, and faint rings around the body (*ibid*). It has the same number of eyespots as *Lineus* sp., and is chiefly distinguished from it by its regenerative powers and its ability to coil in a spiral, which *Lineus* sp. do not do. It is included in the Puget Sound key, while *L. ruber* is not (*ibid*), it extends south to Mexico (Correa 1964).

L. pictifrons, about 12 cm long, and 3 mm wide, is soft and flattened with a head, which is narrower than its body. It is deep brown or reddish all over, with a paler posterior end: it has numerous yellow rings and longitudinal yellow lines, as well as 2 orange spots on the snout (Correa 1964). Its range is from Puget Sound to Mexico (*ibid*).

L. bilineatus is dark brown or olive with a yellow or white stripe and no transverse markings: low-water mark and below, range: Europe. Africa: local distribution-Alaska to San Diego (*ibid*).

L. torquatus is dark reddish brown or purple with a single narrow whitish band connecting the posterior ends of its cephalic furrows: it is intertidal and occurs from Alaska to San Francisco, California (*ibid*).

L. flavescens is small (8-120 mm), yellowish, pale yellow and orange, or ochre with pale head margins and 3-7 irregular red, purple or black ocelli, the largest being most anterior: it is more southern and in deeper water.

Systematically, the *Lineus* group of *viridis, sanguineus. pseudo-lacteus*, and *Lineus* sp. are considered as a "complex" (Gontcharoff 1951).

As with other nemerteans, many of the identifying characteristics are internal, rather than external and visible.

Ecological Information

Range— circumpolar. also South Africa: Pacific coast: Alaska to Monterey Bay. California (Correa 1964).
Local Distribution—in Coos Bay: several stations in South Slough, Airport Island.
Habitat—a wide range of habitats in bays as well as on the open coasts: beneath stones, among algae, in sand and mud (Haderlie 1975) habitat determined by substrate, predator density, angle of slope (Eason)

(Gibson 1972); salt marsh poois: bay muds (Green 1968).
Salinity—can tolerate great changes (Coe 1943): down to 8 ‰ (Gibson 1972); typically found in brackish water (Haderlie 1975). Very sensitive to toxic substances, strong chemical changes (Gibson 1972).
Temperature—a wide range of toleration possible: can survive seven days at variations from 0-30°C (*ibid*).
Tidal Level—intertidal, but also found down to 10 meters (Coe 1943).
Associates—

Quantitative Information
Weight—
Abundance—"uncommon" (northern California) (Correa 1964), but best known and most widespread nemertean on the Atlantic coast (Coe 1943) also common in Britain (Green 1968).

Life History Information
Reproduction—sexes separate: worms come together in pairs during season, secrete a mucus layer into which female deposits her eggs (fig. 4); male fertilizes them as they are laid. Embryos have a larval stage within this gelatinous mass, and so avoid the usual planktonic larval stage of most marine nemerteans, emerging as a crawling stage (Green 1968). *Lineus* sp. is not adept at the asexual fission managed by some other of the genus, particularly *L. vegetus*.
Growth Rate—
Longevity—
Food—living or dead oligochaetes, polychaetes. small crustaceans: detects prey chemotactically up to 8 cm away (*ibid*). Feeds mostly at night (Hyman 1940b): can withstand long periods of starvation (Hyman 1940b).
Predators—
Behavior—movement sluggish; creeps over substrate, can move on water's surface, but can't swim. Doesn't have superior regenerative properties of *L. vegetus*.

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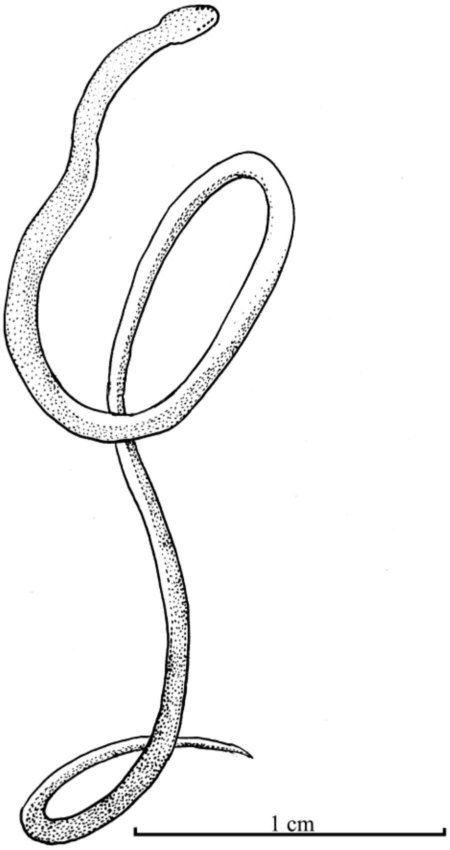
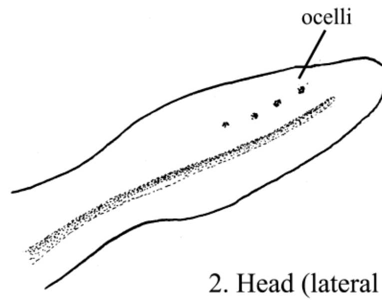
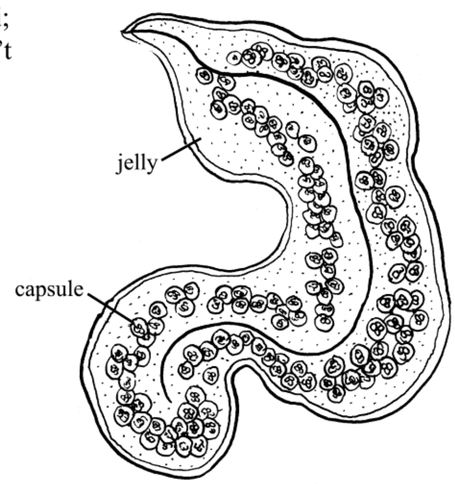
Lineus sp.



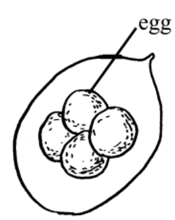


2. Head (lateral view) x20:
deep cephalic grooves.

1. *Lineus sp.* x5:
solid,brownish, lighter ventrally;
head snake-like; 4-8 pairs ocelli;
body contracts, thickens, doesn't
coil; no caudal cirrus.



3a. Egg string
(Hyman 1951)



3b. Egg capsule

Paranemertes peregrina

"The wanderer" Coe, 1901

Phylum: Nemertea (Rhynchocoela)
Class: Enopla
Order: Hoplonemertea, Monostylifera
Family: Emplectomenatidae

Description

Color-dark dorsally, including head brown, purple or olive green: lighter ventrally: white or pale yellow: midventral section sometimes lighter than the rest; no lines or other patterns, except V-shape behind head.
Size—more northern specimens (var. ataskensis) larger than southern ones (var. californiensis): 40 cm vs. 10 cm: long and slender (Coe 1905).
Head— usually truncate, a little larger than body: no cephalic grooves; striking markings: a narrow V-shaped marking just back of the head (sometimes quite faint), a pair of white transverse lines on the lateral margins (fig. 2) (Kozloff 1974A).
Proboscis—eversible. usually enclosed in sheath (rhynchocoel) half to three quarters body length: genus *Paranemertes*. whitish; one short, straight stylet (order Monostylifera), with spiral grooves (southern variety): fig. 4. Stylet can be .09 mm long in large specimen (Coe 1905). Two (*californiensis*) to four (*ataskensis*) pouches of accessory stylets, each pouch with 6-10 stylets (fig. 3). Proboscis can be everted with fresh water or dilute acetic acid (Morris et al. 1980).
Mouth— in front of brain; united with proboscis pore: suborder Monostylifera, (not figured).
Ocelli—two groups on each side of head, of 5-12 large ocelli in an irregular row: the same number of small ocelli is found in an irregular group near the brain (fig. 2).
Body— elongate, contractile, non-segmented; Nemertea; soft but muscular: can lengthen and shorten easily (Kozloff 1974a): no caudal cirrus (tail).

Possible Misidentifications

There are five genera of the family: *Emplectonematidae* on the Pacific coast, all of which have a short proboscis, numerous ocelli, and a long, slender body: *Carcinonemertes* is parasitic on crabs; *Emplectonema* is very slender with 12-14 eyes in each of two rows; *Nemertopsis* and *Dichonemertes* have only four ocelli (Coe 1940).

Of the four known Pacific species of *Paranemertes*, none is as common as *P. peregrina*: *P. pallida* has been found only in Alaska.

P. carnea. with six accessory stylet pouches, is whitish, pink, or flesh-colored, and is reported only from Alaska to Puget Sound.

P. californica, pale gray or orange anteriorly and gray or salmon posteriorly, which exterior pigmentation is often obscured by its green digestive tract, has not been found north of Monterey Bay.

Ecological Information

Range—4000 miles: Bering Sea to southern California: widely distributed in many habitats.
Local Distribution—in Coos Bay, several stations: Barview, North Slough, Haynes Inlet, Kentuck Inlet, South Slough, Charleston (OIMB 1970).
Habitat—found under a great variety of conditions: rocky shores, mussel beds, seaweeds, coralline algaes, mudflats. Avoids bright light.
Salinity—collected at 30 ‰.
Tidal Level—intertidal and below.
Temperature—the wide distribution range would indicate a tolerance of very cold to temperate conditions.
Associates—

Quantitative Information

Weight—
Abundance—common in many habitats: a maximum average density of 14 worms/m (Coe 1905), usually less (Haderlie 1975). Easily the most common mudflat nemertean at Charleston.

Life History Information

Reproduction—deposits of single or gelatinous clusters of many eggs can be found in the warmer months (Coe 1940). Spawning in spring and summer; eggs take up to 6 months to mature. Eggs hatch third day. Females may outnumber males in some populations (Washington) (Morris et al. 1980).
Growth rate—
Longevity—to 1 3/4 years; may spawn 3 times (Morris et al. 1980)
Food—diet consists almost entirely of nereid worms. although it occasionally will take the polychaete *Polydora,* prefers the small, timid *Platynereis bicanaliculata* which lives in tubes in *Ulva* (Puget Sound); also eats *Nereis vexillosa.* Some Syllid polychaetes are partly immune to *Paranemertes*' venom (Roe 1971).
Predators—crabs will eat nemerteans only if very hungry and after first cleaning off the mucus with their claws (Eason) (Gibson 1972).
Behavior—a diurnal feeder. *P. peregrina* is well known as a voracious, aggressive hunter. It conducts its haphazard searches when the tide is out and nereids are unable to escape. On cloudy days (it stays in on rainy days!) It has a temporary burrow to which it retreats on its slime track (Kozloff 1974a). Its predatory attacks involve little chemoreception: its proboscis wraps around the nereid, emits a venomous mucus (the toxin anabaseine) (Gibson 1970 and Roe 1970), which stuns the prey for just 20 minutes (Roe 1971), withdraws and draws the prey into its mouth. Worms of a great length can be eaten by *P. peregrina*, but not those of a large diameter.

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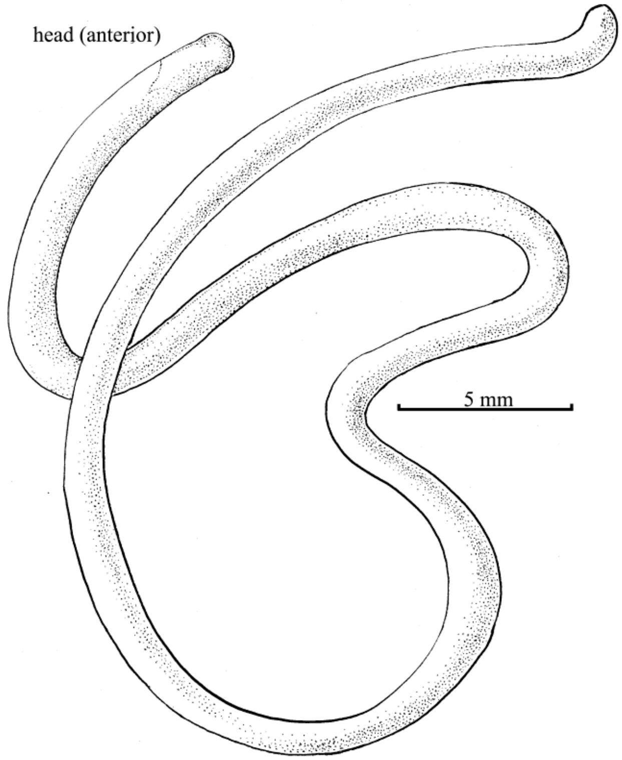
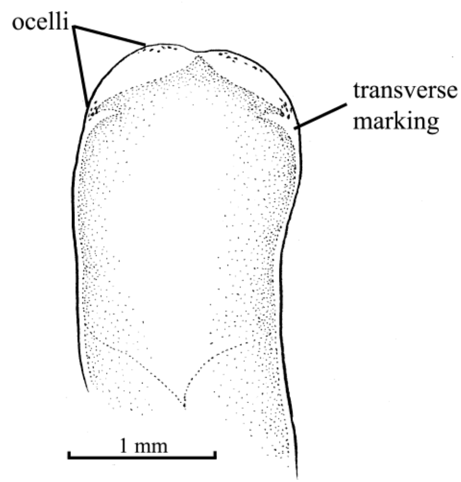
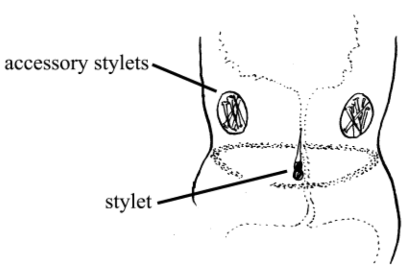
Paranemertes peregrina



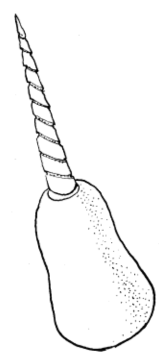
1. *Paranemertes peregrina* x6:
long, slender; dark dorsally; no cephalic grooves or caudal cirrus; solid color, no patterns; narrow, v-shaped marking behind head.



2. Head (dorsal view) x25:
a pair of transverse lateral white markings; two groups of 5-12 ocelli near anterior edge, two groups farther back; light ventral color shows at edges



3. Stylet area, proboscis:
everted; central stylet and two pouches of accessory stylets (Coe, 1905).



4. Central stylet and base showing spiral grooves (Coe 1905, Gibson 1973).

Tubulanus polymorphus

An orange ribbon worm Renier, 1804

Phylum: Nemertea (Rhychocoela)
Class: Anopla
Order: Paleonemertea
Family: Tubulanidae

Description

Color—usually boldly colored: red. brown, or orange: solid, no patterns, no dorsal or ventral color differences
Size—large, up to three meters when extended: long and thin: very soft (Coe 1905).
Head— rather broad. Set off from body, flattened, no ocelli, no cephalic grooves: order Paleonemertea but with lateral transverse grooves (fig- 2a); not capable of being completely withdrawn into body (Kozloff 1974a).
Mouth—a long slit-like opening (fig. 2c); behind brain, separate from proboscis pores (fig. 2c); just behind transverse furrows (Coe 1905).
Proboscis—eversible (usually coiled inside rhynchocoel (cavity): short: sheath usually one third body length; without stylets. pore almost terminal (fig- 2c).
Body—soft, elongate, non-segmented: phylum Nemertea. Cylindrical. Can be flattened posteriorly (fig- 1).

Possible Misidentifications

The genus *Tubulanus* is slender, soft, extensible without ocelli or cephalic grooves (Correa 1964), and with flattened head with transverse lateral grooves. Seven other species of *Tubulanus* are found on the Pacific Northwest beaches. *T. polymorphus* can be distinguished from the others by its large size and strong color, lack of pattern and free-living habit.

Some of the other species are:

T. pellucidus. a small (to 2.5 cm), white translucent tube-dweller in estuaries;

T. cingulatus. deep brown with white rings and four long stripes: to 15 cm: subtidal and lower;

T. sexilineatus. to 50 cm, chocolate brown with white rings and 5-6 long lines: a tube dweller;

T. capistratus, slender and brown, up to one meter, with many narrow white rings and three long lines: a tube dweller. Two other species are subtidal, or southern.

Ecological Information

Range—Aleutian Islands south to Monterey, California: Europe and Mediterranean coasts.
Local Distribution—more exposed parts of Oregon estuaries, as well as rocky outer shores, where it is very obvious. Coos Bay: Charleston, Barview, Pony Slough.
Habitat— under heavy boulders, among mussels, in mud, on both open coast and in bays (Haderlie 1975). It is the common large red nemertean of the outer coastal rocky intertidal.
Salinity—
Temperature—found in cold and temperate waters.
Tidal Level—intertidal (Correa 1964); low intertidal and subtidal zones (Morris et al. 1980).
Associates—

Quantitative Information

Weight—
Abundance—"rather common" (Correa 1964): quite common on the outer coast, Oregon.

Life History Information

Reproduction—sexually mature in July, August (Coe 1905); can produce great numbers of eggs which are often used for experimental studies (Coe 1940).
Growth Rate—
Longevity—
Food—a predator.
Predators—
Behavior—can be found at low tide searching for food.

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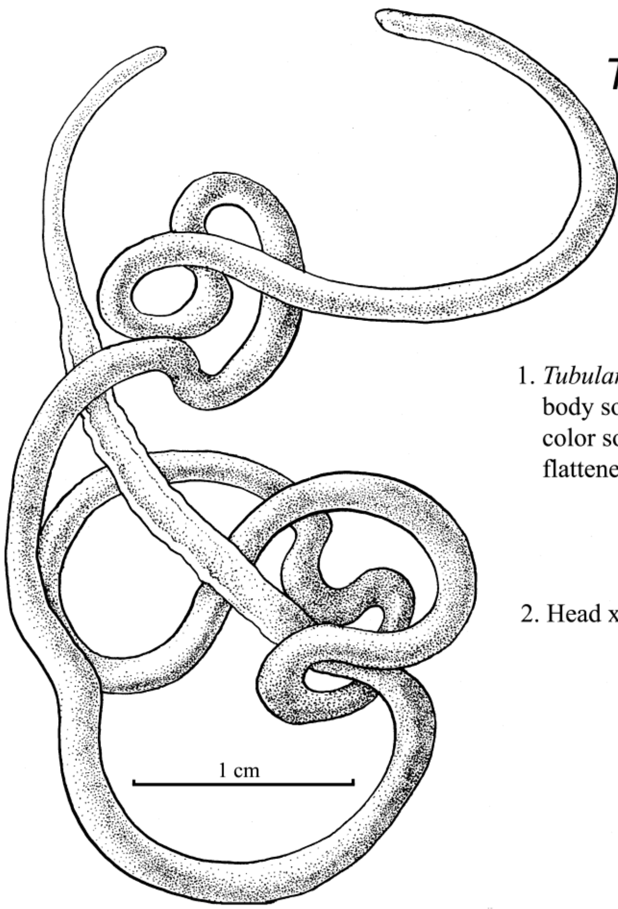
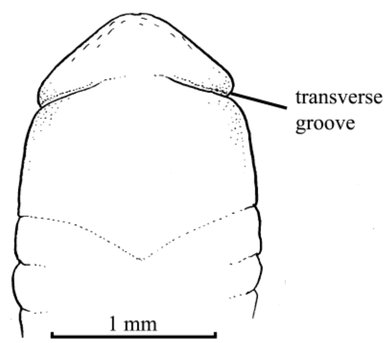
Tubulanus polymorphus

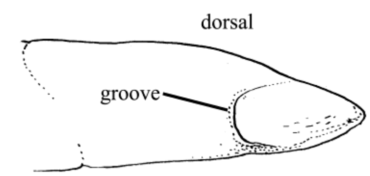


1. *Tubulanus polymorphus* (L:25 cm) x4:
   body soft, cylindrical; can be flattened posteriorly; color solid orange, red or brown; no pattern; head flattened, without ocelli or cephalic grooves.

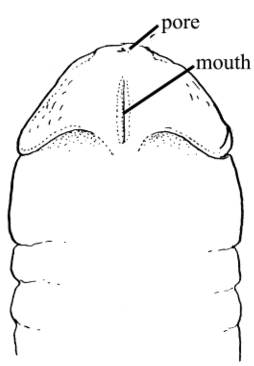
2. Head x30



2a. (dorsal view) showing transverse grooves; no ocelli or lateral cephalic grooves.



2b. (lateral view) showing flattening, transverse grooves.



2c. (ventral view) showing proboscis pore, long, slit-like mouth, grooves.

Tubulanus sexlineatus

The six-lined ribbon worm (Griffin, 1898)

Phylum: Nemertea
Class: Anopla
Order: Paleonemertea
Family: Tubulanidae

Description

Size—average length 20 cm; can extend to 1 meter; (this specimen 25 cm long, 1.5-2 cm wide) (Haderlie 1975).
Color—orange to dark brown ground with many regular horizontal bands and 5-6 longitudinal lines. One of these is mid-dorsal, two dorso-lateral. Two are ventral, dividing ventrum into 3 parts (fig. 2b). (If six lines are present, the sixth will be a faint mid-ventral line.) Horizontal bands begin at the tip of the head; only about half of them continue down through the lateral edge to the ventrum (fig. 3). Bands sometimes very wide in midsection (Morris et al. 1975).
Body—soft, elongate, non-segmented: Phylum Nemertea. Cylindrical, can be slightly flattened posteriorly: Order Paleonemertea (Heteronemertea are often flat, ribbonlike; see *Cerebratulus*).
Head—blunt, not snake-like: Paleonemertea. Often flattened dorsoventrally; disc-like, wider than trunk, from which it is separated by a constriction (fig. 2b). Distinct dark cephalic fur-rows extend from sub-terminal proboscis pore (figs. 2b, 2c), but no lateral cephalic grooves are present: Order Paleonemertea. (For lateral grooves, see *Lineus ruber*, fig. 2). No ocelli: Order Paleonemertea. Head not completely retractible into body.
Mouth—directly behind brain: Class Anopla; not connected to proboscis pore; situated ventrally just behind transverse grooves (fig. 2b) (Haderlie 1975).
Lateral Transverse Grooves—just above constriction which separates head from trunk (fig. 2b).
Proboscis—short, without stylets: class Anopla (not figured); proboscis sheath less than 1/2 body length (not figured). Proboscis pore sub-terminal (fig. 2b).
Lateral Sense Organ (Nephridiopore)—a flat, shallow, orange-colored pit in lateral area just next to fifth horizontal ring: family Tubulanidae (Coe 1940); (fifth ring is wider than any more posterior ring (figs. 1, 3).
Posterior End—flattened, light-colored around anal pore; no caudal cirrus (fig. 1).
Tube—long, white, rather transparent, papery; open at both ends (fig. 4); secreted by worm's epidermis (Coe 1905).

Possible Misidentifications

The brown color of *T. sexlineatus*, with both vertical and horizontal markings, is quite distinctive, especially in nemerteans without ocelli or lateral cephalic grooves. There are several other species of *Tubulanus* in our area. Those with possible confusing surface patterns include:

Tubulanus cingulatus, which is deep brown with white rings, but has only four longitudinal lines, not 5-6; it is subtidal;

Tubulanus capistratus, is slender and brown with many narrow white rings but only three longitudinal lines; it is up to 1 meter long;

Tubulanus albocinctus is deep red with many narrow white rings, but without any longitudinal lines.

Ecological Information

Range—Alaska to southern California (Coe 1905).
Local Distribution—Coos Bay: spoil islands of lower bay.
Habitat—in tubes among algae, mussels; under rocks and on pilings.
Salinity—collected at 30 ‰ salt water.
Temperature—
Tidal Level—intertidal (Coe 1905); collected at about + 1.0 ft.
Associates—found with terebellids, polynoid polychaete *Halosydna brevisetosa*.

Quantitative Information

Abundance—" rather common" (Coe 1905).

Life History Information

Reproduction—
Growth Rate—
Longevity—
Food—predatory on polychaetes.
Predators—

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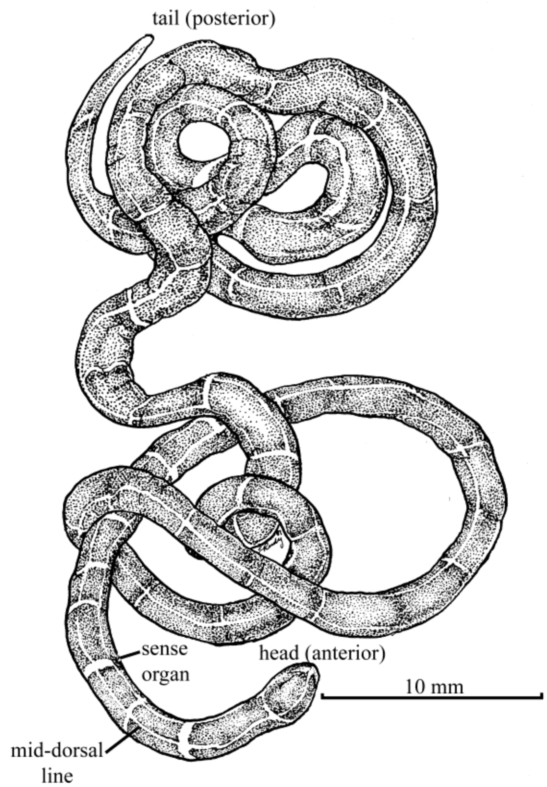
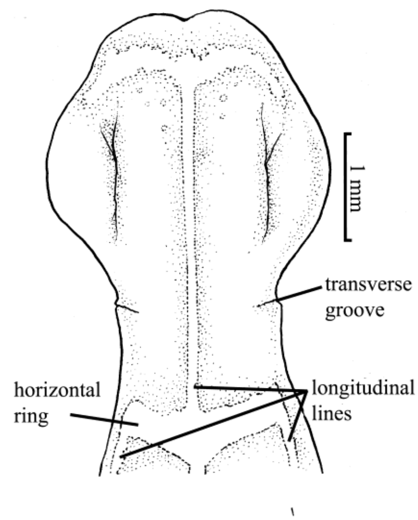
Tubulanus sexlineatus

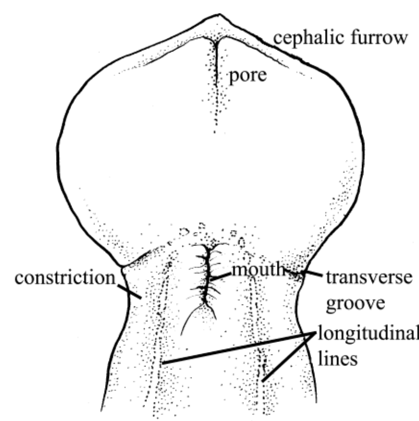


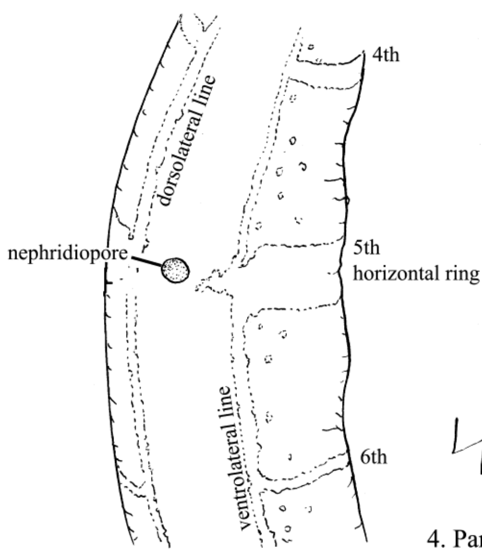
1. *Tubulanus sexlineatus* (L:25cm) x4:
delicate, extensible; posterior flattened; 5-6 thin white longitudinal lines, many regular horizontal rings on brown ground.

2a. Head (dorsal view) x20:
flattened, eyeless; constriction between head and trunk; three longitudinal lines; lateral transverse grooves just anterior to constriction.

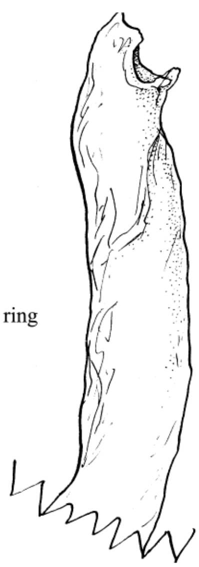


2b. Head (ventral view):
proboscis pore subterminal, mouth posterior to transverse grooves.

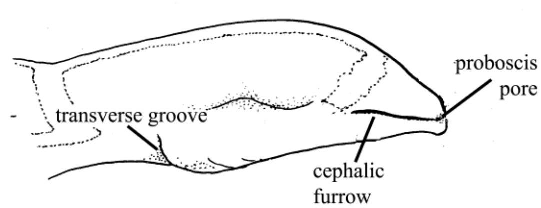




3. Lateral sensory organ



4. Part of tube x4:
whitish, clear and papery.



2c. (Lateral view):
cephalic furrow; no ocelli.

Phascolosoma agassizi

Common peanut worm (Keferstein, 1866)

Phylum: Sipuncula
Class: Phascolosomatida
Order: Phascolosomaformes
Family: Phasoclosomatidae

Description

Size—up to 14 cm (extended); commonly 5-7 cm (Rice 1975b). This specimen (Coos Bay) 13 cm. Young 10-13 mm (extended) (Fisher 1950). (Juveniles could be up to ca 30 mm (Gibbs 1985).

Color—trunk brown (this specimen) with darker pigment blotches, dark conical papillae, particularly at posterior end. Skin thick, rough. Introvert pale, shiny, smooth, with dark bands and splotches. Tentacles light tan. (figs. 1, 1a). Color variable- gray, pink, ochre, brown (Fisher 1950).

Body—trunk bulbous, with pointed posterior. Introvert slender, can be extended to be longer than trunk (Stephen 1964) (fig. 1). Trunk when contracted is peanut-shaped (fig. 3). Body wall divided into longitudinal bands; can be noticeable on outside. No true segmentation (contrast annelids).

Anterior End—oral disc bordered by ridge (cephalic collar) with tentacles enclosing dorsal nuchal gland, mouth: Also has a thin flange (cervical collar) posterior to oral disc (fig. 2).

Mouth—inconspicuous, just ventral to and outside of arc of tentacles (fig. 2).

Tentacles—inconspicuous, finger-like, not branched (Rice 1975b), 18-24, in crescent shaped arc, enclosing a heart-shaped nuchal gland (fig. 2).

Eyes—internal: a pair of ocelli at anterior end, in ocular tube (fig. 4) (Hermans and Eakin 1969).

Papillae—conical glandular structures, each with hard round center and on a platelet (fig. 1a). Thickest around posterior end and middorsally, near anus.

Hooks—tiny chitinous spines on anterior of introvert; arranged in a variable number of dark, colored rings (usually 15-24 in this species) (fig. 2). First three rows can be small and colorless; last two can be incomplete (through wear) (Fisher 1950).

Anus—dorsal, at base of introvert, a light, raised area (fig. 1.).(Intestinal tract is U-shaped (fig.4).

Nephridiopore—lateral, just posterior to anus (fig. 1). Nephridia are two long structures lying freely in coelom (fig. 4).

Introvert—looks like "neck"; can be extended, or retracted into self and into trunk.

Trunk—bulbous, pointed posteriorly. Divided into longitudinal bands (not always obvious on exterior).

Gonads—at origin of ventral retractors (fig. 4). Sexual products extruded through nephridiopores (fig. 1).

Larva—two stages: trochophore and pelagosphera stage, the latter long lived, and with locomotory (metratrochial) cilia. Prototrochial cilia regress in pelagosphera, which has complete digestive tract and can feed. Its adhesive terminal organ is retractile (not figured).

Young—have enlarged papillae, especially in pre-anal area. Pigment includes transverse bands on introvert, but trunk pigment spots are rare. Introvert hooks: 12-25 rings- usually 15-16. Tentacles 11-12; nuchal organ present (Fisher 1950) (not figured).

Possible Misidentifications

The Sipunculans as a phylum are fairly easily distinguished from other worms by their lack of segments, and by their peanut like shape when contracted. There are other similar phyla:

The Echiurans, or spoon worms, are also unsegmented, of a similar size, shape and habitat. They have an extensible spoonshaped proboscis, however, and a posterior anus (not mid-body, as in *Sipuncula*).

Priapula is another small phylum of sausage shaped nonsegmented worms. *Priapulus* is a predatory worm with a bulbous spiny proboscis, quite unlike any in Sipuncula.

Other Sipunculan families include Golfingiidae, which have continuous long muscle tissue in the body wall (not bands). The tentacles always surround the mouth (contrast Phascolosomatidae}. Two genera could be found locally, *Golfingia* and *Themiste*:

Golfingia pugettensis (Fisher, 1952) is whitish to dark grey, smooth, with only inconspicuous papillae. Its introvert is about half the body length, and is without hooks (Hyman 1959). From Puget Sound.

G. *margaritacea californiesis* is small and threadlike and only 25 mm long. It is known (so far) only from Monterey, California (Rice 1975b).

G. hespera has an extremely long introvert, and is found in the burrows of other invertebrates. Its range is probably too southern for us (Rice 1975b).

Themiste (=Dendrostomum) has 4 possible local species. These have conspicuous branched tentacles, quite different from the filiform ones in *Phascolosoma. T. pyroides* has been reported from Coos Bay (Fisher 1950).

Worms of the family Sipunculidae have well defined muscle bands in the body wall; their oral tentacles always surround the mouth (Stephen and Edmonds 1972). Examples include:

Siphonosoma, with a short introvert and numerous tentacles *S. igens* and *S. nudus* are found in California (Rice 1975b).

P. agassizi and its family Phasocolosomatidae are characterized by a horseshoe shaped arc of tentacles lying dorsal to the mouth, by the four retractor muscles (fig.4) and by the longitudinal muscle bands in the body wall (except in the small genus *Apiosoma* Cutter, 1979 *(=Fisherana)* (Stephen and Edmonds 1972)). (Sipunculidae also have longitudinal muscle bands (Rice 1975a)). Like some other families, Phascolosomatidae have papilliform glands on the trunk. Other sipunculans of this family include:

Antillesoma antillarum (=Phascolosoma), found in California. It is stout, with a short introvert and a crown of 200 tentacles superficially resembling that of *Themiste,* above.

There are 60 species of *Phasocolosoma* sp., nearly all distinguished by rings of single hooks on the introvert (Stephen and Edmonds 1972). Most species are from warm water or from New Zealand or the Atlantic. *P. japonicum,* a Japanese species, has been reported from Vancouver Island. Its trunk papillae are much larger platelets than are those of *P. agassizi* (Fisher 1950) *P. perlucens, P. rickettsi* (*=pectinatum),* and *P. puntarenae* are eastern Pacific species found from California south. None of these is likely to be found in our area.

Phascolosoma agassizi is readily recognizable by its long, pale introvert with dark bands and rows of hooks, its single crescent of 15-24 finger-like tentacles with the mouth outside the arc, and by its conical papillae on a rough brown trunk.

Ecological Information

Range—Kodiak Island, Alaska, to Bay of San Quintin, Baja California.
Local Distribution—Coos Bay: Fossil Point, Clam Island; also on outer shore rock intertidal (Cape Arago).
Habitat—nestling in rock and gravelly mud (but without a tube). Also in shells, holdfasts, *Phyllospadix* roots, with hydrocoral *Allopora,* in *Mytilus* beds: protected situations. Not found in shifting sediments (Fisher 1950).
Salinity—collected at 30‰ (Coos Bay)
Temperature—temperate to warm waters
Tidal Level—from midtide down to 110 fathoms (59.5 m), but most common in lower half of intertidal zone and just below low tide (Fisher 1950).
Associates—polychaetes: terebellid *Thelepus, Glycera:* chitons, serpent stars, shore crabs, gastropod *Nucella*.

Quantitative Information

Weight—5.3g (wet) - Coos Bay specimen
Abundance—the most common sipunculan (California (Rice 1975b), Alaska to Pt. Concepcion (Rice 1974).

Life History Information

Reproduction—separate sexes. Found with eggs January (Humboldt Bay) (Fisher 1950), March - May (Monterey, Calif.), June - September (Puget Sound) (Rice 1975a). Mature gametes can compose 37% dry mass

of animal. Gametes extruded from nephridiopores into seawater, where fertilization takes place. (Of 200 specimens collected Humboldt Bay, January, all were female (Fisher 1950).
Growth Rate—Eggs spherical to elliptical, 0.1 - 0.14 mm diameter (Humboldt Bay), Eggs of species with small amount of yolk (i.e. *Phasocolosoma)* have 2 larval stages - trochophore (like polychaete's) and pelagosphera, with locomotory cilia, which lives for several months in plankton (Morris et al 1980). Eggs develop in lab at 12 °C. Some larvae kept up to 7 months, grew to 1mm, did not metamorphose into adults (Rice 1967).
Longevity—sipunculans are estimated to live for 25 years (Morris et al 1980).
Food—digest organic matter from large quantities of their substrate. Can also ingest small particles by the ciliary action and mucus secretion of their tentacles.
Predators—fish, gastropods. Man in tropical Indo-Pacific, for foods (Morris et al 1980).
Behavior— mostly sedentary, but more strictly a "nestler." Introvert searches actively for food.

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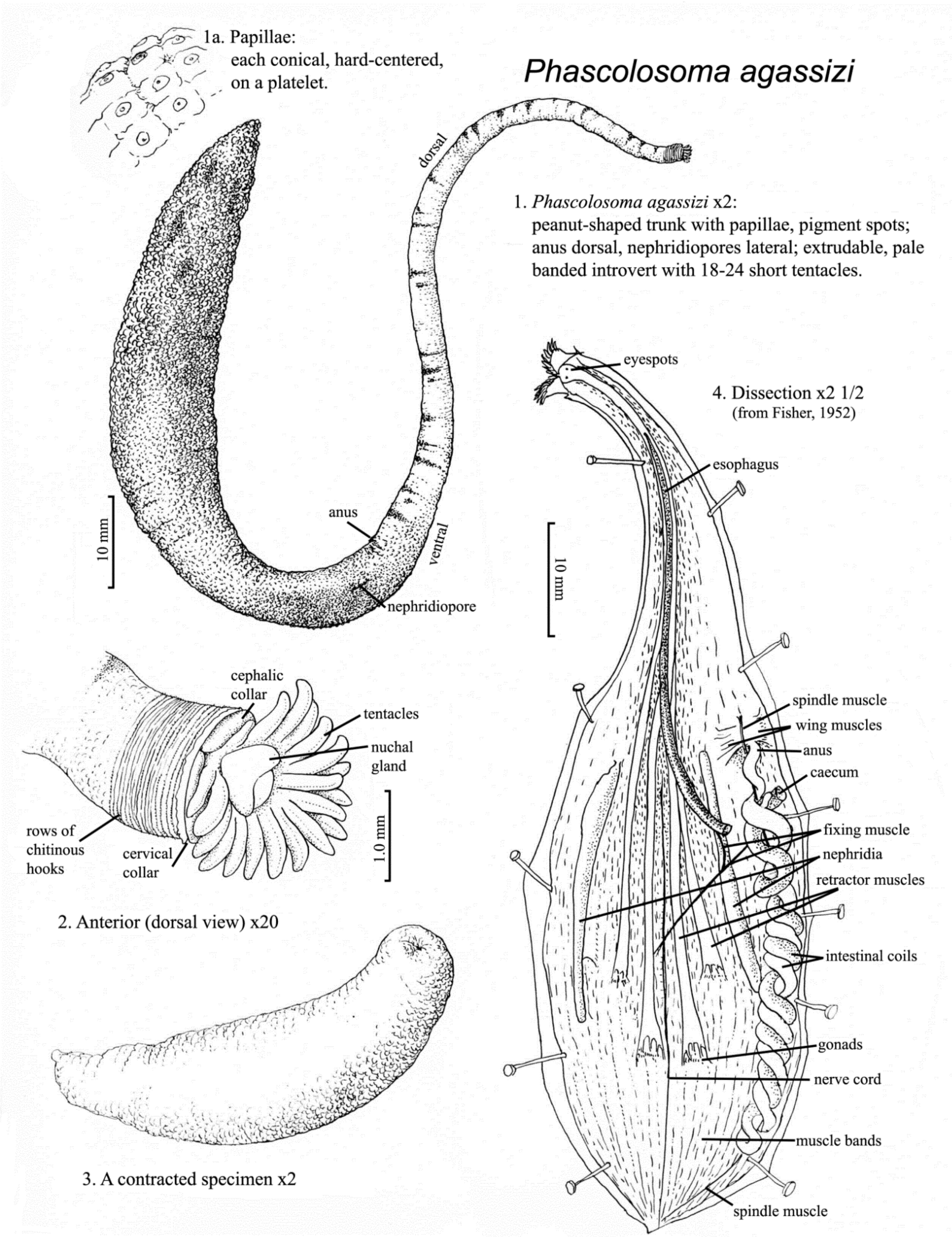

Phascolosoma agassizi
1a. Papillae:
each conical, hard-centered,
on a platelet.
1. Phascolosoma agassizi x2:
peanut-shaped trunk with papillae, pigment spots;
anus dorsal, nephridiopores lateral; extrudable, pale
banded introvert with 18-24 short tentacles.
dorsal
ventral
anus
nephridiopore
10 mm
cephalic
collar
tentacles
nuchal
gland
rows of
chitinous
hooks
cervical
collar
1.0 mm
2. Anterior (dorsal view) x20
3. A contracted specimen x2
eyespots
4. Dissection x2 1/2
(from Fisher, 1952)
esophagus
10 mm
spindle muscle
wing muscles
anus
caecum
fixing muscle
nephridia
retractor muscles
intestinal coils
gonads
nerve cord
muscle bands
spindle muscle

Abarenicola pacifica

The lugworm, or sand worm (Healy and Wells, 1959)

Phylum: Annelida
Class: Polychaeta
Family: Arenicolidae

Description

Size—often over 10 cm long, 1 cm wide: present specimen small: 4 cm (South Slough of Coos Bay), west coast family average 6" (15 cm) (Ricketts and Calvin 1971).
Color—head. abdomen orange: parapodial areas; branchiae red.
Prostomium— non-retractile. Naked; eyeless (fig. 2).
Proboscis—"a large. eversible sack" with mucus glands (Healy and Wells 1959) (fig. 1).
Body Characteristics—divided into 3 sections 1) anterior of 6 setigers, without branchiae and with strong chaetigerous annuli: 2) medial branchial region (setigers 7-19: 13 prs. large branchial gills), 3) posterior apodous, achaetous. Epidermis "very thick. strongly aerolated" (Fauchald 1977).
Parapodia—noto & neuropodia segments 1-19, reddish, well separated (far from ventral line), (fig. 3).
Nephridiopores—naked (without hoods). 5 pairs, on segments 5-9 (fig. 2): sometimes difficult to see.
Branchiae—prominent. thickly tufted, segments 7-19 (13 pairs), with bunched setae.
Esophageal Caeca—one large anterior pair. 3-6 smaller pairs (Ricketts and Calvin 1971): seen by dissection only (fig. 4).

Possible Misidentifications

Other Arenicolidae have the same bushy gills in the middle third of the body: only genus *Abarenicola* has well-separated neuropodia, a non-retractile prostomium, more than one pair of esophageal caecae, and five pairs of nephridiopores. Both *Arenicola marina* and *pusilla* have been found in Oregon estuaries. Other *Abarencola* are *A. (clapareddi) oceanica*, which has hooded nephridial pores and 7-9 smaller pairs of esophageal caecae; *A. vagabunda*, from Puget Sound, (but possibly from Oregon) (Oglesby 1973) is usually larger, and dark brown; it, too, has hooded nephridial pores, and from 11-18 smaller esophageal caecae. Its burrows, less permanent than *A. pacifica's*, are found in deep sand, and may be more sub-tidal (Hobson 1966).

Ecological Information

Range—Humboldt Bay. California, to Alaska. Japan. Holotype: Puget Sound.
Distribution—a north Pacific form: most common lugworm in Puget Sound area intertidally (Hobson 1966). Found in Coos Bay from estuary mouth to Coos River mouth (marker 15), and at Sunset Bay outside (Oglesby 1973).
Habitat—builds a substantial L- or J- shaped tube in sand and mudflats; mixed, gravelly sediments; mud and chips (South Slough of Coos Bay) (Kozloff 1974a). Tolerates a muddier, less permeable, more poorly sorted sediment than does *A.c. vagabunda* (Hobson 1967), but does not live in very soft mud (Porch 1970).
Tube—firm, mucus impregnated, up to 40 cm, with typical fecal castings at tail end; head end is collapsed as worm consumes mud (Healy and Wells 1959). Water is pumped through burrow by worm.
Salinity—does not live in waters of low salinity or in heavily polluted anaerobic conditions (Porch 1970), but is a conformer and can tolerate a wide range of salinities. (lower limit: 50 ‰seawater)(Oglesby 1973).
Temperature—

Quantitative Information

Abundance—often to 50/ m^2 (Kozloff 1974a); very dense in specialized habitats. Probably 2nd most abundant macroscopic animal in Coos Bay (Porch 1970), up to 100/ m^2 (Okuda 1938).

Life History Information

Reproduction—eggs and sperm discharged from nephridiopores, into water, while both sexes are in their burrows. Fertilization occurs in female's borrow, where eggs accumulate into a tube.
Growth Rate—
Longevity—
Food—detritus, picked up from surface by mucus of proboscis (fig. 1), digested out of sand and mud, which is defecated.
Predators—man, for fish bait: birds, fish.

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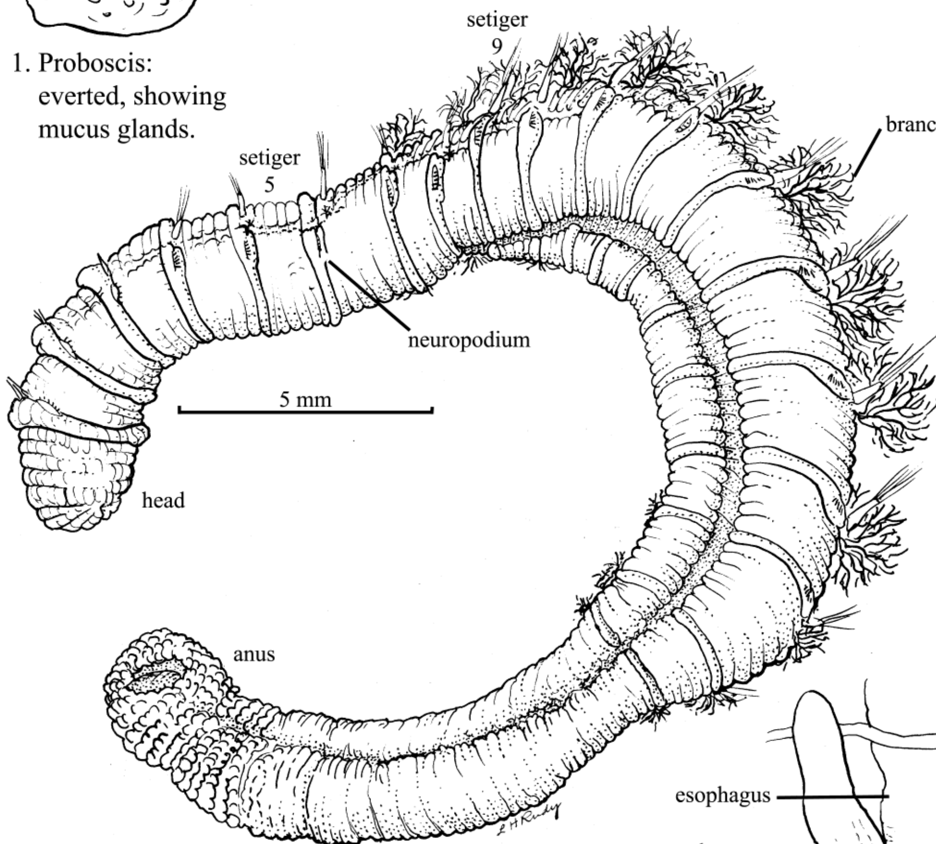
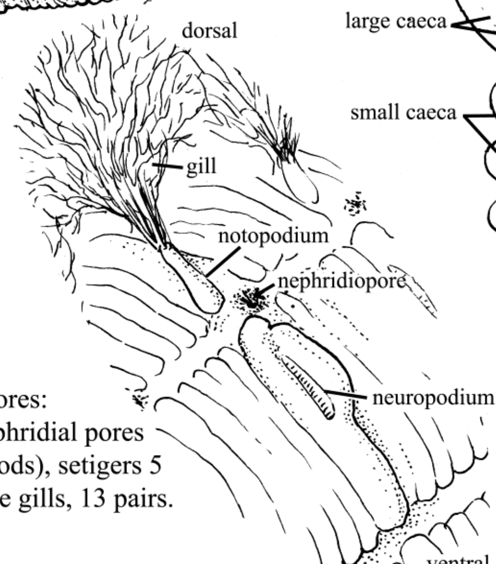
Abarenicola pacifica

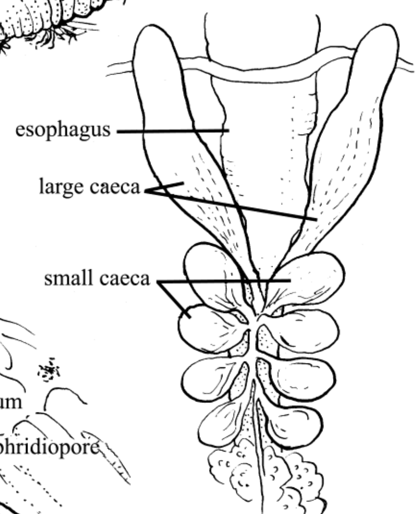
1. Proboscis: everted, showing mucus glands.



2. *Abarenicola pacifica* x8: nineteen setigers; orange head, abdomen; red parapodal areas; three body sections, medial one with branchiae.



3. Nephridiopores: exposed nephridial pores (without hoods), setigers 5 to 9; fan-like gills, 13 pairs.



4. Esophageal structure (dissection): 1 pair large caecae, 3 to 6 pairs small caecae.

Armandia brevis (=A. bioculata)

Moore, 1906 (Moore 1906) Hartman, 1938 (Hartman 1938)

Phylum: Annelida
Class: Polychaeta
Order: Opheliida
Family: Opheliidae

Description

Size—present specimens: 1-2 cm.
Color—pale "flesh" to red orange, with eleven pairs of dark eyespots on segments.
Prostomium—sharply tapered, with small terminal palpode. nuchal organs (fig. 3a) probably olfactory. and palps (fig. 3b) for food gathering.
Parapodia—on 29 setigers. Branchiae. present from the second segment, are cirriform. (fig. 2).
Eyespots—lateral, on segments 7 through 17: dark. paired, near branchiae (fig. 2).
Body Characteristics—29-30 segments, "soft-bodied... often grub like" (Hartman and Reish 1950): rather transparent. Body somewhat stiff (personal communication, R. Boomer).
Ventral Groove—well defined, running the entire body length. (fig. 1).

Possible Misidentifications

Only local species in the genus. *A. bioculata* Hartman, once thought to be separate (Hartman 1948), now included with brevis (Blake 1975).

Ecological Information

Range—originally described from Alaska, ranges to California.
Distribution—found in South Slough of Coos Bay and at Cape Arago (Hartman and Reish 1950).
Habitat—sandy mud (Metcalf Preserve, South Slough) "loose sand" (Ricketts and Calvin 1971).
Salinity—
Temperature—
Tidal Level— shore to 40 fathoms, (Alaska); + 1.2 feet: (South Slough of Coos Bay and Puget Sound) (Woodin 1974).
Associates— other small polychaetes, and *Pista pacifica*, amphipod *Corophium brevis*.

Quantitative Information

Weight—
Abundance—720/m (Hartman 1944a) (Mitchell Bay, San Juan Islands. Wash) (Woodin 1974).

Life History Information

Reproduction—free spawner: settlement after 3-4 weeks of planktonic development (Hermans 1966). Spawns April-Nov. (Wash.) (Woodin 1974).
Growth Rate—2-3 generations per summer possible (Hermans 1966).
Longevity—six weeks to maturity, then spawning and deaths
Food—a deposit feeder (Hermans 1966)
Preyed Upon By— *Cancer magister*; escapes by burrowing (Woodin 1974).
Predators—*Cancer magister*; escapes by burrowing (*ibid*).
Behavior—a burrower, not a tube builder (*ibid*); usually within 3 cm of surface (Hermans 1966).

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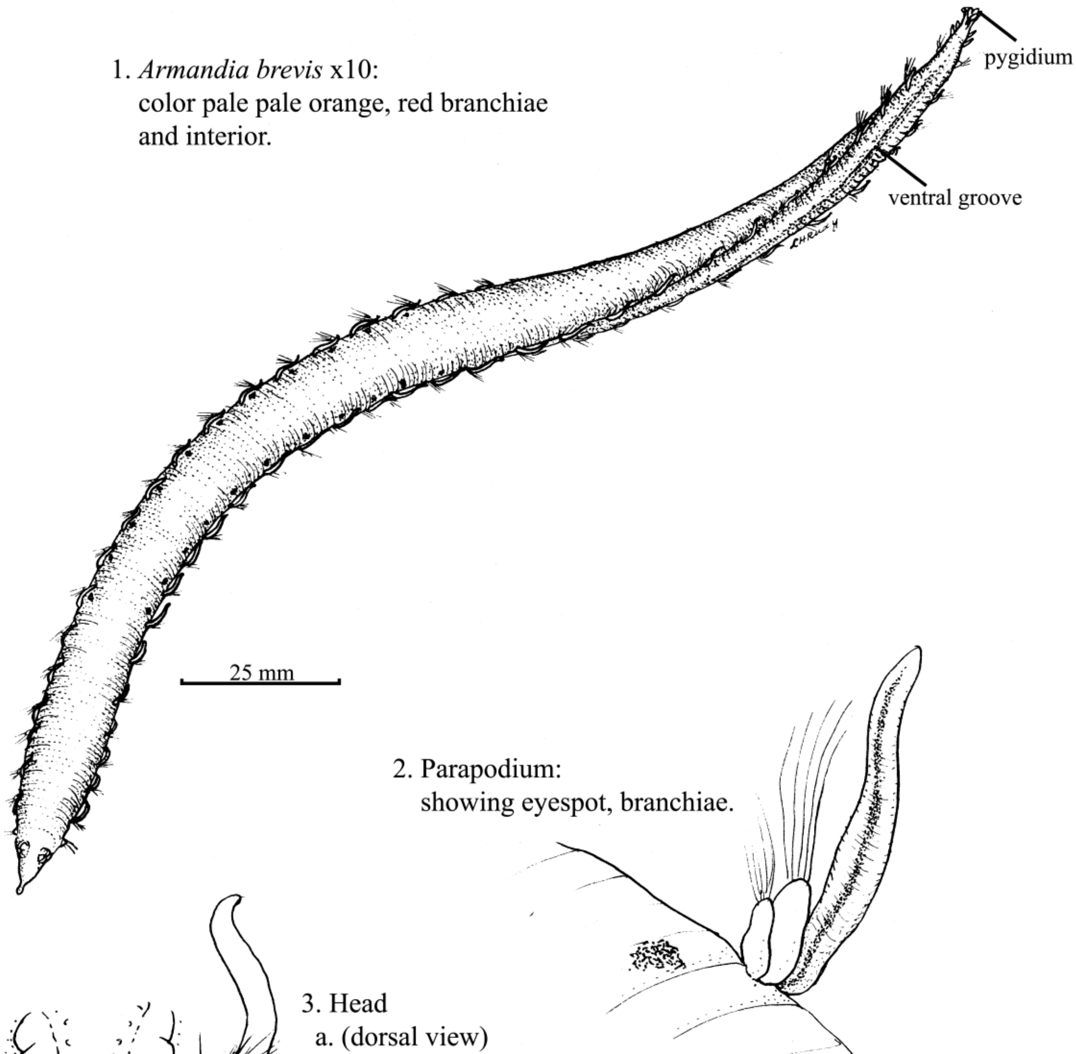
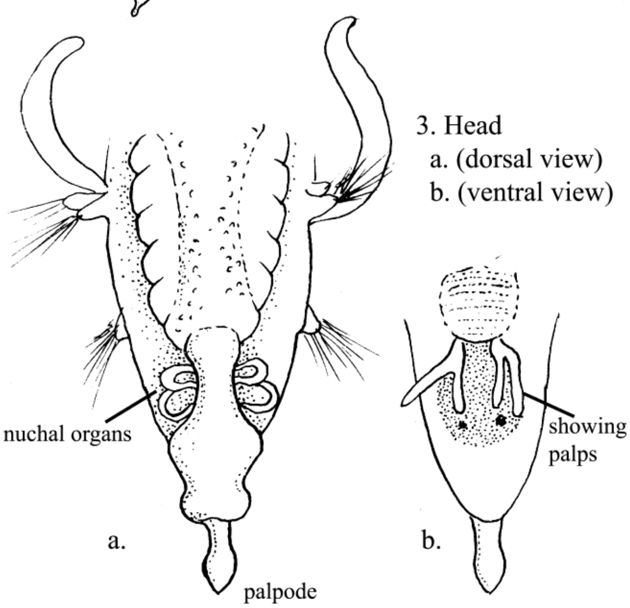
Armandia brevis

1. *Armandia brevis* x10:
color pale pale orange, red branchiae and interior.



2. Parapodium:
showing eyespot, branchiae.

3. Head
a. (dorsal view)
b. (ventral view)



4. Pygidium (dorsal view):
with long cirri.

Boccardia proboscidea

A burrowing spionid worm (Hartman, 1940)

Phylum: Annelida
Class: Polychaeta
Order:
Family: Spionidae

Description

Size—to 30-35 mm long, 1.5 mm wide; can extend in life (Hartman 1940a). Segments: 120-130, (fig. 1).
Color—yellow orange, with red branchiae; dusky areas around prostomium and parapodia (Hartman 1969).
Body—long, depressed, somewhat flattened, tapering posteriorly (Hartman 1940a). First setiger (segment with setae) small, with insignificant bunches of capillary setae in bunches (fig. 5a). Setiger 5 modified, with 2 kinds of dark, strong setae in notopodia; this setiger almost twice length of setiger 4 (figs. 2, 3) (Hartman 1940a).
Prostomium—long, rounded, without medial groove: "snout-like," thus *proboscidea* (Hartman 1940a). 4-6 eyespots between palpal bases; caruncle (sensory organ) present (fig. 3).
Palpi—long, simple, longitudinally grooved tentacle-like structures, characteristic of family Spionidae (fig. 1).
Parapodia—biramous from 1st setiger (not lobed, small and inconspicuous); 2nd setiger's parapodial lobes become twice as large as first's, and continue large to posterior of animal.
Setae—all simple; include bunches of short, capillary spines to setiger 6 (except for modified setiger 5) (figs. 5a, b). A transverse row of about 8 neuropodial uncini (hooded hooks) with bifid (two-pronged) tips begins on setiger 7 and continues to posterior end (fig. 5e), with bunches of a few capillary setae below them (to the 11th setiger, where they disappear). Dorsal setae of setiger 5 are heavy, dark, and arranged vertically in two rows of five: pairs of long, falcate spines (fig. 5c), and shorter brush-topped clubs (fig. 5d). All noto-setae are capillary except for those of setiger 5.
Branchiae—(gill-like structures, in this species a long, single vascular process), present on setigers 2 to 4, and from setiger 7 to near posterior end (figs. 2, 3).

Pygidium—(anal end): a round, flaring disc with 4 unequal lobes (dorsal lobes smaller): (fig. 4) (Hartman 1969).

Possible Misidentifications

Spionid polychaetes are distinguished by their long palps. Two other families have long palps: Magelonidae, with adhesive palps, not long and flowing ones, and with flattened spade-like prostomiums; Chaetopteridae have palps, but their bodies are very obviously divided into 3 quite different sections.

The genus *Boccardia* is distinguished by having branchiae on the setigers anterior to 5. Of these, 2 species have only 1 kind of setae on setiger 5, not 2 kinds as in *B. proboscidea.*

B. hamata (=*uncata*) has recurved spines, not straight bifid uncini, on its posterior parapodia; its pygidium has 2 lappets. It is common in oyster beds.

B. truncata is green in color, has a saucer-like pygidium and a truncate anterior end. It is not usually estuarine.

Of those *Boccardia* species with 2 kinds of setae on setiger 5.

B. tricuspa has falcate and tridentate (not bruso-topped) setae on setiger 5; its branchiae anterior to setiger 5 are small and inconspicuous; it bores in molluscs and is usually a more southern species than *B. proboscidea.*

B. polybranchia has a notched not an entire prostomium. Its 1st setiger lacks notosetae; it has only 60-80 segments, and a pygidium like a thick ring. It is green and lives in estuarine mud.

Two species of *Boccardia* have both falcate and brush-topped setae on setiger 5 as in *B. proboscidea*:

B. berkeleyorum has no notosetae on setiger 1, only neurosetae. Its bristle-topped setae (on setiger 5) have a small accessory tooth at the distal end; its posterior notopodia have acicular setae (Blake 1975). This species bores in coralline algae, hermit crab shells and the jingle shell *Pododesmus*.

B. columbiana is closest to *B. proboscoidea*. Its chief difference is that the fascicles of fine setae on setiger 1 are long and fanned forward; they are short on *B. proboscidea*. This species is reddish brown, and bores into wood pilings and coarse algae.

B. proboscidea was the only one of its genus found in Oregon by Hartman and Reish (Hartman and Reish 1950).

Ecological Information

Range—Western Canada south to southern California (Hartman 1969).
Local Distribution—Coos Bay, several sites; outer rocky coast and offshore as well (Hartman and Reish 1950).
Habitat—builds vertical, U-shaped burrows in rocky shale; in *Mytilus* (mussell) colonies. Inhabits a variety of niches (Hartman 1940a).
Salinity—collected at 30 ‰; great toleration for salinity variation (Hartman 1940a).
Temperature—residence in tidepools evidence of temperature toleration (Hartman 1940a).
Tidal Level—high rocky intertidal pools, in crevices; sandy mudflats (Blake 1975).
Associates—*Mytilus* and its accompanying organisms; in rocky crevices: small, red harpacticoid copepod, *Tigriopus* (Hartman 1940a).

Quantitative Information

Weight—
Abundance—the only *Boccardia* found in Oregon by Hartman and Reish, 1950 (Hartman and Reish 1950); most common member of a common family (Hartman 1940a).

Life History

Reproduction—larval stages, or chaetosphaeres, found in plankton in the summer (Hartman and Reish 1950). Eggs, in 5 or more capsules of 50 eggs each, are deposited in a tube, and aerated while developing by adult's rhythmic movement (Hartman 1940a).
Growth Rate—egg development rapid; eggs easily developed in lab; capsules in same tube often at different development stages. Settlement after some weeks as plankton (Hartman 1940a).
Longevity—
Food—spionids feed by sweeping tentacles across surface of substrate; particles collected and wiped on underside of prostomium (Dales 1967). Also eats small copepods (Hartman 1940a); a voracious predator on algal particles, Bryozoa, Hydrozoa, other attached and free-swimming animals (Hartman 1940a).
Predators—
Behavior—a burrower; colonial; can be seen with tentacles protruding from burrow (Ricketts and Calvin 1971).

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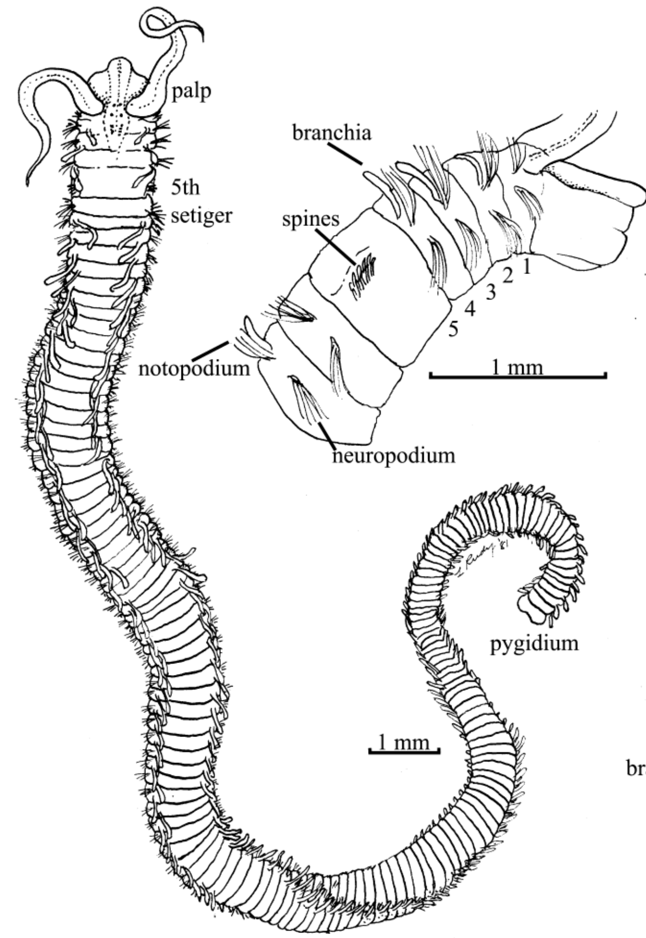
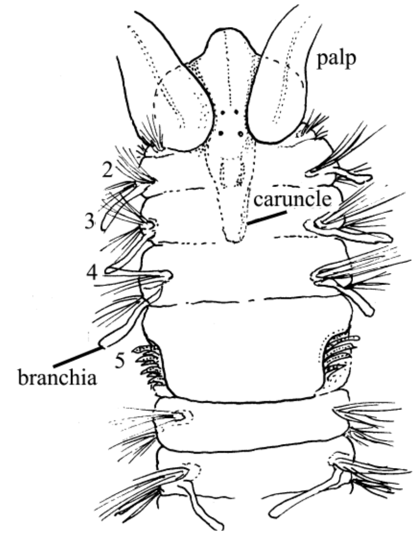
Boccardia proboscidea

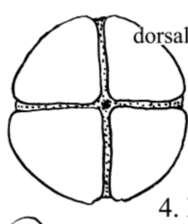


1. *Boccardia proboscidea* x12:
typical Spionid palps; body flattened, depressed; pygidium a flaring disk.

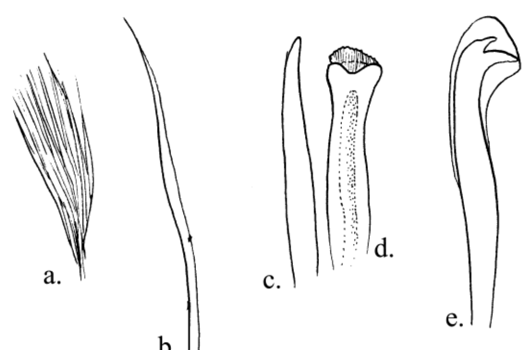
2. Anterior (lateral view) x30:
biramous parapodia with branchiae; fifth setiger wide, modified, with stout dorsal spines.



3. Anterior (dorsal view) x30:
prostomium rounded, snout-like; 4-6 eyes; inconspicuous parapodia on first setiger; setiger 5 with dorsal spines; caruncle obvious.



4. Pygidium (posterior view) x40:
dorsal lobes smaller.



5. Setae:
a. neuropodial fascicle
b. capillary from a.
c. falciger from setiger 5
d. brush-topped club, setiger 5
e. neuropodial hooded hook

Capitella sp. (Capitella capitata)

A thread worm (Fabricius, 1780)

Phylum: Annelida
Class: Polychaeta
Order:
Family: Capitellidae

Description

Size—20-100 mm long, 1-2 mm wide.
Color—dark red or brownish.
Body—earthworm-like (Hartman and Reish 1950); cylindrical, slender, threadlike, without obvious parapodia or peristomial appendages. Lacks a circulatory system (Morris et al 1980). Body divided into thorax of 9 segments, abdomen of about 90 segments; posterior is a simple flange (Hartman 1969). (Fig. 1: drawing done from somewhat compressed specimen.)
Prostomium—a depressed triangular lobe, without eyes, appendages, palps, etc (Hartman 1969). (fig. 2).
Proboscis—eversible, but rarely seen everted (Hartman 1969).
Parapodia—biramous (neuropodium and notopodium), without branchiae (long, gill-like structures); 1st 7 thoracic setigers with long, fine setae in both notopodia and neuropodia (Fauchalf 1977), (fig. 2). Setigers 8 and 9 with long yellow spines in notopodia (male, fig. 4a), only stout hooks in neuropodia; abdominal parapodia (from setiger 10) with hooks only in both branches (fig. 2).
Setae—all simple (not jointed): anterior parapodia (1st 7 thoracic) with long, fine capillary spines (fig. 5a); abdominal segments (and 8th and 9th neuropodia) with stout hooks with transparent hoods (fig. 5b). 8th and 9th neuropodia (male) each with 2 stout yellow copulatory spines (fig. 4a).
Genitalia—males with lateral generative pore between setigers 7 and 8; 2 yellow copulatory spines in each notopodium of setigers 8 and 9 (fig. 4b). Females with middorsal pore between setigers 8 and 9 (fig. 3) (Hartman 1969).

Possible Misidentifications

There are other mud-dwelling genera of Capitellidae; *Capitella* is the only 1 with hooks as well as capillary setae on the last 2 thoracic setigers (Hartman 1969), as well as genital spines on setigers 8 and 9. *C. capitata* is the only species with setae on the 1st segment (Hartman and Reish 1950). Three subspecies of *C. capitata* are included in Hartman, 1969; they are not likely to be found in estuarine intertidal situations (Hartman 1969).

Other fairly common Capitellidae in Oregon's estuaries are *Mediomastus californiensis,* with a thorax of 10 setigers, not 9, only capillary setae on setigers 1-4 (not to setiger 7 like Capitella); it has long-handled hooks on setigers 5-10.

Heteromastis filobranchus and *H. filiformis* has 11 setigers in the thorax, of which the 1st 5 have only capillary setae, and the 5th to 11th have hooks. *H. filobranchus* has spaghetti-like filamented branchiae on its posterior parapodia, *H. filiformis* lacks these branched branchiae.

Ecological Information

Range—chiefly northern: western Canada to California (Hartman 1969); cosmopolitan (Blake 1975).
Local Distribution—in Coos Bay: South Slough, several stations; North Spit, Barview. Netarts Bay, several stations (Stout 1976).
Habitat—mudflats: muddy sand to pure mud (Porch 1970), can be found in fish wastes, sulfurous sediments, etc. where it may be a pollution indicator, if found in great numbers and in the absence of many other invertebrate species (Filice 1959; Reish 1955). This does not hold true in Coos Bay, where it is not found in the polluted areas, (but *Heteromastis*) (Porch 1970). Found in vertical, dirt-encrusted, black, membranous tubes (Ricketts and Calvin 1971); in the mud of *Salicornia* marsh channels, Coos Bay (Porch 1970). No real preference for substrate, but likes quiet intertidal conditions (Filice 1959).

Salinity—can tolerate low saline condition (Porch 1970); collected at 14 ‰, San Francisco Bay, where it is reported to prefer saline conditions (Filice 1959).
Temperature—cold waters to tropics, more commonly in temperate waters (Morris et al 1980).
Tidal Level—collected at +3.-4. ft.; particular about depth. not substrate. Also found down to 30 fathoms (Filice 1959).
Associates—Coos Bay: other polychaetes *Abarenicola; Mediomastis* (Netarts Bay); tanaids (*Leptochelia*), amphipods.; pea crabs *Pinnixa* (Morris et al 1980).

Quantitative Information

Weight—
Abundance— common; cosmopolitan in mudflats (Blake 1975): if found in great numbers in an area with few other invertebrates, heavy pollution of the habitat may be indicated (Reish 1955). Found in great beds of many acres on the Berkeley, California mudflats (Ricketts and Calvin 1971).

Life History Information

Reproduction— special copulatory setae (fig. 4): definite separate sexes. Active all year (California) with mild peaks summer and winter. Males transfer spermatophores (packets) to females which can store them until eggs are ripe. Eggs laid, early development occurs in female's tube. Larvae emerge in 5 days as metatrochophores, or hatch in 7-14 days as juveniles. Sexual maturity attained within 1 month at 20°C (Porch 1970).
Growth rate—
Longevity—
Food—a direct deposit feeder.
Predators—
Behavior—

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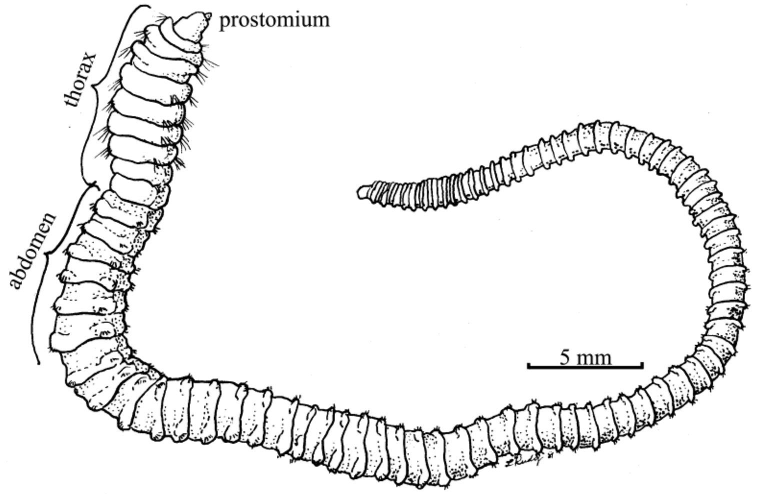
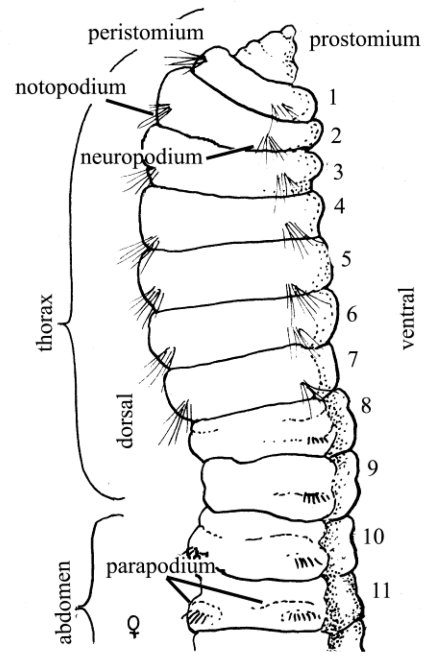
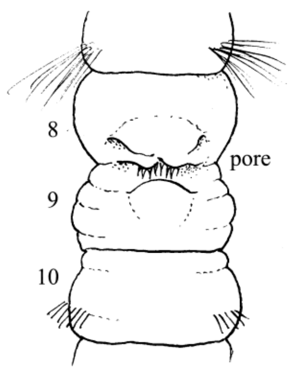
Capitella sp.
(Capitella capitata)



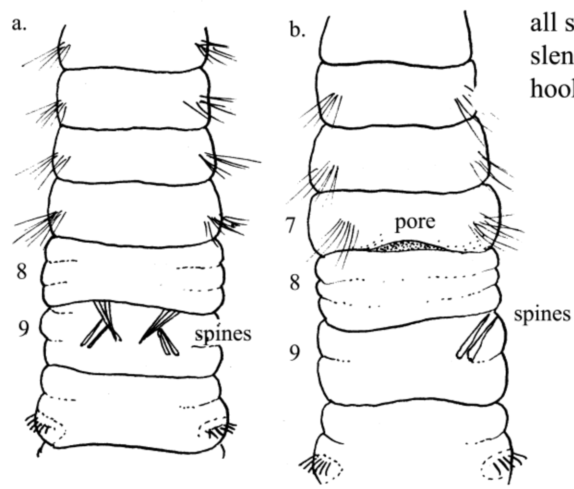
1. *Capitella sp.* (lateral view) ♀x4:
dark red body, threadlike, with 9 thoracic and about 90 abdominal setigers; prostomium a depressed triangular lobe, without eyes or appendages.



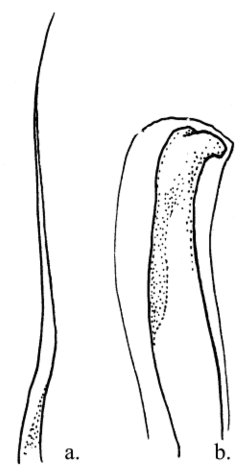
2. Prostomium and anterior setigers (lateral view) x30:
setae begin on peristomium; biramous parapodia, no branchiae; all setae simple, thoracic long, slender; abdominal stout, hooded hooks.



3. Female genital area (dorsal view): showing genital pore between setigers 8 and 9.



4. Male genital area:
a. (dorsal view) showing two copulatory spines on each notopodium, setigers 8 and 9.
b. (lateral view) generative pore between setigers 7 and 8.



5. Setae:
a. long, fine capillary seta (thorax).
b. stout, hooded hook (abdomen).

Eteone lighti

A paddleworm (Hartman, 1936)

Phylum: Annelida
Class: Polychaeta
Order: Phyllodocida
Family: Phyllodocidae

Description

Size—to 30 mm long, 1-1.5 mm wide, with parapodia (Hartman 1936).
Color—pale or white, deep yellow dorsal transverse stripes (Hartman 1968); dorsal cirri tipped with deep yellow.
Body—75-100 segments (fig. 1); 1st segment incomplete dorsally: genus *Eteone*, where it expands into tentacular cirri (fig. 2a).
Prostomium—trapezoidal, wider than long, with a median longitudianl groove (fig. 2a); with 2 pairs of short, conical antennae, and 2 pairs of short, slender tentacular cirri: genus *Eteone*. 2 eyes on posterior 3rd of prostomium, no nuchal papilla.
Proboscis—can be smooth or wrinkled, but lacks papillae (Hartman 1968) (fig. 1).
Parapodia—uniramous: neuropodia only. All but 1st segment with a flat triangular dorsal cirrus, about as wide as long (fig. 3), these become longer and narrower farther back (*ibid*); the ventral cirrus has a broad base tapering to a blunt tip and is shorter than the neuropodial lobe (fig. 3). Note: parapodium should be viewed in plane (side) view to check for flatness, inflatedness, etc.
Setae—compound: family Phyllodocidae (Blake 1975); long, fine, colorless spinigers (Hartman 1968) (fig. 4a,b).
Anal Cirrus—1 pair, cirriform, attached laterally (figs. 1, 5); about 2x as large as peristomial cirri (fig. 2) (*ibid*).

Possible Misidentifications

Other polychaetes of the family Phyllodocidae can have flattened, leaflike paddlelike or globular parapodial cirri (Blake 1975): they all have 4 frontal antennae on the prostomium (and occasionally a medial one), 2-4 pairs of tentacular cirri, uniramous parapodia and compound setae. Other similar families are Syllidae and Nereidae, although neither has uniramous parapodia. The genus *Eteone* has only 2 pairs of short tentacular cirri, and short prostomial antennae (Fauchald 1977) (fig. 2a).

The species closest to *E. lighti* in our area is *E. pacifica*, which has no (or inconspicuous) eyes, a prostomium longer than wide, flat broadly rounded asymmetrical dorsal cirri, irregularly spaced black spots on its yellowish body. It can be more than 50 mm long (Blake 1975). A variety, *E. p. spetsbergensis*, has parapodial setae with 2 large, equal teeth at the end of the shaft (*E. pacifica sensu stricto* has setae with 2 unequal teeth at the end of the shaft) (Banse and Hobson 1974).

Other species of *Eteone* include *E. californica,* which also has a broad prostomium, but has a nuchal papilla between its eyes, and wide, dorsal parapodial cirri. Its ventral cirri are very short in the posterior parapodia, and it has small brown pigment spots on its body (Banse and Hobson 1974).

E. longa, found in the Puget Sound literature, but not in California, has a long, symmetrical conical dorsal cirrus, and a ventral cirrus almost as long as the parapodial lobe; its anal cirri are broad and spheroidal (Banse and Hobson 1974; Kozloff 1974a).

E. dilatae is a long, slender worm with up to 250 segments; it is found on sandy beaches of the outer coasts (Hartman 1936).

E. tuberculata has a prostomium with a narrow base, a prominent nuchal papilla, and a long parapodial dorsal cirrus (Banse and Hobson 1974). This species, with *E. p. spetsbergensis* which also has anatomical differences, seems to be a more northern animal.

E. balboaensis is an eyeless species from southern California (Hartman 1936).

Ecological Information

Range—central and southern California: extends into Oregon, but probably not to Washington (Hartman 1968).
Local Distribution—Coos Bay, several stations, including South Slough, and particularly North Slough (Porch 1970).
Habitat—mudflats; muddy sediments rather than sandy rim (Coos Bay) (Porch 1970).
Salinity—20-30 ‰ (North Slough. Coos Bay, summer (Baker et al 1970).
Associates— eelgrass.

Quantitative Information

Weight—a Coos Bay specimen: 0.17g wet weight 25 mm worm (Baker et al 1970).
Abundance— in upper Coos Bay, this can be one of the most common and widespread mudflat worms: up to several hundred/m^2 in part of North Slough (Porch 1970).

Life History Information

Predators—in Tillamook Bay, *Hypomesus, pretiosus* (surf smelt) and *Parophrys vetulus* (English sole) prey on a species of *Eteone* (Forsberg et al 1977).
Behavior—utilizes paddle shaped parapodia for swimming.

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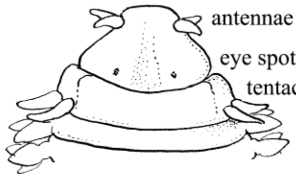
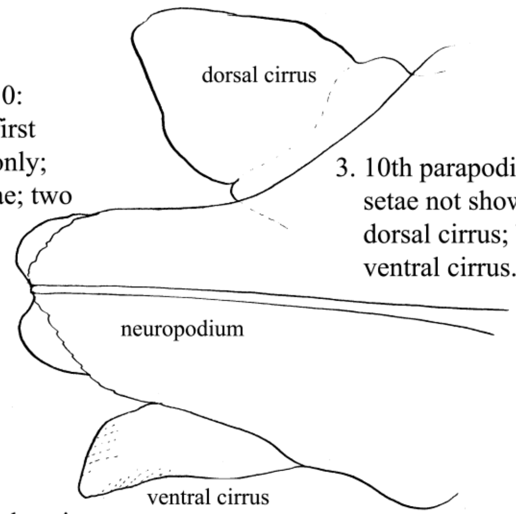
Eteone lighti

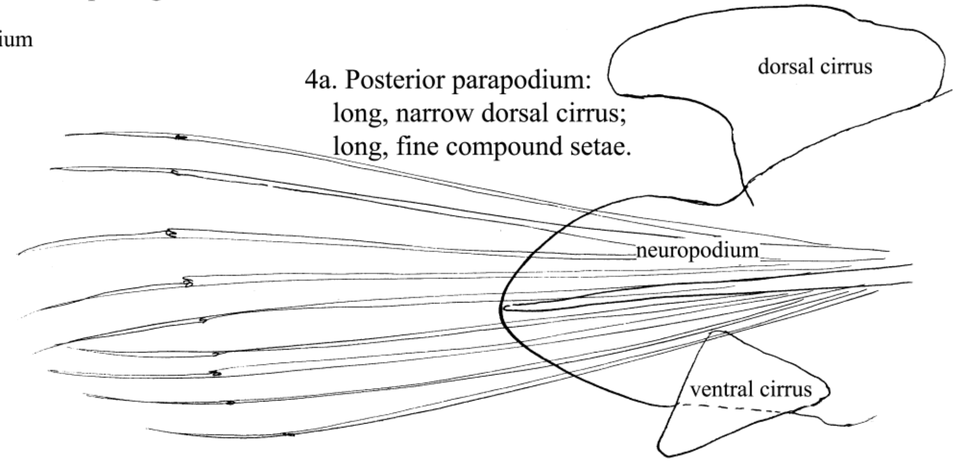


2a. Prostomium (dorsal view) x30: trapezoidal, wider than long; first segment with tentacular cirri only; two pairs short frontal antennae; two eyes, medial groove.



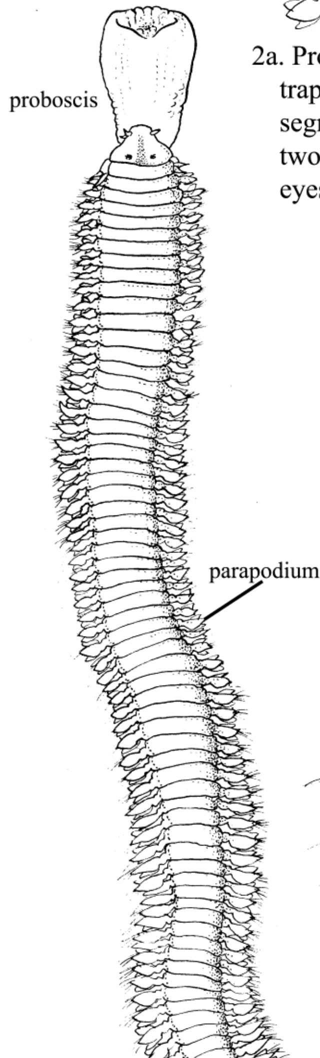
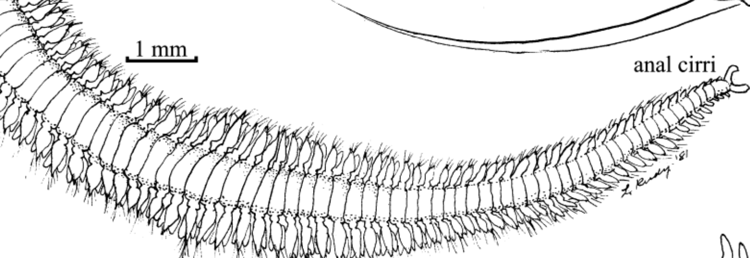
3. 10th parapodium: setae not shown, triangular dorsal cirrus; brood-based ventral cirrus.

2b. Prostomium (ventral view) x30: showing proboscis opening.



4a. Posterior parapodium: long, narrow dorsal cirrus; long, fine compound setae.

4b. Setae tip: spiniger compound, fine-bladed.

1. *Eteone lighti* proboscis, everted x12: prominent uniramous parapodia; proboscis without papillae.

5. Anal cirri x30: one pair.

Eteone pacifica

A paddleworm (Hartman, 1936)

Phylum: Annelida
Class: Polychaeta
Order: Phyllodocida
Family: Phyllodocidae

Description

Size—50 to 75 mm; 200-300 segments.
Color—pale yellow green with small black spots.
Prostomium—definitely trapezoidal, longer than wide (fig. 2); 2 pairs of small frontal (prostomial) cirri, eyes inconspicuous.
Proboscis—fleshy, smooth, no paragnaths (side teeth) (fig. 3).
Body Characteristics—1st segment with 2 pairs of thick, conical cirri, the ventral pair being the larger; 200-300 body segments (fig. 1).
Parapodia—uniramous, with short, rounded dorsal cirri (fig. 4); setae: composite, spinigerous.
Anal Appendages—one pair, lateral (fig. 1).

Possible Misidentifications

Four other local species of *Eteone*, all smaller than 50mm; differ from *E. pacifica* in several ways. *E. lighti* is closest in appearance, but has a broad prostomium, becoming very narrow, with triangular dorsal parapodial cirri, (not round). It is pale, or white in color. *E. californica* has a broad truncate prostomium, inflated dorsal parapodial cirri, only 80-95 body segments, and a prostomial nuchal papilla above and between the (eyes). It is pale with brown pigment spots. E. dilatae is pale green like *E. pacifica*, but its prostomial antennae are long and slender, and its first body segment is twice as long as the 2nd. *E. longa*, from Puget Sound, is much like *E. californica*, but without the nuchal palp. It has thick, conical dorsal parapodial cirri.

Ecological Information

Range—western Canada to central California.
Local Distribution—Oregon: Cape Arago, Sunset Bay (outer shore) (Hartman and Reish 1950), South Slough.
Habitat—intertidal muddy sand; littoral depths (Hartman 1968); common in large muddy areas, upper Coos Bay (Porch 1970).
Salinity—surface water salinity where *E. pacifica* was collected in Coos Bay varies from 10-30 ‰.
Temperature—surface water temperature where *E. pacifica* was collected in Coos Bay varies from 8-18 °C.
Tidal Level—collected at about the +4.0 foot level (Coos Bay).
Associates—other polychaetes, tanaidacean *Leptochelia dubia*, amphipod, *Corophium brevis*, and clam, *Macoma* sp. (South Slough).

Quantitative Information

Weight—
Abundance—highest in Coos Bay; several hundred/meter (Berkeley and Berkeley 1948)

Life History Information

Reproduction—
Growth Rate—
Longevity—
Food—
Predators—*Hypomesus pretiosus* (surf smelt) on *Eteone* sp.: lower Tillamook. *Parophrys vetulus* (English Sole): mid Tillamook Bay (Forsberg et al 1977)
Behavior—

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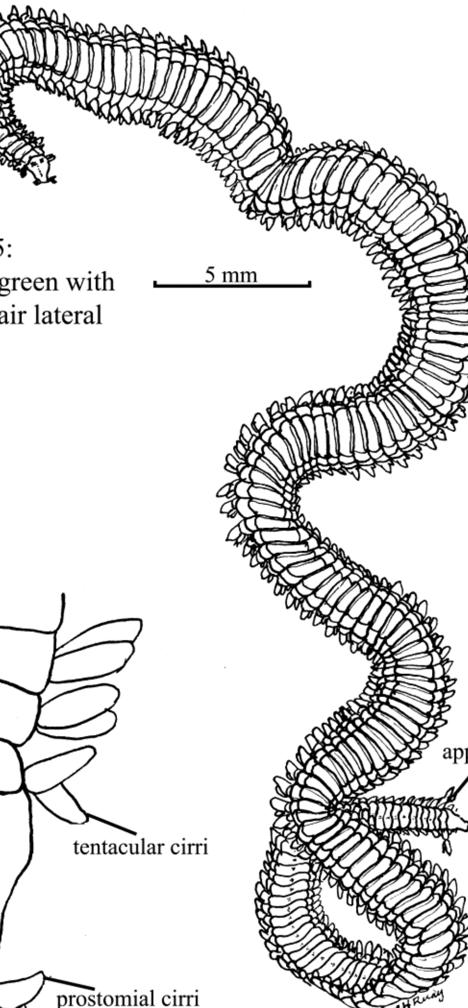
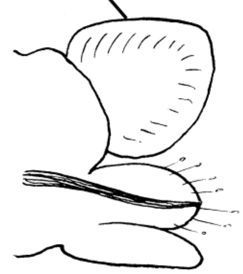
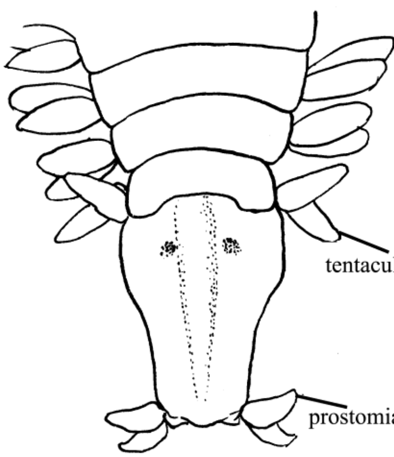
Eteone pacifica



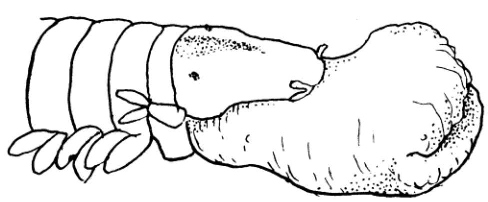
1. *Eteone pacifica* x5:
color pale yellow green with black spots; one pair lateral anal appendages.



4. Medial uniramous parapodium: dorsal cirri rounded, thin.



2. Prostomium:
two pairs of short tentacular cirri; small eyes; two pairs small postomial cirri.



3. Proboscis, everted:
fleshy, smooth; no paragnaths.

Eudistylia vacouveri

A feather duster worm (Kinberg, 1867)

Phylum: Annelida
Class: Polychaeta
Family: Sabellidae, Sabellinae

Description

Size—one of the largest sabellids: 300-480 mm long, 15-20mm diameter, tube up to 10 mm diameter (Kozloff 1974b).
Color—dark red and green radially striped (5-8 stripes) crown of tentacles (Kozloff 1974b); (dark red and orange or yellow in California) (Hartman 1969); some tentacles white-tipped; body buff colored, with light green markings, white spots (Coos Bay specimen); tube buff or grey.
Crown—made up of 2 equal parts composed of many radioles (fig. 1), each part: base spiraled about twice; characterizing genus *Eudistylia*; crown conceals mouth and head. Edges of crown are smooth, not incised (fig. 5): distinguished *E. vancouveri* from *E. polymorpha*.
Radiole—also called cirrus or tentacle: individual branch of crown; single, undivided; has forked, simple side branches or pinnules (fig. 2), and dark eyespots along the lower edge, especially near bases of radioles (fig. 2).
Prostomium—or head; reduced and indistinguishable.
Body—thorax of 8 segments, abdomen of many segments, tapers to slender pygidium (fig. 1).
Thoracic collar—with 4 lobes (fig. 4), visible on ventral side; no long thoraicic membrane. Collar is used to build tube: by incorporating sand grains with exuded mucus and attaching this “rope” to top of tube.
Parapodia—biramous, (figs. 1, 6) except for 1st or collar segment, which has only notopodia (Hartman 1969). In thoracic setigers (2-8), the notopodia have bundles of long and short slender setae (figs. 7b, c), the neuropodia have pairs of short uncini (hooks) (fig. 7a) encased in zipper-like, raised ridges called tori (fig. 6). This arrangement is inverted or reversed in the abdomen, where the notopodia contain hooks in the abdominal segments, and the neuropodia have long spines (fig. 6).

Setae—
Thoracic— notopodia: 2 kinds: genus *Eudistylia;* long, slender, bilimabte (fig. 7b); and spatulate, no scimitar-like (fig. 7c) (Hartman 1969); neuropodia: wo kinds, in torus; pennoned or flagged setae, and avicular (bird-like) hooks or uncini (fig. 7a) arranged in a long row of about 20 pairs,
Abdominal— notopodia: short avicular uncini (fig. 7e).Neuropodia: long pointed setae (fig. 7d).
Tube—long, cylindrical, flexible, permanent, tough, leathery, membraneous; of mucus and cementer sediment, not calcareous as in Serpulidae; without operculum: animal can completely withdraw into tube (Terebellidae cannot).

Possible Misidentifications

Characteristics of the family Sabellidae are the tentacular crown of bipinnate radioles, lack of gills in the body segments, and setal types inverted in avdominal region (see *parapodia*, above). These characters they share with the Serpulidae; the family differs in having a leathery tube of mucus and sand, it lacks an operculum or trap door (serpulids have a calcareous tube and a staked operculum like a golf tee) (O’Donoghue 1924). A serpulid example would be the introduced *Merceriella enigmatica*, a cosmopolitan fouler of brackish waters (Blake 1975).

Other tube worms include Terebellidae, which have soft cirri that cannot be completely retracted into the tube; they sometimes have gills on their anterior segments, and their setal types are not inverted (Blake 1975).

A family with an easily confusing name is the Sabellaridae, which builds sand tubes. These have 2-3 rows of palae (flattened setae) forming highly modified cephalic structures (not crowns); their bodies have easily defined thorax, abdomen and long caudal section.

Within the family Sabellidae, the subfamily Sabellinae is noted for its avicular uncini in the thoracic neuropodia, and for its permanent, tough leathery tubes. Other genera of the sub-family include:

Schizobranchia, or split branch, common in Puget Sound; a smaller worm occurring in great masses on floats; its radioles are branched, not single; it is often tan colored with a bright red crown (not striped) (Kozloff 1974b)*;*

Megalomma, usually deepwater, but sometimes intertidal with composite eyes spiraled around the ends of some of its radioles (Blake 1975);

Pseudopotamilla, including 3 species of small, rare tube worms which share with *Eudistylia* the simple pinnate crown of radioles, but the bases of whose 2 crowns of tentacles are curved in a semicircles, not spiraled;

Sabella, with 2 lobes on its thoracic collar, not 4; *S. crassicornis* has paired eyespots in deep red bands on its radioles; *S. media* lacks eyespots, and is pale colored, with red and white mottled radioles (Blake 1975).

The subfamily Fabricia differs from the Sabellinar in its small size and in its temporary fragile mucus tubes. Several north-west genera exist, including:

Chone, a tiny worm with a membrance partly uniting its radioles, and a thoracic collar which is entire, not lobed; local species have 15 or fewer pairs of radioles (*ibid*);

Fabricia species have few segments and sparse radioles; they are quite small; *Oriopsis* is very like *Rabricia*, but with 7-8 abdominal segments, not 3 (*ibid*).

A third subfamily of Sabellidae, the Myxicolinae, represented by the genus *Myxicola*, has a thick mucus sheath covering its body; its radioles are joined by a web by most of their length.

E. vancouveri and *E. polymorpha*, may in fact be the same species (Ricketts and Calvin 1971); some believe hybridization occurs (Blake 1975). There are 2 obvious differences between them; *E. polymorpha* does not have striped radioles, they are solid dark red with light tips, and the dorsal edge of its crown of radioles in not entire (fig. 5), but notched. *E. polymorpha* was originally described and figured by Johnson, 1903, as *Bispira polymorpha*. Puget Sount keys do not include this species; it may be a southern species or morph.

Ecological Information

Range—Alaska to central California; type locality Vancouver Island, B.C. (Hartman 1969)

Local Distribution—Coos Bay—floating docks.

Habitat—wharves, floats, sandy mudflats, as well as vertical rock faces in heavy surf (Kozloff 1974b).

Salinity—collected at full sea water in an area of heavy flushing; doesn't tolerate reduced salinity (Ricketts and Calvin 1971).

Temperature—range would indicate a cold to temperate environment is best.

Tidal Level—collected on floats just below water surface; intertidal (Hartman 1969).

Associates—copepod *Gastrodelphys dalesi* (at Tomales Piont, California); worm tubes form a complex microhabitat in which many animals and plants survive.

Quantitative Information

Weight—

Abundance—gregarious; the principal sabellid in rocky habitats (Puget Sound) (Kozloff 1974b); grow in large clumps, in "Shrub-like masses" (Ricketts and Calvin 1971).

Life History Information

Reproduction—asexual; some regeneration possible; sexual; dioecious (two sexes). Free spawners; green eggs or white sperm produced, move out through abdominal nephridial pore to central groove (fig. 4) and out of tube.

Growth Rate—
Longevity—
Food—a filter feeder; plankton particles trapped by funnel of pinnules, driven by beating cilia, carried down to radiole base, sorted and ingested.
Predators—used by man for fish bait.
Behavior—

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1. BLAKE, J. A. 1975. Phylum annelida: class polychaeta, p. 151-243. *In:* Light's manual; intertidal invertebrates of the central California coast. S. F. Light, R. I. Smith, and J. T. Carlton (eds.). University of California Press, Berkeley.
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4. O'DONOGHUE, C. H. 1924. A note on the polychaetous annelid Eudistylia gigantea Bush. Contributions to Canadian Biology. 1:443-453.
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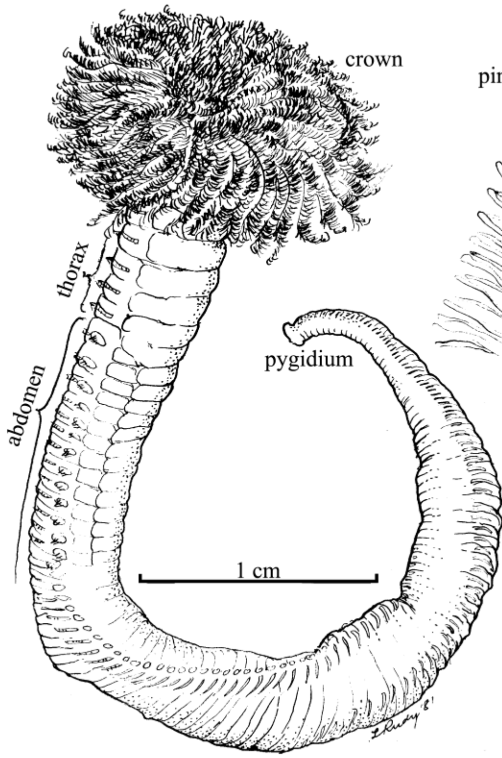
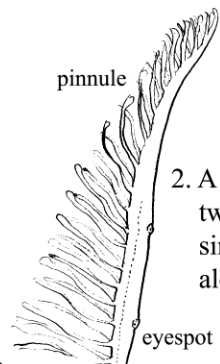
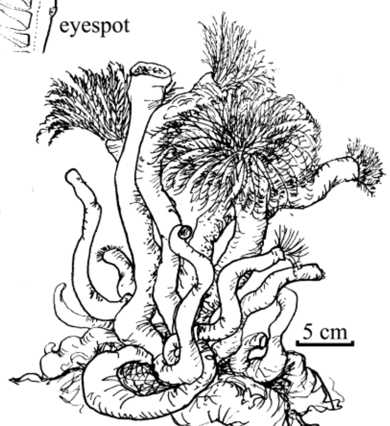
Eudistylia vancouveri



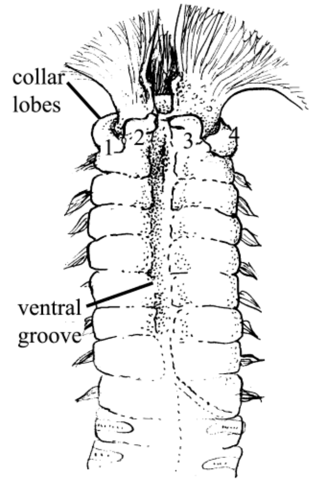
1. *Eudistylia vancouveri* , out of tube x4: a small specimen; thorax of 8 segments; tentacle crown maroon and green striped; many abdominal segments.



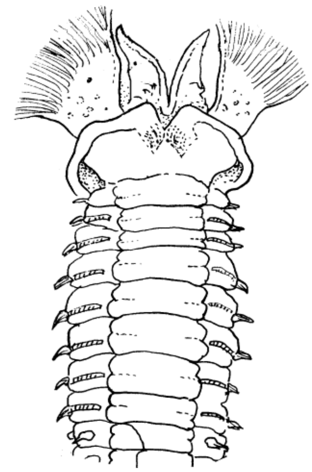
2. A single radiole (cirrus): two rows of side branches simple pinnules; eyespots along rib.



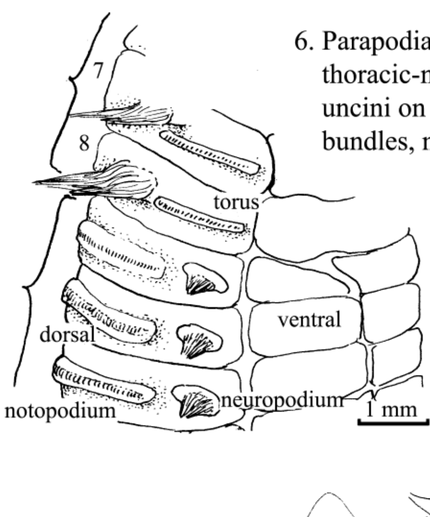
3. Worms, in situ x1/5: dense, shrub-like growth.



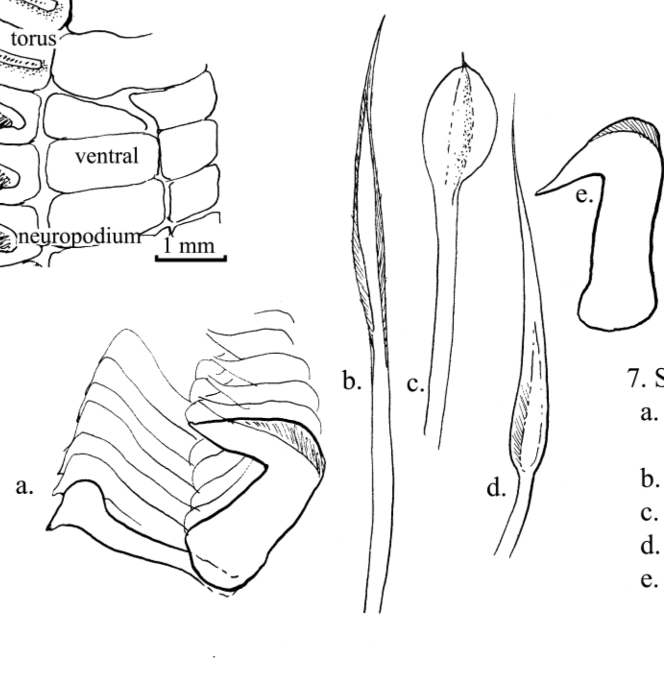
4. Anterior (ventral view): thoracic collar with four lobes.



5. Anterior (dorsal view): dorsal edge of crown without cleft.



6. Parapodia (lateral view) x12: thoracic-neuropodial setae in bundles, notopodial uncini on tori; abdominal- notopodial setae in bundles, neuropodial uncini on tori.



7. Setae:
   a. pennoned setae and avicular uncini (thoracic)
   b. long, bilimbate seta (thoracic)
   c. spatulate seta (thoracic)
   d. pointed seta (abdominal)
   e. avicular uncinus (abdominal)

Euzonus mucronata (=*Thoracophelia mucronata*)

A bloodworm (Treadwell, 1914)

Phylum: Annelida
Class: Polychaeta
Order: Opheliida
Family: Ophellidae

Description

Size— to 50 mm (2 inches).
Color—iridescent, a shimmering dark blue to dark red. Some specimens have a pebbly surface.
Anterior—"head", including setigers 1 and 2, is set off from the thorax by a constriction (fig. 1) 3 asymmetrical "eyes" in the brain area.
Thorax—a mantle covers the 1st 8 segments. The setigers are distinctly marked, with several muscle bands between them.
Branchiae—parapodial branchiae are 2-branched and simple, without "pinnules" (feather-like branches) (fig. 2)
Posterior—a well-defined ventral groove, limited to the posterior area (fig. 1).

Possible Misidentifications

In the genus *Euzonus*, the anterior region (with 1st 2 setigers), is set off by a constriction. Other species of *Euzonus* to be found on sandy beaches include *E. williamsi*, whose 2 or 3 branched branchiae have a few lateral pinnules; *E. dillonensis* has single, not double branchiae, each with 15-20 pectinate divisions (Hartman 1969).

Ecological Information

Range—British Columbia to northern Baja California.
Distribution—clean sand of outer shore beaches, bays; Coos Bay: Crown Point, Fossil Point and North Bay, Cape Arago beaches.
Habitat—clean sand; the "inhabitant par excellence" of the protected beaches (Ricketts and Calvin 1971).
Salinity—
Temperature—
Tidal Level—middle level.
Associates—

Quantitative Information

Abundance—often found in dense mats of many hundreds or thousands of worms.

Life History Information

Reproduction—
Growth Rate—
Longevity—
Food—micro-organisms filtered from the fine sands in which they burrow much as do earthworms.
Predators—
Behavior—

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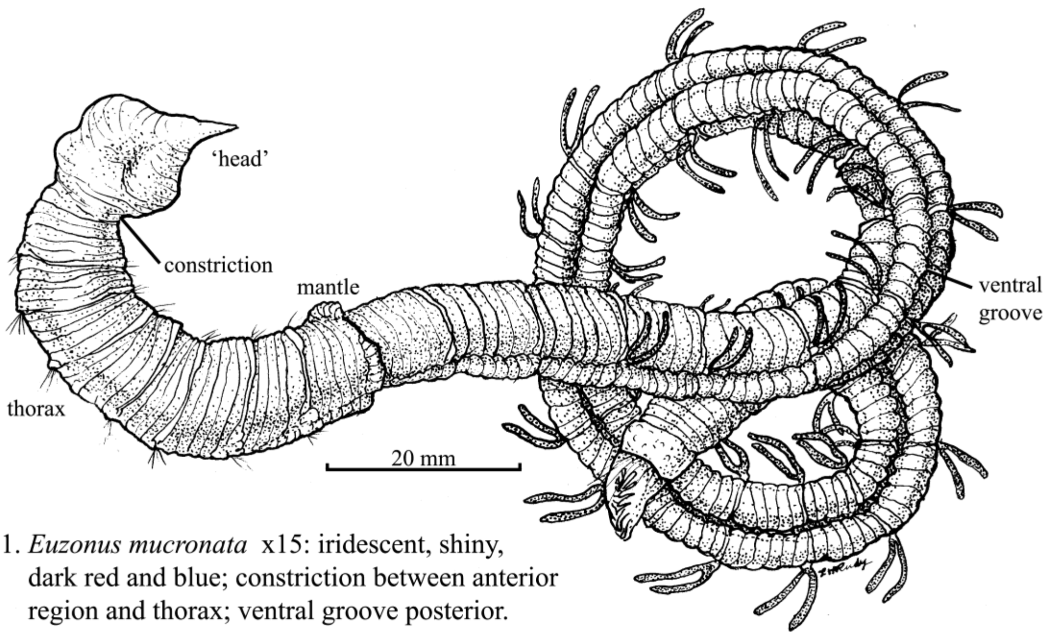
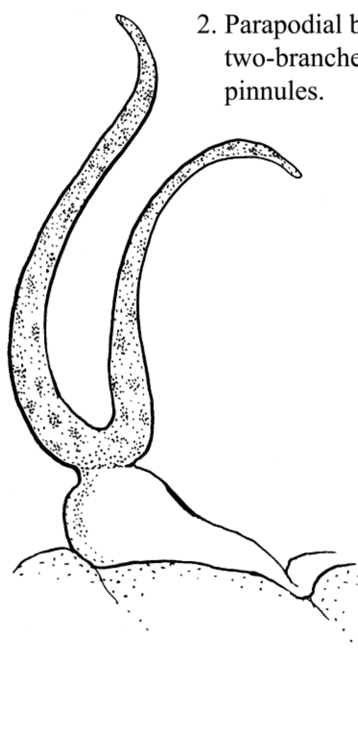
1. HARTMAN, O.1969. Atlas of the sedentariate polychaetous annelids from California. Allan Hancock Foundation, University of Southern California, Los Angeles.
2. RICKETTS, E. F., and J. CALVIN. 1971. Between Pacific tides. Stanford University Press, Stanford, California.

Euzonus mucronatua



1. *Euzonus mucronata* x15: iridescent, shiny, dark red and blue; constriction between anterior region and thorax; ventral groove posterior.



2. Parapodial branchia: two-branched, simple, without pinnules.

3. Mouth, extended

4. 'Head' (ventral view)

Euzonus mucronata (=*Thoracophelia mucronata*)

A bloodworm (Treadwell, 1914)

Phylum: Annelida
Class: Polychaeta
Order: Opheliida
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Description

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Thorax—a mantle covers the 1st 8 segments. The setigers are distinctly marked, with several muscle bands between them.
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Posterior—a well-defined ventral groove, limited to the posterior area (fig. 1).

Possible Misidentifications

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Temperature—
Tidal Level—middle level.
Associates—

Quantitative Information

Abundance—often found in dense mats of many hundreds or thousands of worms.

Life History Information

Reproduction—
Growth Rate—
Longevity—
Food—micro-organisms filtered from the fine sands in which they burrow much as do earthworms.
Predators—
Behavior—

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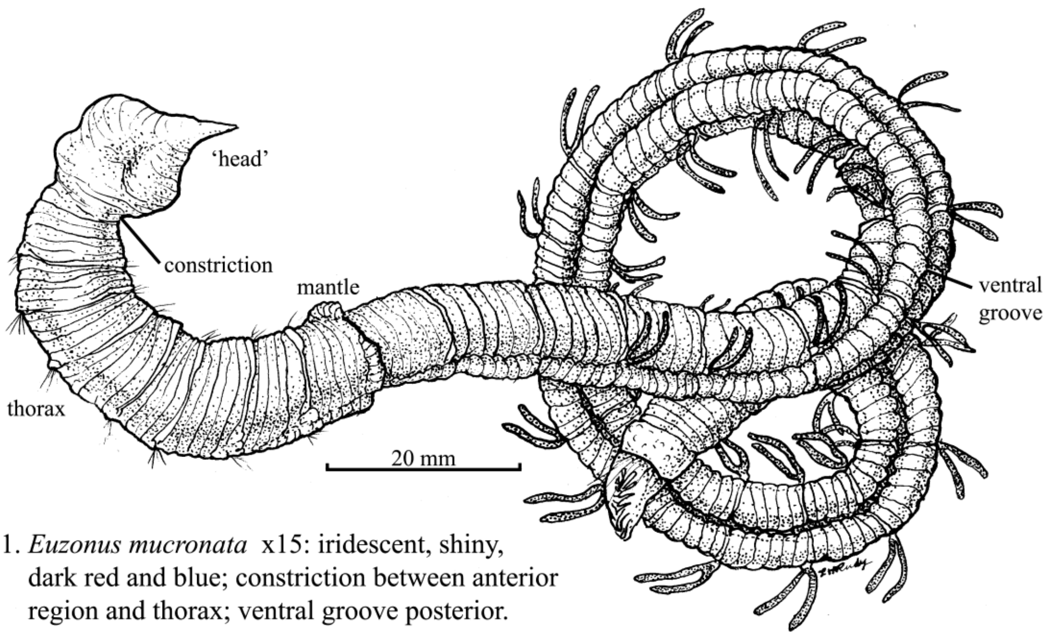
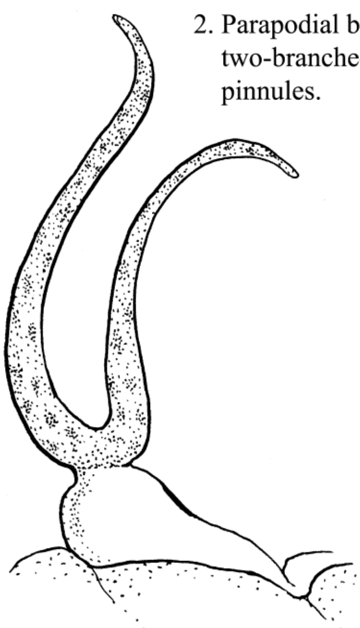
Euzonus mucronatua



1. *Euzonus mucronata* x15: iridescent, shiny, dark red and blue; constriction between anterior region and thorax; ventral groove posterior.



2. Parapodial branchia: two-branched, simple, without pinnules.

3. Mouth, extended

4. 'Head' (ventral view)

Glycinde armigera

Proboscis worm (Moore, 1911)

Phylum: Annelida
Class: Polychaeta
Order: Phyllodocida
Family: Goniadidae

Description

Size—3 cm.
Color—pale orange, slightly iridescent.
Prostomium—an annular cone with 8-9 annulations, ending in 4 small antennae; fused with peristomium (fig 2).
Proboscis—"large, powerful," when everted (Blake 1975): large, chitinized spines, circle of denticies, 2 large toothed jaws (fig. 3). Used for propulsion?
Body Characteristics—divided into 3 regions: anterior (27-30 segments) with uniramous parapodia (fig. 4a) a transitional area (47 + segments) in which notopodia gradually develop; posterior area (25-60) with biramous parapodia (fig. 4a): 100-144 segments.
Parapodia—both dorsal and ventral cirri are conical to fingerlike; dorsal not incised; pre-setal lobes of 25^{th} parapodia are heart-shaped (fig. 4a).

Possible Misidentifications

Closest to *G. potygnatha*, whose anterior dorsal cirri are incised (fig. 4b), and whose proboscidial armature is lacking (Blake 1975). Other similar Goniadidae are *Goniada brunnea*, large, dark brown, and with distinct chevrons on the sides of the proboscis: *Glycinde picta*, from British Columbia north has 5-6 yellow, simple hooded hooks on elongate dorsal cirri, presetal lobes of 25^{th} parapodia narrow distally, not heart-shaped.

Other "proboscis worms": family Glyceridae-all parapodia similar: proboscis with 4 horny jaws with supports.

Ecological Information

Range—Western Canada to Panama.
Local Distribution—off Reedsport, Depoe Bay, Oregon 20-74 fms (Hartman and Reish 1950). South Slough of Coos Bay, intertidally: (dredged from stations 1-6 South Slough of Coos Bay) (Porch 1970).

Habitat: Substrate—"muddy & mixed sand flats": intertidally: mud, eelgrass (Hartman 1968).
Salinity—
Temperature—
Tidal Level—"low intertidal to 275 fathoms", South Slough: +0.5 feet (Hartman 1968).
Associates—other polychaetes, amphipods, grass shrimp, barnacles.

Quantitative Information

Weight—
Abundance—widespread but in low numbers in Coos Bay (Porch 1970).

Life History Information

Reproduction—
Growth Rate—
Longevity—
Food—
Predators—
Locomotion—very active; proboscis used in burrowing and feeding.

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1. BLAKE, J. A. 1975. Phylum annelida: class polychaeta, p. 151-243. *In:* Light's manual; intertidal invertebrates of the central California coast. S. F. Light, R. I. Smith, and J. T. Carlton (eds.). University of California Press, Berkeley.
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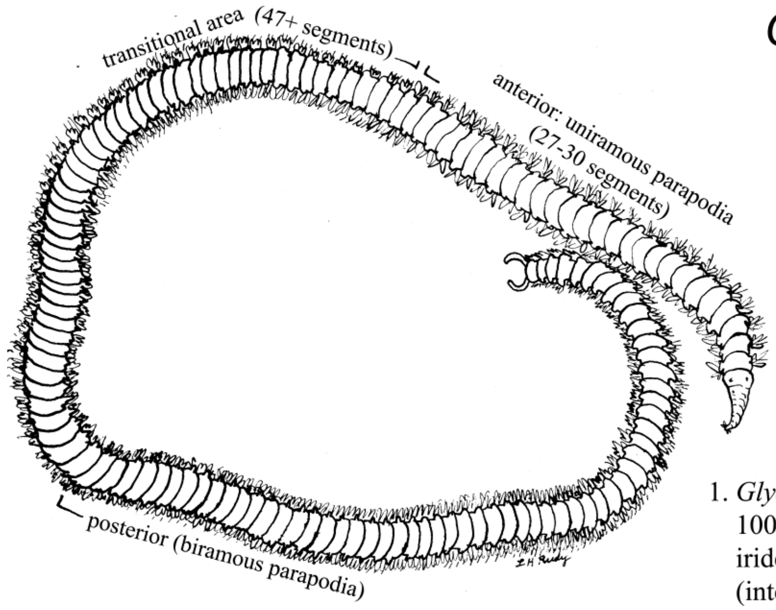
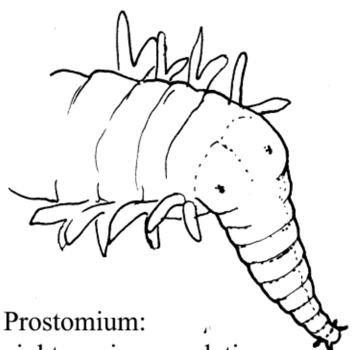
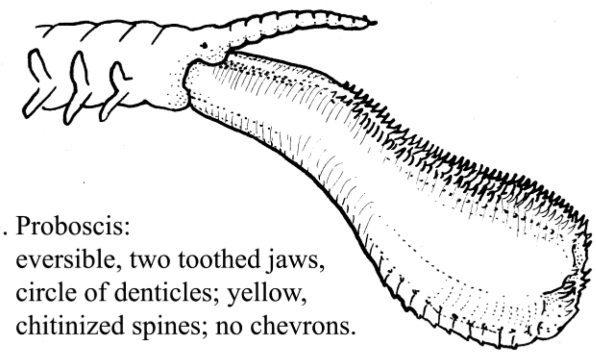
Glycinde armigera



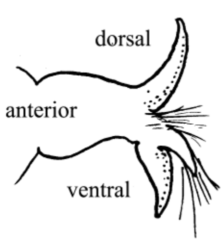
1. *Glycinde armigera* (L:3cm) x15:
   100-144 segments; pale orange, slightly iridescent, darker under parapodia (interior blood).



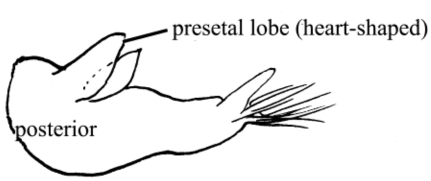
2. Prostomium:
   eight or nine annulations;
   basal eyes (distal not shown).



3. Proboscis:
   eversible, two toothed jaws,
   circle of denticles; yellow,
   chitinized spines; no chevrons.



4a. Parapodia:
   dorsal and ventral cirri conical,
   dorsal cirri not incised.



4b. Doral cirrus:
   G. polygnatha, anterior,
   dorsal incised.

Halosydna brevisetosa (=*H. johnsoni*)

Short-haired scaleworm (Kinberg, 1855; Dorboux, 1899)

Phylum: Annelida
Class: Polychaeta
Order: Phyllodocida
Family: Polynoidae

Description

Size—40 to 100 mm (Hartman 1968); this specimen: 22 mm. Commensal specimens larger than free-living (Morris et al 1980).
Color—variable; this specimen: mottled brown scales, with black and white spots.
Proboscis—strongly developed, 4-jawed (not figured).
Prostomium—broadest behind 4 eyes, frontal antennae attached terminally, 1 central frontal antenna (fig 2).
Parapodia—notopodia small, with short serrate setae; neuropodia large with many simple falcate neurosetae (fig. 3): all setae simple.
Elytra—18 pairs; occur on segments 2. 4, 5, 7 and alternately on odd segments; after 23, they occur on every 3rd segment; elytra reniform to ovate, varied in color, a few tubercuies.
Body Segments—37.

Possible Misidentifications

The number of pairs of elytra make identifications easy in this family; closest are *Harmothoe*, *Lepidathenia*, and *Arctonoe sp*. with 15 pairs of elytra. *H. johnsoni*, a southern California species with distally bifid neuropodial setae, is treated as a separate species (Hartman 1968), or as the same (Blake 1975). Other species of the genus *Halosydna* do not occur in the Northwest.

Ecological Information

Range—southern California to Alaska: type locality, Sausalito, California.
Local Distribution—as commensal with terebellied worms, hermit crabs, moon snails; free-living in mussel beds, under stones. Very common in South Slough (Hartman and Reish 1950).
Habitat—free-living: in rocks or on pilings; as commensal: with mud-dwelling forms. Prefers clean waters; seldom occurs where dissolved oxygen levels drop below 2.5 mg/l (Morris et al 1980).
Salinity—

Temperature—
Tidal Level—intertidal; South Slough, at 0.5 ft.
Associates—hosts: *Pista pacifica*, (South Slough); hermit crab *Paguristes*, living in shell of moon snail *Polinices* (McGinitie and McGinitie 1949).

Quantitative Information

Weight—
Abundance—most common scaleworm in central, northern California (Blake 1975); also very abundant in Oregon and Washington.

Life History Information

Reproduction—sexes separate; gonads in segments 12-34; larvae found Tomales Bay, Sept. and Oct.; newly settled juveniles 0.9 mm long, with 11 segments (Morris et al 1980).
Growth Rate—
Longevity—
Commensalism—animals not chemically attracted, possible tactile responses (Davenport and Hickok 1950).
Food—voracious eaters (cannibals in captivity); probably share food of host when commensal.
Predators—

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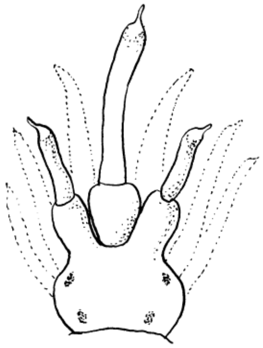
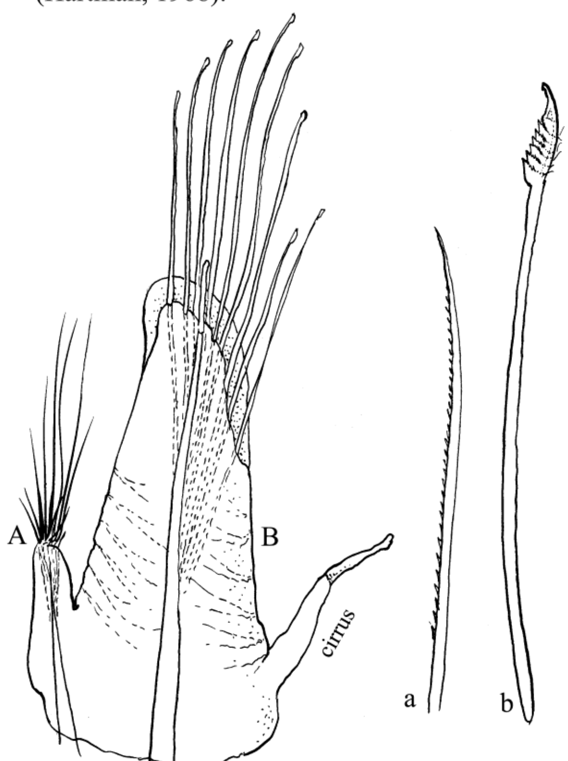
Halosydna brevisetosa

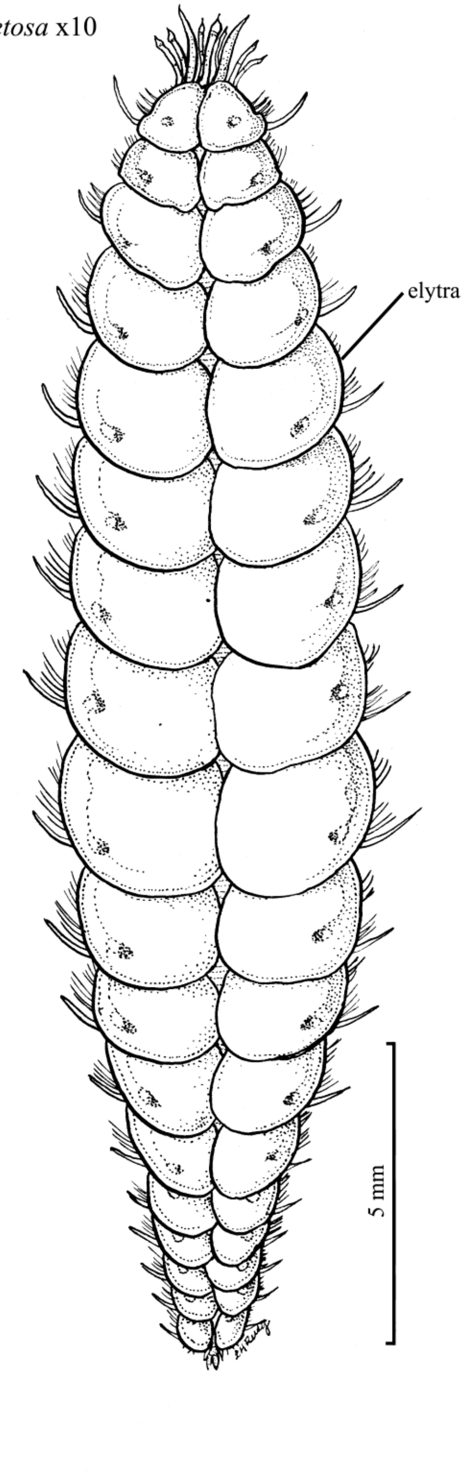


2. Prostomium:
broodest behind four eyes;
central frontal antenna;
antennae attached terminally
(Hartman, 1968).



3. Parapodia:
notopodia small, with short, serrate setae (A,a);
neuropodia large; simple falcate setae (B,b).

1. *Halosydna brevisetosa* x10



Hesperonoe complanata

Commensal scale worm (Johnson, 1901)

Phylum: Annelida
Class: Polychaeta
Order: Phyllodocida
Family: Polynoidae

Description

Color—"flesh"; reddish around head; elytra pale, translucent; setae clear.
Mite—to 1½ inches (MacGinitie and MacGinitie 1949); (21 mm), width to 6 mm including setae (Johnson 1901).
Shape—flattened dorso-ventrally; almost all covered with 15 pairs of scales (elytra) (fig. 1); 36-38 segments.
Protomium—6-sided, as long as wide, deeply incised; 4 ocelli (fig. 2); large medial antenna, 2 small prostomial biarticulate antennae (inserted below lateral lobes of prostomium) (fig. 3). Lateral palpi: 1 pair, longer than medial antenna, red. 2 pairs tentacular cirri (figs. 2, 3).
Parapodia—distinct noto- and neuropodia; notopodia short, with 2 kinds of simple setae; long dorsal cirrus, easily detached (fig. 1, 5), alternate with elytra (fig. 1). Neuropodia long, with one kind of long setae (although lower ones can be thicker than upper ones) (Fauchald 1977); ventral cirrus (fig. 5).
Setae—notosetae, two kinds: many, stout, blunt, minutely serrated, both short and long (fig. 5a); a few (4-5) slender, pointed and serrate: genus *Hesperonoe* (fig. 5b) (Fauchald 1977). Neurosetae, one kind: curved, simple, with lateral serrations (fig. 6), although upper neurosetae can be more slender, lower ones stouter.
Elytra—15 pairs, reniform (kidney-shaped) (Hartman 1968), covering most of body. Thin, delicate easily detached; with widely spaced low papillae (fig. 4). Species with relatively smooth elytra, like this one, are often commensal (Fauchald 1977).

Possible Misidentifications

Hesperonoe complanata is the only scale worm known to be commensal with the ghost shrimp *Callianassa* (which see). Another species, *H. adventor*, lives with the echiuroid *Urechis*. It is larger (to 40 mm), has short, ciliated palpi, antennae, and dorsal cirri; its roundish elytra have dark crescents on their posterior thirds. The third Pacific species, *H. laevis*, is found in deep water off Santa Barbara, California, with another echiuroid.

The genus *Hesperonoe* can be distinguished from other polynoids by its 15 pairs of smooth elytra covering almost the entire body as well as by its prostornial antennae, which are inserted ventrally, not terminally (fig. 3), and by the 2 kinds of simple notosetae.

Of other common intertidal scale worm genera, Polynoe has fifteen pairs of elytra, but they are only on the anterior end of the body and it has more than 50 segments, not 36-38; *Arctonoe* has 20 or more elytra pairs; *Halosydna* has 18 pairs of elytra.

Ecological Information

Range—western Canada to southern California (Hartman and Reish 1950). Type locality: Puget Sound.
Local Distribution—in many *Callianassa* burrows in larger Oregon estuaries; *Callianassa* is found in Alsea, Nestucca, Netarts, Umpqua, Tillamook, and Yaquina estuaries, Coos Bay.
Habitat—the burrows of the ghost shrimp *Callianassa* are large, sloppy, permanent, with side tunnels. They occur in the sandy mud of low mudflats in extensive beds; also among oyster beds. The juvenile *Hesperonoe* are found lying on the abdomens of *Callianassa*; the adults are free-living in the burrow (MacGinitie and MacGinitie 1949).
Salinity—collected at 30 ‰, Coos Bay; southern Puget Sound, 27 ‰ (communication, R. Boomer).
Temperature—quite a variant: from cold temperate to warm temperate.

Tidal Level—intertidal; *Callianassa* occurs from "upper to mid-intertidal" (Ricketts and Calvin 1971).
Associates—other commensals with the ghost shrimp can include the pea crabs *Scleroplax* and *Pinnixa*, copepods *Hemicyclops* and the red *Clausidium*, the goby *Clevelandia*, the shrimp *Betaus* (farther south), and the clam *Cryptomya* with mud shrimp *Upogebia* in California.

Quantitative Information

Weight—
Abundance—MacGinitie found them in one fifth of the *Callianassa* burrows, but thought some might have escaped detection. Only one adult is found in a burrow, and no other polychaete will be resident there (macGinitie and MacGinite 1949).

Life History Information

Reproduction—
Growht Rate—
Longevity—
Food—eats particles brought in with current or trapped in *Callianassa* burrow, and which are too big for the shrimp; occasionally it nibbles on the mucus lining of the burrow as well, which would make it parasitic, not just commensal (MacGinite and macGinitie 1949).
Predators—
Behavior—

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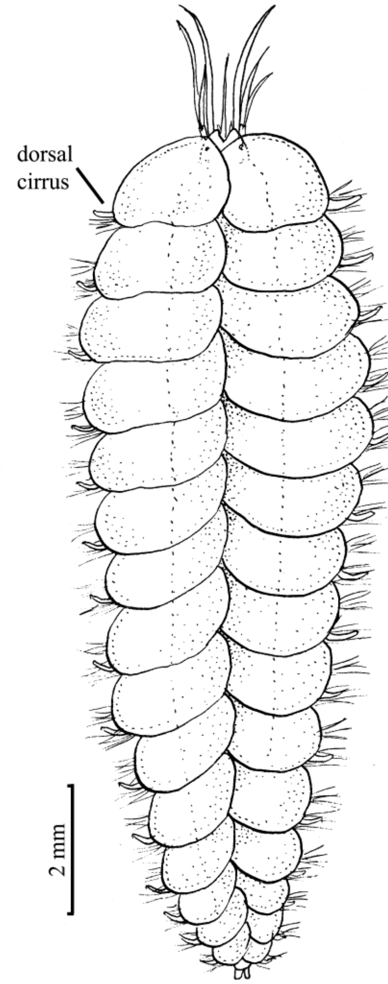
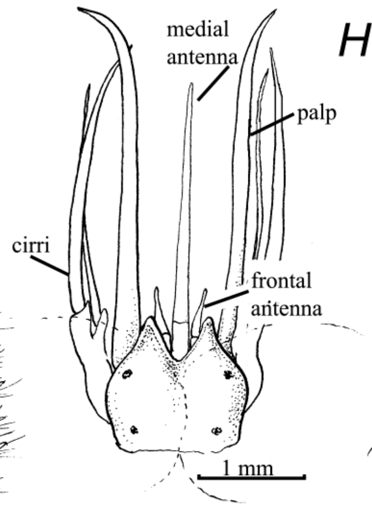
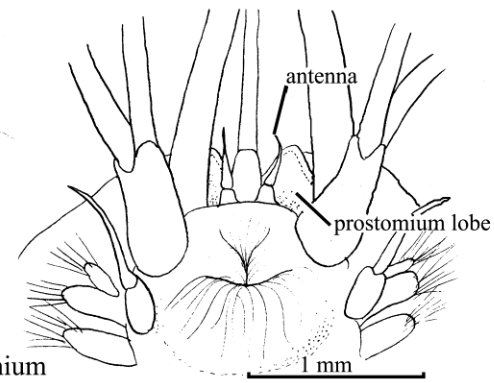
Hesperonoe complanata



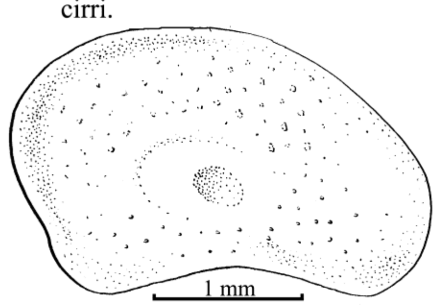
1. *Hesperonoe complanata* x11:
15 pairs smooth elytra; body flattened;
dorsal cirri alternate with elytra.



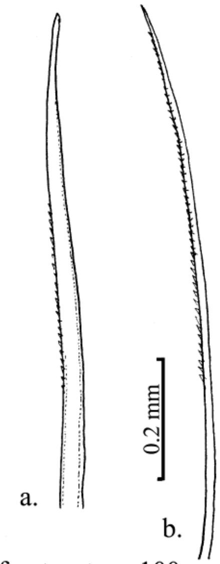
2. Head (dorsal view) x18:
two pairs of eyes; prostomium deeply incised; short frontal antennae, long medial one; one pair palps, two pairs tentacular cirri.



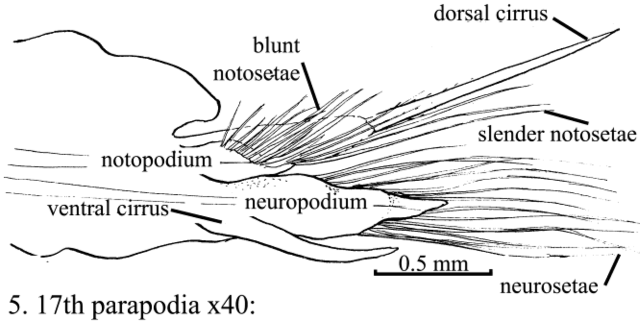
3. Head (ventral view) x30:
antennae inserted ventral to prostomium, not terminal.



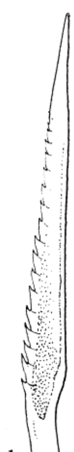
4. Elytron x25



6. Ends of notosetae x100:
a. stout, blunt, minutely serrate (both short and long)
b. long, slender, serrate.



5. 17th parapodia x40:
notopodia short, notosetae of two kinds- many stout, blunt serrate; a few slender, pointed; serrate. Neuropodia long, neurosetae long, slender, serrate; dorsal and ventral cirrus.



7. Neuroseta, tip x100:
curved, simple; lateral serrations.

Hobsonia florida *(Amphicteis gunneri floridus (Zottoli 1974))*

A tube-dwelling polychaete worm (Hartman, 1951)

Phylum: Annelida
Class: Polychaeta
Order: Terebellida
Family: Ampharetidae

Description

Size— 8-15 mm long (Zottoli 1974); illustrated specimens (Columbia River) up to 12 mm x 1.5 diameter. Earliest recruits (juveniles) 200 µ.x 9µ (Gallagher 1979).
Color— orange with whitish spots in life (Banse 1979); white in preservation.
Body— rather conical: large anteriorly, becoming small at posterior end; about 43 segments (17 in thorax, 26 in abdomen (Zottoli 1974). 8 smooth cylindrical branchiae; up to 20 retractile feeding tentacles; prostomium snout-like; fine paleae; capillary notosetae, uncigerous neurosetae (fig. 3). Internal: 2 pairs of long nephridia in segments 6, 7; stomach with internal medioventral diverticulum (Banse 1979) (not figured).
Eyespots—2, small; behind glandular ridges on prostomium (fig. 2) - preserved specimens. (Live animals can have clusters of pigment spots on underside of upper lip (Banse 1979). See Pygidium below.
Prostomium—well developed, prolonged into a snout (Hartman 1951); 4-lobed. Lobes may be more noticeable in preserved specimens, as some live animals are smooth (Pettibone 1953). Glandular ridges present, but not in all specimens (Banse 1979). No palps or other prostomial appendages (fig. 2).
Paleae—(flabellum (Hobson and Banse 1981)); fascicles of about 8 (on each side): fine, flattened setae on segment 3 (fig. 1) (Banse 1979), with delicate flexed tip (fig. 3b). Paleae not much more obvious than capillary notosetae.
Branchiae—(dorsal, four pairs; cylindrical, smooth, pointed, all of the same type. 1st pair attached to segment 3 (paleal segment), subsequent pairs attached to segments 3, 4, 5 (fig. 1). Branchiae can have white transverse pigment bands, making them appear to be jointed (Fauchald and Jumars 1979), (but not in these specimens).
Feeding Tentacles—up to 20: fine, grooved, transparent; lateral ones shorter than ventral ones (fig. 2). Very distensible, can be as long as worm (Banse 1979). Retractile into mouth:

family Ampharetidae (Kozloff 1974a; Blake 1975).
Thorax—stout, with 17 setigerous segments and 2 anterior acaetous segments (fig. 1).
Abdomen—22-28 segments: sp. *florida* (*Zottoli 1974*), (23-26 segments (Banse 1979)). Abdomen has neuropodia only, no notopodia - only rudimentary lobes in anterior segments (fig. 1): sp *florida* (Banse 1979). Abdomen narrow, reduced; these specimens with 26 segments - 23 setigerous, last 3 achaetous (reference needed) (fig. 1).
Parapodia—reduced; biramous in thorax, uniramous (neuropodia only) in abdomen (fig. 1).
Notopodia—17, beginning on segment 4 (Pettibone 1953); each consists of a single lobe with a fascicle of capillary setae (fig. 3a). Notopodium with a small cirrus (not shown).
Neuropodia—14 in thorax, 23 in abdomen. Thoracic neuropodia begin on segment 7 (setiger 4) (Pettibone 1953) (fig. 1). Each is made up of a single row of uncini in a torus (fig. 4). Thoracic uncini have 4 teeth, abdominal uncini have 5 (fig. 3c) (Pettibone 1953). A long dorsal cirrus is present on abdominal neuropodia (Banse 1979) (fig. 4).
Pygidium—without anal cirri or papillae: sp. *florida* (Zottoli 1974); slightly lobed. Posterior end (last few segments of worm) can be turned inside. A pair of eyespots in young at posterior end of worm visible in live specimens, and in some freshly preserved adults (Banse 1979). (Not in these specimens).
Tube—composed of sediment particles and debris on outside which give tube a shaggy, annulated appearance (fig. 2). Tube about 5x body length, is mucus lined. Upper 1/3

projects above substrate. Juveniles build first tubes a few days after settling (Fauchald and Jumars 1979).

Possible Misidentifications

Ampharetidae are small worms (usually less than 5 cm long (Kozloff 1974a)), with clearly defined thorax and abdomen, both of which have neuropodia with uncini. The notosetae are capillary in the thorax and are reduced or absent in the abdomen (Fauchald 1977). They have 2 to 4 pairs of simple branchiae, and completely retractable feeding tentacles (Blake 1975).

The Terebellidae, which they resemble closely, are usually over 5 cm long. Terebellids also have feeding tentacles, but these are not completely retractile into the worm's mouth. Their branchiae are not simple, but consist of masses of aborescent or filamentous structures. Their prostomium is a simple fold. (See *Thelepus, Pista).*

There are numerous genera of Ampharetidae, many of them deepwater inhabitants. Some of the intertidal and shallow water genera include:

Amage-anops Johnson is the local representative. This genus lacks paleae, unlike *Hobsonia.* Like *Hobsonia,* it has smooth branchiae, which are all of 1 type (Kozloff 1974a). It has been found in Puget Sound (Banse 1979).

Ampharete sp. have 14 thoracic setigers (not 17, as in *Hobsonia). A.labrops* Hartman has 4 pairs of smooth branchiae (like *Hobsonia) (Blake 1975),* but has numerous eyespots on the margin of its large upper lip, as well as 2 small ones on the upper side. It has 13 abdominal uncinigers and 2 anal cirri. *A. arctica* Malmgren is found in Puget Sound (Kozloff 1974a). Its 4 pairs of branchiae are in 2 rows - 3 pairs in the first row, 1 pair in the second row near the midline. *A. acutifrons* (Grube) has been reported from Alaska, British Columbia, and Washington, and has long anal cirri (Banse 1979). Its 4 pairs of branchiae are in 2 rows - 2 pairs in each row (Gallagher 1979).

Anobothrus sp. has 4 pairs of branchiae and anterior paleae (like *Hobsonia),* but has only 15 thoracic setigers and 12 uncinigers (not 17 and 14). It has 1 thoracic setiger (the 10th or 11th) with elevated and modified notosetae (Fauchald 1977).

Hypaniola is unispecific *(kowalewskii),* and possibly found only in Europe. Like *Hobsonia* is has 4 pairs of smooth branchiae and small paleae; unlike *Hobsonia,* it lacks glandular prostomial ridges. *Hypaniola grayi* (Pettibone, 1953) was synonymized with *Amphicteis florida* (Zottoli 1974) (now *Hobsonia).*

Melinna sp. have 4 pairs of smooth branchiae and only 14 thoracic uncinigers- like *Hobsonia.* But unlike *Hobsonia, Melinna* has nuchal hooks anterior to the branchiae, and a dorsal crest on segment 6. *M. elizabethae* is found in the Arctic and northeastern Pacific (Banse 1979).

Schistocomus sp,- *hiltoni* Chamberlin is the most common local form (Blake 1975) - has 3 pairs of pinnate, and 1 pair of smooth branchiae. (All of *Hobsonias branchiae* are simple and smooth). It has only 15 thoracic setigers (not 17), and it lacks paleae. It is found most often on open coasts (Blake 1975).

The genus *Hobsonia* (Banse, 1979) is distinguished by its lack of anal cirri, its great number of abdominal segments (23-26) and its lack of all but rudimentary notopodial lobes in the abdomen (Banse 1979). The genus was removed from *Amphictes: Amphicteis gunneri floridus,* (Hartman 1951) is the same animal. *Hypaniola grayi (*Pettibone,1953) and *Amphicteis floridus* (Zottoli 1974) are probably synonymous also: the genus is unispecific (Banse 1979).

Ecological Information

Range—restricted to Oregon Biogeographic Province, ie. British Columbia, Washington and Oregon (Banse 1979).

Local Distribution—Columbia River: Young's Bay, near Astoria, Gray's Harbor (Washington side); also Siletz, Salmon Rivers.

Habitat— in salt marshes near river mouths, and in intertidal mud (Banse 1979); subtidal estuarine muds as well (Zottoli 1974). Worms live in tubes projecting obliquely above surface, oriented depending on available food (Fauchald and Jumars 1979).

Salinity—salt content or water can be near zero; worm can reach sexual maturity in areas of low salinity (Banse 1979).
Temperature—
Tidal Level— Intertidal and subtidal
Associates—amphipod *Corophium salmonis* replaces *H. florida* in succession (Gallagher 1979). Atlantic coast: polychaetes *Haploscoloplos, Heteromastus, Polydora.*

Quantitative Information

Weight—
Abundance—densities of 150/10 cm^2, Skagit, Wash., 3 weeks after colonization (Gallagher 1979).

Life History Information

Reproduction—spawning from late May to early September (New Hampshire) (Zottoli 1974). Eggs released by female into tube; sperm brought into tube from surrounding waters by ciliary currents. Embryos develop in tube to 2-setiger stage, when they leave tube and develop on bottom. Eggs (about 100) irregular, each 0.20 x 0.15 x 0.05 mm (Washington (Banse 1979)). Eggs do not develop inside a sac, but are free in tube; female remains inside tube during their development (Zottoli 1974).
Growth Rate—from 1 to 18 setigers in 36.14 days (in lab); branchiae developed by 11-setiger stage; larvae easily raised in lab (Zottoli 1974). Earliest colonist in succession (sand flats, Skagit, Wash.): population crashes and is replaced by amphipods and other polychaetes (Gallagher 1979).
Longevity—
Food—a surface deposit feeder, picking up particles with tentacles; family eats detritus, unicellular algae, larval invertebrates (Fauchald and Jumars 1979). Worms begin feeding as newly settled juveniles of 2-3 setigers, by muscular pumping of lips, before tentacles develop (Zottoli 1974). When feeding, adult stretches out of tube, spreads tentacles over substratum, keeps branchiae up in water (fig. 2) (Fauchald and Jumars 1979). Food ingestion dependent on particles' surface texture, size; sorting for specific gravity done in gut (Self and Jumars 1978)·
Predators—amphipod *Eogammarus confervicolus* (on juveniles) (Gallagher 1979).
Behavior— sessile, but moves by continuous tube-building, especially when food is scarce (Fauchald and Jumars 1979).

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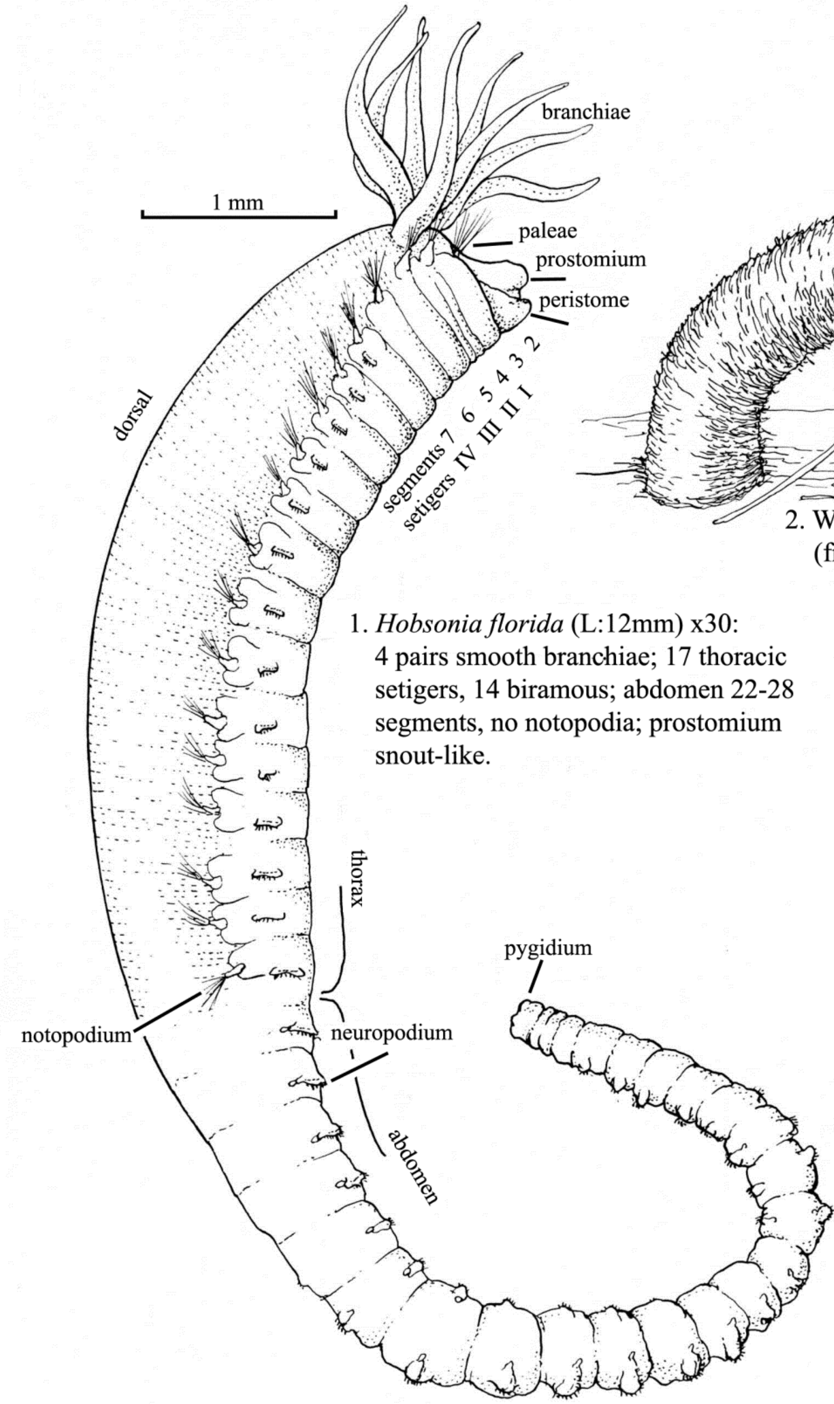
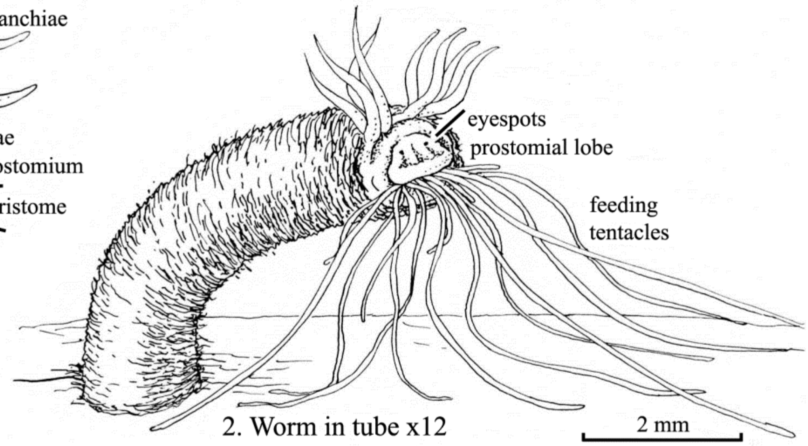
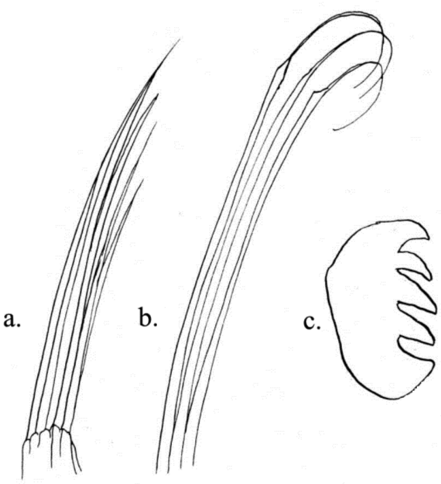
Hobsonia florida



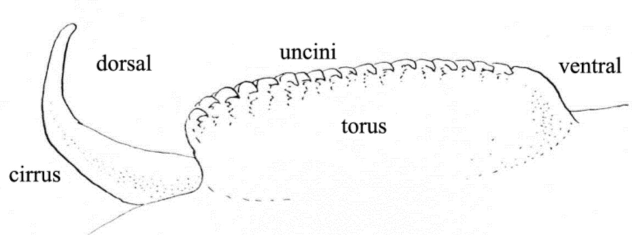
1. *Hobsonia florida* (L:12mm) x30:
4 pairs smooth branchiae; 17 thoracic setigers, 14 biramous; abdomen 22-28 segments, no notopodia; prostomium snout-like.



2. Worm in tube x12
(from Fauchald & Jumars, 1979).



3. Setae:
a. capillary notosetae x150
from setiger 8; 6 in fascicle;
b. paleae x100
from segment 2;
c. uncinus (neuropodial) x1000
(abdominal-5 teeth).



4. Neuropodium x400:
from abdominal setiger 4
long dorsal cirrus.

Leitoscoloplos pugettensis *(=Haploscoloplos elongates)*

A burrowing polychaete worm (Pettibone, 1957)

Phylum: Annelida
Class: Polychaeta
Order: Orbiniida
Family: Orbiniidae

Description

Size—100- 200 mm long x 3 mm (Hartman 1969). This specimen (Coos Bay) 136 segments, 75 mm long.
Color—when sexually ripe, males are pink, females gray (Blake 1980).
Body—long, slender, 200 to 300 short segments (Johnson 1901). Posterior easily lost. Broadest at segments 9-17; narrows gradually after segment 200. Thorax: dorsum flat, ventrum convex.
Prostomium—no palps or appendages: family Orbiniidae (Fauchald 1977). Prostomium small, pointed: genus *Leitoscoloplos* (Day 1977). Small palpode (fig. 2a).
Peristomium—no palps or appendages. Increases rapidly in width toward 2nd segment (fig. 2a). Can be annulated.
Eyes—none.
Proboscis—eversible, with leaf-shaped lobes (fig. 2b).
Segments—1st one achaetous (without setae) (figs. 1, 2).
Parapodia—lateral anteriorly; Orbiniidae (Fauchald 1977). Biramous; small papillar postsetal lobes in both branches in thorax (Hartman 1969) (fig. 3). In abdomen, lobes become longer, leaf-like (Johnson 1901) (fig. 5); abdominal parapodia become dorsal (Hartman 1969) (fig. 1), and are supported by acicula (fig. 5).
Setae—all simple: Orbiniidae (Fauchald 1977). All slender, pointed: *leitos* = simple, *scoloplos* = thorn (Day 1977). In thorax, nolo- and neurosetae are finely crenulate (fig. 4a). Neurosetae can be transversely spinose (Hartman 1969) (not in these specimens). Abdominal setae (in both lobes) have slender capillaries, as in thorax, and a few furcate spines (Hartman 1969) (fig. 4c).
Branchiae—begin on setigers 13 - 18 (Hartman 1969); sp. *pugettensis;* (18 in these specimens, Coos Bay). Branchiae small anteriorly, becoming flat and subdistally inflated, laterally fringed ("fimbriated") posteriorly (fig. 5) (Hartman 1969).

Ventral Papillae—none in posterior thorax in genus *Leitoscoloplos* (Day 1977) (fig. 1).
Pygidium—slightly expanded, hemispherical (Johnson 1901); anus dorsal. Long, slender anal cirri (fig. 1 - *Scoloplos acmeceps*).

Possible Misidentifications

The order Orbiniida (Fauchald 1977) includes Orbiniidae, Paraonidae and Questidae. It can be distinguished from superficially similar orders by its lack of prostomial appendages, by its maximum of 2 asetigerous anterior segments, and by a lack of additional cephalized segments or of palps. Its eversible pharynx is either an axial sac or a ventrolateral pad; its parapodia are biramous; all setae are simple.

Orbiniidae have a prostomium and peristomium without appendages. They have 1 - 2 asetigerious anterior segments. Thoracic parapodia are lateral, becoming dorsal in the abdomen. Setae can be capillary or simple hooks; some species have brush-topped bifid or furcate setae.

There are several similar families: Ophelidae are short and stout, and have a strong ventral groove. Goniadidae and Glyceridae have palps or some kind of buccal appendage. Ampharetidae have retractible tentacles, and Lumbrineridae have hard jaw pieces and hooded hooks among the setae. (None of these families is in the order Orbiniida.)

Among those families which are Orbiniids, the Paraonidae have branchiae occurring only on a maximum of 15 – 20 segments, and beginning on the 4th – 10th setigers (not on all the posterior segments). The body in Paraonidae is not divided into distinct regions (by setae and parapodial shapes), but these change gradually along the body (Fauchald 1977); regions are distinct in Orbiniidae. A

Paraonidae prostomium can have a medial antenna, lacking in Orbiniidae. Paraonidae, which can occur locally, include *Aricidea, Cirrophorus, Paraonella,* and *Tauberia* (Hobson and Banse 1981).

Questidae, like Paraonidae, lack distinct differences in thoracic and abdominal setae and parapodia. Their branchiae, if present, are posterior only (Fauchald 1977). Questidae neuro- and notopodial setae include bifid falcigers (single toothed hoods, see *Boccardia proboscidea,* fig. 5e). The local genus is *Questa* (Hobson and Banse 1981).

There are several other genera of Orbiniidae in our area: The separate subfamily Protoarciinae are small (under 20 mm), with a rounded prostomium, 1 - 2 asetigerous anterior segments, and can lack branchiae. Genera include:

Orbiniella, with 2 asetigerous anterior segments and no branchiae. Neuropodia have both hooks and capillary setae Hobson and Banse 1981). *O. nuda* is found in Washington and British Columbia, intertidally in gravel and in rock.

Paraorbiniella Rullier is another northeastern Pacific genus in the family (Hobson and Banse 1981) (no further information is available).

Protoaricia sp. has 2 asetigerous segments; it is less than 6 mm long and has been found in northern California (Blake 1975).

Protoariciella differs from *Protoaricia* by the presence of hooks in its abdominal neuropodia (Hobson and Banse 1981). Its branchiae appear first at setigers 4-5 and continue to setigers 28-47. Most of its notosetae are forked. *P. oligobranchia* is found in British Columbia (Hobson 1976).

Polychaetes in the subfamily of *L. pugettensis,* the Orbiniinae, have only 1 asetigerous anterior segment, and its members are usually over 20 mm long. Other genera include

Naineris, which has a broadly rounded prostomium (unlike that of *Leitoscoloplos). N. dendritica,* often found in algae or in the marine grass *Phyllospadix,* occurs inside Coos Bay (Hartman and Reish 1950) and offshore. *N. quadricuspida* and *N. uncinata* are found farther north (Hobson and Banse 1981).

Polychaetes of the genus *Orbinia* (like *L. pugettensis)* have a pointed prostomium and 1 asetigerous anterior segment, but they also have very conspicuous ventral papillae on the posterior thoracic segments, lacking in the latter species. *O. Johnsoni* (Moore, 1909) is a rocky intertidal species. *Phylo* is a subgenus of *Orbinia* (Hobson and Banse 1981).

Scoloplos is the genus most likely to be confused with *Leitoscoloplos. Scoloplos* spp. have a pointed prostomium, 1 asetigerous anterior segment, and no ventral thoracic papillae. These 2 genera must be separated by their setae: *Scoloplos* have blunt spines as well as slender pointed setae in the thoracic neuropodia. *Scoloplos acmeceps* has a few incomplete rows of curved and ridged uncini in its thoracic neuropodia. Some of these neuropodia also have a single postsetal lobe. This species is found in the Coos Bay and Umpqua estuaries, usually subtidally. In California, it is also intertidal, in mud and algae holdfasts and in *Zostera* roots (Blake 1975). *S. armiger,* found in southern California, is distinguished from the former species by the presence of 2 post-setal thoracic neuropodial lobes, not 1.

The genus *Leitoscoloplos* (Day, 1973) now includes all former *Haploscoloplos* species without parapodial hooks. *(Haploscoloplos* is now a junior synonym of *Scoloplos;* for nomenclature see Blake 1980; Day 1973; Day 1977). In *Leitoscoloplos* the thorax is rounded, and lacks parapodial hooks and ventral papillae. There is only 1 other known Pacific northwest species, *L. panamensis* (Monro) (=Haploscoloplos (Hartman 1969)). This species can have 1 or 2 subpodial lobes on its posterior thoracic parapodia (fig. 3, dotted lines, arrow) - lacking in *L. pugettensis.* Branchiae begin on setigers 11 -13 in *L. panamensis* and on setigers 13-18 in *L. pugettensis.* From British Columbia to Panama.

Ecological Information

Range— Alaska to southern California (Hartman 1969).

Local Distribution— Coos Bay: South Slough, Shore Acres; offshore. Columbia mouth, Yaquina Bay.
Habitat— burrows in sandy shores (Johnson 1901); in gravelly, silty, or fine sands (Parkinson 1978); in sandy mud (Hartman 1969); particularly in fine mud (Barnard and Reish 1959): all substrates but black sulfide mud. Found occasionally with eelgrass or algae, but not as closely associated with plant growth as in *Naineris* (Blake 1975). In Bodega Bay, California, most common in sandy mud with a large grain size and with little algal *(Ulva)* cover (Parkinson 1978).
Salinity—collected at 30‰ (Coos Bay).
Temperature—larvae successfully cultured at 15°C (Blake 1980)
Tidal Level—"near low-water mark" (Johnson 1901). Also subtidal, but not as often as *Scoloplos* in Coos Bay. Down to 700 f (380 m) (Parkinson 1978).
Associates—

Quantitative Information

Weight—
Abundance—one of most common intertidal and subtidal benthic polychaetes of the Pacific Coast of North America (Blake 1980). A stable population (over 12 months, Tomales Bay, Calif.), but densest Oct- Dec., and Mar.-Apr. Size distribution also stable (Blake 1980). Most frequently found orbiniid in Newport Bay, California (Barnard and Reish 1959) and in northern California (Day 1977).

Life History Information

Reproduction— species dioecious. Individuals may pair up during spawning; males release sperm, which find eggs as they are released by females (Blake 1980). Ripe females found June - Dec. (Tomales Bay); largest number in July. Females form a 2 cm, pear-shaped cocoon at sediment surface, then secrete a jelly-like substance from ventrum. Eggs are extruded from medial segments through nephridial pores at notopodial bases; egg deposition takes 1-2 hrs. Female anchors jelly mass into sediment as an escape hatch for larvae. Egg diameter mean 210 μ. In lab, at 15°C: 2 days to trochophore, a barrel shape with 2 red eyes; 11 days to 3 setiger nectochaete. Hatching from 3-12 setiger stage, 11 to 20 days. A few larvae escape at 7 segment state and swim; most crawl, lacking swimming cilia at 12 segments (Blake 1980).
Growth Rate—at 15°C and 33‰: at 6 days, a 3 segment larva almost 5 mm; at 14 days, a 10 segment larva 9 mm; at 21 days, a 14 segment larva was 12 mm (Blake 1980).
Longevity—
Food— all orbiniids are considered to be non-selective deposit feeders: they have a sac-like pharynx; (but no work done to test for selectivity (Fauchald and Jumars 1979). Gut contents: diatoms, foraminifera, sand, Unidentified (Parkinson 1978).
Predators—
Behavior—a free burrower: pointed prostomium used as anchor to penetrate substrate and to enlarge burrow (Parkinson 1978); muscular thorax used for digging. Proboscis soft, not used for digging. Movement by retrograde waves - back or *forward,* much like *Arenicola marina (Parksinson 1978).* Larva burrows with pharynx (Fauchald and Jumars 1979).

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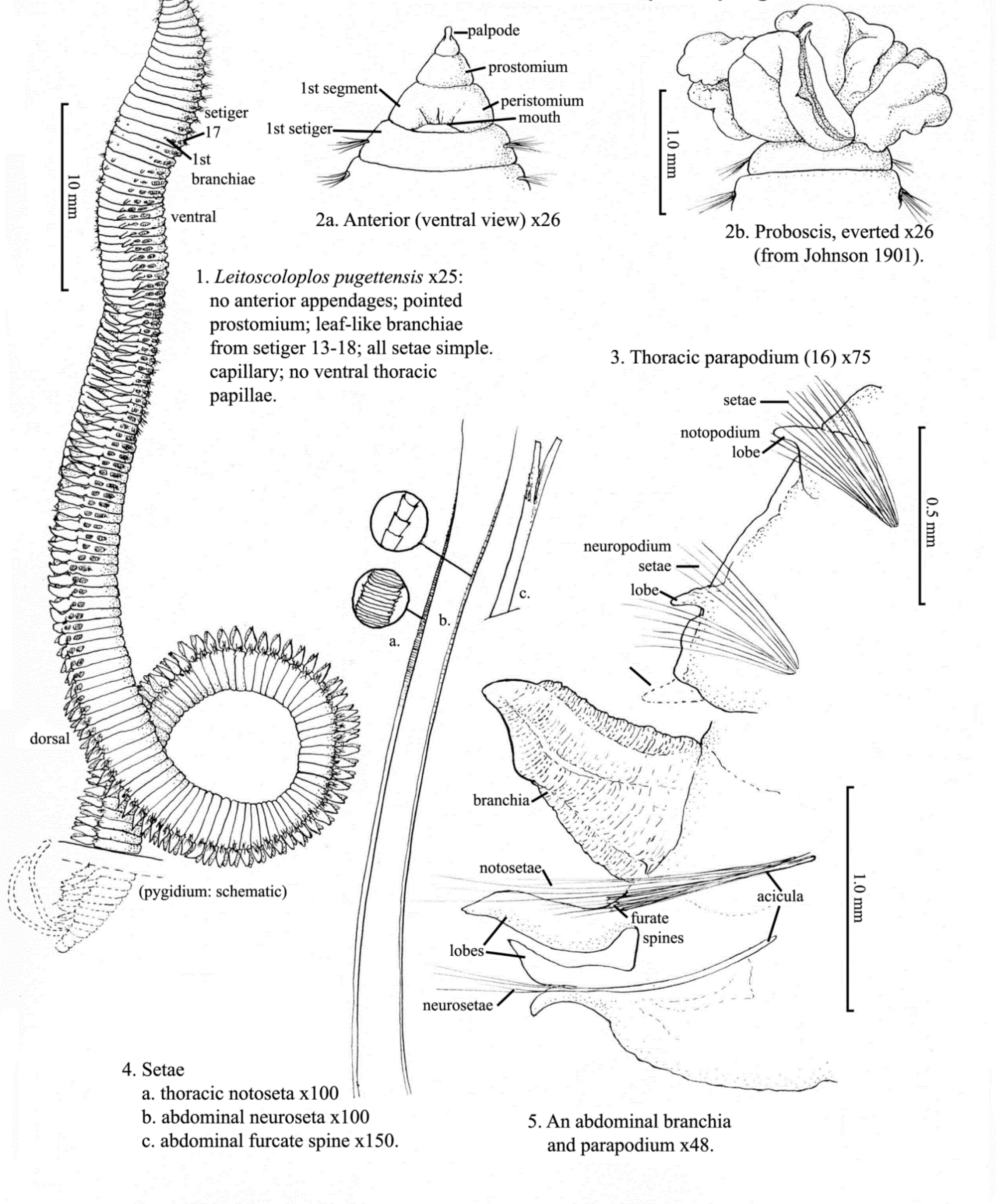
Leitoscoloplos pugettensis



2a. Anterior (ventral view) x26

2b. Proboscis, everted x26 (from Johnson 1901).

1. *Leitoscoloplos pugettensis* x25: no anterior appendages; pointed prostomium; leaf-like branchiae from setiger 13-18; all setae simple. capillary; no ventral thoracic papillae.

3. Thoracic parapodium (16) x75

4. Setae
   a. thoracic notoseta x100
   b. abdominal neuroseta x100
   c. abdominal furcate spine x150.

5. An abdominal branchia and parapodium x48.

Magelona sacculata

A burrowing polychaete (Hartman, 1961)

Phylum: Annelida
Class: Polychaeta
Order: Spionida
Family: Magelonidae

Description

Size— 2 - 30 mm long x 0.7 to 1.5 mm wide (Hartman 1961). Illustrated specimen (Coos Bay, South Slough) 30 mm long. About 100 segments (Hartman 1961); the Oregon specimens 50-80 segments.
Color—ivory, with paired dorsal lavender spots (Hartman 1961).
Body—long, separated into thoracic and abdominal regions. No branchiae. First segment a smooth ring; tenth segment (ninth setiger) short (figs. 1, 3). Lateral pouches between setigers 10 and 11: species sacculata (figs. 1, 3).
Prostomium—transparent, flattened, shovel-shaped (Fauchald 1977); often much wider than rest of body. Tip rounded, with slight medial ridge (fig 2). No horns, eyes or appendages, but with a ventral pair of conspicuous, elongate papillate palps: family Magelonidae. Prostomium widens posteriorly; has two strong muscles supporting it from below. (One key gives prostomium width as equal to or greater than length (Jones 1963): not true for our specimens).
Palps—long (about 2/3 body length); adhesive, coarsely papillated (Hartman 1961). Attached ventrally at juncion of peri- and prostomiums (Fauchald 1977).
Proboscis—smooth, globular when everted (not shown) (Hartman 1961).
Parapodia—begin on 1st setiger (2nd segment). First 9 setigers have biramous parapodia, with pointed setae in both rami (fig. 6). Inconspicuous lamellar postsetal lobes in thoracic setigers (not figured). 9th (or short) setiger with specialized setae - *i.e.* unlike those of setigers 1-8. Abdominal parapodia have small dorsal and ventral cirri, and broad, foliose medial lamellae (fig. 5).
Setae—several types: (1) *limbate* (simple, capillary, with flattened margin, can be pennoned), found in both rami and in notopodia in abdomen (fig. 6); (2) *crenulate* setae (clubbed, like a molar), found as specialized setae (Jones 1963) (figs. 4, 7); (3) *mucronate* (sharp tip and abruptly tapered)

found as specialized setae on setiger 9 (but not on these specimens- fig. 8); and (4) *hooded hooks* (each with a large fang and 2 small teeth), of uniform size: sp. *sacculatas* (Hartman and Reish 1981), found only abdominally (fig. 9).
Pouches—found between setigers 10-11 (and irregularly along abdomen). These are lateral and open anteriorly (fig. 3): sp *sacculata* (Blake 1975).
Pygidium—tapering, with a pair of slender anal cirri (Hartman 1969) (fig. 1a).

Possible Misidentifications

There are 3 other large, common families of the order Spionida: The Spionidae, very numerous and diverse, have grooved palps. Unlike Magelonidae, they have palps which are not papillate or adhesive, or exceedingly long; their prostomiums (unlike those of Magelonidae) are not flattened. Spionidae often have eyes, nuchal tentacles and/or branchiae; Magelonidae do not. Cirratulidae have long palps and long, filamentous gills, which are lacking in the Magelonidae. Chaetopteridae, also a Spionida family, have very distinct body regions, thick spines on setiger 4, and often have fan-like medial parapodia. Their tubes are parchment-like or annulated (Fauchald 1977).

Trochochaetidae and Heterospionidae are small, obscure Spionida families each containing only 1 genus. Trochochaetidae have bodies divided into two regions, a large flattened prostomium with a pair of palps, a single occipital tentacle, and 2 pairs of parapodia directed forward. Like the Magelonidae, they are not tube dwellers. Heterospionidae have short thoracic and very long abdominal setigers. They have a prostomium without appendages, and a pair of palps as well as filiform branchiae on the thorax. They do not inhabit the intertidal zone.

Poecilochaetidae are spionoforms with long, slender bodies; they have a small prostomium with a single antenna and palps. Their parapodia have prominent dorsal and ventral cirri.

Magelona is the only genus in the family Magelonidae; there are 35 described species (Fauchald 1977). *M. sacculata* is unique in having large, lateral open pouches between setigers 10 and 11, uniform hooded hooks on the abdominal parapodia, and mucronate or crenulate specialized setae on the 9th setiger. Other species in the genus include:

Magelona pacifica (Monro, 1933), seemingly a southern species, is unlikely to be found in Oregon (Hartman 1969).

Magelona cerae (Hartman, 1950) (Hartman and Reish 1950) was found in 20-40 fm sand off Coos Bay, forming beds. Further reports of it are lacking. They are up to 10 mm in length (incomplete specimen of 31 segments); the prostomium has slight, blunt horns at the corners; the thoracic notopodia have a dorsal cirrus which disappears by the 9th segment. Each of the abdominal hooded hooks has 1 large fang with a small tooth above it.

Magelona californica (Hartman, 1944), although found in southern California, is considered a "northeastern Pacific" species by Hartman. It has a rounded prostomium like that of *M. sacculata,* but it lacks lateral pouches, and its abdomen is abruptly wider than the thorax (Hartman 1969).

Magelona pitelkai (Hartman, 1944), has been reported from Coos Bay. This species has recently been redescribed by Jones, 1978, as *M. hobsonae* (Hobson and Banse 1981). This is a large species - 54 segments were 35 mm long; the prostomium has a truncate margin; the special setae on setiger 9 have pennoned tips, not mucronate ones. It lacks lateral pouches. This is the most common magelonid in central and northern California (Blake 1975).

Magelona longicornis (Johnson, 1901), *(=M. japonica* Okuda, 1937 (Jones 1971)) has prostomial horns, lateral parapodial lamellae in setigers 1-8, no specially modified 9th parapodium, bidentate hooded hooks (Jones 1971), and no lateral pouches. This species is the one most likely to be found in Puget Sound (Kozloff 1974a).

Magelona berkeleyi (Jones, 1971), has inconspicuous anterior prostomial horns, extended lateral lamellae on its parapodia, and no lateral pouches. Like *M. sacculata,* it has tridentate hooded hooks. It has no specialized setae on the 9th setiger. *M. berkeleyi* has been found in Puget Sound, Washington (Jones 1971).

Ecological Information

Range—British Columbia (Hobson and Banse 1981) to southern California (Hartman 1969).
Local Distribution—Coos Bay, Yaquina Bay, Umpqua estuary.
Habitat—fine sands (Blake 1975); sandy mud in Coos Bay (South Slough). Builds poorly supported burrows; no distinct tube.
Salinity—collected at 30‰
Temperature—
Tidal Level—more likely to be found subtidally than intertidally in Oregon. Found down to 40m in southern California (Hartman 1969).
Associates—

Quantitative Information

Weight—
Abundance—considered rare in California, where *M. pitelkai* (now *hobsonae)* is more common (Blake 1975). In Oregon it is the most common magelonid.

Life History Information

Reproduction—
Growth Rate—
Longevity—
Food—motile surface deposit feeder: chooses large particles of detritus, diatoms. Small crustaceans are captured on papillated surface of palps. A looping motion moves food up the palp; mucus may help final movement to mouth. Some suspension feeding may also take place. Magelonid larvae feed on veligers (Fauchald and Jumars 1979).
Predators—
Behavior— a good burrower.

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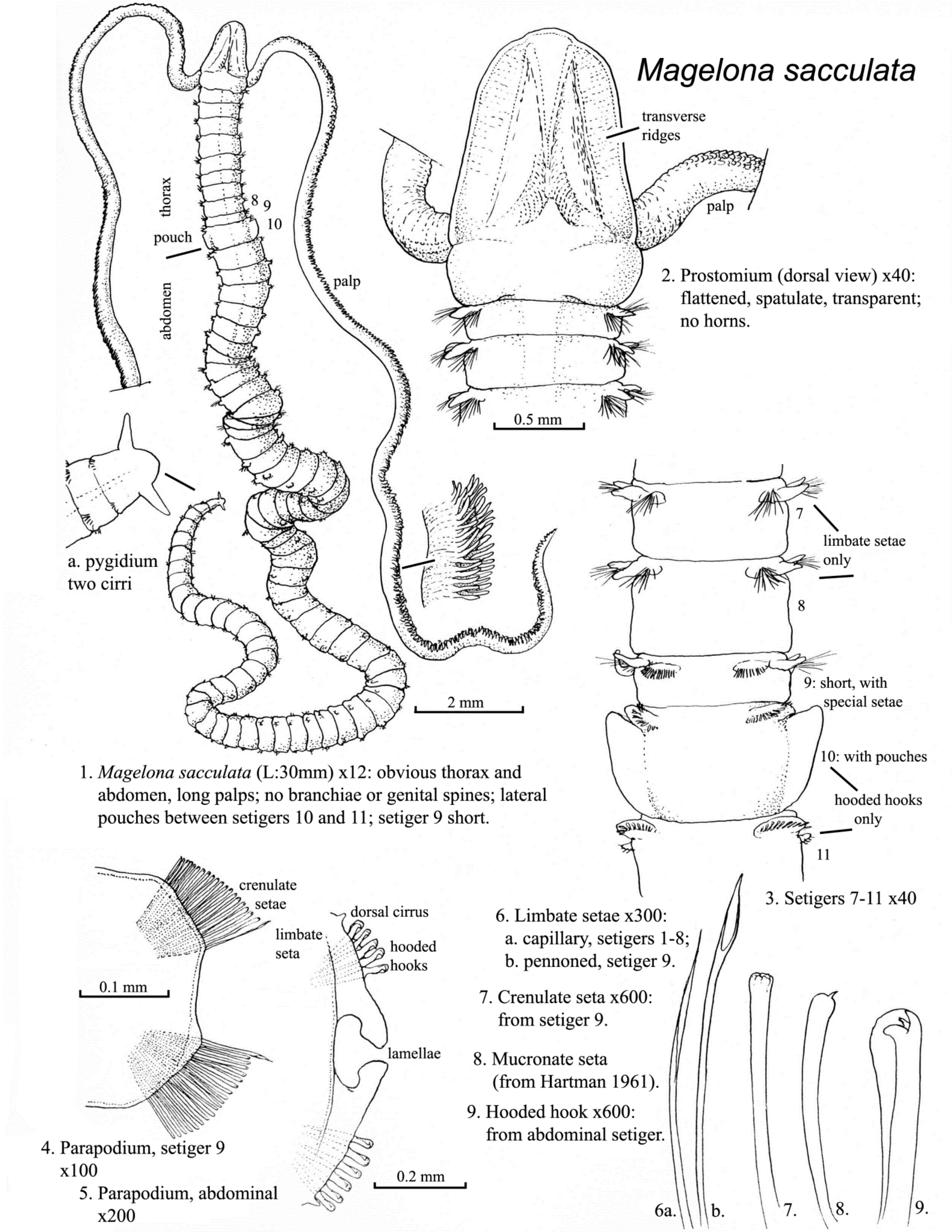
Magelona sacculata



a. pygidium two cirri

1. *Magelona sacculata* (L:30mm) x12: obvious thorax and abdomen, long palps; no branchiae or genital spines; lateral pouches between setigers 10 and 11; setiger 9 short.

2. Prostomium (dorsal view) x40: flattened, spatulate, transparent; no horns.

3. Setigers 7-11 x40

4. Parapodium, setiger 9 x100

5. Parapodium, abdominal x200

6. Limbate setae x300:
   a. capillary, setigers 1-8;
   b. pennoned, setiger 9.

7. Crenulate seta x600: from setiger 9.

8. Mucronate seta (from Hartman 1961).

9. Hooded hook x600: from abdominal setiger.

Mediomastus californiensis

A mud dwelling thread worm (Hartman, 1944)

Phylum: Annelida
Class: Polychaeta
Order: Capitellida
Family: Capitellidae

Description

Size—about 25 mm long, less than 1 mm wide; 100 segments or more (Hartman 1969). Our specimens (Coos Bay) from 60 to 120 segments, to 5 mm long.
Color—translucent (Hartman 1969); our specimens reddish brown.
Body—long, thread-like (Hartman 1969); earthworm-like. Widest at thoracic setigers 2 and 3 and at anterior abdominal segments. Segments uniannulate, shortest anteriorly; longer and cylindrical posteriorly. Segments with ridges (fig. 2). Change from thorax to abdomen indistinct except for texture: thorax wrinkled, abdomen smooth.
Thorax—11 wrinkled segments: 1 achaetous periostomial ring and 10 setigers (fig. 2): genus *Mediomastus* (Hartman 1944a). Setigers 1-4 with capillary setae only, setigers 5-10 with hooks (Blake 1975). No genital spines, no branchiae.
Abdomen—smooth, coiled; 1st segment shorter than following segments (Hartman 1944a). Most posterior segments become short again, have more elevated parapodia, but are still not conspicuous. Many Coos Bay specimens with short, bell-shaped posterior segments (fig. 3).
Prostomium—with an elongate palpode at anterior end, followed by a depressed ring (often lost in collecting, fig. 2). First (achaetous) segment longer than following first setiger. Prostomium eyeless, without appendages or palps: family Capitellidae (Fauchald 1977).
Proboscis—a soft, glandular sac, with tiny widely scattered low papillae (Hartman 1944a) (fig. 2).
Parapodia—biramous; inconspicuous (Hartman 1944a). All setae simple, unjointed; setigers 1-4 with only bundles of capillary setae in both rami (figs. 2, 5). All following posterior setigers with only longhandled hooded hooks (uncini) - figs. 2, 6 - each with a large fang and 3 small teeth. Hooks on segments 10-11 are dorsolateral,

but not modified for copulation (Hartman 1944a).
Pygidium—single cirrus, attached ventrally (fig. 4). Easily lost in collecting.

Possible Misidentifications

The Capitellidae lack conspicuous parapodia, ie. branchiae, lobes and prostomial appendages; their superficial appearance is earthworm-like. Several genera occur in muddy estuarine situations:

Capitella spp. have hooks as well as capillary spines on the thoracic setigers, and lack an asetigerous 1st segment. They have large genital spines on segments 8 and 9, and their 9 thoracic segments are all setigerous.

Heteromastus spp. have 12 thoracic segments (not 11) and one is asetigerous; their hooded hooks begin on setiger 6, not setiger 5; they have notopodial branchiae in the distal posterior segments.

Notomastus spp. like *Heteromastus,* also have 12 thoracic segments (one asetigerous); they can have branchiae in some species. But all their thoracic setigers have capillary setae only (as in fig. 5).

Other *Mediomastus* spp. (there are 7) include *M. acutus* Hartman, which has a long pointed prostomium. This is a very thin species, only about 9 mm long; it has been found in Coos Bay (Jones n.d.), and occurs also off southern California (Hartman 1969).

Mediomastus capensis (Day 1967) is distinguished by very minute character differences: the hooded hooks have more than 3 teeth above the main tooth; the posterior notopodia also lack capillary setae (as in *M. californiensis);* found in British Columbia, see Hobson 1974.

Mediomastus abmiseta (formerly *Capitata abmiseta* Hartman) has posterior notopodia with 1-2 capillary setae*;* it has been found subtidally in Washington (Hobson and Banse 1981).

Ecological Information

Range—British Columbia, Washington, Oregon, California; Florida (Santos and Simon 1980). Also Arctic, Aleutians, Alaska (Jones n.d.).
Local Distribution—Coos Bay, Yaquina Bay
Habitat— compact, fine muddy sand (Hartman 1947).
Salinity—collected at 30‰
Temperature—
Tidal Level—at low water line (Hartman 1947)
Associates—*Capitella capitata* (Coos Bay); with *Notomastus tenuis* in Tomales Bay, California (Hartman 1944a).

Quantitative Information

Weight—
Abundance—Coos Bay (South Slough): from core 13 *x* 15 cm at high tide (3.6'): one animal; at mid tide (3.4'): 1-5 animals; at low time (3.0'): 3-10 animals (Posey 1985).

Life History Information

Reproduction—
Growth Rate—an "r-strategist": can attain a large population rapidly (Florida, where great sumrner defaunation can occur) (Santos and Simon 1980).
Longevity—
Food—a direct deposit feeder.
Predators—
Behavior—

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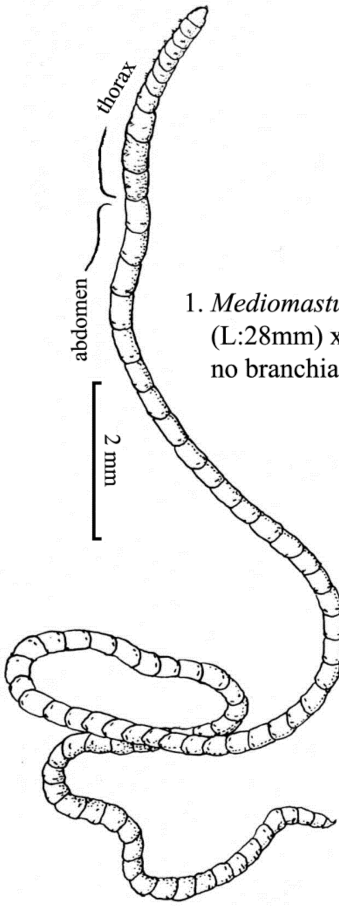
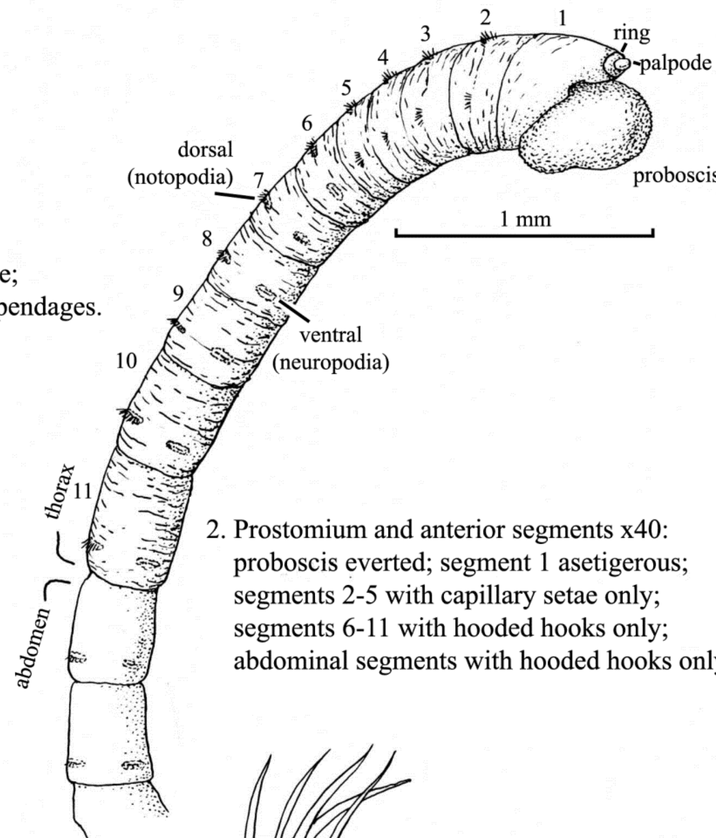
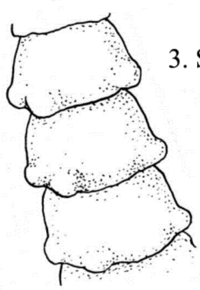
Mediomastus californiensis



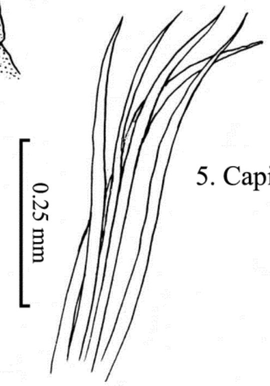
1. *Mediomastus californiensis* (L:28mm) x12: earthworm-like; no branchiae or prostomial appendages.



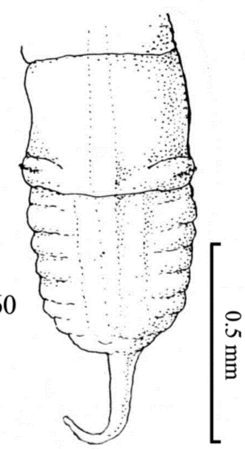
2. Prostomium and anterior segments x40: proboscis everted; segment 1 asetigerous; segments 2-5 with capillary setae only; segments 6-11 with hooded hooks only; abdominal segments with hooded hooks only.



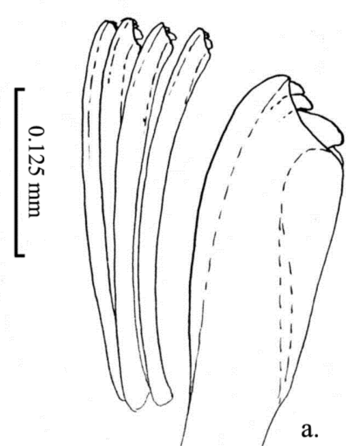
3. Some posterior segements x60



5. Capillary setae x100



4. Pygidium (ventral view) x60



6. Hooded hooks (uncini) x200:
a. enlargement x800

Neanthes brandti (*Nereis brandti*)

A clam bed worm (Malmgren, 1866)

Phylum: Annelida
Class: Polychaeta
Family: Nereidae

Description

Size—atokous or sexually immature individuals up to 185 mm long, 166 segments; epitokous, or "heteronereids" to 520 mm long, 18 mm wide, 230 segments (Hartman 1968). Rather wide for length (Fig. 1.).
Color—usually a dark iridescent green-brownish or blueish, with a paler ventrum (Hartman 1968).
Body—rather wide for length (fig. 1); flattened dorso-ventrally; extremely active.
Prostomium—short, broad; not as long as peristomiurn (fig. 2) (*ibid*).
Palpi—at sides of prostomium; thick at bases, each with a small style (fig. 2).
Ocelli—four: family Nereidae (Hartman and Reish 1950); in trapezoidal arrangement (fig. 2) (Hartman 1968).
Tentacular Cirri—four pairs, second dorsal pair longest (*ibid*).
Antennae—two: short, conical (fig. 2).
Proboscis—horny jaws with six to eight teeth; many conical paragnaths in all areas of both oral and maxillary rings: most important species characteristic (*ibid*). In area I: three cones in tandem; area II, Ill, IV: each with many cones in dense patches; V: one, sometimes none (Banse and Hobson 1974); VI: a median row of 4 to 5 large cones; VII, VIII: each with a broad band of many cones (Hartman 1968) (at least 4 to 5 rows: species *brandti*) (figs. 3, 4) (Banse and Hobson 1974).
Peristomium—first segment, asetigerous: a long ring, longitudinally ridged (fig. 2).
Parapodia—begin on second segment; biramous: family Nereidae (Hartman and Reish 1950); posterior notopodial lobes broadly expanded, leaf-like. All other lobes small (fig. 6).
Dorsal Cirrus—short; inserted half way along dorsal (notopodial) lobe (fig. 6).
Notosetae–medial and posterior notopodia with composite spinigers only(fig. 5) (Pettibone 1963).
Neurosetae—both composite spinigers and short shafted falcigers (fig. 5). (Subgenus *Neanthes* lacks the special fused falciger in the upper bundle of the neuropodium.)
Caudal Cirrus—two slender cirri (Fig. 1).

Possible Misidentifications

N. brandti has been at times considered a subspecies of *Neanthes virens*, the large, coldwater form. This latter species, however, has only a few paragnaths on its proboscis rings, (i.e. 2-3 rows in VII, VIII), not many as in *N. brandti* (4-5 rows in VII, VIII). The prostomium of *N. virens* is small and triangular; its eyes are small and on the posterior half of the prostomium. It has short antennae, and massive palpi.

Nereis (Hediste) succinea has very enlarged posterior notopodial lobes, with the dorsal cirrus attached at the end of the lobe; its distribution is possibly too southern for Oregon estuaries.

Neanthes limnicola is usually pale and translucent, not dark green; its posterior parapodial lobes are not expanded like those of N. brandti.

Other common nereid worms include the very abundant *Nereis vexillosa*, found in many diverse marine environments, especially in mussel beds. It has greatly elgngated, strap-like notopodial lobes in the posterior parapodia. And like all representatives of the subgenus *Nereis*, it has homogomph falcigers on its posterior notopodia as well as on its neuropodia; *Neanthes* has only composite spinigers on its posterior notopodia, not falcigers.

Other species of *Neanthes* in Oregon estuaries include *N. eakini*, from rocky habitats, with a long prostomium and proboscis rings covered with small round paragnaths: the bright green *N. grubei (= mediator)* with greatly expanded posterior notopodial parapodial lobes and no paragnaths in area V of the proboscis. *N. procera* is subtidal in sand, has tiny eyes, a very long body, and unusually inconspicuous paragnaths on its proboscis (Hartman 1968).

Ecological Information

Range—northeast Pacific to southern California (*ibid*).
Local Distribution—Coos Bay: South Slough, Charleston (Hartman and Reish 1950).
Habitat—variable: found in sand bars, stiff mud (Kozloff 1974b), *Enteromorpha* beds (MacGinitie and MacGinitie 1947); largest specimens in fine mud, eelgrass beds rather than in pure sand; disappears near sulfite-polluted areas (Porch 1970).
Salinity— saline areas near seawater (*ibid*).
Tidal Level— low and below tidal limits (Hartman 1968), burrows deeply in sand.

Quantitative Information

Abundance—most abundant nereid (Coos Bay, 1970); otter most abundant in eelgrass beds (Pettibone 1963).

Life History Information

Reproduction—provides observers with one of the most spectacular displays of nereid swarming (Porch 1970): The sexually mature (epitokous) animals swim wildly at night on the water's surface, their medial parapodial lobes having developed and swollen for swimming. After expelling sperm and eggs, the distended worms will die.
Food—castings similar to the lug worm *Arenicola*'s, but smaller, contain seaweed. Immature worms appear to eat *Ulva, Enteromorpha*, although their relatives are predaceous (MacGinitie and macGinitie 1947).
Behavior—very fast swimmers speeds of 50-80 mm/sec. recorded (Morris and Abbott et al 1980).

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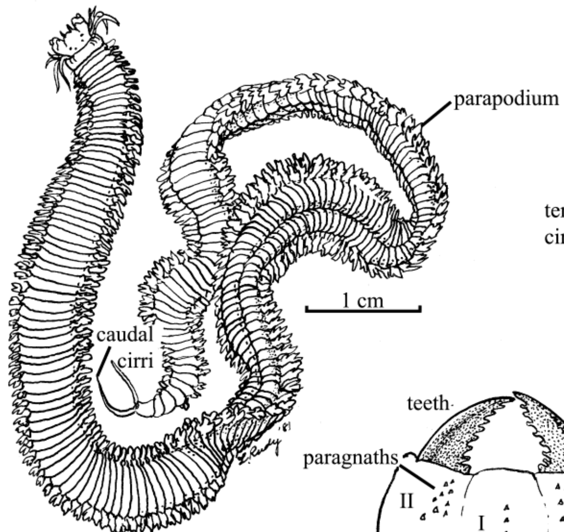
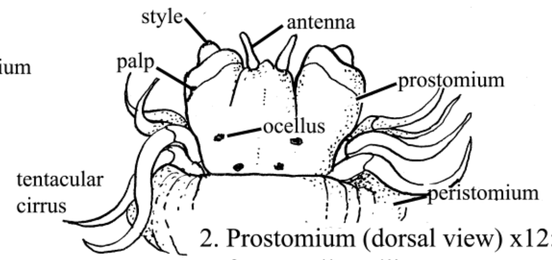
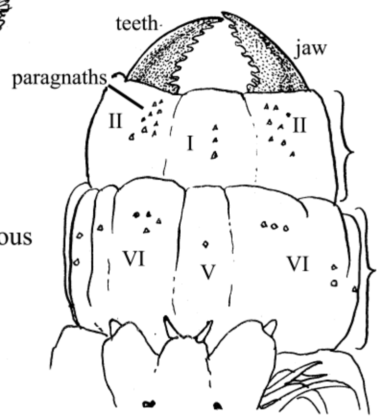
Neanthes brandti



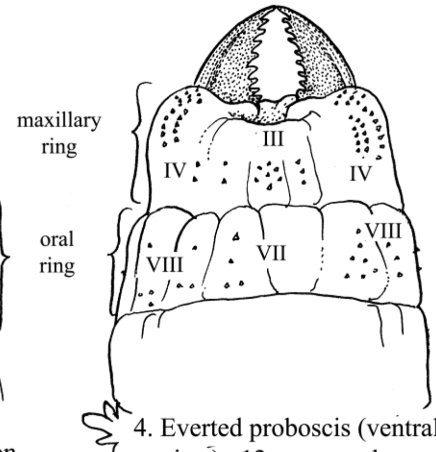
1. *Neanthes brandti* x2:
dark green color; biramous parapodia; caudal cirri.



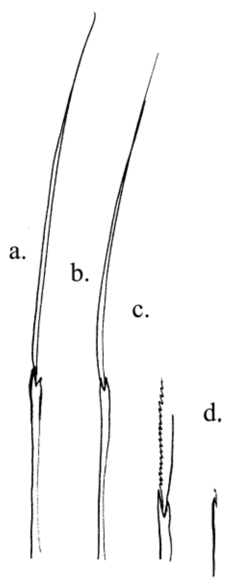
2. Prostomium (dorsal view) x12:
four small ocelli; antennae-one small pair; tentacular cirri-four pairs; large palps; small styles.



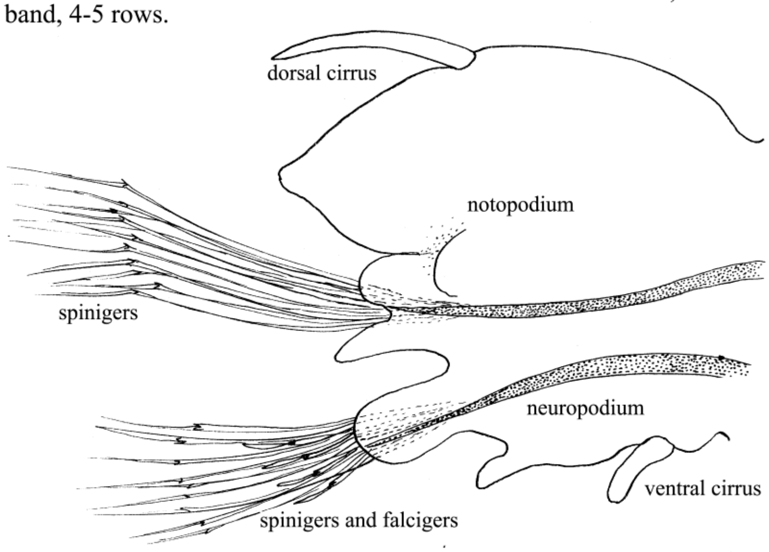
3. Everted proboscis (dorsal view) x12 conical paragnaths on oral and maxillary rings; jaws 6-8 teeth; paragnaths area I: 3 in tandem, II: 7-8^{+} in patch, V:0-1,VI: median band, 4-5 rows.



4. Everted proboscis (ventral view) x12: paragnaths area III: dense patch,IV: several rows (patch), VII: broad band4-5 rows, VIII: broad band, 4-5 rows.



5. Setae x300:
a. heterogomph spiniger
b. homogomph spiniger
c. heterogomph falciger
d. homogomph falciger



6. Posterior parapodium: biramous, dorsal notopodium and ventral neuropodial lobes; notopodial lobe leaf-like;dorsal cirus medial.

Neanthes limnicola (*Nereis limnicola*)

A mussel worm (Johnson, 1903)

Phylum: Annelida
Class: Polychaeta
Family: Nereidae

Description

Size—25-45 mm long (Hartman 1938); this specimen 25 mm; width 2.5 mm to 4 mm without parapodia; 45-82 segments.
Color—pale, translucent (*ibid*): pale yellow green (this specimen, Coos Bay).
Prostomium—trapezoidal, wider than long, with a longitudinal depression (fig. 2b).
Ocelli—four, large: family Nereidae (fig. 2b).
Antennae—a small frontal pair, separated at their bases (fig. 2b).
Palpi—a pair of stout, cylindrical processes, with small hemispherical palpostyles at the distal ends (fig. 2b).
Tentacular Cirri—four pairs, family Nereidae; second of dorsal pairs longest (fig. 2b) (Johnson 1903), others, including a more ventral pair, quite short for a nereid.
Proboscis—when everted, shows horny jaws with teeth (figs. 3a,b), and conical paragnaths. In genus *Neanthes* paragnaths occur on both oral and maxillary rings, whose sections are numbered for identification (the even-numbered areas occur in pairs). In this species Area I usually has one tooth; Area II has the largest teeth, about 12 in a crescent; Area Ill has a broad patch of 2025: IV has broad crescents of 30-35: V usually has no paragnaths (Hartman 1938); VI has three small points, Areas VII and VllI have two continuous rows: (figs. 3a,b).
Parapodia—biramous, with a distinct notopodium and neuropodium (figs. 1, 5). Both branches also have medial triangular lobes, or ligules, the notopodial ligule is always smaller than the neuropodial one. The parapodial lobes are conical, not leaf-like or globular as in the family Phyllodocidae. (A parapodium should be removed and viewed under a high powered microscope (100x) for certain identification).
Notopodia—(top. or dorsal lobe) fig. 5: only one kind of seta-nomogomph spinigers (fig. 4a), notopodial lobes at posterior end of animal are normal, not elongate, but smaller than anterior lobes (Hartman 1938).

Neuropodia—(ventral lobes of parapodia) fig. 5: contain several each of three kinds of setae: homogomph and heterogomph spinigers, and heterogomph falcigers (fig. 4a,b,c). There is also a single, unusual faiciger in the upper bundle of the neuropodium. It has its appendage completely fused to the shaft (fig. 4d), and is the sole indicator of the subgenus *Hediste* (Pettibone 1963).
Setae—all composite: subgenus *Nereis (Hediste*) has only one kind of seta in its notopodia. homogomph spinigers-long, sharp composite spines (spinigers) with even bases (homogomphs) fig. 4a. The neuropodia have two kinds of spinigers, homogomph and heterogomph, (uneven bases, fig. 4b). They also have heterogorph and homogomph falcigers, blunt, short, curved setae with uneven bases (fig. 4c). *N. (Hediste) limnicola* has one special fused falciger in the supracicular neuropodium (figs. 4d. 5) (Johnson 1903). (Differentiation among these setae must be made with a high-powered microscope after placing the parapodium in glycerin or mounting medium, on a slide.)
Acicula—heavy, black spines at the base of each parapodial lobe (fig. 5).
Caudal Cirri—two: styliform as long as last seven segments (fig. 1) (Hartman 1938).
Tube—builds thin, pale brown, loosely constructed tubes in vertical burrows (*ibid*): Y-shaped, mucus lined (Smith 1950). Newly hatched young build protective tubes of sand grains and mucus (*ibid*).

Possible Misidentifications

The prostomia of nereid worms are quite alike. with four eyes, a pair of frontal antennae and biarticulate palps, and 3-4 pairs of tentacular cirri (Blake 1975). The genus

Nereis has subgenera *Hediste* (with 1-3 fused falcigers on the supra-acicular bunch of posterior neuropodial setae*). Neanthes* (with only homogomph spinigerous setae in the posterior notopodia, a trait it shares with *Hediste* but without the fused falcigers); *Nereis* sensu stricto with homogomph falcigers as well as spinigers in its medial and posterior parapodia (based on Kinberg, 1866) (Pettibone 1963 and Smith 1959). Other writers use a new definition of *Neanthes* (Banse and Hobson 1974 and Hartman 1968).

The genus *Neanthes* is further distinguished by having only conical paragnaths on both proboscis rings, arid biramous parapodia with composite setae (Hartman and Reish 1950). Other closely related species of *Neanthes* include:

Neanthes brandti with a great many cones on its proboscis, rather than a few like *N. limnicola.* It is very large and green, and occurs in more saline areas than does *N. limnicola;* its posterior notopodial lobes are broadly expanded and leaf-like. It is sometimes considered to be the same species as *N. (N.) virens* (see description *N. brandti*).

Nereis (Neanthes) virens, a very large (50-90 cm), cold water, form, has small eyes, massive palpi, and large, leaf-like posterior notopodia.

Nereis (Neanthes) succinea has very enlarged posterior notopodial lobes, on which the dorsal cirrus is carried distally, not dorsally. It has a heteronereid form: *N. (H.) limnicola* does not. *N. succinea* is thought to be a more southern form (although it has been reported from Netarts Bay's)

Nereis (Hediste) diversicolor, sometimes synonymized with *N. (H.) limnicola* (Hartman 1968)*,* is an Atlantic form with a different reproductive life; it has fused falcigers in its posterior neuropodia. It is reddish brown with a pale ventrum (*ibid*).

Nereis (Nereis) vexillosa, olive green or brown, is found abundantly in mussel beds and rocky substrates. It has long, strap-like notopodial lobes on its posterior parapodia. It has a swarming or heteronereid form.

Ecological Information

Range—Salinas River, California, north to Vancouver Island, B.C. (Smith 1958) Type locality, Lake Merced, California (Johnson 1903).
Local Distribution—Coos Bay estuary: South Slough, Charleston, Cooston, Kentuck Inlet, Coos River mouth.
Habitat—in isolated populations in loose burrows in sand and claylsand banks; likes soft mud; in channels with *Salicornia* (Smith 1953). Not limited much by substrate; can survive in mud if not entirely dry (Smith 1953).
Temperature— from cool and temperate waters; warmth affects reproduction, does not cause fatalities (30°C) (Smith 1953).
Salinity—adapts to a wide range (115‰ down to 2‰ salt water) but is usually found in areas of reduced salinity (Smith 1950). In Coos Bay, usually 90‰ of seawater, or less in interstitial water; highest salinity in which found: 25.2 ‰. Can survive in unstable environment (Salinas River) (Smith 1953).
Tidal Level—shallow water.
Associates—Salinas River: isopod *Gnorimosphaeroma oregonensis*, amphipods *Corophium spinicorne, Anisogammarus contervicolus* (Smith 1953). Does not overlap with other *Nereis* species *vexillosa or brandti* (Coos Bay, 1970 unpublished student report).

Quantitative Information

Abundance—abundant at Cooston, east side of Coos Bay (L.C. Oglesby, communication), irregularly distributed in shallow water (Salinas River, California) (Smith 1950). Tends to occur in isolated populations (Smith 1958).

Life History Information

Reproduction—viviparous; hermaphroditic, no copulatory organs. Animals spawn in burrows; some adults survive spawning (Smith 1950). Eggs self-fertilized internally; larvae escape from coelom at a size (about 20 segments) to withstand osmotic environmental conditions (Dales 1967).
Growth Rate—Several hundred eggs may be produced, and develop in coelom by typical spiral cleavage. Rapid growth leads to ciliated trochophore larva. Birth is by rupture of the body wall of the parent (Smith 1950). Total development time 21-28 days. Breeding in

late winter through spring and summer, when high temperatures and salinity suppress sexual activity (Smith 1953).
Food—algal and diatomaceous scum and detritus from the surface of the bottom (Smith 1950).
Behavior—tree-living; constructs burrow somewhat Y-shaped and mucus lined (*ibid*). Worm is above fork of Y: can escape down into burrow during dry periods. Can swim well. Newly hatched young immediately build protective tubes of sand grains and mucus (*ibid*).

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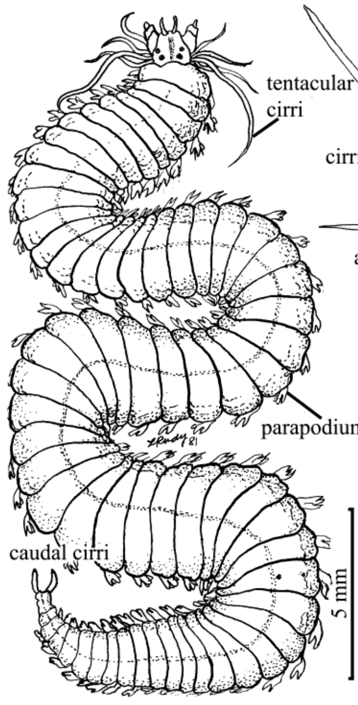
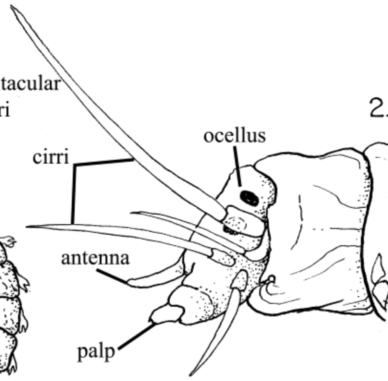
Neanthes limnicola

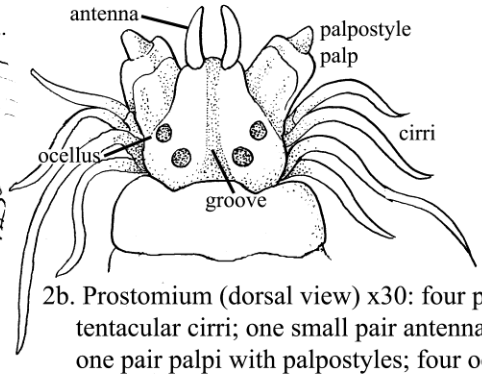


1. *Neanthes limnicola* x8.5: typical Nereid tentacular cirri; body 25-45 mm long, 45-82 segments; pale, translucent; two caudal cirri

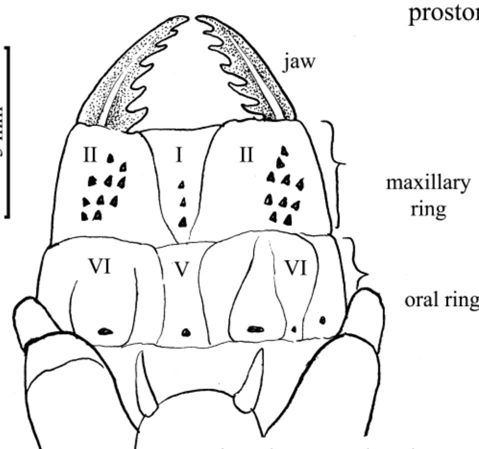
2.



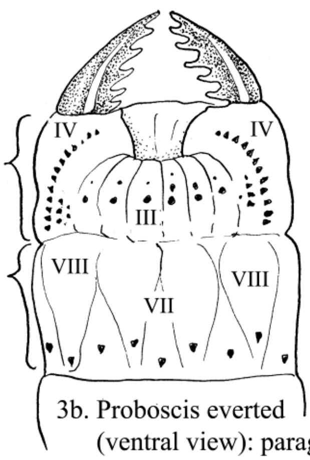
2a. Prostomium (lateral view) x30.



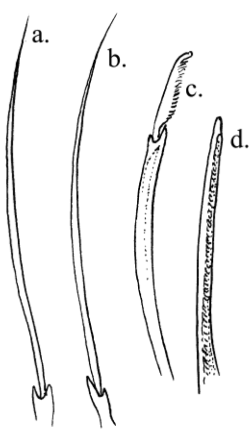
2b. Prostomium (dorsal view) x30: four pairs tentacular cirri; one small pair antennae; one pair palpi with palpostyles; four ocelli; prostomium trapezoidal, grooved.



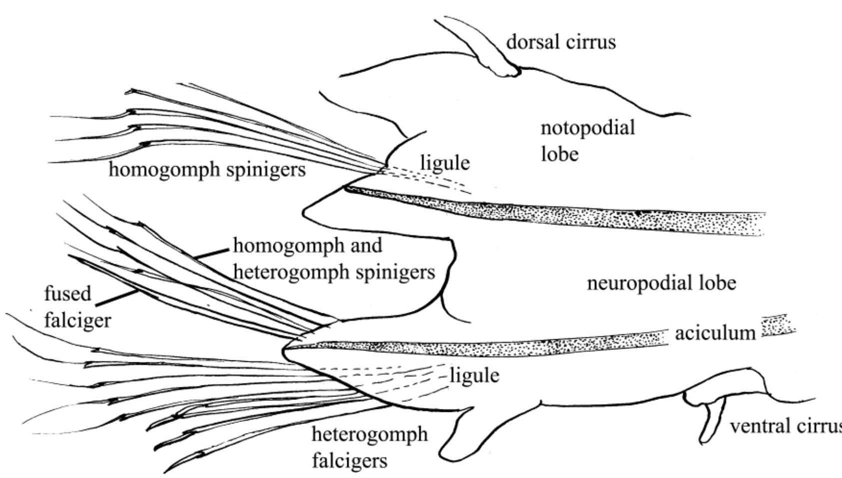
3a. Proboscis everted and head (dorsal view): conical paragnaths on oral and macillary rings; stout jaws; paragnaths area I: usually one, II:about 12 large, V: usually none, VI 3 small.



3b. Proboscis everted (ventral view): paragnaths area III: 20- 25, IV: crescent, 30-35, VII: continuous rows, VIII: continuous rows.



4. Setae:
   a. homogomph spiniger
   b. heterogomph spiniger
   c. heterogomph falciger
   d. fused falciger



5. 60th parapodium x100: biramous, notopodium dorsal and neuropodium ventral; all lobes conical; small dorsal ligule.

Nephtys caeca

A sand worm (Fabricius, 1780)

Phylum: Annelida
Class: Polychaeta
Order:
Family: Nephtyidae

Description

Size—to 20 cm long, 10-15 mm wide (Hartman 1968).
Color—pale pink; can be light to dark green or brown (*ibid*); no pigment patterns. Iridescent proboscis.
Prostomium—pentagonal, flattened, no pigment pattern; with four small simple (unforked) antennae; eyeless (fig. 2).
Proboscis—when everted: globular, with 22 rows of paired distal papillae forming a crown-like structure; also 22 rows of subdistal papillae with five small papillae in each row (fig. 1). Proximal (basal) surface of proboscis rough, and covered with minute wart-like papillae (fig. 1).
Parapodia—fleshy flaps extending laterally off the segments. biramous (two-lobed): family Nephtyidae. Each lobe with a notopodium and a neuropodium, each broad and rounded; post-acicular lobes becoming "foliaceous" posteriorly (Hartman 1968) (fig. 5).
Interramal Cirri—long, recurved, between the two parapodial lobes (figs. 3, 5).
Setae—fan-like bunches of neuro- and notosetae on the parapodial lobes. Post-acicular setae (fig. 5) long and fine, with single lateral barbs (fig. 4a); preacicular setae short and with transverse bars (figs. 4b, 5).
Body—90-150 segments; long, slender, quadrangular in cross-section (Hartman 1968).

Possible Misidentifications

There are many other species of *Nephtys* in the northwest. The chief intertidal species are:

N. caecoides, averaging slightly smaller than *N. caeca*, with dark bands of color pattern on its anterior end, and a shiny proboscis, not a rough one. It is probably the closest morphologically to *N. caeca*, but is usually a more southern species; it is one of the most common sand worms in California (Blake 1975). The two worms overlap in Coos Bay (Porch 1970).

N. californiensis is a large, pale sand worm, usually found in coarse, clean sand in marine environments, rather than in bays. It has a unique "spread eagle" pigment pattern dorsally on its prostomium.

N. parva is a small, pale mud dweller without a prostomial pigment pattern except for one dark spot. It has a proboscis with a smooth proximal end without an unpaired median papilla. On the third segment of its body is a pair of eyespots; the interramal cirri begin on the fourth setiger, and are short and only slightly recurved (Dales 1967). Its long postacicular setae are transversely serrated, with many fine spines. It is found in California bays, but not in Washington.

N. ciliata, from Puget Sound (and not found in California) has a rough proboscis; it has a fingerlike dorsal papilla on its proboscis.

N. cornuta cornuta has branched second prostomial antennae; *N. cornuta franciscana* is a small subtidal species (to 7.5 mm) with only 21-28 segments, branched second prostomial antennae, and eyespots on setiger three.

N. assignis is found below two fathoms, and has expanded parapodial and interramal cirri which begin on the sixth setiger.

Ecological Information

Range—Alaska to northern California; type locality, Green-land; Arctic and circumboreal.
Local Distribution—Coos Bay: many stations; especially South Slough. Distribution much like that of the polychaete *Lumbrineris zonata.*
Habitat—sand, mud or mixed sediments; with eelgrass; likes more mud than *Lumbrineris* (Porch 1970).

Salinity—collected at 30 ‰. Can tolerate low salinities, i.e. freshwater of stream beds (Porch 1970).
Temperature—a Coldwater animal: doesn't extend far into California.
Tidal Level—found at + 0.5 feet.
Associates—barnacles; the large polychaete, *Pista pacifica*.

Quantitative Information

Abundance—not common.

Life History Information

Reproduction—
Growth Rate—
Behavior—can move rapidly through loose sand; makes temporary burrows: A good swimmer (MacGinitie 1935).

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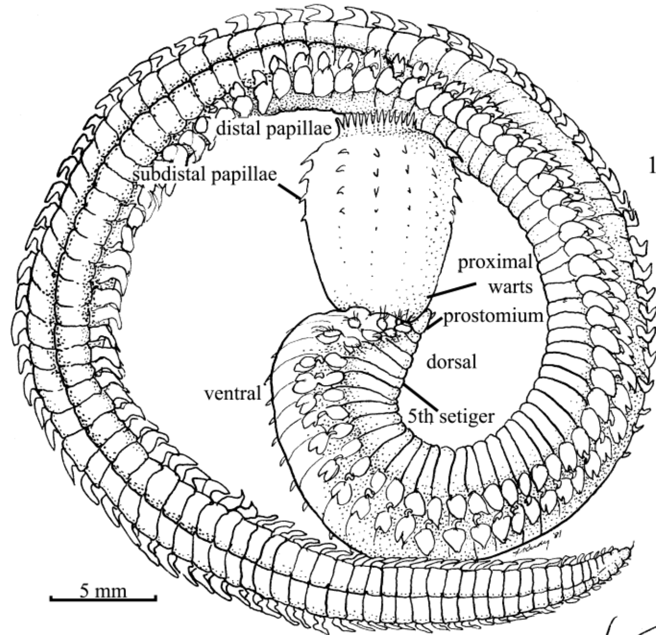
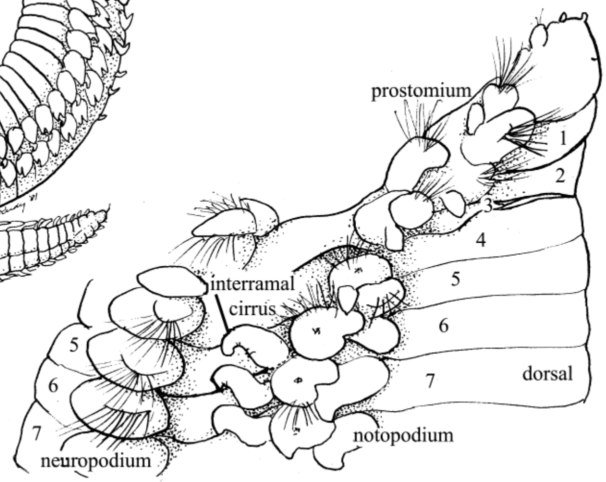
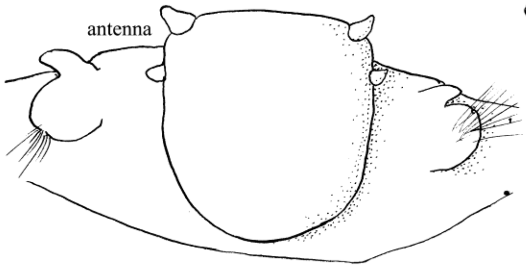
Nephtys caeca



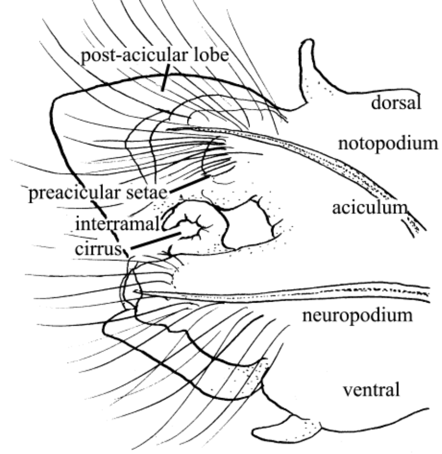
1. *Nephtys caeca* (lateral view) x4: to 150 segments; everted proboscis with 22 rows of distal papillae; subdistal papillae 22 rows of 5; proximal proboscis surface rough; body cross section rectangular.

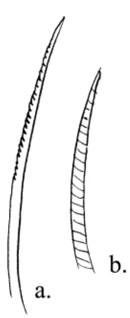


3. Anterior parapodia (lateral view) x30: interramal cirri begin on 5th cirri; parapodia bilobed neuro- and notopodia.



2. Prostomium (dorsal view) x30: pentagonal, eyeless; four small antennae.





4. Setae, tips:
   a. long, barbed postacicular seta
   b. transversely barred preacicular seta (notopodial)

5. 90th parapodium x30: biramous; post-acicular lobes large, foliaceous; recurved interramal cirrus beginning on fifth segment; long, fine noto- and neurosetae; shorter, barred pre-acicular notosetae.

Nephtys caecoides

A sand worm Hartman, 1938

Phylum: Annelida
Class: Polychaeta
Order:
Family: Nephtyidae

Description

Size—to 10 cm; width 5-8 mm; segments, about 120 (Hartman 1968).
Color—a strong pigment pattern on prostomium and first few segments (fig. 2) persists through preservation. body usually steel- to dark gray (Hartman 1938).
Body—trim, stiff, slender in appearance (Hartman 1938); rectangular in cross section (Hartman and Reish 1950); first segment incomplete dorsally (Hartman 1968) (fig. 2).
Prostomium—four small simple antennae on a trapezoidal "head " (Fig. 2).
Proboscis—globular, with 22 rows of papillae at the end (distal), and 22 rows near the end (subterminal); distinct medial unpaired papilla (fig. 3).
Parapodia—bilobed: family Nephtyidae; both noto- and neuropodia are rounded in the posterior end of the animal (fig. 5b). The acicular lobes are incised in the middle of the animal (fig. 5a).
Interramal Cirri—beginning with the fourth setiger (segment with setae), and continuing to near the end of the worm, there is a recurved cirrus between the parapodial lobes (fig. 5). In juvenile specimens, this can be nearly straight (Fauchald 1977). The interramal cirrus is larger than the dorsal cirrus, except in the last nine segments (Hartman 1968).
Setae—three types: a bunch of short, slender barred setae (preacicular) fig. 4b); simple, capillary barbed setae (fig. 4c) (post-acicular); and short, barbed setae (fig. 4a).

Possible Misidentifications

Worms of the family Nephtyidae can be distinguished by their rather rectangular bodies (in cross section), well-developed bi-lobed parapodia and interramal cirri, four small prostomial antennae, and eversible globular proboscis with terminal rows of papillae.

There is some confusion in the *Nephtys caeca* group: several species are distinguished from each other by very fine morphological details. The other closely related species of *Nephtys* include:

N. caeca, slightly larger, iridescent, with no prostomial pigmentation, a rough proboscis with no unpaired medial papilla, and interramal cirri beginning on the 5th or 6th setiger, not the 4th. This is a northern species, rare in California.

N. californiensis, while very like the other two of the *N. caeca* group, is found mostly on the outer coast, or if in bays, only in very clean coarse sand. It has a "spread eagle" pattern of pigmentation on the lower end of the prostomium, a smooth proboscis usually without a medial papilla, soft silky flowing setae. and interramal cirri beginning on the third setiger.

Three other *Nephtys* species, not so easily confused with the above, are:

N. cornuta, whose second antennae are forked;

N. punctata, much like *N. caeca* in size and form (Hartman 1938), but with interramal cirri beginning on the 8-10th setiger, and with incised acicular lobes in the anterior parapodia;

N. parva, colorless except for a dark spot in the middle of its prostomium (Hartman 1968), and a smooth proboscis proximally, no medial papilla, eyespots on its third setiger, and interramal cirri beginning on the 4th setiger;

N. ciliata, a Puget Sound polychaete, has a rough proboscis with an unpaired medial papilla at the end, and long setae.

Ecological Information

Range—western Canada to southern California; type locality, Tomales Bay, California.
Local Distribution—Coos Bay: many stations, especially South Slough. Distribution

very close to *Scoletoma zonata* but occurs in sandier mud (Porch 1970).
Habitat—mud, sand, and mixed sediments of bays and lagoons; eelgrass flats (Hartman 1938); not found in areas with large amounts of silt (Clark and Haderlie 1962). Likes a fine, stable substrate *(ibid)*.
Salinity— distribution more a function of protection from exposure, than of salinity (*ibid*). Can tolerate low salinities, (i.e. freshwater stream beds) (Porch 1970).
Tidal Level—intertidal; also found at littoral depths (one specimen from 25-58 fathoms) (Hartman and Reish 1950). Densest populations at Bodega Bay at + 1.04 feet and at -1.70 feet MLLW (Clark and Haderlie 1962).
Associates—*Nephtys caeca* has much the same habitat (Porch 1970).

Quantitative Information

Weight—
Abundance—one of the most common nephtyids in California (Blake 1975); San Francisco Bay at densities of 130/m^2 (Jones 1961); greatest density at Bodega Bay: 32/m^2 (Clark and Haderlie 1962); most commonly found in nephtyid in Coos Bay.

Life History Information

Reproduction—
Growth Rate—
Longevity—
Food—a carnivore (Clark and Haderlie 1962).
Predators—
Behavior—very active, a good swimmer and burrower.

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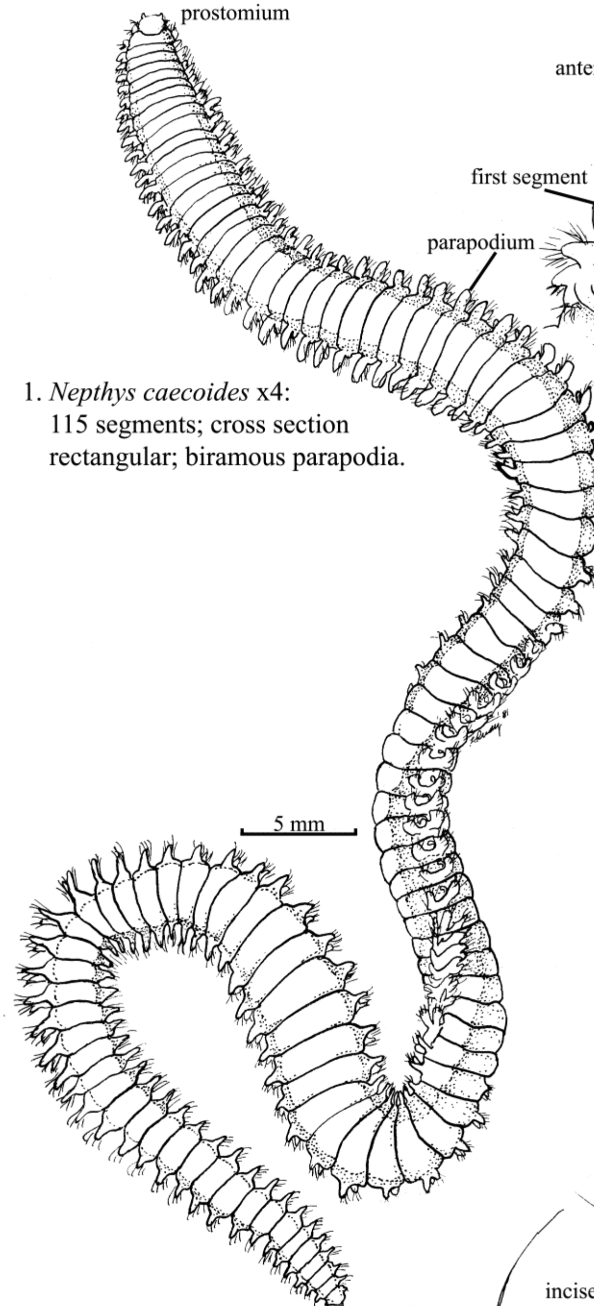
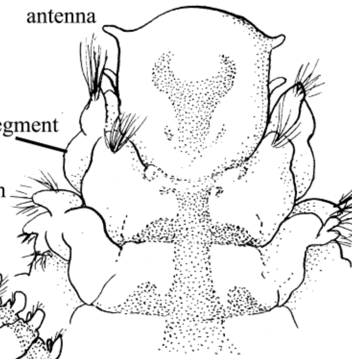
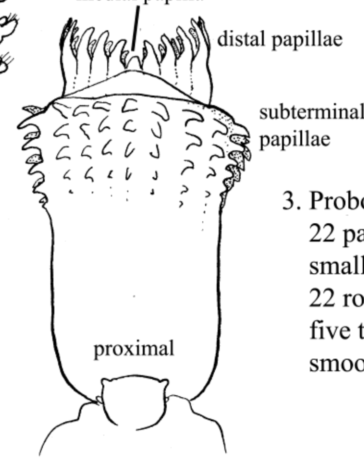
Nephtys caecoides



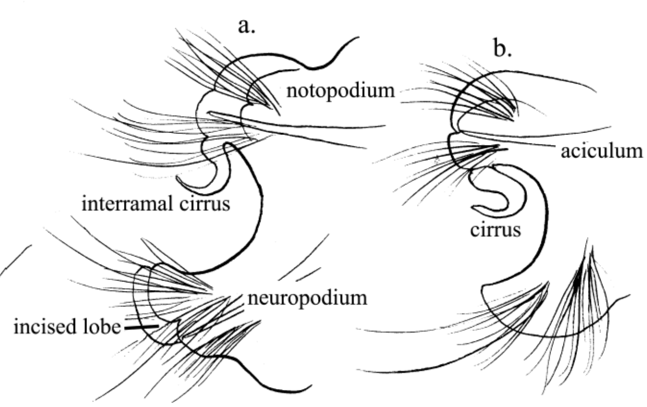
1. *Nepthys caecoides* x4:
115 segments; cross section rectangular; biramous parapodia.

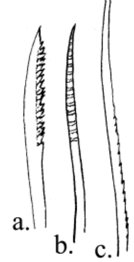


2. Prostomium (dorsal view):
flattened, pentagonal; eyeless; four small antennae, first segment incomplete dorsally; strong pigment pattern.



3. Proboscis, everted x12:
22 pairs distal papillae, a small unpaired medial papilla; 22 row subterminal papillae, five to a row; proximal surface smooth.





4. Parapodial setae:
a. short, barbed
b. pre-acicular setae; transverselyt barred.
c. post-acicular seta; single lateral barbs.

5. Parapodia, (a.) medial and (b.) posterior x30:
biramous, well separated; long, recurved interramal cirri beginning on setiger five; noto- and neurosetae in fan-shaped fascicles (bunches); acicular lobes incised.

Nereis vexillosa

The large mussel worm Grube, 1951

Phylum: Annelida
Class: Polychaeta
Order:
Family: Nereidae

Description

Size—to 13cm (Ricketts and Calvin 1971); to 30 cm in Puget Sound (Johnson 1943); individuals living in gravel are larger than those on pilings." Segments: more than 100 (Hartman 1968); this specimen: 105.
Color—in life: olive green.
Prostomium—two small antennae, massive palpi with small styles; four small ocelli. Four pairs of tentacular cirri, two dorsal pairs are longest (fig. 2).
Proboscis—horny jaws with 6-8 teeth, visible when everted.
Paragnaths— (conical teeth) on both oral and maxillary rings (fig.3). Area I: several small cones in tandem; Area II (paired): an oblique, small transverse patch, (fig. 3). Area III: a circular patch; Area IV (paired) with an oblique patch of several rows; both are ventral; Area V: no paragnaths; Area VI with a mass of 6-9 or more; both are dorsal (fig. 3). Areas VII and VIII both have continuous bands of many paragnaths, those anterior being largest; both are ventral (fig. 4).
Parapodia—typical nereid biramous structure (figs. 5, 6, 7); notopodia (dorsal branch) with falcigers as well as spinigers: genus Nereis (Hartman 1968). Posterior notopodiallobes gradually change into long straplike ligules (fig. 6), with dorsal cirrus inserted terminally: most important species characteristic.
Notopodial Setae—composite spinigers only in anterior segments (fig. 8d); posterior notopodia have a few homogomph falcigers (stout curved blades on an even base): (fig. 8a).
Neuropodial Setae—both anterior and posterior neuropodia have both composite spinigers-about 20 hetereogomph (or uneven based) (fig. 8c), and falcigers-about 5 heterogomph (fig. 8b).
Acicula—(heavy internal black spines): on all noto- and neuropodia (figs. 5, 6).
Caudal Cirri—four, fine, with accessory lobes (fig. 1): often broken in collecting.
Tube—newly hatched animals build flimsy mucus and sand tubes (Johnson 1943).

Possible Misidentifications

All nereid worms have a prostomium with four eyes, 2 or 4 pairs of tentacular cirri (Fauchald 1977), a pair of frontal antennae, and biarticulate palps. Most identifications must be done on proboscis teeth and parapodial setae and lobe differences. The other common Oregon nereids are:

Nereis *(Neanthes) brandti*, possibly a subspecies of *N. virens*, a large, sand-dwelling worm, iridescent and green in color like *N. vexillosa*. It is usually paler ventrally. In contrast to *N. vexillosa*, it has many teeth on all areas of the proboscis; its posterior parapodial lobes are leaf-like, not long and strap-like; it has no falcigers in the posterior notopodia; its ecological niche is different: it does not live in mussel beds or on pilings.

Nereis (Hediste) limnicola, from sand or mud habitats, is pale and translucent, not dark green; its posterior parapodial lobes are conical, not strap-like.

Nereis eakini, an inhabitant of rocky areas, has a long prostomium and both proboscis rings covered with minute round paragnaths. It has large eyes, and jaws with only 3-5 teeth (Blake 1975).

Nereis grubei (= mediator) is bright green like N. vexillosa, and found in mussel beds, so is sometimes confused with it, especially in its southern range. This worm is small, 5-10 cm (Ricketts and Calvin 1971) with large and expanded posterior notopodial parapodial lobes, not strap-like lobes. Like *N. vexillosa*, it also lacks paragnaths on Area V. However, characteristic *N. vexillosa* egg masses have not been found in the California areas where *N. grubei* occurs (Johnson 1943), so the two territories probably do not overlap. An annelid of the family Orbinidae, *Nainereis dendritica*, while not resembling *Nereis vexillosa* at all in prostomium, is bright green and occurs in the same sorts of gravel beds *with N. vexillosa*. It is collected for bait.

Ecological Information

Range—Eastern Siberia to Alaska and south to central California (Hartman 1968). (Specimens from southern California are probably *N. mediator* (= grubei). Type locality, Alaska and Siberia.
Local Distribution—Coos Bay, many stations; Yaquina Bay.
Habitat—among heavy algae, eelgrass, under rocks; cobblestones, or bark with muddy sand or sandy substrate; in mussel beds, barnacle clusters on intertidal pilings (ibid).
Salinity—strictly marine.
Temperature—essentially a cold water form (Johnson 1943)
Tidal Level—intertidal and shallow water (*ibid*)
Associates—with Nereis (Neanthes) virens; in mussel beds: scaleworm Halosydna, porcelain crab Petrolisthes, isopod Cirolana·

Quantitative Information

Weight Abundance—ubiquitous (Ricketts and Calvin 1971); most abundant large annelid of the Pacific Northwest (Johnson 1943); unusual because of its abundance throughout wide geographical range (Ricketts and Calvin 1971).

Life History Information

Reproduction—has heteronereid (swarming) form characterized by modified parapodia (fig. 7). Swarming at night (June, Coos Bay): males appear first on water's surface, then females. After producing eggs, females sink with males to bottom, where eggs are dislodged. Both adults then die. Eggs in a firm, irregular, gelatinous mass, 1-3 inches (2.5-75 em) in diameter, translucent; and blue green, green or brown when freshly laid; each egg 0.22 mm in diameter. Eggs can withstand strong wave action. *N. vexillosa* is the only nereid with a solid egg mass. The heteronereids observed were about one year old (Johnson 1943) and at least 56 mm long (Johnson 1901).
Growth Rate—varies greatly; at 4-12 months and 60 segments, species characteristics obvious, including strap-like parapodial lobes (Johnson 1943).
Longevity—
Food—omnivorous; prefer fresh animal food, and reject dead food. Not a scavenger by preference (Johnson 1943).

Predators—sometimes preyed upon by nemertean *Paranemertes peregrina* (Roe, 197O). Widely used by man for fish bait.
Behavior—very active, can bite human collector. Young build flimsy mucus and sand tubes, and rarely leave them completely to feed (*ibid*).

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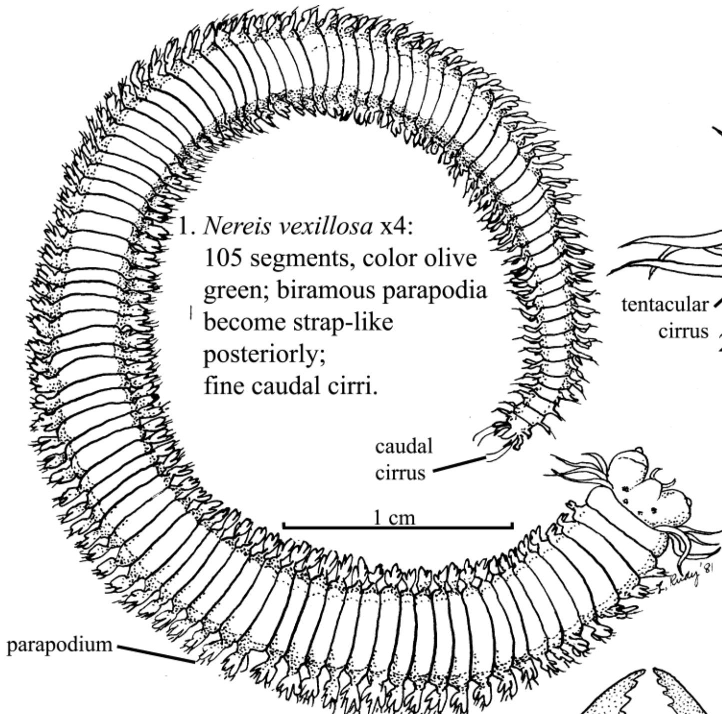
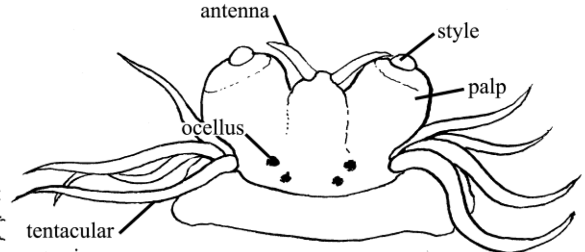
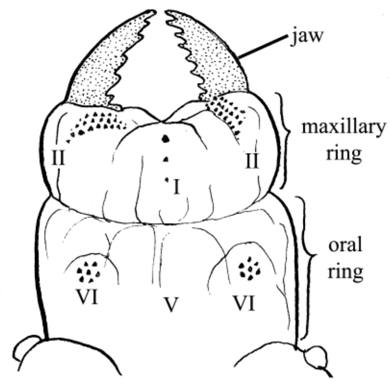
Nereis vexillosa



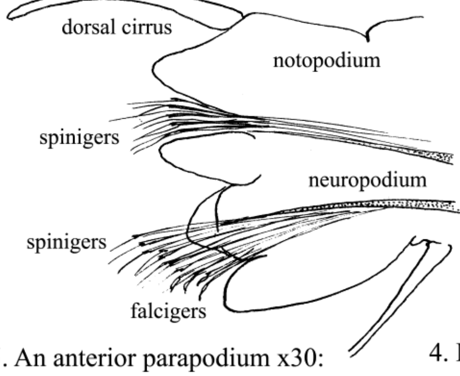
1. *Nereis vexillosa* x4:
105 segments, color olive green; biramous parapodia become strap-like posteriorly;
fine caudal cirri.

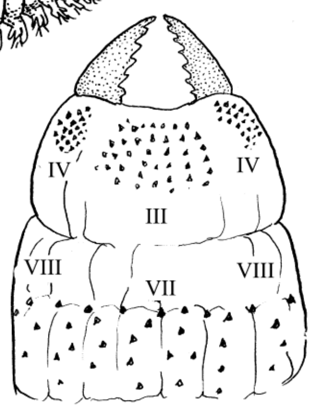


2. Prostomium (dorsal view) x12:
four small ocelli; one pair antennae; massive palps, small styles; four pairs tentacular cirri.



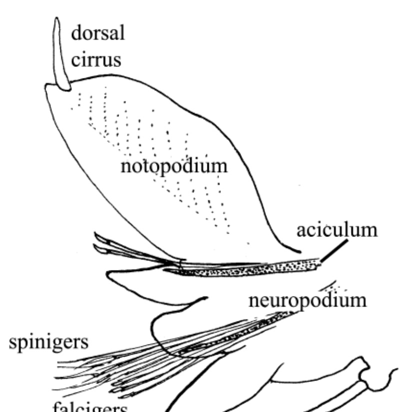
3. Everted proboscis (dorsal view) x12:
conical paragnaths, oral and maxillary rings; jaws 6-8 teeth; paragnaths area:
I: several small cones in tandem, II: an oblique, small transverse patch,
V: none, VI: 6-9 or more in a mass.



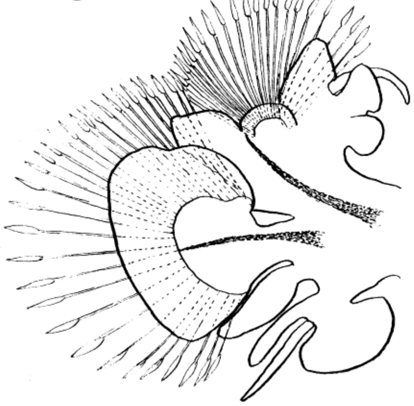


5. An anterior parapodium x30:
biramous; notopodial and neuropodial lobes 'normal', not strap-like.

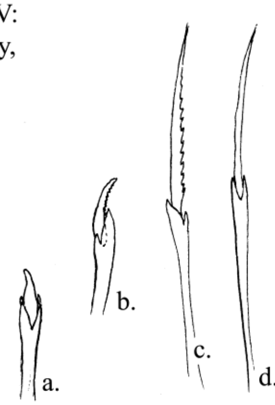
4. Everted proboscis (ventral view) x12:
paragnaths area - III: circular patch, IV: oblique patch, several rows, VII: many, continuous band, VIII: anterior cones largest.



6. A posterior parapodium x30:
notopodial lobe long, strap-like;
dorsal cirrus attached terminally.



7. Heteronereia parapodium,
female (Johnson, 1943).



8. Setae:
- a. homogomph falciger (notopodial)
- b. heterogomph falciger (neuopodial)
- c. heterogomph spiniger
- d. homogomph spiniger

Ophelia assimilis

A sand worm (Tebble, 1953)

Phylum: Annelida
Class: Polychaeta
Order: Opheliida
Family: Ophelidae

Description

Size—to 33 mm long, 4 mm wide; this specimen 22 mm (Hartman 1969).
Color—white, or pink iridescent (Coos Bay specimens).
Prostomium (Head)—a small triangular lobe; eyeless; pro-stomium not set off from body by constriction (Blake 1975); head simple: without appendages, palps, etc. Nuchal organs present but invaginate, not visible (*ibid*).
Proboscis—eversible, sack-like (not figured).
Body—fusiform (cigar-shaped); weakly segmented. 33 setigers (segments with setae); first setiger small, with biramous parapodia (fig. 1). A mid-ventral groove from setiger 8 to posterior: genus *Ophelia* (fig. 2) (Fauchald 1977). Anterior with a ventral depression, not a true groove. Last three setigers with paired prominent dorsolateral ridges (fig. 3) (Hartman 1969). Body not clearly regionated (Fauchald 1977); inflated anteriorly.
Parapodia—low folds; biramous (neuro- and notopodia); small on first setiger, larger from second, with interramal pore (not figured); middle parapodia ventrolateral, with crenulated branchiae (fig. 4).
Setae—all capillary, simple: family Ophelidae (Fauchald 1977); noto-setae longer than neurosetae (Hartman 1969) (fig. 4).
Branchiae—(capillary structures on parapodia, fig. 4): none on first 10 setigers, then 19 branchiate and 4 post-branchiate setigers; (branchiae often disintegrate in preservation).
Nephridiopores—six pairs, on setigers 11-16 (branchial segments 2-7) (not figured).
Pygidium—a pair of large ventral lobes and about 11 smaller subglobular lobes in 2 crescents above anal pore (fig. 3) (Hartman 1969).

Possible Misidentifications

Ophelidae are sand or mud dwellers, having a limited number of segments, with a simple blunt or rounded prostomium, and biramous parapodia with capillary setae. Some have a ventral groove, branchiae, and/or eyes (Fauchald 1977). At least six genera are found in our area:

Travisia sp. are cigar shaped, without a ventral groove but with branchiae; their posterior parapodia have large lobes. *T. gigas* is stout and up to 85 mm long; it has a 'garlic-like odor' (Kozloff, pers com.) and is found on sandy mudflats. Also called *T. pupa*, or *T. foetida (*Hartman 1969*)*.

Polyophthalmus sp. have a ventral grove along the whole body, no branchiae, but lateral eyes. They have a short anal tube with small anal cirri (Fauchald 1977). *P. pictus* lives in rocky habitats with algae (Blake 1975).

Ammotrypane (Ammotrypanella) have a ventral groove along the whole body (Fauchald 1977), cirriform branchiae only on the posterior setigers, no lateral eyes, and a long narrow anal tube with two internally attached ventral cirri (*ibid*). *A. aulogaster*, a mud dweller, is relatively slender and has 42-50 setigers.

Armandia sp. have a ventral groove along the whole body, cirriform branchiae, lateral eyes, and a long slender anal tube with paired long, internally attached ventral cirri and shorter dorsal cirri. The abundant estuarine polychaete *A. brevis (= bioculata)* is the only local species, living in sandy mud and silt. It is slender, 15-17 mm long, with 29 setigers.

Euzonus sp. live on clean sandy beaches and have three distinct body regions-an inflated head with a constriction setting it off from the inflated anterior (thorax) region, and a narrow posterior with branchiae and a ventral groove. Three species occur in our area:

E. dillonensis has unbranched branchiae with fine, comb-like divisions. This species is purple, 50-70 mm long, with 38-setigers.

E. mucronata (= Thoracophelia), the bloodworm, has simple two-branched branchiae, is iridescent blue to red color, up to 97 mm long and has 38 setigers.

E. williamsi is also dark red and iridescent with 38 setigers. It is smaller than *E. mucronata* (34-60 mm), and has branchiae with two or three branches, each with a few lateral pinnules on it.

The species of *Ophelia* are differentiated from other genera of Ophelidae by the fusiform body, inflated anterior, and posterior ventral groove. They generally have branchiae on setigers 8-10.

Two other species of Ophelia occur in our area:

Ophelia limacina, a cosmopolitan species, has 39 setigers (not 33 like 0. assimilis). It is rose to purple, with red branchiae (Hartman 1969), 15-40 mm long, with a long, conical prostomium (not short and triangular); it lives intertidally in sand. It has been found in Coos Bay (Hartman and Reish 1950).

Ophelia pulchella, with 38 setigers, 19-23 mm long, has 9 abranchiate anterior setigers (not 10 like the other two) (Hartman 1969). It has a long conical prostomium and long flowing tufts of setae: it is found in sandy mud sediments.

None of the *Euzonus* or *Ophelia* species above has been included in Kozloff's or Berkeley's Puget Sound work.

Ecological Information

Range—(Oregon) and northern California (Hartman 1969): type locality: Pacific Grove, California.
Local Distribution—Coos Bay: near bay mouth; Netarts Bay (Stout 1976).
Habitat—clean sand; on spit near bay mouth in nearly marine conditions (Coos Bay); often where current is strong (Wilson 1948).
Salinity—collected at 30 ‰ saltwater.
Temperature—range would indicate temperate conditions preferred.
Tidal Level—intertidal; found at I/2 tide level where it is uncovered several hours each tide (England) (Wilson 1948).
Associates—razor clam *Siliqua patula*, olive snail *Olivella*.

Quantitative Information

Abundance—not common, but can be abundant locally.

Life History Information

Reproduction—eggs and sperm spawned into water. In similar species *0. bicornis*: ripe eggs dark green/brown; larvae attached to substrate by four anal papillae and parapodial lobes; pelagic life short, metamorphosis by 19th day (Wilson 1948).
Behavior—proboscis unarmed, probably used for digging (Dales 1967).

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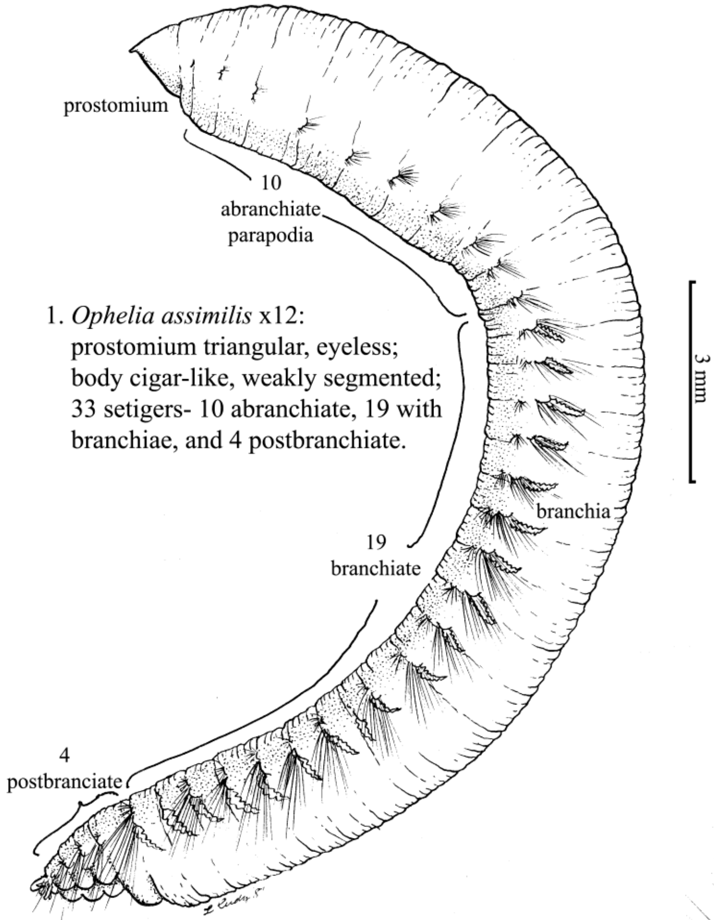
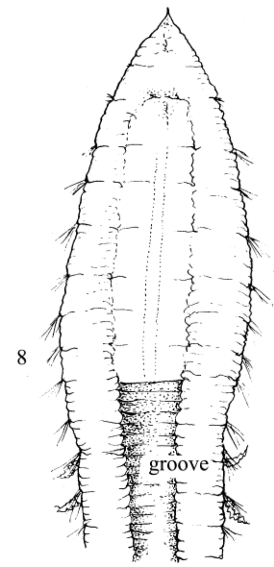
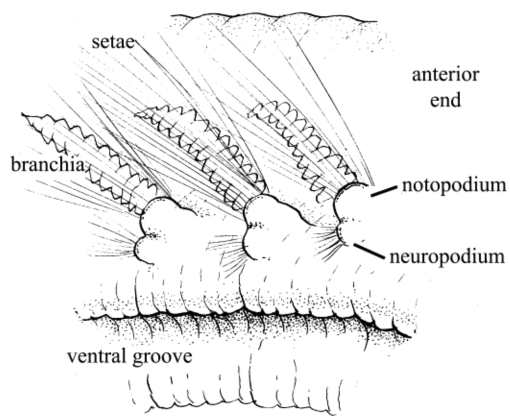
Ophelia assimilis



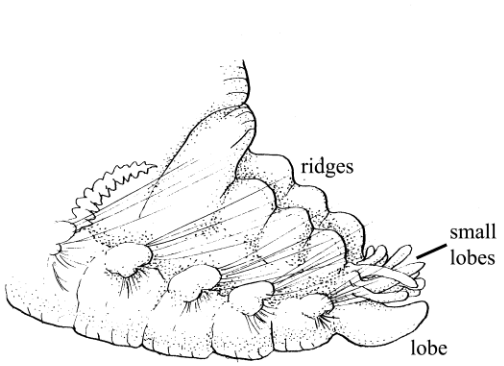
1. *Ophelia assimilis* x12:
prostomium triangular, eyeless;
body cigar-like, weakly segmented;
33 setigers- 10 abranchiate, 19 with
branchiae, and 4 postbranchiate.



2. Deep groove (anterior,
ventral view) x12: from setiger 8.



4. Some medial parapodia x30:
biramous parapodia, long notosetae;
crenulated branchiae.



3. Pygidium (lateral view) x30:
3 dorsolateral ridges; a pair of
ventral lobes; smaller lobes above.

Owenia collaris *(Owenia fusiformis)*

A tube-dwelling polychaete worm (Hartman, 1955)

Phylum: Annelida
Class: Polychaeta
Order: Oweniida
Family: Oweniidae

Description

Size— to 100 mm (Berkeley and Berkeley 1952). Illustrated specimen 27 mm long by 1.0 mm diameter (from Coos Bay, South Slough).
Color—buccal membrane (crown) pale gray green, with white band; body pale green flushed with pale reds. Preserved specimens pale with large reddish brown shield pattern running length of 1st 3 setigers (fig. 2a).
Body—cylindrical; 1st 4 anterior segments short; middle segments long; posterior segments short (fig. 1). Thorax and abdomen not morphologically distinct. 18-28 segments (Dales 1967); this specimen: 18 segments (fig. 1).
Proboscis—a muscular pad (Fauchald 1977); (not shown).
Prostomium—reduced; no sensory appendages except frilly buccal membrane. Prostomium fused to anterior segment, produced into a collar, whose margin is entire except for a pair of ventral lateral notches (Hartman 1969) (fig. 2b).
Buccal Membrane—all of anterior end of worm is a crownlike funnel: genus *Owenia.* Crown has 4-10 main branches divided into 100's of slender tips all of same length (Hartman 1969) (fig. 2). Membrane functions in respiration and feeding (Dales 1967).
Lips—3: 1 dorsal, 2 ventral (fig. 4). Can be used for direct feeding (Dales 1967).
Eyespots—2, ventral (fig. 2b) sp. *collaris* (Hobson and Banse 1981).
Parapodia—reduced; biramous, with 1st 3 setigers having capillary notosetae only (fig. 2a): genus *Owenia.* Both notosetae and neurosetae begin on setiger 4 and continue to posterior: "Neuropodia from setiger 4, form nearly encircling girdles of closely packed uncini, at anterior end of segment" (Hartman 1969) (figs. 2b, 3b). Each uncinus has a straight stem and 2 teeth (fig. 3c).
Pygidium—lobed when expanded; usually contracted when collected (Berkeley and Berkeley 1952) (fig. 1).
Tube—cylindrical or spindle-slhaped, up to 90 mm long, of hard shell fragments or sand grains. Each grain is attached at its lower end, giving tube a tiled appearance (fig. 1a). Tube lining is closefitting, chitinous and tough (genus *Owenia),* made up of fine filaments secreted by 7 pairs of thread glands. Tube grains, usually light-colored, are cemented together by the buccal organ (Lippen organ (Watson 1901)), concealed by the crown.

Possible Misidentifications

The prominent buccal membrane of Oweniidae is unique: it is not feathery, or composed of long branchiae, tentacles or of palps. It encircles the entire anterior end of the worm.

Other tube-dwelling polychaete families have buccal tentacles, palae, a crown of radioles, or palps, but none has the entire anterior end transformed into a tentacular membrane, and thus a greatly reduced prostomium. In addition, none of the following families has very short posterior segments with middle and some anterior segments long: Ampharetidae, see *Hobsonia florida;* Sabellidae, see *Eudistylia;* Terebellidae, see *Pista* and *Thelepus.* Other tube-dwelling sedentary polychaete families include Pectinaridae, Sabellariidae, and Serpulidae (not covered in this guide).

The Oweniidae is a small family with its own order (Fauchald 1977). It is characterized by its lobed or membranous prostomium fused to the anterior segments. All the anterior segments are long (except the first four in this species); the posterior segments are short. The neuropodial hooks occur in dense horizontal bands; the notosetae are capillary. Oweniida are all tube dwellers.

There are 4 other genera in the family Oweniidae:

Galathowenia spp. have a prostomium with a low collar incised ventrally. Only 1 species, from South Africa, is known (Dales 1967).

Myriowenia spp. have deeply bilobed prostomiums, with paired palps and no tentacular crown; their tubes are loosefitting and easily torn. *M. californiensis* has been reported from southern California (Hartman 1969), but not from Oregon or Washington (Hobson and Banse 1981).

Myriochele spp. have a rounded prostomium and no tentacular crown. Like *Owenia*, they have only notosetae in the first 2 or 3 setigers. *M. oculata* Zachs has a pair of eyespots and a dorsal pigment band; it occurs in British Columbia and in Washington (Hobson and Banse 1981). Of the dozen or so species of *Myriochele* worldwide (Hobson and Banse 1981), 2 others occur on the west coast - in southern California. These are *M. gracilis* Hartman and *M. pygidialis* Hartman (Hartman 1969). Both are subtidal.

Myrioglobula sp. also have a rounded prostomium and no crown of tentacles; however the 1st setiger has only notosetae. It is an Antarctic species (Fauchald 1977).

The genus *Owenia,* is characterized by its tentacular crown, its lack of neurosetae on the first 3 setigers, and its closefitting, firm tube. There are 11 species worldwide (Fauchald 1977).

Ecological Information

Range—cosmopolitan (Berkeley and Berkeley 1952): in northern Pacific from Alaska, British Columbia, south to California.
Local Distribution—Coos Bay (South Slough and bay mouth); Yaquina Bay.
Habitat— forms large colonies in mud and silts. Found in clean sand in Britain (Dales 1967); among eelgrass roots in Coos Bay.
Salinity—collected at 30‰
Temperature—
Tidal Level— Intertidal and subtidal. Below low water of neap tides in Britain (Dales 1967).
Associates—

Quantitative Information

Weight—
Abundance—

Life History Information

Reproduction—
Growth Rate—
Longevity—
Food—both a filter and a surface deposit feeder, picking up particles directly with the lips. Has a good ability to select particles for size and composition (Fauchald and Jumars 1979).
Predators—
Behavior— can move tube up and down (Fauchald 1977; Watson 1901).

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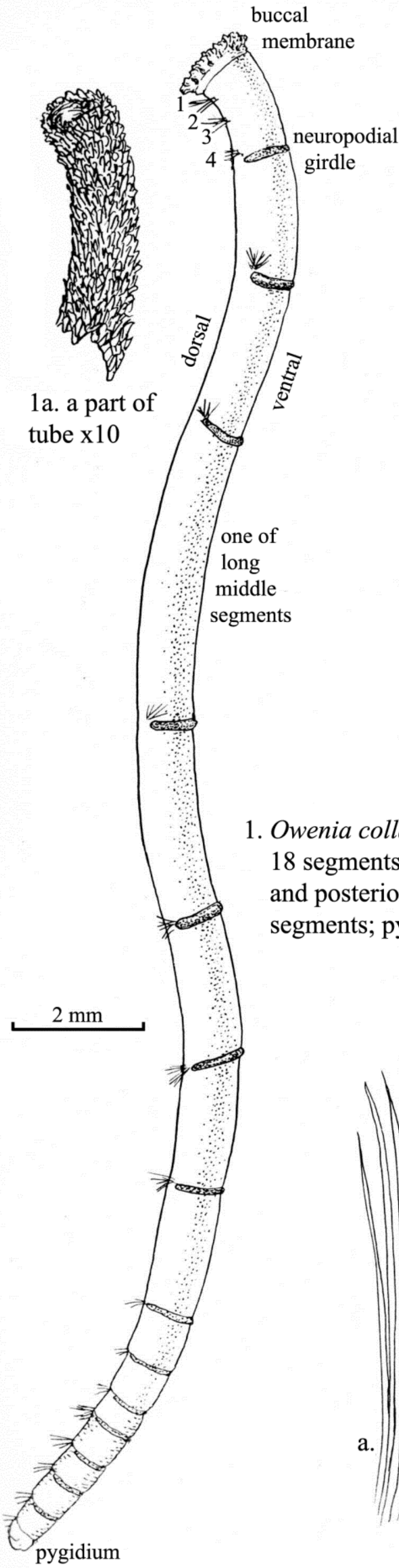
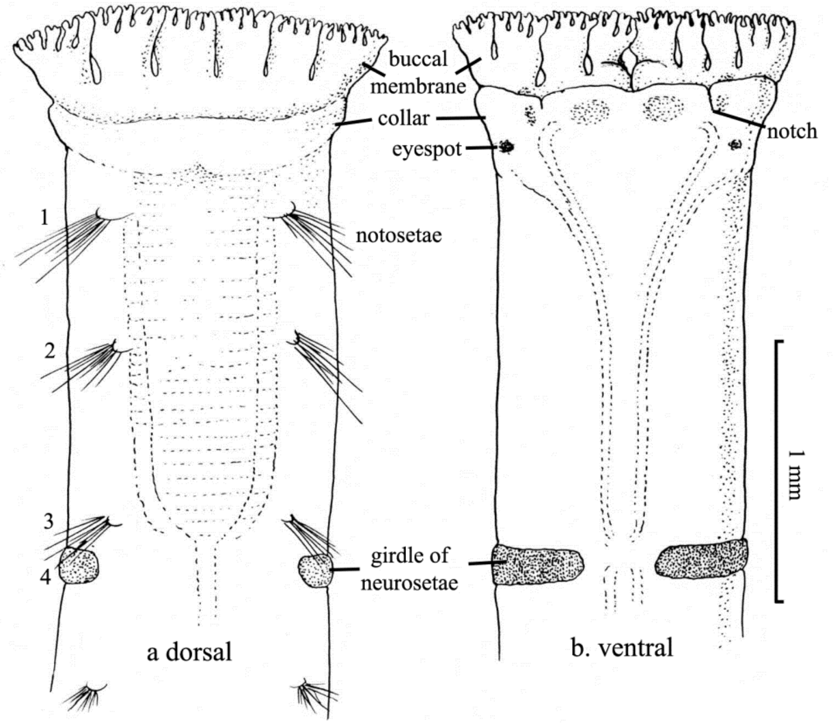
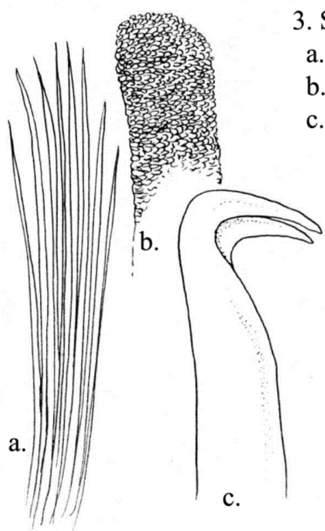
Owenia collaris



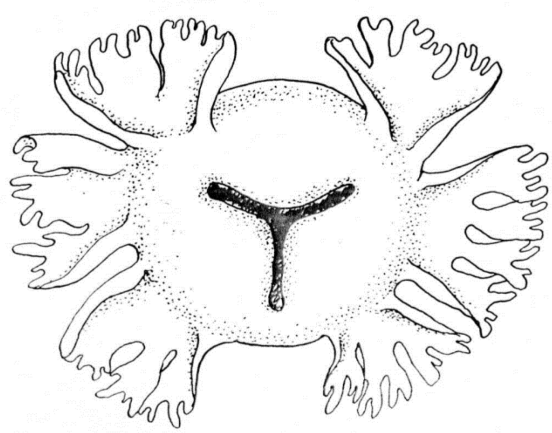


1. *Owenia collaris* (L:27mm) x10:
   18 segments; cylindrical, short anterior and posterior segments, long middle segments; pygidium contracted.

2. Anterior segments x40:
   prostomium reduced to a buccal membrane; two ventral eyespots; first three setigers with capillary notosetae only; neurosetal girdles from fourth setiger.



3. Setae:
   a. notopodial capillaries (a posterior fascicle) x100
   b. part of a neuropodial girdle; uncini closely packed x150
   c. uncinus from b. x600



4. Lips, from above x40:
   one dorsal, two ventral lobes (after Watson, 1901).

Paraonella platybranchiata

A sedentary polychaete worm (Hartman, 1961)

Phylum: Annelida
Class: Polychaeta
Order: Orbiniida
Family: Paraonidae

Description

Size— about 15 mm long (Hartman 1969), to 0.45 mm wide (Hobson 1976); 65-120 segments. This specimen 8mm x 0.3mm (Coos Bay).
Color—pale translucent with green tinge postbranchially (Hartman 1961).
Body—long, slender. Threadlike (Hartman 1961). Segments wider than long; body not divided into distinct regions: Paraonidae.
Proboscis—short, eversible, sac-like (Fauchald and Jumars 1979) (not figured).
Prostomium—long: sp. *platybranchiata* (Hartman 1961)*;* triangular, acute; anterior half set off by constriction (fig. 2). A pair of nuchal elevations on sides of peristomium, near mouth: genus *Paraonella* (Fauchald 1977)*.*
Eyes—1 small pair at base of posterior half of prostomium: sp. *platybranchiata* (Hartman 1961). Some specimens with accessory eyespots: this specimen (Posey 1975) (fig. 2).
Mouth—a triangular slit between prostromium and 1st segment (fig. 2). Long notch forms lower lip (Hartman 1961).
Segments—65-120 (Hartman 1961); all setigerous (fig. 1).
Branchiae—16-29 pairs, (18, this specimen), beginning on setiger (Hartman 1969). Branchiae broad, flat, distally pointed, lying flat across dorsum, just meeting (fig. 2). "Platybranchia" means plate-like branchiae.
Parapodia—on all segments; with short, setigerous papillae, and a short to long notosetallobe which is longest in branchial Segmenls (Hartman 1969). Lobes begin on setiger 4 (fig. 3).
Setae—all long, capillary, hairlike: genus *Paraonellas* (Hobson and Banse 1981)*.* 2-4 limbate setae on 1st 3-5 notopodia and on 1st 13 -14 neuropodia (Hobson 1976) (not in Coos Bay specimens, see fig. 4). In branchial segments, notosetae are in sparser fascicles than are neurosetae. No acicular spines (as in *Nereis vexillosa*).

Pygidium—a flat, auricular ventral lobe about 2x wider than last posterior segment (fig. 1). 3 cirriform processes (2 lateral, 1 shorter, midventral) attached dorsally to lobe (Hobson 1976) (easily lost). Anal pore dorsal.

Possible Misidentifications

Paraonidae are included (Fauchald 1977) in the order Orbiniida, along with Orbiniidae (see *Leitoscoloplos) and* Questidae. All families in this order lack prostomial appendages, have a maximum of 2 asetigerous anterior segments, and lack additional cephalized segments or palps (Fauchald 1977). All have a sac or pad-like eversible pharynx, biramous parapodia, and simple setae.

Orbiniidae can be distinguished from Paraonidae and from Questidae by the distinct thoracic and abdominal regions of the body (the parapodia are lateral in the thorax, dorsal in the abdomen). Orbiniidae never have a medial prostomial antenna, as can Paraonidae; their branchiae occur in all the posterior segments, not just on a limited number of medial segments as in Paraonidae.

Questidae are like Paraonidae in that they lack a distinct thorax and abdomen; their branchiae, if present, are posterior only (Fauchald 1977), not medial as in Paraonidae. Prostomiums in Questidae have no appendages (Paraonidae can have a single one); their setae include bifid falcigers; all setae are simple in Paraonidae.

Paraonidae are small and often overlooked. They are long and slender. without distinct body regions. The prostomium lacks appendages (although some species can have a single antenna). They have branchiae on some median setigers in most species. The parapodia are lateral; there is a post-setal lobe on the posterior notopodia (Hobson and Banse 1981). The setae are all simple; some of the post-branchial ones are modified into hooks, etc. (Fauchald 1977). Pacific genera include:

Aedicira spp. with a median prostomial antenna; all of their setae are simple, none are modified. *A. antennata* (Annenkova, 1934), with a truncate prostomium, has a medial antenna as long as 10 setigers. It is found from western Canada to southern California (Hartman 1969).

Aricidea spp. also have a medial prostomial antenna, but they have modified setae in all species in the postbranchial neuropodia. Gills begin on setiger 4 in this genus (Hobson and Banse 1981). At least 7 species occur in the northeastern Pacific.

Cirrophorus spp. have medial and posterior notopodia, which are forked or acicular, unlike other genera of this family. They can have a short medial antenna. *C branchiata (=Aricidea* Berkeley & Berkeley) and C. *lyra* (Southern) *(=Paraonis* Banse and Hobson, 1968) are both found in the northeastern Pacific (Hobson and Banse 1981).

The cosmopolitan *Tauberia,* like *Paraonella,* has no medial prostomial antenna. It does have hooded hooks in its postbranchial neuropodia, which *Paraonella* lacks. The local (Pacific) species, *T. gracilis* (Tauber) *(=Paraonis ivanovi* Annenkova) and *(=P. gracilis* Hartman, 1969) has no eyespots *(Paraonella* has them), and has but 10-16 pairs of branchiae. *Paraonella* has 12-20 pairs - in *P. spinifera* (Hobson (Hobson and Banse 1981)) or 16-29 as in *platybranchiata.*

There are 4 species in the genus *Paraonella* (Fauchald 1977). *P. spinifera* (Hobson) *(=Paraonis)* is the other local species. Unlike *P. platybranchiata,* it lacks eyespots; it has fewer pairs of branchiae, a blunt triangular prostomium, and heavy spinelike notosetae. This species was formerly in *Paraonis,* all of whose members have modified neuropodial setae in the abdominal parapodia (Hartman 1961).

Ecological Information

Range—Pacific Coast from British Columbia and Washington (Hobson and Banse 1981); Oregon, California (Hartman 1961), to Panama (Hobson 1976). Original description: San Diego.
Local Distribution—Coos Bay (South Slough), and subtidally and offshore in main Coos Bay channel.
Habitat— in clean, fine sand (Coos Bay intertidal and offshore). Also in muddy (Hobson 1976) or coarse sand (San Diego (Hartman 1969)).
Salinity—collected at 30‰ Coos Bay
Temperature—
Tidal Level—Intertidal (South Slough) to subtidal.
Associates—in San Diego: polychaetes *Prionospio malmgreni, Dispio uncinata, Nepthys caecoides, Eteone* sp.

Quantitative Information
Weight—
Abundance—

Life History Information
Reproduction—2 oval or round eggs/segment postbrancially (Hobson 1976); each egg 190-230 µd.
Growth Rate—
Longevity—
Food—probably a non-selective, burrowing deposit-feeder or surface feeder (Fauchald and Jumars 1979). Searches ripple troughs of sand for plant debris and dead animals - pennate diatoms, foraminifera, small crustaceans.
Predators—
Behavior—posterior end burrows corkscrew fashion into sediment, making characteristic spiral patterns (also found in fossil record) (Fauchald and Jumars 1979). Worm often curled when found (Posey 1985).

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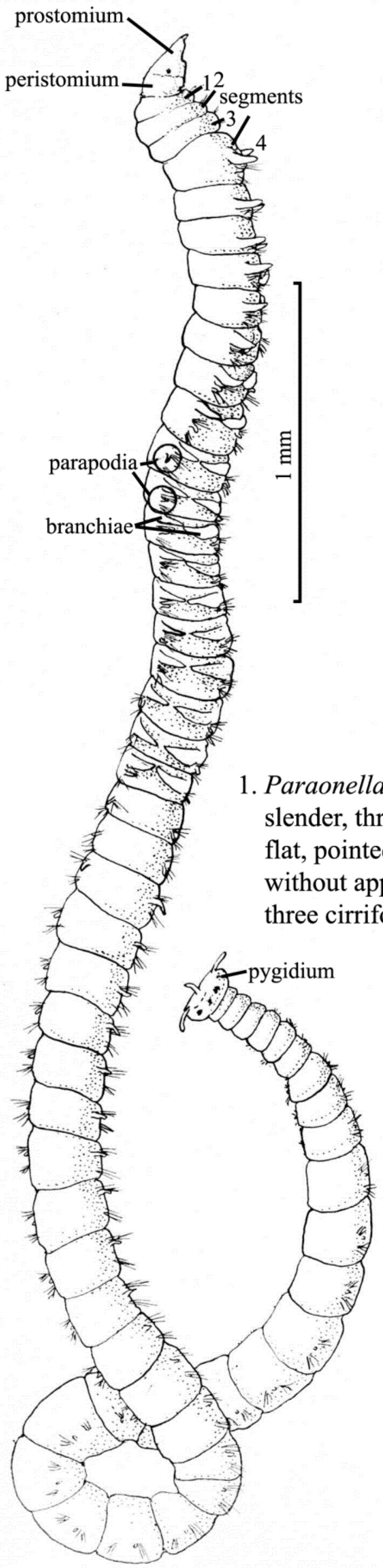
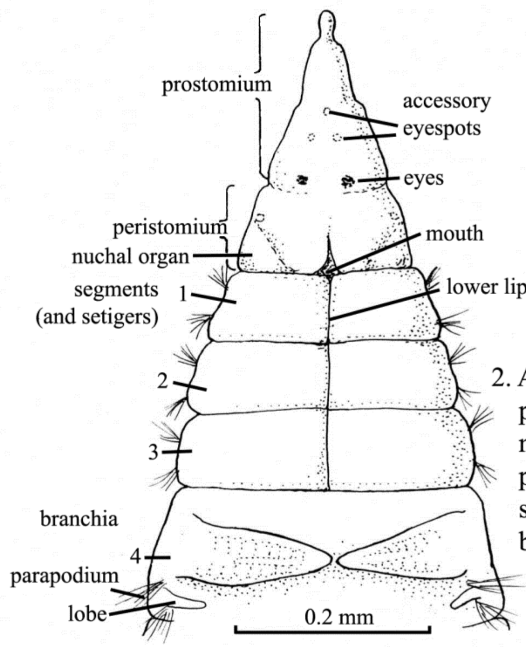
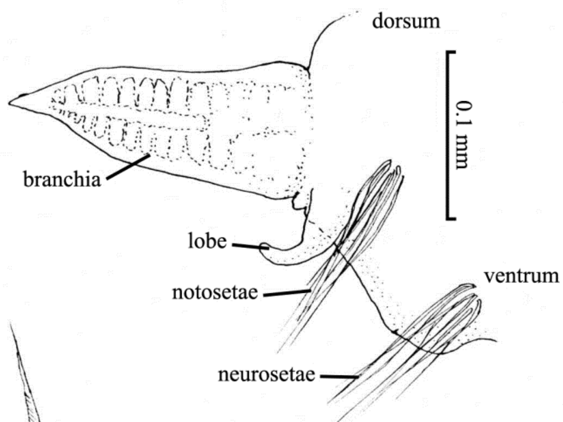
Paraonella platybranchia



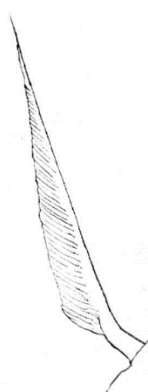
1. *Paraonella platybranchia* (L:15mm) x50: slender, threadlike; 65-75 segments; 16-29 pairs flat, pointed branchiae; acute prostomium without appendages; pygidium a flange with three cirriform processes.



2. Anterior (dorsal view) x150: prostomium long, narrow, 2 eyes; nuchal organs, mouth on peristomium long lower lip; all segments setigerous; branchiae begin on setiger.



3. Parapodium 13 x250



4. A libate neuroseta x1300: from setiger 2 (from Hobson 1976).

Pista Pacifica

(Berkeley and Berkeley, 1942)

Phylum: Annelida
Class: Polychaeta
Order: Terebellida
Family: Terebellidae, Amphitritinae

Description

Size—up to 15 Inches (39 cm): (diameter 1.4 cm).
Color—anterior segments light red to brownish pink; 12 tongue-shaped maroon lobes. "scutes", on the first segments; ventral surface gray with ochre and light yellow spots: posterior pink and blackish; dark red branchiae, white tentacles with light gray and brown stripes.
Prostomium—a simple fold, with a hood-like membrane (fig. 2).
Tentacles—long, filamentous, white with light stripes: mucus covered.
Branchiae—three pairs of dark, red, branched gills. plumose and spreading; arising dorsally from segments 2-4 (Hartman 1969). Branchiae contain vascular hemoglobin which transfers oxygen to coelomic hemoglobin (Terwilliger 1974).
Parapodia—first setae on segment four (small fascicles at cuter bases of branchiae5); thorax with zipper-like neuropodia containing double rows of uncini (fig. 3) which are "avicular" (beak-like) on first few segments, and become short-stemmed posteriorly; notopodia (fig. 2) contain capillary notosetae which are long, slender, "limbate" (winglike).
Thorax—17 setigers, (16 uncinigers) with biramous parapodia; tongue-shaped lobes, or scutes, through tenth setiger; lap-pets: 2nd & 3rd branchial segments (Hartman 1969).
Abdomen—about 300 segments, with reduced neuropodia only. no notopodia: Terebellidae (Fauchald 1977); prominent ventral groove (fig. 2).
Tube—rough, large anterior overlapping membrane (often broken when animal is taken); posterior end of tube with "star of *Pista*": characteristic pattern (fig. 1) (Terwilliger 1974).

Possible Misidentifications

The closest species is *P. elongata*, which has lappets on the second segment, but not on the third; it has no tongue-shaped lobes on the fourth segment; its tube has a sponge-like, reticulated top. Its tubes are in crevices among rocks, not in estuarine mud. *Pista cristata* (Puget Sound) has gills which form a globular mass, and is only up to 9 cm. *P. fasciata*, also from Puget Sound, has prominent prostomial lobes.

Ecological Information

Range—California to western Canada.
Distribution—Oregon estuaries: (South Slough of Coos Bay), also Cape Arago coves.
Habitat—deep mud and sand of estuaries, where it makes large tubes; eelgrass areas (Porch 1970).
Salinity—
Temperature—
Tidal Level— + 0.5 to subtidal.
Associates—commensals: polynoid worm *Halosydna brevisetosa* in tube, white "nodding heads" (entroprocts) on worm midsection.

Quantitative Information

Abundance—3.5/m^2 in eelgrass areas of South Slough (Winnick 1978).

Life History Information

Food—detritus, picked up by thread-like tentacles, passed to mouth by cilia and mucus glands.
Predators—

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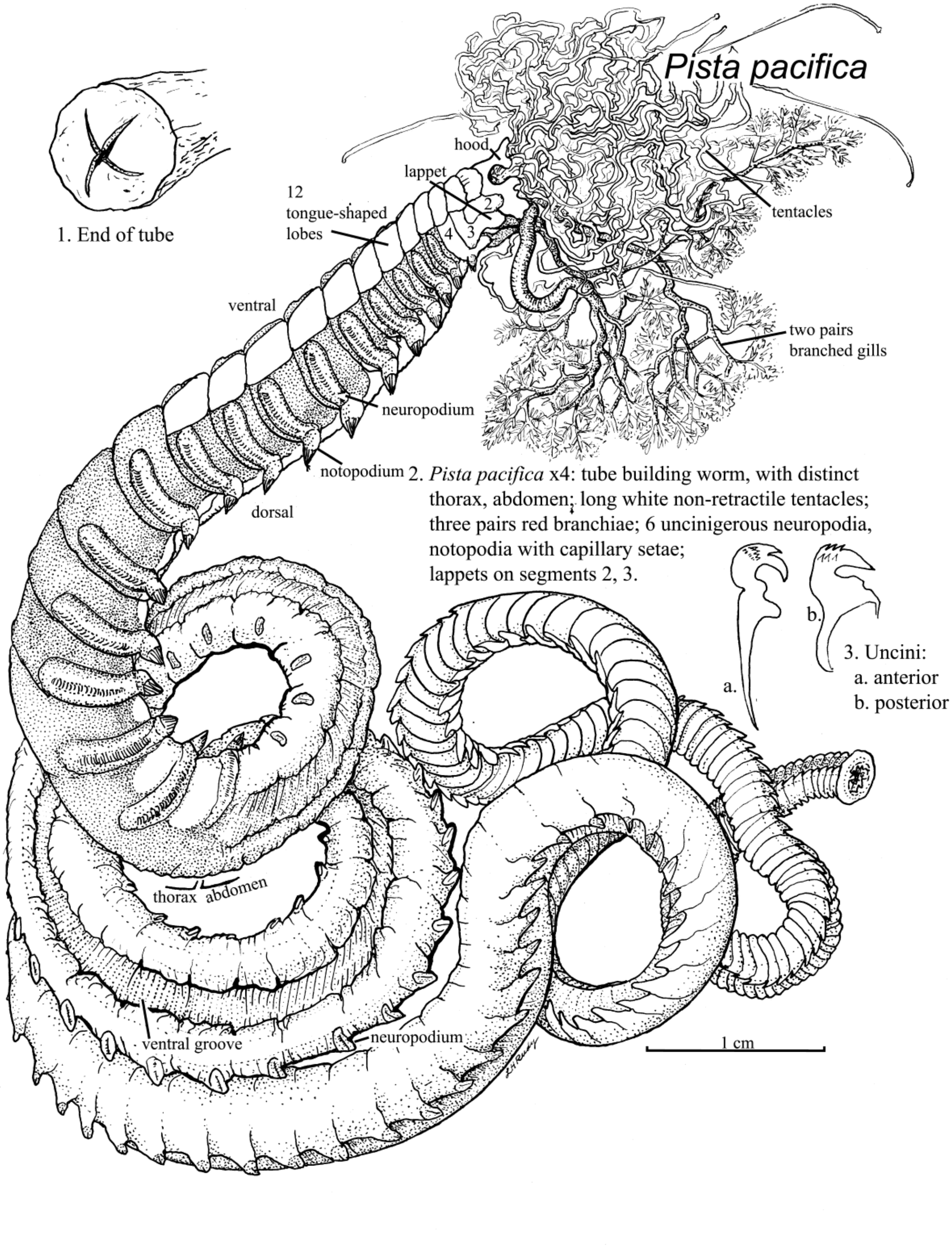

1. End of tube

2. *Pista pacifica* x4: tube building worm, with distinct thorax, abdomen; long white non-retractile tentacles; three pairs red branchiae; 6 uncinigerous neuropodia, notopodia with capillary setae; lappets on segments 2, 3.

3. Uncini:
a. anterior
b. posterior

Polydora nuchalis

A spionid worm (Woodwick, 1953)

Phylum: Annelida
Class: Polychaeta
Order:
Family: Spionidae

Description

Size—28 mm.
Color—pale orange, this specimen with a broad red vertical dorsal stripe, red cirri and in palps.
Prostomium—obvious nuchal (olfactory) tentacle, dorsally (fig. 1): prostomium blunt, tri-lobed, with two eyespots: caruncle to third segment (Woodwick 1953).
Setiger Five—modified, with special setae, no post-setal lobe, a crescent shaped row of spines (fig. 4). two types of spines: simple, falcate (A) and plumose (B), fig. 3.
Setiger Seven—beginning of hooded hooks on neuropodia and of strap-like branchiae (fig. 4).
Body Characteristics—80 segments; pygidium lacking papillae (fig. 2).
Tentacular Palps—long, coiling, reaching to 25 segments (fig. 2).

Possible Misidentifications

Numerous group: 13 in genus locally, 36 in family (Blake 1975): *P. ligni*, the closest species, also has a nuchal tentacle; its branchial gills also begin on setiger 7. Its heavy spines on setiger five have an accessory tooth; its companion setae are feather-like. Its habitat is mud or water-logged wood; it is also an oyster borer (Blake and Evans 1973). All *Polydora* species have modified fifth setigers: see key (Blake 1975), note habitat differences. *P. elegantissima*, a boring species, has very short branchiae beginning on the eighth setiger, but rarely on the seventh, and its nuchai caruncle extends back over several segments (fig. 1). *P. socialis*, common in San Francisco, also has branchiae beginning on the eighth setiger.

Ecological Information

Range—type locality Puget Sound.
Local Distribution—Coos Bay: South Slough.
Habitat—**Substrate**—"mudflats of estuaries and bays" (Blake 1975); orange tubes, 2 cm long, bottom of a drainage channel, Salicornia marsh; (South Slough of Coos Bay); "non-calcareous substrates" (Blake and Evans 1973).
Salinity—area of collection; 10 ‰ surface waters-Coos Bay, Oregon.
Temperature—area of collection; 8°C-18°C surface waters-Coos Bay, Oregon.
Tidal Level— + 4.5 feet (South Slough of Coos Bay).
Associates—amphipods, sphaeromid isopods, the gastropod *Ovatella*, alga *Fucus*.

Quantitative Information

Weight—
Abundance—June, in plankton collections under South Slough bridge. Spionid larvae: 300/m: February. 4000/m (Blake and Evans 1973).

Life History Information

Reproduction-up to 100 eggs are kept in transparent mucous capsules in chains, attached to tube walls. Only 1-8 larvae (of 100) will survive. Larvae develop 9-12 segments before they are freed to be plankton (Woodwick 1953). Some spionid larvae remain in plank-ton as long as 3 months (Dales 1967).
Growth Rate—
Longevity—*Polydora ligni* completes life cycle in 30 days (Light).
Food—detrital, collected by long palps.

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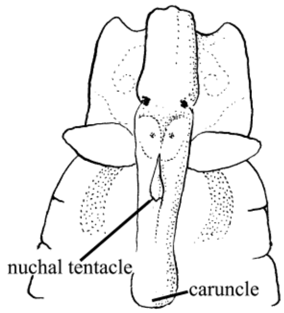
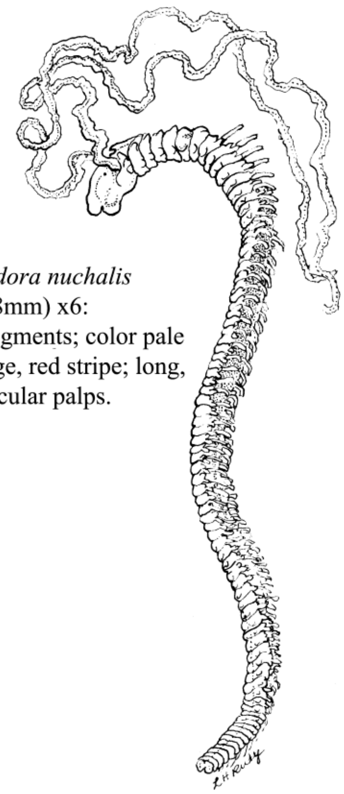
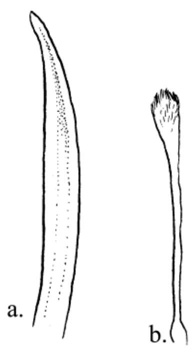
Polydora nuchalis



1. Prostomium (dorsal view)

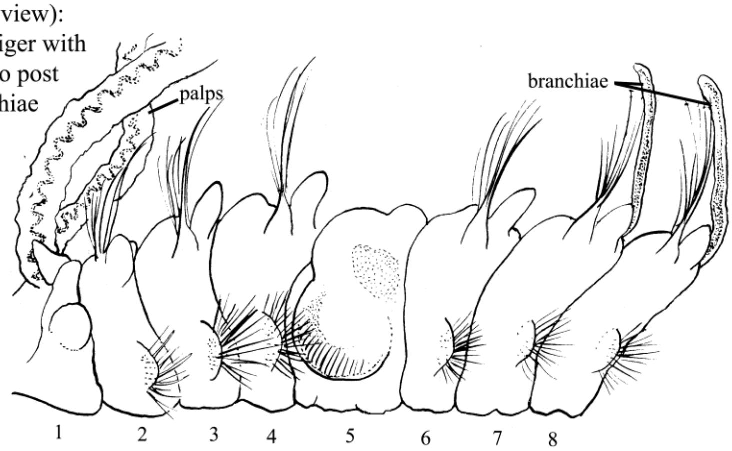


2. *Polydora nuchalis*
(L:28mm) x6:
80 segments; color pale orange, red stripe; long, tentacular palps.



3. Spines of setiger five:
a. heavy spines; simple, falcate (sickle-like)
b. companion setae, fine, plumose.

4. First eight setigers (lateral view): showing modified fifth setiger with crescentic row of spines, no post setal lobe; strap-like branchiae (gills) beginning setiger seven.



Pseudopolydora kempi

A tube-dwelling sedentary polychaete worm (Southern, 1921)

Phylum: Annelida
Class: Polychaeta
Order: Spionida
Family: Spionidae

Description

Size—up to 28 mm long (Blake 1975). Our specimens (Coos Bay) 16 mm long x 1.5 mm, and nearly 40 segments. Average specimens 12 mm long, with 50 body segments (Light 1978).
Color—pigmentation variable (Light 1978), but typically pale, with transverse intersegmental rows of black spots anteriorly on most specimens: sp. *kempi* (Blake 1975) (fig. 3).
Body—thickened anteriorly; becomes narrower posteriorly. No division of body into distinct sections. 5th setiger only slightly modified (fig. 4).
Prostomium—rather blunt, with small bi-lobed lateral horns (fig. 2). No caruncle, but with occipital cirrus between palpi (fig. 2). 4 small eyes, outer pair anterior and darker; inner pair subdermal, close together, between palpi. 2 conspicuous palpi, about 1/3 body length (fig. 1).
Branchiae—15 to 25 pairs, beginning on setiger 7 (Light 1978) (figs. 1, 3).
Parapodia—biramous; notopodial post-setal lobes on setigers 2-5 (fig. 3). Neuropodial lobes reduced by setiger 8, when they become tori with hooded hooks. Anterior noto- and neurosetae include several kinds of capillary and limbate spines (figs. 5a and b). Setiger 1 with neurosetal fascicle only, no notosetae (figs. 2, 3). Posterior neurosetae (from setiger 8) are bidentate hooded hooks in row of 18-20 (fig. 5c): genus *Pseudopolydora* (Light 1978).
Major Spines, Setiger 5—modification consists of a special J-shaped double row of falcigers (fig. 5a): sp. *kempi* (Light 1978), in addition to typical bilimbate setae (fig. 5b).
Pygidium—cup shaped, flaring, with 2 dorsal processes (fig. 4).
Tube— (not figured); mucoid; animal completely hidden except for palpi.

Possible Misidentifications

Pseudopolydora spionids can be distinguished from other genera by their unusual J-shaped row of hooks on setiger 5, and by their neuropodial hooded hooks, which begin on setiger 8; the branchiae begin on setiger 7 (Fauchald 1977).

Other genera in this common estuarine family include: *Boccardia,* which have branchiae from setiger 2 and a strongly modified setiger 5. *Polydora* also have a strongly modified 5th setiger; their branchiae begin on setiger 6; they lack postsetal parapodial lobes (Hartman 1969). *Pygospio* (see *P. elegans)* have branchiae beginning posterior to setiger 10 and the 5th setiger unmodified. Their tubes are papery and clear, with fine sand grains adhered to them.

There are 11 species of P*seudopolydora* (Light 1978)*: P. paucibranchiata* is probably the only other common Pacific coast species. It has a rounded prostomium (not a bi-lobed one) with no pigment stripes on the anterior segments. Branchiae are present from setiger 7 - only 10 to 12 pairs (Light 1978). The major setae on setiger 5 are U- or horseshoe-shaped (Light 1978). Its pygidium is narrow and saucerlike, and lacks dorsal processes. *P. paucibranchiata* is small (4-6 mm, rarely to 12 mm (Light 1978)), and its palps have yellow reflective spots (Blake 1975).

The subspecies *Pseudopolydora kempi californica* (Light, 1969) and *P. k. japonica* (Imajaima and Hartman, 1964), are considered to be invalid (Light 1978).

Ecological Information

Range—widely distributed: India, South Africa, Kurile Islands, Pacific coast. Introduced with oysters *(Crassostrea)* from Japan in the 1960s (Light 1978).

Local Distribution—Coos Bay: South Slough; Columbia estuary.
Habitat— inhabits mucoid tubes in sandy mud of bays. Often found outside beds of mudshrimp *Callianassa.*
Salinity—brackish to nearly fresh water: 6.3-31.9‰. Collected at 30‰ (Coos Bay)
Temperature—10 - 15 °C.
Tidal Level—intertidal to "shallow depths" (Hartman 1969); high intertidal (Coos Bay, South Slough *Callianassa* beds).
Associates—amphipod *Eobrolgus spinosus.*

Quantitative Information
Weight—
Abundance—South Slough, June: in core 15 x 13 cm: high intertidal (3.6' MLLW) 221.10 animals; mid intertidal (3.4' MLLW) 4885.79 animals; low intertidal (3.0' MLLW) 4113.17 animals (Posey 1985).

Life History Information
Reproduction—
Growth Rate—
Longevity—
Food—primarily a deposit feeder. but can shift to suspension feeding when water currents increase, by forming palpi into helix shapes.
Predators—fish, shorebirds.
Behavior—when lugworm *Abarenicola* sp. disturbs surface with castings, *Pseudopolydora* can move tube location (Wilson 1981).

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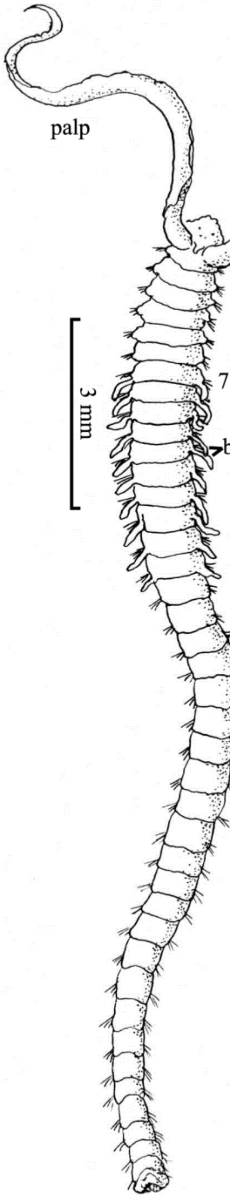
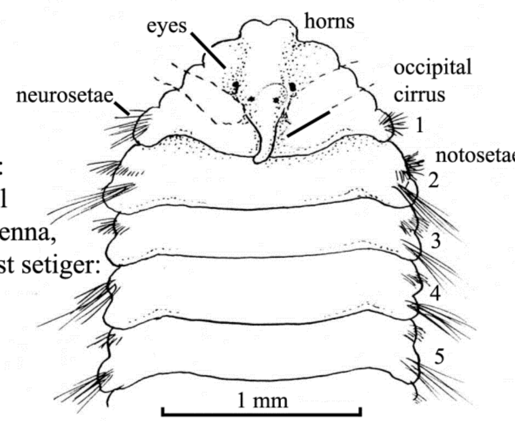
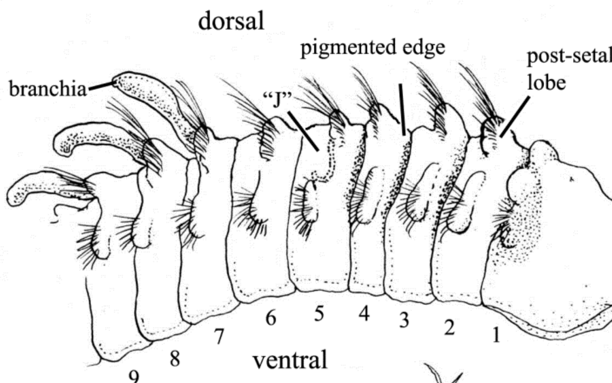
Pseudopolydora kempi



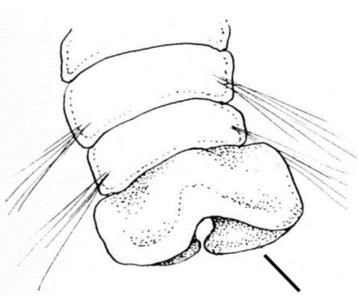
1. *Pseudopolydora kempi* (L:16mm) x10: paired palpi; 10-12 pairs branchiae, beginning on setiger 7.



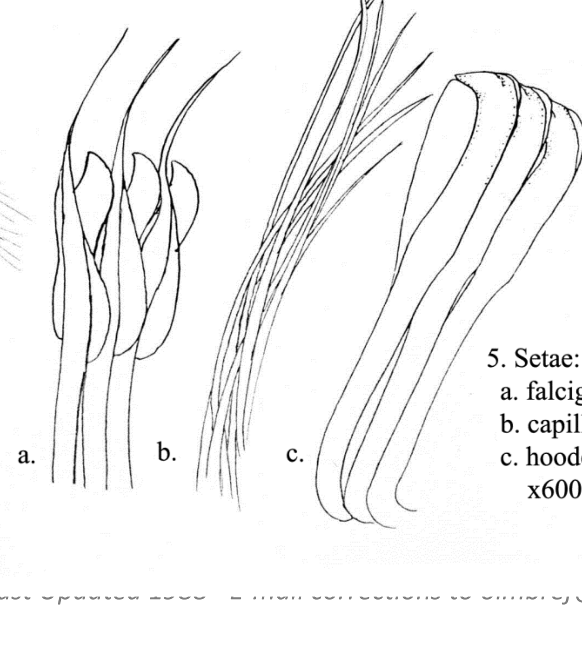
2. Prostomium and anterior setigers (dorsal view) x30: prostomium bilobed, small lateral horns; occipital antenna, no caruncle; four eyes; first setiger: small neurosetae only.



3. Anterior (lateral view): 5th setiger with J-shaped double row of falcigers; pigmented setment edges; branchiae begin on setiger 7; post-setal lobe on setigers 2-5.



4. Pygidium (ventral view) x60: cup-shaped, 2 dorsal processes.



5. Setae:
   a. falcigers from 5 x32
   b. capillaries from setiger 5 x213
   c. hooded hooks from setiger 10 x600.

Pygospio elegans

A spionid polychaete worm (Claparede, 1863)

Phylum: Annelida
Class: Polychaeta
Order: Spionida
Family: Spionidae

Description

Size—10-15 mm; 50-60 segments (Light 1978). Illustrated specimen 5mm x 0.3mm; 36-37 segments (fig. 1).
Color—light, almost white; with black markings on anterior segments (fig. 2), but not on proboscis (Light 1978).
Body—slightly flattened dorsolaterally. Fifth setiger normal (not strongly modified as in some spionids).
Proboscis—partially eversible conical sac (not shown).
Prostomium—without horns, but with two massive short dorsolaterally grooved palps (figs. 1, 5), often lost during collection. Prostomium blunt anteriorly, with lateral swellings; slightly bi-lobed in some specimens. Never conical or tapering: sp. *elegans* (fig. 2).
Eyes—four; anterior pair widely separated, lighter in color than distal pair (fig. 2). But can have 2-8 eyespots, irregularly arranged segments (Light 1978).
Parapodia— biramous, with cirriform lobes beginning on second setiger, and diminishing posteriorly. Notopodia with tong setae only; neuropodia with spoonlike hooded hooks beginning on setigers 8 and 9: sp. *elegans* (fig. 4). Neuropodia without interramal pouches (not shown).
Branchiae— numerous pairs, first appearing on setiger 11-13; none on last few segments.
Pygidium—with four pigmented conical cirri: sp. *elegans* (fig. 3).
Tube—unique to species: tong, papery, clear, covered with fine sand grains (fig. 5).
Sexual Dimorphism—males may have small pair of elongated dorsal cirri ("auxiliary gills" of some authors) on setiger 2: genus *Pygospio* (Blake 1975). Often lost in collection (not shown).

Possible Misidentifications

The Spionidae are easily recognized by their grooved palps; they also have reduced biramous parapodia, with most setae simple, and with hooded hooks on the posterior noto- or neuropodia. They can have paired branchiae. A well developed prostomium is often fused with the peristomium (Blake 1975). *Pygospio* spp. have branchiae beginning posterior to setiger 10; they lack the dramatically modified 5th setiger of some spionids. Other small tube dwelling spionids include some *Polydora* spp. whose tubes are mucoid (Hartman 1969), and *Pseudopolydora kempi* (Southern), which also has a mucoid tube, as well as a J-shaped row of falcigers on setiger 5, and a cup-shaped pygidium.

Pygospio californica Hartman, 1936 is the most closely related species. It is green in life, and is twice the size of *P. elegans,* being 10-15 mm long and having 85 segments (Hartman 1969). *P. californica's* prostomium has a tapered conical tip, and is not bi-lobed; it has a narrow caruncle that reaches to the first setiger *(P. elegans* has no caruncle). There are brown spots on the proboscis; a reddish brown ventral stripe runs down the first 10-20 segments (Light 1978). The paired branchiae in *P. californica* begin on setiger 19, not *on* 11-13 as in *P. elegans. P. californica* is found on intertidal sand flats; the only record in Oregon is from Umpqua estuary.

Ecological Information

Range— northern Atlantic; northern Pacific; western Canada to California (Light 1978).
Local Distribution— Coos Bay: South Slough; Columbia River estuary.
Habitat— lives in papery sandy tubes in mud or sand flats. Considered an indicator species for slight organic pollution (domestic sewage, Germany (Anger 1977)). Ability to eat

suspended as well as deposited matter increases survivability in variable environments (Taghon et al 1980).
Salinity—30‰ to 28‰ Coos Bay
Temperature—
Tidal Level—only at high tide *level* (Coos Bay).
Associates—sabellid polychaete *Chone ecuadata* (California (Blake 1975)).

Quantitative Information

Weight—
Abundance—June, core 13 x 15 cm: high intertidal (3.6' MLLW) 5-7 animals; mid intertidal (3.4' MLLW) 6-16 animals; low intertidal (3.0' MLLW) 13-20 animals. Most abundant in April (Posey 1985) .

Life History Information

Reproduction—eggs emerge from nephridial pores with substance which forms cocoon within tube (Soderstrom, (Hartman 1941)). Eggs present April (Coos Bay).
Growth Rate—
Longevity—high mortality when disturbed by castings of polychaete *Abarenicola* (Wilson 1981)
Food—a deposit and filter feeder, searching mud surface and water above for food. *Can* switch from deposit to suspension feeding when water flow velocity increases (Taghon et al 1980). Most versatile feeder studied: can build mucus net within tube as well as above it (Fauchald and Jumars 1979).
Predators—fish; shorebirds: species lives at high tide level.
Behavior—moves tube when disturbed *ie.* by activity of the large lugworm *Abarenicola* sp. (Wilson 1981).

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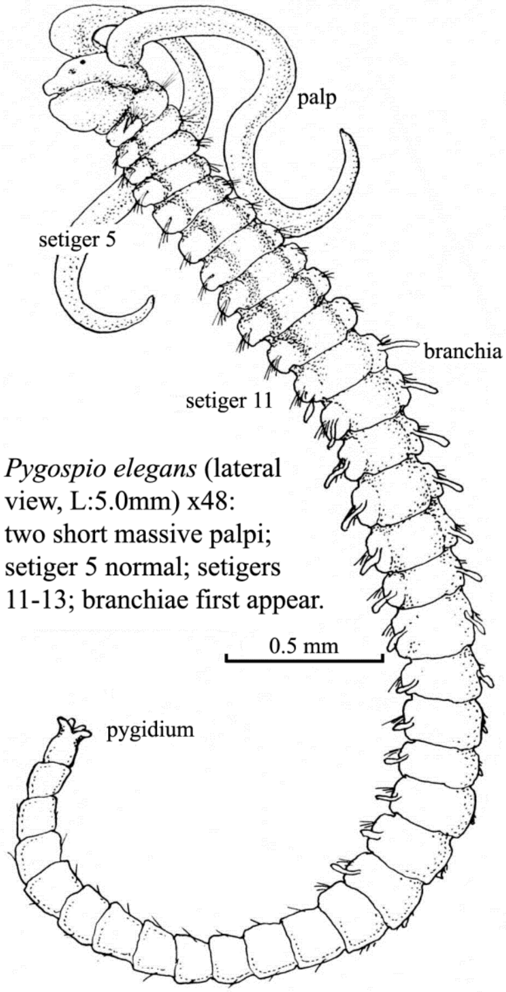
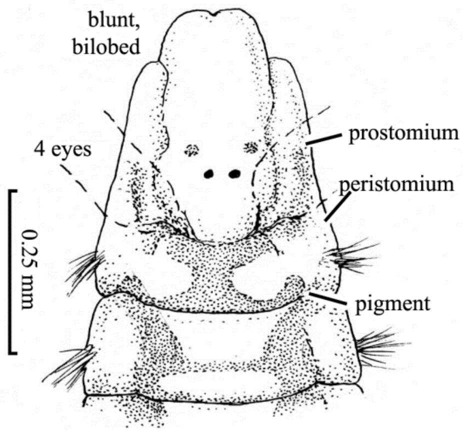
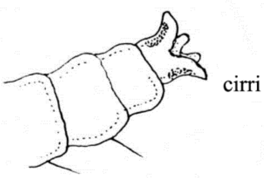
Pygospio elegans



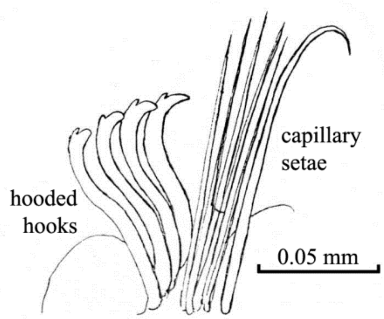
1. *Pygospio elegans* (lateral view, L:5.0mm) x48: two short massive palpi; setiger 5 normal; setigers 11-13; branchiae first appear.



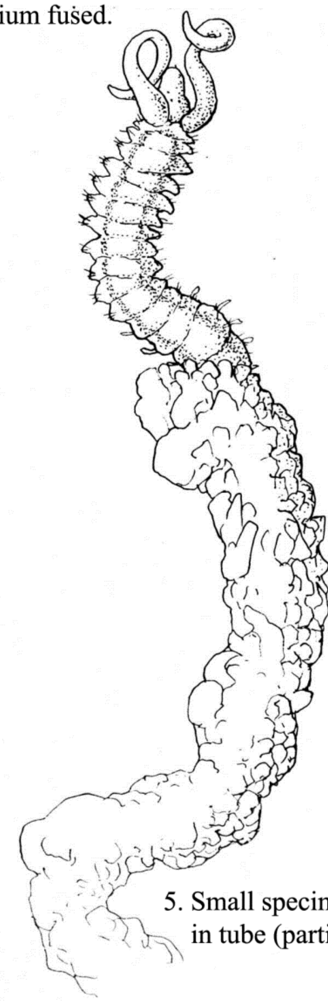
2. Prostomium, anterior segments x100: strong pigment pattern; prostomium, peristomium fused.



3. Pygidium x75: conical cirri.



4. Setae from midsection nuropodium x350.



5. Small specimen in tube (partial) x48.

Scolelepsis foliosa

A very large spionid polychaete (Audouin & Milne-Edwards, 1833)

Phylum: Annelida
Class: Polychaeta
Order: Spionida
Family: Spionidae

Description

Size—500 mm by 15 mm; first 130 segments 140 mm (Coos Bay); over 500 segments. (S. *alaskensis*, probably same species, 130 segments, 80 mm (Treadwell 1914)).
Color—these specimens golden tan; palps green with white lines and spots; red vessels (within).
Body—rectangular in cross-section. 5th setiger not modified (arrow, figs. 1, 2a); no interparapodial pouches (brackets -fig. 1): genus *Scolelepsis* (Light 1978) (fig. 2a).
Prostomium—pointed tapered: genus *Scolelepsis* (Light 1978; Pettibone 1963b). Can also be rounded (Berkeley and Berkeley 1952; Hobson and Banse 1981) (fig. 2b). No frontal horns. Small occipital cirrus (fig. 2a); no caruncle ("dorsal sense organ" (Hobson and Banse 1981)) (arrow, fig. 2b).
Peristomium—enlarged, envelops prostomium with 2 rolls (Light 1978) (fig. 2b); also a large, eversible proboscis (saclike), not shown.
Eyes—2 pairs in some specimens - not figured.
Palps—for feeding: simple, massive and long (to 20th setiger) (fig. 1). Easily broken off.
Branchiae—begin on setiger 2 (figs. 2a, b). Long, cirriform, partly fused to parapodial lamellae (figs. 4a, b, c). Branchiae continue almost to posterior end: genus *Scolelepsis* (Light 1978) (fig. 1).
Parapodia—bi-lobed, lamellar; shape variable. Becoming small at posterior end (fig. 5d), but not glandular or thick.
Setae—fine spines (capillaries) in all noto- and neuropodia. Hooded hooks (fig. 5a) begin in neuropodia after setiger 57: sp. *foliosa* (Light 1978). Hooks also on notopodia on extreme posterior setigers (figs. 4a, 5c, d). Hooks hooded, unidentate (or multidentate and worn) (fig. 4a). Capillary setae (spines) alimbate (no wings), very finely striated (fig. 4b). Some with horizontal ribs (fig. 4c, from setiger 39). None with distal fringe. Notosetae present in setiger 1 (fig. 2a).

Pygidium—a thick, lobed pad. Anus and pygidium dorsal (fig. 3). No cirri.

Possible Misidentifications

Spionidae can be distinguished by their grooved palps; they also have hooded hooks in the posterior segments. They may or may not have prostomial appendages or branchiae (Blake 1975). The similar family Cirratulidae may also have a large pair of palpi, but they have tentacular filaments, lacking in the spionids. Spionid bodies are not divided into distinct regions; the prostomium is well developed and fused with peristomium; pharynx is without jaws; setae are mostly simple (Blake 1975). Often certain segments are highly modified and have special setae; prostomium can have horns but not in *Scolelepsis*. Parapodia in Spionidae are biramous, with acicula (see *Leitoscoloplos pugettensis),* but sometimes have stout sabre setae (not in this species).

Several other genera of spionids have well developed branchiae and pointed prostomia: In *Aonides,* the branchiae begin on setiger 2 - as in *Scolelepsis* - but there are only about 30 pairs; they do not extend to the posterior end (Light 1978). *Dispio* has gills from setiger 1; they have finger-like accessory branchiae in the median and posterior segments (Light 1978). *Spio* also has gills from setiger 1, but lacks accessary branchiae. In *Pygospio,* the gills first appear on setiger 10. (Males have an additional pair on setiger 2 (Light 1978)).

In both genera *Malacoceros* and *Laonice* the branchiae begin on setiger 2. But *Malacoceros* spp. have ventral sabre setae in the median and posterior segments, and a prostomium with horns (Light 1978). *Laonice* lack the horns and sabre setae, but have a very long caruncle, interparapodial pouches, and anal cirri; they have branchiae only on the anterior segments – all characteristics lacking in *Scolelepsis*.

The genus *Scolelepsis* is characterized by its pointed prostomium (blunt in S. *foliosa),* caruncle (if present) to setiger 2, a possible occipital cirrus, cirriform branchiae beginning on setiger 2, an unmodified 5th setiger, no interparapodial pouches or sabre setae, and a pad-like pygidium (Light 1978). The genus currently includes species from the now invalid genera *Nerine, Nerinides, Pseudomalacoceros,* and *Pseudonerine* (Fauchald 1977; Light 1978). Other species that could be found in our area include:

Scolelepsis squamata (Muller), called *Nerinides acuta* when it was found in San Francisco Bay (Jones 1961). As *Nerine cirratulus,* it appeared in South Slough, Coos Bay (Hartman and Reish 1950), among many other places (Berkeley and Berkeley 1952; Hartman 1969). This species is primarily distinguishable from *S. foliosa* by its hooded hooks, which appear first on setiger 25-40 - not on setiger 57. Other differences include its capillary setae, which are limbate and without "ribs": its prostomium, pointed fore and aft; it usually has 2 pairs of eyes. *S. squamata* can be up to 80 mm long, and have up to 200 segments (Light 1978). Unlike S. *foliosa,* it has no occipital cirrus, and it does have a caruncle to setiger 2. Like *S. foliosa,* it has long cirriform branchiae from setiger 2. The postsetal lamellae of setiger 1 are well developed. This species has previously been described as *Spio acuta* Treadwell, *Nerine minuta* Treadwell, and *Nerine agilis* Verrill (Light 1978).

Scolelepsis tridentata (Southern, 1914) has been found in California and in Ireland. It is not known if it is present in Oregon. It has tridentate hooded hooks, each with a large central fang; these hooks begin on setigers 15-16, not on setiger 57. Capillary setae are limbate (unlike *S.* foliosa's), but are similarly ribbed.

Scolelepsis alaskensis (Treadwell 1914) is tentatively identified by Pettibone (Pettibone 1963b) as being synonymous with *S. foliosa.* However, the parapodial lamellae in *S. alaskaensis* are thick and glandular, not lamelliform as in *S. foliosa* (Hobson and Banse 1981).

The truly amazing thing about these specimens from Coos Bay is their size - from 160 mm to 500 mm long. Berkeley and Berkeley (Berkeley and Berkeley 1952) do report a specimen from British Columbia of 160 mm long, however. The subtidal specimens report by Hartman (Hartman 1969) were less than half this size.

Ecological Information

Range— cosmopolitan. On Pacific coast: British Columbia (Berkeley and Berkeley 1952), Washington (Imajima and Hartman 1964), Oregon, California (as *S. f. occidentafis* (Audouin and Milne-Edwards 1833)).
Local Distribution— Coos Bay: Clam Island, Pigeon Point, Charleston mudflat (Portside); bay mouth, subtidally.
Habitat— loose sandy mud, gravel: Coos Bay. Makes loose vertical burrow in shifting sands; has no definite tube (Pettibone 1963b). Offshore in clean well-sorted sand (Hancock et al 1984).
Salinity—collected at 30‰
Temperature—9-15 °C.
Tidal Level— about 0.0 ft. (Pigeon Point, Coos Bay). Offshore in about 10 fathoms (5.4 m) (Hancock et al 1984).
Associates—

Quantitative Information

Weight—
Abundance—not common (Coos Bay).

Life History Information

Reproduction— development pelagic; mostly planktotrophic (Hannerz 1956).
Growth Rate—
Longevity—
Food— selective surface deposit feeder (Fauchald and Jumars 1979).
Predators—
Behavior—

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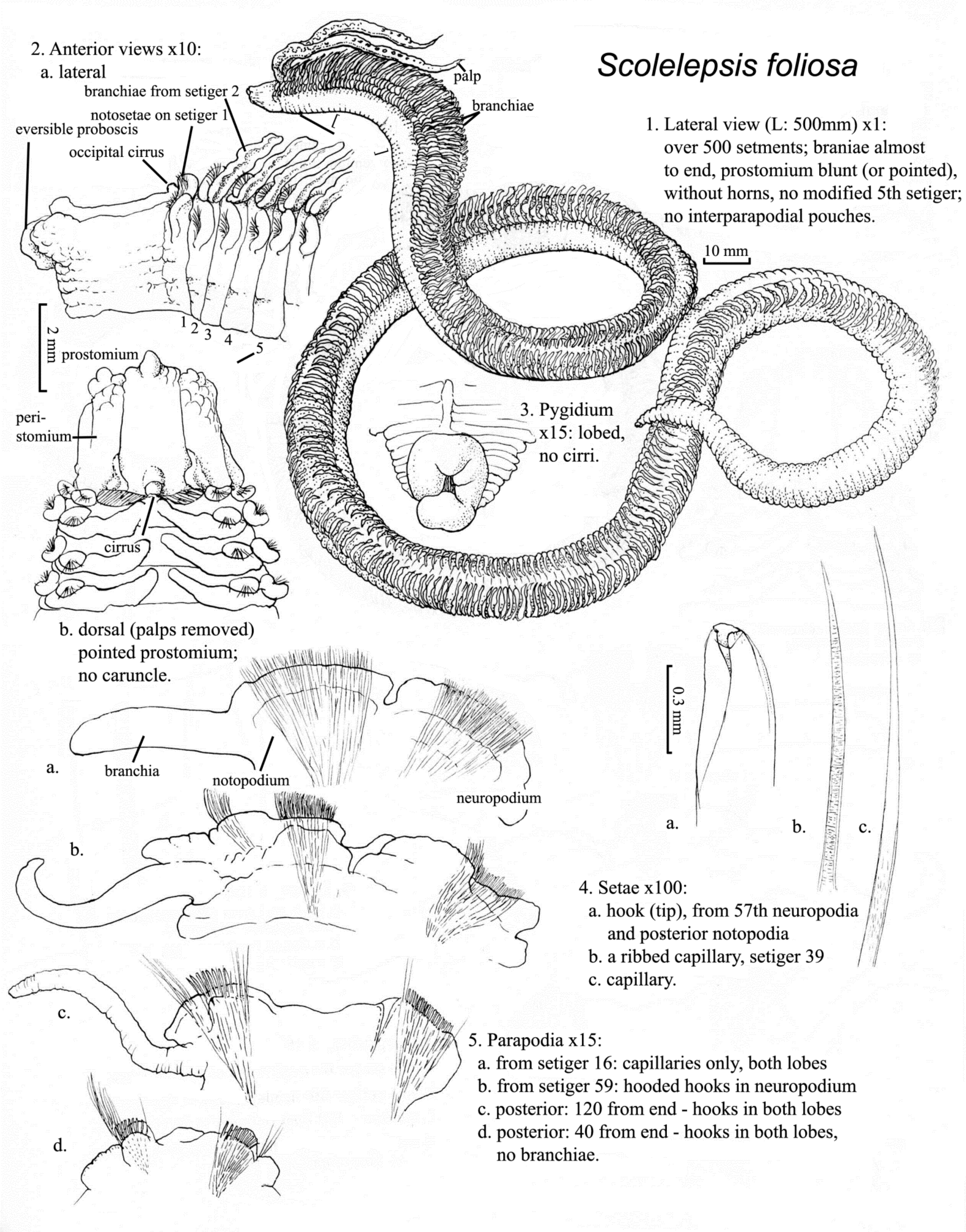
Scolelepsis foliosa



1. Lateral view (L: 500mm) x1: over 500 setments; braniae almost to end, prostomium blunt (or pointed), without horns, no modified 5th setiger; no interparapodial pouches.

2. Anterior views x10:
   a. lateral
   b. dorsal (palps removed) pointed prostomium; no caruncle.

3. Pygidium x15: lobed, no cirri.

4. Setae x100:
   a. hook (tip), from 57th neuropodia and posterior notopodia
   b. a ribbed capillary, setiger 39
   c. capillary.

5. Parapodia x15:
   a. from setiger 16: capillaries only, both lobes
   b. from setiger 59: hooded hooks in neuropodium
   c. posterior: 120 from end - hooks in both lobes
   d. posterior: 40 from end - hooks in both lobes, no branchiae.

Scoletoma zonata (*Lumbrinerius zonata*)

(Johnson, 1901)

Phylum: Annelida
Class: Polychaeta
Order: Phyllodocida
Family: Lumbrineridae

Description

Size—"often exceeding 20 cm (Kozloff 1974a)," 16-20 cm (Hartman 1968). this specimen (South Slough):16 cm.
Color—light red orange, highly iridescent.
Prostomium—simple, bluntly conical. eyeless (fig. 2).
Body Segments—first two achaetous. apodous: more than 200 segments; body smooth, elongated, cylindrical. Earthworm-like (Ricketts and Calvin 1971), no ventral groove (fig. 1).
Parapodia—small

anterior. limbate setae, simple falcigers, no branchiae: postsetal lobes shorter than presetal lobes (fig. 3).

Posterior: postsetal lobes only slightly longer than presetal. simple falcigers, with multidentate tips, yellow acicula (fig. 4a, 4b).

Possible Misidentifications

Five local *Lumbrineris* (Ricketts and Calvin 1971); seven in Puget Sound (Kozloff 1974a); none red orange, iridescent like *L. zonata. L. luti*, with yellow acicula, is very small (under 5 cm) and has very long posterior postsetal lobes; *L. latreilli*, pale red to brown also has yellow acicula; some of its anterior parapodia have composite hooded hooks.

Others with long posterior postsetal lobes are *L. erecta*, on which these lobes stand erect, and which is iridescent bronze, and the rare *L. japonica*. reddish-brown and iridescent, and with black acicula.

L. bicirrata. also found in Oregon (Hartman and Reish 1950), has bilabiate posterior parapodial lobes. black acicula, and like *L. zonata*, naked first and second body segments- L., near *sarsi* (*ibid*), is very like *L. zonata*, except for its long postsetal lobes on the posterior parapodia (Hartman 1968).

Ecological Information

Range—Alaska to western Mexico, intertidal to 46 fms.

Distribution— most common lumbrinerid in northern California (Ricketts and Calvin 1971), Common in Puget Sound (Kozloff 1974a) and in Coos Bay area intertidally in mud, and in mussel and barnacle beds and rocks (outer coast); in holdfasts and mudflats of protected outer coasts (Ricketts and Calvin 1971).
Habitat: Substrate—mud and chips (Metcalf tide flat, South Slough): eelgrass areas (Porch 1970).
Salinity—found in area that varies 10-30 ‰ for surface water (Coos Bay)
Temperature—found in area that varies 8-18 °C for surface water (Coos Bay).
Tidal Level—high intermediate.
Associates—other polychaetes. *Abarenicola*, amphipods, tanaidaceans.

Quantitative Information

Abundance—most common lumbinerid in northern California: and in intertidal or northeast Pacific (Hartman 1944B): common in seaward half of Coos Bay (Porch 1970).

Life History Information

Reproduction—
Growth Rate—
Longevity—
Food—ingests mud for detritus: no animal remains in *L.* sp. Guts (Banse and Hobson 1968).
Predators—
Locomotion—an active burrower, but does not build permanent burrow (as some Lumbrineris do) (*ibid*).

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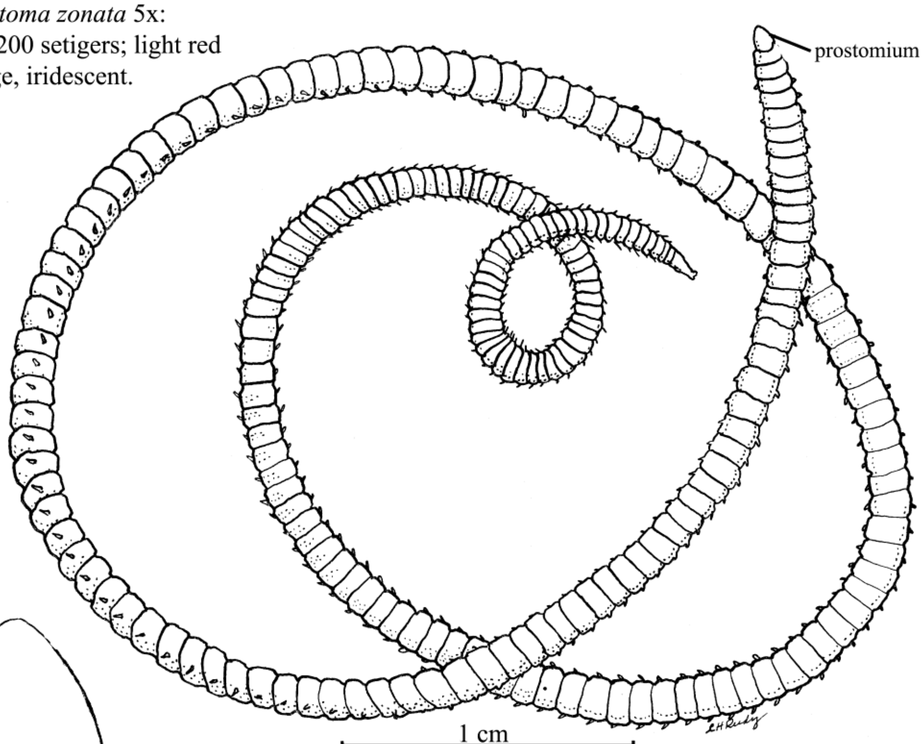
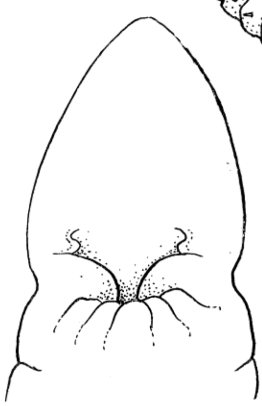
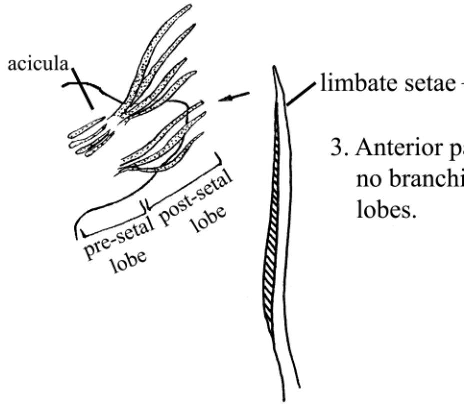
Scoletoma zonata

1. *Scoletoma zonata* 5x:
over 200 setigers; light red orange, iridescent.

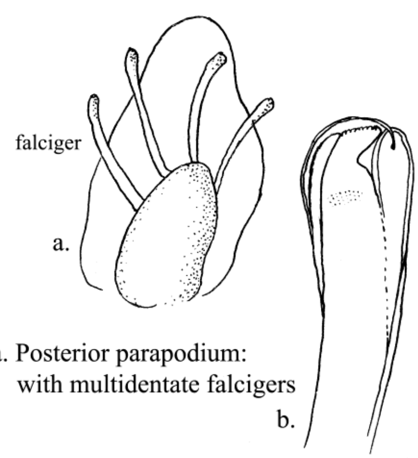




2. Prostomium (ventral view):
bluntly conical, eyeless; firt two segments no setae or parapodia.



3. Anterior parapodium:
no branchiae, short post-setal lobes.



4a. Posterior parapodium:
with multidentate falcigers

4b. Simple falciger, enlarged.
(Hartman 1968, p. 777).

Thelepus crispus

A terebellid worm (Johnson, 1901)

Phylum: Annelida
Class: Polychaeta
Order: Terebellida
Family: Terebellidae, Thelepinae

Description

Size—length 70-200 mm (Hartman 1969); greatest body width at segments 10-16: 13 mm; 88-147 segments. This specimen 120 mm. COLOR--pinkish orange and cream; bright red branchiae, gray tentacles and periostomium, dark pink prostomium (this specimen Coos Bay).

Body Shape—rather stout; two distinct sections: a distinct thorax with neuro- and notopodiai and a tapering abdomen with only. neuropodia.

Prostomium—head reduced, with ample dorsal flap transversely corrugated dorsally; no eyespots (fig. 5).

Peristomium—(segment 1): with circlet of strongly grooved, unbranched tentacles (fig. 5) which cannot be retracted fully: ias in Ampharctidae, for example).

Thorax—well over 25 segments (Hartman and Reish 1950); anterior end not greatly enlarged. Thoracic ventral plates not clearly distinguishable (as in Pista) and do not extend into "lappets."

Branchiae—present: subfamily Thelepinae; three pairs, filiform: on segments 2, 3, and 4; each with many slender single filaments.

Notosetae—from second branchial segment (third body segment); continuing almost to end of body (to 14th segment from end in mature specimens). Notosetae appear as groups of long capillary setae in raised parapodia (figs. 1, 5); each seta is limbate (wing-shaped), with smooth margins (fig. 2).

Neurosetae—all short handled, avicular (bird-like) uncini, imbedded in a single row on oval-shaped tori (neuropodia) (figs. 3, 5). Single row curves into a hook, then a ring in latter segments (fig. 3). Each uncinus a thick, short fang surmounted by a few small teeth (2 in this specimen) (fig. 4). Uncini begin on fifth body segment (third setiger). (Authors differ: Johnson 1901 and Hartman (1969) have uncini beginning on setiger 2).

Tube—of coarse sand and gravel over a chitinized base:. attached to shell or rock, or within empty pholad burrows.

Possible Misidentifications

The Terebellidae are one of a number of tube-building polychaete families with soft tentacles for deposit feeding and with gills on their anterior segments (Blake 1975). Many terebellids occur in our Northwest bays. All of them have bodies with numerous segments and two distinct regions, a tapering abdomen wan neurosetae only. and both capillary setae and uncinigerous tori on the thorax (Berkeley and Berkeley 1952). They all have a modified and reduced head with the prostomium and periostomium at least partly fused, and many non-retractible filiform tentacles emerging from the folded orostomium.

The subfamily Thelepinae always have branchiae and uncini which occur in single rows which may curve around into a circle Other genera in this subfamily include *Streblosoma* and *Naneva* (Hartman 1969). The latter does not occur in our area.

Streblosoma has uncini arranged in single straight rows throughout the body, not changing into a depressed ring as in *Thelepus crispus*. It, too, has three pairs of branchiae; its notosetae begin on the first branchial segment, not on the second (Blake 1975). This species has many eyespots (*T. crispus* does not): Its tube is tightly coiled, and it has a small number of tentacles. its ventral plates are conspicuous.

Streblosoma bairdi, reported from Puget Sound, is small (to 80 mrn), with only 30-40 setigers, a fragile posterior, notosetae beginning on the first branchial segment, and uncinal tori which become projecting rectangular pinnules (Berkeley and Berkeley 1952 and Kozloff 1974a).

There are three other species of *Thelepus* which might occur in our area:

Thelepus hamatus is a small, delicate terebellid. about 50 mm long, with only a few thick, deeply grooved tentacles. It has only two pairs of branchiae, with few filaments. It is orange and probably subtidal and below in distribution.

Thelepus setosus, a cosmopolitan terebellid, is distinguished from *T. crispus* chiefly because all of its uncini are in single rows which do not curve into rings as in *T. crispus*; the uncini are on projecting rectangular pinnules as in *T. hamatus* (Berkeley and Berkeley 1952). *T. setosus* has three pairs of branchiae, and capillaries beginning on the third segment as in *T. crispus*. *T. setosus* has conspicuous black eyespots behind the tentacle bases, noticeable ventral plates (about 20), and a long narrow posterior. It is yellow to brown, with red branchiae and orange-broom tentacles (Berkeley and Berkeley 1952).

Thelepus cincinnatus (Fabricius, 1780), found in Puget Sound, has capillary setae beginning on the third segment (Kozloff 1974a). and only two pairs of gills. No other references can be found for this animal.

Ecological Information

Range—Alaska south to California.
Local Distribution—Coos Bay: Pigeon Point: also at many stations inside and outside the bay, and from Yaquina Bay (Hartman and Reish 1950).
Habitat—attaches its tube to undersides of rocks, shells: found in Coos Bay in empty pholad burrows.
Salinity—collected at 30 ‰ salt: found in lower pans of bays where salinity is not likely to be reduced.
Temperature—
Tidal Level—intertidal.
Associates—nearly all specimens had the polynoid polychaete *Halosydna brevisetosa* inside the tube (Coos Bay). In its under-rock habitat in mudflats of bays: *Cancer oregonensis*, burrowing clams *Adula, Penitella*.

Quantitative Information

Abundance—can be fairly abundant within its narrow requirements. One of the most common intertidal terebellids

Life History Information

Food—a deposit feeder, trapping detritus particles with is tentacles, passing food in a mucus film along tentacle grooves and into the mouth.

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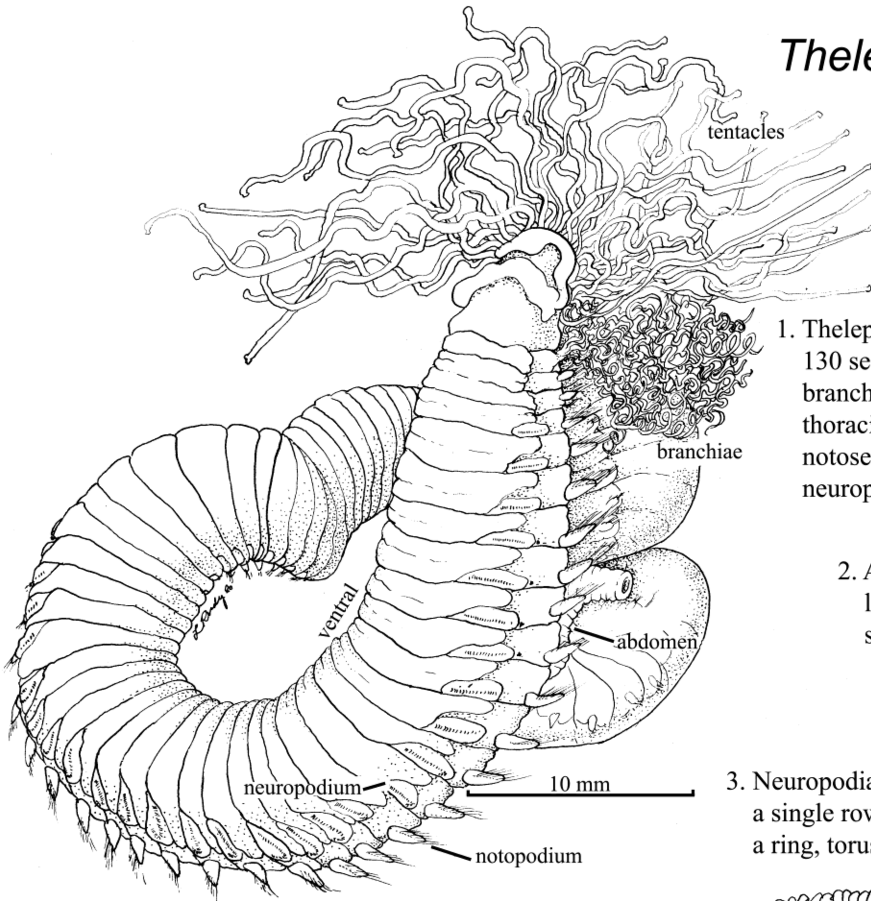
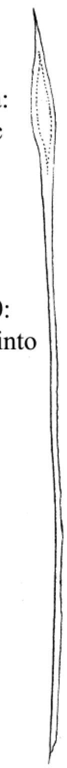
Thelepus crispus

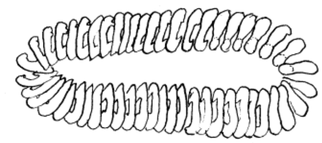


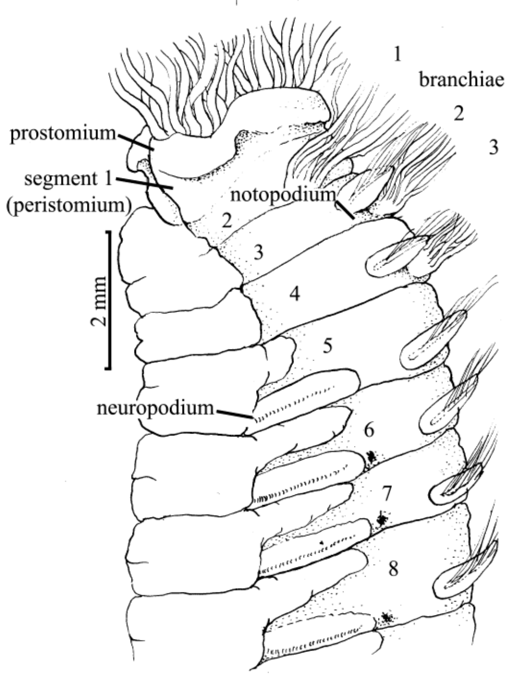
1. Thelepus crispus x4:
130 segments; pinkish-orange, red branchiae, whitish tentacles; many thoracic segments with neura- and notosetae; abdomen short and with neuropodia only .



2. A capillary notoseta:
limbate; on thoracic setigers.

3. Neuropodial torus, medial x90:
a single row of uncini curved into a ring, torus a low, flat oval.





4. Single uncinus:
large avicular fang with small teeth above it; short handled.

5. Anterior segments x12:
branchiae - 3 pairs beginning segment 2; capillary notosetae begin segment 3; uncinigerous tori begin segment 5.

Allorchestes angusta

(Dana, 1854)

Phylum: Arthropoda
Class: Crustacea
Order: Amphipoda, Gammaridea
Super Family: Talitroidea
Family: (Hyalidae)(Barnard 1969a)

Description

Size—6 mm; 8 mm (South Slough of Coos Bay) male; female smaller.
Color—bright green. dark red eyes and spots, yellow-green antenna; females splotchy brown.
First Antenna—shorter than 2nd antenna (male); female's antenna subequal.
Second Antenna—longer than 1st 5 body segments (fig. 1) (Barnard 1952).
Head—small rostrum, eyes large, red, latero-anterior; lateral lobes broadly subtruncated (Barnard 1952).
Mouthparts—mandible with well developed rasping surface on molar (fig. 2); 2-3 spines, 5 teeth, no palp. Maxilliped: tip of inner plate with 3 stout spines, setae; article 4 developed (fig. 4). First maxilla with minute palp (fig. 3) (Shoemaker 1941).
First Gnathopod—stout, article 5 produced (fig. 1).
Second Gnathopod—very large, article 5 produced, article 6 oval, tapering, palm oblique; dactyl large, curved, fitting palm (fig. 5), article 4 larger than 3.
Pereopods—3 and 4 with short setae; 5 longer than 4.
Uropods—3rd with one small, flexible ramus, one spine (fig. 6) (Barnard 1975).
Telson—rectangular, cleft halfway; compressed laterally in cross section (fig. 7a, b) (Barnard 1975).
Females—smaller, antenna subequal, 1st gnathopod palm transverse, not oblique; 2nd gnathopod just slightly larger than 1st.

Possible Misidentifications

Parallorchestes ochotensis, a similar species, does not have the produced article 5 on the 2nd gnathopod, and has a small inner ramus on the 3rd uropod. Its telson has 2 triangular lobes.

Ecological Information

Range—Japan; Northwest Pacific waters to Laguna Beach, California; rare south of Monterey (Barnard 1969).

Local Distribution—Coos Bay area: North Bay of Cape Arago, Bay channel; South Slough of Coos Bay: Metcalf Preserve (Barnard 1969).
Habitat—algae and eelgrass; substrate (Metcalf Preserve) mud, chips: also in plankton haul (Barnard 1954).
Salinity—
Temperature—
Tidal Level—high intermediate (Metcalf Preserve): + 2-4 feet.
Associates—other amphipods, tanaid *Leptochelia*, polychaetes.

Quantitative Information

Weight—
Abundance—one of the common amphipods along the outer coast.

Life History Information

Reproduction—ovigerous female found in July (Barnard 1954).
Growth Rate—
Longevity—
Food—
Predators—
Behavior—

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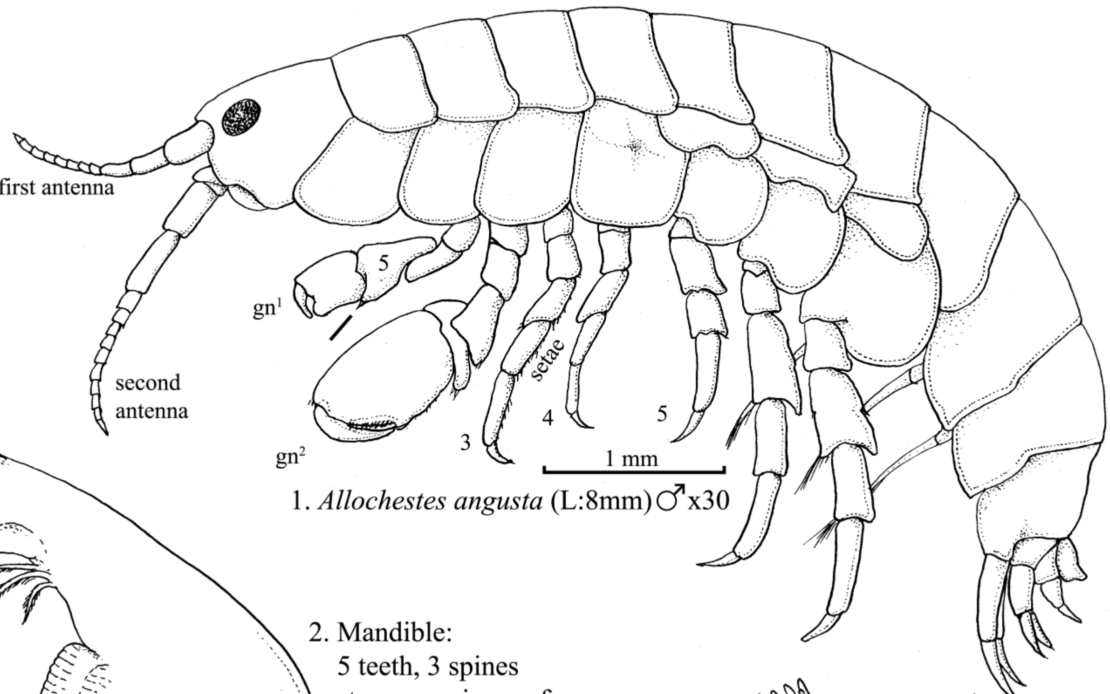
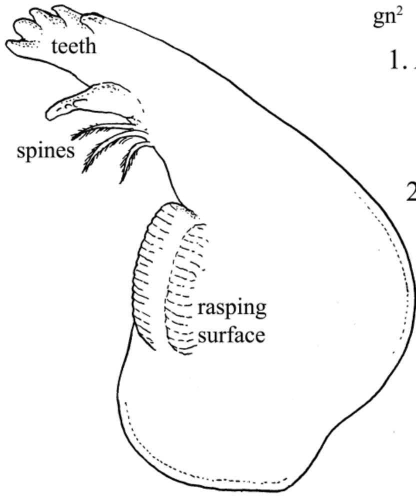
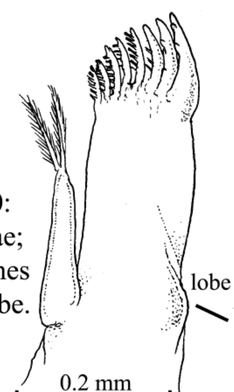
Allorchestes angusta



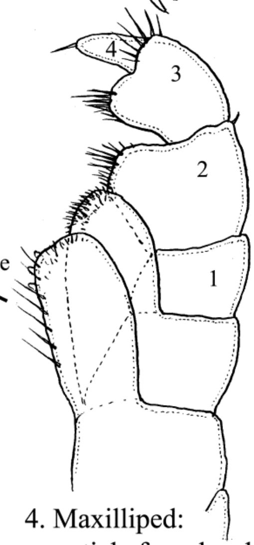
1. *Allochestes angusta* (L:8mm) ♂ x30



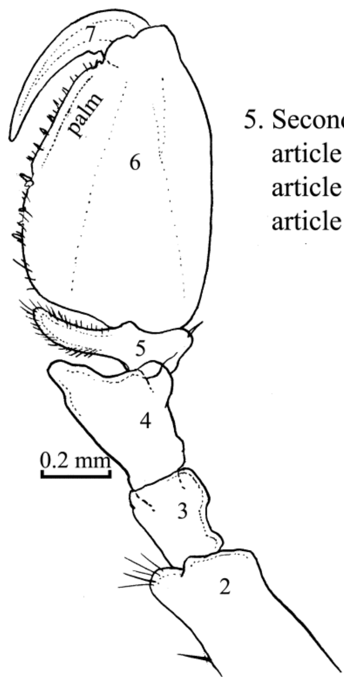
2. Mandible:
5 teeth, 3 spines
strong rasping surface,
no palp.



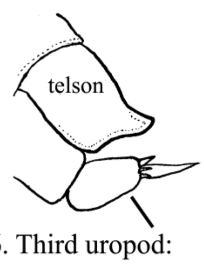
3. First maxilla x130:
inner plate: 2 setae;
outer plate: 3 spines
minute palp or lobe.



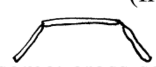
4. Maxilliped:
article four developed
(from Bousfield 1982).



5. Second gnathopod ♂ x55:
article five produced;
article three short;
article seven curved.



6. Third uropod:
one ramus, flexible and
rudimentary; no minute
inner ramus.



7a. Urosome: cross-section
urosome compressed laterally.

7b. Telson:
rectangular, cleft halfway.

Americorophium brevis (=*Corophium brevis*)

(Shoemaker, 1949)

Phylum: Arthropoda
Class: Crustacea
Order: Amphipoda, Gammaridea
Family: Corophiidae

Description

Male: (Sexes described separately because of strong differences).
Size—8 mm (South Slough of Coos Bay): 3.5 mm (Shoemaker 1949).
Color—transparent, with brown mottled markings, especially on large second antenna.
First Antenna—reaches a little beyond 4th article of 2nd antenna: flagellum with about 11 articles: (Siuslaw estuary specimens): 9-14: (fig. 1) (Shoemaker 1949). Base not expanded laterally.
Second Antenna—with groups of setae. large: almost as long as body: 4th article with a large, distal tooth forming a half moon, and with an accessory tooth within it (fig. 2): 5th article with 2 small teeth, 1 distal, 1 proximal (fig. 2).
Rostrum—small central triangle. shorter than sharp ocular runes (fig. 1).
Second Gnathopod—"filtering" type, with fine long setae: both sexes (fig. 3).
Pereopods—quite setose.
Urosome—3 segments separate and distinguishable (fig. 4): both sexes.
Telson—posterior rounded. convex: parallel rows of spines (fig. 4)
First Uropods—lateral edge of peduncle with about 8 short, blunt spines (fig. 4).
Third Uropods—a few fine setae on distal end only, both sexes (fig. 4).

Female
Size—4 mm: Siuslaw estuary: 4.5 mm (Shoemaker 1949).
Color— same as male's.
First Antenna—flagellum of 7-8 joints: almost as long as 2nd antenna (fig. 6).
Second Antenna—not massive like male's, instead of half moon tooth, and accessory tooth: 3 pairs of equally spaced, heavy spines on the lower margin (fig. 5).
Second Gnathopod, Urosome, Third Uropod, Rostrum—like male's.

Possible Misidentifications

All *Corophium* species have filtering-type 2nd gnathopods and long setae on the 3rd uropods. "Section A" *Corophium* (Shoemaker 1949). have separate segments on the urosome (fig. 4). Of these species, sexual dimorphism is strong in 3 Pacific northwest animals and especially marked in the 4th articles of the 2nd antenna. These are *C. brevis*, *C. salmonis*, and *C. stimpsoni*. (Check also first antenna, telson, first uropods and third uropods for species differences, particularly between *C. brevis* and *C. salmonis*).

C. stimpsoni, principally a northern California species, does not seem to have been found in Oregon. Its chief key characteristic is a prominent male rostrum, almost as long as the ocular lobes. The females are much like those of *C. salmonis*.

C. spinicorne, another prominent northwest species, has less sexual dimorphism: both males and females have the half moon tooth on the 4th article of the 2nd antenna, but without the small accessory tooth. Is strongly euryhaline: often found in fresh-water habitats.

Ecological Information

Range—Alaska to San Francisco Bay: Type specimen, Puget Sound (Shoemaker 1949).
Local Distribution—estuaries: South Slough of Coos Bay, several locations: Siuslaw estuary (Barnard 1954).
Habitat—
Substrate—mud; in South Slough: mud and chips; a tube builder.

Salinity—
Temperature—
Tidal Level— high intermediate
Associates—tanaidaceans. small polychaetes, other Corophiidae.

Quantitative Information

Weight—
Abundance—populations often very dense: sometimes it can be the only obvious animal.

Life History Information

Reproduction— females in evidence and ovigerous in summer: European species, *C. volulator* breeds in February (Over-wintering population), again in July, August by spring age class: young in brood pouch 4 weeks: 4 broods per year possible (Green 1975).
Growth Rate—
Longevity—
Food—organic detritus. sorted by filtering gnathopods.
Behavior—females often in tubes. males out in mud and preyed upon by fishes, especially young salmon for whom male *Corophium* seem to be a major food.

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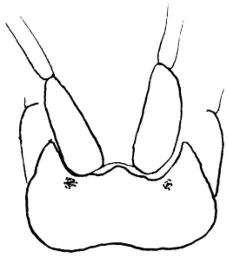
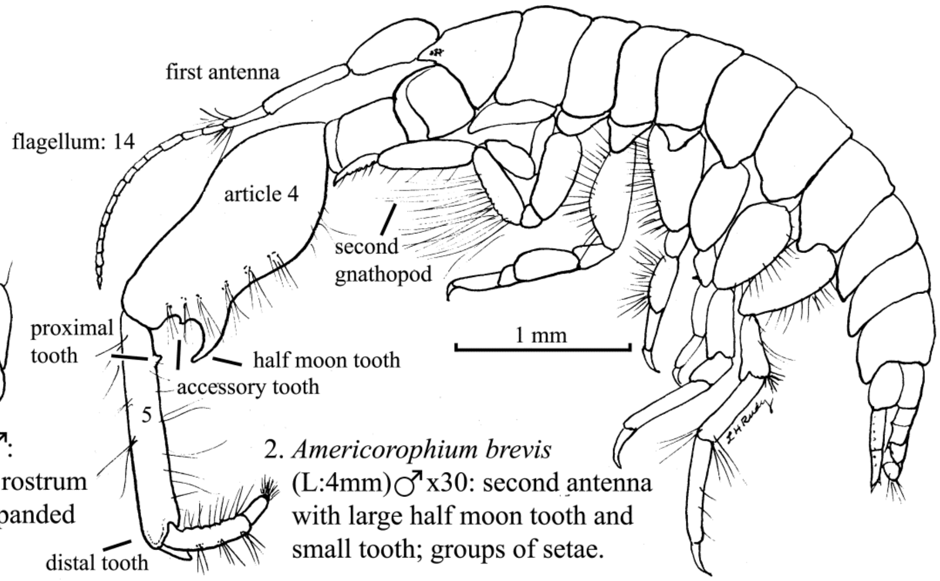
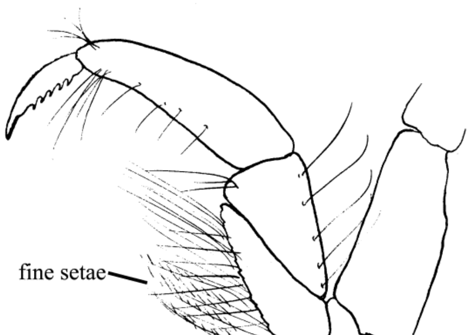
Americorophium brevis



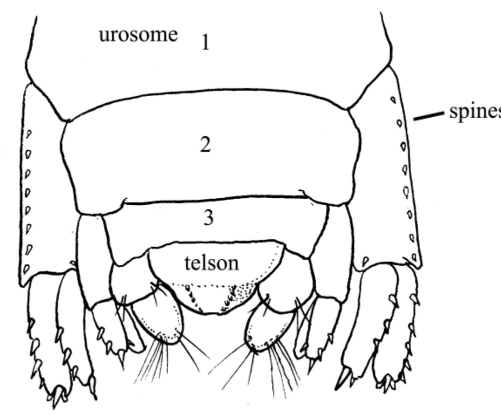
1. Head (dorsal view) ♂: small, low, triangular rostrum antennal bases not expanded laterally.



2. *Americorophium brevis* (L:4mm)♂x30: second antenna with large half moon tooth and small tooth; groups of setae.

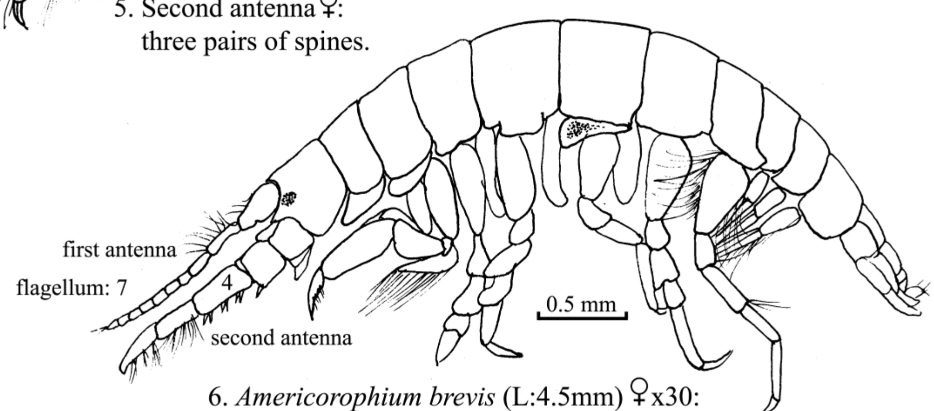


3. Second gnathopod: "filtering" type.



4. Urosome and telson♂: three distinct segments, telson convex, with rows of small spines; first uropods with eight small spines.

5. Second antenna♀: three pairs of spines.



6. *Americorophium brevis* (L:4.5mm) ♀x30: first antenna almost as long as second; three pairs of spines on article four, below.

Americorophium salmonis (=*Corophium salmonis)*

(Stimpson, 1857)

Phylum: Arthropoda
Class: Crustacea
Order: Amphipoda, Gammaride
Family: Corophiiadae

Description

Male: (Sexes described separately because of strong differences)
Size—largest males, 6 mm from rostrum to end of uropods; South Slough of Coos Bay, 4-6 mm; Siuslaw estuary, 7.5 mm.
Color—transparent, with brown mottling, especially on large 2nd antenna (fig. 3).
First Antenna—reach to middle of article 4 of 2nd antenna: flagellum of 14-16 articles, but occasionally 11-12; 1st article of peduncle flat, greatly expanded laterally (fig. 1) (Shoemaker 1949).
Second Antenna—much longer than body in mature specimens: 4th article with large distal tooth, forming half moon, with small tooth within it (fig. 3); 5th article with 2 teeth below, at distal end and near proximal end (fig. 3); proximal tooth lies below flexed half moon tooth. Gland cone on second article below, 2 lobed, elaborate (fig. 2) (Shoemaker 1949).
Rostrum—straight, slightly convex, or with low central projection; (fig. 2) (Shoemaker 1949).
Second Ganthopod—"filtering type", both sexes, (fig. 3, *C. brevis*).
Urosome—posterior margin straight, slightly concave, with a spine in each corner, 2 spines on each lateral edge, 2 inside edge (fig. 5).
First Uropods—3 to 6 slender spines along outside edge of peduncle; 2 to 3 small, blunt spines at distal corner, (fig- 5).
Third Uropods—many slender setae, on all edges (fig. 5).

Female:
Size—about 7 mm; South Slough of Coos Bay, specimens 6 mm (Shoemaker 1949).
Color—like other *Corophium* sp: clear, with brown mottling, especially on 2nd antennae.
First Antenna—(about as long as the 2nd): flagellum of about 10 joints (Shoemaker 1949): 1st articles not expanded.
Second Antenna—not as massive as male's; 4th article without large half moon tooth and accessory but with 2 single spines on the lower edge and 2 on the 3rd article (fig. 4); gland cone simpler than on male, without lobes (fig. 8).
Rostrum—broad, low triangle (fig. 7).
Second Gnathopod, Urosome, Third Uropod—same as male, see above for "typical" *Corophium* characteristics.
Setose Lamellae—pairs of brood plates, attached to bases of coxae 2-5 on females only, for holding eggs and young. (Do not confuse with fleshy gills, also attached to coxae; (fig. 7, C. spin/come).

Possible Misidentifications

Males: Of the *Corophium sp*. males which have separate urosome segments. *C. stimpsoni*, *C. brevis*, and *C. salmonis* all have a half moon and accessory tooth on the fourth article of the 2nd antenna.

Rostrum—*C. brevis* and *C. salmonis* have often similar rostrums, but that of *C. stimpsoni* has a prominent central lobe nearly as long as the ocular lobes. First antenna—*C. salmonis* and *C. brews* can be distinguished by length: that of *C. brews* is longer and reaches to the middle of the 5th article of the antenna. In *C. salmonis* it reaches only to life middle of the 4th article. *C. brevis* does not have the flat expanded 1st articles of the 1st antenna. *C. salmonis* usually has 14-16 articles in the flagellum, (though occasional specimens will have 11-12): in *C. brevis* the males "about" 11 articles in the flagellum of the 1st antenna.

Uropods—*C. salmonis* and *C. brevis* are quite dissimilar: In *C. salmonis*, the peduncle of the 1st uropod is armed on the outside edge with 3 to 6 long slender spines, and at the distal edge with 2 to 3 short, blunt spines. *C. brevis* has instead only 8 short blunt spines. The 3rd uropods of *C. salmonis* have many more and longer setae than those of *C. brevis*. Telson—shape and spination of the 2 species are quite different (see fig. 4, *C. brevis*, and fig. 5, *C. salmonis*).

Female: *C. salmonis* and *C. stimpsoni* are very much alike, with no strong distinguishing characteristics, so the species should not be differentiated solely by females. The only Corophium female of this "cluster" to have the half moon hook is *C. spinicorne*, so this species is easily distinguished. *C. brevis*. instead of having 2 single spines on the underside of the 4th article of the 2nd antenna, has 3 pairs of spines, as well as a spine on the gland cone. Its 1st antenna has 8 joints in the flagellum; that of *C. salmonis* has 10.

Ecological Information

Range—Coos Bay to Puget Sound and Alaska (Barnard 1954).
Local Distribution—mudflats of South Slough of Coos Bay; Cox Island, (Siuslaw estuary); Tillamook Bay: Sixes River, Ten Mile Creek; Columbia River (Forsberg et al 1977).
Habitat—
Substrate—mud. sometimes with algae. *Ulva*.
Salinity—
Temperature—
Tidal Level—
Associates—

Quantitative Information

Weight—
Abundance—often "swarm"; also see *C. brevis*.

Life History Information

Reproduction—only ovigerous females and young found in October (Ten Mile Creek).
Growth Rate—
Longevity—
Food—organic detritus.
Predators—young fish, especially chinook salmon (Forsberg et al 1977).
Behavior—

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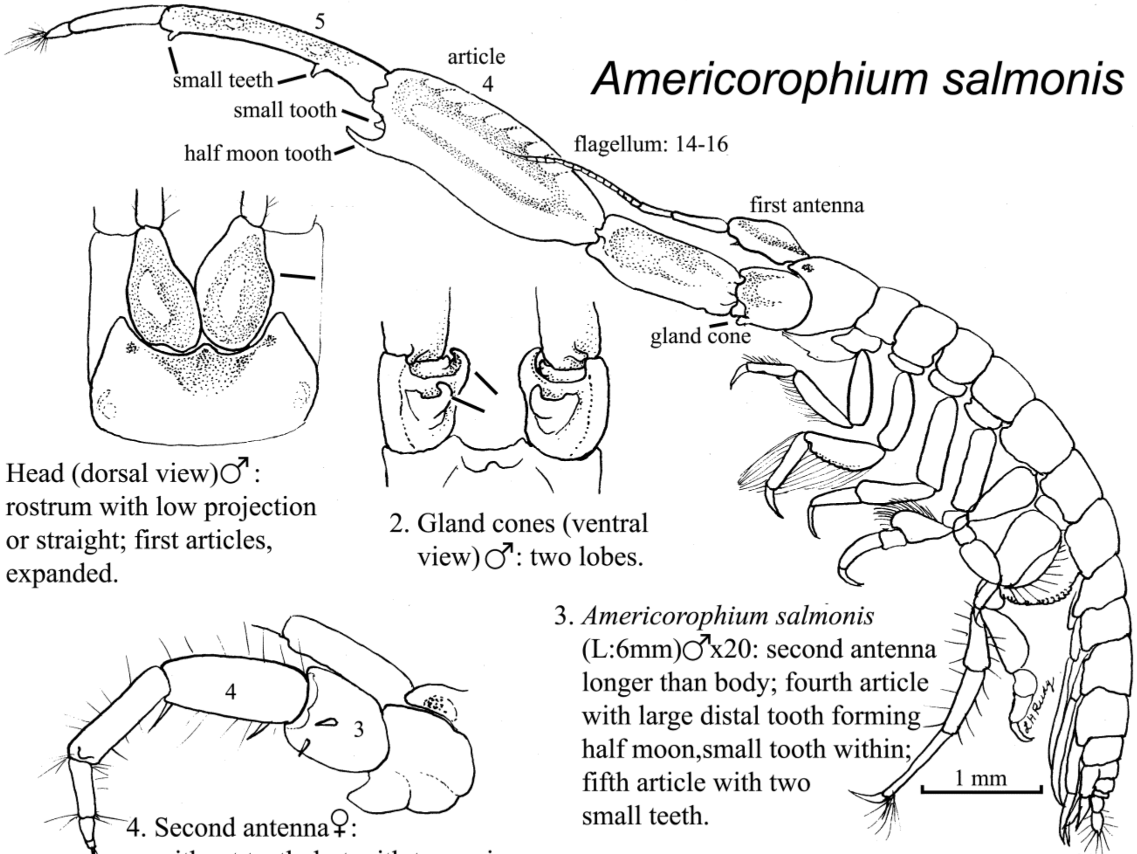
Americorophium salmonis

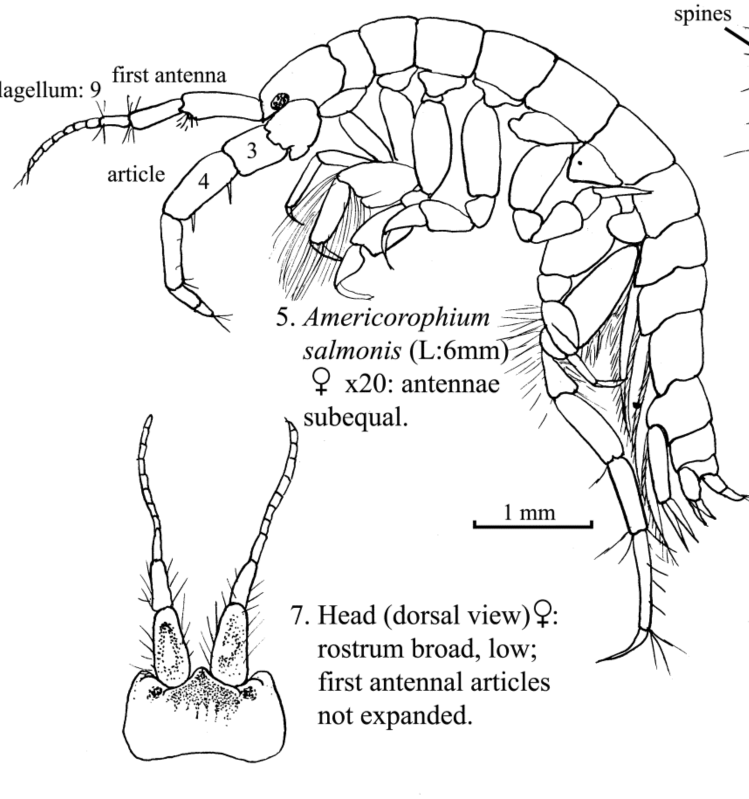


1. Head (dorsal view)♂: rostrum with low projection or straight; first articles, expanded.

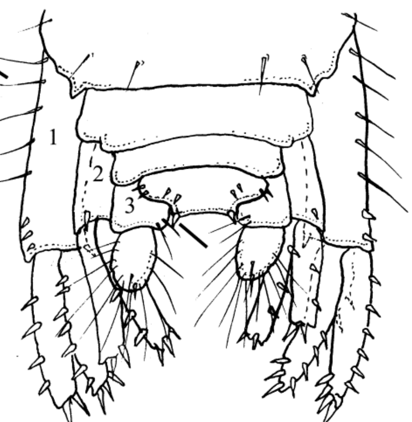
2. Gland cones (ventral view) ♂: two lobes.

3. *Americorophium salmonis* (L:6mm)♂x20: second antenna longer than body; fourth article with large distal tooth forming half moon,small tooth within; fifth article with two small teeth.

4. Second antenna♀: without teeth, but with two spines each on articles three, four.



5. *Americorophium salmonis* (L:6mm) ♀ x20: antennae subequal.



6. Urosome and telson: first uropods with slender, blunt spines; telson margin straight, two spines.

7. Head (dorsal view)♀: rostrum broad, low; first antennal articles not expanded.

8. Gland cones (ventral view)♀: simple, lobeless.

Americorophium spinicorne (=*Corophium spinicore*)

(Stimpson, 1857)

Phylum: Arthropoda
Class: Crustacea
Order: Amphipoda, Gammaride
Family: Corophiiadae

Description

Size—largest species of *Corophium* on the west coast: to 8 mm, females, 10 mm, South Slough of Coos Bay, males, 6 mm, females, (largest) 8.5 mm (Shoemaker 1949).
Color—clear, with dark brown markings on antennae and thoracic segments.
First Antenna—reaching to middle of 5th segment of 2nd antenna: flagellum of 14-16 joints (male) or 11 (female) Female may have 1 to 3 spines on 1st and 2nd joints of peduncle (fig. 5).
Second Antenna—in males as long as or longer than body: 4th joint with large distal half moon tooth; no small accessory tooth; 5th joint with distal spine, and proximal spine which is well within tooth when joint is flexed (fig. 1). Females have similar toothed 4th joint (fig. 5), with spines also on the 5th joint; the 5th joint proximal spine. However, opposes the large half moon tooth when the joint is flexed. Both sexes have prominent gland cones on the 2nd article (figs. 1, 5), but that of the female is acute and curves forward sharply (fig. 5).
Rostrum—both sexes: rounded (fig. 3b, 4); but males sometimes straight (fig 3a) (Shoemaker 1949).
Second Gnathopod, Urosome, Third Uropod—"typical" *Corophium* types: (see *C. brevis*, (figs. 3.4).
Setose Lamellae—pairs of broodplates attached to bases of coxae (fig. 6) on females only. (Do not confuse with fleshy gills, present on both sexes.)

Possible Misidentifications

None of the other *Corophium* in this "cluster" have the large tooth on the 2nd antenna without the small accessory tooth inside it. First, it is important to determine that the segments of the urosome are separate. not fused.

Males and females of *C. spinicorne* can be separated by the 2nd antennal features (see above), and by lamellae and/or eggs in the females.

Ecological Information

Range—estuaries and brackish waters from Santa Cruz, California to Alaska; also in freshwater.
Distribution—Oregon estuaries and lakes; South Slough of Coos Bay, Tillamook Bay: Floras Lake.
Habitat—Substrate-mud: beach and log boom (Barnard 1954): areas of heavy silting (Kozloff 1974b): prefers sand (Eriksen 1968).
Salinity—brackish to freshwater: 0.02-33.6 ‰ (Eriksen 1968).
Tidal Level—
Temperature—10.-22.8°C (Eriksen 1968).
Associates—

Quantitative Information

Weight—
Abundance—in excess of 100/m^2 (Eriksen 1968).

Life History Information

Reproduction—
Growth Rate—
Longevity—
Food—
Predators—young Chinook (Forsberg et al 1977).
Behavior—

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limno-ecology of *Corophium spinicorne*. Stimpson (Amphipoda) and *Gnorimosphaeroma oregonensis* (Dana) (Isopoda). Crustaceana. 14:1-12.

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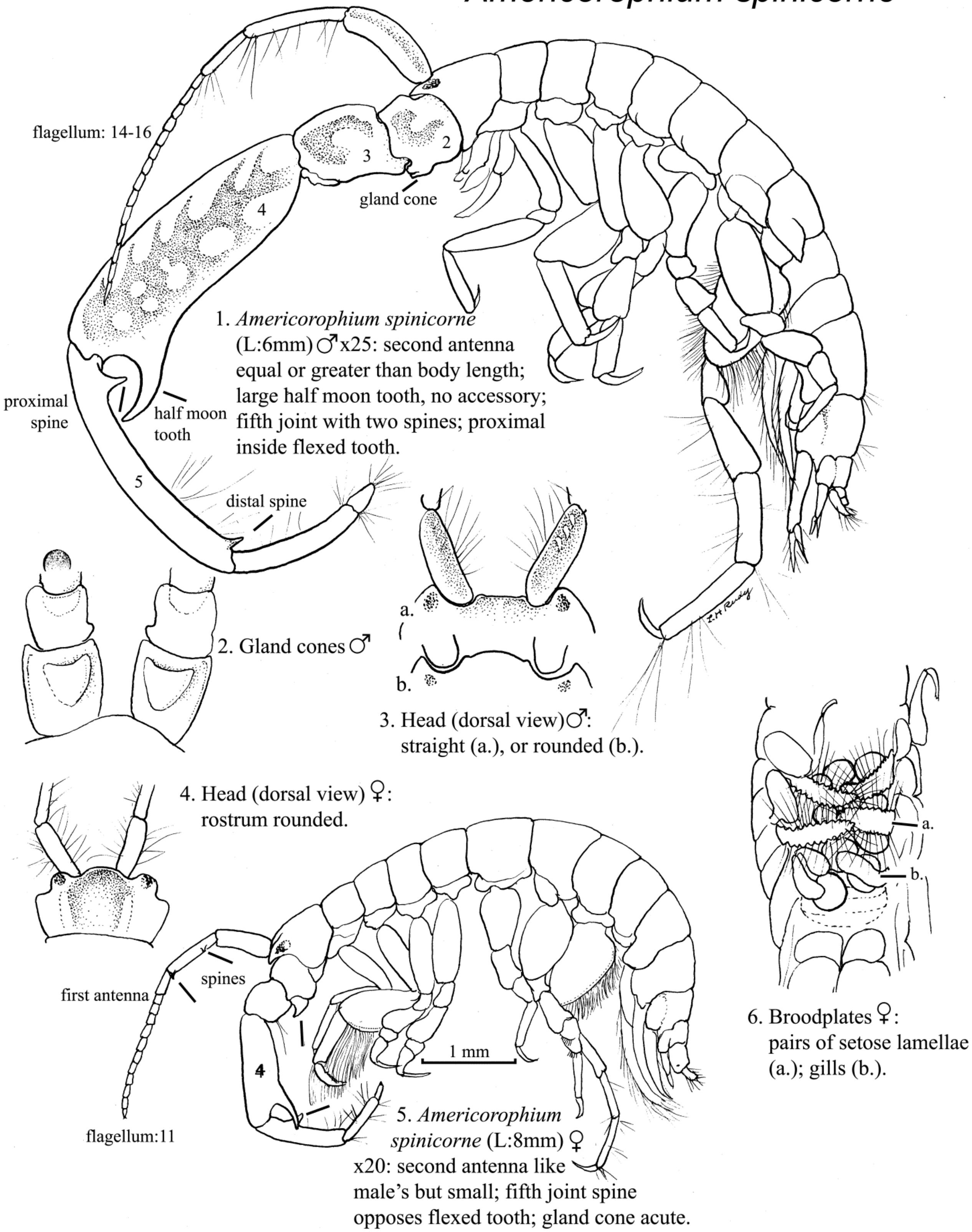
Americorophium spinicorne



1. *Americorophium spinicorne* (L:6mm) ♂x25: second antenna equal or greater than body length; large half moon tooth, no accessory; fifth joint with two spines; proximal inside flexed tooth.

2. Gland cones ♂

3. Head (dorsal view)♂: straight (a.), or rounded (b.).

4. Head (dorsal view) ♀: rostrum rounded.

5. *Americorophium spinicorne* (L:8mm) ♀ x20: second antenna like male's but small; fifth joint spine opposes flexed tooth; gland cone acute.

6. Broodplates ♀: pairs of setose lamellae (a.); gills (b.).

Ampithoe lacertosa

Gammarid amphipod (Bate, 1858)

Phylum: Arthropods
Class: Crustacea
Order: Amphipoda
Family: Ampithoidae

Description

Size—1.5 cm (South Slough of Coos Bay).
Color—pale green, large red eyes, small black spots.
Head—lateral lobes, eyes oval, red.
First Antenna—flagellum twice as long as that of 2nd antenna: 42 articles (fig. 1) (Barnard: 48-52): no accessory flagellum. Flagellum about as long as body (Barnard 1954).
Second Antenna—flagellum 16 articles; (Barnard: 30) (Barnard 1954).
Mouthparts—lower lip has a gap between the sub-lobes of its outer lobes (fig. 2).
First Gnathopod—male: article 5 equal to or smaller than article 6: palm angle oblique (fig. 5), female: article 5 longer than 6 in mature. large females: can be shorter in younger ones: palm oblique (Barnard 1965).
Second Gnathopod—mature males with transverse. sinuous palm (fig. 4): females with oblique palm (fig. 6).
Pleonal Epimeron—2 and 3 with small point at posterior corner (fig. 1a).
Uropods—1st uropod without interramal tooth (fig. 1 b); uropod 3 with flat, setose inner ramus, 2 curved hooks on outer ramus (fig 7).
Telson—fleshy, uncleft, rounded, 2 small spines laterally (fig.7).

Possible Misidentifications

The most similar species is *Ampithoe valida*, which also has the transverse palm in the second male gnathopod, but which has shorter antennae, and compressed lower lips. *A. valida* is an important estuarine species existing well up into brackish waters, on alga *Enteromorpha* (E. L. Bousfield communcation). *Ampithoe simulans* is also similar, except for the male second gnathopod, which is oblique and concave, not transverse. A northern species; subtidal and rare in southern California (Barnard 1969a).

Ecological Information

Range—Japan, Alaska, Washington, South to Magdalena Bay, Baja California.
Local Distribution—Coos Bay: Cape Arago, (North Bay), Charleston, South Slough.
Habitat—builds tubes in alga *Macrocystis*: in eelgrass on mudflat, South Slough (Barnard 1975).
Salinity—collected at 30 ‰.
Tidal Level— + 0.5 feet.
Temperature—
Associates—

Quantitative Information

Weight—
Abundance—

Life History Information

Reproduction—
Growth Rate—
Food—
Longevity—
Predators—
Behavior—

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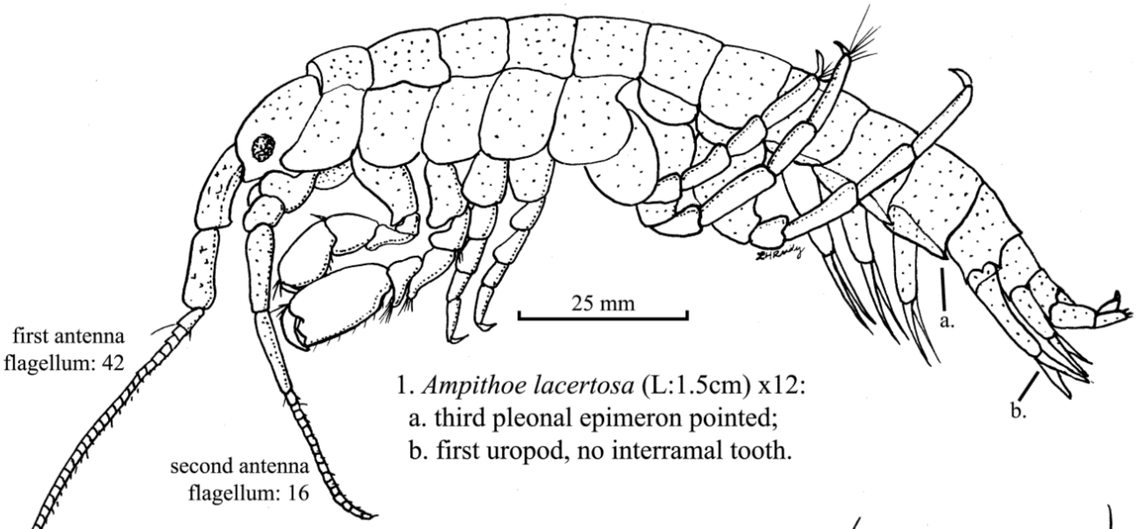
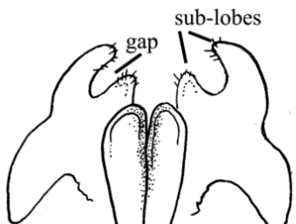
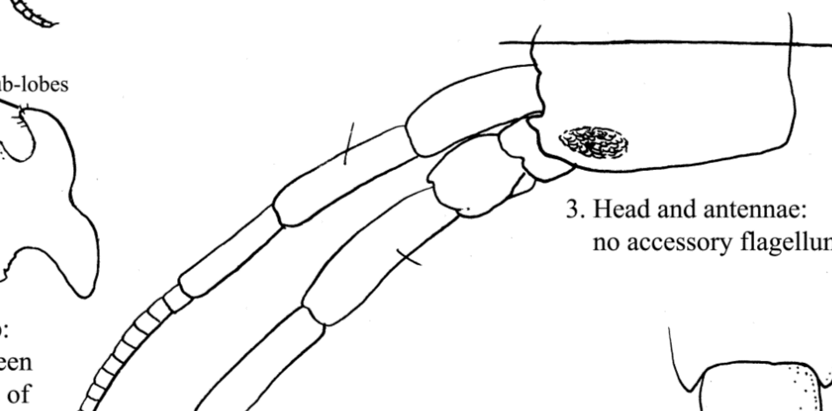
Ampithoe lacertosa



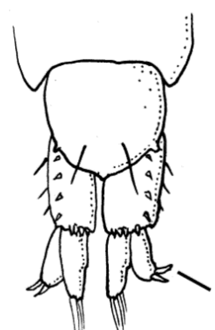
1. *Ampithoe lacertosa* (L:1.5cm) x12:
a. third pleonal epimeron pointed;
b. first uropod, no interramal tooth.



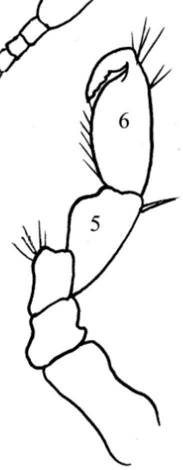
2. Lower lip: gap between sub-lobes of outer lobes.



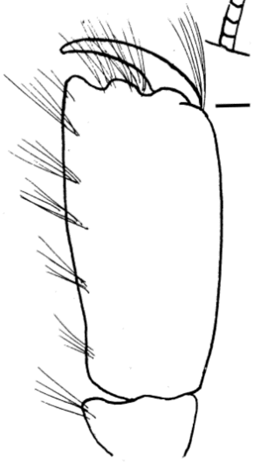
3. Head and antennae: no accessory flagellum.



7. Telson: third uropod with flat, setose inner ramus two curved hooks on outer ramus.



5. First gnathopod ♂: palm angle oblique article 5 equal or less than article 6.



4. Second gnathopod ♂ x32: palm angle transverse.

6. Second gnathopod ♀: palm angle oblique (and in first gnathopod ♀).

Ampithoe valida

A gammarid amphipod (Smith, 1873)

Phylum: Arthropoda
Subphylum: Crustacea
Class: Malacostraca
Order: Amphipoda
Suborder: Gammaridea
Family: Ampithoidae

Description

Size—both male and female 10 mm long (illustrated specimens, Coos Bay).
Color—green with black chromatophores, red eyes (live).
Antennae—1st antenna flagellum twice as long as that of antenna 2 (fig. 1). 1st and 2nd antennae equal in length in male; female has slightly longer 1st antenna proportionately. Both 1st and 2nd antennae with a few setae, no spines (Barnard 1965). No accessory flagellae.
Mouthparts—Lower lip with a notch between the sublobes of its outer lobes (fig. 5): family Ampithoidae (Barnard 1965); sublobes compressed. Mandible with a large palp and an obvious rasping surface (fig. 2).
Gnathopod 1—male: article 5 has a distal projection and is slightly longer than article 6. Article 2 is very setose; article 6 has an oblique angle to the palm (fig. 3). Female: palm also oblique (not figured).
Gnathopod 2—male: articles 2 and 3 have large rounded lobes; article 5 with a narrow hind lobe; article 6 elongate, rectangular, with a transverse palm and a quadrate middle bump; dactyl (article 7) is curved (fig. 4). Female: like female gnathopod 1, but stouter; palm oblique (not figured).
Coxae—coxa 1 produced forward (fig. 1) (Barnard 1965).
Pleonal Epimeron—2nd and 3rd epimera rounded, with very slight points (Barnard 1965) (fig. 1).
Urupods—uropod 1 with a vestigial peduncular process; 3rd uropods with 2 hooks on stout outer ramus (Barnard 1965), inner ramus flattened, with bristles (Kozloff 1974a) (fig. 6).
Urosomites—all three short, the first two with spines (fig. 1).
Telson—blunt, with small knobs at corners (fig. 6).
Sexual Dimorphism—morphological differences in the antennae and gnathopods mentioned: species determination must be made from male specimen.

Possible Misidentifications

Other similar Ampithoidae include *Ampithoe simulans* Alderman, also found in marine intertidal habitats of Coos Bay (Barnard 1965). This species has an oblique and concave article on the 2nd gnathopod- not a transverse one. (This article has a large sinus, and a small process on its inner margin (Barnard 1954)).

Ampithoe plumulosa Shoemaker, as its name suggests, has a very setose 2nd antenna; the 1st antenna is very long. The lower lips gape, and are not compressed as they are in *A. valida.*

Ampithoe pollex Kunkel does have compressed lower lips; its name comes from its large pointed process or thumb which meets the dactyl (male 2nd gnathopod, 6th article).

Ampithoe lacertosa, another species found in estuaries (which see) is very similar in appearance to *A. valida.* It differs chiefly in its lower lip, which gapes. The antennae are unequal in *A. lacertosa*, the first being longer than the second. The 6th article of the 2nd gnathopod is transverse and sinous, but lacks the central bump present in *A. valida.* The 5th article of gnathopod 1 lacks the distal projection present in *A. valda.*

Ecological Information

Range—British Columbia to southern California; Atlantic coast: new Hampshire to Chesapeake Bay (Carlton 1979); Japan (Carlton 1979).
Local Distribution—Coos Bay: South Slough (Barnard 1954), especially in Metcalf Preserve.

Habitat— tube dweller among eel grass (Barnard 1975); typically in *Enteromorpha* habitats. (This specimen built a tube in lab Petri dish.)
Salinity—collected at 5.0 ‰; occurs in brackish waters.
Temperature—
Tidal Level—collected at +5.0 ft. MLLW.
Associates—South Slough: corophid amphipod *Grandidierella japonica,* sacoglossan *Aplysiopsis smithi.*

Quantitative Information
Weight—
Abundance—locally common, South Slough.

Life History Information
Reproduction—
Growth Rate—
Longevity—
Food—
Predators—
Behavior—

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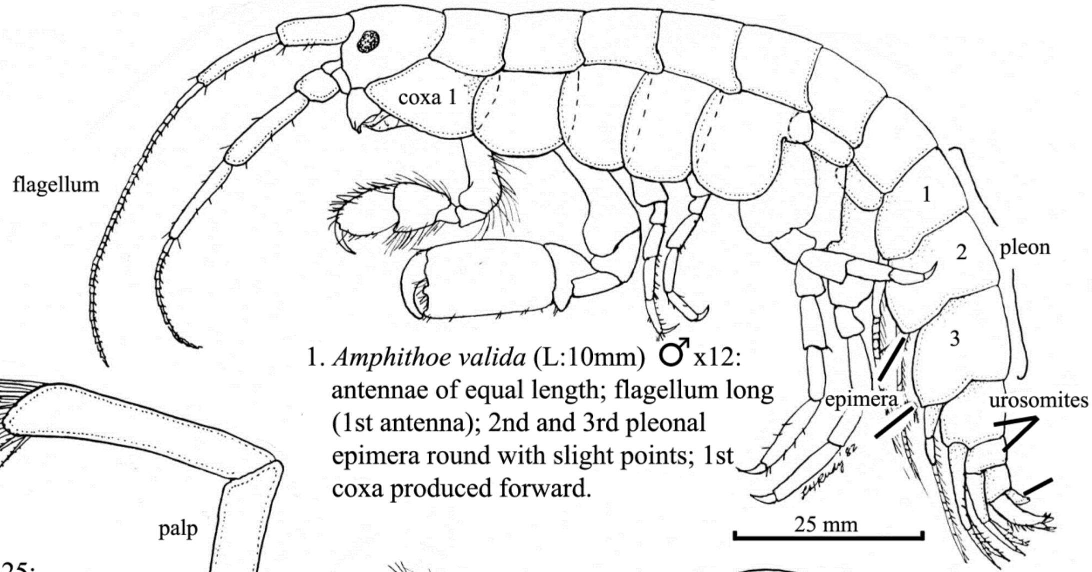
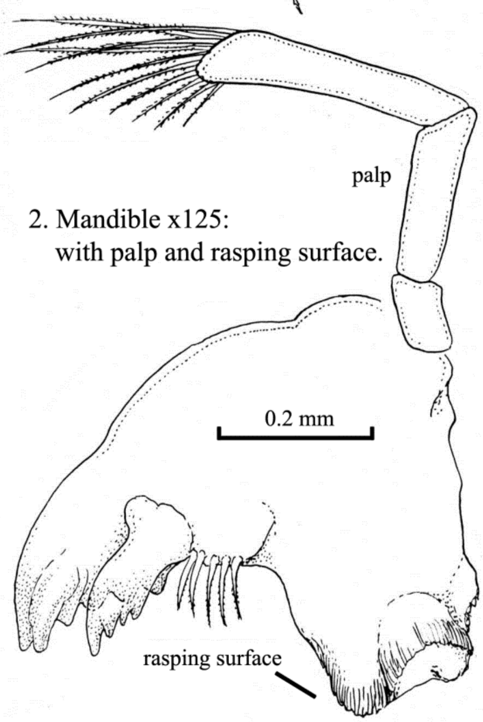
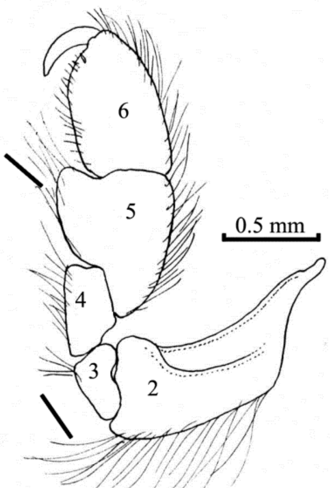
Amphithoe valida



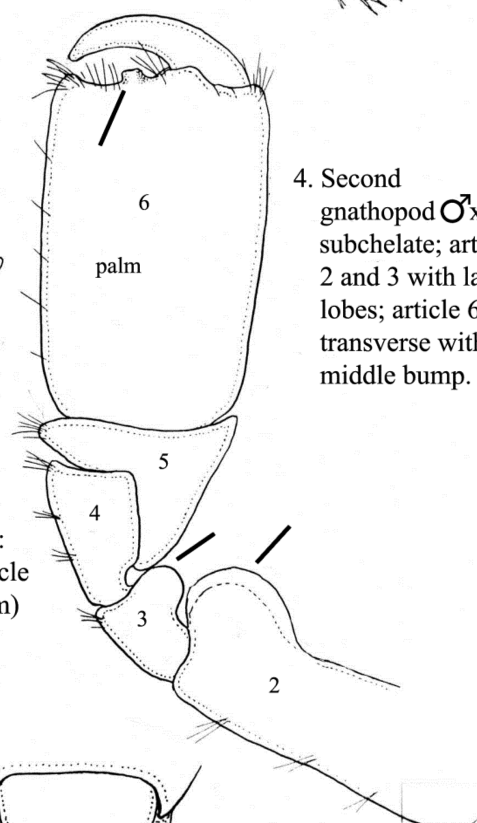
1. *Amphithoe valida* (L:10mm) ♂ x12: antennae of equal length; flagellum long (1st antenna); 2nd and 3rd pleonal epimera round with slight points; 1st coxa produced forward.



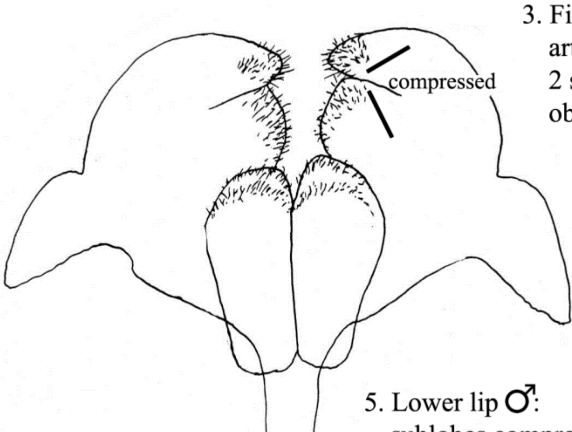
2. Mandible x125: with palp and rasping surface.



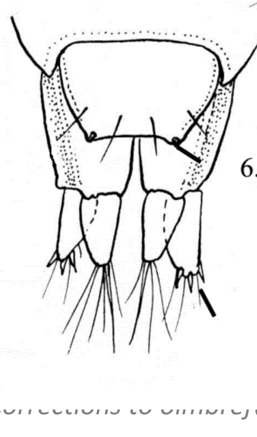
3. First gnathopod ♂x30: article 5 produced; article 2 setose; article 6 (palm) oblique.



4. Second gnathopod ♂x30: subchelate; articles 2 and 3 with large lobes; article 6 transverse with middle bump.



5. Lower lip ♂: sublobes compressed (from Barnard 1965, fig. 23).



6. Urosome: telson with small knobs; laminar, thickened only ventrally; third uropods flat, outer rami with hooks.

Archaeomysis grebnitzkii

A mysid, or opossum shrimp (Cserniavsky, 1882)

Phylum: Arthropoda
Subphylum: Crustacea
Class: Malacostraca
Order: Mysida
Family: Mysidae

Description

Size—length of males 9-14 mm, females 13-21 mm (Holmquist 1975). These specimens (Columbia River) 4.5 mm and 17 mm.
Color—transparent, with stellar melanophores ("maculate'). Some mysids can change color to blend with their background (Tattersall and Tattersall 1951).
Body—carapace covers most of thorax, attached dorsally by anterior-most segments; the last thoracic segments are exposed, the posterior end of the carapace is free. Eyes are stalked; antennules are biramous; antennae have large scale-like squama ("exopodite'). Thoracic limbs have swimming exopodites; abdominal pleopods are reduced; uropods are lamellar, forming a tail fan. Females have a distinctive marsupium, composed of pairs of oostegites.
Antennae—almost as long as body; slender multiarticulate flagellum (fig. 1). 3 jointed peduncle is longer than its antennal scale, but shorter than the antennular peduncle (fig. 2).
Antennae Scale—(squama) extends to distal end of 2nd joint of peduncle; 3 ½x as long as broad. Straight outer margin, without setae: genus *Archaeomysis* (Banner 1948a); strong terminal spine, weak or absent distal suture. Scale is setose only (no spines) on anterior and inner margins (Kozloff 1974a) (fig. 2).
Antennules—peduncle with 1st joint about equal in length to remaining joints combined; 2nd joint with 2 spines on outer margin (Tattersall 1951) (fig. 2).
Eyes—large, movable, stalked, with black corneas; somewhat pear shaped. Rather less than twice as long as broad (eye and stalk) (fig. 2).
Mouthparts—labrum longer than broad (Tattersall and Tattersall 1951); with strong frontal spiniform process: genus *Archaeomysis* (Banner 1948a) (not figured).
Carapace—attached to 1st 2 or 3 thoracic segments (free dorsally at posterior edge): order Mysidacea (Banner 1948a) (figs. 1, 1a). Posterior margin with rounded lateral lobes: genus *Archaeomysis* (Banner 1948a)*;* no

fringe, etc. Carapace produced anteriorly into short rostrum (fig. 2).
Rostrum—"shortly produced": original description, genus *Archaeomysis* (Holmquist 1975); shorter than eyestalk (fig. 2). Can be grooved, bent down slightly, rounded: sp. *grebnitzkii* (Holmquist 1975).
Thoracic Legs—(pereiopods (Holmquist 1975)) - without well developed gills: suborder Mysida (Banner 1948a). 1st leg with exopodite (not figured); 2nd leg without a lobe-like process on merus (not figured). Limbs 3 – 8 with carpopropodus (carpus and propodus fused) of endopod divided into many subjoints: 9 - 11 in female legs (fig. 3), 7 - 9 subjoints in male legs (not figured). Exopod in both male and female legs 3 - 8 has a basal joint with an acute outer distal corner (fig. 3). No branchiae on thoracic legs: order Mysida (Mauchline 1980).
Oostegites—(females only): thoracic brood pouch of two pairs of lamellae: subfamily Gastrosaccinae (Mauchline 1980). Oostegites arise from 7th and 8th thoracic legs (Mauchline 1980) to form marsupium (fig. 1).
Abdomen—5th abdominal somite with a small medial projection; 6th somite with corresponding ridge (fig. 5). Females: lateral pleura on first somites help form brood pouch (fig. 1); inconspicuous pleura on somites 3-5, none on 6 (Banner 1948a) (not figured).
Pleopods—Male: Variable, order Mysida (Mauchline 1980). All biramous; 3rd with elongate exopod: genus *Archaeomysis* (Banner 1948a). 1st pleopod with uniarticulate endopod, multiarticulate exopod: spp. *Grebnitzkii* (Banner 1948a) of 7- 9 articles (Holmquist 1975) (not figured); 2nd pleopod

with endopod of 4- 7 articles, exopod of 8 - 9 articless (not figured); 3rd pleopod with elongate copulatory exopod of 8 - 10 articles, endopod of 5 articles (Holmquist 1975) (fig. 4); 4th pleopod with exopod of 5 - 9 articles (Holmquist 1975); this specimen with 7 articles (fig. 5), endopod a simple plate; 5th pleopod like 4th, but shorter, with 4 - 8 exopod Articles (Holmquist 1975) (not figured). Female: "usually degenerate"' i.e. reduced: order Mysida (Mauchline 1980). All biramous: genus *Archaeomysis* (Mauchline 1980), each ramus of one small article. 1st pleopod with an elongate protopodite, with basal and distal tufts of long setae; endopod longer than exopod, and more than ½ as long as protopodite (fig. 6); 2nd pleopods with short protopodite and exopod, longer endopod (fig. 7); 3rd, 4th, and 5th pleopods like 2nd, but with shorter endopods (not figured).
Uropods—biramous, neither branch articulate (Banner 1948a): subfamily Gastrosaccinae. Both rami with setae on distal margin: genus *Archaeomysis* (Banner 1948a). Endopod longer than exopod, with statocyst near base, 2 basal spines (fig. 8). 6 spines on inner edge (male), 7 in female (Banner 1948a) (not figured). Exopod truncate, without suture: subfamily Gastrosaccinae (Mauchline 1980). Exopod with 14 lateral spines (male) or 17 (female) on outer margin (more than 10: genus *Archaeomysis);* no setae on outer exopod margin (Banner 1948a): subfamily Gastrosaccinae.
Statocyst—light and balance organ on endopod or uropod: order Mysida (fig. 8). (Found in all neritic, and in common oceanic mysids (Banner 1948a).) Distinguishes mysids from larval decapods (Green 1968).
Telson—with distinct apical cleft: subfamily Gastrosaccinae (Mauchline 1980) margins of cleft denticulate (Banner 1948a) (fig. 8). Telson 2 ½ x as long as broad (at base); 8 - 9 spines of each margin, last 2 spines long, strong, close together (fig. 8).
Juveniles—are miniature adults at post-emergence molt, when they are usually 1.5-3.0 mm long (Mauchline 1980).

Possible Misidentifications

Mysidacea and Euphausiacea, being superficially similar in appearance, are often treated together (Banner 1948a; Mauchline 1980). (They were formerly combined as the Schizopoda.) Both are orders of the subclass Malacostraca, but euphausiids are in the division Eucarida with the Decapoda. Like the mysids, euphausiids differ from decapods in having biramous thoracic legs (Kasaoka 1974). Unlike the mysids, euphausiids have a carapace that is fused dorsally with all the thoracic segments. The mysid carapace is attached only to the 1st 2 or 3 thoracic segments; mysid females have oostegites, euphausiids do not.

Other orders of Pericarida include Isopoda, Tanaidacea, and Amphipoda, which are all fairly easily distinguished from Mysidacea. One order that might be confused is Cumacea, small crustaceans of up to ½ inch long, with an inflated, shrimplike carapace, a single compound recessed eye (except for some eyeless females of some species), and a flexible, tubular abdomen.

Mysids characteristically have large, stalked, movable eyes, and well developed exopodites on their thoracic legs. The females have oostegites. Additionally, northeast Pacific mysids lack thoracic gills, have reduced pleopods in the females – and usually in the males as well. They have a statocyst on the inner ramus of the uropod. The 2 oceanic species, the large *Gnathophausia gigas* (Willemoes-Suhm) and *Eucopia unquiculata* (WiIlemoes-Suhm) lack these characteristics; they do have the unattached carapace and 7 pairs of female oostegites.

The suborder Mysida, to which *A. grebnitzkii* belongs, lack gills or branchiae on the thoracic legs (fig. 3); they rarely have 7 pairs of female oostegites, and have rather reduced female pleopods. The male pleopods are often modified for copulation. (The other suborder is the Lophogastrida.) Mysidae is the only family in Mysida. There are 6 subfamilies; some are not found in the northeastern Pacific. Of those are:

The subfamily Boreomysinae (one genus, *Boreomysis* spp.) has at least 2 species in our area. These mysids have 7 pairs of oostegites in the female, not 2. Their thoracic legs have only 2-3 articulations, not many; the outer uropods have a spine or spines on the outer margin; the statocyst is reduced (Banner 1948a). This genus is bathypelagic and widely distributed; individuals could be found in our estuaries.

The subfamily Mysinae is composed of 4 or 5 tribes, 3 of.which occur in the northeastern Pacific: the Erythropini: the Mysini, and the Heteromysini. Characteristics of the subfamily Mysinae include a wide labrum, uropod exopods with only setae on the outer margin (not spines only as in Gastrosaccinae), and 2 or 3 pairs of female oostegites. Like Gastrosaccinae, they can have various types of male pleopods. Northeastern Pacific genera of Mysinae include *Pseudomma* and *Holmesiella* (Erythropini), *Neomysis, Holmesimysis* and *Acanthomysis* (Mysini), and *Heteromysis* (Heteromysini).

The subfamily Mysidellina has but 1 genus, *Mysidella.* These mysids are stout and robust, with a labrum that is produced posteriorly into unequal lobes. *M. americana* has been found in deep water off British Columbia (Banner 1948a).

The subfamily Gastrosaccinae, to which *Archaeomysis* belongs, includes 8 genera (Banner 1948a); none of the others occurs in the northeastern Pacific. *(Gastrosaccus,* from Japan, is very close to *Archaeomysis* (N. li, 1964)). *Bowmaniella* (Bacescu, 1968) from the Atlantic, is known on the Pacific coast only from southernmost California south (Holmquist 1975). *B. banneri* is the new name for *Archaeomysis* species Tattersall (Holmquist 1975; Tattersall 1932)

Archaeomysis maculata (=*Callomysis maculata* (Holmes, 1895) is now considered to be a synonym of *A. grebnitzkii* (Holmquist 1975).

Ecological Information

Range—Found only in northern Pacific (Holmquist 1975): S.W. Bering Sea, Washington, Oregon, northern California.
Local Distribution—estuaries of Coos Bay, Yaquina Bay, lower Columbia River. Also on open coast.
Habitat—primarily littoral; buried in sand; in sand, pebbles and boulder mixture on both open ocean coast and in inland waters. In mud and alga *Zostera;* with *Phyllospadix* and kelp intermixed (Holmquist 1975). Burrows in bottom substratum, rising to surface of water at night, especially during breeding season (Mauchline 1980; Tattersall and Tattersall 1951); very sensitive to oxygen reduction (Green 1968).
Salinity—quite variable: from fresh water to 34 ‰ (Holmquist 1975) (but salinity figures could refer to surface, and the species is an inhabitant of the saltier, bottom water (Holmquist 1975)).
Temperature—a wide range: from 8.5 °C or lower to 24 °C. (Holmquist 1975)
Tidal Level—predominantly intertidal; also found in shallow waters close to shore (Holmquist 1975). Moves up and down with tide. At extreme low water (Puget Sound (Banner 1948a)); subtidal (Coos Bay); intertidally and at low water on ocean beaches.
Associates—

Quantitative Information

Weight—
Abundance—the most common mysid of the northeastern Pacific, followed by *Neomysis mercedis* (Holmquist 1975)*,* which see.

Life History Information

Reproduction—copulation at night lasts only a few seconds (Mauchline 1980). Occurs just after female releases young from brood pouch and then moults (Nouvel 1937, in Tattersall and Tattersall 1951). Sperm is shed into female brood pouch and female then lays eggs, which are immediately fertilized (Mauchline 1980). Early embryos are spherical or sub-spherical. Young develop to a subadult stage in brood pouch, and emerge from external genital openings of oviducts near bases of 6^{th} thoracic legs (Mauchline 1980). Brood size can vary seasonally: largest produced in early summer *(Gastrosaccus,* Japan). Number of eggs depends on size of female and of embryos and in temperate and high latitudes on season, but not on temperature (Mauchline 1980). The Japanese *G. vulgaris,* similar in size to *A. grebnitzkii* (17 mm long), had 100 young in her pouch (Mauchline 1980).

Numbers of broods/year not definitely known for *Archaeomysis,* but most shallow-living neritic and littoral species have 3/year, including the closely related *Gastrosaccus* at a comparable latitude (Japan) (Mauchline 1980): see “Longevity” below. Chromosome counts for *A. grebnitzkii* were 2n = 10, plus an extra small chromosome (Holmquist 1975). Sex ratios vary within populations; females frequently outnumber males (Mauchline 1980).

Growth Rate—larval development time depends on temperature: in *G*. *vulgaris* 10.9 - 25 days (Matsudaira *et al*. in Mauchline 1980). Mysids generally take about 1 year to attain full growth; are sexually mature in considerably less time (Tattersall and Tattersall 1951). Females usually grow larger than males (Mauchline 1980). Number of instars is fewer than for most crustaceans. First and 2nd occur in marsupium, and 10 or more after release of young (Mauchline 1980).

Longevity—mysids will probably live 12 - 18 months in temperate water, over 2 years in Arctic (Tattersall and Tattersall 1951). No longevity rates known for *Archaeomysis.* Overwintering generation, most born in autumn, a few in summer, produces a few young in winter. Spring breeding is intensive: females may produce 2 broods; spring generation produces in summer (possibly twice), and usually dies by autumn (Mauchline 1980).

Food—feeds either on large masses picked up by thoracic endopods, or on fine suspended matter filtered by thoracic exopods (more usual method). Food can be living or dead: Danish *Gastrosaccus* spp., also bottom dwellers, eat detritus, algae, copepods and amphipods (Tattersall and Tattersall 1951). To stir up food for filtering, mysid will balance, head down, on antennal scales and inner flagella of antennulae, and create currents with thoracic exopods. It can also "plow" bottom with scales and flagellae (Cannon and Manton 1927, in Mauchline 1980). South African *Gastrosaccus* sp. feeds most often at night (Mauchline 1980).

Predators—fish are most important predators (Tattersall and Tattersall 1951): the major mysid eaten by Columbia River fishes (Haertel and Osterberg 1967). Birds: eider duck in Aleutians. Also shrimp, ctenophores, squid; possibly cetaceans and seals. Mysids are ground to paste for fish bait in Channel Islands; in India they can be eaten by humans (Tattersall and Tattersall 1951).

Behavior— locomotion mostly by exopods of thoracic legs (pleopods reduced, not locomotory); motion is rotary, unceasing. Also typical is an "escape mechanism": sudden downward flex of abdomen and tail fan; animal springs backward and can even leap out of water (Tattersall and Tattersall 1951), or through mud (Mauchline 1980). In some species, females will recapture escaped larvae (especially ones older than their brood) and return them to their marsupium. Larvae can belong to other individuals, or to other species. Males will eat escaped larvae (Mauchline 1980). Mysids avoid bright light (Tattersall and Tattersall 1951), but are attracted to weak light sources (and to lures) (Mauchline 1980). *Archaeomysis* did not respond to atmospheric pressure changes of 0.1 atm (Mauchline 1980). Other burrowers (*Gastrosaccus* sp.) have pronounced diel vertical migration: in substrate by day and pelagic at night. Females can migrate more regularly than other population components (*G. sanctus,* Mediterranean (Mauchline 1980)). Burrowing mysids orient by rheotaxis · by facing into water current. They may move offshore to avoid breaking waves; waves can also wash them out of their burrows (Mauchline 1980).

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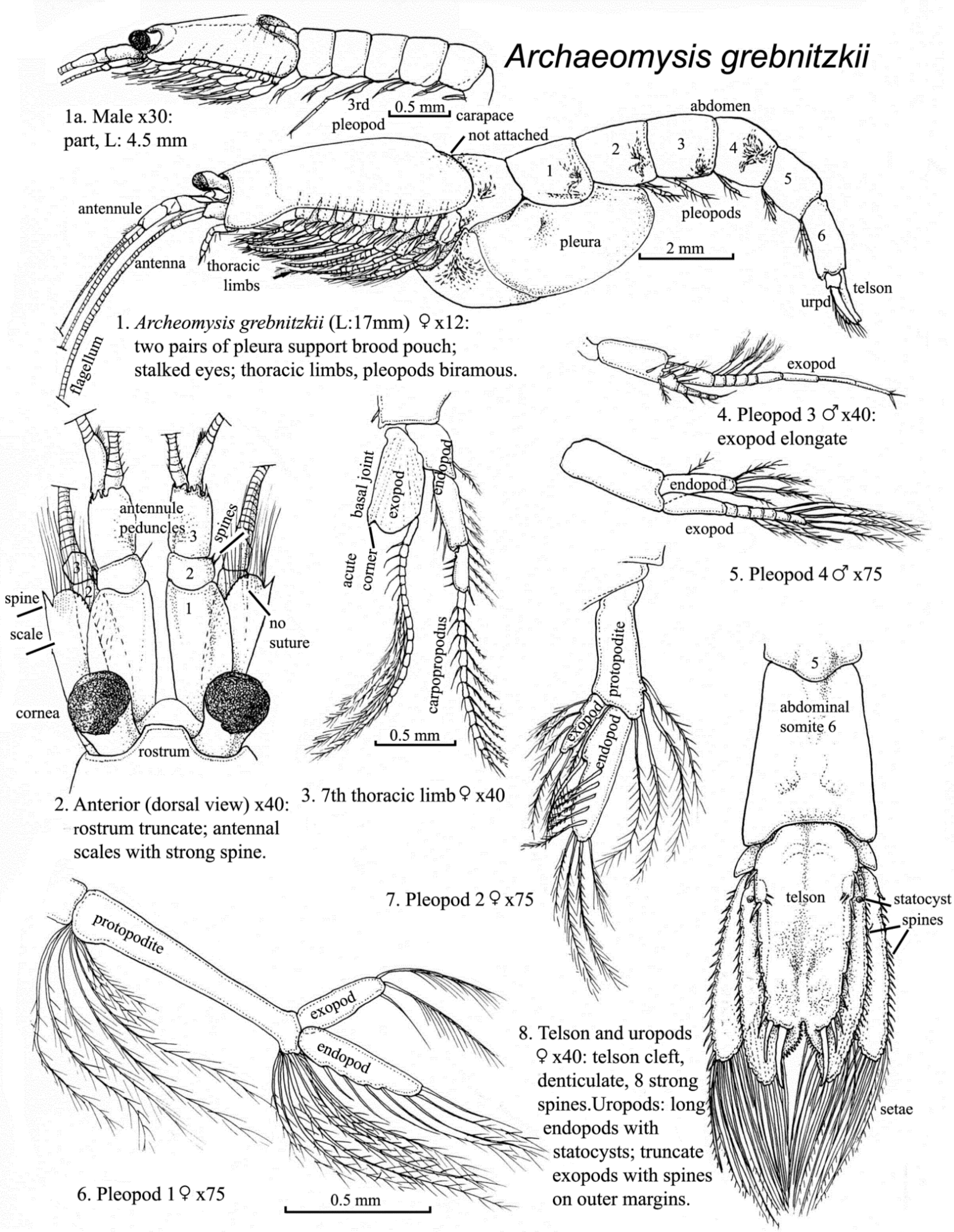

1. *Archeomysis grebnitzkii* (L:17mm) ♀x12: two pairs of pleura support brood pouch; stalked eyes; thoracic limbs, pleopods biramous.

2. Anterior (dorsal view) x40: rostrum truncate; antennal scales with strong spine.

3. 7th thoracic limb♀x40

6. Pleopod 1♀x75

7. Pleopod 2♀x75

8. Telson and uropods ♀x40: telson cleft, denticulate, 8 strong spines.Uropods: long endopods with statocysts; truncate exopods with spines on outer margins.

Balanus crenatus

The crenulated barnacle (Bruguière, 1789)

Phylum: Arthropoda
Class: Crustacea, Cirripedia
Order: Thoracica, Balanomorpha
Family: Balanidae

Description

Size—small, rarely more than ½ inch diameter (Cornwall 1977); average about 14 mm (Cornwall 1951). Largest found 28 mm (Henry 1940).
Color—white with yellowish epidermis (Cornwall 1977); exterior without colored markings (Newman1975); can be rough or smooth; varies greatly (Henry 1940).
Shape—Alaskan species are generally rugose, Oregon animals smooth. Conical, but can be cylindrical if crowded.
Base—calcareous, attaching animal to substrate: sessile—suborder Balanomorpha.
Plates—calcareous; six plates with rostrum overlapping adjacent lateral plates (fig. 3a, *Balanus glandula*): family Balanidae.
Wall—formed by 6 unequal plates; carinal edge of wail projects forward over base (fig. 3); radii narrow; internal surface of wall ribbed horizontally (fig. 4); lower inner wall can be ribbed, smooth, rough, or plicated (Henry 1940).
Orifice—large, rhomboidal (fig. 1), internal edge projects inward in some specimens: Darwin (Pilsbry 1916).
Longitudinal Tubes—in parietes (walls), visible if wall is broken (fig. 4): in single row, uniformly spaced (Newman1975). Some specimens can have cross-septa in upper part of wall.
Opercular Valves (Tergum, Scutum)—seen in orifice (fig. 1): one pair of scuta opposite rostrum, a pair of terga at carinal end of orifice; growth lines in both valves are not highly prominent.

Scutum—lacks adductor ridge; small. flattened beaks (not peaked), and a shallow adductor muscle pit a well-developed articular ridge (fig. 5b).
Tergum—a short spur wider than long which occupies at least ½ of basal margin (Newman1975); a long, high, articular ridge and a deep furrow beside it (fig. 5a) (Henry 1942). A narrow tergal spur is characteristic of *B. c. curviscuturn* from Alaska and Washington (Cornwall 1951).

Body—6 pairs of cream-colored feeding cirri, penis (fig. 2); body rust-colored.

Possible Misidentifications

Balanus crenatus is a difficult barnacle to identify, even for a barnacle: "Not only does every external character vary greatly in most species, but the internal parts very often vary to a surprising degree; and to add to the difficulty, groups of specimens not rarely vary in the same manner Charles Darwin (Cornwall 1951). *B. crenatus* is generally found in the intertidal at a lower level than the ubiquitous and easily confused *B. glandula*. This latter has no longitudinal wall tubes (except when young), and its terga and scuta are different (see *B. glandula*, opercular valves): the terga have shorter spurs, the scuta have an adductor ridge.

Balanus improvisus shares many of the same characteristics of *B. crenatus* (Newman1975). Its scuta, however, have a long spur. It is an Introduced species, found only in brackish water.

Balanus cariosus, another northwest species, is large and has a thatched appearance; *B nubilis*, subtidal and very large, has a ribbed surface and usually some surface coloration. *B. hesperius*, a northern species, has wide radii, strong interior ribbing, and no wall tubes. *B. balanus pugetensis* is small and smooth: it has wide radii and shingle-like scrotal ridges. *B. rostratus alaskensis*, another Puget Sound species, is much like *B. Balanus pugetensis*; it has a small orifice and transverse septa in its longitudinal wall tubes; its tergum is beaked (Henry 1940). It can be brown, and may be over 5 cm in diameter (Kozloff 1974).

Ecological Information

Range—North Atlantic; Pacific from Bering Sea to Santa Barbara, California. Type locality: English coast; common in the fossil record.
Local Distribution—protected waters of most Northwest bays; Coos Bay: many stations.
Habitat—pilings, worm tubes, mollusc and crab shells boat bottoms; amid eelgrass and debris. Light does not affect growth, fertilization or embryo development (Morris et al 1980).
Salinity—collected at 30 ‰; usually in full seawater, but found once on Vancouver Island in brackish water (Henry 1942).
Temperature—found in cold and temperate waters.
Tidal Level—low intertidal down to 90 fathoms; but from shallower waters in Pacific (Pilsbry 1916).
Associates—*B. glandula*, *B. cariosus* (British Columbia)(Cornwall 1977), *Chthamalus dalli* (Puget Sound) (Henry 1940). In mud and eelgrass: amphipods, littorine snails, isopods, *B. glandula*, *Mytilus edulis* (South Slough).

Quantitative Information

Abundance—quite common (Cornwall 1951); sessile barnacles: most common of all invertebrate animals on rocky shores (Yonge 1963).

Life History Information

Reproduction—internal fertilization: usually hermaphroditic, but some writers question whether self-fertilization possible (Macginitie and MacGinitie 1949; Pilsbry 1916). (See *B. glandula*--- reproduction) Has 2 broods/ year even at southern edge of range (Barnes and Powell 1953). Larvae spend 2-3 weeks in the plankton (Morris et al 1980).

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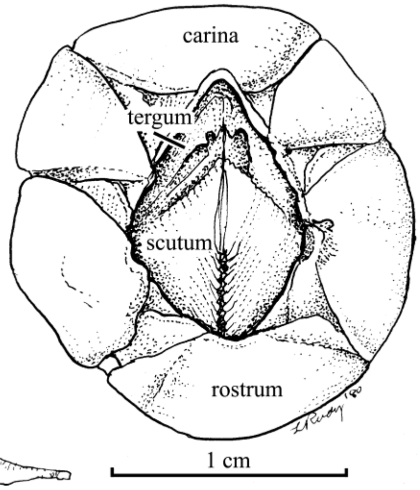
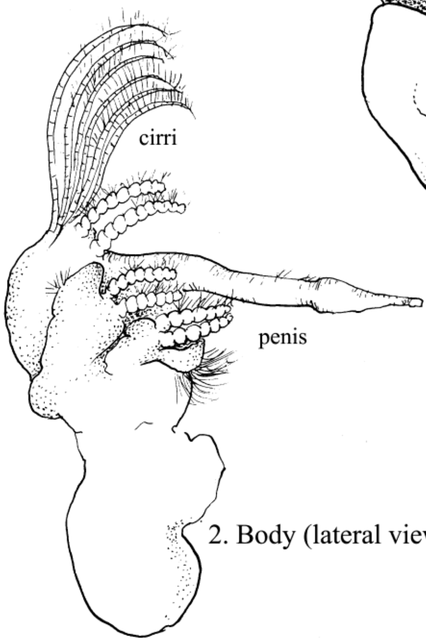
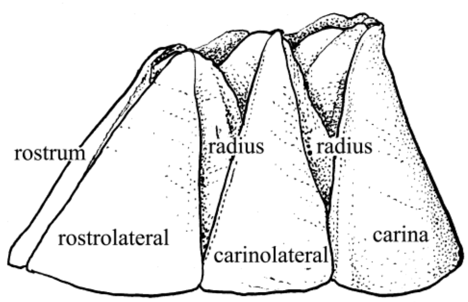
Balanus crenatus



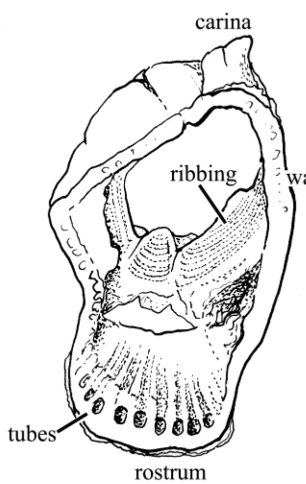
1. *Balanus crenatus* x4:
   actual diameter 17 mm
   six plates; rostrum overlaps rostrolaterals; orifice large, rhomboidal; opercular valves (tergum, scutum) in pairs; exterior smooth.



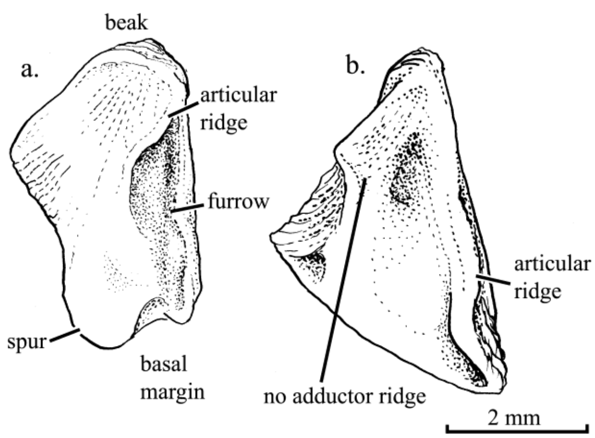
2. Body (lateral view)



3. Lateral view x4:
   narrow radii.



4. Posterior view x4:
   wall: single row longitudinal tubes horizontal ribbing, upper walls.



5. Opercular valves x12:
   a. tergum, right, interior beak flat; spur half width basal margin;
   b. scutum, right, interior strong articular ridge, no adductor ridge.

Balanus (Balanus) gandula

A feather duster worm (Kinberg, 1867)

Phylum: Arthropoda
Class: Crustacea, Cirripedia
Order: Thoracica, Balanomorpha
Family: Sabellidae, Sabellinae

Description

Size—up to 1.5 cm in diameter: usually less than one half inch (Ricketts and Calvin 1971).
Color—usually white, often irregular, eroded.
Base—calcareous, attaches animal to substrate, making it a sesile, or attached barnacle: the Balanomorpha.
Plates—calcareous, nearly conical, columnar. Six in family Balanidae: each plate composed of the *paries* (pl. parietes), the exposed triangular part (fig- 3a, 3b): edges are called *ala* (pl. alae) when they are over-lapped by an adjacent plate, or called *radius* when the edge is marked off from the paries by a definite change in direction of growth lines (fig. 3b) (Newman1975). The plates themselves are called the *rostrum* (which has radii, not alae), opposite it the *carina*, which has alae. Between carina and rostrum are 4 side plates, the *carinolateral* and *rostrolateral* plates.
Wall—formed by the 6 plates (fig. 2), composed of irregular, vertical, filled tubes, giving the exterior the appearance of rough ribbing.
Operacular Valves—2 pairs of movable plates inside the wall, which close the aperture, and are called the *tergum* (pl. terga), at the carinai (posterior) end of the animal, and the *scutum* (pl. scuta) toward the rostral (anterior) end (fig. 3a). Tha terga are the upper, smaller plate pair. Each tergum (in *Balanus glandula*) has a short spur at its base (fig. 4), deep crests for depressor muscles, a prominent articular ridge, and an articular furrow (Pilsbry 1916) The scuta (Latin: shield), have a pit on either side of a short adductor ridge (fig. 5), fine growth ridges, and a prominent articular ridge.
Body—6 pairs of black and white cirri (feeding appendages) are noticeable, (fig. 1).
Juveniles—wall consists of empty vertical tubes, which only become filled and irregular in adult.

Possible Misidentifications

Juvenile *Balanus glandula* and *Chthamalus dalli*, often found together, are very alike. The genus *Chthamalus* has alae on its rostral plates, not radii (ie. the rostral plate is overlapped by the rostrolateral plates). *Chthamalus* are usuaiiy brown.

Balanus crenatus is found at lower tide levels than is *B. glandula*. It differs in structure of terga and scuta: the tergal scut is very wide, the scutum has no adductor ridge (Newman1975).

B. cariosus has a thatched appearance, being irregularly ribbed: its wails have uneven, longitudinal tubes (Pilsbry 1916).

Ecological Information

Range—Alaska to Baja California.
Distribution—ubiquitous: open rocky shores, salty bays of the Oregon coast (Kozloff 1974b).
Habitat—very adaptable: rocks, pilings, wood; on crustaceans, molluscs, other barnacles. Often in conditions of extreme exposure to sun, wind, rain (Ricketts and Calvin 1971). Can tolerate estuarine quiet as well, including conditions of poor water circulation, low oxygen, and little wave action (Ricketts and Calvin 1971).
Salinity—collected at 30 ‰. Can survive at low salinities (Shelford) (Ricketts and Calvin 1971). Resists desiccation better than other *Balanus* (Morris et al 1980).
Temperature—survives at a wide range.
Tidal Level—one of the most important zonation indicators; very small barnacles often settle high in the dry uppermost zone, below *Littorirra* (Ricketts and Calvin 1971), most common from high to mid-tide (Darwin 1854).
Associates—*Collisella digitalis* (limpet) at high tide levels; mussels. other limpets. Sometimes found on the larger *Balanus*

cariosus; red algae *Endocladia* is found in the well-known association above the *Mytilus* zone, with almost 100 multicellular organisms (Morris et al 1980).

Quantitative Information

Weight—

Abundance—one of the most abundant single animals on the coast; can be like cells in a honeycomb; up to 70,000 per square meter (Ricketts and Calvin 1971).

Life History Information

Reproduction—2-6 broods/year, winter and spring (Morris et al 1980), internal fertilization (ie. copulation) necessary; hermaphroditic. Self fertilization possible (Newman1975); but: not self-fertilizing and thus isolated individuals sterile (MacGinitie and MacGinitie 1949; Yonge 1963). Eggs, embryos retained within parent's shell, discharged as nauplius after 4 months (Yonge 1963). Animals from upper tidal levels spawn during 2nd year; those from lower areas the 1st year (Yonge 1963). Few spawn in very sheltered waters. Ascorbic acid in water stimulates copulation (communication R. Boomer).

Growth—6 nauplius stages (Newman1975); last is the cypris, a non-feeding stage which attaches to a substrate by its antennae, secretes a cement, and begins building calcareous shell (Ricketts and Calvin 1971). Molts like other crustaceans by shedding thin exoskeleton of animal, not shell. Cypris needs rough surface, shade, for settlement (Yonge 1963).

Growth Rate—those that settle lowest grow fastest 1st year, but after that, those higher lead in growth (Yonge 1963). Basal diameters 7-12 mm 1 yr., 10-16 mm in 2 yrs., 14-17 mm in 3 yrs (Morris et al 1980).

Longevity—8-10 years (Morris et al 1980).

Food—to paraphrase T H. Huxley, they stand on their heads and kick food into their mouths (Yonge 1963). Food is strained from incoming currents by several pairs of cirri (fig. 1): it consists of plankton, some detritus (MacGinitie and MacGinitie 1949).

Predators—snail *Nucella*, at low tide levels. Starfish; worms (on juveniles); birds; occasionally man: Northwest Indians; plankton feeders, including fish, feed on the larvae (MacGinitie and MacGinitie 1949).

Behavior—entire life cycle unusual for a crustacean, from settlement on its head to building an exterior calcareous shell to feeding behavior. Young cyprids can search out settling area.

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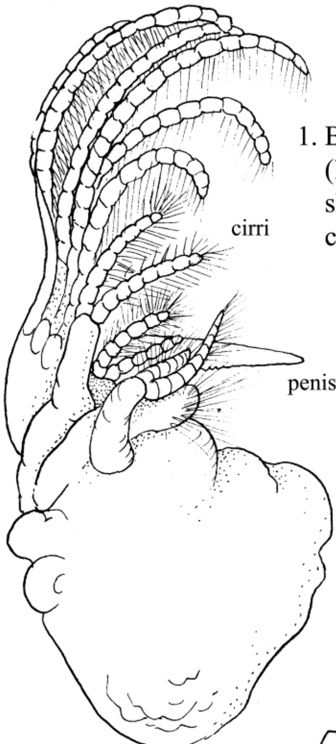
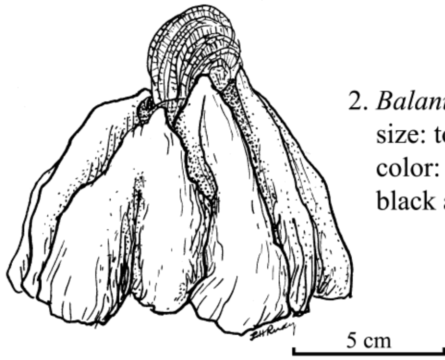
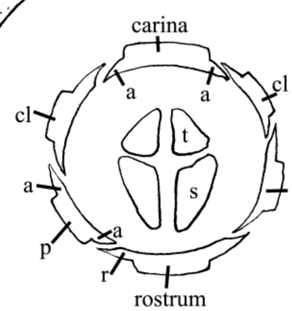
Balanus glandula



1. Body (lateral view): showing six pairs cirri.

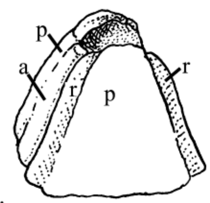


2. *Balanus gladula* x5: size: to 1.5 cm; six plates; color: white, walls eroded, black and white cirri.

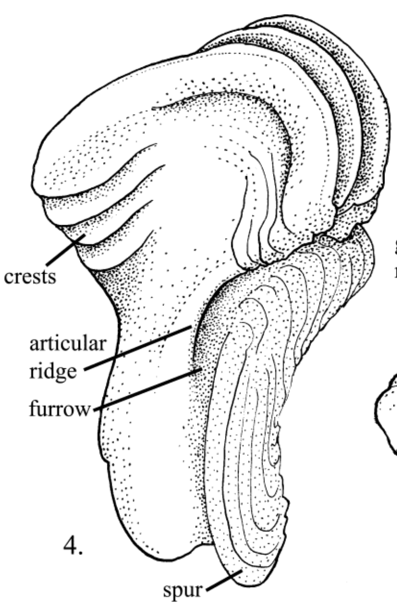


A.

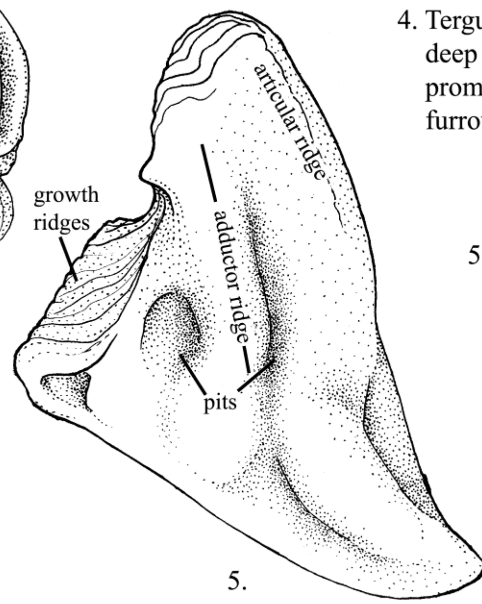
3a and b. Plate arrangement (schematic cross-section) in Balanidae, rostrum overlaps lateral plates; t=tergum, s=scutum, r=radius, a=ala, p=paries, cl=carinolateral, l=lateral (Newman, 1975).



B.



4.



5.

4. Tergum: deep depressor muscle crests; prominent articular ridge and furrow; short spur.

5. Scutum short adductor ridge with pit on each side; fine growth ridges, (exterior) prominent articular ridge.

Balanus nubilus

The giant barnacle (Darwin, 1854)

Phylum: Arthropoda
Class: Crustacea, Cirripedia
Order: Thoracica, Balanomorpha
Family: Balanidae

Description

Size—up to 100 mm in diameter, and nearly as high (Cornwall 1951); illustrated specimen. Coos Bay: 90 mm. Largest barnacle on Pacific coast, probably in world (Ricketts and Calvin 1971).
Color—dirty white; interior of scuta and terga, buff; tergal beak usually purple tipped (Cornwall 1951).
Base—calcareous attaching animal to substrate sessile: suborder Balanomorpha. Base thick, porous at edges. thin at center.
Plates—6, unequal, with rostrum overlapping rostrolateral plates: family Balanidae (see *B. glandula* plates for definitions). Internal surfaces with fine horizontal ribbing above, smooth ear base (older specimens) (Pilsbry 1916) Radii rather narrow (Darwin 1854).
Shape—steeply conical like other barnacles, they can become cylindrical when crowded. Young specimens can also be cylindrical (Henry 1940). Exterior rugged, worn; well-developed ribs become eroded in older animals, (fig. 1. 2) (Cornwall 1977).
Orifice—large, flared (Newman 1975); with a jagged edge (Cornwall 1977).
Longitudinal Tubes—single row, uniform, in walls (Ricketts and Calvin 1971).
Opercular Valves (Tergum, Scutum)—thick and yellowish, buff on interior, never white. Tergal beaks project above orifice edge (Cornwall 1977).

Tergum—beak triangular, often purple (fig 4a), especially in older specimens (Cornwall 1951); external growth ridges narrow and regular, with narrow, shallow longitudinal furrow. Internal: numerous depressor muscle crests; spur wide at base, tapers to narrow truncate end; moderate articular ridge with shallow broad articular furrow (fig. 4a).

Scutum—external surface with prominent growth lines, a deep canal from apex down in old eroded specimens (fig. 4b). Internal: low articular ridge, very narrow articular furrow. Prominent adductor ridge large, shallow adductor pit.

Body—6 pairs of cirri (feeding appendages).
Juveniles—often cylindrical.

Possible Misidentifications

No other barnacle approaches *B. nubilus* is size, although the following are fairly large:

B. rostratus alaskensis, not reported south of Puget Sound, can be up to 2 inches across. Its radii are glossy and partly covered with brown epidermis; its longitudinal wall tubes have cross-septa from base to apex (which *B. nubilus* lacks) (Kozloff 1974a). Like *B. nubilus*, it is subtidal; it also occurs in deep water; *B. nubilus* does not.

B. balanus, up to 1 $^{3}/_{8}$ inches in diameter (35 mm), is usually strongly ribbed. Its opercular valves are white interiorly, not buff: it has hollow longitudinal wall tubes, but without cross septa. It is very like *B. rostratus* above.

B. aquila, a large southern form, with a beaked tergum and longitudinal striations on both opercular plates, has a small unflared orifice; it is rare north of San Francisco (Newman 1975).

Pilsbry's *B. n. flos* and Cornwall's *B. altissimus* are probably only varieties of B. nubilus, not different species (Cornwall 1951 and 1977). Darwin's original description dealt with smaller specimens than are now known and Pilsbry described the larger animals (Henry 1942).

Ecological Information

Range—west coast of North America; southern boundary of Alaska to mid Baja California coast. Type specimen: Monterey Bay (Cornwall 1951).
Local Distribution—Coos Bay: South Slough: Port Orford (Pilsbry 1916).

Habitat—pilings in bays with strong tidal action (Cornwall 1951); rocks. "shelly bottoms"; holdfasts of kelp (Cornwall 1977). Reaches its greatest development on fairly exposed wharf pilings; can grow on top of each other to make accretions a foot high (Ricketts and Calvin 1971).
Salinity—collected at 30 ‰; no known collections from brackish water.
Temperature—from temperate waters.
Tidal Level—from low water to shallow waters (10-20 feet) occasionally to 30 fathoms (Cornwall 1977).
Associates—often encrusted with other barnacles *B. rostratus alaskensis*, *B. Balanus pugetensis*, and *B. engbergi* (Puget Sound): with sea stars and anemones on overhanging rocks (British Columbia) (Cornwall 1951); boring sponges erode shells (Cornwall 1977). Found on boat bottom with mussels and *B. tintinnablum californiunum* (MacGinitie and MacGinitie 1949). Often covered with brown furry mats of entoproct *Barentsia* (Pilsbry 1916).

Quantitative Information
Weight—
Abundance—second commonest barnacle of low zone (most abundant *B.* cariosus) (Pilsbry 1916). More common in Puget Sound and north (Ricketts and Calvin 1971); characteristically grows in large clumps on rocky bottoms (Henry 1940).

Life History Information
Reproduction—barnacles are usually hermaphroditic cross-fertilization is the rule in gregarious types like *B. nubilus*.
Growth—
Longevity—
Food—filter feeder.
Predators—other *Balanus* species preyed upon mainly by the sea star *Pisaster*, and by the nemertean *Emplectonema* (Cochran 1968).
Behavior—growth habit: accretion into deep cluster often creates a heavy clump which falls off substrate (ie. piling) and sinks to bottom where animals cannot live: unusual in ability to increase capacity by deepening base, rather than extending compartments (Pilsbry 1916).

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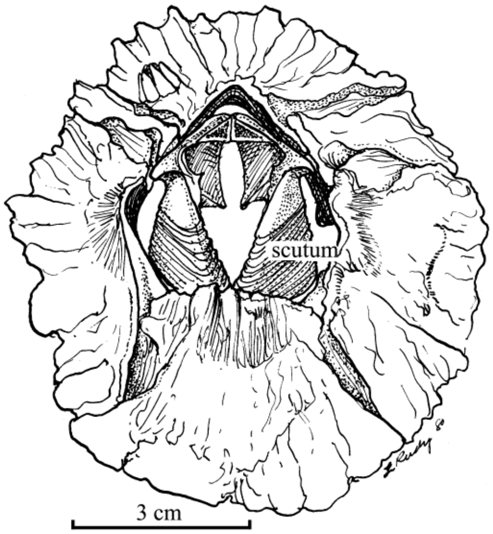
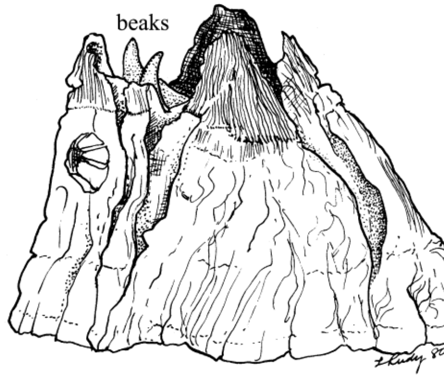
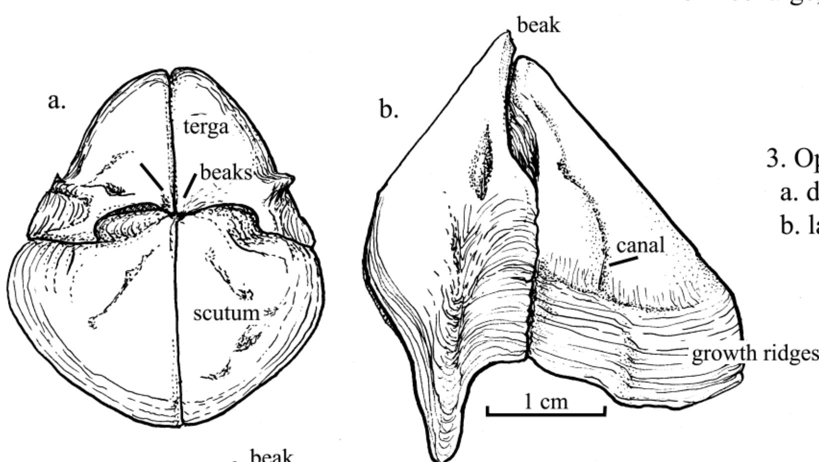
Balanus nubilus



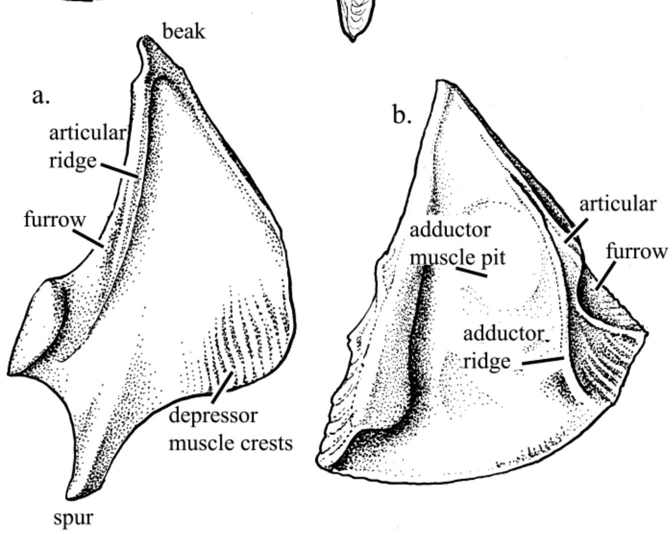
1. *Balanus nubilus* x1:
six plates; ribs eroded;
very large: up to 10 cm diameter.



2. Lateral view:
walls a steep cone, steeply conical;
orifice large, flaring.



3. Opercular plates, exterior x2:
a. dorsal
b. lateral



4. Opercular plates, interior

Cancer antennarius

A rock crab (Stimpson, 1856)

Phylum: Arthropoda
Class: Crustacea, Malacostraca
Division: Eucarida
Order: Decapoda, Reptantia
Section: Brachyura
Family: Cancridae

Description

Size—carapace usually not over 5 inches (13 cm) (Roesijadi 1976); type: 11.8 cm (4 ½ inches) (Rathbun 1930).
Color—unique among *Cancer*: red spots on a light yellow undersurface, especially frontally (Ricketts and Calvin 1971).
Eyes—eyestalks short, orbits small; eyes frontal; a small supra-orbital tooth (fig. 1).
Frontal Area—not produced; 5 medial teeth, of which the outer pair is the largest; center tooth small, below its flanking pair (fig. 2).
Carapace—oval; widest at 8^{th} tooth (11 teeth total); antero-lateral and post-lateral margins meet at distinct angle; surface lumpy, uneven, finely granulated (fig. 1).
Carapace Teeth—11 antero- and post-lateral teeth, curved forward; carapace widest at 8^{th} tooth (fig. 2).
Chelipeds—black-tipped; heavy, nearly smooth; inner carpus (wrist) with single sharp spine.
Legs—rough and hairy; dactyls with 5 longitudinal rows of bristles (Rathbun 1930).
Sexual Dimorphism—females smaller, show usual wide abdomen of *Cancer* species (fig. 3b, *C. magister*).
Juveniles—may have 2^{nd} small spine on carpus; carapace with crowded granules; manus of cheliped light, fingers with dark blotch, extreme tips light-colored; carapace widest at 9^{th} tooth, 10^{th} (and last) prominent and spiny (not figured). Prezoea, 3^{rd} zoea, (fig. 3 a, b).

Possible Misidentifications

In color, *C. productus* is much alike in color (dark red, black-tipped chelae), but never has red spots on its underbody, though its legs may be mottled; it has 10 teeth, not 11. *C. antennarius* is smaller than *C. productus*, and lacks its obviously produced frontal area; they can inhabit the same ecological niche. *Cancer magister* is larger than either and is colored very differently from them.

Ecological Information

Range—British Columbia to Baja California; type specimen: San Francisco; not common in Puget Sound, or in keys.
Local Distribution—Coos Bay (and probably other Oregon estuaries); most common on protected outer coast.
Habitat—often buried in the sand, under rocks (Ricketts and Calvin 1971).
Salinity—in San Francisco, found at 26.6 to 33.3 ‰ (Schmitt 1921). Cannot tolerate brackish conditions; cannot osmoregulate (Morris et al 1980).
Temperature—San Francisco Bay: collected at 8.7 to 14.3° C (Schmitt 1921).
Tidal Level—characteristic of the lower tide pool (Ricketts and Calvin 1971); “in 2 or 3 fathoms” (Stimpson) (Schmitt 1921) to 40 m (Kittredge et al 1971).
Associates—often encrusted; iphitimid polychaetes in branchial cavities (southern California) (Carlton and Kuris 1975).

Quantitative Information

Weight—
Abundance—common in California, becomes rarer farther north.

Life History Information

Reproduction—females ovigerous November to January (Ricketts and Calvin 1971); in the lab males stimulated to pre-mating behavior by release of molting hormone by *Pachygrapsus crassipes* (Kittredge et al 1971).

Growth Rate—1 prezoeal, 5 zoeal, one megalops stage (Roesijadi 1976); larvae reared at 13.8°C. averaged 36 days (hatch to megalops) (Roesijadi 1976); shorter than *C. magister* or *C. productus*. Prezoea (fig. 3a) much like those of other *Cancer* species; zoeae and megalops much smaller and with fewer setae than other two.
Longevity—
Food—a scavenger and predator; likes hermit crabs (Morris et al 1980).
Predators—occasionally man, for food; juveniles preyed upon by filter and plankton feeders (herring, salmon, etc.); octopus.
Behavior—male reacts to crustecdysone (molting hormone) by searching behavior (Kittredge et al 1971).

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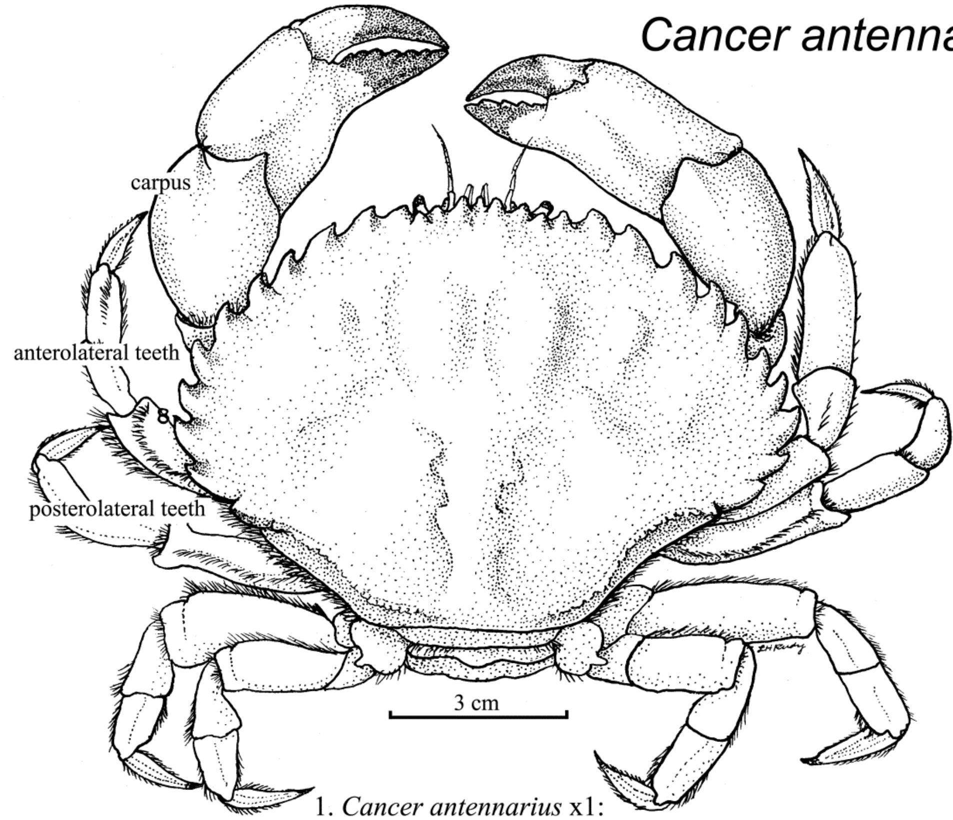
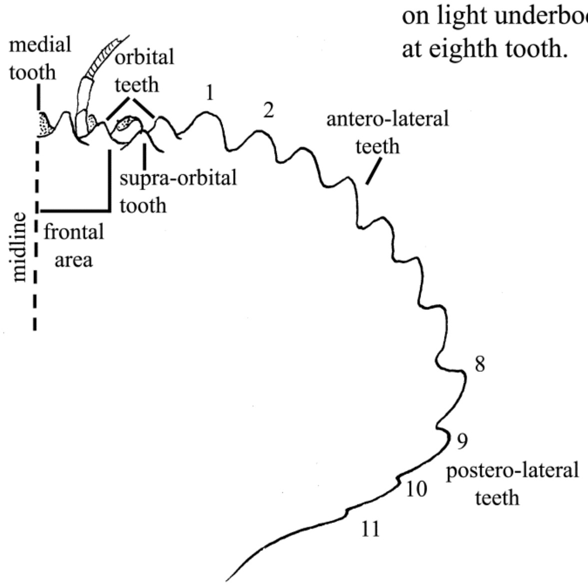
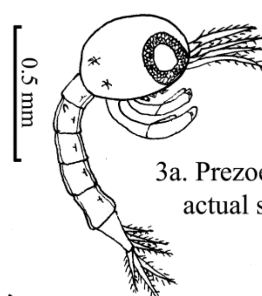
Cancer antennarius



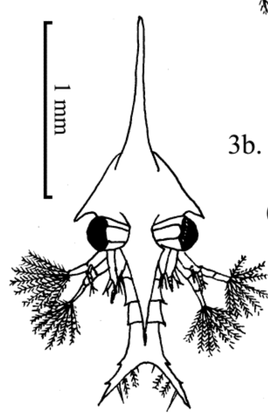
1. *Cancer antennarius* x1: actual size 10 cm; dark red; black tipped claws; red spots on light underbody; widest at eighth tooth.



2. Carapace (right front) eleven antero- and post-lateral teeth; frontal area not produced; eyes small, frontal; supra-orbital tooth; small medial tooth (below).



3a. Prezoea x45: actual size 1.65 mm.



3b. Third zoea x30: actual size 2.25 mm (from Roesijadi, 1976).

Cancer magister

Dungeness, or market crab (Dana, 1852)

Phylum: Arthropoda
Class: Crustacea, Malacostraca
Division: Eucarida
Order: Decapoda, Reptantia
Section: Brachyura "true crabs"
Family: Cancridae

Description

Size—type: carapace 120.7 mm long, 177.8 mm wide.
Color—light reddish brown, darkest anteriorly, often light orange below (Rathbun 1930), sometimes gray-purple, light below; inner sides of anterior dactyls and propodi crimson, fingers not dark (Rathbun 1930).
Eyes—eyestalks short, orbits small.
Antennae—antennules folded lengthwise; antennal flagella short, more or less hairy (Rathbun 1930).
Carapace—broadly oval, uneven but not highly sculptured; granular. Widest at 10^{th} tooth; no rostrum (fig. 1).
Frontal Area—narrow with 5 unequal teeth, not markedly produced beyond outer orbital angles; middle tooth largest, more advanced than outer pair; outer pair form inner angles or orbit (fig. 2).
Teeth—(antero-lateral) 10, counting orbital tooth; widest at 10^{th} tooth, which is large and projecting; all teeth pointed, with anterior serrations.
Postero-Lateral Margin—unbroken, entire, without teeth; meets antero-lateral margin with distinct angle.
Abdomen—narrow in male, broad in female (fig. 3).
Chelipeds—dactyls not dark; dactyl spinous on upper surface; fixed finger much deflexed; hand (Propodus) with 6 carineae on upper outer surface; wrist (carpus) with strong inner spine.
Walking Legs—rough above; broad and flat (especially propodus and dactylus of last pair).
Juveniles—antero-lateral and postero-lateral margins meet at distinct angle; carapace widest at tenth tooth; postero-lateral margin entire; carpus of cheliped with single spine above, dactyls light colored (Rathbun 1930); carapace not as broad as adult's.

Possible Misidentifications

Cancer productus also has 10 antero-lateral teeth; its frontal teeth are subequal, (not equal) and the frontal area is markedly produced beyond outer orbital angles (Carlton and Kuris 1975); its cheliped dactyls are black. Its carapace is widest at the 8^{th} large tooth.

Cancer antennarius, like *C. productus*, is dark red with black tipped chelae; it is widest at the eighth tooth, and red-spotted below. *C. oregonensis*, a small, oval crab, has 12 teeth. Two rather rare species, *C. gracilis* and *C. jordani*; both have 9 teeth.

Ecological Information

Range—Alaska to Monterey Bay, California (Ricketts and Calvin 1971), type locality, San Francisco Bay (Schmitt 1921).
Distribution—Northwest estuaries and offshore waters; near shore and bays in summers (Ricketts and Calvin 1971).
Habitat—found in many substrates, from mud to sand, gravel and rock (Schmitt 1921); prefers sand (Weymouth 1914), in mud with eelgrass in bays (Kozloff 1974b).
Salinity—Coos Bay: collected from 15-30 ‰; smaller crabs more tolerant to low salt (Hunter and Rudy 1957).

Quantitative Information

Weight—to 3 lbs. (1.36 k.) (OR Fish & Wildlife figures).
Abundance—commercial catch cyclic in nature; has ranged from a high to 16,202,659 lbs. (1976-77) to a low of 3,334.909 lbs. (1974-75) (OR Fish & Wildlife records).

Life History Information

Reproduction—late spring to fall when female is about to molt, male clasps her and copulation takes place after several days (Snow and Nielsen 1966); internal fertilization takes place after molting, while female is soft; females carry the eggs (up to 1.5 million) usually from October to December in Oregon; the young hatch in the spring (Waldron 1958). Larval forms occur in nearshore waters and progressively move offshore. They return to bays, estuaries and near-shore waters for metamorphosis, often hitching rides with *Velella velella*, the "by the wind sailor".
Young—megalops of genus *Cancer* difficult to differentiate.
Growth Rate—"first crab" stage: 80 days, at 11 °C (Anderson 1978); matures at 4-5 years (Ricketts and Calvin 1971). Size, age 1: male and female: 30 mm; age 2: male and female: 95 mm; age 3, male: 150 mm, female, 120 mm; age 4, male: 175 mm. Sexual maturity at 1 $^{3}/_{4}$ years (Morris et al 1980).
Longevity—average age 8 years, maximum probably 10 (Ricketts and Calvin 1971).
Food—largely small clams (Kozloff 1974b), crustaceans; also a scavenger.
Predators—man, for food; larval forms eaten by filter and plankton feeders (herring salmon, other fishes).
Behavior—

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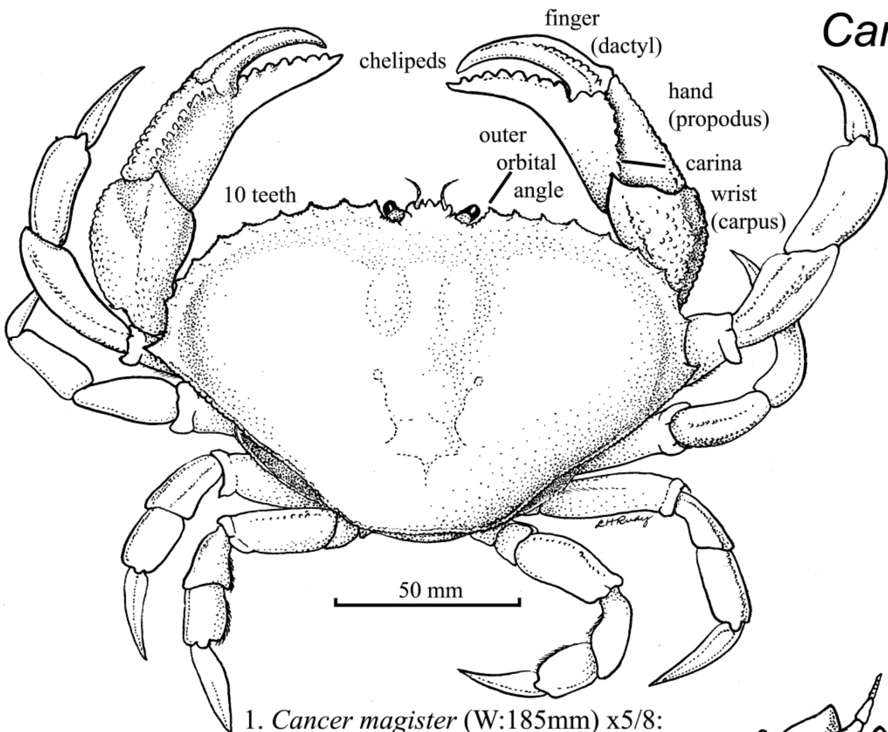
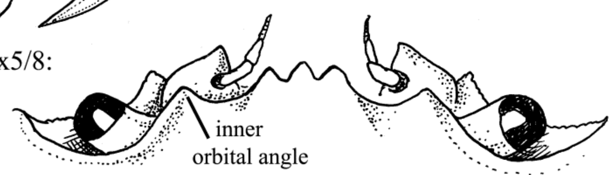
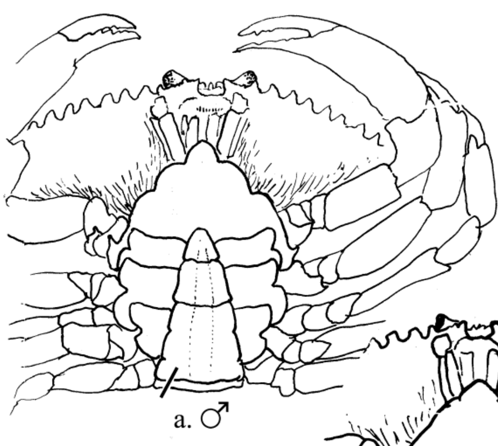
Cancer magister

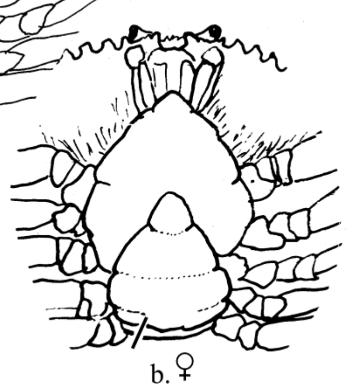


1. *Cancer magister* (W:185mm) x5/8:
ten antero-lateral teeth;
postero-lateral margin entire;
front: five unequal teeth;
carapace: broadly oval, widest at
tenth tooth; fingers light.

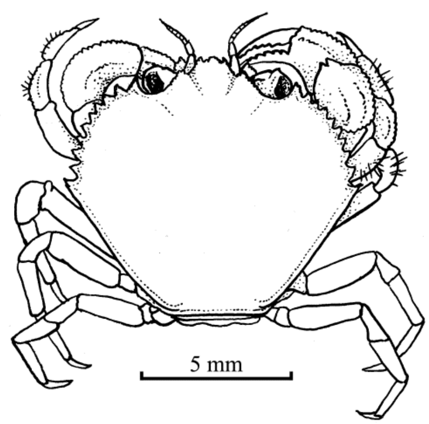


2. Front:
not markedly produced; middle
tooth largest, most advanced;
outer pair form inner orbital angles.





3. Abdomen
a: male: narrow
b. female: broad



4. Juvenile (W:10mm) x5:
carapace rectangular; ten
teeth; fingers light.

Cancer oregonensis

The Oregon *Cancer* crab (Dana, 1852)

Phylum: Arthropoda
Class: Crustacea, Malacostraca
Division: Eucarida
Order: Decapoda, Reptantia
Section: Brachyura (true crabs)
Family: Cancridae

Description

Size—type: 23 mm wide, 18 mm long; a large female 47.1 mm wide, 36.5 mm long (Rathbun 1930). This specimen 15 mm wide, 11 mm long. Usually not over 40 mm wide (Kozloff 1974a).
Color—carapace reddish, flesh-colored; fingers dark red, almost to tips; legs flesh with small red spots; ventral side light. Considerable variation: yellow or orange bands; sometimes gray.
Eyes—short eyestalks.
Antennae—antennules folded lengthwise (down), (fig. 3); short hairy flagella.
Carapace—broadly oval, subelliptical (Rathbun 1930); widest at teeth 7-8; aerolated; anterior-lateral and posterior-lateral margins do not form a distinct angle: species *oregonensis* (Rathbun 1930).
Frontal Area—wide: about 1/2 width of carapace. Five truncate frontal teeth slightly produced beyond outer orbital angles. Three central teeth lobed: species *oregonensis* Outer pair of teeth form inner orbital angles (fig. 3) (Rathbun 1930).
Mouthparts—outer maxillipeds: merus is produced at antero-external angle (fig. 2).
Antero-Lateral Teeth—12-13, of which the 1st 9 are prominent, equal, large, forward curving. Numbers 3-9 have spines; numbers 10-13 are small, obscure or absent; carapace widest at 7-8.
Posterior—lateral margin-unbroken, entire, without teeth; does not meet antero-lateral margin with a strong angle (fig. 1).
Abdomen—narrow in males, wide in females (see *Cancer magister*, fig. 3).
Chelipeds—similar; fingers dark nearly to tips (fig. 4); carpus (wrist) tuberculate above, short spine at inner angle with tooth below it; hand (propodus) thick and high, with 2 rows of tubercules above, 5 granulate lines on outer surface (fig. 4). Chelae rougher in females than in males (Rathbun 1930).
Walking Legs—hairy, light colored.
Sexual Dimorphism—females often with more uneven, lumpier carapace; sometimes with high, flattened elevations, and rougher chelae.
Juveniles—very much like adults (Schmitt 1921).

Possible Misidentifications

True crabs of the family Cancridae can be distinguished by the generally oval carapace with several frontal teeth and 1 medial tooth; antennules which fold lengthwise, with short hairy flagella. The genus *Cancer* have subelliptical carapaces, usually aerolate, a five-lobed frontal area, and short eyestalks.

Other *Cancer* species include 3 whose adult forms are much larger than those of *C. oregonensis*:

Cancer antennarius, a small feisty crab of the intertidal, dark red above and red-spotted below. Adults have black fingers; juveniles' fingers are light with a dark splotch. *C. antennarius* is widest at the 8th tooth (as *C. oregonensis* can be) but it has a prominent 10th tooth and a strong angle at the postero-lateral margin. It is typically 100 mm wide.

Cancer magister juveniles are widest at the 10th and last tooth; the hands are light-colored, the fingers without dark color. It has a rather hexagonal, angular profile, rather than an elliptical one. Few adults are less than 30 mm wide (Carlton and Kuris 1975). *Cancer productus* juveniles have a markedly produced frontal area like the adults, a fan-shaped carapace with sharp antero-posteriorolateral angles, dark fingers, and variable coloring, often striped. Adults are over 20 mm wide (Schmitt 1921).

Three *Cancer* species are small in the adult form:

Cancer gibbulosus (=*branneri*) whose adults are to 35 mm long, has a fan-shaped carapace much like that of *C. antennarius* (Carlton and Kuris 1975; Kozloff 1974b), with 11 teeth, the 1st 9 being strongly curved; it is widest at the 9th tooth. The carapace surface is strongly aerolated rather like *C. oregonensis*, but its hairiness extends to the chelipeds and carapace, not just to the walking legs, as in *C. oregonensis*. It has dark fingers like *C. oregonensis*, but its carapace shape is distinctly different. Adults can be from 11 to 35 mm wide (Schmitt 1921).

Cancer gracilis can be to 40 mm wide and is much like a smooth *C. magister*: olive with reddish spots. The carapace is very convex, widest at the 9th tooth with a strong projecting 10th tooth and the usual (except for *C. oregonensis*) sharp antero-lateral angle. Its fingers are light. Adults can range from 3-76 mm wide (Schmitt 1921).

Cancer jordani, with adults to 33 mm wide, is hairycarapaced, widest at the 9th tooth and with a rudimentary 10th tooth. The teeth alternate large and small in size. The fingers of this crab are dark, the extreme tips are light, as in *C. oregonensis*. The carapace shape is strongly attenuated posteriorly, as in most of the *Cancer* species. This is a southern crab and occurs only rarely in Oregon (Carlton and Kuris 1975). Adults can be as narrow as 19.5 mm (Schmitt 1921).

Cancer oregonensis is the only member of the genus with a distinctly elliptical carapace, without a distinct angle at the posterior-anterior margin. It is smaller than most of the other adult *Cancer* species, but can be confused with their juveniles, which incidentally will be found only seasonally, not all year, as will *C. oregonensis*. The key characteristics of the rounded, not angled carapace shape, 4 being widest at the 7-8th teeth, not the 9th or 10th, should make identification easy. *C. oregonensis* occupies a very particular niche: in the under-rock habitat, often found nestled in a well-fitting discarded mollusc or barnacle shell.

Ecological Information

Range—extreme range Aleutian Islands to Lower California (Schmitt 1921), rare south of Oregon (Ricketts and Calvin 1971).
Local Distribution—Coos Bay: Fossil Point, Pigeon Point.
Habitat—rocky low intertidal areas of quiet bays; well embedded rock and mud. Likes closely fitting shells, crannies.
Salinity—found at lower (saltier) end of bays.
Temperature—a cold and temperate water dweller (by geographical range).
Tidal Level—low intertidal (and down to 238 fathoms) (Rathbun 1930).
Associates—the under-rock low intertidal of bays: burrowing clams (Pholadidae), terebellid polychaete *Thelepus* (and its associate *Halosydna*). Subtidally, the large barnacle *Balanus nubilis*, whose discarded shell is often home to *C. oregonensis*. A parasitic barnacle (Rhizocephalan) becomes prevalent in Alaskan animals (Ricketts and Calvin 1971).

Quantitative Information

Weight—
Abundance—occurs fairly often in its own particular habitat.

Life History Information

Reproduction—females ovigerous (orange eggs) December (Coos Bay).
Longevity—
Food—predator and scavenger on other small invertebrates.
Predators—larger crabs, fish.
Behavior—reclusive.

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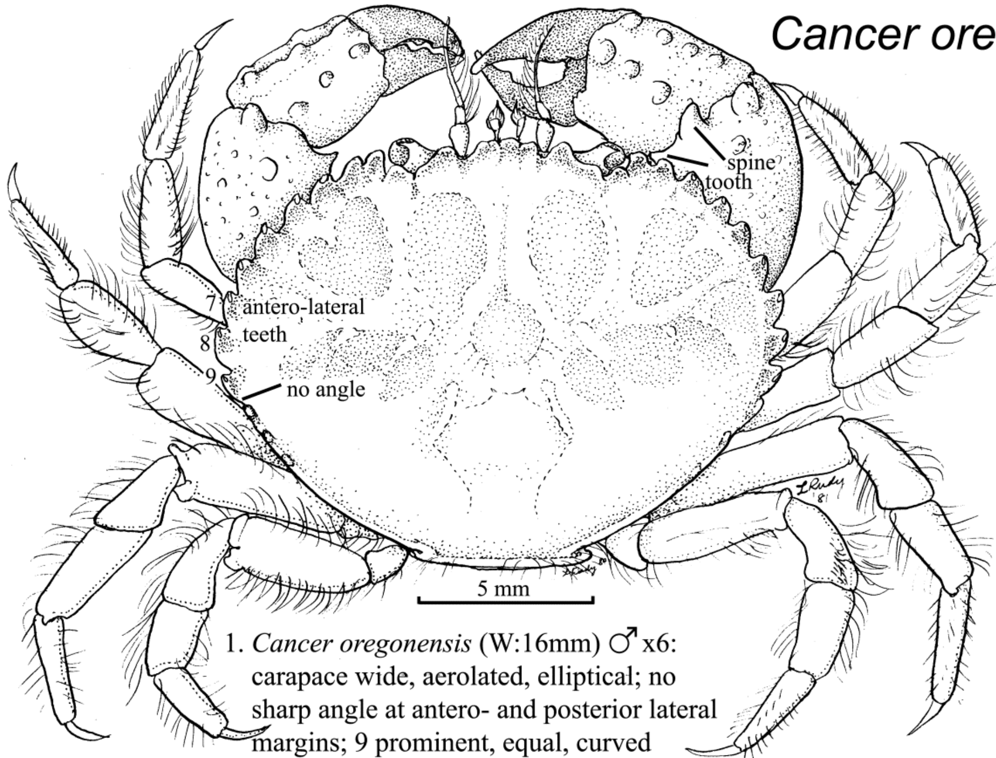
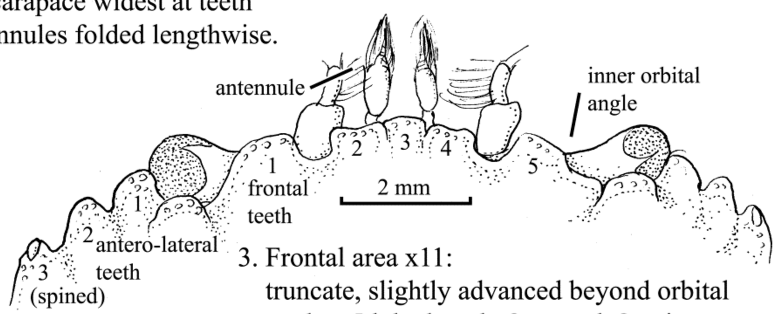
Cancer oregonensis

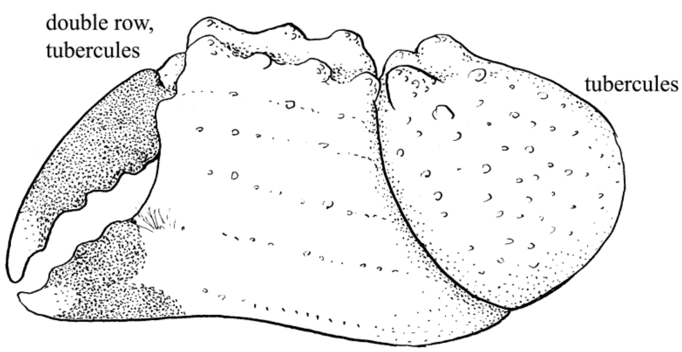


1. *Cancer oregonensis* (W:16mm) ♂ x6: carapace wide, aerolated, elliptical; no sharp angle at antero- and posterior lateral margins; 9 prominent, equal, curved teeth (12-13 total); carapace widest at teeth 7-8; legs hairy; antennules folded lengthwise.

2. Maxilliped (ventral view) x11: produced at antero-external angle of merus.



3. Frontal area x11: truncate, slightly advanced beyond orbital angles; 5 lobed teeth: 3 central, 2 at inner orbital angles; eyestalks short; antero-lateral teeth 3-9 spined; antennules fold down.



4. Left cheliped x11 (outside): double row of tubercules, 5 rows fine granulate lines: hand; fingers dark almost to tips; wrist tuberculate.

Cancer productus

The red rock crab (Randall, 1839)

Phylum: Arthropoda
Class: Crustacea, Malacostraca
Division: Eucarida
Order: Decapoda, Reptantia
Section: Brachyura
Family: Cancridae

Description

Size—width to 157.5 mm (Rathbun 1930); length 97 mm: can be up to 173.5 mm (Schmitt 1921).
Color—dark red above, light below, legs mottled red; juveniles striped (fig. 3), or otherwise colored.
Eyes—eyestalks short, orbits small.
Antennae—antennules folded lengthwise; antennal flagella short, hairy (Queen 1930).
Carapace—broadly oval, uneven, slightly convex. Widest at 8th antero-lateral tooth (fig. 1).
Frontal Area—markedly produced beyond eyes, with 5 nearly equal teeth (fig. 2).
Antero-Lateral Teeth—10 (counting orbital tooth); 9 large teeth, becoming more acute posteriorly; 9th tooth smaller; a small, acute orbital tooth; one obscure post-lateral tooth.
Abdomen—typical Cancroid: narrow in male, wide in female.
Chelipeds—dactyls dark-tipped; hands rough above, car-pus wrinkled, with single tooth at inner angle (Queen 1930).
Walking Legs—dactyls thickly fringed above and below.
Juveniles—often brightly colored with a few or many spots; carapace widest at ninth tooth (1st tooth rudimentary); teeth (frontal and antero-lateral flat, rounded, fairly uniform; carapace naked, smooth, often spotted or striped; shaped like adult (fig. 3).

Possible Misidentifications

While *Cancer productus* is often taken in crab nets with *C. magister*, it is easily distinguished from it by its bright red color. Another red dark-handed crab is *Cancer antennarius*, with 11 teeth, (but widest at the 8th tooth), and with red blotches on its underside, the only *Cancer* so marked.

Ecological Information

Range—Kodiak, Alaska, to Magdalena Bay, Baja California (Schmitt 1921).
Distribution—Oregon estuaries: Coos, Yaquina, Umpqua, Coquille, Tillamook (Gaumer et al 1973); and on semi-protected rocky shores (Morris et al 1980).
Habitat—prefers gravel, rock, hard bottom (as it does not burrow, and lacks "straining apparatus" for sand removal) (Ricketts and Calvin 1971); rocky tidepools (*ibid.*), and among eelgrass (Morris et al 1980).
Salinity—collected at 30 ‰; S. F. Bay, range of 21.7 to 33.3 ‰(Schmitt 1921).
Temperature—collected at 11° to 17°C., S. F. Bay area (Schmitt 1921).
Tidal Level—intertidal to about 19 fathoms; closer to shore than *C. magister*.
Associates—often netted with *C. magister*.

Quantitative Information

Weight—
Abundance—common (Carlton and Kuris1975).

Life History Information

Reproduction—most mating occurs June-August (Puget Sound) (Knudsen 1964). Mating occurs while female is soft. Most eggs extruded in December or January. Most hatching by early April (Knudsen 1964). Eggs are bright orange when deposited and become gray when ready to hatch.
Growth Rate—
Longevity—
Food—a scavenger and predator on Crustacea, especially barnacles and other crabs (Knudsen 1964), molluscs and polychaete worms.
Predators—man; (use for food limited, as proportion of meat, to shell is small); octopus, birds; adults can hide from large fish (Knudsen 1964). Larval forms, by filter and

plankton feeders (herring, salmon, other fishes).

Behavior—stalks the tidepools at night, a dominant animal (Ricketts and Calvin 1971); also active in daylight (Knudsen 1964). Aggregation by sex and age, depending on egg-laying and molting cycles (Knudsen 1964); possibly has a vertical or off-shore migration like *C. magister*.

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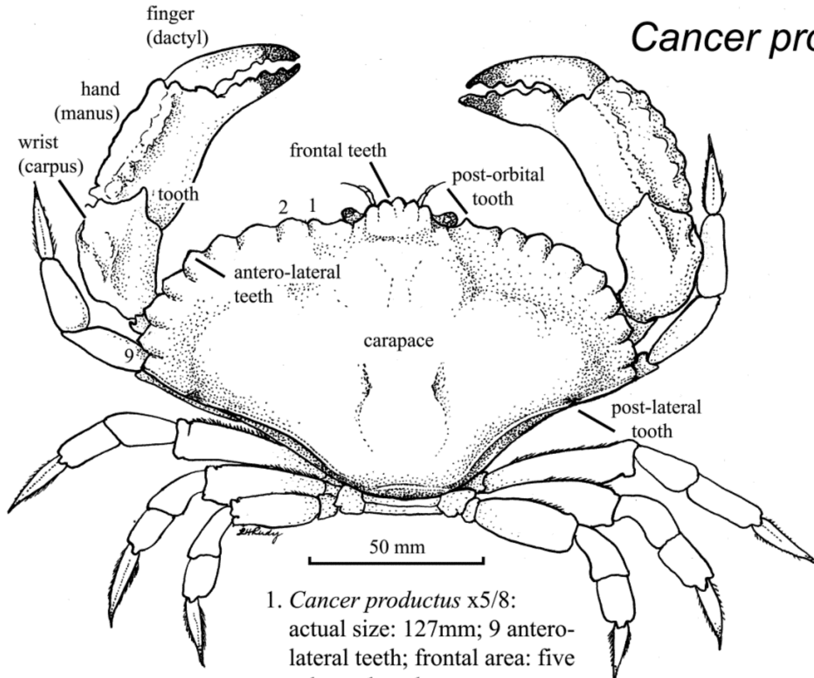
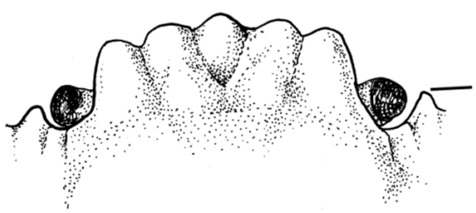
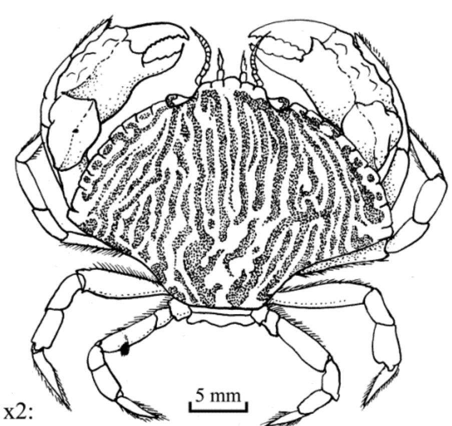
Cancer productus



1. *Cancer productus* x5/8:
actual size: 127mm; 9 antero-lateral teeth; frontal area: five subequal teeth; carapace broadly oval; fingers dark-tipped; one post-lateral tooth, one post-orbital tooth.



2. Frontal area:
markedly produced;
five subequal teeth;
post-orbital tooth.



3. Juvenile x2:
actual size 2.5mm
carapace like adult; striped;
nine antero-lateral teeth.

Caprella drepanochir

A skeleton shrimp, or caprellid amphipod (Mayer, 1890)

Phylum: Arthropoda
Subphylum: Crustacea
Order: Amphipoda
Family: Caprellidae

Description

Size—illustrated specimens (Coos Bay) male 13 mm, female 8 mm. Japanese males: 13 mm (Arimoto et al 1976; Utinomi 1943); Alaskan male 12.4 mm (Laubitz 1970). (Measured from anterior of head to posterior of abdomen or pereonite (Laubitz 1970)).

Color— white, with brown chromatophores; female darker than male: these specimens.

1st Antennae—(ant 1) less than ½ body length (Laubitz 1970). Male: approximately equal to cephalon plus pereonite 2 (Laubitz 1970) (fig. 1). Articles 2, 3 of peduncle setose; flagellum shorter than peduncular articles 1 and 2, and with 11 articles (Laubitz 1970) (fig. 1). Female: this specimen with ant 1 a little longer than cephalon + pereonite 1; flagellum with 10 articles (fig. 2).

2nd Antennae—male: longer than ant 1 peduncle; flagellum with short setae (Laubitz 1970) (fig. 1)

Eyes—small: typical caprellid (Laubitz 1976) (fig. 1).

Mouthparts—mandible with molar (McCain 1975); without palp: family Caprellidae (McCain 1975). Left *lacinia mobilis* with 5 teeth (fig. 5); right *lacinia mobilis* denticulate but not 5-toothed (McCain 1975) (not figured).

Head (cephalon)—round, without rostrum: typical caprellid (Laubitz 1976). No dorsal spines or tubercles (fig. 1). Head joined to pereonite 1 by partial suture (fig. 1). Male: pereonite 1 not more than 2 x as long as head (Laubitz 1970)`. Female: with short 1st pereonite (Laubitz 1970) (fig. 2).

Ventral Spines—between insertions of 2nd gnathopods: lacking in this species (fig. 1a).

Gnathopod 1—male: small; propodus and dactyl have serrate grasping margins (fig. 1). Female: small, setose (fig. 2).

Gnathopod 2—male: very large, especially propodus, whose width is less than ½ length. Gnathopod is setose, except dactyl and distal part of propodus: sp. *drepanochir* (Laubitz 1970). Basis small, no lateral spines at base (figs. 1, 1b). Propodus tuberculate anterodistally; palm with small proximal grasping-spine, large distal poison spine (normal for genus), large triangular projection distal to poison spine, separated by cleft (Laubitz 1970); no anterodorsal projections on propodus in this species (Laubitz 1970) (fig. 1). Dactyl heavy, slightly curved, inner margin slightly denticulate, not setose. Gnathopod attached just posterior to middle of pereonite 2 (in male). Female: attached near middle of pereonite 2, not at its anterior end: sp. *drepanochir* (Laubitz 1970) (fig. 2). Palm of propodus has a proximal grasping spine and an accessory spine, and a minute distal poison spine (fig. 3). Female gnathopods much smaller than male's.

Gills—on pereonites 3 and 4 only. Round in outline: sp. *drepanochir* (Mayer 1980) (figs.1,2)

Pereopods—with only 6 segments, not 7: typical caprellid (Laubitz 1976). No pereopods on pereonites 3 or 4: family Caprellidae (McCain 1975). Pereopods 5 - 7 prehensile (grasping), and increase in size posteriorly (fig. 1). Propodus on preopods 5 - 7 rather stout, with a concave inner edge and a proximal tooth with a pair of grasping spines (fig. 1c). Female pereopods more slender than male's (Laubitz 1970) (fig. 2).

Pereonites—(body segments) - cylindrical, longer than deep: typical caprellid (Laubitz 1976). Pereonites in this species are without dorsal spines or tubercules, but are covered with fine hairs (fig. 1). Male pereonite 1 is not more than 2 x length of head; female pereonite 1 is shorter (Laubitz 1970) (fig. 2).

Abdomen—(pereonite 7) - reduced and often unsegmented in caprellids (McCain 1975). Female: with one pair of lobes, but no single-articled appendages above these lobes (figs. 2, 4) (McCain 1975): genus *Caprella.*

Oostegites—(marsupium) - in female only: 2 pairs of "leaves", typical of caprellids (Laubitz 1976) (fig. 2). Oostegites grow from bases of gills (Arimoto et al 1976).
Sexual Dimorphism—males much larger than females, with a longer 1st pereonite and an exaggerated 2nd gnathopod. Females when brooding have oostegites.

Possible Misidentifications

Caprellidea are a very distinctive suborder of amphipods. In contrast to the more familiar Gammaridea, their bodies are elongate and cylindrical, their pereonites are very long, their 3 pairs of pereopods are prehensile. Caprellids have 2-3 pairs of gills on the middle pereonites, and lack the abdominal pleopods of gammarid amphipods. (A 3rd amphipod suborder, the Hyperiidea. is marine, pelagic, and has a very large head and large eyes). There are 4 caprellid families:

Cyamidae are parasitic on cetacean mammals. They are very short bodied, dorso-ventrally flattened (like isopods), and have 3rd and 4th pereonites especially adapted for hanging on to their host.

The 3 intertidal caprellid families include:

Phtisicidae, which have 3 pairs of gills, not 2 (unlike Caprellidae). In addition, they have no molar surface on the mandible. Unlike Caprellidae, Phtisicidae have rudimentary pereopods on pereonites 3 and 4 (Laubitz 1970). Of this family, *Perotripus brevis* (La Follette, 1915) has been reported from California (McCain 1975). It, as well as *Cercops compactus* (Laubitz, 1970), occurs in Puget Sound. *C. compactus* has also been reported from the outer coast of Oregon, at Cape Arago (Laubitz 1970).

Aeginellidae have only 2 pairs of gills (like Caprellidae). Also like Caprellidae, the mandible has a molar surface – but it has a palp as well, lacking in Caprellidae (McCain 1975) (fig. 5). Aeginellidae also have rudimentary appendages on pereopods 3 and 4 - very small and difficult to see.

Pacific genera include *Deutella, Mayerella,* and *Triitella. Tritella* pereopods have only one article; their 2nd antennae have swimming setae (Laubitz 1970; McCain 1975). 2 species are found in Oregon: *T. laevis* is strongly stenohaline, and is found offshore. It has anteriorly pointed body spines and short spines on the stout flagellum of its 2nd antennae. This species can display "intersex" features (Laubitz 1970). *T. pilimana* has laterally pointed body spines; its 2nd antennal setae are long, on a slender flagellum. It is more euryhaline than *T. laevis*.

Caprellidae, the largest family, has 2 genera in our area. The genus *Metacaprella* has a pair of appendages above the usual lobes on the female abdomen (McCain 1975); *Caprella* spp. have only the one pair of lobes (fig. 4). The 2 *Metacaprella* species in our area both have a small pair of sharp spines on the heads: *M. anomala* and *M. kenneryli* are reported from California (McCain 1975) and from Puget Sound (Keith 1971).

The genus *Caprela* includes at least 20 species that might be found in Oregon's estuaries. (They have been grouped below by obvious morphological characteristics, *ie.* ventral spines, cephalic spines.)

Caprella greenleyi (McCain, 1969) has been reported living on hydroids and algae and on the sea star *Henricia* both in Oregon and in California (McCain 1975). Unlike most free living caprellids, it is quite stout, and has unusual antennae: both pairs have only a uniarticulate flagellum (McCain 1975).

A few caprellids have a ventral spine between the insertions of the 2nd gnathopods (C. *drepanochir* does not): *C. californica, C. equilibra, C. mendax,* and *C. pilidigita.* None of these species has yet been reported from Oregon (Laubitz 1970).

Caprella californica (Stimpson, 1857) has a long, forward directed cephalic spine (Laubitz 1970). Both the propodus and basis of the male gnathopod 2 are very long in this species. It occurs in Humboldt Bay and in Puget Sound (Laubitz 1970).

Caprella equilibra (Say, 1818) has no cephalic spine (McCain 1975) (like *C. drepanochir).* But unlike the latter, it has anterior lateral projections on pereonite 5, large lateral spines at the base of the gnathopod 2 (McCain 1975) (fig. 1b), and the ventral spines between the gnathopods (figs. 1, 1a). Found in British Columbia (Laubitz 1970).

Caprella mendax (Mayer, 1903) has no cephalic spine, no lateral projections on pereonite 5, and only small lateral spines at the bases of the 2nd gnathopods. Its dactyl is not setose. From California and British Columbia (Laubitz 1970).

Caprella pilidigita (Laubitz, 1970) has no lateral spine near the base of gnathopod 2; its dactyl is setose - pili-digit. It is found in Puget Sound (Keith 1971), and in California (Laubitz 1970).

One group of *Caprella* spp. has at least a slight cephalic spine (and lacks ventral spines between the 2nd gnathopods, as above): It includes *C. angusta, C. borealis, C. brevisrostris, C. natalensis, C. pustulata,* and *C. scaura:*

Caprella angusta (Mayer, 1903) (=uniforma? (McCain 1975)) has a slight cephalic spine and small dorsal pereonite spines, except on pereonite 1. Its male gnathopod 2 is attached at the anterior end of the 2nd pereonite; it has been reported from Oregon (Laubitz 1970).

Caprella borealis (Mayer, 1903) has a dorsal, upward-directed cephalic knob, and only a few tubercles on its head and pereon, like *C. pustulata* below (Keith 1971). None of the antennal setae are more than 2x as long as the width of the articles from which they originate (contrast *C. pustulata).* The body and gnathopod 2 are not setose in the male; they are in *C. pustulata.* This is an Arctic, cold water species (Utinomi 1943): borealis = northern.

Caprella brevirostris (Mayer, 1903) has only a very slightly produced rostrum, not a cephalic spine (Arimoto et al 1976). It differs chiefly from *C. drepanochir* in that it lacks grasping spines on its pereopodal propodi (fig. 1c). It has been reported from Japan (Arimoto et al 1976), and from Calilornia (McCain 1975), but not from Puget Sound (Keith 1971) or from Oregon (Laubitz 1970).

Caprella natalensis (Mayer, 1903) has a well-developed cephalic spine and no dorsal tubercles on the pereonites. It occurs in California only as far south as Monterey Bay. (*C. penantis* (Leach, 1814) is very like it, and appears south of Monterey (McCain 1975).) Neither has yet been reported from Oregon (Laubitz 1970).

Caprella pustulata (Laubitz, 1970) has a dorsal, upward directed knob on its head, like *C. borealis,* above; the head and pereon are covered with large and small tubercles (Keith 1971). The male is setose on the 2nd gnathopods and on much of the body; the antennae have some very long setae. Reported from Puget Sound and from Oregon (Laubitz 1970), but not from California (McCain 1975).

Caprella scaura (Templeton, 1836), a cosmopolitan species newly found in North America (Marelli 1981), is very like *C. californica* above, except that it lacks a ventral spine between the gnathopods, and has 2 pairs of dorsal tubercles on pereonites 5 (Marelli 1981).

Obvious dorsal tuberculations on the pereonites, lacking in *C. drepanochir,* characterize the group composed of *C. alaskana, C. ferrea, C. incisa, C. mutica, C. pilipalma, C. rudiuscula, C. striata,* and *C. verrucosa:*

Caprella alaskana (Mayer, 1903) has quite variable dorsal pereonite spines. Like *C. striata* below, it has long 1st antennae, but the flagellum is shorter than the peduncle, not longer, as it is in *C. striata.* The male 2nd antenna is shorter than the 1st 2 articles of the 1st antenna. Like *C. drepanochir* and *C. striata, C. alaskana* has a 1st pereonite not more than 2x the length of its head (Keith 1971). It is an intertidal species, found in Puget Sound (Keith 1971), and in Trinidad Bay and San Francisco Bay, Calilornia (Marelli 1981).

Caprella ferrea (Mayer, 1903) has a pair of small blunt spines on its head (Laubitz 1970). The dorsal pereonite tubercles become large spines in the posterior pereonites (Keith 1971). The 1st pereonite in the male is about as long as the head (Keith 1971). (Juvenile and immature, but not adult, *C. ferrea* can be similar to *C. alaskana* above (Laubitz 1970).) Found in British Columbia and in Puget Sound (Keith 1971).

Caprella incisa (Mayer, 1903) has small dorsal tubercles on its pereonites; the propodus (on gnathopod 2 male) is as long as pereonite 2 (Keith 1971); its 1st antennal peduncle is finely setose (McCain 1975). It has a triangular cephalic projection, directed anteriorly (McCain 1975), lacking in *C*. *drepanochir. C. incisa* has been reported from the Oregon coast (Laubitz 1970).

Caprella mutica (Schurin, 1935), an Asian species, has now been reported from California (Marelli 1981), and was found in Coos Bay with *C*. *drepanochir* (authors). It has also been called *C*. acan*thogaster humboldtiensis* (Martin 1977). *C*. *mutica* has dorsal projections on pereonites 3-5, but not on the anterior pereonites, which are setose. It has no cephalic projections. The entire 2nd gnathopod (male) is setose in this species (including the dactyl). The pereopodal grasping spines (on propodus) are medial, not proximal as in *C*. *drepanochir.*

Caprella pilipalma (Dougherty & Steinberg, 1953) has low tubercles dorsally, especially on its posterior segments. It has a small, erect, pointed, dorsally directed cephalic spine (Dougherty and Steinberg 1953); its 2nd gnathopods are attached posteriorly to the 2nd pereonites in the male, and anteriorly in the female (contrast *C*. *drepanochir).* The large propodus on the male gnathopod 2 has no poison spine or grasping spine, but does have many long colorless hairs (Dougherty and Steinberg 1953). Found in California.

Caprella rudiuscula (Laubitz, 1970) a Puget Sound species (Keith 1971), is rather similar to *C*. *ferrea* above, but it has a 1st pereonite about 1 ½ x longer than the head (male), not 2x. It has a pair of small cephalic projections; its posterior pereonites have small dorsal tubercles (Laubitz 1970), not large dorsal spines. The poison spine on the male 2nd gnathopod is enormous (Laubitz 1970).

Caprella striata (Mayer, 1903) is a northern subtidal species with a long 1st antenna – at least 112 the body length. The 1st antennal flagellum is longer than its peduncle. Its male 2nd antenna is about as long as the 1st antennal peduncle (Keith 1971). *C*. *striata* has a few dorsal tubercles on some posterior pereonites; its 1st pereonite is not more than 2*x* the length of the head (as in *C*. *drepanochir* (Keith 1971)). From British Columbia, Puget Sound (Keith 1971), and Alaska.

Caprella verrucosa (Boeck, 1872) has large, blunt tubercles on all pereonites - it is the most tuberculate of this group. Unlike many of the genus, *C. verrucosa,* like *C*. *drepanochir,* has an antennal peduncle which is scarcely setoset (Dougherty and Steinberg 1953). The propodus on its 2nd gnathopod is shorter than the 2nd pereonite (Keith 1971). This species has an anteriorly directed triangular cephalic projection (Keith 1971). Found in Puget Sound (Keith 1971), California, British Columbia, Japan. Some specimens of *C*. *verrucosa* from protected waters have a ventral spine between the 2nd gnathopods, in contradiction to most keys (Marelli 1981).

There are 3 other *Caprella* species, which, like *C*. *drepanochir,* have no cephalic spines, no ventral spines between the gnathopods, and no dorsal pereonite projections; they are *C*. *irregularis, C*. *gracilior,* and *C. laeviuscula:*

Caprella irregularis (Mayer, 1890) is also similar to *C. drepanochir,* in its rather stout pereopodal propodi, with a proximal tooth and grasping spines (Laubitz 1970) (figs. 1, 1c). Also like the latter, *C. irregularis* has a male gnathopod 2 in which the basis is shorter than the propodus, and the dactyl is not setose. Unlike *C drepanochir,* however, the male *C. irregularis* has 2 small spines at the base of a large proximal grasping spine on its gnathopod 2 propodus (*C*. *drepanochir* has only 1 small spine). The 1st pereonite in the male of *C*. *irregularis* is 3x longer than the head, not 2*x* or less. In addition, *C*. *irregularis* has antero-dorsal projections on the male gnathopod 2 propodus; *C*. *drepanochir* has none (fig. 1)(Laubitz 1970). From British Columbia and Puget Sound (Keith 1971).

Caprella gracilior (Mayer, 1903) is occasionally found intertidally, but usually inhabits deep water (below 30 ft., even down to 958 fathoms (Laubitz 1970)). It has a smooth body, except for 2 tubercles on pereonite 5. The grasping spines on the slender pereopod propodus are medial (not proximal as in *C*. *drepanochir).* The basis of the male gnathopod 2 is much longer than the propodus; the dactyl is setose (Laubitz 1970). It has been reported from Alaska, Washington, and California, but not from Oregon (Laubitz 1970).

Caprella laeviuscula (Mayer, 1903) is the most common northeastern Pacific species (Laubitz 1970), and would be expected to be found intertidally in Oregon's estuaries. It is the species most similar to *C. drepanochir* in (according to McCain 1975, which does not include *C. drepanochir).* The main difference is in the gills: they are long and oval in *C. laeviuscula* and round in *C. drepanochir.* The male 2nd gnathopod in *C. laeviuscula* has an extremely large poison spine; (it is large in *C. drepanochir,* but a normal size tor the genus). The female gnathopod 2 in *C. laeviuscula* is attached near the middle of the pereonite (Laubitz 1970); contrast fig. 2.

Caprellids from Oregon are not well described; many of the Puget Sound and northern California species included in this section may yet be reported from our area.

Ecological Information

Range—"amphi-Pacific" (Laubitz 1970): Japan, Russia, Arctic; Alaska as far as Prince William Sound; original description probably China (Laubitz 1970; Mayer 1890). This location (Oregon) a range extension.
Local Distribution—Coos Bay: Charleston small boat harbor.
Habitat— these specimens on *Obelia* sp. on floating docks. In Japan on *Tubularia. S*ubstrate determined by food source: caprellids can cling to almost any surface; can be found on algae, sponges, etc., but not on bare sandy or muddy bottoms (McCain 1975).
Salinity— collected at 30 ‰ (Coos Bay).
Temperature—primarily an Arctic species - in Prince William Sound, in a protected, cold-temperature zone (Laubitz 1970).
Tidal Level—intertidal (Laubitz 1970) and subtidal.
Associates—on hydrozoan *Obelia* sp. with *Caprella mutica* (Coos Bay).

Quantitative Information

Weight—
Abundance— locally common where collected (Coos Bay), July.

Life History Information

Reproduction—eggs carried by female in marsupium (fig. 2), until 0.4 - 0.5 mm: hatch size. Larvae, *ca* 1 mm long, with external resemblance to adult, may stay in marsupium until mother's first molt (Japan, Kawana, in Arimoto et al 1976).
Growth Rate—caprellids undergo repeated moltings as they grow; thus individuals of a single species can show great variability in size depending upon their age (Arimoto et al 1976). Maturity: females 7.5 mm; males, 18 mm (Arimoto et al 1976).
Longevity—
Food—caprellids can eat many things by different methods. Presence of plumose setae on 2nd antennae shows ability to filter food and to scrape periphyton from habita (Caine 1977) *(Obelia,* in Coos Bay). When feeding, caprellid hangs on with prehensile pereopods, uses antennae and gnathopods for eating.
Predators—caprellids are fed upon by bottom fishes (cod, blennies, skates, sea bass), also by shrimp, anemones (McCain 1975).
Behavior— movement is inchworm-like: grasping substrate with large gnathopods, then pulling up posterior and grabbing on with pereopods.

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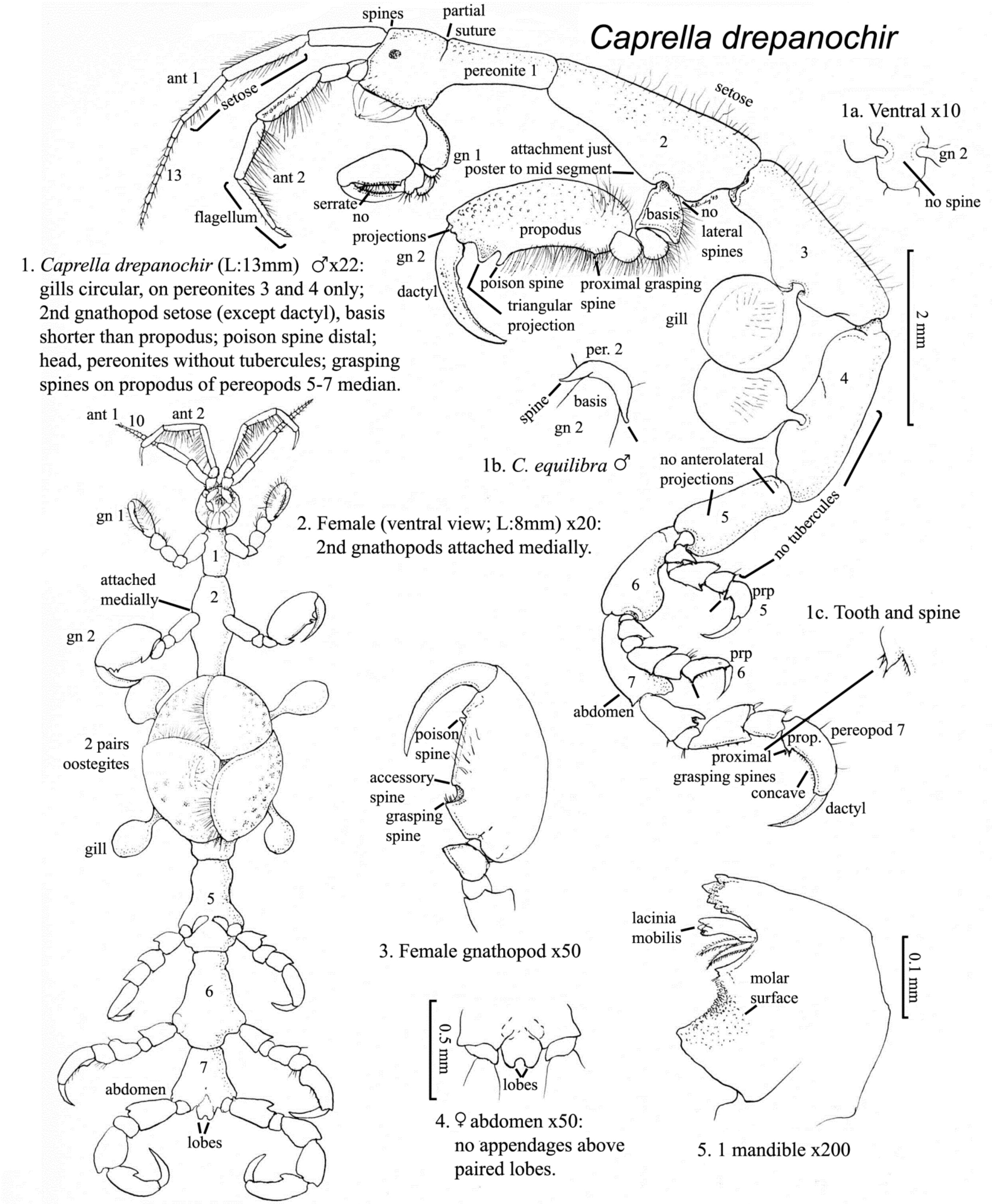
Caprella drepanochir



1. *Caprella drepanochir* (L:13mm) ♂x22: gills circular, on pereonites 3 and 4 only; 2nd gnathopod setose (except dactyl), basis shorter than propodus; poison spine distal; head, pereonites without tubercules; grasping spines on propodus of pereopods 5-7 median.

1b. *C. equilibra* ♂

2. Female (ventral view; L:8mm) x20: 2nd gnathopods attached medially.

3. Female gnathopod x50

4. ♀ abdomen x50: no appendages above paired lobes.

5. 1 mandible x200

Crangon alaskensis (*C. alaskensis elongate*)

Common gray shrimp (Lockington, 1877)

Phylum: Arthropoda
Class: Crustacea
Sub-Class: Malacostraca
Order: Decapoda, Natantia
Tribe: Caridea
Family: Crangonidae

Description

Size—type: about 7.6 cm (Carlton and Kuris 1975); South Slough (of Coos Bay) specimen, female: 6.5 cm.
Color—white, mottled with small black spots, giving gray appearance; eyes salmon (Carlton and Kuris 1975).
Rostrum—short, flattened, rounded (fig. 2): unornamented.
Eyes—free, not covered by carapace: *Crangon* and *Lissocrangon*.
Antennal Scale—about $^3/_4$ the length of the carapace: blade broad, rounded and shorter than spine (fig. 2).
Chelipeds—hands subchelate: *Crangon* and *Lissocrangon*; hand (propodus) at least 4 times as long as wide; finger closed nearly longitudinally (fig. 3) (Carlton and Kuris 1975).
Carapace—with a single medial spine: *Crangon* and *Lissocrangon*; a pair of lateral spines as well (Schmitt 1921).
Abdomen—shrimp-like, with typical Caridean bend; 2nd segment overlaps 1st (fig. 1).
Telson— nearly equal in length to uropods; sp. *franciscorum*.

Possible Misidentifications

Other northwest *Crangon* species with only 1 medial carapace spine are *C. nigricauda*, *C. nigromaculata*, *C. alaskensis*, and *C. handi*.

C. nigricauda, the "black tailed shrimp". has antennal blade and spine of nearly equal length, its fingers of the chelipeds close almost transversely.

C. nigromaculata has a striking round marking on the side of the sixth abdominal segment; its fingers also close transversely, and it may not range north as far as Oregon.

C. alaskensis is a small shrimp, with a slender rostrum, and, in common with all these closely related species, without *C. franciscorum*'s very long propodus.

C. handi, from the outer coast, has a very short, stout antennal scale, and a short 6th abdominal segments. Butler (Butler 1980)

calls this species *Crangon franciscorum franciscorum*, to distinguish it from *C.f. angustimana* (Rathbun 1902), the long-clawed Crangon. This latter species lives in deeper water, and within a narrower range of temperatures than does *C. f. franciscorum*.

Ecological Information

Range—southeastern Alaska to San Diego, California; type locality, San Francisco (Carlton and Kuris 1975).
Local Distribution—Yaquina Bay (Rathbun 1902); South Slough (Collver Point, channel).
Habitat—"sandy coves" (Carlton and Kuris 1975); in bay channel, substrate of mud, rock (South Slough); also offshore.
Salinity—collected at 30 ‰; determines distribution (Rathbun 1902).
Temperature—great toleration of temperature variation; prefers warmer water than *C. nigricauda*.
Tidal Level—down to 29 fathoms (91 meters) (Carlton and Kuris 1975).
Associates—collected in trawl with *Cancer jordani*, *Hermissenda sp., Rostanga pulchra*, sponges. Can be infested with Bopyrid isopod *Argeia pugettensis* Dana (Butler 1980).

Quantitative Information

Weight—
Abundance—"common to abundant'"; with *C. nigricauda*, comprise the major decapod shrimp epifauna, Yaquina Bay (Rathbun 1902), caught commercially, San Francisco (Kozloff 1974a).

Life History Information

Reproduction—spawning December to August (Rathbun 1902) (Yaquina Bay); ovigerous female collected April; eggs hatch in water of high salinity: larval stages occur floating in the plankton: earliest post-larval shrimp found in brackish water of shallow tidal flats; maturing animals move into deeper water (Kozloff 1974a).
Growth Rate—differential growth rate: large females and males, (Rathbun 1902).
Longevity—females live a maximum 1 ½ years, males up to 1 year (Rathbun 1902).
Food—
Predators—sport and food fishes-important food item of young striped bass in upper Coos Bay (Rathbun 1902); primary food shrimp in San Francisco Bay.
Behavior—

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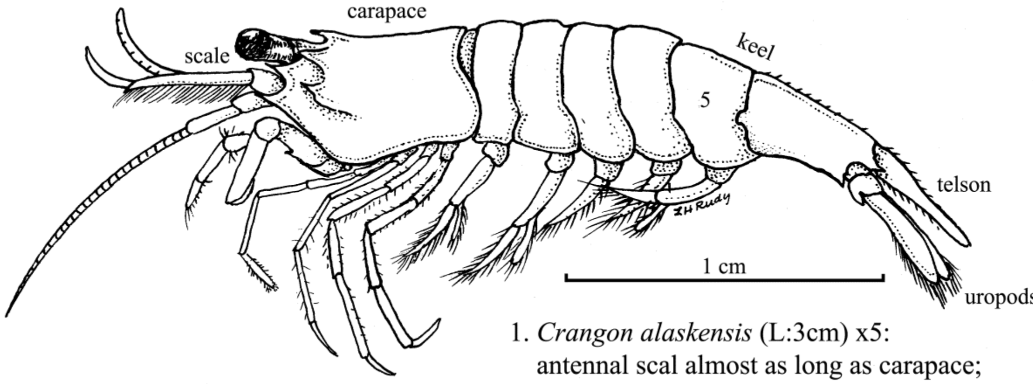
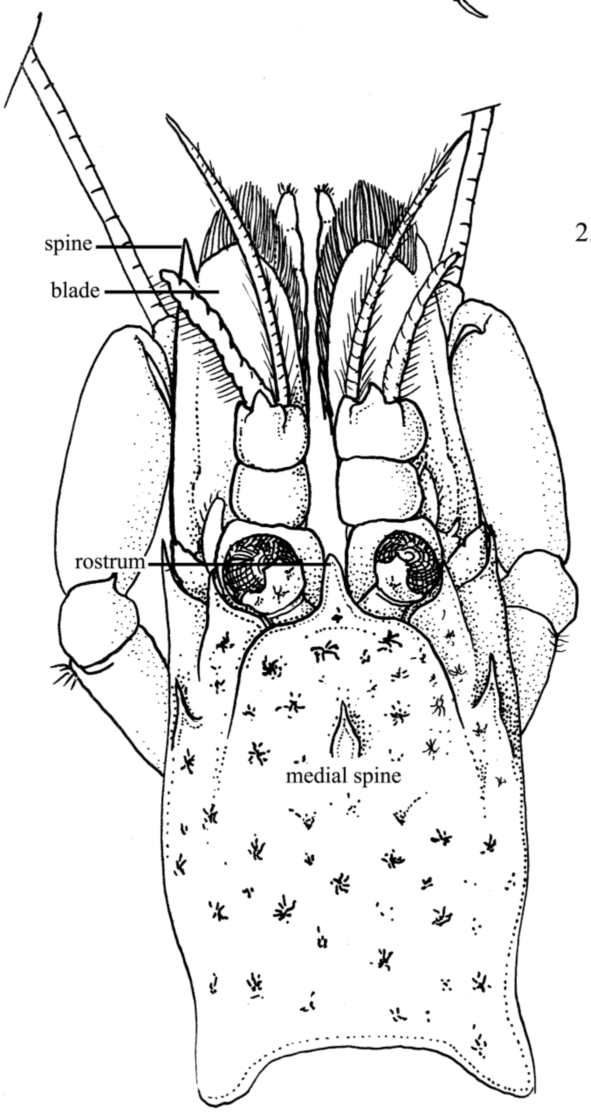
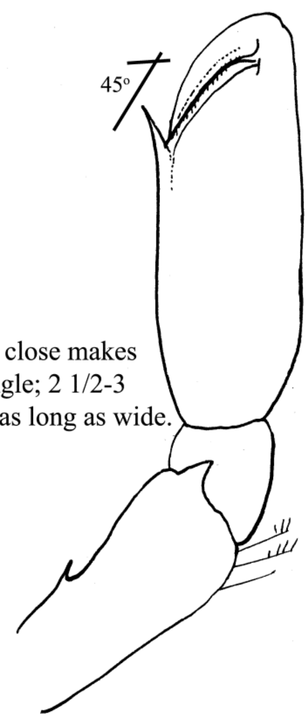
Crangon alaskensis



1. *Crangon alaskensis* (L:3cm) x5:
antennal scal almost as long as carapace;
telson almost as long as uropods;
hands of first legs subchelate; eyes free.



2. Frontal region (dorsal view):
antennal spine larger than blade;
rostrum slender;
carapace: one medial spine.



3. Hand:
finger close makes
45° angle; 2 1/2-3
times as long as wide.

Crangon franciscorum

Common gray shrimp

Phylum: Arthropoda
Class: Crustacea
Sub-Class: Malacostraca
Order: Decapoda, Natantia
Family: Crangonidae

Description

Size—type: about 7.6 cm; South Slough (of Coos Bay) specimen, female: 6.5 cm (Schmitt 1921).
Color—white, mottled with small black spots, giving gray appearance; eyes salmon (Schmitt 1921).
Rostrum—short, flattened, rounded (fig. 2): unornamented.
Eyes—free, not covered by carapace: *Crangon* and *Lissocrangon* (Carlton and Kuris 1975).
Antennal Scale—about $^{3}/_{4}$ the length of the carapace: blade broad, rounded and shorter than spine (fig. 2).
Chelipeds—hands subchelate: *Crangon* and *Lissocrangon*; hand (propodus) at least 4 times as long as wide; finger closed nearly longitudinally (fig. 3) (Schmitt 1921).
Carapace—with a single medial spine: *Crangon* and *Lissocrangon*; a pair of lateral spines as well (Kuris and Carlton 1977).
Abdomen—shrimp-like, with typical Caridean bend; 2nd segment overlaps 1st (fig. 1).
Telson— nearly equal in length to uropods; sp. *franciscorum*.

Possible Misidentifications

Other northwest *Crangon* species with only one medial carapace spine are *C. nigricauda*, *C. nigromaculata*, *C. alaskensis*, and *C. handi*.

C. nigricauda, the "black tailed shrimp". has antennal blade and spine of nearly equal length, its fingers of the chelipeds close almost transversely.

C. nigromaculata has a striking round marking on the side of the sixth abdominal segment; its fingers also close transversely, and it may not range north as far as Oregon.

C. alaskensis is a small shrimp, with a slender rostrum, and, in common with all these closely related species, without *C. franciscorum*'s very long propodus.

C. handi, from the outer coast, has a very short, stout antennal scale, and a short 6th abdominal segment (Kuris and Cartlon 1977).

Butler calls this species *Crangon franciscorum franciscorum*, to distinguish it from *C.f. angustimana* Rathbun 1902, the long-clawed Crangon (Butler 1980). This latter species lives in deeper water, and within a narrower range of temperatures than does *C. f. franciscorum* (Butler 1980).

Ecological Information

Range—southeastern Alaska to San Diego, California; type locality, San Francisco (Schmitt 1921).
Local Distribution—Yaquina Bay; South Slough (Collver Point, channel) (Krygier and Horton 1975).
Habitat—"sandy coves"; in bay channel, substrate of mud, rock (South Slough); also offshore (Schmitt 1921).
Salinity—collected at 30 ‰; determines distribution, (Krygier and Horton 1975).
Temperature—great toleration of temperature variation; prefers warmer water than *C. nigricauda*.
Tidal Level—down to 29 fathoms (91 meters) (Schimitt 1921).
Associates—collected in trawl with *Cancer jordani*, *Hermissenda sp., Rostanga pulchra*, sponges. Can be infested with Bopyrid isopod *Argeia pugettensis* Dana (Butler 1980).

Quantitative Information

Weight—
Abundance—"common to abundant'"; with *C. nigricauda*, comprise the major decapod shrimp epifauna, Yaquina Bay (Krygier and

Horton 1975), caught commercially, San Francisco (Israel 1936).

Life History Information

Reproduction—spawning December to August (Yaquina Bay) (Krygier and Horton 1975); ovigerous female collected April; eggs hatch in water of high salinity: larval stages occur floating in the plankton: earliest post-larval shrimp found in brackish water of shallow tidal flats; maturing animals move into deeper water (Israel 1936).
Growth Rate—differential growth rate: large females and males, (Krygier and Horton 1975).
Longevity—females live a maximum 11/2 years, males up to one year (Krygier and Horton 1975).
Food—
Predators—sport and food fishes-important food item of young striped bass in upper Coos Bay (Krygier and Horton 1975); primary food shrimp in San Francisco Bay.
Behavior—

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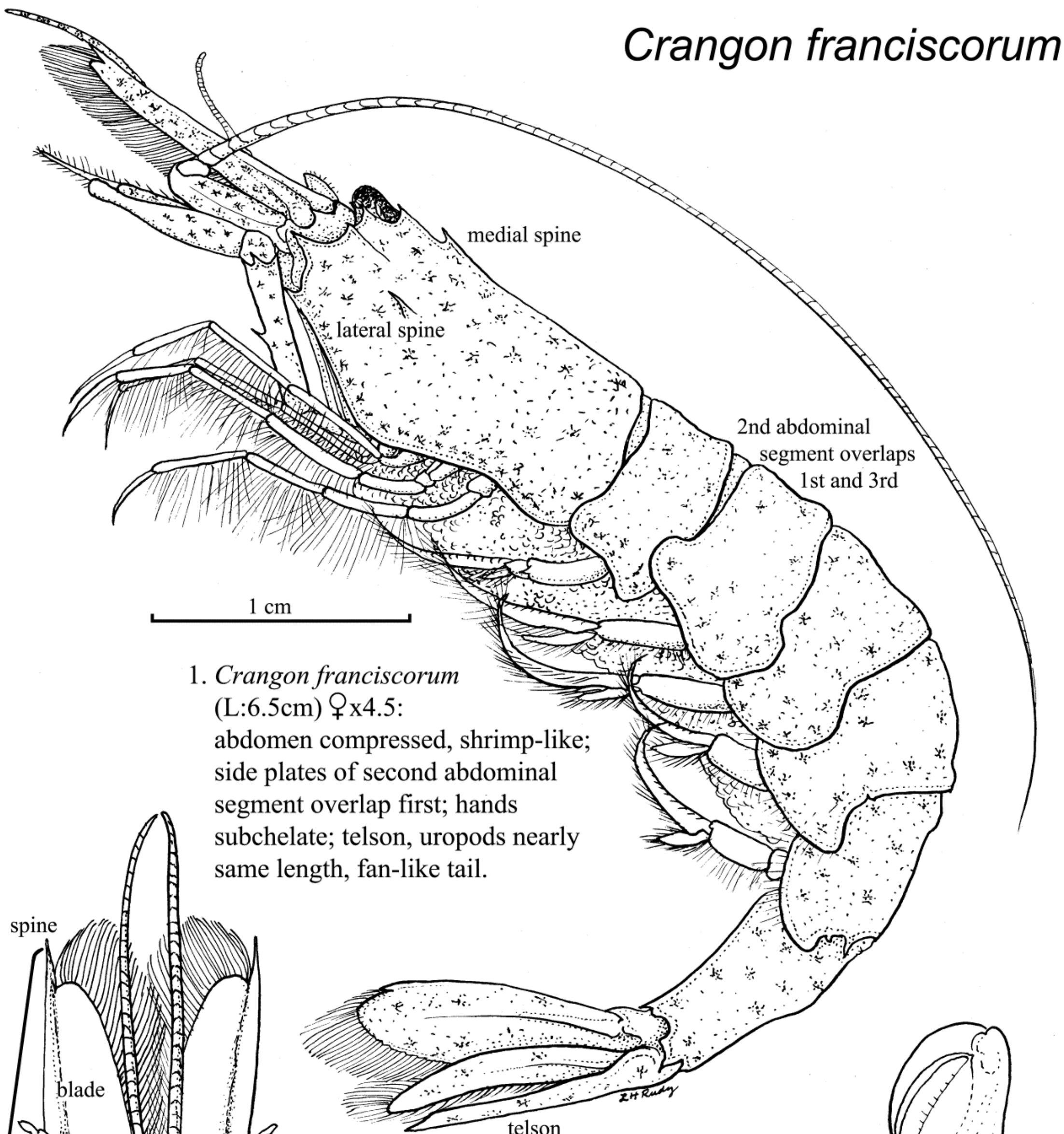
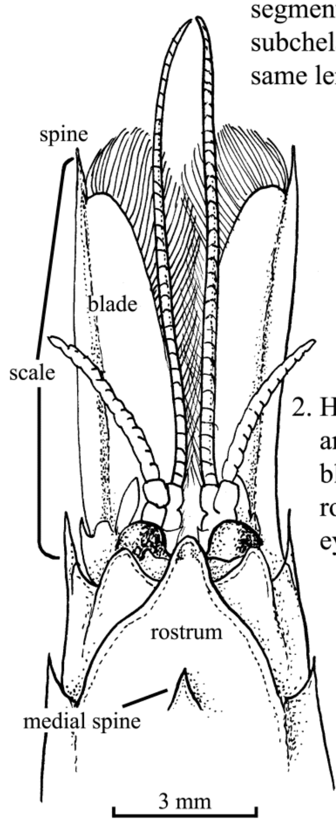
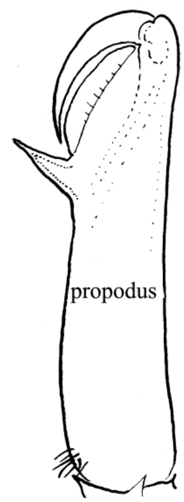
Crangon franciscorum



1. *Crangon franciscorum*
(L:6.5cm) ♀x4.5:
abdomen compressed, shrimp-like; side plates of second abdominal segment overlap first; hands subchelate; telson, uropods nearly same length, fan-like tail.



2. Head x8:
antennal scale 3.4 length of carapace; blade broad, rounded; spine long; rostrum short, flattened; rounded; eyes free; carapace with medial spine.



3. First cheliped:
hand slender, finger turned back, nearly longitudinal; propodus at least four times as long as wide.

Cumella vulgaris

A cumacean (Hart, 1930)

Phylum: Arthropoda
Subphylum: Crustacea
Class: Malacostraca
Order: Cumacea
Family: Nannastacidae

Description

Size—original description. Vancouver Island: ovigerous female. 2.5 mm long; male. 3.0 mm (Hart 1930). Illustrated specimens (Coos Bay): largest female, 2.5 mm; male (young?) 2.1 mm. One of the smallest cumaceans (Sars 1900).
Color—Males: dark brown except for lighter distal segments. appendages. Females: carapace, 6th pleonite dark brown, rest light brown or white (Gonor et al. 1979).
Eyes—conspicuous, circular in female (Gonor et al. 1979) (fig. 1). Male: prominent, a single central sessile eye, with 7 equal lenses (Gonor et al. 1979) (fig. 2).
Antennule—Female: rather stout; not easily visible (not figured); with rudimentary inner flagellum: family Nannastacidae (Fage 1951).
Antenna 2—Female: with 2 large plumose setae (Hart 1930) (not figured).
Mouthparts—mandibles "normal": bases not massive (Fage 1951) (not figured).
Carapace—Female: large and deep, with a smooth mid-dorsal carina with a depression on each side of it (on posterior margin); deep antennal notch, acute antero-lateral angle (fig. 1). Male: carapace slender, antennal notch not as deep as in female, dorsal carina almost absent (fig. 3).
Pseudorostrum—Female: relatively short, minutely serrate anteriorly, strongly produced (fig. 1). Male: pseudorostral projection shorter (Sars 1900) (fig. 3).
Pereopods—Female: 1st legs with bases serrate on outer distal margin, dactyl and propodus equal to carpus in length; 2nd legs stout, dactyl 2x propodus. Exopodites on 1st 2 pairs of pereopods only: genus *Cumella* (Lie 1969); last 3 pairs of legs stout. Males: 1st 4 pereopod bases more dilated than on females; exopodites present on 1st 4 pereopods, absent on 5th (figs. 2, 4).
Pleopods—Female: none: order Cumacea (fig.1). Male: none: family Nannastacidae (Watling 1979) (fig. 3). (But see *Hemileucon,* Possible Misidentifications.)

Abdomen—6 articles; telson fused to 6th article (figs. 1. 3). Long, narrow in male; stouter in females.
Uropods—Female: peduncle inner margin with only 1 spine on inner distal angle: sp. *vulgaris* (Gonor et al. 1979). Uropod endopod with 1 article - larger than exopod, denticulate on inner margin, and with 2 stout spines, 1 strong apical spine. Exopod with 2 articles (as in all cumaceans). Exopod ½ width of endopod, with 1 slender apical spine (fig. 6) (Gonor et al. 1979). Male: uropods slim; peduncle denticulate, longer than rami: genus *Cumella* (Fage 1951); peduncle with 3 distal spines. Endopod with only a single article: family Nannastacidae (Watling 1979). Exopod with 2 articles (fig. 5).
Telson—not distinct, but fused to last abdominal segment: family Nannastacidae (Watling 1979) (figs. 1. 3).
Sexual Dimorphism—quite strong: female generally shorter, stouter than male and has a brood pouch; female eye lacks the obvious large lenses found in male. Female has a broader carapace and uropods, and a strong carapace carina. Female exopodites appear only on 1st 2 pairs of pereopods. Male has a compound eye, is slim, lacks a strong carapace carina and has a very long 2nd antenna. Male also has 4 exopodites on the pereopods and has some uropod distinctions.

Possible Misidentifications

Cumaceans are very small and shrimplike; they are only a few millimeters long. Their heads are fused to the thorax to form a carapace; the abdomen is tubular, the uropods are slender and biramous.

Cumaceans can be separated from mysids by their single compound eye (particularly in the males); mysids have large stalked eyes. Mysids have a carapace which covers all the thorax; cumaceans have several posterior segments exposed (figs. 1, 2). Euphausiids, pelagic and marine, might occasionally be found in estuaries; they have biramous thoracic appendages (cumacean pereopods are uniramous, with some thoracic exopodites). Euphausiids have strong pleopods for swimming; cumacean pleopods - when they are present - are small.

Of the 7 cumacean families, 3 have a separate independent telson, and are thus immediately distinguishable: these are Lampropidae. Pseudocumatidae and Diastylidae. The remaining 4 families lack an independent telson: they are Nannastacidae. Leuconidae. Hemileuconidae and Bodotriidae.

The family Nannastacidae, in which *Cumella* occurs, lack an independent telson; the males have no pleopods; the endopod of the uropod has 1 article. Pereopodal exopodites in Nannastacidae are as follows: males have 5 (rarely 4 or 3) pairs; females have 3 (rarely 4 or 0) pairs (Watling 1979).

Several other cumacean families are represented in the northeastern Pacific:

The Leuconidae (like the Nannastacidae) lack the independent telson. However, they always have a biarticulate uropod endopod, not a uniramous one as in Nannastacidae. Lueconidae often have up to 2 pairs of male pleopods (there are none in Nannastacidae). Leuconidae males have exopodites on all 5 pairs of pereopods (rarely on 3); females have exopodites on 4 (rarely on 3) pairs of pereopods (Watling 1979); thus, numbers of pereopodal exopodites on both sexes are too alike in the families Leuconidae and Nannastacidae to serve as dependable determining characters. Of the Leuconidae, the genera *Eudorella, Eudorellopsis,* and *Leucon* occur on the Pacific Coast

The family Hemileuconidae, including *Hemileucon* spp. is much like the Leuconidae in telson and uropods, but the males lack pleopods entirely (like the Nannastacidae) and have 4 pairs of pereopodal exopodites, not 3 or 5 as in Leuconidae (Given, 1965). Both Hemileuconidae and Leuconidae have biarticulate uropod endopods; (the endopod is uniramous in Nannastacidae).

Bodotriidae. the 4th family in which the independent telson is lacking, is represented on our coast by the genera *Cylaspis* and *Leptocuma.* These have exopodites only on the 1st pereopod (in both sexes), not on the 1st 2 as in *Cumella* females, or on the 1st 4 as in *Cumella* males. (Females in the families Bodotriidae and those of Leuconidae or Hemileuconidae can thus be differentiated by number of exopodites.) The endopod uropod in Bodotriidae can be of 1 or 2 articles. The most striking difference is that the Bodotriidae males have 5 pleopods; Nannastacidae males have none. *Cyclaspis* spp. have been reported from Puget Sound (Lie 1969) and from Dillion Beach, California (Gladfelter 1975b).

The only other genus of Nannastacidae from our area (besides *Cumella*) is *Campylaspis:* (C. *rufa* Hart, 1930). In this genus, both males and females have exopodites only on the 1st pair of pereopods (Lie 1969). The females have a bulbous carapace with its anterolateral angles rounded (unlike *Cumella*, which has an uninflated carapace and an acute anterolateral angles).

There is no other known species of *Cumella* on the Pacific Coast. However, *C. pygmaea* (Sars, 1900), the European species is very like *C. vulgaris* in color and size. The female of *C. pygmaea* is stouter than that of *C. vulgaris,* with a less inflated carapace and with a dentate crest on the carina. The male of *C. pygmaea* is similar to that of *C. vulgaris.* except that its "pedigerous" segments are more uneven (Hart 1930).

Ecological Information

Range— Puget Sound (Hart 1930); central California (Gladfelter 1975a); Oregon
Local Distribution—Coos Bay, Yaquina Bay.
Habitat—cumacean species choose substrate mostly for available food. *C. vulgaris* prefers fine sand (grains of d. of <160 *µ);* it dislikes dry sand (in lab); males can be found in sand with grains of 200 *µ* and smaller (Wieser 1956). Males can also be found on water's surface near shore (Hart 1930).
Salinity—collected at 30 ‰ (Coos Bay).

Temperature—
Tidal Level—intertidal: usually found below +5.0 ft. MLLW down to -2.0 Wieser 1956). Found in standing water at low tide, on surface (Hart 1930).
Associates—

Quantitative Information

Weight—
Abundance—the most common cumacean in Puget Sound and San Juan Islands (Wieser 1956); the common intertidal species in central California (Gladfelter 1975a). In Coos Bay, it was the 2nd most abundant crustacean found (by numbers) in the North Bend study site (Gonor et al. 1979). With *Nippoleucon hinumensis*, it was found at up to 5600/m^2 in South Slough of Coos Bay (personal communication, M. Posey, OIMB).

Life History Information

Reproduction—no specific information available. In *Manocuma stellifera,* an Atlantic intertidal cumacean, mating occurs at night in plankton (See Gnewuch and Croker 1973 in Watling 1979), during the short swarming period. Females moult 12 - 96 hours before oviposition (in lab). Eggs probably fertilized as released into marsupium, where they are carried to nauplius stage, then moult 3 times to manca stage, which resembles adult without last pair of pereopods. Young leave marsupium, moult several more times to subadult (gonads mature, secondary sexual characteristics present). Some other intertidal spp. have 2 breeding generations per year: summer and fall (see Corey 1969, 1976 in Watling 1979).
Growth Rate—
Longevity—In Atlantic intertidal cumaceans' longevity varies with time of year released: early summer generation may live 5 months; late summer and fall broods will overwinter and live 12 and 9 months respectively (see Corey in Watling 1979).
Food—a deposit feeder in fine sand and mud; in coarse sand (>150 *µ*), it is an epistrate feeder: scrapes food off individual Grains (Watling 1979). Cumaceans feed while buried, swim to new site when one site has been exploited. *C. vulgaris* aggregates to feed (Watling 1979).
Predators—
Behavior—males swim well; females and juveniles do not (Watling 1979).

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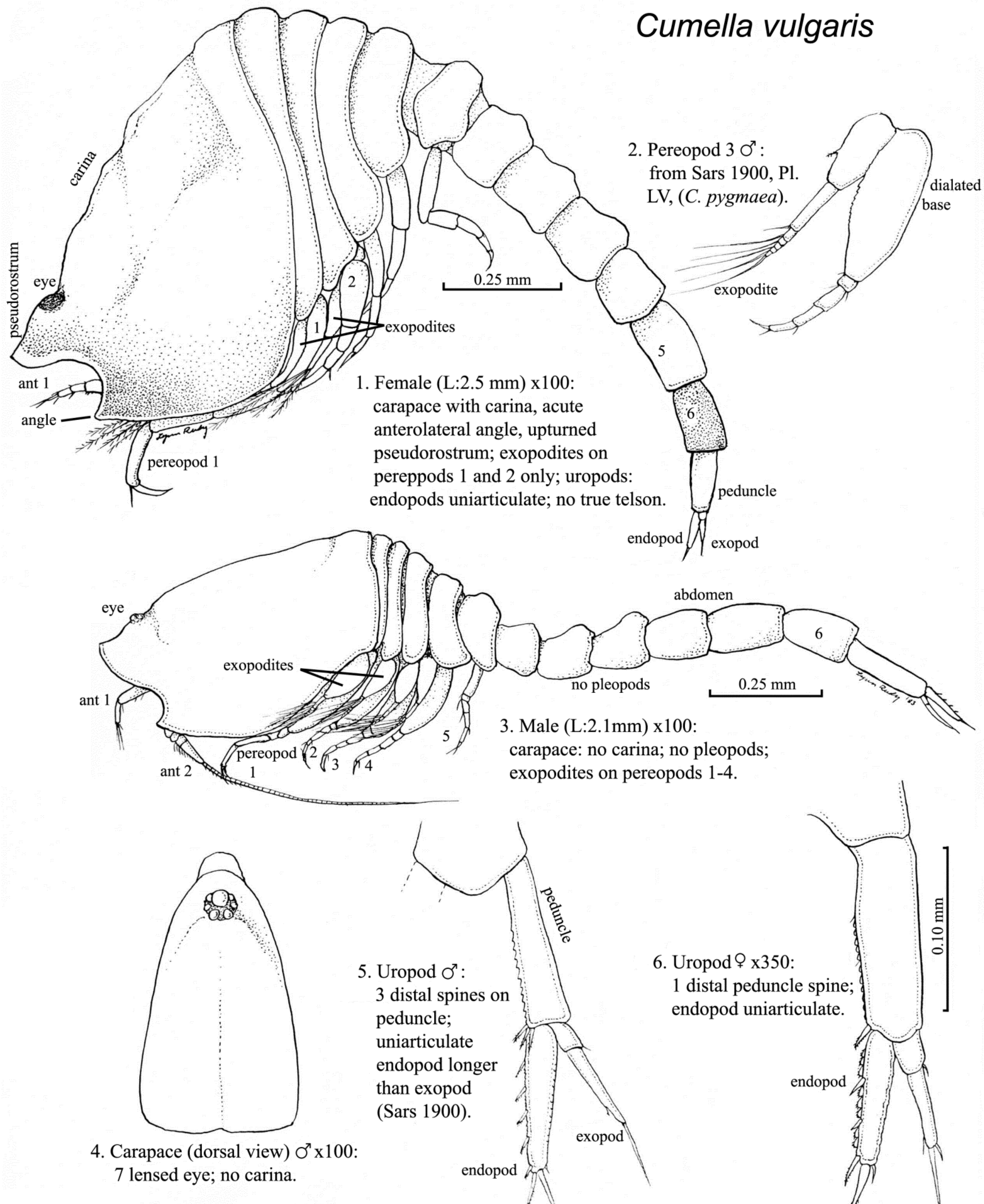
Cumella vulgaris



2. Pereopod 3 ♂: from Sars 1900, Pl. LV, (*C. pygmaea*).

1. Female (L:2.5 mm) x100: carapace with carina, acute anterolateral angle, upturned pseudorostrum; exopodites on pereppods 1 and 2 only; uropods: endopods uniarticulate; no true telson.

3. Male (L:2.1mm) x100: carapace: no carina; no pleopods; exopodites on pereopods 1-4.

4. Carapace (dorsal view) ♂ x100: 7 lensed eye; no carina.

5. Uropod ♂: 3 distal spines on peduncle; uniarticulate endopod longer than exopod (Sars 1900).

6. Uropod ♀ x350: 1 distal peduncle spine; endopod uniarticulate.

Detonella papillicornis (=*Trichoniscus papillicornis*)

A sow bug (Richardson, 1904)

Phylum: Arthropoda
Class: Crustacea
Order: Isopoda
Suborder: Oniscoidea
Family: Aequoreidae

Description

Size—6 mm (South Slough of Coos Bay); to 3.8 mm (Hatch 1947).
Color—dark red and white mottled; "light brown" (preserved?) (Miller 1975).
Head—no rostrum, but slightly produced and with concavity at apex (fig 2): large lobes at antero-lateral angles: eyes with about eight ocelli, ("about six ") (Lohmander 1927).
First Antenna—vestigial: Oniscoidea.
Second Antenna—peduncle of 6 (5) joints, last 3 with setose tubercules, (5th joint with distal process) (fig 3): flagellum of 4 articles (Richardson 1905).
Thorax—thoracic segments about equal, each with 2 rows of tubercules: postlateral angles produced backwards (Lohmander 1927).
Abdomen—pleon narrower than pereon, but not abruptly so: Scyphacidae: 5 free pleonites.
Telson—spatulate (fig. 4); variable: more triangular in original description (Richardson 1905).
Uropods—styliform, extend beyond body: outer branch stouter, longer than inner branch: inserted postero-laterally, base not expanded, (fig. 4).

Possible Misidentifications

Other Scyphacidae resident in upper beach litter are of the genus *Armadilloniscus*, which have a definite rostrum and an oval body with no narrowing of the pleon. The uropods have expanded bases and all 4 branches (which are small) are near the center line. *D. sachalina*, the same or a closely related species is reported from Kurile Islands, eastern Russia.

Ecological Information

Range—Southern Alaska, to Washington; not included in northern California keys; essentially an Arctic and Antarctic species (Lohmander 1927).
Distribution—Day's Creek, South Slough of Coos Bay.
Habitat— beach debris, substrate: sand.

Salinity—
Tidal Level—upper levels of beaches.

Temperature—
Associates—amphipod *Orchestra*; other Oniscoidea *Armadiliomiscus tuberculatus*. *Philoscia richardsona* (Hatch 1947).

Quantitative Information

Weight—
Abundance—rather sparse.

Life History Information

Reproduction—
Growth Rate—
Food—
Longevity—
Predators—
Behavior—

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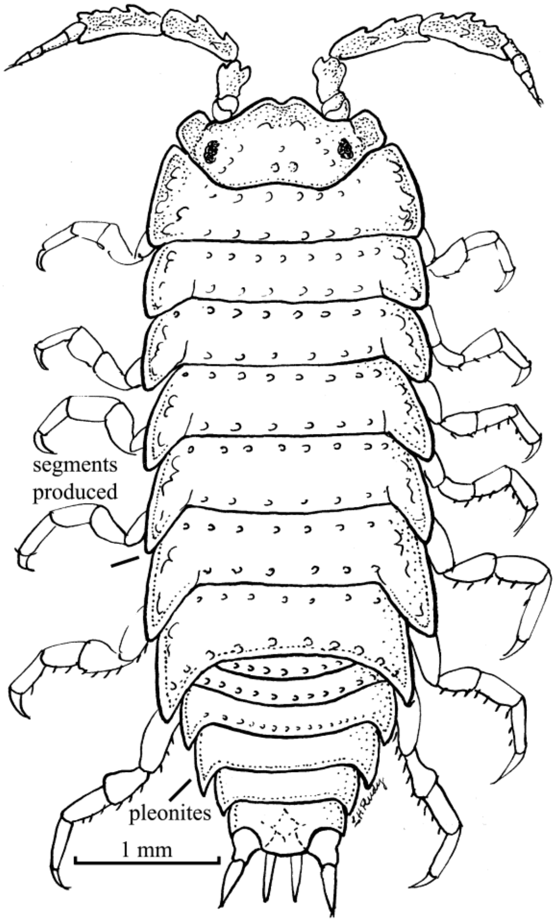
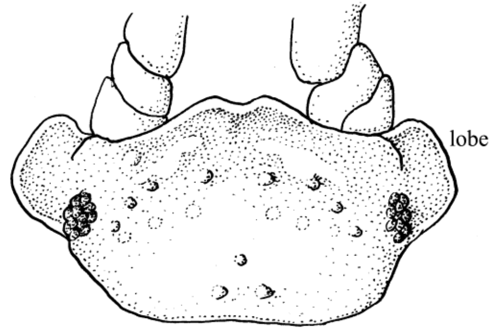
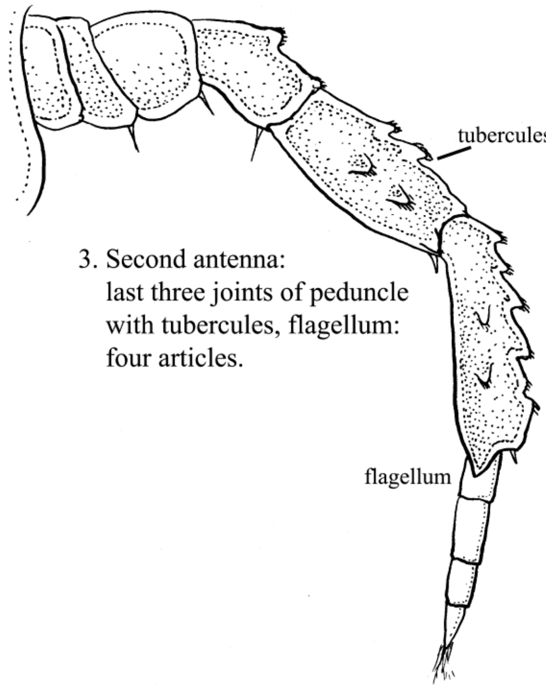
Detonella papillicornis



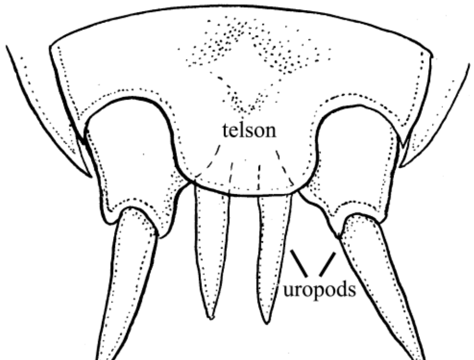
1. *Detonella papillicornis* (L:6mm) x25:
thoracic segments produced backwards;
abdomen with five free pleonites.



2. Head:
no rostrum, simple eyes;
large lateral lobes.



3. Second antenna:
last three joints of peduncle
with tubercules, flagellum:
four articles.



4. Telson and uropods:
telson spatilate; uropods
styliform; bases not
expanded.

Eobrolgus spinosus *(=Paraphoxus, Pontharpinia)*

A gammarid amphipod (Holmes, 1905)

Phylum: Arthropoda
Subphylum: Crustacea
Order: Amphipoda
Suborder: Gammaridea
Family: Phoxocephalidae

Description

Size—to 4.5 mm long (Barnard 1960) (Puget Sound specimens); largest Coos Bay specimens 3.5 mm. Ovigerous females not over 5 mm long: sp. *spinosus* (Barnard 1975).
Color—white, with black eyes.
1st Antennae—female: equal in length to 2nd antenna; flagellum of about 7 articles (fig. 3a); accessory flagellum (in both sexes) of about 5 articles.
2nd Antennae— female: peduncle with some heavy spines, setae; flagellum of about 7 slender articles, shorter than peduncle (Barnard 1960). Male: flagellum longer than body in mature males. Can have sensory clubs on proximal flagellal articles and on 5th peduncle articles (not figured); immature males have flagella a little longer than peduncle.
Head—about as long as pereonites 1 through 3 (Barnard 1975). Rostrum well developed, not constricted: genus *Eobrolgus* (Barnard 1979). Head tapers evenly, is not abruptly narrowed (fig. 2).
Eyes—large, black; about same size in females, immature males (figs. 1,2); much larger in mature males (not figured).
Mouthparts—Epistome (a part of the lip) not produced into cusp (fig. 1a) (Barnard 1960). (The Phoxocephalidae is one of few groups in which epistome is of taxonomic importance. For quick lateral view, push antennae and mandibular palps aside (Barnard 1960).) Mandible with tri-articled palp, feeble molar, no large process. Right female mandible with simple lacinia mobilis: sp. *spinosus* (Barnard and Barnard 1981) (fig. 4). 1ST maxilla with biarticulate palp, outer plate with 9 spines: sp. *spinosus* (Barnard and Barnard 1981) (not figured). Maxilliped - palp of article 4 without large distal setae (not figured).

Gnathopod 1—small, similar in size and shape to 2nd gnathopods: gen. *Eobrolgus* (Barnard 1979). Article 6 broad.
Gnathopod 2—much like 1st gnathopods; 4th article not produced, *ie.* with even margins; 6th article broad.

Coxae—coxa 1 almost as large as coxa 2; 4th coxa broad, 5th rounded (fig. 1). Simple setae on most coxal margins.
Pereopods—with stout spines: sp. *spinosus* (figs. 1, 6, 7). Pereopod 4 "normal" in orientation, not reversed like pereopods 5-7 (Barnard 1975). Pereopod 5 with broad article 2, articles 4-5 expanded but narrower than article 2 (fig. 1). Pereopod 6 much different in form from pereopod 7: long and slender, with narrower article 2 (fig. 6). Pereopod 7 very different from pereopod 6: short, stout, with article 2 very broad. Rounded posterior edge with fine spines, no large spur (fig. 7).
1st Uropods—peduncle with at least one dorsal margin with only one or no spines; 2 spines on inner peduncle margin. Inner and outer branches similar: with one apical and one margin spine (fig. 9a).
2nd Uropods—female: 4 stout spines on peduncle margin; rami shorter than peduncle, without marginal spines (fig. 9b) (Barnard 1960). Male: more spines on peduncle (not figured).
3rd Uropods—female: inner ramus half as long as outer, or less (fig. 9d). Male: inner ramus more than half as long as outer, quite setose in mature specimens (fig. 9c) (Barnard 1960).
Pleonal Epimeron—3rd epimeron not produced into a tooth, and is naked- no setae: sp. *spinosus* (Barnard and Barnard 1981) (fig. 1).

4th Pleonite—male: proximal edge strongly depressed. Female: edge almost flush with segment 3: genus *Eobrolgus* (Barnard 1960).
Telson—cleft; thin, lamellar, each lobe with one short spine and one fine seta (fig. 8, female).
Sexual Dimorphism—not as strong as in some families. Males have larger eyes, much longer 2nd antennae and spinose uropods. Usual amphipod gnathopod differences do not occur in this genus (Barnard 1960).

Possible Misidentifications

Phoxocephalids can be distinguished primarily by their 6th and 7th pereopods, which are greatly different from each other. They also have distinctive multiarticulate accessory flagellae (on antenna 1), and a long rostrum (Barnard 1960). Hyalidae and Dogielinotidae (suborder Talitroidea) are also estuarine families; they lack mandibular palps and inner rami on the third uropods. The Pleustidae have uncleft telsons and only vestigial antennal accessory flagella (Barnard 1975). Both the Gammaridae and Haustoriidae have pereopods that are similar in size and shape (not like the Phoxocephalidae); in these families, pereopod 4 is reversed. Gammaridae have a telson with connected lobes (see *Eogammarus contervicolus),* while the telson lobes of Haustoriidae are disjunct (see *Eohaustorius estuaris),* and are much heavier than those of *Eobrolgus.*

There are several genera of estuarine Phoxocephalidae:

Mandibulophoxus is distinguished from *Eobrolgus* by its sickle-shaped mandibular palp borne on a large process. It has a biarticulate palp on the 1st maxilla (like *Eobrolgus). M. unicirostratus* (Giles) is an eyeless, long-rostrumed species that has been found subtidally in Yaquina Bay and other Oregon estuaries.

Most American species formerly in *Paraphoxus* have been placed (by Barnard 1979) in 6 genera – *Metharpinia* Schellenberg, and the new genera *Eobrolgus, Eyakia, Foxiphalus, Grandifoxus,* and *Rhepoxynius:*

Rhepoxynius tridentatus (=Pontharpinia) (Barnard, 1954) (Barnard 1979) and others of this genus have an abruptly narrowing, untapered rostrum; the 2nd article of pereopod 7 has 3 large teeth on the posterior edge (Barnard 1954). *Rhenpoxynius epistomus* (Shoemaker, 1938) has a spatulate rostrum and a long epistomal cusp. *Rhepoxynius abronius* (Barnard, 1960) with a broad head and narrow short rostrum, has a long, sharp epistomal process. This species has large teeth on the posterior edge of pereopod 7. It has been reported from Yaquina Bay.

Foxiphalus major (Barnard 1979) *(=Pontharpinia obtusidens* (Alderman, 1936)(Barnard 1954)) is probably the species most similar to *E. spinosus.* Adults are larger than those of *E. spinosus* and ovigerous females are over 6 mm long, not under 5 mm. *F. major* amphipods have longer heads and smaller eyes than do *E. spinosus*; their 5th pereopod is slender, not stout; the inner ramus of the female 3rd uropod is more than ½ the length of the outer ramus (not less than ½, fig. 9d). The third pleonal epimeron is concave or straight on its posterior edge, and setose. *F. major* was found under its old name on Oregon's outer coast (Barnard 1954).

Grandifoxus milleri (Thorsteinson, 1941) (Barnard 1979) is found in the Columbia River estuary. This closely related species has a narrow gnathopod "hand" (6th article), and an abruptly narrowing rostrum (Barnard 1960; Barnard 1979).

Eobrolgus chumashi (Barnard and Barnard, 1981) is an endemic oceanic species whose range is probably only south of us (Barnard and Barnard 1981). Its body is dwarfed, the head and eyes are large. The pleonal epimeron are not naked as in *E. spinosus,* but have 1 - 2 ventral setae. The lacinia mobilis (on the right mandible of the female) is bifid, not simple. Some hybridization between these two species of *Eobrolgus* may occur (Barnard and Barnard 1981).

Ecological Information

Range—western Atlantic, from which it may have been introduced to the eastern Pacific. From Puget Sound to Newport Bay, California (Barnard and Barnard 1981).

Local Distribution—Oregon estuaries: Yaquina, Coos Bay (South Slough, Jordan Cove, Pigeon Point) (Barnard 1975).
Habitat—a burrower in sandy and muddy bottoms of estuaries; tolerates substrates with wood chips (Jordan Cove, Coos Bay).
Salinity—collected at 30 ‰ (Coos Bay).
Temperature—
Tidal Level—high and mid intertidal, Coos Bay.
Associates—in beds of ghost shrimp *Callianassa:* polychaete *Pygospio elegans;* polychaete *Pseudopolydora kempi* outside shrimp beds (Coos Bay, South Slough) (Posey 1985).

Quantitative Information
Weight—
Abundance—dominant invertebrate at Jordan Cove, Coos Bay. June: lower intertidal (+3.0 ft. MLLW) 60-162 animals /13 x 15 cm core; mid intertidal (+3.4 ft. MLLW) 92-174 animals; high intertidal (+3.6 ft. M LLW) 37 - 58 animals (Posey 1985). Generally not as abundant as its close relative *Foxiphalus major* (Barnard 1960).

Life History Information
Reproduction—
Growth Rate—
Longevity—
Food—
Predators—fish, shorebirds.
Behavior—males positively phototropic: attracted to night light. May be correlated with very large eyes.

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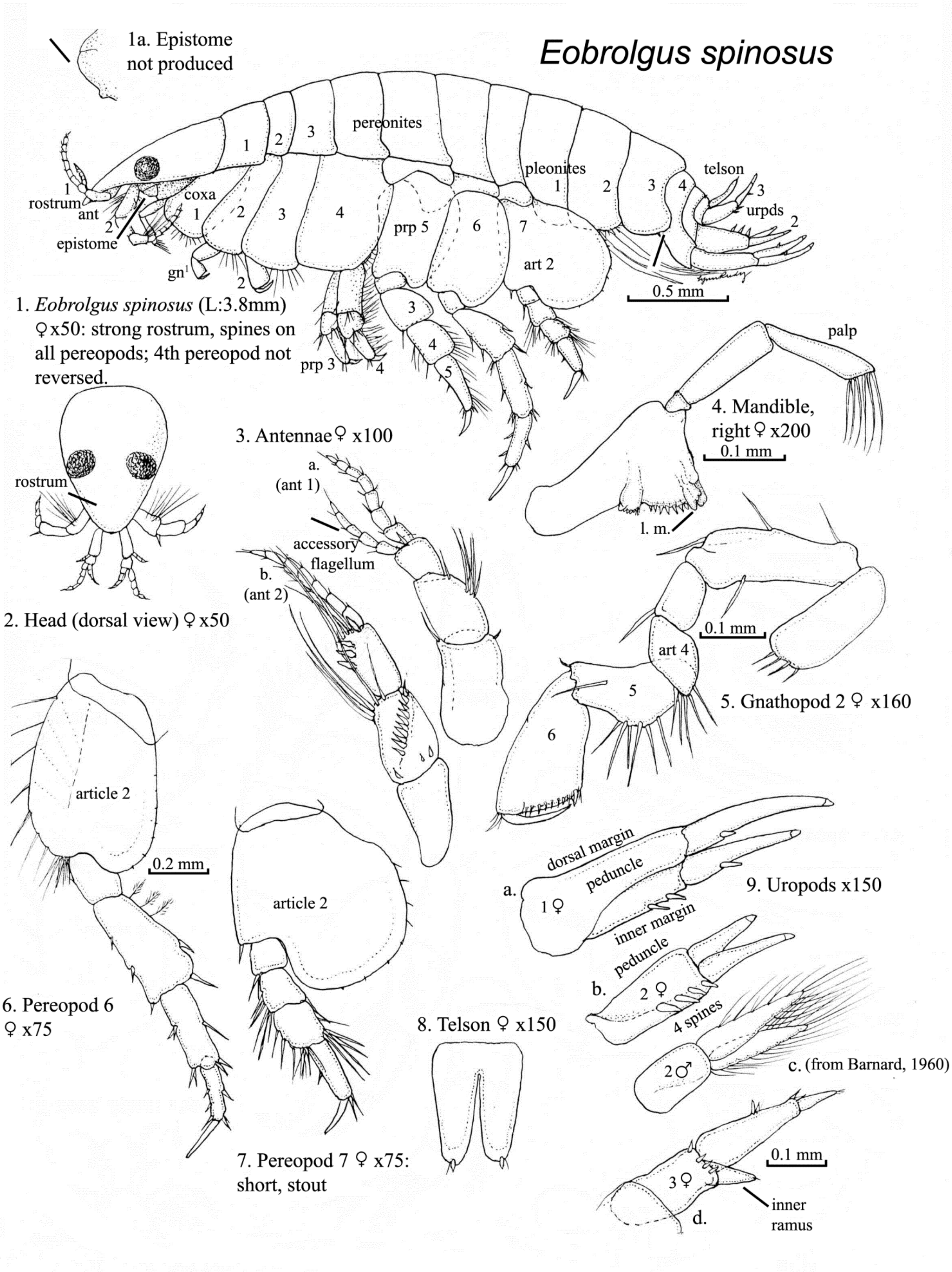
Eobrolgus spinosus
1a. Epistome not produced
pereonites
1
2
3
pleonites
1
2
3
4
telson
3
urpds
2
1
rostrum
ant
2
coxa
1
2
3
4
prp 5
6
7
epistome
art 2
gn1
2
0.5 mm
1. Eobrolgus spinosus (L:3.8mm) ♀x50: strong rostrum, spines on all pereopods; 4th pereopod not reversed.
3
4
5
prp 3
4
palp
4. Mandible, right ♀ x200
0.1 mm
l. m.
rostrum
2. Head (dorsal view) ♀ x50
3. Antennae ♀ x100
a. (ant 1)
accessory flagellum
b. (ant 2)
0.1 mm
art 4
5
6
5. Gnathopod 2 ♀ x160
article 2
0.2 mm
6. Pereopod 6 ♀ x75
article 2
7. Pereopod 7 ♀ x75: short, stout
8. Telson ♀ x150
dorsal margin
peduncle
a.
1♀
inner margin
9. Uropods x150
peduncle
b.
2 ♀
4 spines
2♂
c. (from Barnard, 1960)
0.1 mm
3♀
d.
inner ramus

Eogammarus confervicolus

(Stimpson, 1857)

Phylum: Arthropoda
Class: Crustacea
Order: Amphipoda, Gammaridea
Family: Gammaridae

Description

Size—to 21 mm; South Slough of Coos Bay largest (males) 12 mm: Siuslaw estuary, 16 mm (males).
Color—white with dark brown mottling: brown stripes on 1st and 2nd antenna.
First Antenna—almost ½ body length; an accessory flagellum of 5 articles (fig. 1). Longer than (or subequal to) 2nd antenna; usually with posterodistal spine on peduncle: genus *Eogammarus* (Bousfield 1979).
Second Antenna—stout, shorter than 1st, with 14 articles; peduncles 4, 5 with 2 (rarely 3) posterior marginal groups of setae (in addition to terminal group) (Bousfield 1979).
Rostrum—vestigial.
Mouthparts—mandible with palp, molar large, with rasping surface.
First Gnathopod (gn1)—slightly smaller than 2nd gnathopod: article 6: palm oblique, 9 peg-like teeth, dactyl curved (fig. 2a).
Second Gnathopod—much like 1st gnathopod, but larger; palm with 7 stout pegs (fig. 2b).
Coxae—1st 4 plates become gradually larger: 4th is rounded (fig. 1): 5th, 6th and 7th quite small.
Pereopod—strong and well spined, becoming larger posteriorly.
Pleonites—no dorsal spines; only 0-2 posterior marginal setae (fig. 1).
Urosomites—urosome 1 with 4 dorsal groups of 3 spines each; urosome 2 with dorsal spines in 2 groups; no prominent median tooth (fig. 3): primary key character (Bousfield 1979).
Uropods—uropods 1 and 2 with 2-4 groups of spines; uropod 2: rami extend beyond peduncle of uropod 3 (fig. 1) (Bousfield 1979); uropod 3: inner margin of outer ramus usually with 4 groups of strong spines, but less than 10 isolated plumose setae; inner ramus less than ½ length outer ramus (fig. 4) (Bousfield 1979).
Telson—split, with connected lobes; each lobe with 2 spines, only 1 apical (at the tip): (fig. 3).

Sexual Dimorphism—very little. Females are smaller, have smaller gnathopods, and shorter antenna than do the males.

Possible Misidentifications

A closely related genus is *Anisogammarus*, whose members have 1st antennae shorter than the 2nd antennae. In *Anisogammarus* each of the urosomites has a prominent median tooth and a smaller pair of dorsolateral teeth, not 2-4 groups of spines as in *Eogammarus*. Finally, on uropod 3, the rami are subequal, not disparate in size as in *Eogammarus*. There are 3 species of *Anisogammarus*:

Anisogammarus ramellus has its urosomite spines arranged in horizontal rows; *Anisogammarus pugettensis* has a prominent fixed median spine on its 2nd urosomite, and no rows of spines. Its 3rd uropod has an inner ramus $^3/_4$ as long as the outer one.

Another closely related genus is *Ramellogammarus*, characterized by dorsal groups of spines on its pieon segments; spines in groups of 1-3 on urosomes 1 and 2, urosome 3 with 2 posterodorsal groups of (or single) spines: 1-4 groups of posterior marginal setae on peduncle segments of both 1st and 2nd antennae (Bousfield 1979). *Ramellogammarus oregonensis* is strongly armed on pleonites 1-3. It has been reported only from Coos Bay, on alga *Cladophora* (Shoemaker 1964).

Other species of *Eogammarus* in the Northeastern Pacific Region include *Eogammarus oclairi*, a pelagic estuarine form very like *E. confervicolus*. Its 2nd antenna have 4th and 5th peduncles with 3-4 groups of posterior marginal setae (in addition to the terminal group); each of its telson's lobes has 2 terminal setae, not 1 as in *E. confervicolus* (Bousfield 1979).

Ecological Information

Range—San Diego, California to Alaska.
Distribution—*Salicornia* marsh (South Slough. Metcalf Preserve); on log boom, in mud, Siltcoos River; South Slough of Coos Bay; Siuslaw estuary (Barnard 1954).
Habitat—Substrate: mud; gets name from the "conferva" or long green algae in which it lives: *Salicornia*, *Cladophora*. *Fucus*, among others.
Salinity—full salt to brackish.
Temperatures—
Tidal Level–in South Slough of Coos Bay: in drainage channels at +4.5 feet.
Associates— isopod *Gnorimosphaeroma insulare*, (South Slough of Coos Bay); *Corophium slamonis* (Siuslaw estuary).

Quantitative Information

Weight—
Abundance—often occurs in great numbers: to 25,000/ m^2; 5% of benthic fauna, beginning of June, 17% August (Sixes River) (Martin 1980).

Life History Information

Reproduction—
Growth Rate—
Longevity—
Food—detritus.
Predators—fish, birds.
Behavior—

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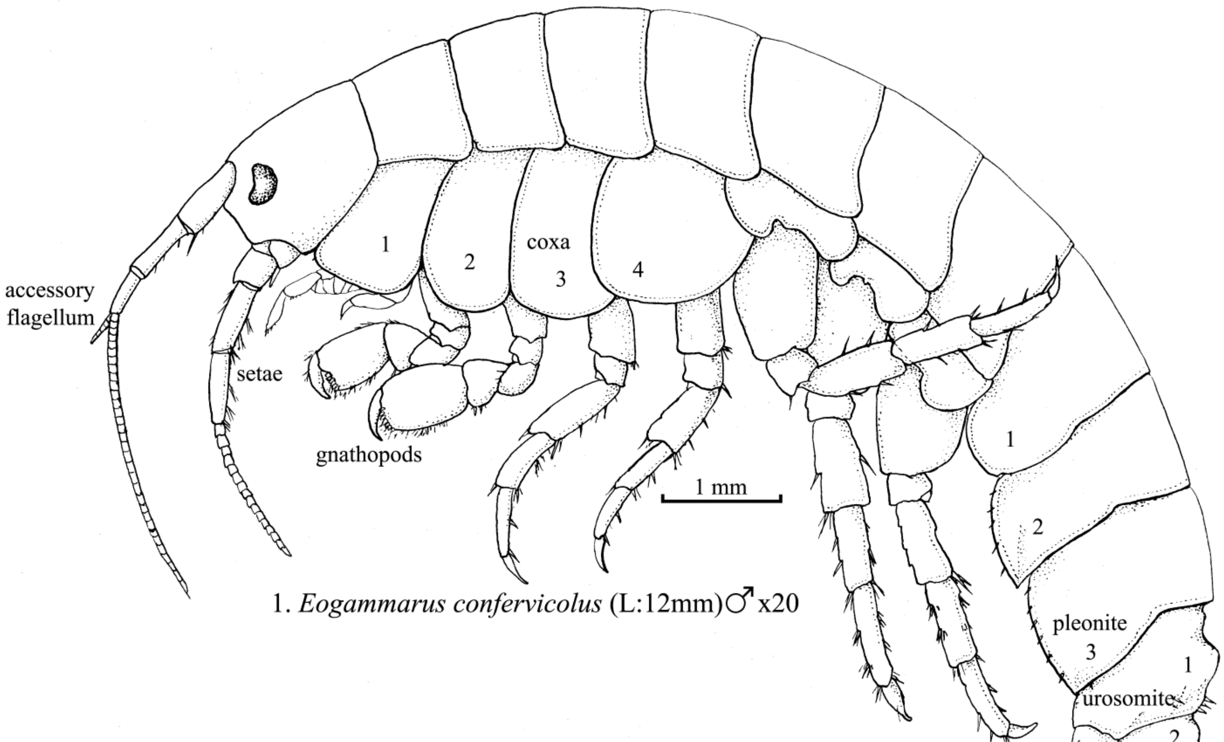
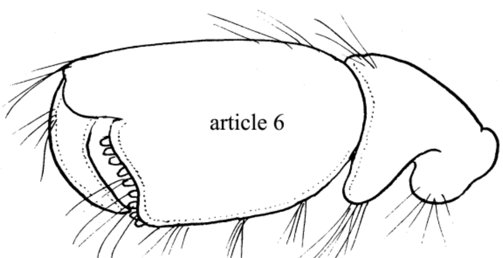
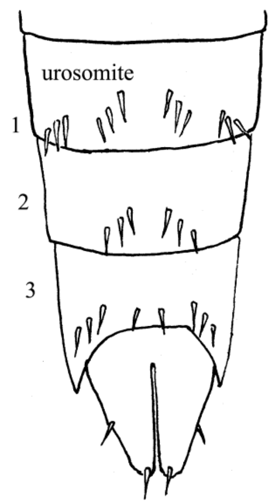
Eogammarus confervicolus



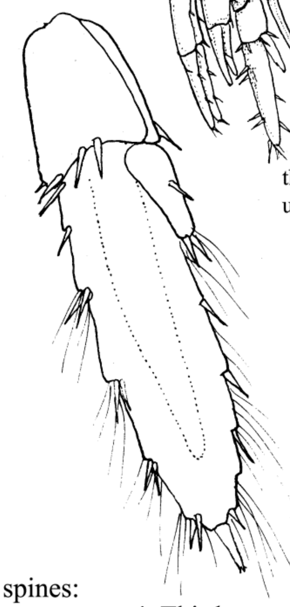
1. *Eogammarus confervicolus* (L:12mm)♂ x20



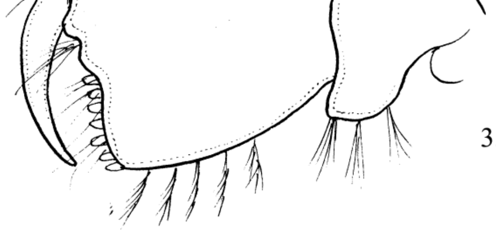
2a. First gnathopod ♂:
9 pegs, strongly curved dactyl.



3. "Basic" gammarid split telson, connected lobes, each with two spines: urosomites: stout spines aligned anterior to posterior in vertical bunches.



4. Third uropod with small inner branch.



2b. Second gnathopod ♂:
7 pegs, 5 fascicles; narrow dactyl.

Eohaustorius estuarius

A sand-burrowing amphipod (Bosworth, 1973)

Phylum: Arthropoda
Subphylum: Crustacea
Order: Amphipoda
Suborder: Gammaridea
Family: Haustoriidae

Description

Size—holotype female, Yaquina Bay, Oregon, 4 mm long; paratypes 2.0- 4.5 mm (Bosworth 1973). Illustrated specimens, (lower Columbia River) up to 6 mm long (fig. 1).
Color—white, in life and in preservation (Bosworth 1973).
1st Antennae—massive, setose; not "geniculate': i.e. bent like a knee (fig. 2).
2nd Antennae— peduncle articles large and flat, very setose; with multiarticuate accessory flagellum (fig. 3).
Rostrum—short, visor-like, pointed (fig. 2).
Eyes—visible in life (not in preservation): "bright, white" (Bosworth 1973), in anterior distal corners of head. Ovoid, with irregular indentations, not protruding above surface; probably not compound (fig. 2).
Mouthparts—mandible with palp, always of 3 articles: family Haustoriidae (Barnard 1969). Palp with smooth molar (fig. 4).
Gnathopod 1—small, feeble, simple; article 5 longer than article 6 (Kozloff 1974a) (fig. 1).
Gnathopod 2—feeble, small, minutely chelate (Barnard 1969) (fig. 5).
Coxae—1 and 2 small, hidden beneath 3 and 4 (fig. 1); coxal margins rounded, not pointed (Kozloff 1974a).
Pereopods—(numbered 3 - 7): lack dactyls (only 6 articles); furry: fringed with long bristles: genus *Eohaustorius* (Kozloff 1974a). Pereopod 4 reversed: positioned like pereopods 5 - 7, not like 1 – 3 (Barnard 1975); pereopod 4 smaller than pereopod 3 (Barnard 1969) (fig. 1). Pereopod 5 with only one fascicle (bundle) of spines on posterior edge of article 6, and with articles 5 and 6 relatively equal in length (Bosworth 1973) (fig. 1). Pereopod 6 like pereopod 7 in length, general shape: i.e. not excessively long (Barnard 1975). Pereopod 7 with posterior dorsal corner of article 2 smoothly rounded, without a cusp (arrow, fig. 1), with article 5 having 2 fascicles of spines on its anterior edge (fig. 1).

3rd Urupods—each with 2 rami of equal length (Barnard 1969) (fig. 7).
3rd Pleonites—with a fine posterior fringe (fig. 1).
Urosomites—segments 2 and 3 not fused, but freely articulated (Kozloff 1974a); urosomites small, hidden beneath pleonites (figs. 1,6).
Telson—thin flattened lobes widely separated at bases by urosomite; setose: family Haustoriidae (Barnard 1975) (fig. 6).
Sexual Dimorphism—no obvious differences (Bosworth 1973).

Possible Misidentifications

The Phoxocephalidae are probably the family most resembling the Haustoriidae. Unlike the latter, Phoxocephalidae have very dissimilar pereopods 6 and 7: 6 is long, 7 has a broad 2nd article (see *Eobrolgus spinosus).* In the phoxocephalids, the 4th 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; *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).

Four species in the genus have been found in Oregon; the 1st 2 inhabit only the open coast (Bosworth 1973):

*Euhaustorius brevicuspis (*Bosworth, 1973) was described from Lost Creek Beach, south of Newport, Oregon (Bosworth 1973). It has a small cusp on the dorsal posterior margin of article 2 of pereopod 7; it has only 2 fascicles of spines on the posterior edge of article 6 or pereopod 7. This species is found high in the intertidal, from +2.0 ft. to +12 ft. MLLW, and never in brackish water (Bosworth 1973).

Eohaustorius sawyeri (Bosworth, 1973) found with *E. brevicuspis* above, lacks the cusp on the 7th pereopod, and has instead a bulge on the posterior edge of the 2nd article (of the 7th pereopod). The posterior edge of the 6th article of pereopod 7 has 4 fascicles of spines. This species is subtidal and marine. found from MLLW down to -2.5 ft. It has not been found in estuarine conditions (Bosworth 1973).

The species most likely to be confused with *E. estuaries*, and which is also found occasionally in the more marine portions of estuaries, is *Eohaustorius washingtonianus* (Thorsteinson, 1941). Described from Puget Sound, and common there (Kozloff 1974a), it has also been found in Coos Bay, Yaquina Bay, and in the lower Columbia River. This species can be larger than *E. estuaries*, to 8 mm long (Kozloff 1974b). It has a prominent crescent shaped cusp on the dorsal posterior edge of article 2 of pereopod 7; there are 3 fascicles of spines on the posterior edge of article 6, pereopod 5. In the Newport area (Yaquina Bay), it overlaps with *E. brevicuspis* intertidally, and with *E. sawyeri* subtidally, being found from +4.0 ft. to -2.5 ft. (Bosworth 1973).

There are 3 other Pacific species which have not yet been reported from our area:

Eohaustorius sencillus (Barnard, 1962) has a 1st gnathopod with a 6th article that is swollen and has an apical spine; the 7th article on this gnathopod is quite long. This species lacks the cusp on article 2 of pereopod 7 (as does *E. estuarius). E. sencillus* is found commonly in Monterey Bay, California (Barnard 1962), and to southern California.

Eohaustorius eous (Gurjanova, 1951) and *E. cheliferus* (Bulcheva, 1952) are Asiatic in range (Barnard 1969).

Ecological Information

Range—northeastern Pacific.
Local Distribution—Coos Bay: North Bend Airport extension site; Yaquina Bay, near Marine Science Center; lower Columbia River.
Habitat—burrows in relatively clean, medium sized sand with a fairly high proportion of organic material (Bosworth 1973). An estuarine species, it is found on open coast only where there is freshwater runoff (Bosworth 1973).
Salinity—brackish water: type locality ranges from 1 - 25‰; salinity probably limits distribution in the species (Bosworth 1973).
Temperature—
Tidal Level—intertidal and subtidal. Some small permanent populations occur in high intertidal if freshwater stream runoff occurs (Bosworth 1973).
Associates—does not overlap with habitats of other 3 Oregon *Eohaustorius* species (Bosworth 1973).

Quantitative Information

Weight—
Abundance—densest at intertidal heights (Bosworth 1973).

Life History Information

Reproduction—
Growth Rate—
Longevity—
Food—
Predators—fish, shorebirds.
Behavior—a strong digger, it possesses an impressive armament of spines and setae.

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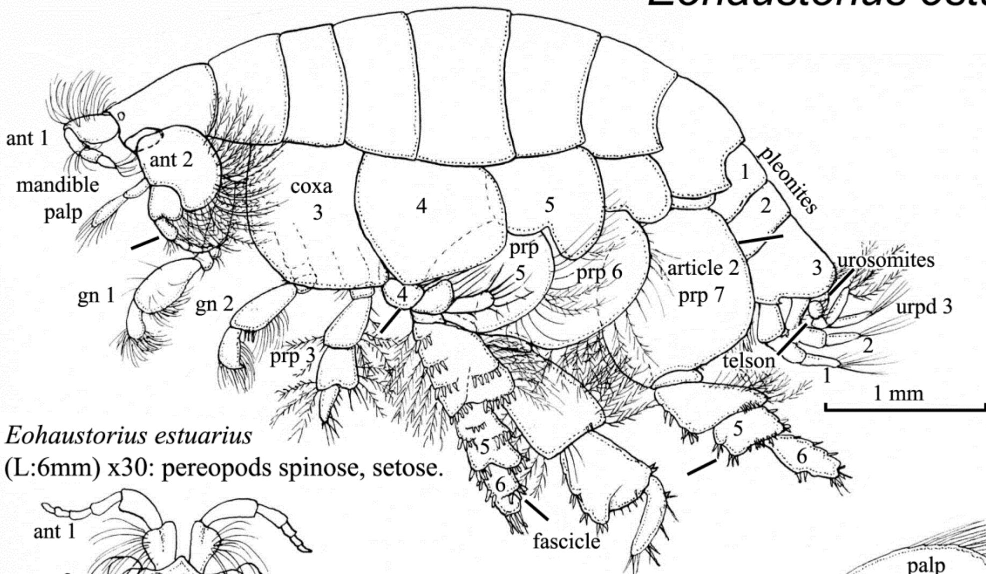
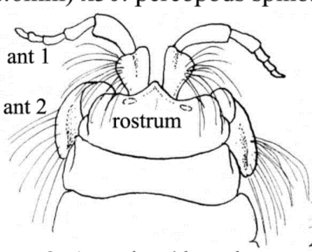
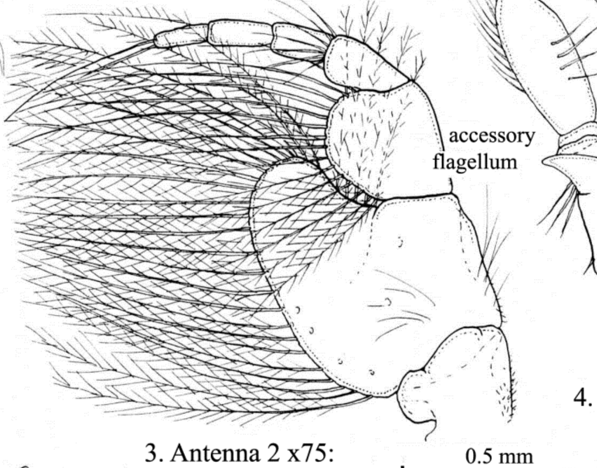
Eohaustorius estuarius



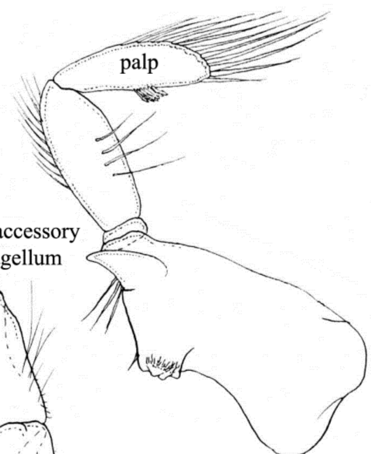
1. *Eohaustorius estuarius*
(L:6mm) x30: pereopods spinose, setose.



2. Anterior (dorsal view) x30

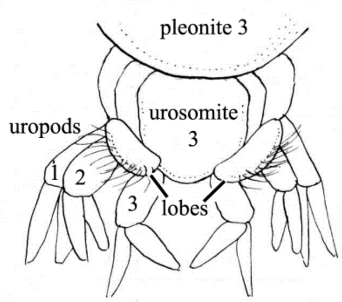


3. Antenna 2 x75: mulitarticulate.

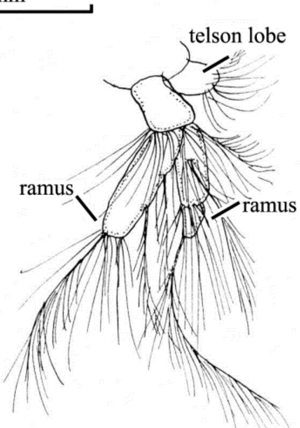


4. Left mandible x75

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.

Gnorimosphaeroma insulare (=*G. lutea*)

(Van Name, 1940)

Phylum: Arthropoda
Class: Crustacea
Order: Isopoda
Suborder: Flabellifera
Family: Sphaeromatidae

Description

Size—males up to 8 mm (Miller 1975), about 1.7 to 2 times longer than wide.
Color—white, with small black chromatophores: surface smooth.
First Antenna—longer than 2nd basal articles separated by the rostrum (fig. 3).
Head— frontal border smooth (fig. 3).
Mouthparts—mandible with a palp; maxilliped: 4 articles of pale produced, hairs on antero-lateral edge of articles 2, 3, and 4 less than ½ the length of the article.
Pereopods—7 pairs: basis (of 1st pereopod) hairless; distal extremity with 1 hair or hairless (fig. 6).
Body Segments—able to roll into a ball: characteristic of most Sphaeromatidae; 8 flattened segments (head and 7 free pereonites) from cephalon and pereon; pleon of 3 parts: 1st concealed under last pereonite. 2nd of several coalesced pleonites often with partial sutures (fig. 1); 3rd of large pleotelson.
Pleonites—only 2 of 3 reach lateral margin, 3rd pleonite under 2nd (figs. 1, 4).
Telson—rounded, convex (fig. 1).
Uropods—2 branched visible dorsally; endopod rigid, exopod movable (fig. 5).
Pleopods—5 pairs: 1st pair not widely separated at base, similar in size to 2nd; 1st 3 pairs with marginal plumose setae: 4th with bent exopod; 4th and 5th fleshy, but without transverse folds (fig. 2, 1-v).

Possible Misidentifications

Two other *Gnorimosphaeroma* species occurring in our area should first be separated by habitat. *G. oregonensis*, a marine form, is found above the mid-tide line, in full salt water, and usually under stones. *G. rayi*. so far found only in Tomales Bay and in Japan, is an estuarine species found also above the mid-tide line, and also under stones. *G. oregonensis* is stouter than *G. insulare*, being 1.5 to 1.75 times longer than wide; all its 3 pleonites reach the lateral margin (fig. 4b) and the frontal border of its head has several curves. The exopod of the uropod is only $^2/_3$ as long as the endopod (Richardson 1905) *G. rayi* also has 3 pleonites reaching the lateral margin; the basis of the 1st pereopod is setose. It is stout like *G.oregonensis*, and has longer antennae than either *G. oregonensis* or *G. insulare.*

Ecological Information

Range— Alaska to California (Menzies 1954a).
Distribution—Medcalf Preserve (South Slough of Coos Bay); Cox Island, Siuslaw estuary.
Habitat—estuarine intertidal; among *Fucus* and under logs of *Salicornia* marsh and in mud or drainage channels, Metcalf Preserve; in Tomales Bay on bay bottom.
Salinity—estuarine waters to fresh water. Can tolerate salinities of 0.6-135% seawater (Morris et al 1980).
Temperature—
Tidal Level—Metcalf Preserve: -4.5 feet; to subtidal (Hoestlandt 1969a).
Associates—alga *Fucus*, amphipod *Orchestia*, littorine snail *Ovatella* (Metcalf Preserve): amphipod *Anisogammarus* (Siuslaw estuary).

Quantitative Information

Weight—
Abundance—tendency to congregate.

Life History Information

Reproduction—not known. *G. rayi* reproduces in spring only, on a one year cycle; *G. oregonensis* has young in spring and fall (Hoestlandt 1969).
Longevity—*G. rayi*: one year, *G. oregonensis*: 2.3 years (Hoestlandt 1969).
Growth Rate—
Predators—
Food—detritus: a scavenger.

Behavior—

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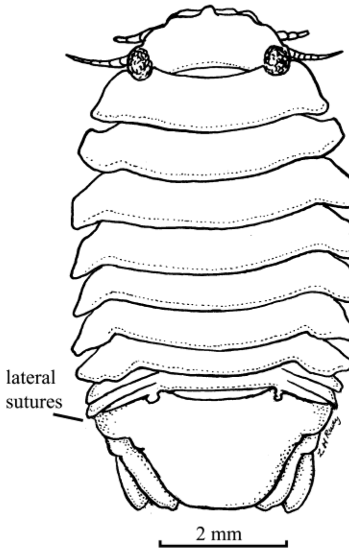
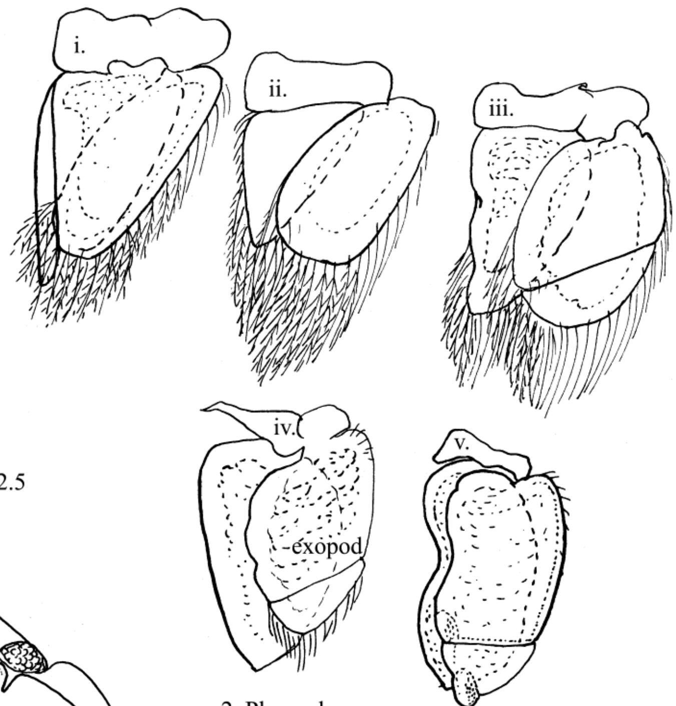
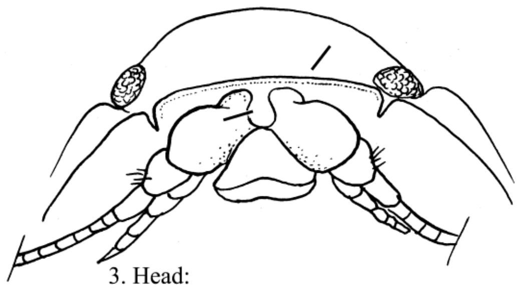
Gnorimosphaeroma insulare



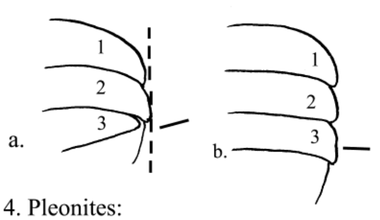
1. *Gnorimosphaeroma insulare* x12.5



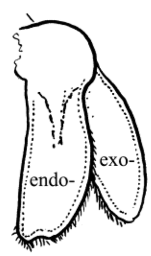
2. Pleopods:
   i, ii similar in size, i not separated at base
   i, ii, iii with marginal plumose setae
   iv bent; iv, v fleshy, without transverse folds



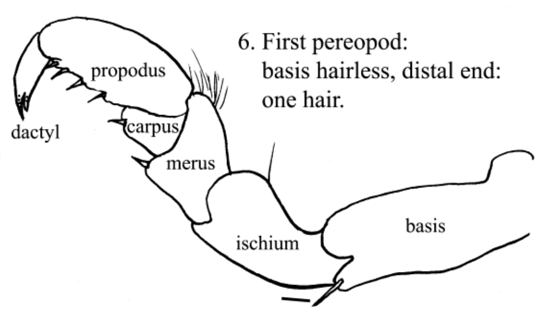
3. Head:
   antennal bases separated by rostrum,
   frontal border smooth.



4. Pleonites:
   a. two pleonites reach margin, third visible beneath: *G. insulare*
   b. three pleonites reach lateral margin: *G. oregonensis, G. rayi.*



5. Right uropod:
   biramous,
   endopod rigid,
   exopod movable.



6. First pereopod:
   basis hairless, distal end:
   one hair.

Grandidierella japonica

A brackish water amphipod (Stephensen, 1938)

Phylum: Arthropoda
Subphylum: Crustacea
Order: Amphipoda
Suborder: Gammaridea
Family: Aoridae

Description

Size— up to 22 mm long male, 13 mm female: San Francisco Bay (Chapman and Dorman 1975). Illustrated specimen (male, Coos Bay), 10 mm.

Color— mottled grey to grey brown (Chapman and Dorman 1975); distal parts of limbs white (Stephensen 1938). This specimen white (in ETOH).

1st Antennae—male: more than ½ body length (Chapman and Dorman 1975); female: much shorter. Peduncle with short accessory flagellum in both sexes (fig. 1b). Male flagellum of 20 articles, a little longer than peduncle; female flagellum equal to peduncle, of 18 articles (Stephensen 1938). Male antenna 1 longer than its antenna 2 (Barnard 1973); female antennae of equal size (Stephensen 1938). (Female not figured.)

2nd Antennae—length from ¾ to longer than antenna 1 (Chapman and Dorman 1975); spines on peduncle articles 3, 4 and 5. Male antenna stout, flagellum of 7 articles (Stephensen 1938). Female antenna length equal to antenna 1, 5th article of peduncle with 4 strong spines; female flagellum of 6 articles (not figured).

Eyes—"typical": a single mass on each side of head (Kozloff 1974a). Black, oval, medium sized (Stephensen 1938).

Mouthparts—mandible with large molar, toothed lacinia mobilis, incisors, long 2 articled mandibular palp with 3rd article setose. Maxilliped with 4 articled palp, article 4 claw-like, article 2 twice length of 1 and 2 (Chapman and Dorman 1975); outer plates twice length of inner plates. (Mouthparts not figured.)

Gnathopod 1—male: greatly enlarged, "carpochelate": i.e. not filtering type: genus *Grandidierella* (Barnard 1973). Articles 2 and 5 greatly enlarged, subequal (Chapman and Dorman 1975). Article 2 oval, article 3 small, article 4 small and elongate. Article 5 with sides parallel, and with 1 enlarged tooth forming thumb and 2 smaller teeth: genus *Grandidierella (Barnard 1975).* Anterior edge of article 5 with 18-20 transverse fine ridges ("stridulating organs" (Stephensen 1938)), and 4 spines (figs. 1, 1a). Female gnathopod 1 small, but larger than gnathopod 2; setose article 2 narrow (Stephensen 1938) (fig. 5).

Gnathopod 2—male: simple, much smaller than gnathopod 1. Article 2 twice length of article 5; article 3 short; dactyl "normal" i.e. not chelate (fig. 1). Female: gnathopod 2 smaller than gnathopod 1; article 2 about 2/3 length of male article 2; setose (Barnard 1973). (Not figured.)

Coxae— reduced (Chapman and Dorman 1975); serially barely contiguous (Barnard 1973) (fig. 1). Coxa 1 with a media-ventral tooth (Chapman and Dorman 1975) (just slightly produced in illustrated specimen).

Pereopods— simple, not prehensile (Barnard 1973); increasing in length: 7th very long (fig. 1). Female pereopods with narrow 2nd articles (Stephensen 1938) (not figured).

Urupods—1st: biramous; longer than 2nd or 3rd; peduncle with peduncular process, 2 anterolateral spines on urosomite (Barnard 1969) (fig. 3). 2nd: biramous: genus *Grandidierella* (Barnard 1975); "normal", i.e. thin peduncle and long rami (Barnard 1975) (fig. 4). 3rd: uniramous, without hooked apical spine or long setae (Barnard 1975); not fleshy, blunt or elongate; ramus is 3 times peduncle (Barnard 1973): sp. *japonica* (fig. 6).

3rd Pleonites—without dorsal tooth (Barnard 1975)

Urosomites—all three short (fig. 1).

Telson—uncleft, somewhat swollen (Kozloff 1974a); button-like, with medial groove (Chapman and Dorman 1975) (figs. 1, 2).

Sexual Dimorphism—male 1st gnathopod article 2 is expanded; article 5 is large, with parallel sides, teeth, stridulating organ- all features lacking in female. Male antenna 1 is longer than 2; female antenna are equal.

Tube—U-shaped (Chapman and Dorman 1975).

Possible Misidentifications

Ampithoidae have a poorly recessed head (Barnard 1973) and a short 3rd article on the peduncle of antenna 1. At least one ramus of the 3rd uropod in this family is very setose terminally; the 3rd 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; A. lacertosa, A. valida,* (which see), and others.

Cheluridae are a wood boring family with a huge dorsal tooth on the 3rd pleonite; the urosomites form a box-like structure, and the 2nd uropods are "flabellate", i.e. paddle-like. *C terebrans* is an introduced species found on the Pacific coast.

Ischyroceridae is another closely related family; they have an unusual thorn-like rostrum, and a rather cylindrical body. The telson is broad and short, and it is the 2nd male gnathopod, not the 1st, in this family, which is carpochelate. Ischyroceridae have hooks on the outer ramus of the 3rd uropod (like Ampithoidae), but this ramus is short and slender, not stout; the inner ramus is also slender, and naked of setae. Local genera include *Cerapus, Jassa, Ischyrocerus,* and *Parajassa.* (Identification is best done with male specimens.)

In Podoceridae both gnathopods (especially the second) are large and subchelate. The 1st urosomite is very long, more than twice the length of the 2nd. *Podocerus* is found in our area.

The Photidae (=Isaeidae) include the common genus *Photis.* Characteristics of this "cluster" include a recessed head, and an elongate 3rd article on the 1st antenna (like *Grandidierella). Photis* spp. have elongate coxae and a normal 1st gnathopod, but an enlarged 2nd gnathopod, often highly sculptured. The 3rd uropod has an elongate peduncle. (Identification should be done with male specimens in this family.)

The *Corophium* "cluster" is noted for its greatly elongate 2nd antenna, particularly in the male. Its 1st gnathopods are small; the 2nd gnathopods are the filtering type, *i.e.* with fine long setae- in both sexes. This genus occurs commonly in Oregon's estuaries.

The Aoridae are part of a "cluster" that includes at least 3 genera that are quite similar to *Grandidierella: Erichthonius, Paraoroides,* and *Aoroides.*

Erichthonius spp. have a body much like G. *japonica*'s, but the 1st male gnathopod is normal, and the 2nd is carpochelate, just the reverse of *Grandidierella.* At least 2 species occur in our area, *E. hunteri* and *E. brasiliensis.*

Paraoroides sp. has a uniramous 3rd 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 1st gnathopod is not carpochelate, but only slightly enlarged; the gnathopods are equal in size. The 3rd article of the 1st antenna is not elongate, as it is in *G. japonica.*

Aoroides sp. has an "immensely merochelate" male 1st gnathopod (Barnard 1975), quite different from that of *G. japonica:* Article 4 is elongate, article 5 is oval but lacks teeth. The gnathopod is the filtering type, with long setae. The 3rd uropods in this genus are biramous, not uniramous as in *Grandidierella. A. columbiae* (=*A. californica)* is a Pacific coast species.

Other species of *Grandidierella* have not been recorded from our area; they include a tropical species, *G. nottoni* Shoemaker, and four old world freshwater species.

Ecological Information

Range— Japan: Abasiri River, Hokkaido, 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).
Local Distribution— Coos Bay: South Slough, North Bend Airport site (Gonor 1979).
Habitat— burrows in mud bottoms of bay; build U-shaped tube, in which a pair can often be found (Chapman and Dorman 1975). Males also found out in tide pools at low tide.
Salinity— brackish water in Japan and introduced into Oregon and California estuaries (Chapman and Dorman 1975).
Temperature—

Tidal Level— collected at +5.0 MLLW (South Slough).
Associates— introduced with *Crassostrea.* In South Slough in alga *Enteromorpha* sp. with amphipod *Ampithoe valida,* and sacoglossan *Aplysiopsis smithi.* California associates include polychaetes *Harmothoe* sp., *Heteromastus* sp., *Capitella* sp., *Neanthes* sp., *Streblospio* sp.; mollusca *Mya* sp., *Cryptomya* sp., *Macoma* sp., barnacle *B. improvisus;* isopod *Gnorimosphaeroma lutea;* amphipods *Photis* sp., *Corophium* sp., *Allorchestes* sp., *Ampithoe* sp., *Anisogammarus* sp.; anemone *Haliplanella* sp. (Chapman and Dorman 1975).

Quantitative Information

Weight—
Abundance— can be present in great numbers seasonally. Third most common amphipod at North Bend Airport site (Gonor 1979). South Slough, found 27/m^2 (Posey 1985).

Life History Information

Reproduction—
Growth Rate—
Longevity—
Food—
Predators—
Behavior— builds tubes which protrude from the mud.

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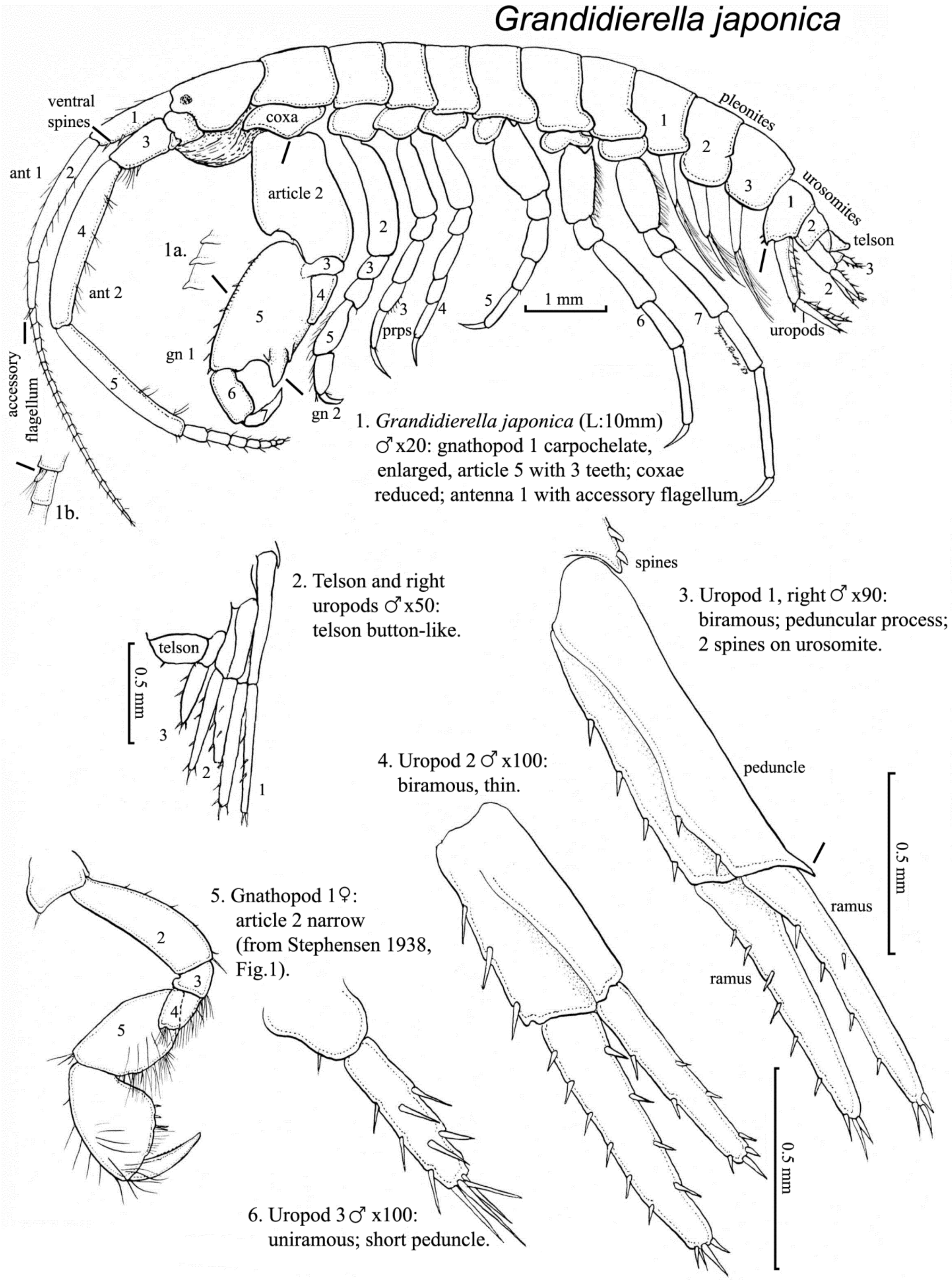
Grandidierella japonica



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.

Hemigrapsus nudus

The purple shore crab (Dana, 1851)

Phylum: Arthropoda
Class: Crustacea, Malacostraca
Division: Eucarida
Order: Decapoda, Reptantia
Section: Brachyura
Family: Grapsidae

Description

Color—red, purple, or whitish; chelipeds red-spotted (Carlton and Kuris 1975).
Size—carapace width 56.2 mm, length 48 mm (Rathbun 1918).
Carapace—flat, smooth and punctate (Schmitt 1921); quadrate with rounded antero-lateral margins (Rathbun 1918); no transverse lines (fig. 1).
Eyes—eyestalks and eyes of moderate size; eyes at antero-lateral angles (fig. 2).
Frontal Area—very slightly rounded, without prominent lobes (fig. 2).
Carapace Teeth—two (below the orbital tooth); lateral; last tooth small (fig. 2).
Chelipeds—smooth, equal or almost equal, stout; mottled above with small round red spots (fig. 1); male with inflated palms, patch of fine hair on inner surface.
Walking Legs—naked (without hair) rather short (Schmitt 1921); dactyls short (fig. 1).
Sexual Dimorphism—male has narrow abdomen, exposing the sternum at the base (fig. 3, *H. oregonensis*); palm of male cheliped with a patch of long, fine hair. Female has a wide abdomen, hiding sternum (fig. 3, *H. oregonensis*), and only a few isolated bristles on the palm of the cheliped.
Juvenile—on frontal area is a shallow depression, not a notch; lateral spines not terribly sharp or clearly separated from the side; eyes large (fig. 3); dactyls short, dactyl of leg 4 quite flat (Carlton and Kuris 1975); both sexes with narrow abdomens.

Possible Misidentifications

The other northwest *Hemigrapsus, H. oregonensis*, is smaller, brownish-green, hairy-legged, and lacks the spots on the chelipeds. Its frontal area is strongly bi-lobed. Another small grapsid is *Pachygrapsus crassipes*, dark green with dark red transverse lines, a straight frontal margin and one lateral tooth, not two.

Ecological Information

Range—Sitka, Alaska, to Gulf of California (Rathbun 1918); type locality: Puget Sound (Ricketts and Calvin 1971). Uncommon in Southern California (Morris et al 1980).
Distribution—rocky outer coasts, rocky estuarine areas and salt marshes; Coos, Siletz, Tillamook, and probably other Oregon estuaries with rocky, brackish habitats.
Habitat—"semiprotected and protected rocky coasts and bays..prefers coarse sand to gravel substrates overlain with large rock cover" (Schmitt 1921); in more exposed situations than *H. oregonensis*, withstands desiccation better (large specimens); in salt marshes, but not as common as *H. oregonensis*; in burrows and under driftwood (Puget Sound) (Kozloff 1974b); dominant grapsid in middle tide pool region (Ricketts and Calvin 1971); only grapsid found in areas of swift water and large boulders (Puget Sound) (Knudsen 1964).
Salinity—in full salt (outer shores), brackish and hyper-saline (estuarine marsh) waters. Can endure low salinities better at high temperatures (Todd and Dehnel 1960).
Temperature—survival poorest with low temperature combined with low salinity (Todd and Dehnel 1960); smallest animals most resistant to temperature extremes (*ibid.*).
Tidal Level—strictly littoral (Ricketts and Calvin 1971); found higher than *H. oregonensis*, but both species are found from high to low levels (Todd and Dehnel 1960); rockweed belt; sand below rocks; commonly found just below high-tide level (Monterey) (Hiatt 1948); often found with *Pachygrapsus* which extends higher into the intertidal and prefers larger rocks.
Associates—territory overlaps with *Pachygrapsus crassipes* over whom it is dominant (Hiatt 1948): occasionally with *H. oregonensis*. Can be host to nemertean *Carcinonemertes epialti*. Parasitic isopod *Portunion conformis* in perivisceral

cavity of some individuals (Morris et al 1980).

Quantitative Information

Weight—an adult male, 32 mm wide weighed 17.5 grams (wet).
Abundance—locally abundant (Ricketts and Calvin 1971).

Life History Information

Reproduction—females with eggs through fall to January (Puget Sound); 70% ovigerous late January, 98.69% with fertilized eggs early April; hatching from early May to middle June; a second brood is rare; copulation similar to *Pachygrapsus* (Knudsen 1964).
Growth Rate—
Longevity—
Food—primarily detritus, algae infrequently (Jones 1941); forages in large numbers on tops of rocks (Knudsen 1964); stomach contents reveal amphipods and other crustaceans provide a small part of the diet (Knudsen 1964).
Predators—*Pachygrapsus*, on newly molted animals; fish, raccoons, probably great blue herons.
Behavior—sluggish; sometimes feigns death when surprised (Hiatt 1948); a nocturnal feeder (Morris et al 1980); males more aggressive than females; (fight when attacked); females autotomize easily in order to escape (Knudsen 1964).

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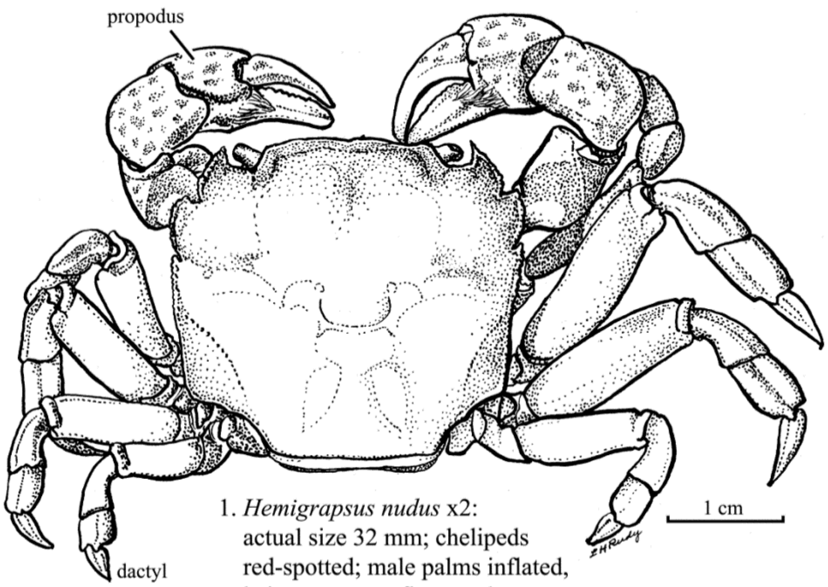
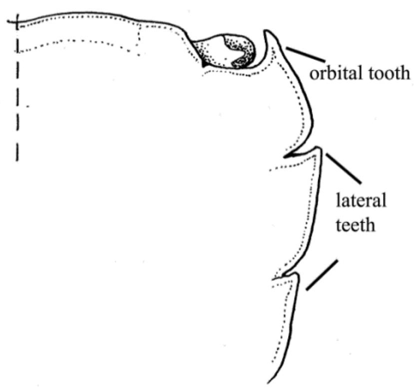
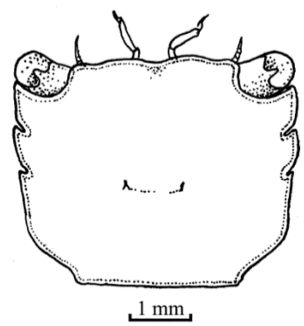
Hemigrapsus nudus



1. *Hemigrapsus nudus* x2:
actual size 32 mm; chelipeds red-spotted; male palms inflated, hairy; carapace flat, quadrate; legs hairless; frontal area slightly rounded.



2. Carapace (right frontal):
eyes moderate, at antero-lateral angle; two lateral teeth (one small).



3. Juvenile x10:
actual size 5 mm; shallow frontal depression; slight lateral spines; eyes large.

Hemigrapsus oregonensis

the hairy shore crab (Dana, 1851)

PHYLUM: *Arthropoda*
CLASS: *Crustacea, Malacostraca*
DIVISION: *Eucarida*
ORDER: *Decapoda, Reptantia*
SECTION: *Brachyura*
FAMILY: *Grapsidae*

Description

COLOR—dull brownish green, no red spots on chelipeds[7]; dull gray, mottled[4]; uniform light gray or muddy yellow, underside white[5].

SIZE—carapace width 34.7 mm, length 28.4 mm[4].

CARAPACE—rectangular, wider than long; antero-lateral margins rounded, toothed; surface smooth, (fig. 1).

EYES—eyestalks and orbits moderate-sized[4]; eyes at anterio-lateral angle (fig. 2).

FRONTAL AREA—less than half the width of carapace: genus *Hemigrapsus;* two prominent frontal lobes.

CARAPACE TEETH—two lateral teeth (below outer orbital tooth); deep sinuses (fig. 2).

CHELIPEDS—equal or almost equal, stout; dactyls hollowed in shallow groove; male with a mat of fine hair on propodus.

WALKING LEGS—more or less hairy (fig. 1).

SEXUAL DIMORPHISM—male has narrow abdomen, exposing sternum at base: genus *Hemigrapsus* (fig. 3); males with hairy palms (chelipeds); females has a wide abdomen, no hairy patch on the palm (only a few bristles).

JUVENILES—very small animals have a marked frontal notch, sharp lateral spines, long dactyls (on walking legs 1-3)[7]; both sexes with narrow abdomens.

Possible Misidentifications

The only other species of *Hemigrapsus* in the Northwest is the larger purple shore crab, *H. nudus,* which is "naked", *ie.* not hairy, on its walking legs. The chelipeds in *H. nudus* have conspicuous red spots; the lateral teeth of the carapace are not as deeply cut as those of *H. oregonensis,* and its front is straight or slightly convex, not prominently bilobed. *H. nudus* lives mostly on the rocky open coast, but is also found in salt marshes[1]. *H. oregonensis* has been called a small, bleached edition of *H. nudus*[5].

Another small grapsid, *Pachygrapsus crassipes,* is dark green and has many transverse dark red striations on its legs and carapace; (*H. oregonensis* is smooth); its frontal margin is straight, it has one lateral tooth, not two[6].

Rhithropanopeus harrisii, an introduced Xanthid mud crab, is sometimes found with *H. oregonensis.* It has slightly convergent sides, strong dorsal ridges on its carapace, and three sharp carapace teeth.

Ecological Information

RANGE—Alaska to Baja California; type locality, Puget Sound (*"in Oregoniae freto Puget"*)[4].

DISTRIBUTION—the common form in Oregon bays[5]; Yaquina, Siletz, Tillamook, Netarts, Coos, Coquille, etc.; less often in quiet parts of open rocky shores.

HABITAT—quiet water...rocky habitats within estuaries, on gravel shores, but prefers mud;[5] on muddy bottoms of estuaries and on eelgrass and in *Enteromorpha.* Also in muddy spots on the open rocky coast.

SALINITY—range (San Francisco Bay): 17.5 to 31.6 o/oo[6]; likes fresh water seeps[2]; cannot tolerate much desiccation[2].

TEMPERATURE—small animals most tolerant to temperature extemes[9].

TIDAL LEVEL—found at very high and very low levels, but most are lower than *H. nudus*[9]; higher tidal reaches of the mudflats[5]; mid and low intertidal of bays and sublittorally[7].

ASSOCIATES—in gravel: isopods *Idotea* and *Gnorimosphaeroma;* occasionally *H. nudus*[2]; alga *Ulva* (sublittorally), pickleweed. *Salicornia* (in marshes)[7]. Parasitic isopod *Portunion conformis* is sometimes in perivisceral cavity[3]. Can be a host to nemertean *Carcinionemertes epialti.*

Quantitative Information

WEIGHT—

ABUNDANCE—in great numbers on estuary bottoms[2]; usually plentiful in gravelly substrates[2].

Life History Information

REPRODUCTION—

GROWTH RATE—

LONGEVITY—

FOOD—primarily an herbivore; scraping *Ulva* or *Enteromorpha* off the rocks; uses tactile, visual and chemical senses to find food[1].

PREDATORS—birds: willet[3].

BEHAVIOR—probably nocturnal[1]. A good digger[3].

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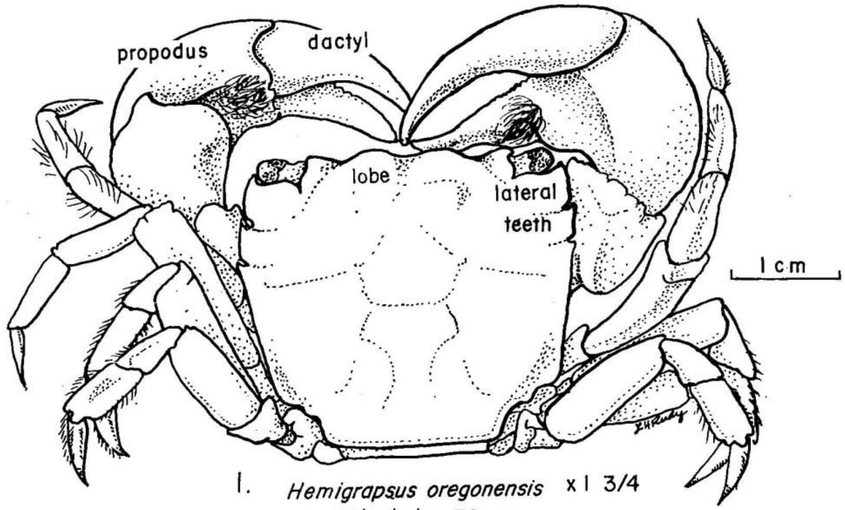
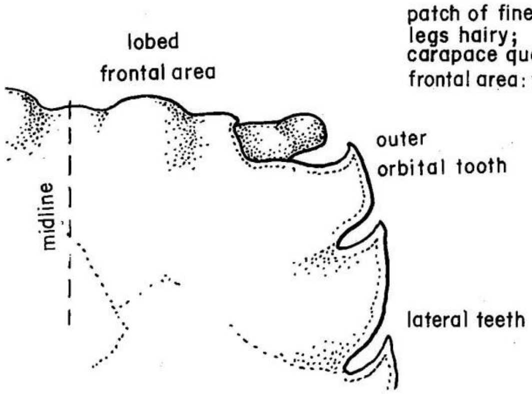
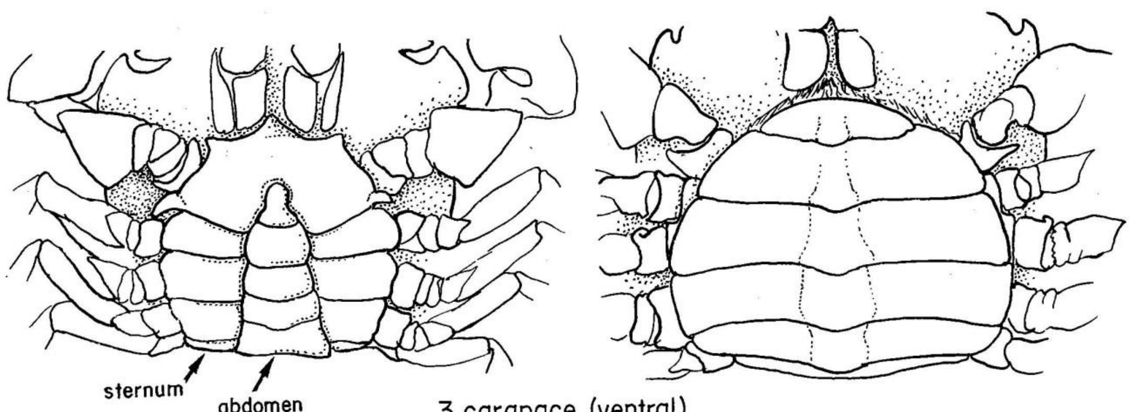
Hemigrapsus oregonensis



1. *Hemigrapsus oregonensis* x 1 3/4
actual size 32 mm
patch of fine hair on male chela,
legs hairy;
carapace quadrate, smooth;
frontal area: two lobes.



2. carapace (right frontal)
eyes moderate, at antero-lateral angles;
two deep lateral teeth.



3. carapace (ventral)

a. male
abdomen narrow, sternum visible at sides.

b. female
abdomen wide, sternum not visible.

Heptacarpus paludicola (=*Spirontocaris*)

A broken back shrimp (Holmes, 1900)

Phylum: Arthropoda
Class: Crustacea
Order: Decapoda, Natantia
Tribe: Caridea
Family: Hippolytidae

Description

Size—3 cm, ovigerous female (South Slough of Coos Bay).
Color—uniform; extremities clear, with orange or brown markings.
Rostrum—well-developed, longer than carapace; dorsal teeth 4-8, ventral teeth 1-5 (adults); rostrum almost as long as antennal scale (fig. 2); dorsal edge of rostrum straight, not curved (Kozloff 1974a); some teeth anterior.
Antennal Scale—never greatly longer than rostrum.
Second Legs—chelate, nearly equal, with seven annulations on carpus (fig. 1).
Mouthparts—3rd maxilliped without expodite; reaching beyond the end of the acicle of the antenna (Kozloff 1974a) (fig. 1); mandible with incisor process, palp of 2 segments (Schmitt 1921).
Carapace—no supraorbital spines (Carlton and Kuris 1975). *Heptacarpus*; no lateral or dorsal spines.
Abdomen—shrimplike, with fantail, body laterally compressed, side plates of second segment overlap those of first, abdomen with sharp bend (Carlton and Kuris 1975) (fig. 1); Caridea. Third segment without hump, 6th segment shorter than telson (Kozloff 1974a) (fig. 1).
First Legs—equal, chelate (fig. 1).

Possible Misidentifications

Very close in color, morphology, and habitat is *Heptacarpus pictus*, whose adult rostral teeth are 6-7/2-4, but whose rostrum, while it can reach to the middle of the antennal scale, does not reach to the end of the scale as does that of *H. paludicola*. The rostral teeth are closer together on *H. pictus* and the rostrum is more slender (Schmitt 1921), as well as being only equal to or shorter than the carapace. (Our *H. pictus* specimens were only 1.5 cm, half the size of the female *H. paludicola*.)

Heptacarpus pictus is the most commonly found transparent shrimp in rockpools (Ricketts and Calvin 1971), while *H. paludicola* is more common in mudflats and in eelgrass. *H. pictus* is not included in the Puget Sound Keys (Kozloff 1974a); Schmitt listed its southern extensions as Monterey (Schmit 1921). (It does occur in southern California). Also see this section under *H. pictus*.

Ecological Information

Range—Alaska to San Diego, California. Type locality: Humboldt Bay, California (Schmitt 1921).
Distribution—south of Charleston Bridge, South Slough of Coos Bay.
Habitat—South Slough; mud and eelgrass (*Zostera*); also in *Ulva*, on pilings, floats, and in rocky pools of outer coasts (Carlton and Kuris 1975).
Salinity—collected at 30 ‰.
Temperature—
Tidal Level—collected at +0.5.
Associates—

Quantitative Information

Weight—
Abundance—"common to abundant" (Schmitt 1921).

Life History Information

Reproduction—ovigerous female found in March, South Slough, Coos Bay.
Growth Rate—
Longevity—
Food— carnivorous (Kozloff 1974b).
Predators—fish.

Behavior—propel themselves backward by flexing their tails forward (Kozloff 1974b).

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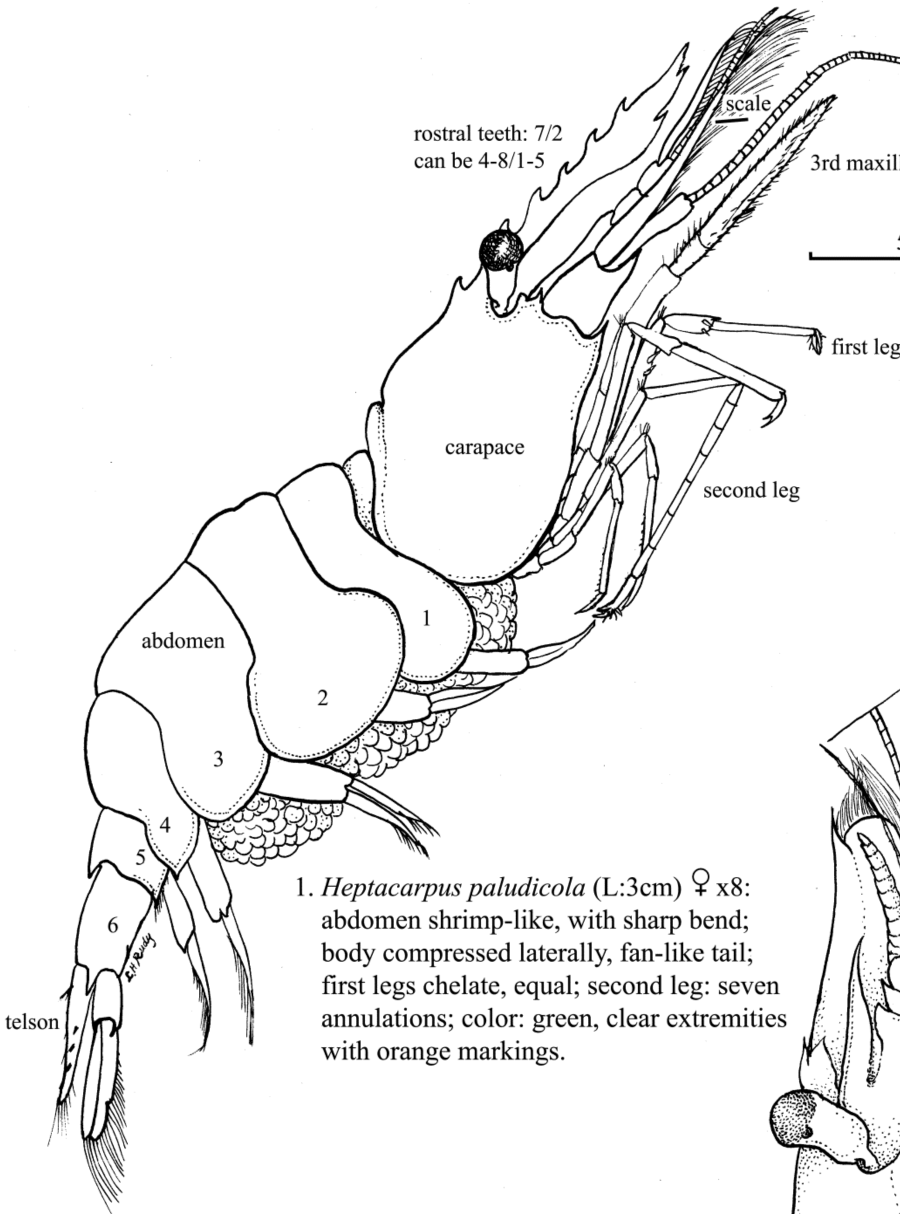
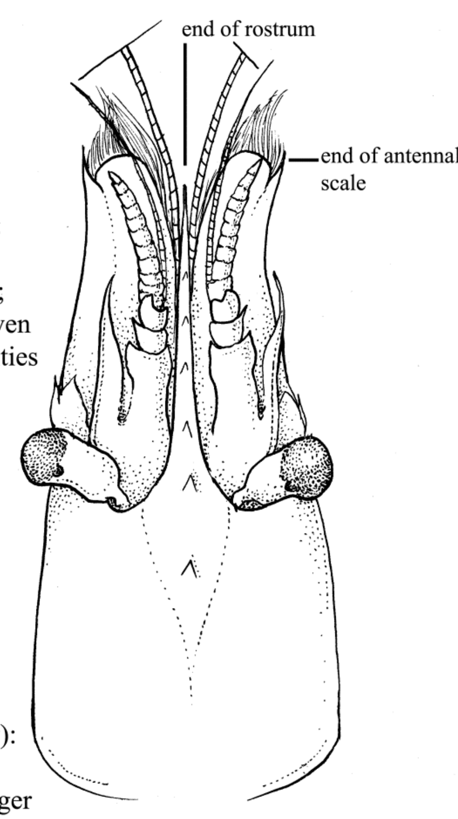
Heptacarpus paludicola



1. *Heptacarpus paludicola* (L:3cm) ♀ x8: abdomen shrimp-like, with sharp bend; body compressed laterally, fan-like tail; first legs chelate, equal; second leg: seven annulations; color: green, clear extremities with orange markings.



2. Frontal region (dorsal view): rostrum almost as long as antennal scale; rostrum longer than carapace (from orbit).

Heptacarpus sitchensis (=*H. pictus*)

A broken back shrimp, glass shrimp (Brandt, 1851)

Phylum: Arthropoda
Class: Crustacea
Order: Decapoda
Suborder: Natantia
Tribe: Caridea
Family: Hippolytidae

Description

Size—2-3 cm; this specimen (South Slough of Coos Bay): 1.5 cm (Hinton 1969).
Color—transparent, with orange lines; green at leg bases, black eyes. Four major color patterns (Morris et al 1980).
Rostrum—well developed, shorter than carapace; dorsal teeth 6-7, ventral teeth 2-4 (fig. 1); slender, teeth close together (Schmitt 1921); rostrum reaches only about $^2/_3$ length of scale (fig. 4).
Mouthparts—3rd maxilliped without exopodite: *Heptacarpus*; mandible with incisor process, 2-segmented palp (Schmitt 1921).
Carapace—no supraorbital or other spines.
Abdomen—shrimplike, with fan tail, laterally compressed body; side plates of 2nd segment overlap those of 1st abdomen with sharp bend, but 3rd segment without hump; 6th segment shorter than telson (fig. 1).
First Legs—equal, chelate (fig. 2).
Second Legs—chelate, nearly equal, with 7 annulations on carpus (fig. 3).

Possible Misidentifications

This species is very like the green *Zostera* dweller *Heptacarpus paludicola*, with a difference chiefly in the length of the rostrum (see *H. paludicola*). Other short-rostrumed *Heptacarpus* species are *H. taylori*, often brightly colored and with a rostrum reaching just to the eye, and

H. cristatus, with rostral teeth 5-8/1-3, and long, slender dactyls on the walking legs;

H. brevirostris, whose rostrum (without lower teeth) reaches only the 1st segment of the antennal peduncle;

H. palpator, very like *brevirostris*, but with a longer rostrum and longer antennal scale;

H. stimpsoni, from Puget Sound, whose rostrum reaches only the 2nd segment of the antennal peduncle; (*H. sitchensis*, *H. decorus*, and *H. kincaidi* are other Puget Sound species);

H. tridens, flexus, and tenuissimus have a hump on the 3rd abdominal segment;

H. carinatus is a long-rostrumed shrimp, its rostral teeth are all distal;

H. gracilis has a very narrow rostrum with 4-5 teeth below, and a long 6th abdominal segment;

H. franciscanus, from San Francisco Bay, has a rostrum longer than the antennal scale, and on its lower edge, 6 or 7 teeth.

Ecological Information

Range—"Monterey Bay to San Diego, California" (Schmitt 1921); type locality, Monterey, California. Not included in Kozloff's Puget Sound work; appears to be a more southern species: common in southern California (Hinton 1969).
Distribution—Coos Bay: near Charleston Bridge, South Slough.
Habitat—most commonly found transparent shrimp in rock pools (Ricketts and Calvin 1971); also in *Zostera* beds, on floats (Carlton and Kuris 1975); in South Slough in *Zostera* on mudflats.
Salinity—collected at 30 ‰.
Temperature—
Tidal Level—collected at +0.5 ft; "middle and lower tidepools of rocky coasts" (Carlton and Kuris 1975).
Associates— polychaetes.

Quantitative Information

Weight—
Abundance—"abundant to common" (Carlton and Kuris 1975).

Life History Information

Reproduction—
Growth Rate—
Food—
Longevity—
Predators—fish
Behavior—

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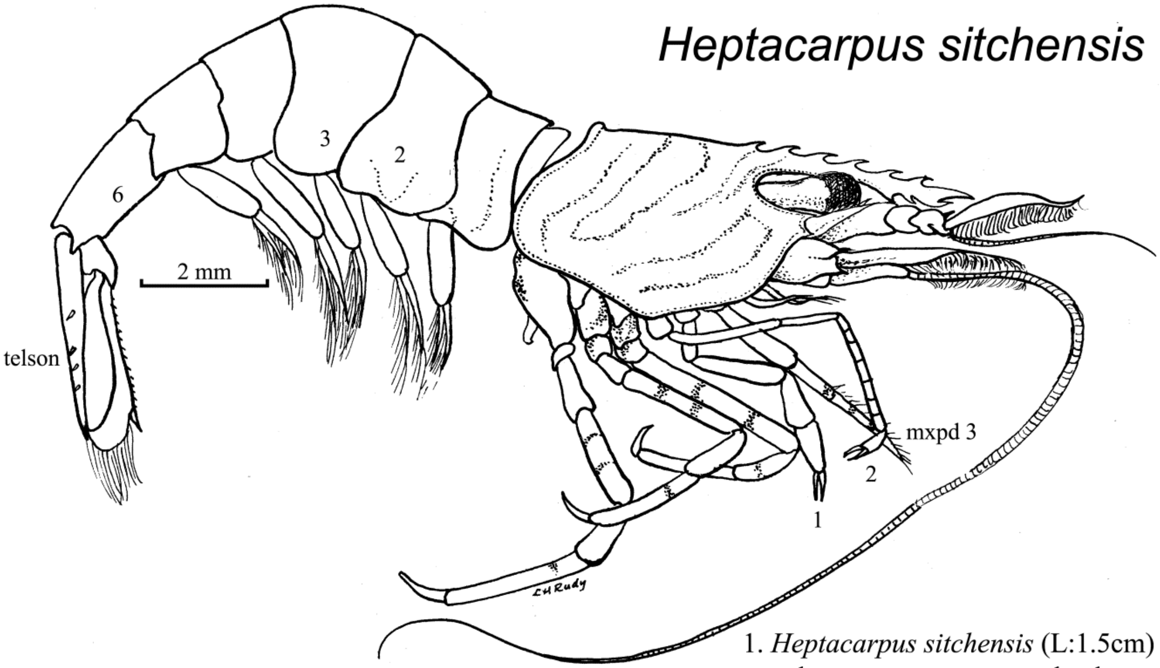
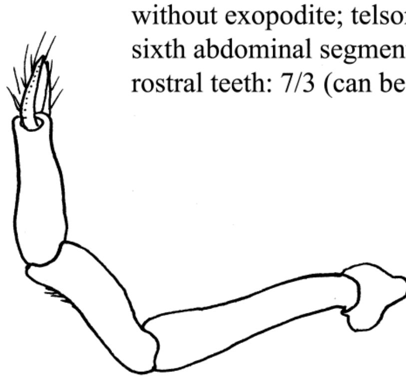
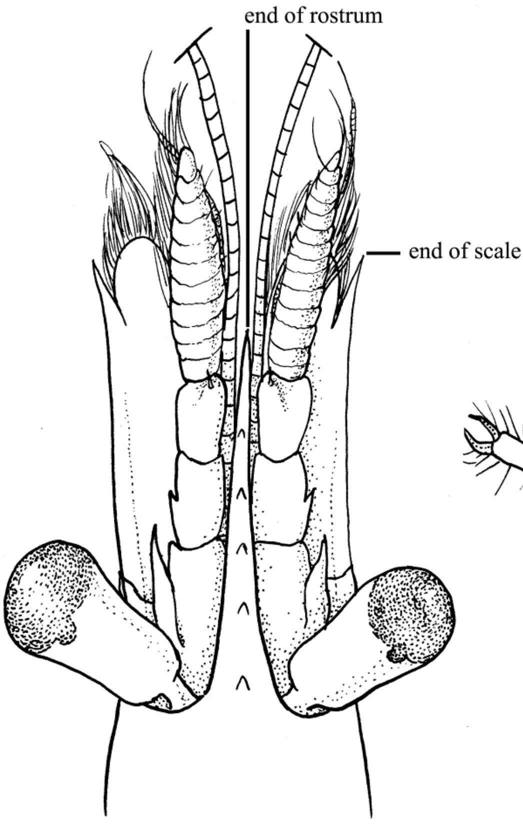
Heptacarpus sitchensis

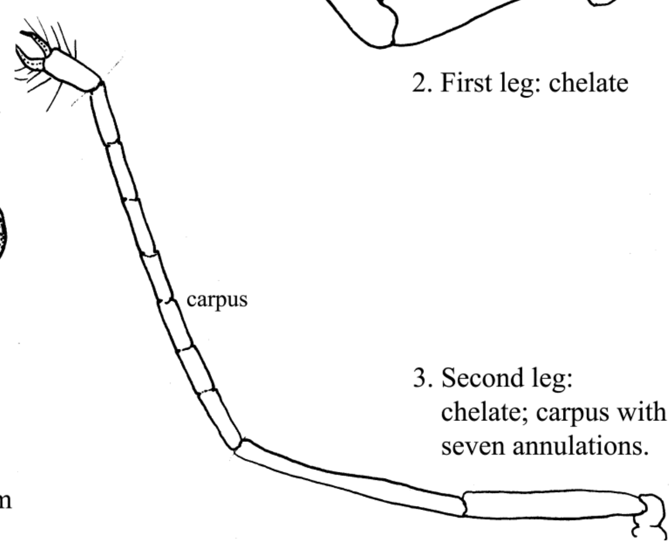


1. *Heptacarpus sitchensis* (L:1.5cm) x10: color: transparent, green leg bases, red striped legs, carapace; third maxilliped without exopodite; telson longer than sixth abdominal segment; rostral teeth: 7/3 (can be 6-7/2-4).



2. First leg: chelate





3. Second leg: chelate; carpus with seven annulations.

4. Frontal region (dorsal view): rostrum narrow at eyes; rostrum more than half length of scale, but not to the end; rostrum (from posterior of orbit) shorter than carapace.

Ianiropsis derjugini

An asellid isopod (Gurjanova, 1933)

Phylum: Arthropoda
Class: Crustacea, malacostraca
Order: Isopoda, Asellota
Family: Paraselloidea, Janiridae

Description

Size—to 4 mm (Menzies 1952); this specimen (Charleston, Coos Bay): 3 mm.
Color—white, with brown chromatophores.
Head—without rostrum: *Janiropsis* (sic) (Sars) (Richardson); no anteriorly projecting anterolateral angles (fig. 1) as opposed to *I. k.* kincaidi: sp. *derjugini* (Miller 1975).
Eyes—well developed, reniform (fig. 1).
First Antenna—quite short, flagellum of 8 articles (fig. 2); 10 articles in ♂ flagellum (Richardson 1905).
Second Antenna—with "squama", or scale, on 3rd article of base (fig. 3) (Miller 1975); about $^2/_3$ length of body; flagellum with many segments and fine setae; peduncle, 6 articles: Asellota (Hatch 1947).
Mouthparts— maxilliped palp with articles 2, 3 much wider than endite (not figured) (Miller 1975).
First Pereopods—inferior edge of propodus smooth, not serrated, on proximal 3rd (fig. 4): *Ianiropsis* (Miller 1975).
Body Segments—7 thoracic segments with variably shaped epimera (fig. 1), no lateral spines.
Pleotelson—shieldlike, lateral borders spineless (fig. 1); postilateral angles at insertion of uropods (fig. 1): *derjugini* (Miller 1975): (no other Janiropsis has this characteristic); 3 posterior segments not differentiated: *Ianiropsis* (Hatch 1947).
Uropods—2 branched; inner branch a little longer than outer; total length less than ½ pleotelson (Miller 1975) (fig. 5).

Possible Misidentifications

Ianiropsis kincaidi kincaidi (Richardson, 1904) has longer uropods: between half and one times as long as pleotelson. Its 1st antennae are elongate; it lacks the posterolateral angles of *I. derjugini*. Habitats of the 2 subspecies are different*: I. k. kincaidi* lives in small pools created by wave splash, and is subject to wide temperature variation (Menzies 1952).

Eight known species of *Ianiropsis* occur in the Pacific coast area covered by Light's Manual. *I. analoga, I. epilittoralis* and *I. tridens* have spine-like serrations on the sides of the pleotelson (Miller 1975): *I. ragnocula, I. minuta*, and *I. montereyensis* lack these serrations, but have other differences: *I. magnocula* has spine-like projections on its head: *I. minuta* has evenly rounded head margins and like the others lacks the postero-lateral angles of the telson; *montereyensis* has uropods longer than the telson.

Ecological Information

Range---Komandorskie Islands, Bering Sea to Monterey County, California (Miller 1968).
Local Distribution—Coos Bay: Charleston small boat basin.
Habitat—under rocks of middle and lower intertidal zones (Menzies 1952); on buoys from the surface to 1.8 m (Miller 1968); this specimen in decayed float with shipworm *Bankia setacea*.
Salinity—collected at 30 ‰.
Temperature—apparently not adaptable to extreme temperatures as is *I. k. kincaidi* (Miller 1968).
Tidal Level—middle and lower intertidal zones (Menzies 1952); surface to 1.8 m deep (Miller 1968): this specimen near water's surface.
Associates—*Bankia setacea*; harpactacoid copepods.

Quantitative Information

Weight—
Abundance—fairly common in wood with *Bankia*.

Life History Information

Reproduction—ovigerous specimens collected February, May and June (Menzies 1952).
Growth Rate—

Longevity—
Food—
Predators—
Behavior—

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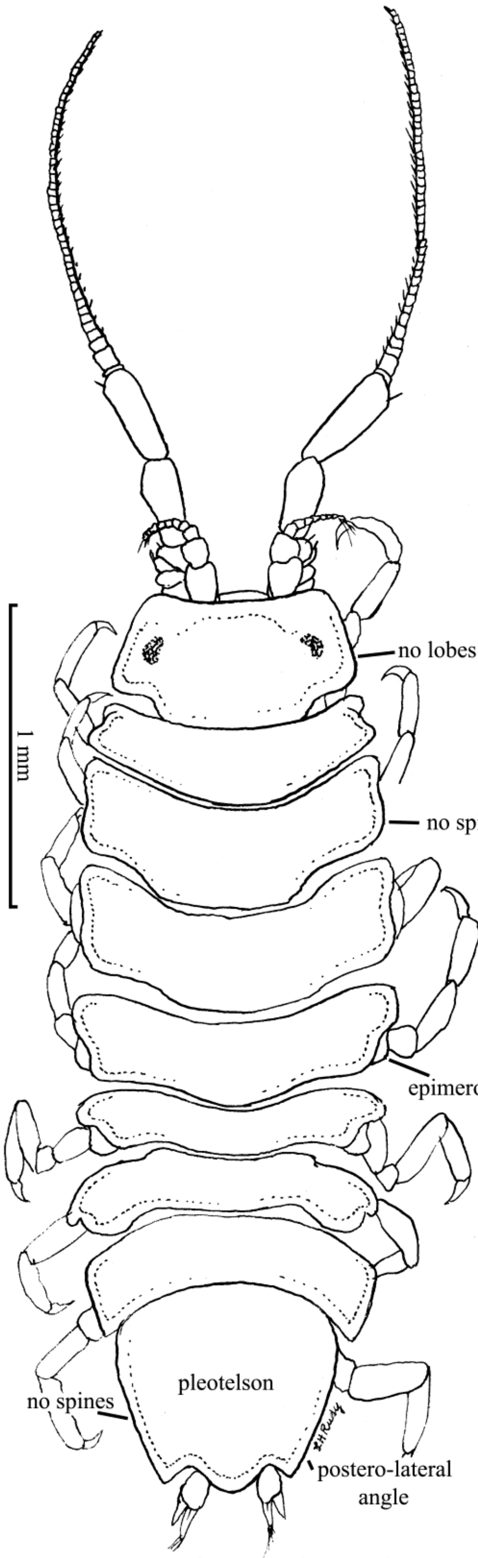
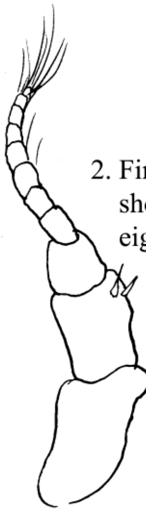
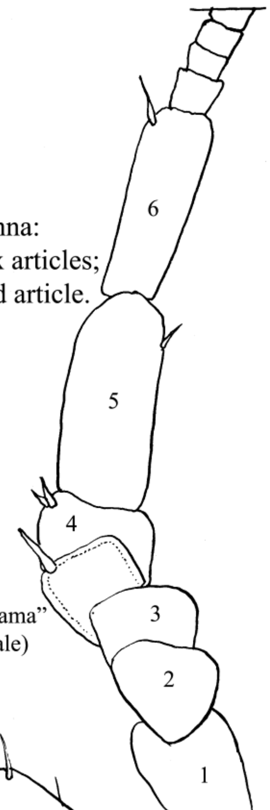
Ianiropsis derjugini



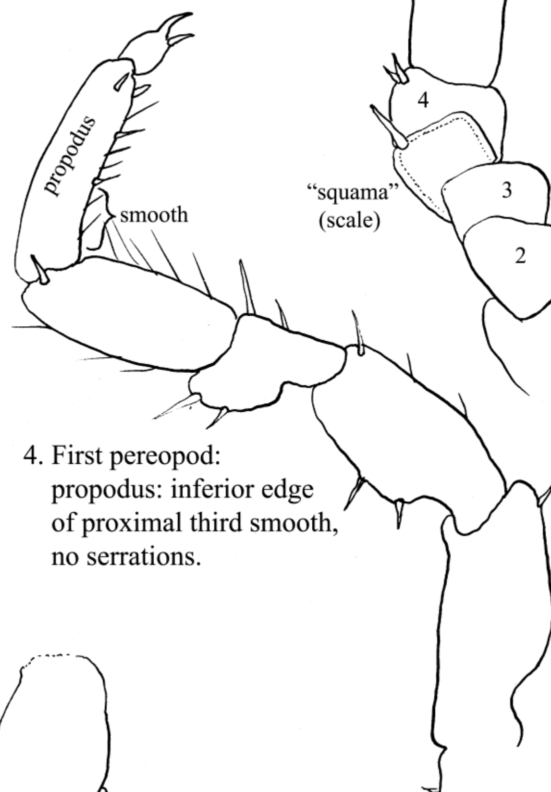
1. *Ianiropsis derjugini* (L:3mm) x50:
head without lobes or rostrum;
thoracic epimera, pleotelson without spines;
second antenna 2/3 body length.



2. First antenna:
short; flagellum:
eight articles.



3. Second antenna:
peduncle: six articles;
scale on third article.



4. First pereopod:
propodus: inferior edge
of proximal third smooth,
no serrations.

5. Right uropod:
two branches: inner longer;
length: less than pleotelson.

Idotea (Pentidotea) resecata

Valviferan isopod (Stimpson, 1857)

Phylum: Arthropoda
Class: Crustacea
Order: Isopoda; Valvifera
Family: Idoteidae

Description

Size—this species grows to 39 mm (Morris et al 1980). 1.2 cm; 4 ½ x longer than wide (Richardson 1905).
Color—light green, black chromatophores when on *Zostera*; brown on kelp: varied (Morris et al 1980).
Head— entire, not notched, sides of head straight slight rostrum (fig 3) frontal process narrow, pointed and exceeding frontal lamina visible from ventral side (fig 2). Eyes oval, not markedly elongate transversely.
Mouthparts—maxilliped with 5 article palp; 1 coupling rook (fig 4) (*Pentidotea*).
Thoracic Somites—body elongate. depressed. all 7 thoracic somites (pereonites) free: (Idoteidae) al but 1st somite with epimeral sutures visible dorsally (fig 1).
Abdomen (Pleon)—2 complete, 1 partial horizontal suture (fig. 1): (*Idotea*).
Pleotelson—large. shieldlike: *Idotea*: posterior border with concave margin, keels (fig 1).
Uropods—ventral, not visible dorsally, and forming opercular or "valves": Valvifera.
Pereopods—7 pairs of ambulatory and nearly similar walking legs.

Possible Misidentifications

I. resecata is the only member of the genus to have a concave pleotelson; this should distinguish it from other light green idoteids, (*I. (P) aculeata; I. montereyensis*).

Ecological Information

Range— Alaska to Baja California (Morris et al 1980); common in Puget Sound.
Local Distribution—below Charleston Bridge, west side (South Slough of Coos Bay).
Habitat—on eelgrass *Zostera*, also on *Macrocystis* (Miller 1975).
Substrate—mud.
Salinity—can survive one hour in fresh water (Morris et al 1980).
Temperature—scarce if surface temperature exceeds 18°C (Morris et al 1980).
Tidal Level—+0.5 (South Slough of Coos Bay); surface to 3.5 fathoms (Richardson 1905).
Associates—gastropod *Littorina*, hermit crab *Pagurus*, amphipods.

Quantitative Information

Weight—
Abundance—

Life History Information

Reproduction— ovigerous July. central California (Morris et al 1980).
Growth Rate—
Longevity—
Food— kelp and *Zoslera* blades (Morris et al 1980).
Predators—more than 20 spp. of marine fishes (Morris et al 1980).
Behavior—always orients along kelp blades.

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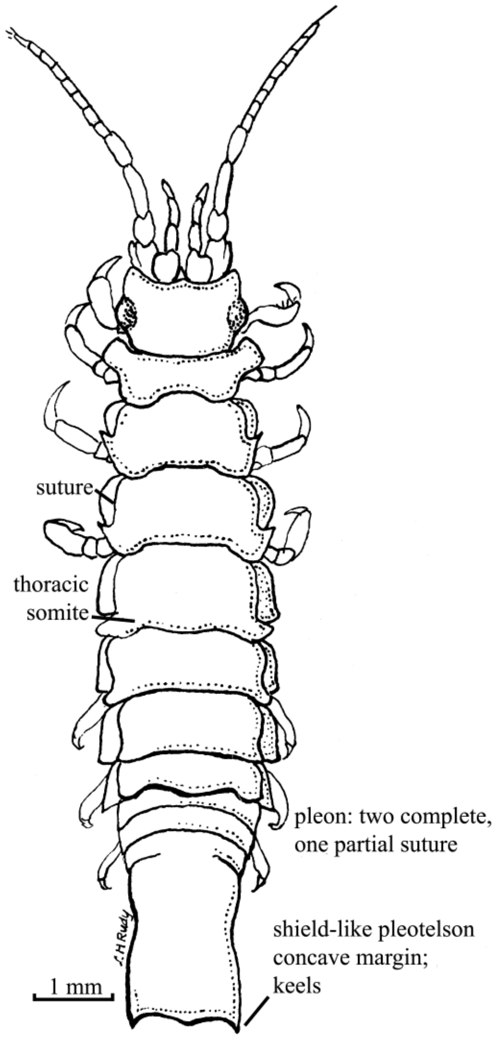
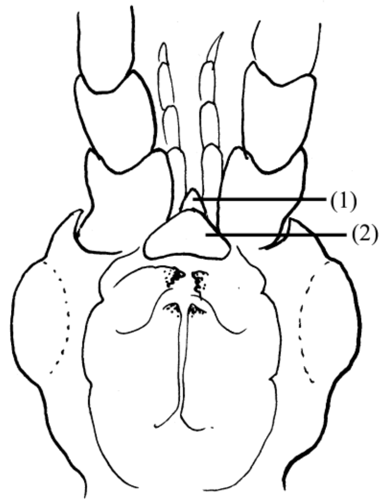
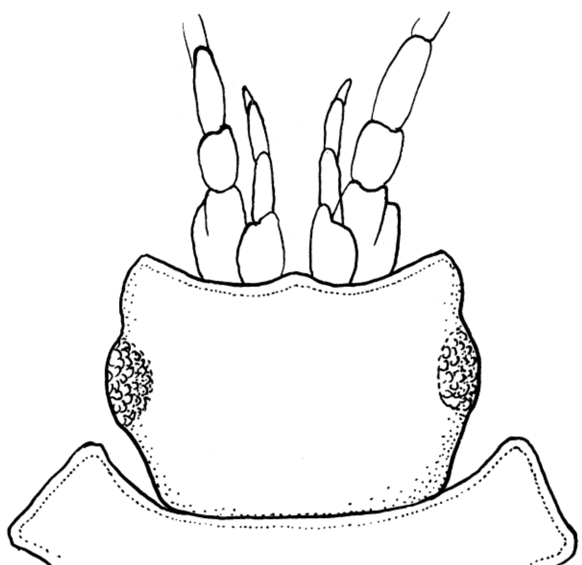
Idotea resecata



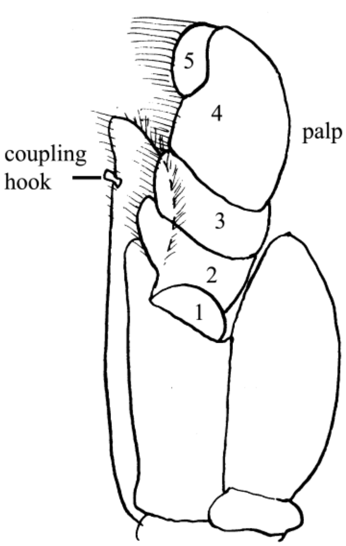
1. *Idotea resecata* x12:
Idoteidae: body elongate, depressed,
legs nearly alike, ambulatory;
seven free thoracic segments.



2. Head (ventral view) x36:
Frontal process (1) narrow, pointed,
and exceeds frontal lamina (2).



3. Head:
entire, not notched
eyes not elongate or pear-shaped
but oval; sides of head straight.



4. Maxilliped:
one coupling hook
five article palp.

Idotea (Pentidotea) wosnesenskii

(Brandt, 1851)

Phylum: Arthropoda
Class: Crustacea
Order: Isopoda; Valvifera
Family: Idoteidae

Description

Size—to 35 mm (Hatch 1947); ½ to $^1/_3$ as wide as long (Fee 1927); this specimen (male) 22 mm long.
Color—dark green or light olive: some living in red algae are dark red and gray (Fee 1927). Males tend to be larger and paler than females (Morris et al 1980).
Body—robust, not tapered; elongate, depressed.
Frontal Process—widely angulate, hidden by and not extending beyond frontal lamina, which is triangulate (dorsal view) (fig 2).
Head—wider than long; frontal margin slightly concave (Miller 1968): posterior portion somewhat wider than anterior portion (Richarson 1905).Head narrower than pleon (Schultz 1969).
Eyes—reniform (kidney-shaped): species *wosnesenskii* (Miller 1975) (fig. 4). Eyes small. compound, transversely ovate; situated at extreme lateral margins, about halfway between the anterior and posterior margins (fig. 1).
Antennae—first antennae (antennules) with four articles, basal one large and flattened. Second antennae with peduncle of 5 articles, flagellum of 12-16 articles (fig. 1).
Mouthparts—maxilliped with 5 article palp, 1 coupling hook: subgenus Pentidotea (Miller 1975). Maxillipeds same in both sexes.
Thoracic Somites—all 7 thoracic somites (pereonites) free: family Idoteidae (Miller 1975). All but 1st somite with epimeral sutures visible dorsally (fig 1). Posterolateral border of last pereonite acute (fig 1).
Abdominal Somites—(pleonites)-pleon with 2 complete, 1 partial intersegmental suture dividing it into 3 divisions: 2 small anterior pleonites and a large shield-like pleotelson with an incompletely fused pleonite near its base (fig. 1): genus *Idotea* (Miller 1975). First pleonite with acute lateral borders: species *wosnesenskii* (pleonite is shorter laterally than medially) (Miller 1975; Kozloff 1974a) (fig 1). Pleon wider than head (Schultz 1969).
Pleotelson—large, shield-like; broadly rounded (Hatch 1947); ends in large blunt point (fig 1).

Uropods—ventral, not visible dorsally, forming opercular plates or valves: suborder Valvifera (not shown).
Pereopods—(legs) 7 pairs, ambulatory and nearly similar all with small sharp claws. Male pereopods with coarse hairs (figs. 1, 4); females with hair only on propodi.
Sexual Dimorphism—males larger, paler, and have hairy legs; females are slightly broader with oöestigites (brood pouches).
Young—with most of adult characteristics, but antennal flagellae shorter than in adult (fig. 3). This specimen found in female brood pouch.

Possible Misidentifications

Idotea sp. isopods have visible epimeral sutures along the last 6 pereonites a pleon with 2 complete and 1 partial sutures and a large shieldlike pleotelson. The genus is divided into sub-genera *Idotea* (4 articles on the maxilliped palp) and *Pentidotea* (5 articles). Other *Pentidotea* similar to *I. (P.) wosnesenskii* include the following:

I. (P.) aculeata, a reddish idoteid with a strong projection on its narrowing pleotelson; oval eyes (not reniform), long antennae and blunt lateral borders on the 1st pleonite (not acute borders as in *wosnesenskii*). It may be too southern for Oregon.

I*. (P.) stenops*, olive green to brown, found on brown algae; with narrow eyes, a slender pointed telson, 2-3 coupling hooks on its maxillipeds, not 1.

I. (P.) montereyensis, slender and small (to 16 mm); red, green brown, or black and white; found on *Phyllospadix* and red algae. It has a telson much like *wosnesenskii*'s, i.e. rounded and with a projection: it differs chiefly in the frontal process, which is narrow, pointed and projects much beyond the frontal lamina; the frontal lamina is triangulate (contrast *wosnesenskii*---frontal process and fig 2).

Males are long and slim; females are broader, more like *wosnesenskii* in outline.

I. (P.) kirchanskii, bright green and found on *Phyllopspadix*; with a rounded telson, oval eyes, epimera of pereonal somites visible dorsally only on segments 5 -7.

I. (P.) resecata, with a very distinctive concave pleotelson, not a rounded, convex one.

Ecological Information

Range—Sea of Okhotsk. U.S.S.R.: Alaska, south to San Luis Obispo Co., Calif.
Local Distribution—Coos Bay: Pigeon Point: Tillamook Bay (Hatch 1947).
Habitat—docks and pilings (Puget Sound) (Kozloff 1974b); under rocks on gravelly or sandy substrates and lots of vegetative debris. Also in mussel beds, on *Ulva* and *Porphyra* (Morris et al 1980). More typical of outer rocky coast than of estuaries (Menzies 1950).
Salinity—tolerates salinity changes better than *I. (P.) resecata* (Brusca 1966; Morris et al 1980).
Temperature—
Tidal Level—upper middle intertidal zone to 16 m deep; this specimen collected at 0.0 ft.
Associates—gastropod *Tegula*, brachyurans *Hemigrapsus*, *Cancer oregonensis*, carnivorous gastropod *Nucella*.

Quantitative Information

Weight—a 22 mm male: 0.3 gr; a 20 mm female, 0.2 gr. (wet).
Abundance—common; probably the most common idoteid isopod, Coos Bay (Kozloff 1974a; Menzies 1950).

Life History Information

Reproduction—little known: females found ovigerous July (California) (Morris et al 1980); a few advanced (8 mm) juveniles found in female oöestigites in April (Coos Bay).
Growth Rate—
Longevity—
Food—
Predators—fish.
Behavior—swims well: clings to vegetation with sharp claws.

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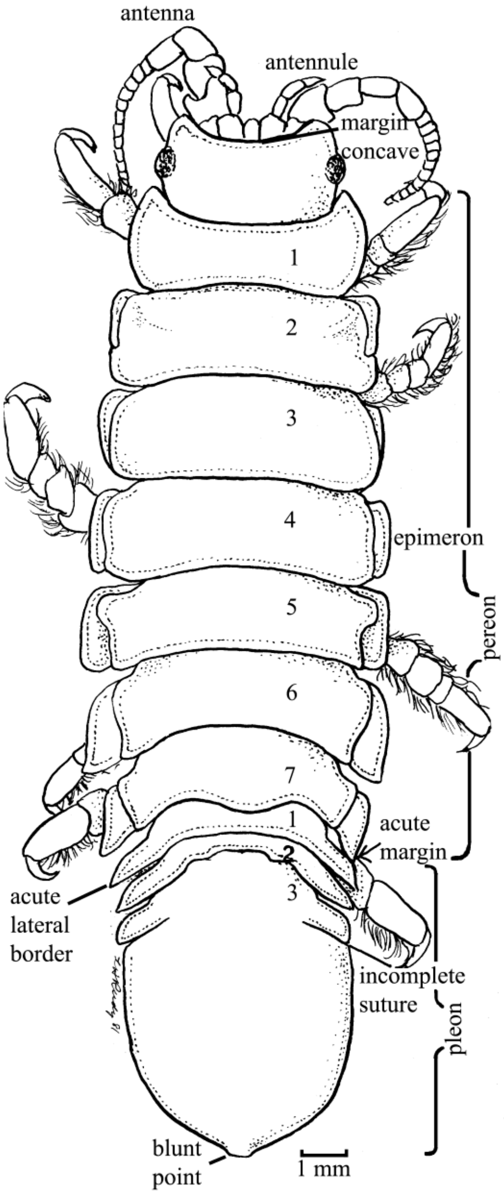
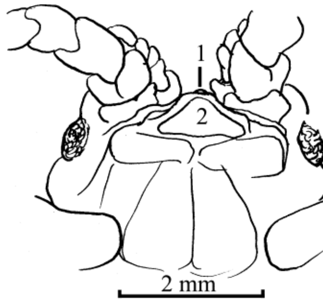
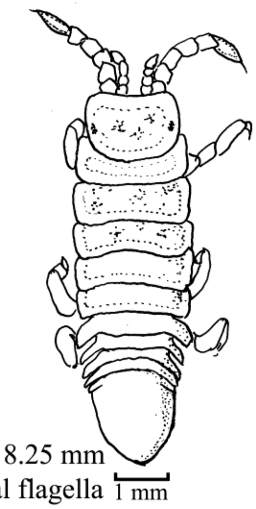
Idotea wosnesenskii



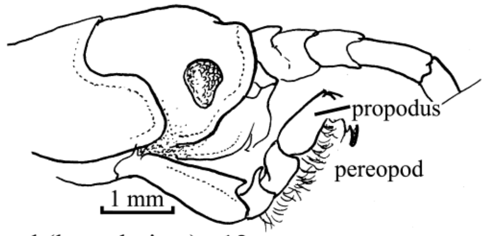


2. Head (ventral view) x12:
frontal process (1) hidden by
frontal lamina (2).

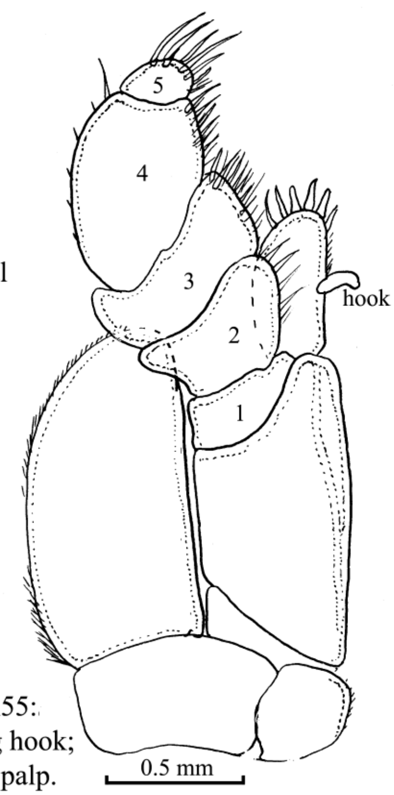


3. Young x7.5:
actual length 8.25 mm
short antennal flagella

1. *Idotea wosnesenskii* (L:22mm W:6.6mm) ♂x7.5:
body elongate, not tapered; dark green; head narrower than pleon, frontal margin concave;
eyes at lateral margins
seven free pereonites,
six visible epimera;
last pereonite with acute
posterolateral border.
Pleon with 2 pointed
pleonites, shield-like
pleotelson, an incomplete
suture, and a blunt terminal
point..



4. Head (lateral view) x12:
eyes reniform; pereopods hairy.



5. Maxilliped x55:
one coupling hook;
five-articled palp.

Lamprops quadriplicata

A cumacean (Smith, 1879)

Phylum: Arthropoda
Subphylum: Crustacea
Class: Malacostraca
Order: Cumacea
Family: Lampropidae

Description

Size—11 mm long (Hart 1930) (from Vancouver Island); illustrated specimen (female, Coos Bay) 6 mm (fig. 1).
Color—light brown, with dark brown on carapace, chromatophores (Hart 1930).
Eyes—Female: none, as in most cumaceans (fig. 1). Male: well developed: genus *Lamprops* (Sars 1900) (fig. 3).
Antenna 1—well developed in female - of 4 to 5 articles: family Lampropridae (Fage 1951) (fig. 1).
Antenna 2—short in female (not visible in fig. 1); male: with articulated flagellum; rather prehensile. Generally concealed, used for clasping in copulation (Sars 1900).
Mouthparts—siphon of maxilliped clearly visible (figs. 1, 3). Mouthparts not figured.
Carapace—with 4 oblique parallel lines on each side: sp. *quadriplicata* (Smith 1879) (fig. 1). (Note: fig. 3 is of close sp. *L. fasciata,* with only 3 parallel lines.)
Pseudorostrum—Female: short, obtuse (Sars 1900) (fig. 1); male: does not extend beyond anterolateral corners (Hart 1930) (fig. 3).
Pereopods—Female: exopodites on pereopods 1, 2; rudimentary exopodites on pereopods 3, 4 (fig. 1). Male: exopodites on all 5 pereopods: family Lampropridae (Watling 1979) (fig. 3).
Pleopods—Female: always absent - order Cumacea (Watling 1979) (fig. 1). Male: absent in genus *Lamprops* (Kozloff 1974a) (fig. 3).
Abdomen—six segments (fig. 1).
Uropods—peduncle about equal to telson in length (Gladfelter 1975a; Smith 1879); endopod with 3 articles: family Lampropidae (Watling 1979)(fig. 2). (Cumacean uropod exopods are always biarticulate (Watling 1979))
Telson—free and distinct: family Lampropidae (as well as 3 other families) (Watling 1979). Male telson has 5 terminal spines about equal in length: sp. *quadriplicata* (Watling 1979) (fig. 2a). Females have 3 to 5 terminal spines, but they are not all equal in length (Kozloff 1974a). Telson also has 2 to 3 pairs of lateral spines (only 2 pairs in most females (Given 1965)). Telson is equal to or slightly longer than uropod peduncle (Smith 1879) and is truncate: genus *Lamprops* (Gladfelter 1975a) (fig. 2).
Sexual Dimorphism—female eyeless, with brood pouch; male with long 2nd antennal flagellum. Females and immatures of both sexes with 3 to 5 apical telson spines; male with 5 subequal spines. Exopodites on pereopods: 5 in male, 2 plus 2 rudimentary ones in female.

Possible Misidentifications

Lampropidae is one of the 3 cumacean families with a distinct telson (in contrast to Bodotriidae, Nannastacidae and Leuconidae). Pseudocumatidae and Diastylidae also have a separate telson:

Pseudocumatidae cumaceans are small and have 2 pairs of rudimentary male pleopods; (Lampropridae males have 3 pairs or none). Pseudocumatidae uropod endopods have only 1 article; Lampropidae endopods are 3-articled. *Petalosarsia* spp., of this family, has been found in the Arctic (Given 1965).

The Diastylidae are represented by many genera in the northeastern Pacific, including Diastylis and Diastylopsis. This family can be most carefully separated from Lampropridae by the telson spines: Diastylidae can have 2 or no terminal spines; Lampropidae have 5 (in mature males; even immatures and females have at least 3 spines). Diastylidae males can have 2 or 0 pairs of pleopods; Lampropidae can have 3 or 0. Uropod endopods in Diastylidae can have 2 or 3 articles; in Lampropidae there are always 3.

Mesolampropidae, separated from Lampropidae (Given 1964), has only 1 genus, *Mesolamprops.* This is characterized by its 2 pairs of male pleopods (Given 1964); *Lamprops* spp. males have no pleopods. *M. dillonensis* (Gladfelter, 1975) has been found in northern California.

In the family Lampropidae there is 1 other genus recorded from our area: *Hemilamprops* spp., represented by *H. gracilis* (Hart, 1930) and *H. californiensis* Zimmer. Both are found in the Puget Sound - Vancouver Island area (and the latter occurs in northern California (Lie 1969)). This genus is noted for its long, slender body and small carapace with a rounded anterolateral edge. *Hemilamprops* spp. lack the 4 carapace folds of *L. quadriplicata,* although *H. californica* (Zimmer, 1936) has 1 recurved fold on its carapace. (It also has 3 pairs of male pleopods, and 3 to 4 pairs of lateral telson spines; *L. quadriplicata* has 0 and 3-5.)

There are several other species of *Lamprops* in the northeastern Pacific:

L. carinata (Hart, 1930) resembles the European *L. fuscata* Sars (see below) in gross morphology except for differences in the 5 apical telson spines. In *L. carinata* these are like the spines of *L. fasciata* (below): the middle one is longest, and the outer spines are longer than the other 2. *L. carinata* has a long telson - 2 x the length of abdominal segment 6; (the *L. quadriplicata* telson is just slightly longer than segment 6). *L. carinata's* telson tapers rapidly, and has no lateral paired spines. The peduncle of the uropod is longer than the telson in this species, and spinous on its inner edge. The males have a 2nd antenna reaching to the telson, much longer than that of *L. quadriplicata. L. carinata* has no oblique carapace folds; it has a short, robust body, a produced pseudorostrum, and unusual prehensile small teeth on the 1st articles of the male antennal flagellum. These characteristics, all shared with *L. fuscata,* are lacking in *L. quadriplicata. L. carinata* has been found in Yaquina Bay.

Lamprops fuscata, found as far south as Vancouver, B.C. (Given 1965), can be separated from *L. quadriplicata* as from *L. carinata* above, and also by its long apical telson spines; (they are equal in *L. quadriplicata).*

Lamprops serrata (Hart, 1930) is more slender than *L. fuscata.* Its carapace has 5 teeth on the anterior lateral margin and a narrow dorsal carina. Its telson is 1 ½ x the length of the 6th abdominal segment; the telson has 2 to 3 pairs of lateral spines and 5 apical spines arranged as in the *L. fuscata* female: the middle one shortest, the 2 outer ones longest (Sars 1900). *L. serrate* has rudimentary exopodites on pereopods 3 and 4. Its uropod endopod has 3 segments, the proximal one being longest (2 x the 2nd or 3rd); it has 7 spines on its inner edge.

Lamprops tomalesi (Gladfelter, 1965) has been described from Dillon Beach, California. It has large chromatophores on its carapace, especially in the ovigerous females; the carapace lacks the 4 oblique folds of *L. quadriplicata.* It has 5 terminal telson spines, but no lateral ones.

L. quadriplicata is perhaps most similar to the large European *L. fasciata* Sars, which is also found in Alaska. *L. fasciata* has only 3 oblique folds on its carapace, not 4 (see in fig. 3). Like *L. quadriplicata,* it has 5 apical telson spines, but they are unequal in length, the outermost and middle ones being the longest (Smith 1879). In addition, *L. fasciata* has strong transverse brownish violet pigment bands, from which it derives its name. It can be up to 9 mm long (female) (Sars 1900).

The number of pairs of lateral telson spines is not now considered to be an accurate systematic characteristic (Given 1965). Spines can vary from 2 to 5 pairs in American *L. quadriplicata;* the European *L. fasciata* has 1 pair.

Ecological Information

Range—Atlantic coast of North America; Alaska Arctic; Pacific from Alaska south to Oregon and central California.

Local Distribution—Coos Bay, Yaquina Bay, Columbia River.

Habitat—on sandy bottoms (Sars 1900); also in mud (Goxon 1936). Prefers grains smaller than 200 µ (Wieser 1956).

Salinity—

Temperature—

Tidal Level—Alaskan Arctic: subtidally from 13 to 67 m (Given 1965); Atlantic: mid - to outer continental shelf (Watling 1979); Puget Sound from +4.5 ft. down to -2.5 ft (Wieser 1956).

Associates—

Quantitative Information

Weight—

Abundance—

Life History Information

Reproduction—for general information, see *Cumella vulgaris.*

Growth Rate—

Longevity—

Food—in muddy areas, it feeds on minute suspended particles (see Zimmer, in Faxon 1936). Feeding takes place when animal is half buried: sand grains collected with 1st pereopods, mouthparts scrape off organic matter. Grains tossed away, up over carapace, burying animal more deeply. This sand grain rolling takes up most of *Lamprop's* time, leaving very little time for resting (Foxon 1936).

Predators—

Behavior—males often found swimming on surface (Foxon 1936). Swimming is with thoracic exopodites and by rapid flexing of abdomen. Telson spines may be used to clean mouthparts while animal swims upward in curved position. Females (*L. fasciata*) can swim at 1 m/90 to 100 seconds at 12 °C; 1 m/65 to 75 seconds at 20 °C. Ovigerous females can sink at 1 m/40 seconds at 12 °C, 1 m/38 seconds at 20 °C. (Foxon 1936); non-ovigerous females can sink at 1 m/55 seconds. Species can bury itself easily, using its 3 pairs of posterior pereopods (Foxon 1936).

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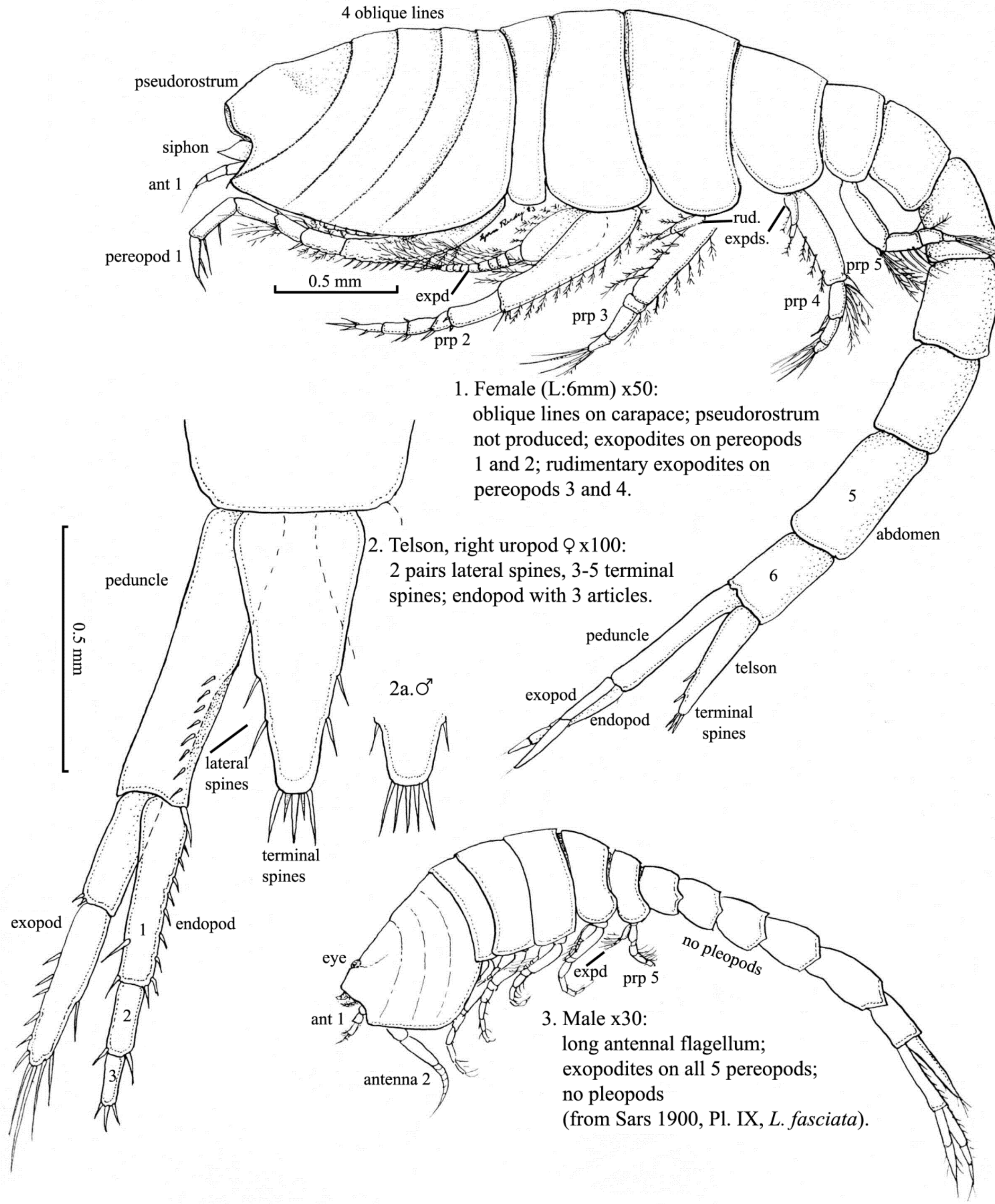
Lamprops quadriplicata



1. Female (L:6mm) x50: oblique lines on carapace; pseudorostrum not produced; exopodites on pereopods 1 and 2; rudimentary exopodites on pereopods 3 and 4.

2. Telson, right uropod ♀ x100: 2 pairs lateral spines, 3-5 terminal spines; endopod with 3 articles.

3. Male x30: long antennal flagellum; exopodites on all 5 pereopods; no pleopods (from Sars 1900, Pl. IX, *L. fasciata*).

Leptochelia sp.

Green tanaid (Krøyer, 1842)

Phylum: Arthropoda
Class: Crustacea
Order: Tanaidacea (Chelifera)
Family: Paratanaidae

Description

Color—transparent to light green. Brightly colored females found in early spring (South Slough of Coos Bay) had red striped antennae. Males found in August were almost transparent.
Size—to 1 cm: South Slough of Coos Bay specimen: 6 mm British Canadian species to 4.5 mm (Fee 1927).
First Antennae—male: long, flagellum with 7 articles (fig- 2): female short, 3 articles (figs. 1. 4); both uniramous: Suborder Disonophora.
Second Antennae—male: shorter than basal article of 1st antennae - 4 articles (fig. 2); female longer than that of male, also with 4 articles (fig. 1).
Head—narrowed anteriorly.
Eyes—stalked (*unlike those of isopods*): large, anterolateral.
Mouthparts—fused and metamorphosed in males, can be dissected in females. Mandible (female) without palp (fig. 3).
Gnathopods—chelipeds very prominent in both sexes, but very different. Males: long and slender; carpus longer than basal article of 1st antenna, propodus shorter than fingers, which have 2 teeth on inner side (fig. 5). Female - short, heavy chela (figs. 1, 6).
Carapace—head and 1st 2 segments fused:
Body Segments—thorax: 6 uniform segments: abdomen: 5 similar segments and telson (fig. 1).
Pereopods—6 pairs beside the chelate gnathopods. A small penal process is attached between the last pair of these legs in the male (and very difficult to see).
Pleopods—5 parts, 2-branched, leaf-like.
Uropods—both sexes biramous: exopodite very small, endopodite of 5 articles (fig. 7).

Possible Misidentifications

Leptochelia savignyi from Puget Sound, with 4 segments in the endopodite of the uropod (Kozloff 1974b), (or 6) also has larger eyes and stubbier first antennae than does *L. dubia* (Lang 1957). In *L. savignyi* the 1st free thoracic segment is shorter than the others: they are fairly equal in *L. dubia*. The male chelipeds of the 2 species are almost identical.

Leptochelia filum, another Puget Sound species is small (2.5 mm), white, and found in 20 fathoms, sand-- a quite different habitat from that of *L. dubia*. The endopodite of the uropod in this species has 3 - 4 articles, not 5 as in *L. dubia*.

Ecological Information

Range—cosmopolitan: 1st described off Brazil. Northwest: British Columbia to northern California.
Distribution—Metcalf preserve, South Slough of Coos Bay; Tillamook Bay: (species) (Forsberg et al 1977).
Habitat—flimsy slime tubes much like those of *Corophium*, in a substrate of mud and chips. (Metcalf Preserve); also dead coral (Richarson 1902), sponge bed at 25 fathoms (Fee 1927), at strand line (sand) at low tide (Hatch 1947), and near the surface on hydroids and algae (Fee 1927); upper limit of sand grain size: 200 µ (Wieser 1959).
Salinity—collected at 30 ‰.
Temperature—
Tidal Level—+3 feet (Metcalf Preserve) to 25 fathoms (Fee 1927).
Associates—amphipod *Corophium*, small polychaetes, clam *Macoma nasuta*.

Quantitative Information

Weight—
Abundance—the dominant animal where collected (Metcalf Preserve)

Life History Information

Growth Rate—
Food—detritus and associated micro-organisms
Longevity—

Predators— *Parophrys vetulus* (English sole). *Plattchttys stellalus* (starry flounder), and *Oncorphvnchus tschawytscha* (chinook salmon) In Tillamook Bay (Forsberg et al 1977).
Reproduction—ovigerous females and nests of young found in February; many more males in evidence in August (Metcalf Preserve). Indicative of breeding period (Lang 1957).
Behavior—

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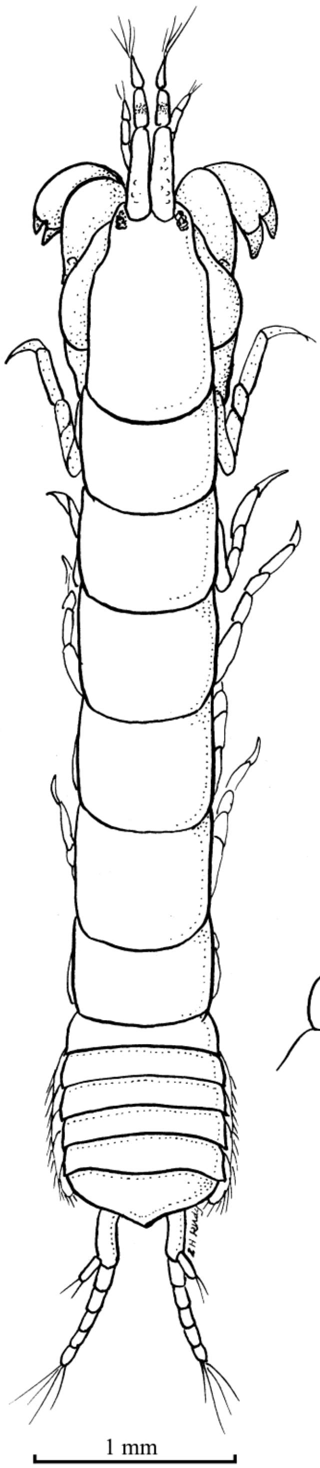
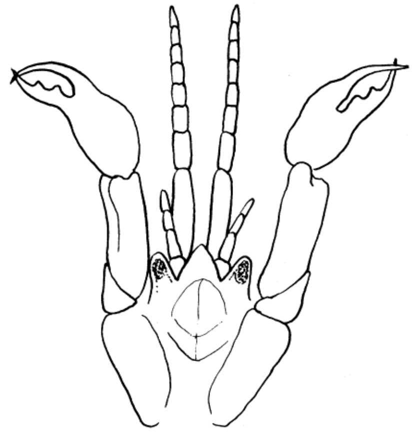
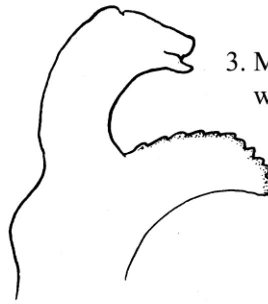
Leptochelia sp.



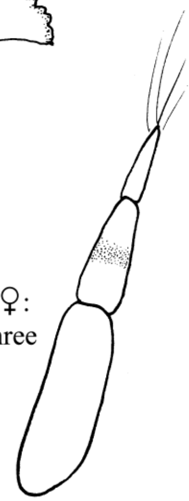
1. *Leptochelia* sp. ♀ x32:
carapace: head, first two segments fused, six thoracic segments, five abdominal segments, and telson.



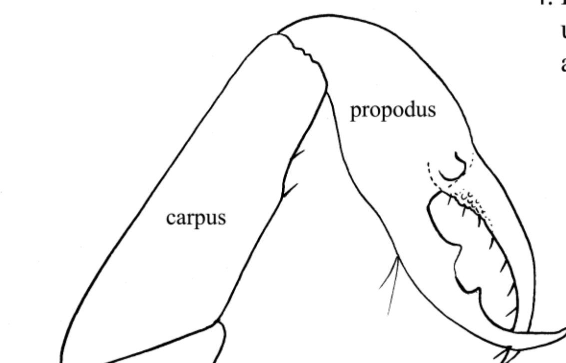
2. Head ♂ (ventral view):
long first antenna, with seven articles in flagellum, eyes separate from head, long chelipeds.



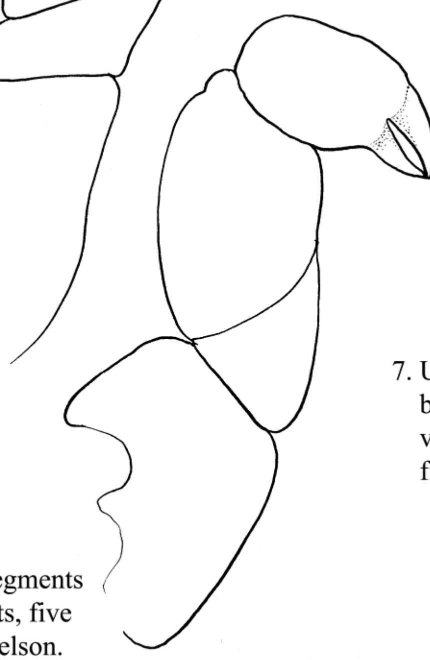
3. Madible ♀:
without palp.



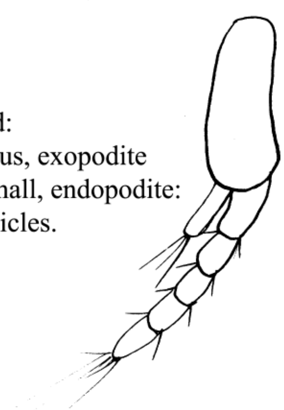
4. First antenna ♀:
uniramous, three articles.



5. Gnathopod ♂ x100:
carpus longer than basal article of first antenna, propodus shorter than fingers, fingers with two teeth.



6. Gnathopod ♀:
short, heavy chela



7. Uropod:
biramous, exopodite very small, endopodite: five articles.

Ligia (Ligia) Pallasii

A rock louse, or shore isopod (Brandt, 1833)

Phylum: Anthropoda
Class: Crustacea
Order: Isopoda, Oniscodidea
Family: Ligiidae

Description

Size—to 35 mm long, including uropods (Brusca and Brusca 1978); about 11 mm wide, uropods 3 mm long. This specimen (Coos Bay): 22 mm.
Color—mottled gray, surface granular. Often brown.
Antennae—1st antennae vestigial: suborder Oniscoidea (Miller 1975); 2nd antennae with peduncle of 5 articles, the 1st 2 short, the 3rd 2x as long as the 2nd, the 4th 1 ½ x longer than the 3rd, the 5th 1 ½ x length of 4th (Morris et al 1980). Flagellum of 15 articles (Hatch 1947). Second antennae reach to middle of 4th thoracic segment (fig 1).
Head—more than 2x as wide as long, rounded anterior margin, without lobes: family Ligiidae (fig. 1) (Miller 1975).
Eyes—large, round, composite, close to lateral margin (fig. 1) (Morris et al. 1980). Separated in front by 2x the length of the eye: subgenus (*Ligia*).
Mouth Parts—in order from outside of buccal cavity.

Maxillipeds-with palp of 5 articles (fig. 8);
Second maxillae-with 2 plumose processes on inner side of lobe (fig. 5);
First maxillae-3 plumose processes on inner lobe (fig. 4);
Mandible-with large, broad molar surfaces, no palp (fig. 3).

Thorax—1st segment, or thoracomere, fused with head; 7 free pereonites. First 4 subequal, last 3 somewhat shorter along medial line, extending downward laterally. Epimera (flattened lateral extensions to pereonites) form broad plates, especially in males, indicated by distinct lines (figs 1, 4).
Abdomen—(pleon) as wide as thorax: with 5 free pleonites and a short pleotelson (fig. 1): suborder Oniscoidea. First 2 pleonites narrow and without downwardly produced lateral edges which mark last 3 segments.
Pleotelson—rounded on middle of posterior edge; post-lateral projections: genus *Ligia*; not quite as long as middle (fig. 1).
Pleopods—paired breathing appendages beneath pleonites: whitish tissue showing aerial adaptation. Male genitalia, paired but not fused, on 2nd pleopods (fig 7).
Uropods—terminal, styliform; bases about as long as wide: subgenus (*Ligia*). No process at inner distal margin of basal joint (fig. 6); uropod rami equal, about 2x length of peduncle; (less than $^1/_2$ body length: genus *Ligia*) (Hatch 1947).
Pereopods—7 pairs of delicate walking legs. Carpus and merus of 1st leg swollen, not grooved (not figured) (Hatch 1947).
Sexual Dimorphism—males with penial processes on 2nd pleopods, and with wide epimera (fig. 2). Females with oöstegites when ovigerous.

Possible Misidentifications

The terrestrial isopods have vestigial 1st antennae, thoracic epimera, a pleon of 5 segments and a pleotelson, terminal uropods, seven pairs of walking legs, and pleopods for aerial respiration (Hatch 1947). Of these Oniscoidea, the Ligiidae are usually littoral. They can swim, but in our area are restricted to the upper littoral (spray) zone (Hatch 1947).

Ligiidae can be distinguished from the other Oniscoidean families by having more than 4 articles in the flagellum of the 2nd antennae, and by their lack of anterolateral head lobes. The other genus of Ligiidae, *Ligidium*, is a river dweller, not a littoral marine isopod. It has uropods with a process at the inner distal margin, to articulate the endopod; *Ligia* does not. It lacks the posterolateral projections on the telson which *Ligia* has (Miller 1975).

The species closest to *L. pallasii* on the northeastern Pacific shore is *Ligia (Megaligia) occidentalis*, an inhabitant mostly of rocky outer shores, which shares *L. pallasii'*s liking for fresh-water seeps (Wilson 1970). It can tolerate greater extremes of dryness than *L. pallasii*. *L. occidentalis* is a narrower animal than *L. pallasii*, being over twice as long as wide; its eyes are closer together: about an eye's length apart. Its uropod bases are several times longer than broad (*L. pallasii*'s are almost square) (Miller 1975). Its 2nd antennal flagella are longer, to the 6th thoracic segment, and contain 29 articles, not 15. This species is not known to live north of the California border.

Ligia exotica is a tropical species with very long uropods and 2nd antennae.

Ecological Information

Range—western Aleutians south to Santa Cruz Co., California (Morris et al 1980).
Local Distribution—Coos Bay, Depoe Bay, Florence, as well as outer shores (Hatch 1947).
Habitat—outer shore: deep crevices, under ledges; likes freshwater seeps. Estuaries: hard-packed beaches, pilings, docks, as well as rocks. Cannot tolerate extreme wetting or drying for very long but must alternate with periods of each; with cool, moist condition being the prevalent one (Wilson 1970).
Salinity—found near full salt water, but where there are fresh water seeps. It is able to hyper-regulate well in its prolonged periods of hyposaline conditions, and to hyporegulate in sea-water of over 100% concentrations, to avoid body water loss. Found in fluctuating, hyposaline conditions (Wilson 1970).
Temperature—does not tolerate extended heat or drying: lives permanently in cool moist habitats (Wilson 1970).
Tidal Level—al Moss Beach, California, animals live on cliffs 5-20 ft. above tide; on estuarine beach (South Slough, Coos Bay), they are found at about 5.0 ft.
Associates—in beach wrack and wood debris: gribble *Limnoria*, amphipods *Orchestia*, *Orchestoidea*.

Quantitative Information

Weight—
Abundance—most common *Ligia* species on extreme northern California coast (Brusca and Brusca 1978).

Life History Information

Reproduction—females carry young in brood pouch; found with young in early spring through summer (prime April-May) Coos Bay. Average brood size: 48 ±11 young (Morris et al 1980).
Growth Rate—
Longevity—1.5-2 years (Morriss et al 1980)
Food—scavenger, feeding mostly on decayed algal material: also animal detritus (Kozloff 1974b; Brusca and Brusca 1978). Food gathering restricted to cool, humid periods (Wilson 1970).
Predators—birds, man: for fish bait; *Pachygrapsus crassipes* (Morris et al 1980).
Behavior—males shield females and young with large epimeral plates during drying periods (Miller 1938). Species slow moving (Wilson 1970). Uropod rami are dipped into pools to obtain moisture for gills (pleopods) (Brusca and Brusca 1978).

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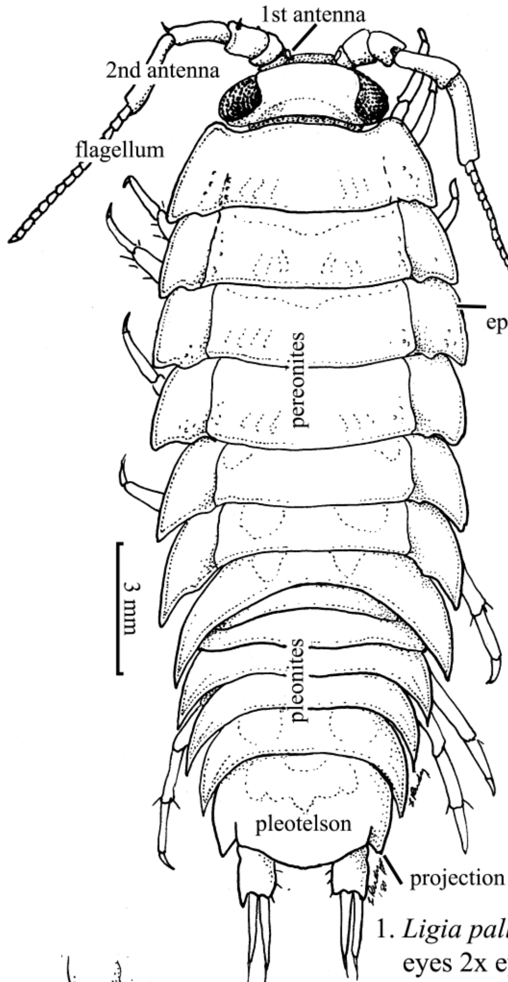
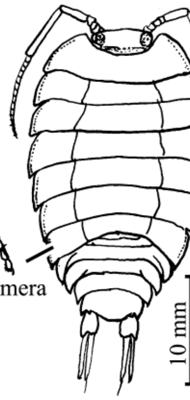
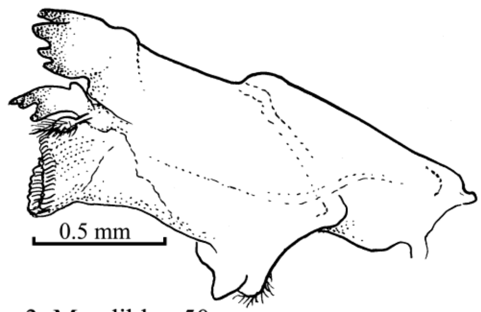
Ligia pallasii



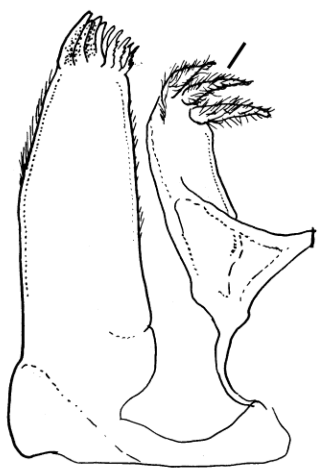
1. *Ligia pallasii* ♀ x8: eyes 2x eye length apart; first antennae vestigial; second: 15 articled flagellum; post-lateral pleotelson projections.



2. Male x2

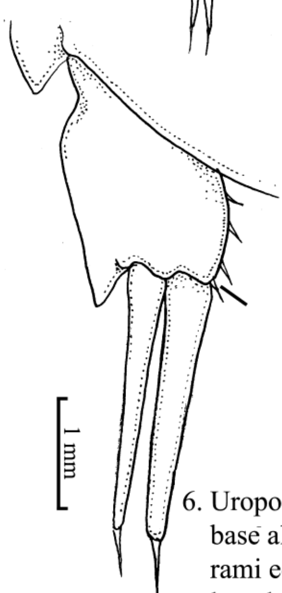


3. Mandible x50: no palp; broad molar surface.

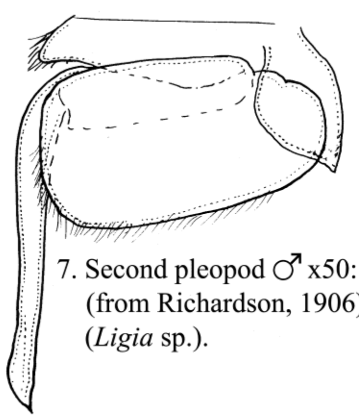


4. First maxilla x50: three plumose processes, inner lobe.

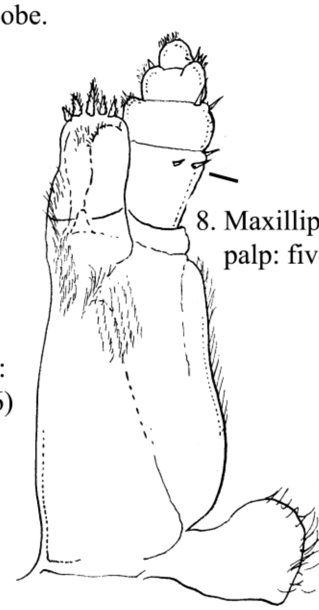
5. Second maxilla x50: two plumose processes.



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



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



8. Maxilliped x50: palp: five articles

Limnoria (Limnoria) tripunctata

A gribble (Menzies, 1951)

Phylum: Arthropoda
Class: Crustacea
Order: Isopoda; Flabellifera
Family: Limnoridae

Description

Size—to 2.5 mm.
Color—light tan, whitish; often encrusted with debris.
Antenna—flagellum with 4 articles (fig. 3): both antennae reduced, separated at midline: in a nearly transverse line (fig. 1).
Second Antenna—flagellum with 5 articles (fig. 4).
Head—smooth, rounded, modified for boring; eyes lateral (fig. 1).
Mouthparts—mandibles with file-like ridges (right) and rasping surface (left), not figured.
Pereopods—in mature females a leaf-like ooestegite at base of each of 1st 4 pairs of legs forms a broodpouch (not figured, but see fig. 6, *Corophiurn spinicorne*).
Thorax—7 segments, the 1st being widest (figs. 1, 2): can roll into a ball.
Abdomen—5 free pleonites, ornamented pleotelson; 5th somite with 3 tubercules (fig. 1).
Telson—with 3 anterior tubercules (fig 1): posterior and lateral borders tuberculate (fig 5).
Uropods—branches dissimilar: exopod snort, claw-like; endopod long, apically blunt (fig. 6).

Possible Misidentifications

There are only 4 known Limnoridae on the north Pacific coast. One, *L. (Phycolimnoria) algarum*, bores into algal holdfasts, not wood; its mandibles lack the rasp and file of the woodborers. There are 3 wood-boring west coast Limnorians: *L. lignorum*, the cosmopolitan coldwater gribble, white, with a X-shaped carina on its telson, not tubercules, *L. quadripunctata*, sometimes found with *L. tripunctata*, with 4 anterior tubercules on its telson, which has smooth posterior borders. So far, it has been found only as far north as Humboldt Bay.

Ecological Information

Range—Atlantic and Pacific coasts in temperate and tropical waters (44-12° N). Type specimen: San Diego.

Local Distribution—upper bays: Coos, Yaquina, Tillamook estuaries; British Columbia.
Habitat—docks and pilings, chiefly in bays and estuaries, where it burrows into wood. (The wood serves as both food and protection). Reputed to attack creosoted wood.
Salinity—tolerates salinity fluctuation: found in warm, often salty upper bays. Other *Limnori* species (i.e. *L. lignorum*) can't tolerate low salinity (15%) or dissolved oxygen content below 1.6 ppm; animals can stand periodic oxygen depletion, however (Menzies 1957).
Temperature—15° and 30°C (mean) (Menzies 1957): reproduction seriously impaired below 6°C (Menzies 1957).
Tidal Level—mostly shallow water: surface to 60 feet. Only limited data available. Prefers lower depths when salinity is low or tidal fluctuation is great. Animals prefer area near estuary bottom: thus the heavy attack at the bases of pilings
Associates—*Limnoria* burrows can be inhabited by the commensal isopod, *Caecijaera,* the sphaeromid isopod, *Gnorimosphaeroma*, the amphipod *Chelura* and the copepod *Donsiella* (Menzies 1957). None is a borer. The boring mollusk *Teredo* can attack the same wood where *Limnoria* burrows.

Quantitative Information

Weight—
Abundance—

Life History Information

Reproduction—peak breeding time April, May (Friday Harbor, WA) (Morris et al 1980). Lowest temperature for breeding, 14 °C; total egg development time 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).
Growth Rate—Average number eggs/female: 22 (Morris et al 1980).
Longevity—
Food—wood and probably the fungi on it: reportedly can enter creosoted wood (Menzies 1951b). Gut sterile, lacking resident microorganisms (Morris et al 1980).
Predators—polychaete worms (Reish 1954).
Behavior—Dispersal by swimming and crawling young and adults. (In *Teredo*, dispersal is by larvae only; adults burrow but do not swim or crawl). *L. tripunctata* may represent a resistant strain of gribble which developed in response to creosote (Morris et al 1980).

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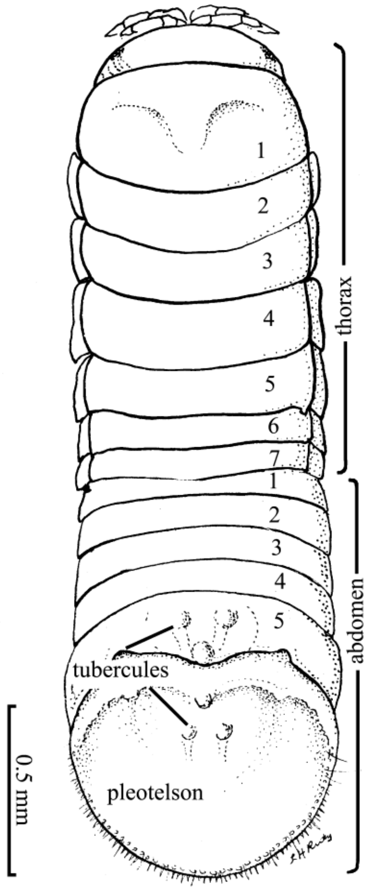
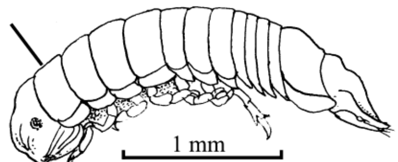
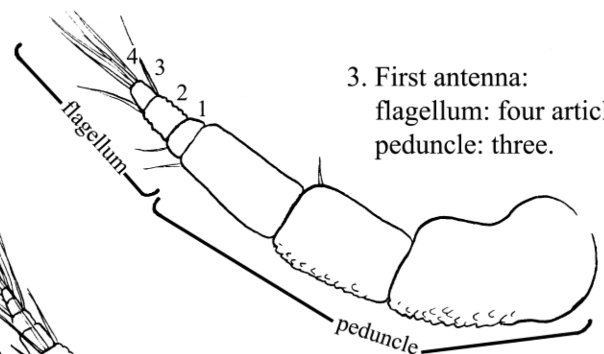
Limnoria tripunctata



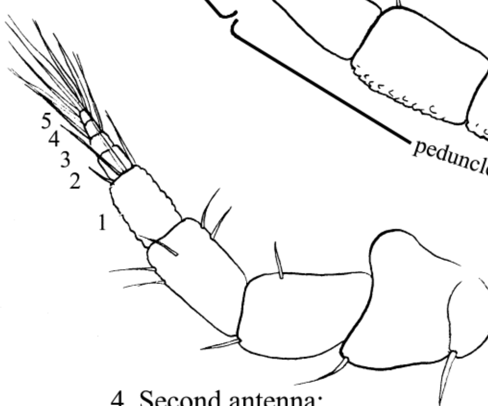
1. *Limnoria tripunctata* (L:2.5mm) x56:
head smooth; antennae reduced, transverse;
fifth abdominal somite: three tubercules;
telson: three tubercules.



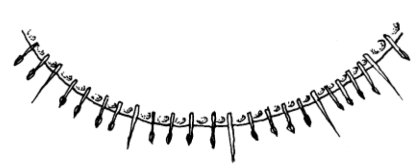
2. Lateral view x26:
eyes lateral; head rounded for boring;
first thoracic segment widest.



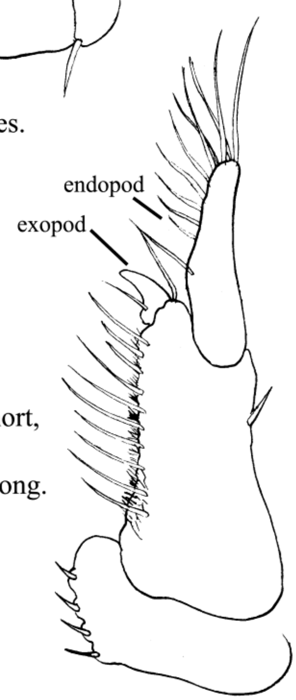
3. First antenna:
flagellum: four articles
peduncle: three.



4. Second antenna:
flagellum: five articles.



5: Pleotelson:distal border:
small tubercules.



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

Lissocrangon stylirostris (=*Crangon stylirostiris*)

Common shrimp (Holmes, 1900)

Phylum: Arthropoda
Class: Crustacea
Subclass: Malacostraca
Order: Decapoda, Natantia
Tribe: Caridea
Family: Aequoreidae

Description

Size—type: 5.5 cm, average 3-47 mm; this specimen (Coos Bay): 5.5 cm (Ricketts and Calvin 1971).
Color—white with black and brown chromatophores, giving gray appearance.
Rostrum—narrow and pointed downward, grooved; (without dorsal teeth); acute tip.
Eyes—free, not covered by carapace.
Antennal Scale—short, just a little over half length of carapace; blade with oblique inner margin; spine longer than blade (fig. 2).
Chelipeds—hands (manus) subchelate, slightly widened distally, and about twice as long as wide (Fig. 3).
Carapace—without medial spine: *Lissocrangon* (Kuris and Carlton 1977); ("lisso": smooth); a pair of hepatic (lateral) spines (fig 1).
Abdomen—shrimplike, with typical Caridean bends: 6th segment not grooved ventrally (Ricketts and Calvin 1971).
Telson—distinctly shorter than uropods (fig 4).

Possible Misidentifications

Lissocrangon stylirostris is the only local species of the family without the medial carapace spine. This distinguishes it from the other genera, which have one or more medial spine. (The common local intertidal and shallow water genus is *Crangon*, with one spine).

Ecological Information

Range—Alaska to Santa Cruz, California. Type locality: Trinidad, California.
Local Distribution— Coos Bay: Pt. Adams beach at the mouth of South Slough.
Habitat—often along high energy sandy beaches (Kuris and Carlton 1977); a bottom-dweller, preferring hard sand (Ricketts and Calvin 1971).
Salinity—collected at 30‰; range 17‰ - 33‰ (Morris et al 1980).

Temperature—8.7°-16°C (Morris et al 1980).
Tidal Level—collected at -1.0: can be found as deep as 80 meters.
Associates—infested by Bopyrid isopod *Argeia pugettensis* Dana (Markham 1977).

Quantitative Information

Weight—
Abundance—"common in surf zone of semiprotected sandy beaches" (Schmitt 1921).

Life History Information

Reproduction—
Growth Rate—
Longevity—
Food—
Predators—fish.
Behavior—

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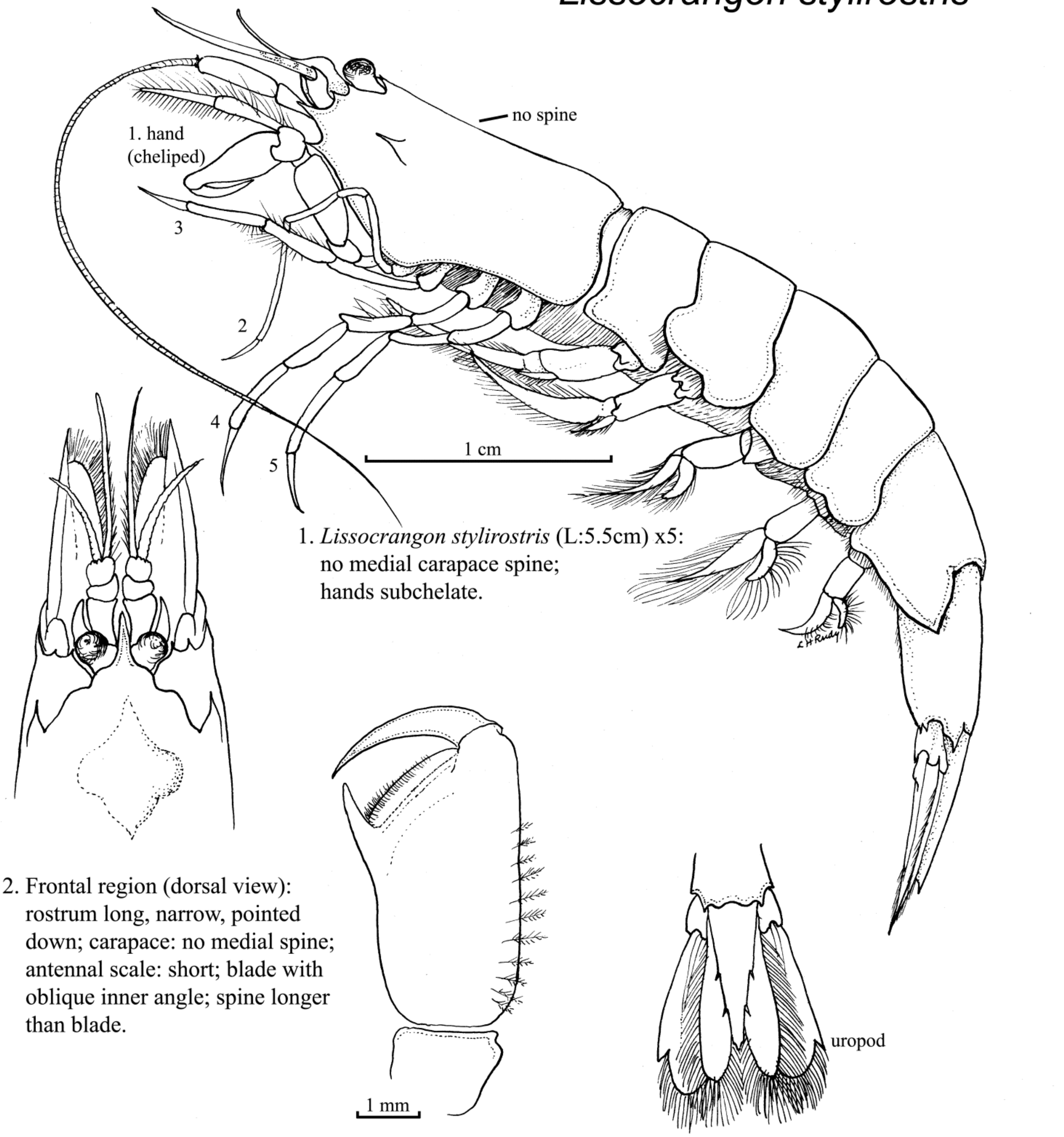
Lissocrangon stylirostris



1. *Lissocrangon stylirostris* (L:5.5cm) x5:
no medial carapace spine;
hands subchelate.

2. Frontal region (dorsal view):
rostrum long, narrow, pointed down; carapace: no medial spine; antennal scale: short; blade with oblique inner angle; spine longer than blade.

3. Cheliped, manus x12

4. Telson:
telson shorter than uropods.

Megalorchestia pugettensis

A beach hopper (Dana, 1853)

Phylum: Arthropoda
Class: Crustacea
Order: Amphipoda, Gammaridea
Family: Talitridae

Description

Size—to 18 mm; this specimen 17 mm, without antennae (Bowers 1964).
Color—white; usually with three spots on last three coxae (Bowers 1963).
First Antenna—short; not quite to middle of third article is longer than flagellum, especially in males (fig. 1) (Barnard 1975). Flagellum of about 20 articles.
Second Antenna—massive peduncle of three articles is longer than flagellum, especially in males (fig. 1) (Barnard 1975). Flagellum of about 20 articles.
Head—rostrum rounded, simple; eyes large, oval (fig. 1).
Mouthparts—mandible without palp: family Talitridae. (Mouthparts not figured, see *Orchestra traskiana*). Maxilliped article four not well developed.
First Gnathopod—simple, not subchelate, in both sexes: genus *Orchestoidea*; strong dactyl adapted for digging (fig. 2) (Barnard 1975). Translucent blister on article 6: species *pugettensis*. Also a blister on article 3.
Second Gnathopod—large, subchelate in male (fig. 1, 3); simple in female (not figured, more like gnathopod one).
Coxae—(first article of pereopod): first plate ½ as large as second (fig. 1).
Pleonites—5 and 6 separate, not fused: Talitridae; anteroventral margin of pleonite 1 with 1-7 spines: species *pugettensis*, (fig. 1).
Pereopods—6 longer than 7: genus Orchestoidea (fig. 1).
Pleopods—(small breathing organs within pleosome): 3, biramous; third about equal in size to first and second (not figured).
Telson—spinose, notched at tip (fig. 7). See figs. 1, 6 for position. Often lost in collecting.
Uropods—three pairs:

One—outer branch with marginal spines (fig. 4); no interramal spine (not figured). Inner branch: double row of spines.
Two—outer branch without spines on inner margin (figs. 5, 6).
Three—one branch: Talitridae; ramus broad distally, about as long as peduncle: genus *Orchestoidea* (fig. 6) (Barnard 1975).

Sexual Dimorphism—males with very large powerful second gnathopods; simple in females and young.

Possible Misidentifications

Beach hoppers (Talitridae) are obvious dwellers in damp sands, where they live on seaweed. They survive well in air. Talitridae have a single branched third uropod (figs. 1, 4), and a mandible without a palp (not figured, see *Traskorchestia traskiana*).

Within the Talitridae, the genus *Megalorchestia* are found on exposed beaches and are usually larger than *Orchestia*. *Orchestia sp*. have subchelate first gnathopods (like male second gnathopods), not simple ones; slender first gnathopod dactyls, not heavy ones; 7th pereopods longer than the 6th, not the reverse as in Orchestoidea; and narrowing 3rd uropod branches, not broad ones.

Other species of *Megalorchestea* include: *Orchestoidea californiana*, the largest species (in the Puget Sound area, Kozloff, 1974a), is found on beaches high in the intertidal. It has a second antenna with a long flagellum (males), spines on the inner margin of the outer rami of the 2nd uropod. The females have a translucent process on article 5 of the first gnathopod; the rami of the pleopods are short.

Orchestoidea corniculata, another large species found on coarse sand beaches with lots of protection, seaweed and a steep slope, has short second antennal flagella and spineless inner margins on the outer rami of its second uropods, like *O. pugettensis*. However, it has an entire, not a notched telson, and no spines on the margin on its first pleonites.

Orchestoidea columbiana, found on coarse sand beaches with little seaweed, has long second antennal flagella, and no spines on the margins of its pleonites. Unlike *O. californiana*, it has no translucent process on the females' gnathopod 1, and its pleopod rami are ½ to ¾ the length of the peduncle. It can be as large as 22 mm long (Bowers 1964).

O. benedicti is small (9-13 mm), and is found on fine sand beaches; its pleonites have 1-5 spines on their posterior margins, which might confuse it with *O. pugettensis*. Its telson is notched, however, and it lacks the characteristic blister on the 6th article of the male gnathopod of *O. pugettensis*.

Other genera of Talitridae include *Talitroides* and *Talitrus*, small introduced amphipods of the highwater drift line, mostly terrestrial. These have been found in the San Francisco Bay area.

Ecological Information

Range—

Local Distribution—Coos Bay: South Slough, several stations.

Habitat—under debris on coarse sand beaches with little seaweed (Barnard 1975).

Salinity—

Temperature—

Tidal Level—above tide level, likes dampness, but avoids immersion in seawater.

Associates—

Quantitative Information

Weight—

Abundance—not as common as *Traskorchestia traskiana* (Coos Bay).

Life History Information

Reproduction—pairing occurs in spring: in *O. californiana* and *O. corniculata*; young carried until 3 mm (Bowers 1964).

Growth Rate—

Longevity—possible two years maximum life span for *O. californiana* (Bowers 1964).

Food—scavenges detritus from beach debris. The closely related *O. californiana* and *O. corniculata* are omnivorous, macrophzgrous, and partial to seaweed, wet cardboard and the bodies of other arthropods. They avoid putrefied matter.

Predators—shorebirds

Behavior—nocturnal: to avoid diurnal birds, for better moisture and temperature conditions for feeding, and because they are sensitive to light (Bowers 1964).

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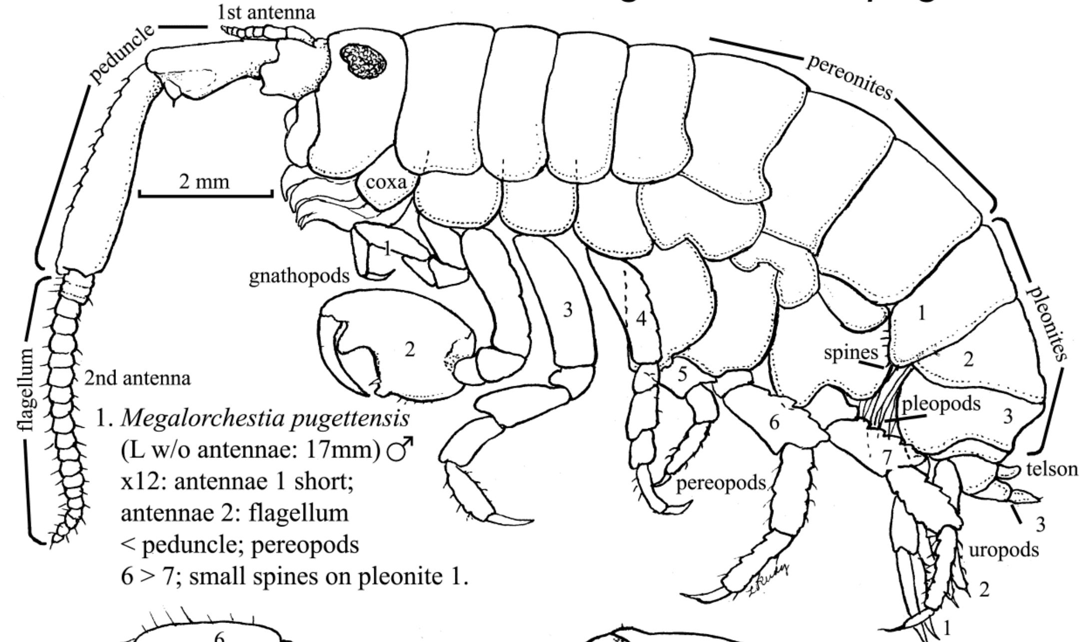
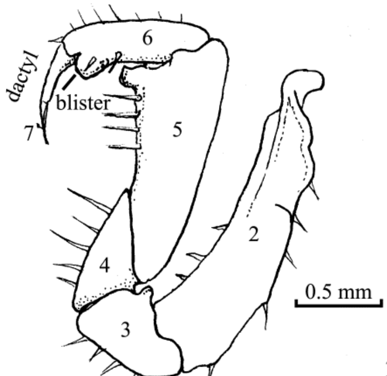
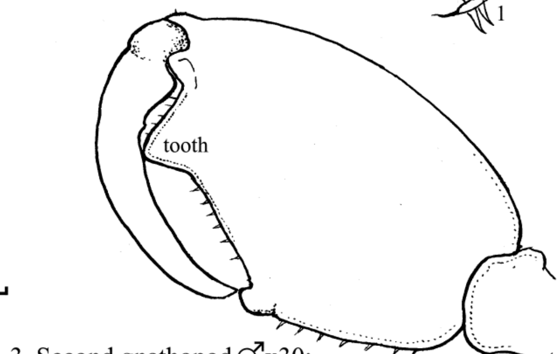
Megalorchestia pugettensis



1. *Megalorchestia pugettensis*
(L w/o antennae: 17mm) ♂
x12: antennae 1 short;
antennae 2: flagellum
< peduncle; pereopods
6 > 7; small spines on pleonite 1.

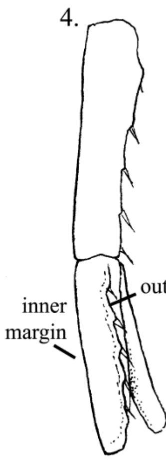


2. First gnathopod ♂ x30:
dactyl simple, strong;
blister on article 6.

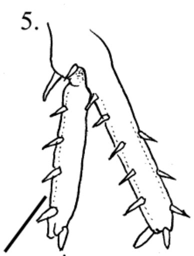


3. Second gnathopod ♂ x30:
chela large, powerful; tooth on palm.

4.

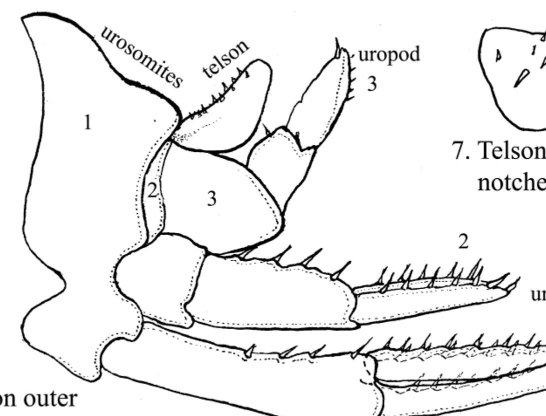


5.



4. Uropod 1 x30:
outer branch: spines on outer margin, inner margin smooth.

5. Uropod 2 x30:
outer branch: inner margin smooth.



6. Urosome x30:
uropod 3: ramus broad, as long as peduncle.

7. Telson (dorsal view):
notched at tip.

Megalorchestia pugettensis

A beach hopper (Dana, 1853)

Phylum: Arthropoda
Class: Crustacea
Order: Amphipoda, Gammaridea
Family: Talitridae

Description

Size—to 18 mm; this specimen 17 mm, without antennae (Bowers 1964).
Color—white; usually with three spots on last three coxae (Bowers 1963).
First Antenna—short; not quite to middle of third article is longer than flagellum, especially in males (fig. 1) (Barnard 1975). Flagellum of about 20 articles.
Second Antenna—massive peduncle of three articles is longer than flagellum, especially in males (fig. 1) (Barnard 1975). Flagellum of about 20 articles.
Head—rostrum rounded, simple; eyes large, oval (fig. 1).
Mouthparts—mandible without palp: family Talitridae. (Mouthparts not figured, see *Orchestra traskiana*). Maxilliped article four not well developed.
First Gnathopod—simple, not subchelate, in both sexes: genus *Orchestoidea*; strong dactyl adapted for digging (fig. 2) (Barnard 1975). Translucent blister on article 6: species *pugettensis*. Also a blister on article 3.
Second Gnathopod—large, subchelate in male (fig. 1, 3); simple in female (not figured, more like gnathopod one).
Coxae—(first article of pereopod): first plate ½ as large as second (fig. 1).
Pleonites—5 and 6 separate, not fused: Talitridae; anteroventral margin of pleonite 1 with 1-7 spines: species *pugettensis*, (fig. 1).
Pereopods—6 longer than 7: genus Orchestoidea (fig. 1).
Pleopods—(small breathing organs within pleosome): 3, biramous; third about equal in size to first and second (not figured).
Telson—spinose, notched at tip (fig. 7). See figs. 1, 6 for position. Often lost in collecting.
Uropods—three pairs:

- **One**—outer branch with marginal spines (fig. 4); no interramal spine (not figured). Inner branch: double row of spines.
- **Two**—outer branch without spines on inner margin (figs. 5, 6).
- **Three**—one branch: Talitridae; ramus broad distally, about as long as peduncle: genus *Orchestoidea* (fig. 6) (Barnard 1975).

Sexual Dimorphism—males with very large powerful second gnathopods; simple in females and young.

Possible Misidentifications

Beach hoppers (Talitridae) are obvious dwellers in damp sands, where they live on seaweed. They survive well in air. Talitridae have a single branched third uropod (figs. 1, 4), and a mandible without a palp (not figured, see *Traskorchestia traskiana*).

Within the Talitridae, the genus *Megalorchestia* are found on exposed beaches and are usually larger than *Orchestia*. *Orchestia sp*. have subchelate first gnathopods (like male second gnathopods), not simple ones; slender first gnathopod dactyls, not heavy ones; 7th pereopods longer than the 6th, not the reverse as in Orchestoidea; and narrowing 3rd uropod branches, not broad ones.

Other species of *Megalorchestea* include: *Orchestoidea californiana*, the largest species (in the Puget Sound area, Kozloff, 1974a), is found on beaches high in the intertidal. It has a second antenna with a long flagellum (males), spines on the inner margin of the outer rami of the 2nd uropod. The females have a translucent process on article 5 of the first gnathopod; the rami of the pleopods are short.

Orchestoidea corniculata, another large species found on coarse sand beaches with lots of protection, seaweed and a steep slope, has short second antennal flagella and spineless inner margins on the outer rami of its second uropods, like *O. pugettensis*. However, it has an entire, not a notched telson, and no spines on the margin on its first pleonites.

Orchestoidea columbiana, found on coarse sand beaches with little seaweed, has long second antennal flagella, and no spines on the margins of its pleonites. Unlike *O. californiana*, it has no translucent process on the females' gnathopod 1, and its pleopod rami are ½ to ¾ the length of the peduncle. It can be as large as 22 mm long (Bowers 1964).

O. benedicti is small (9-13 mm), and is found on fine sand beaches; its pleonites have 1-5 spines on their posterior margins, which might confuse it with *O. pugettensis*. Its telson is notched, however, and it lacks the characteristic blister on the 6th article of the male gnathopod of *O. pugettensis*.

Other genera of Talitridae include *Talitroides* and *Talitrus*, small introduced amphipods of the highwater drift line, mostly terrestrial. These have been found in the San Francisco Bay area.

Ecological Information

Range—

Local Distribution—Coos Bay: South Slough, several stations.

Habitat—under debris on coarse sand beaches with little seaweed (Barnard 1975).

Salinity—

Temperature—

Tidal Level—above tide level, likes dampness, but avoids immersion in seawater.

Associates—

Quantitative Information

Weight—

Abundance—not as common as *Traskorchestia traskiana* (Coos Bay).

Life History Information

Reproduction—pairing occurs in spring: in *O. californiana* and *O. corniculata*; young carried until 3 mm (Bowers 1964).

Growth Rate—

Longevity—possible two years maximum life span for *O. californiana* (Bowers 1964).

Food—scavenges detritus from beach debris. The closely related *O. californiana* and *O. corniculata* are omnivorous, macrophzgrous, and partial to seaweed, wet cardboard and the bodies of other arthropods. They avoid putrefied matter.

Predators—shorebirds

Behavior—nocturnal: to avoid diurnal birds, for better moisture and temperature conditions for feeding, and because they are sensitive to light (Bowers 1964).

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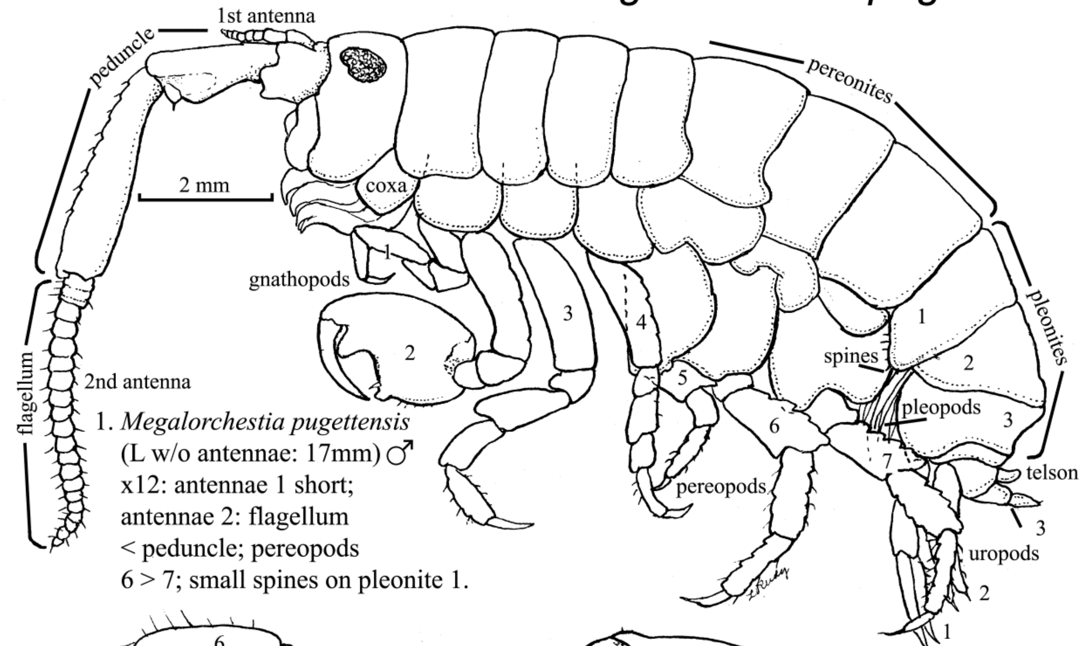
Megalorchestia pugettensis



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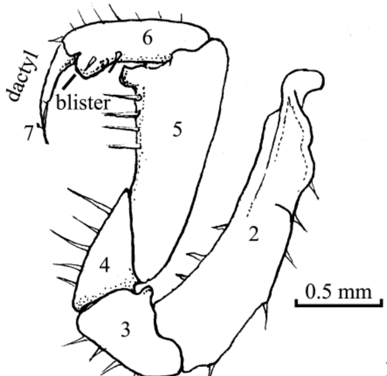
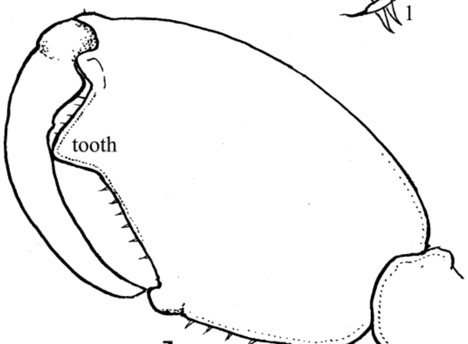


2. First gnathopod ♂ x30: dactyl simple, strong; blister on article 6.



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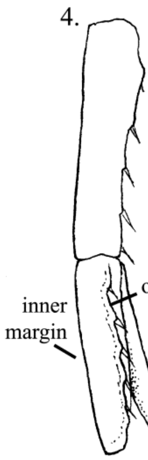
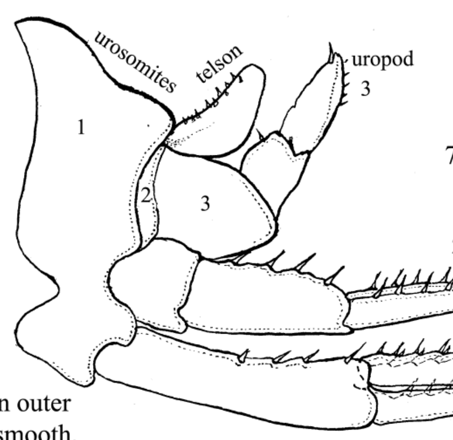


5.

4. Uropod 1 x30: outer branch: spines on outer margin, inner margin smooth.

5. Uropod 2 x30: outer branch: inner margin smooth.



6. Urosome x30: uropod 3: ramus broad, as long as peduncle.

7. Telson (dorsal view): notched at tip.

Neomysis mercedis

A mysid, or opossum shrimp (Holmes, 1897)

Phylum: Arthropoda
Subphylum: Crustacea
Class: Malacostraca
Order: Mysida
Family: Mysidae

Description

Size—11 to 15 mm in length (Banner 1948b); these specimens (Columbia River): to 17 mm.
Color—clear, black chromatophores; an eelgrass specimen was yellow green (Banner 1948b).
Body—carapace attached to thorax by anterior segments only; posterior dorsal edge free: order Mysidacea (Banner 1948a) (fig. 1). Eyes stalked, antennules biramous, antennae with long scale or squama; thoracic legs with swimming exopodites; pleopods often reduced. Females with oostegites (brood pouch or marsupium): order Mysidacea. Uropods lamellar, forming tail fan.
Antennae—long, slender, multiarticulate (fig. 1).
Antennae Scale—(squama) long, narrow, about 8 times longer than wide: sp. *mercedis* (Banner 1948b); but variable, not dependable character trait (Holmquist 1973). Scale setose all around, apex pointed: genus *Neomysis* (Tattersall 1933); tip articulated (fig. 3).
Eyes—on movable stalks; about 1.5x as long as broad. Corneas expanded, not separated into 2 portions (fig. 3).
Mouthparts—labrum "normal," i.e. not produced posteriorly as a cleft plate, and with anterior sharp point (Tattersall 1933) (not figured). Anterior pointed, but not with long sharp spine: sp. *mercedis* (Holmquist 1973). Mandibles without expanded cutting lobe (Banner 1948a) (not figured).
Carapace—not attached dorsally at posterior edge; anterior lateral angles acute (fig. 3).
Rostrum—a short triangle with obtusely pointed apex, and rounded, “flanged” corners (Tattersall and Tattersall 1951). Medial depression obscures apex (Holmquist 1973). Rostrum only as long as bases of eyestalks (Tattersall and Tattersall 1951) (fig. 3).
Thoracic Legs—first with endite of basipodite well developed (Banner 1948b); endopod developed into a maxilliped-like feeding structure; 2nd, 3rd and 4th segments with enlarged lobes: subfamily Mysinae (Banner 1948b) (fig. 4). 3rd through 8th legs similar; 3rd leg not copulatory: tribe Mysini (Banner 1948); endopods with 8 to 10 articles (fig. 5).
Oostegites—females only: 2 pairs of lamellae, or pleura; anterior pair with posterior "baling lobe" to assist in aerating embryos (not figured); setose ventral edge (fig. 2).
Pleopods—Male: 1st and 2nd rudimentary, 2nd uniramous: tribe Mysini (Banner 1948a) (fig. 6). 3rd pleopod more or less reduced (not figured); only 4th biramous: genus *Neomysis* (Banner 1948b). 4th pleopod short and slightly curved: sp. *mercedis* (Holmquist 1973), with shortened, uniarticulate endopodite, long exopodite of 2 articles, and with 2 terminal pincer setae (Banner 1948b) (fig. 7). 5th pleopods rudimentary (not figured). Female: all small, uniarticulate, rudimentary (fig. 8).
Uropods—endopods with about 30 close set spines (inner edge, ventral) near statocyst (fig. 9); exopods undivided, with setae only (no spines) on outer margin: subfamily Mysinae. Setae on inner margin as well.
Statocyst—balance and light organ on endopod of uropod: large, opaque, white in preservation (fig. 9).
Telson—short (about 2x as long as broad); tip broadly truncate, not cleft. 12 - 15 pairs of lateral spines: sp. *mercedis* (Holmquist 1973). Tip with 2 pairs of spines - outer pair long, inner pair very small, not setose (Banner 1948b) (fig. 9).

Possible Misidentifications

(See *Archaeomysis grebnitzkii* for general discussion of mysids.)

Neomysis mercedis is in the family Mysidea, which have exopodites on the 1st thoracic legs, statocysts on the uropods, and 2 to 3 pairs of female oostegites. *N. mercedis* is in the subfamily Mysinae, whose members have a wide labrum, 2 - 3 pairs of female oostegites, expanded lobes on their first thoracic legs, and only setae (no spines) on the outer margin of their uropod exopods. (The Gastrosaccinae, to which *Archaeomysis* belongs, lack thoracic lobes, and have spines on the uropods. Males in both subfamilies can have various male pleopods.)

There are 4 tribes in the subfamily Mysinae; 3 are present in our area (Leptomysini, the 4th, is not):

Erythropini, represented in the northeastern Pacific by *Pseudosomma* and *Holmesiella,* have biramous male pleopods (the posterior 4 pairs) (Banner 1948a).

Heteromysini differ from both Erthropini and Mysini in having unusual 3rd thoracic legs: they are strongly thickened, with an undivided, thick and spinose propodus. All the male pleopods are rudimentary in this tribe (Banner 1948a). One species, *Heteromysis odontops* Walker has been found off Washington (Banner 1948b).

The tribe Mysini, to which *Neomysis* belongs, have 3rd thoracic legs which are similar to the more posterior legs. At least the 2nd male pleopods are uniramous (Banner 1948a). Several of the 25 genera in this tribe are present in our area; the most common, besides *Neomysis,* are *Mysis*, *Holmesimysis* (Holmquist, 1979) and *Acanthomysis* Holmquist 1979.

Mysis spp. have a 4th male pleopod whose exopod has 6 or more segments (Mauchline 1980). *M. litoralis* (Banner, 1948) is an eelgrass species found so far only in the San Juan Islands (Holmquist 1982). Its uropod endopods are shorter than the telson, and have 7 spines on the inner margins. The telson is cleft, with 2 plumose setae within the cleft. *M. oculata* (Fabricius, 1780) is now considered to be a distinct Alaskan species (Holmquist 1982).

Holmesimysis was extracted from *Acanthomysis* (Holmquist 1979). Its members have 4th male pleopods with only 2 segments; on the tip are 2 spiny peg-like structures (Mauchline 1980). *H. costata* (Holmes, 1900), the type species, has a short, bluntly rounded antennal scale. *Holmesimysis sculpta* (Tattersall, 1933) is a littoral species ranging from Vancouver Island to southern California (Banner 1948b). It has a narrow, uncleft telson armed with 2 pairs of strong posterior spines, which are longer than the lateral spines. The abdominal segments are highly sculptured; the latter segments have strong spines (Tattersall 1933). *Holmesimysis nuda* (considered a subspecies of *H. sculpta* by Banner 1948b) shares the telson armature of *H. sculpta,* but lacks its folds and ridges. *H. sculptoides* and *H. nudensis* are 2 other species in this genus (Holmquist 1979).

The genus *Acanthomysis* has been extensively revised by Holmquist (Holmquist 1979; Holmquist 1981). New genera derived from this genus are *Alienacanthomysis, Disacanthomysis, Exacanthomysis, Pacifacanthomysis* and *Xenacanthomysis.* All of these are distinguished from *Neomysis* by the rounded apex of the antennal scale, (it is pointed in *Neomysis* (fig. 3)) and some by their rounded telsons (truncate in *Neomysis* (fig. 4)). Species from our area include:

Alienacanthomysis macropsis (Tattersall, 1932), with a broadly triangular rostrum with long acute lateral carapace spines. Its eyestalks are long, its telson has a fringe of small spines. Abundant in San Francisco Bay, it becomes rarer farther north (Holmquist 1979). Reported from Yaquina Bay, lower Columbia River. In Puget Sound in bays in *Ulva* and in plankton (Kozloff 1974a). Found from Alaska to southern California, sometimes with *X. pseudomacropsis* below (Holmquist 1982).

Exacanthomysis davisii (Banner, 1948) has a long, narrow telson with small equal lateral spines and 2 long terminal spines. The abdominal segments are folded. It is found in plankton and in eelgrass in Puget Sound (Kozloff 1974a), and ranges from Alaska to southern California (Holmquist 1982).

Pacificanthomysis nephrophthalma (Banner, 1948) also has a long narrow telson, with alternating long and short lateral spines. It is found in plankton in Puget Sound (Kozloff 1974a). Occurring from Gulf of Alaska to Monterey, California (Holmquist 1981), it inhabits both inland and offshore waters and open ocean, from the surface to depths (Banner 1948b).

Xenacanthomysis pseudomacropsis (Tattersall, 1933) has broad, short eyestalks and a rounded telson with spines which become quite thick distally. Like all in this group it has a rounded apex on the antennal scale. Females and immatures of *X.*

pseudomacropsis and *A. macropsis* above are difficult to distinguish (Banner 1948b; Tattersall and Tattersall 1951); the 2 species are often found together, although *X. pseudomacropsis* is more northern (Holmquist 1982). It is found in Puget Sound in the plankton (Kozloff 1974a).

"Acanthomysis" columbiae (Tattersall, 1933) is an "obscure" species (Holmquist 1981) whose descriptions, particularly of the telson – described as broad and square with equal small spines, or as rounded with dense unequal ones - are contradictory. It has been found from British Columbia and from northern California; its status needs clarification.

Other less common northeastern Pacific genera of the tribe Mysini include:

Proneomysis wailesii (Tattersall, 1933) has a rounded apex on its antennal scale, a pair of large spines at the apex of the telson (Hair 1971), and a 4th pleopod with a 3 segmented exopodite (Mauchline 1980). It has been collected off British Columbia, and from shallow water in Puget Sound (Banner 1948b).

Inusitatomysis insolita (Ii, 1940) has a dentate outer edge to its antennal scale; its telson is cleft, with spines and 2 plumose setae within it (Mauchline 1980). It has not yet been found south of British Columbia (Holmquist 1982).

Columbiaemysis ignota (Holmquist, 1982) has been described from female specimens only, and only from British Columbia. Its antennal scale is long, setose all around, and has a suture. Its telson is tongue shaped, with spines becoming dense at the tip, and 2 long spines at the rounded apex. There are 4 spines on the lower edge of the statocyst.

There are several Pacific species of the genus *Neomysis* (all with pointed apex on the antennal scale, 2 pairs of female oostegites, statocyst on the uropod, and only the 4th male pleopods biramous):

Neomysis integer (Leach, 1814) is an Atlantic species; it has also been found in plankton in Puget Sound (Kozloff 1974a). It has a long pointed antennal scale, a long telson with a narrow, truncate apex and long dense lateral spines; there are about 15 spines near the statocyst.

N. kadiakensis (Ortmann, 1908) is a large species (20 to 23 mm long) (Banner 1948b), with over 40 spines near the statocyst. Its telson is long and narrow with 20 or more pairs of lateral spines (Banner 1948b) - longer than the distances between their bases. The eyes have corneas larger than their stalks; the rostrum is bluntly triangular. *N. kadiakensis* ranges from Alaska to Washington and the Columbia river, and occurs in San Francisco Bay. Although considered a neritic species, it is possibly more common inside bays and inlets than outside (Banner 1948b).

N. rayii (Murdoch, 1884) *(=franciscorum)* has a telson at least 2 ½x longer than wide; the truncate telson tip is very narrow; there are 10 to 12 pairs of lateral telson spines. Near the statocyst are 20 to 50 spines. This is a large species (18 to 65 mm long (Banner 1948b)). It ranges from Alaska to San Francisco Bay. Typically found in the plankton in Puget Sound (Kozloff 1974a), it has also been collected in Yaquina Bay and the lower Columbia River.

N. awatschensis (Brandt, 1851) has long been confused with *N. mercedis;* it is now considered to be an Asiatic Pacific species. Eastern Pacific examples of *N. awatschensis* are now in synonymy with *N. mercedis* (Holmquist 1973). The true *N. awatschensis* is small (only to 10 mm long); shallow water specimens are black. It has a sharply pointed rostrum and labrum, an antennal scale 11x as long as broad, and 13 to 15 pairs of spines crowded on the lateral margins of the telson (Holmquist 1973). The male pleopods in *N. awatschensis* are much longer than in *N. mercedis,* and they are straight, not curved (Holmquist 1973). Previous reference to *N. awatschensis* in *Ulva* in Puget Sound (Kozloff 1974a), and in the Sacramento and San Joaquin Deltas of California (Hair 1971; Heuback 1969; Turner and Heuback 1966) may now be considered to be *N. mercedis.*

N. intermedia (Czerniavsky, 1882) is very close to both *N. awatschensis* and to *N. mercedis* (Holmquist 1973; Tattersall 1932). It is an Asiatic and Alaskan species, which mingles with *N. awatschensis* in Japan. It doesn't occur east of the Alaska Peninsula (Holmquist 1973). The chromosome count in *N. intermedia* was n=32, which may be the same as for *N. mercedis* (Holmquist 1973). Morphologically, *N. intermedia* shares more traits with *N.* awatschensis than with *N. mercedis*: the long, sharp process on the labrum, and the length and shape of the males 4th pleopods. *N. intermedia* is much larger than *N. awatschensis* (Holmquist 1973).

None of the preceding aforementioned *Neomysis* species, then, has the short, curved male pleopod with its proximal article 4x the distal article. Also distinctive in *N. mercedis* is the antennal scale, which is 8x longer than wide (Banner 1948b).

Ecological Information

Range—Prince William Sound, southern Alaska, to San Francisco Bay area; possibly to past Pt. Conception, California (Orsi and Knutson 1979). Washington in Puget Sound and inland lakes; Oregon: Fletcher Lake, rivers and coastal waters; California: Lake Merced, Lake Merritt, Sacramento· San Joaquin estuary (Holmquist 1973).
Local Distribution—Oregon coastal waters: lagoons, inlets, estuaries, bays (Holmquist 1973). Planktonic in fresh water; originated in shallow marine bays, from which it has also moved into completely fresh lakes (Banner 1948b). Very sensitive to O_2 content of water; does poorly at less than 8 ppm (Heuback 1969).
Habitat—
Salinity—euryhaline; tolerates a wide range of salinities, but becomes stressed with sudden changes to fresh water (Heuback 1969). Especially common in shallow bays with salinities of 10 ‰ and less (Banner 1948b). Ranges farther upstream into fresh water than any other *Neomysis*: from 30 ‰ to fresh water.
Temperature—eurythermic (Holmquist 1973): 7 - 27 °C in summer; winter temperatures unknown (Holmquist 1973). Upper lethal temperature 24 - 25.5 degrees. Densities low when temperature is over 22 degrees, especially when combined with low dissolved O_2 (Heuback 1969).
Tidal Level—subtidal. Closer to surface at flood than at ebb tide (Heuback 1969).
Associates—sometimes with *Archaeomysis grebnitzkii;* more rarely with *Exacanthomysis davisii, Alienacanthomysis macropsis* and other mysids (Holmquist 1982).

Quantitative Information

Weight—
Abundance—2nd most common mysid of northeastern Pacific after *A. grebnitzkii* (Holmquist 1982). In Coos Bay (summer) densities varied from 0/m^3 to 29/m^3 (Ziegler 1983). Peaks were May 26, July 3 (highest), July 24; correlated with high temperatures and chlorophyll counts, possibly with reproductive swarming. California: Delta densities drop off when temperatures over 18°C., high light intensity, salinities less than 10‰, little flow reversal occurring at floodtide. Greatest densities: 31/m^3 in lowest freshwater stations to 2 ‰, summer (Heuback 1969).

Life History Information

Reproduction—takes place during most of year, but few gravid females in December, January (Heuback 1969). Most active in summer, when populations highest. Numbers of early embryos depend on female body size, egg size, and season (in high and temperate latitudes); estuarine *N. mercedis* females 7 to 17 mm long had a range of 5 to 57 in brood (Heuback 1969). Percentage of small gravid females (7 - 10 mm) greatest late summer, fall; they die soon after; this size group lacked marsupium in winter. 11 - 12 mm females gravid most of year, and do greatest eggbearing early summer. Large females (over 13 mm), gravid late winter, spring: California, Delta (Heuback 1969).
Growth Rate—in Japanese *Neomysis*, the May generation matured in 1 ½ months; August generation in following April (Tattersall and Tattersall 1951). Coos Bay brood time probably 5 weeks (Ziegler 1983).
Longevity—*Neomysis integer* lifespan probably 12 to 18 months; lives shorter time in dense cultures of diatoms and diatom-free water (see Lucas in Tattersall and Tattersall, 1951).
Food—prefers large diatoms in Delta, but 80% of energy from rotifers and copepods. Not an active predator: captures prey in its current; adults feed continuously, especially at night. Juveniles eat rotifers when available, but not copepods. Detritus consumption negligible. Will eat *Artemia* nauplii in lab

(Siegrdied and Kopache 1980). In Fraser River, British Columbia, species eats harpacticoid copepods (Johnston and Lasenby 1982); in Lake Washington, cladoceran *Daphnia* Murtagh 1981). In lab, *N. integer* consumed average of over 1 million cells, and maximum of 6 million cells, of diatom *Nitzschia*/hour (See Lucas in Tattersall and Tattersall 1951).

Predators—a primary food for fishes of upper bays. Principal food of young of year striped bass: California, Delta (Murtagh 1981). Also eaten by shad, white sturgeon, white catfish, caridean shrimp.

Behavior— in sea water, tends to avoid light if in dense diatom cultures (Tattersall and Tattersall 1951). Lives on or close to sediment in day, and migrates toward surface at night. Vertical migration not related to sex, size or maturity (Heuback 1969).

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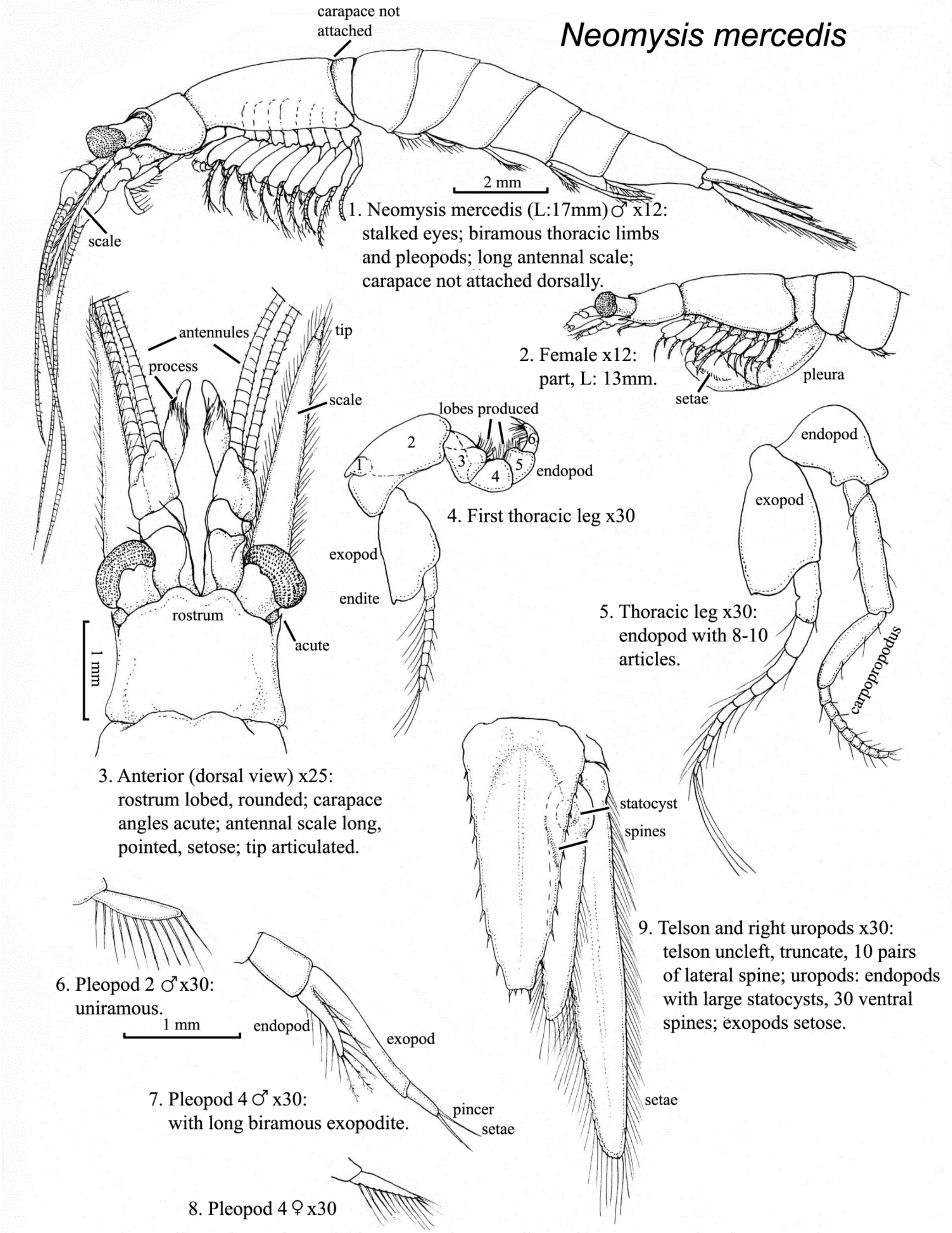
Neomysis mercedis



1. Neomysis mercedis (L:17mm) ♂ x12: stalked eyes; biramous thoracic limbs and pleopods; long antennal scale; carapace not attached dorsally.

2. Female x12: part, L: 13mm.

3. Anterior (dorsal view) x25: rostrum lobed, rounded; carapace angles acute; antennal scale long, pointed, setose; tip articulated.

4. First thoracic leg x30

5. Thoracic leg x30: endopod with 8-10 articles.

6. Pleopod 2 ♂x30: uniramous.

7. Pleopod 4 ♂ x30: with long biramous exopodite.

8. Pleopod 4 ♀ x30

9. Telson and right uropods x30: telson uncleft, truncate, 10 pairs of lateral spine; uropods: endopods with large statocysts, 30 ventral spines; exopods setose.

Neotrypaea californiensis (Callianassa californiensis)

The ghost shrimp (Dana, 1854)

Phylum: Arthropoda
Class: Crustacea, Malacostraca
Order: Decapoda, Reptantia
Section: Macura
Family: Thalassinidea, Callinassidae

Description

Size—to 90 mm (Carlton and Kuris 1975).
Color—can be white to red "ghost-like"; figured specimen pale pink, abdomen light orange; hairless.
Rostrum—not prominent; a small blunt tooth, not acute (Kozloff 1974a).
Eyes—eyestalks flattened, corneas dorsal (fig. 2): Callianassa (genus).
First Legs—chelate and unequal (fig. 1); large cheliped broad, serrate, with an obvious gap in dactyls; carpus almost square; dactyl with recurved hook distally. Either propodus may be larger; more marked in males (McGinitie 1934).
Second Legs—both chelate; propodus, dactyl equal in width (figs. 1, 3).
Walking Legs—third and fourth pairs; fifth pair subchelate". BODY-shrimp-like (Stevens 1928).
Body— shrimp-like (Carlton and Kuris 1975)
Pleopods—three pairs, fan-like (fig. 1): Callianassa (genus).
Tail-Fan—well developed; formed by telson and uropods (fig. 1).
Abdomen—elongate, not reflexed but extended; symmetrical, externally segmented: *Callianassidae* (family).

Possible Misidentifications

Upogebia pugettensis, the blue mud shrimp, is often found with Callianassa. *Upogebia* is larger, its color is strikingly different; its burrows are firm and substantial. The most noticeable morphological difference is its first pair of legs both of which are small, subchelate and equal. Its rostrum is hairy; its color is never reddish.

The only other local intertidal species of *Callianassa* is *C. gigas* (= longimanus), a larger (to 125 mm), rarer animal of the sandy sublittoral, with a prominent flattened tooth on the inner edge of the dactyl of the large male cheliped and a curved, wide propodus on the second pereopod. Its rostrum is sharp, and its first chela closes without a gap. It is more abundant farther north geographically and lower in the tidal zone (Ricketts and Calvin 1971). It is the more commonly found species found in Humboldt Bay, CA.

Ecological Information

Range—Alaska to Baja California. Type: "California".
Local Distribution—Coos Bay; Alsea River (Gaumer et al. 1973b), Nestucca estuary (Gaumer et al. 1973a), Netarts Bay (Gaumer et al. 1974), Umpqua estuary (Umpqua Estuary 1978), Tillamook Bay (Gaumer 1973b), Yaquina Bay (Gaumer et al. 1974).
Habitat—builds large sloppy permanent burrows with side tunnels; a tireless digger, it turns over acres of northwest oyster beds (Rickett sna d Calvin 1971); burrows can be to 30"deep (MacGinitie and MacGinitie 1949). Can survive anoxia for nearly 6 days (Morris and Abbott et al 1980).
Salinity—collected at 30 0/00. Lower lethal limit-25-30% seawater; an osmotic conformer (Thompson and Pritchard 1969). Upper limit tolerated-125% seawater (Morris et al 1980).
Temperature—
Tidal Level—collected at medium high zone (+ 4 ft.); upper to mid-intertidal; most shoreward burrowing shrimp: 0.0- + 1.0 foot (Ricketts and Calvin 1971).
Associates—the blue mud shrimp, *Upogebia pugettensis*, is found overlapping *Callianassa*'s territory, though it is generally lower and in muddier sediments. Common commensals in ghost shrimp burrows include a polynoid worm *Hesperonoe*, pinnotherid crabs, copepods (*Hemicyclops, Clausidium*), the shrimp *Betaeus*, the bopyrid isopod *Ione cornuta*, the goby *Clevelandia* ios, and the clam *Cryptomya californica*.

Quantitative Information

Weight—

Abundance—common in Oregon's estuarine mudflats.

Life History Information

Reproduction—continuous in Central California, optimum June and July (Ricketts and Calvin 1971). Larvae are flushed into nearby ocean by tides, where they spend most of larval period in plankton; exchange between bays probably common (Johnson and Gonor 1982).
Growth Rate—
Longevity—
Food—detritus, obtained by ingesting mud as it burrows the top (richest) layer (MacGinitie and MacGinitie 1949) also filter feeds by pumping water through burrow (Powell 1974A).
Predators—adult: man (for fish bait); keeps to its burrow to prevent predation. Juveniles: larval forms eaten by plankton eaters, (salmon, etc.).
Behavior—constant digger, fastidious self-groomer. See McGinitie (McGinitie 1934 and MacGinitie and MacGinitie 1949). Digging activities smother young oysters. Pesticide Sevin tried, Willapa Bay, WA.

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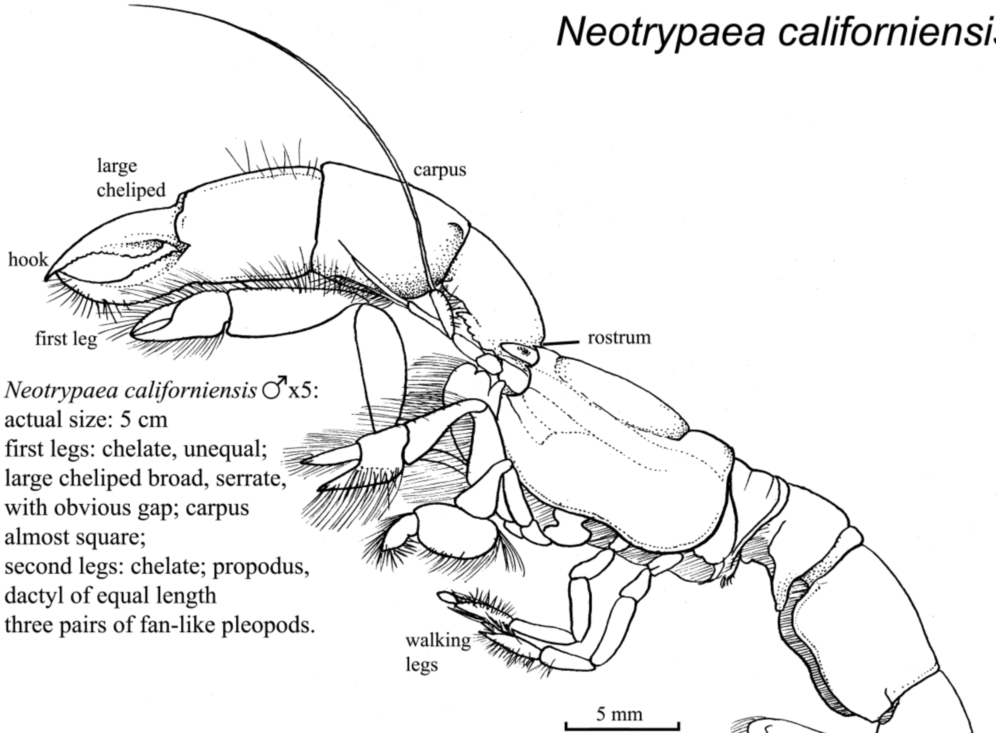
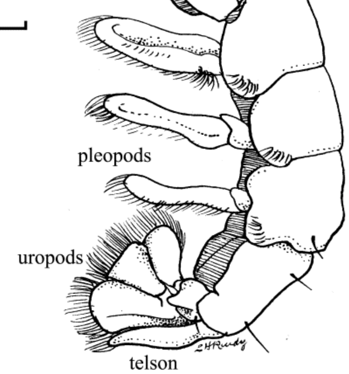
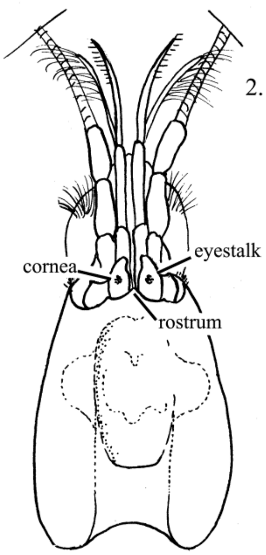
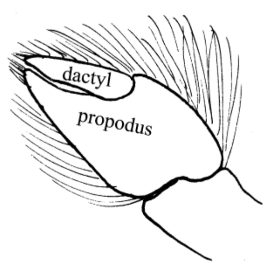
Neotrypaea californiensis

1. *Neotrypaea californiensis* ♂x5:
   actual size: 5 cm
   first legs: chelate, unequal;
   large cheliped broad, serrate,
   with obvious gap; carpus
   almost square;
   second legs: chelate; propodus,
   dactyl of equal length
   three pairs of fan-like pleopods.



2. Head (dorsal view):
   eyestalks flattened, acute,
   pigmented, divergent;
   corneas dorsal
   rostrum: small, blunt



3. Second pereopod:
   dactyl (top) closes to
   propodus without a gap;
   dactyl, propodus same
   width.

Nippoleucon hinumensis *(=Hemileucon comes)*

A cumacean (Caiman, 1907)

Phylum: Arthropoda
Subphylum: Crustacea
Class: Malacostraca
Order: Cumacea
Family: Leuconidae

Description

Size—both males and females 5 mm long; illustrated specimens, Columbia River.
Color—
Eyes—none in either sex.
Antennae—antennae 1 - female: normal, i.e. short. Antennae 2- female: rudimentary (Jones 1963). Male: 5 article peduncle, long flagellum (12 segments) extends to 2nd thoracic segment (Calman 1907) (fig. 3).
Mouthparts—(not figured); 2 pairs maxillae, 3 pairs maxillipeds; mandibles with massive truncate bases: family leuconidae. Mandibles without palp, and with strong molar process, incisor process, lacinia mobilis (Fage, 1951).
Carapace—female: wide antennal notch; produced into a tooth at anterolateral angle (fig. 1). Anterior and posterior edges slightly serrate; anterior half of carina finely and irregularly serrate. (Jones 1963 found 2 oblique ridges on sides of carapace; none seen in these specimens.) Male: anterolateral edge not produced into a tooth; no serrations on anterolateral or lower edges (Jones 1963); no antennal notch (Calman 1907) (fig. 2).
Pseudorostrum—female: abruptly upturned (fig. 1); male: horizontal, truncate (fig. 2).
Pereopods—female: expedites on 1, 2, and 3: family Leuconidae (Stebbing 1913) (fig. 1). Pereopods 4 and 5 without exopodites (fig. 5). Male: exopodites on pereopods 1 - 4, none on 5 (Calman 1907) (figs. 2, 4).
Pleopods—female: none, as in most of order Cumacea. Males: none: genus *Hemileucon* (but see also Nannastacidae, see Possible Misidentifications).
Abdomen—6 segments, 5th being longest. Telson coalesced with 6th somite (figs. 1, 2, 6).
Uropods—peduncle longer than abdominal segment 6 (Calman 1907), and more than 2/3 as long as the rami (Stebbing 1913). Uropods are slender, cylindrical, biramous. Inner branch (endopod) biarticulate: families Leuconidae, Hemileuconidae. 1st article of endopod longer than 2nd, and with 9 spines on inner edge; endopod shorter than exopod

(Jones 1963) (fig. 6). Exopod (outer branch) also biarticulate (as in all Cumacea (Watling 1979)). Exopod has 2 unequal terminal setae (Calman 1907) (fig. 6): sp. *hinumensis* (Jones 1963); a series of setae on both inner and outer edges (Calman 1907). Uropods similar in both sexes.
Telson—none: not independent, but fused with last abdominal segment: family Hemileuconidae (fig. 1).
Brood Pouch—large, simple, transparent; in mature females only (not figured).
Sexual Dimorphism—not as strong in this species as in those in which males have eyes and pleopods. Males are more slender, longer than females. Males have long 2nd antennae, and lack a brood pouch. Young males are much like females.

Possible Misidentifications

The families Lampropidae, Diastylidae and Pseudocumatidae have true telsons. The Hemileuconidae and 3 other cumacean families lack true telsons.

The Bodotriidae have male pleopods, (2, 3, or 5 pairs), entirely lacking in Hemileuconidae. Bodotriidae are represented on our coast by *Cyclaspis* sp.

The Nannastacidae, including the common *Cumella vulgaris,* lack a true telson (like the Hemileuconidae); they also lack pleopods - also like the Hemileuconidae. The best characteristic for separating these 2 families is the endopod of the uropod, which is always uniramous in the Nannastacidea, and is biramous in the Hemileuconidae. The Nannastacidae males have 4 pereopods with exopodites (like *Nippoleucon);* the females, however, have only 2 pereopods with exopodites, as opposed to 3 in *Nippoleucon* females.

The Leuconidae have recently been separated from the Hemileuconidae (Given

1969), and assigned 4 genera, *Pseudoleucon*, *Leucon*, *Eudorella,* and *Eudorellopsis.* (This separation is not followed by Jones 1963, however; see below.) Both the Leuconidae and the Hemileuconidae lack an independent telson; both have a biarticulate endopod on the uropod. In Leuconidae, however, there are usually 2 pairs of male pleopods, rarely 1 or 0 pairs; there are no male pleopods in the Hemileuconidae. The Leuconidae males have 5 pereopods with exopodites, or rarely, 3; the Hemileuconidae males have 4 pairs of pereopodal exopodites. Male Leuconidae have 2nd antennae as long as the body; they are shorter in the Hemileuconidae (Given 1969). Female Leuconidae have 4, or rarely 3 pairs of thoracic exopodites; there are 3 pairs in the Hemileuconidae. Thus it might be difficult separating females of these 2 families, especially those of *Leucon* spp.

Several genera of the Leuconidae are found on the Pacific Coast: *Leucon* spp. (nasica, *fulvus),* have in both sexes an acute (not truncate) anterior edge to the carapace. Both sexes are eyeless (Sars 1900). The males in the genus *Leucon* have 2 pairs of pleopods (Sars 1900); (in *Hemileucon* they have none).

Eudorella and *Eudorellopsis* (both sexes) have a truncate edge to the carapace - like *Nippoleucon. Eudorella* females, however, have a uropod exopod that is shorter than the endoped. *Eudorellopsis* females have an endopod longer than the exopod (Kozloff 1974a).

Jones 1963 does not separate the Hemileuconidae from the Leuconidae; he does not mention *Pseudoleucon* in his work, but includes 2 additional genera, *Paraleucon* Caiman and *Heteroleucon.* Neither of these genera seems to have representatives in our area. By Jones' definition, *Paraleucon* has only 1 pair of male pleopods; otherwise it is very like *Leucon*. *Heteroleucon* differs from *Leucon* in having exopodites on pereopods 1 and 2 in both sexes, and in having a unisegmented endopod on its uropod. The male has no pleopods.

Hemileucon (Calman, 1907) differs from *Heteroleucon* and *Paraleucon* in having no male pleopods (Jones 1963).

The family Hemileuconidae, as described by Given 1961, seems to be unigeneric. One other species, *Hemileucon uniplicatus* (Caiman, 1907) has been described (as was *N. hinumensis*) from New Zealand (Calman 1907; Jones 1963).

N. hinumensis specimens often seem to be identified “tentatively” by northwest workers. Those features that cause trouble include the oblique ridges on the carapace, found both by Jones and Caiman, and the length of the uropod peduncle (Calman1907).

Ecological Information

Range— New Zealand; Oregon.
Local Distribution—Columbia River estuary; Coos Bay: North Bend Airport site (*Nippoleucon* sp.), South Slough.
Habitat—in sediment, except during darkness, when it joins plankton.
Salinity—
Temperature—
Tidal Level—
Associates—

Quantitative Information

Weight—
Abundance—most common species found in Columbia River estuary (R. Emmett, NOAA, Astoria, personal communication). With *Cumella vulgaris,* found at up to 5600/m^2 in South Slough of Coos Bay (M. Posey, OIMB, unpublished data.)

Life History Information

Reproduction—for general cumacean information, see *C. vulgaris.*
Growth Rate—
Longevity—general information: see *Lamprops quadriplicata.*
Food—filters small particles from below surface, or grazes on surface grains (Watling 1979).
Predators—
Behavior—

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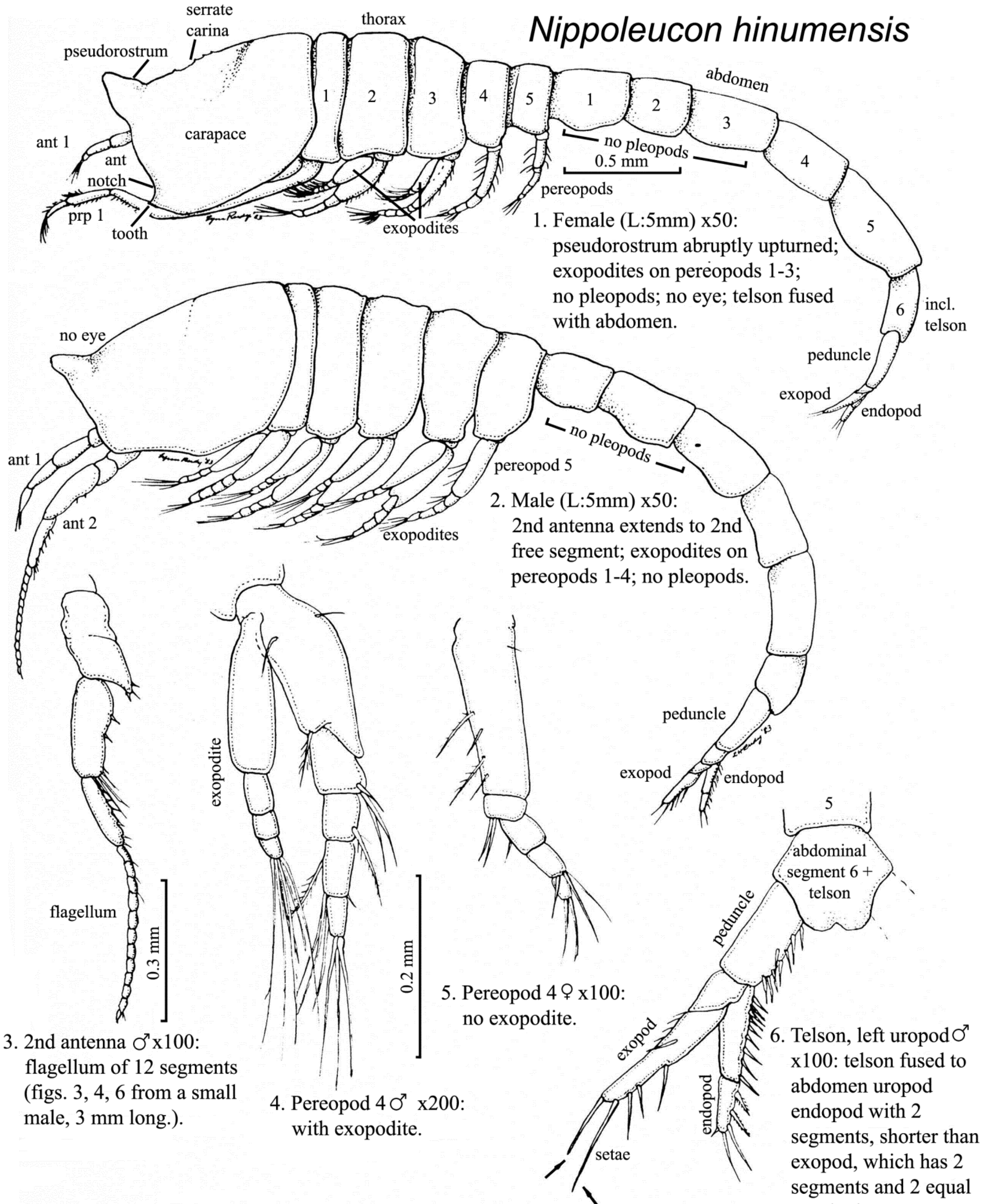
Nippoleucon hinumensis



1. Female (L:5mm) x50: pseudorostrum abruptly upturned; exopodites on pereopods 1-3; no pleopods; no eye; telson fused with abdomen.

2. Male (L:5mm) x50: 2nd antenna extends to 2nd free segment; exopodites on pereopods 1-4; no pleopods.

3. 2nd antenna ♂x100: flagellum of 12 segments (figs. 3, 4, 6 from a small male, 3 mm long.).

4. Pereopod 4♂ x200: with exopodite.

5. Pereopod 4♀x100: no exopodite.

6. Telson, left uropod♂ x100: telson fused to abdomen uropod endopod with 2 segments, shorter than exopod, which has 2 segments and 2 equal terminal setae.

Pachygrapsus crassipes

The lined shore crab (Randall, 1839)

Phylum: Arthropoda
Class: Crustacea, Malacostraca
Division: Eucarida
Order: Decapoda, Reptantia
Section: Brachyura
Family: Grapsidae

Description

Size—carapace about 40 mm wide; sexual maturity: females, 15 mm, males, 12 mm (Hiatt 1948); adult males larger than females (*ibid.*).
Color—dark green carapace, with dark red or blue transverse lines; some light markings.
Eyes—at antero-lateral angle, eyestalks of moderate size; orbits deep, oblique (fig. 2).
Frontal Area—broad margin; smooth, slightly arched, half as wide as carapace; four slight lobes below margin; small lobes at outer corners (fig. 2).
Carapace—quadrate, a little broader than long, transverse lines on anterior; one strong lateral tooth (below orbital tooth); carapace sides nearly parallel, but arched (fig. 1).
Carapace Teeth—one strong lateral tooth (and one post-orbital), fig. 2.
Chelipeds—-usually subequal, massive; chela almost smooth, arm and wrist striated (Rathbun 1918).
Walking Legs—meus of fifth (last) pair smooth at distal end: no sharply distinct teeth (fig. 3); legs broad, compressed, bristled (Rathbun 1918).
Sexual Dimorphism—male abdomen narrow and triangular, exposing sternum at sides (as in *Hemigrapsus* sp.) Female abdomen rounded, wide, hiding sternum in adult. Dirnorphism obvious when animals only 6 mm wide (Hiatt 1948).
Juveniles—alert and quick; especially long-legged, large eyes (ibid).
Megalops—much larger than that of *Hemigrapsus*: 5.6 mm long, 2.7 wide; transparent; telson with two long medial spines, several short ones (fig. 4) (ibid).

Possible Misidentifications

P. crassipes might be confused with the slower *Hemigrapsus nudus*, but the latter has obvious red spots on its chelipeds, and lacks *P. crassipes*' dark green color and transverse striations. *Hemigrapsus oregonensis* (when adult) is smaller, and like *H. nudus* has two lateral teeth and a smooth, square carapace.

The only other species of *Pachygrapsus*, the smaller *P. trans-versus*, occurs only as far north as California.

Ecological Information

Range—Oregon to Gulf of California; type: probably Oregon (erroneously Hawaii) (Hiatt 1948).
Distribution—northernmost boundary 45° (Newport, Oregon), probably due to cold winter temperatures (ibid); found on protected rocky beaches, and in southern Oregon estuaries.
Habitat—prefers hard substrates, especially rocks and boulders with crevices and crannies and algal growth; or *Salicornia* marshes whose roots provide burrows; also found on rock jetties.
Salinity—osmo-regulatory adaptations indicate movement toward terrestrial habitat (ibid); can regulate against salt concentrations in the body during periods of exposure, and thus maintain a constant body salinity (Jones 1941). Occurs less frequently in brackish water than does *Hemigrapsus* (Hiatt 1948).
Temperature—northern limit of range apparently determined by low winter temperatures; can tolerate greater temperature fluctuation than can Hemigrapsus (ibid).
Tidal Level—lives over an extensive vertical range: mean low water to plus eight feet (ibid); found highest in intertidal of all Pacific Northwest crabs, and is especially abundant at the higher levels: upper intertidal (Schmitt 1921); progressing toward terrestrial habitat (Hiatt 1948); but, as blood concentrations of potassium, calcium, and magnesium increase more than sodium when animal is dessicated, this may inhibit terrestrial adaptation (Gross 1959). Also, efficiency of animal's vascular

system, affected by osmotic stress, further limits ecological range (ibid).
Associates—virtually no parasites in western American specimens; with *Hemigrapsus oregonensis* in bays, and with *H. nudus* on rocky outer shores, with both of whom it competes for hiding places (Hiatt 1948), but not for food. *Fucus* (alga) and *Salicornia* (pickleweed) often provide protection. Can be infested by Bopyrid isopods (Southern California) (Schmitt 1921).

Quantitative Information

Weight—15 grams considered mature weight (Gross and Marshall 1960).
Abundance—"ubiquitous in upper intertidal of rocky areas (Carlton and Kuris 1975); more abundant on outer shores than in bays.

Life History Information

Reproduction—no pre-nuptial pairing or exhibitionism; copulation when females are soft, males hard; females usually ovigerous April to September (Pacific Grove, California) (Hiatt 1948), but off-season mating occurs (Ricketts and Calvin 1971); impregnation to extrusion of eggs-16 to 25 days; incubation period (average)-29 days; to megalops stage about six weeks; mating occurs once a year, occasionally twice (Hiatt 1948).
Growth Rate—females to sexual maturity in 11-12 months (to 15 mm wide); males in 7 months (about 12 mm) (ibid).
Longevity—probably about three years (Hiatt 1948).
Food—mostly herbivorous; scrapes off algal film (*Fucus, Ulva*) with excavated chelae (Hiatt 1948); also eats detritus (dead animal and plant tissue), other live animals; perception of food by visual, chemical and tactile stimuli, not by odor; feeds diurnally as well as nocturnally (Hiatt 1948), and chiefly in pools (Bovberg 1960).
Predators—gulls, rats, other *Pachygrapsus* (while soft), large anemones (*Bunodactis, Anthopleura*), which can snare small animals. Because they are nocturnal and fast, *Pachygrapsus* are not much bothered by most birds (Hiatt 1948).
Behavior—mud dwellers seldom more more than 4-5 feet from hole4; pugnacious, solitary, active; move easily and quickly in any direction; poor swimmer (Hiatt 1948). Aggregate in crevices well above the water in daylight (Bovberg 1960).

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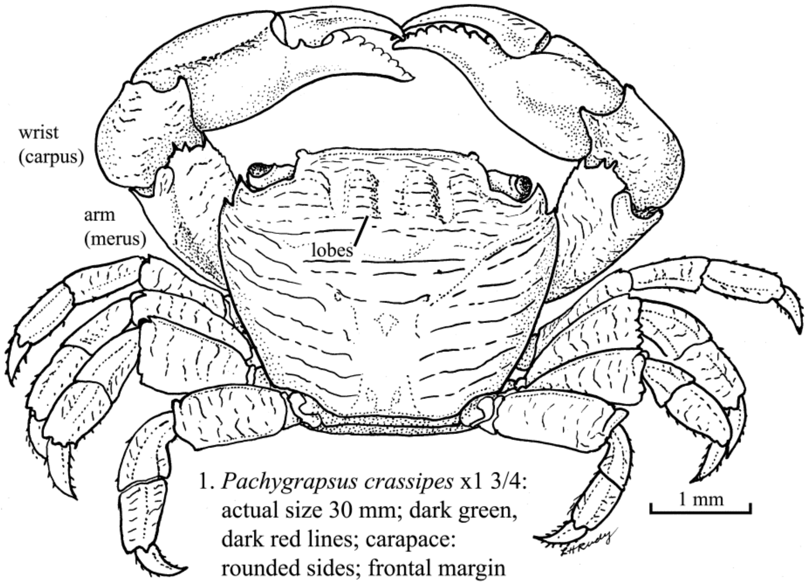
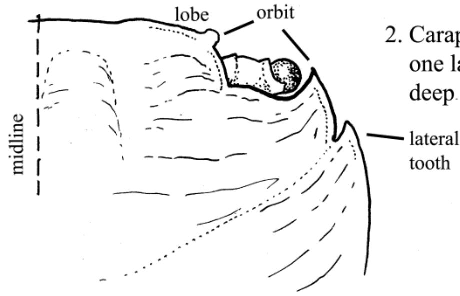
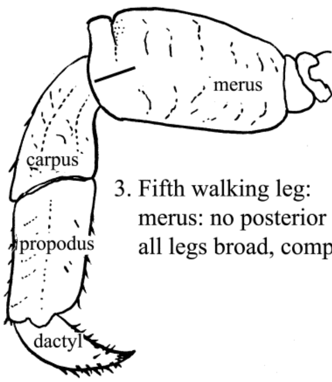
Pachygrapsus crassipes



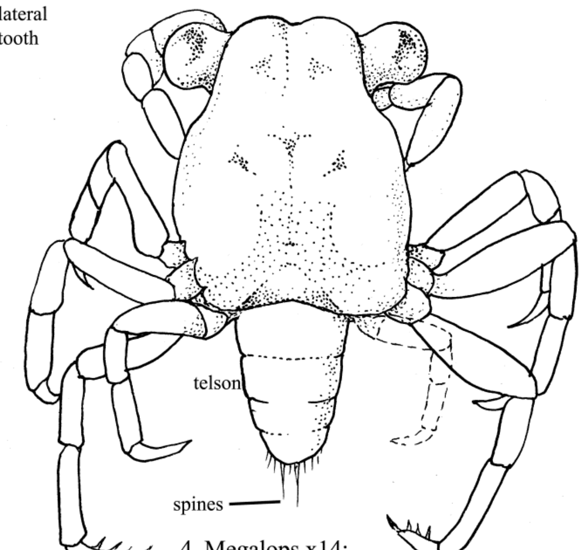
1. *Pachygrapsus crassipes* x1 3/4: actual size 30 mm; dark green, dark red lines; carapace: rounded sides; frontal margin straight; wrist and arm striated; four lobes below frontal margin.



2. Carapace (right front): one lateral tooth, one post-orbital; deep orbits.



3. Fifth walking leg: merus: no posterior teeth all legs broad, compressed.



4. Megalops x14: telson: two long spines (from Hiatt, 1948).

Pagurus hirsutiusculus

Hairy hermit crab (Dana, 1851)

Phylum: Arthropoda
Class: Crustacea
Order: Decapoda, Reptantia
Section: Anomura
Tribe: Paguridea

Description

Size—carapace length to 3.2 cm; males usually larger than females (MacGinitie and MacGinitie 1949); Puget Sound to 2 inch (body) (Ricketts and Calvin 1971).
Color-tan: antennae dark green with white stripes. Propodus of walking legs tipped with white or pale blue; dactyls with vertical red stripes, blue spots at base of dactyl. propodus; generally hairy.
Young—antennae dark green, white stripes; walking legs white-striped, never blue; merus of both chelipeds dark brown, other leg segments light brown (Bollay 1964).
Rostrum—triangular, acute.
Eyestalks—short, stout.
Left Cheliped—(small hand)-surface granular, slightly hairy; wider than deep (fig. 2).
Right Cheliped—(large hand)-rounded, twice as wide as small hand, granular, slightly hairy: one large tubercule on ventral surface (not figured).
Walking Legs—(two pairs) hairy: dactyls about as long as propodi; propodi banded with white. Two pairs of small posterior legs are adapted for holding shell.
Pleopods—small, unpaired.
Telson—with slightly asymmetrical lobes, shallow cleft.
Carapace—shield (hard, anterior portion) wider than long (McLaughlin 1974).
Abdomen—asymmetrical, elongate, twisted, soft, not externally segmented: hermit crabs.
Antennal Acicle—(antennal scale) usually exceeds eye-stalk in length. Chemoreceptors on antennuie hairs (Morris et al. 1980).

Possible Misidentifications

The hermit crabs of the genus Pagurus are hard to tell apart. Of those without red antennae, *P. beringanus*, found on rocky substrates and sublittorally, has light, orange antennae, a whitish body and red banded walking legs, as well as inverted V-shapec tubercules on its hands. *P. samuelis*, *P. hemphilli*, and *P. granosimanus* all have red antennae, as well as other differences.

Ecological Information

Range—Siberia, Pacific Northwest to southern California, where it is replaced by *P h. venturensis* (McLaughlin 1974); type locality Puget Sound.
Local Distribution—inland and coastal waters (Kozloff 1974a); South Slough of Coos Bay: in channel at Collver Point, and in mudflat of Metcalf Preserve.
Habitat—tidepools, under rocks (with coarse gravel), under seaweed (Kozloff 1974a); South Slough specimens from channel bottom, and from *Zostera* bed in mudflat; prefers algal cover (Orians and King 1964); prefers sandy tidepools (Reese 1962).
Shells—in bays, usually inhabits *Nassarius fossatus* or *Nucella lamellosa* (this specimen) (Schmitt 1921). *Nucella emarginata*, or *Littorina* sp. (Kozloff 1974a), moves to a larger shell as it grows; innate selection of shells, depending on specific weight (Reese 1962).
Salinity—collected at 30 ‰. Tolerates brackish conditions (Morris et al. 1980)
Temperature—
Tidal Level—intertidal to depths of 110 m (McLaughlin 1974); in South Slough at +0.5 feet and -15 feet.
Associates—in eelgrass: Littorine snails, amphipods (South Slough), barnacles and other sessile animals live on the shell; polynoid worms (*Halosydna*), and limpets (*Crepidula*) ofter live inside with the crabs. Polydorid worms can infect hermit crabs heavily (*Polydora commensalis*). A parasitic isopoc Pseudione giardi found with Puget Sound specimens (Morris et al. 1980).

Quantitative Information

Weight—
Abundance—usually abundant in tide-pools (Kozloff 1974a); the common hermit crabs (MacGinitie and MacGinitie 1949).

Life History Information

Reproduction—male deposits sperm on female's abdomen, after her molting. She later uses the sperm to fertilize the eggs when they are laid.
Growth Rate—
Longevity—
Food—detritus; scavenge for dead plant, animal material (Kozloff 1974a): some estuarine types filter plankton with their mouthparts (MacGinitie and MacGinitie 1949).
Predators—other crabs.
Behavior—lively, and active (especially shallow water varieties, deepwater animals are more sluggish (MacGinitie and MacGinitie 1949); will abandon shell in quiet waters (Ricketts and Calvin 1971).

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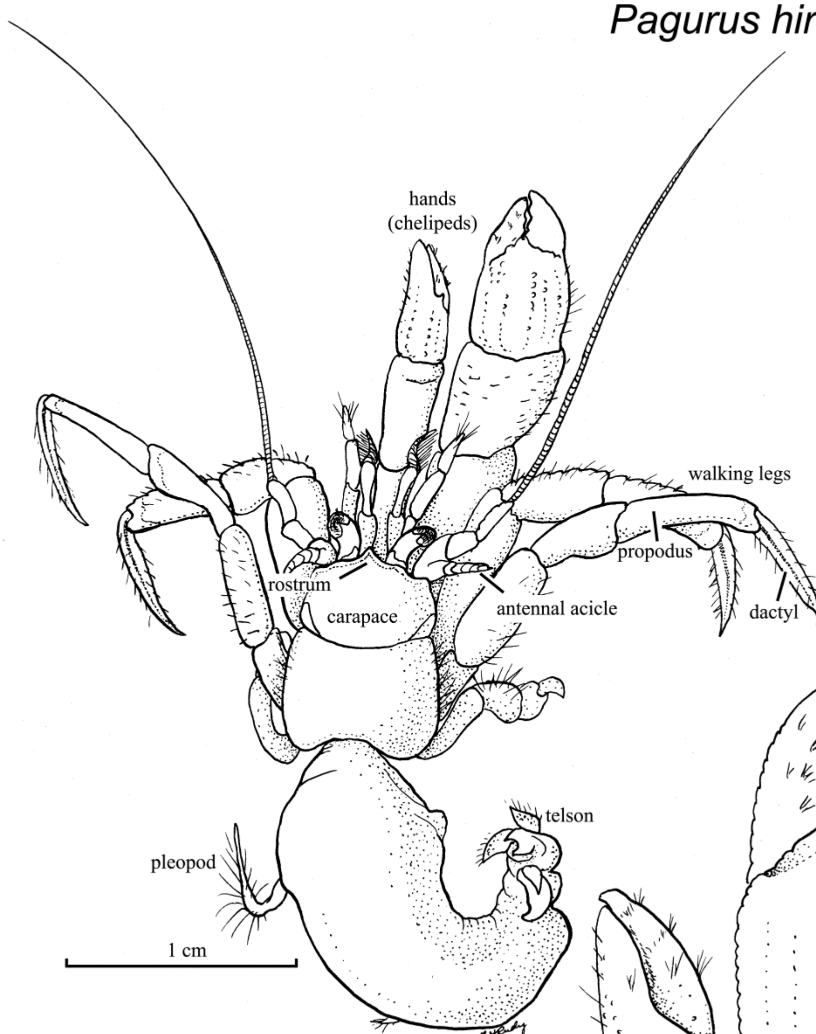
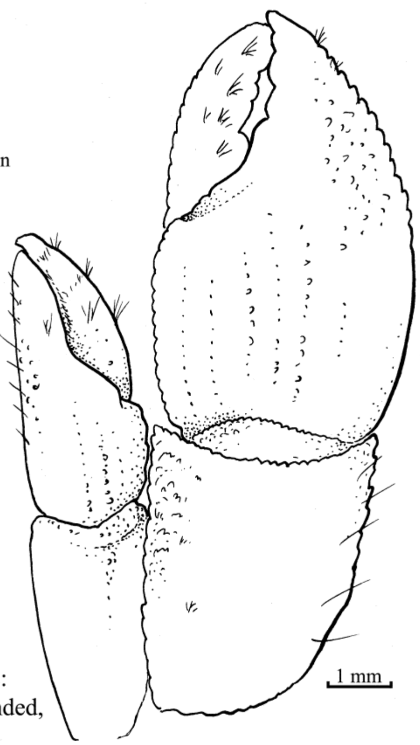
Pagurus hirsutiusculus



1. *Pagurus hirsutiusculus* x4.5:
light hair all over; color tan, dark green antennae white banding; white tips on propodi of walking legs, red lines on dactyls; eyestalks short, stout; rostrum triangular, acute.



2. Left and right chelipeds x12:
surfaces granular; right rounded, twice the width of left.

Petrolisthes cinctipes

The flat porcelain crab (Randall, 1839)

Phylum: Arthropoda
Class: Crustacea, Malacostraca
Order: Decapoda, Reptantia
Section: Anomura
Superfamily: Galatheidea
Family: Porcellanidae

Description

Size—to 24 mm long (across carapace); this specimen 14 mm.
Color—dark blue-brown, somewhat iridescent in life; antennae dark red; maxillipeds bright red-orange; legs blue banded with white (Schmitt 1921).
Body—crab-like- Porcellanidae; convex longitudinally; small fifth legs resting on carapace (fig. 1): most Anomura.
Carapace—round, abdomen symmetrical, short and permanently folded under thorax: family Porcellanidae (*ibid*); carapace front triangulate: genus *Petrolisthes* (Haig 1960). Surface: finely granulate, not rough: genus *Petrolisthes*. No epibranchial (anterolateral) spines; epimera and lateral portions of carapace entire. 7 abdominal plates: (nearly always) *Petrolisthes* (figs. 1, 2).
Telson—7th plate forms tail fan (fig. 2); uropods attached to abdominal segment 5.
Antennae—very long; first (basal) joint of antennal peduncle short, not reaching upper margin of carapace.
Mouthparts—2nd maxillipeds highly developed for filter feeding: long fine hairs, specialized shaped for channeling water currents (fig. 4). Color: bright red-orange: species *cinctipes* (Carlton and Kuris 1975).
Chelipeds—equal, or almost: genus *Petrolisthes*; broad and flattened, not thick and rough: genus *Petrolisthes* (Schmitt 1921); carpus almost invariably 1 1/2 times longer than wide (Schmitt 1921) (fig. 1). Carpus margins converging anteriorly, not parallel; prominent lobe at inner angle: species *cinctipes* (Carlton and Kuris 1975) (fig. 1). A short tuft of hair between fingers on underside, but chelae are generally hairless (figs. 1, 2).
Walking Legs—(2, 3, 4) with a few coarse spines on dactyl, propodus. carpus, not on merus: sp. *cinctipes*. (Fifth legs small, elevated, rest on carapace (figs. 1, 3).

Sexual Dimorphism—not obvious superficially. Inside telson, males have single pleopods on abdominal plate 2; females have long, branched pleopods on plates 3, 4, 5 (not shown).
Young—pelagic zoea is like a "preposterous unicorn" (Ricketts and Calvin 1971): with a long spine to discourage predators from swallowing it (not shown).

Possible Misidentifications

There are two genera of porcelain crabs in our area, *Petrolisthes* and *Pachycheles*. The latter has a thick, rough body and chelae; its chelae are unequal and tuberculate or granular, and hairy, not smooth; the carpus of the chela is as long as broad, not longer than broad as in *Petrolisthes* (Carlton and Kuris 1975).

One other species of *Petrolisthes* may be found commonly in Oregon: *Petrolisthes eriomerus* is superficially quite like *P. cinctipes*. This crab lives under rocks in gravelly substrates; it is a little smaller than *P. cinctipes*. The carpus of the chelipeds in *P. eriomerus* is twice as long as wide (not 1 1/2 times as long); the carpus margins are parallel, not converging; there is no prominent lobe at the inner angle: the carpus has scattered tubercules, not a finely granulated surface.
The merus of the walking legs is hairy, not naked. The outer edge of the maxillipeds in this species is bright blue, not red orange (Carlton and Kuris 1975).

Other Petrolisthes described in Carlton and Kuris, *P. rnanimaculis* and *P. rathbunae*, are found only from northern California south (Haig 1960).

Ecological Information

Range—British Columbia to Pt. Concepcion, California; also offshore islands of southern California, and Baja California (Haig 1960).

Local Distribution—outer, more marine portions of large estuaries: Coos Bay-Pigeon Point; Netarts Bay.
Habitat—protected, semi-protected rocky coasts under rocks (Carlton and Kuris 1975); mussel beds. (Ricketts and Calvin 1971) Prefers open shores and clear waters (Haig 1960).
Salinity—collected at 30 ‰ salt.
Temperature—
Tidal Level—mid- and upper levels. Found only at shore stations, not by dredging (San Francisco Bay, Schmitt) (Schmitt 1921); almost exclusively littoral (Haig 1960).
Associates—mussels, tunicates, sponges; nudibranch *Onchidoris*, chiton *Mopalia*, shore crabs *Hemigrapsus*, *Cancer oregonensis*, predatory gastropod *Nucella*, sea star *Pisaster ochraceus*.

Quantitative Information
Weight—wet: 1.7 gr.
Abundance—very common (Haig 1960) (up to 860/m2, Monterey) (Morris et al. 1980). Usually where it occurs at all, it is abundant (MacGinitie and MacGinitie 1949).

Life History Information
Reproduction—found with eggs every month but April, May, September, October (Haig 1960). Coos Bay, found with developing young, March; these hatch as prezoeae (ibid). Eggs a little over 0.8 mm diameter, deep scarlet to maroon when extruded, becoming brownish red (Gonor and Gonor 1973a). Two carnivorous zoeal larval stages and a filter feeding megalops.
Food—filter feeder: fans plankton and detritus from water with fan-like second maxillipeds. Feeding behavior evoked by presence of amino acids, sugars (Hartman and Hartman 1976).
Predators—
Behavior—autotomizes claws very easily when disturbed.

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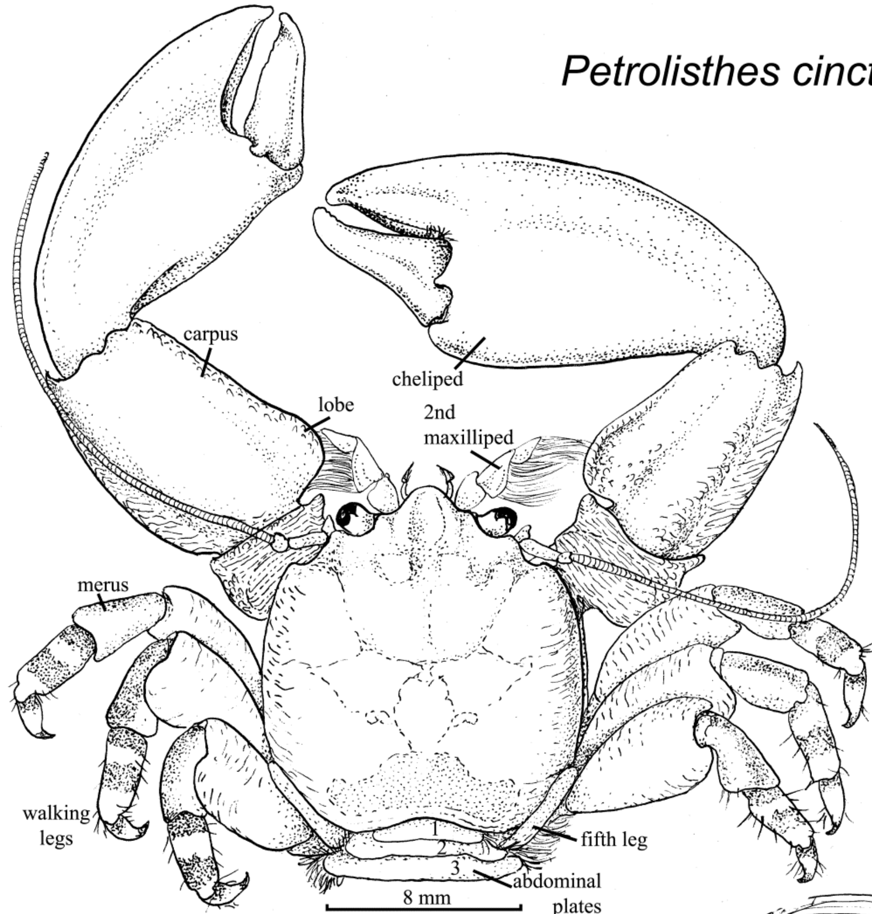
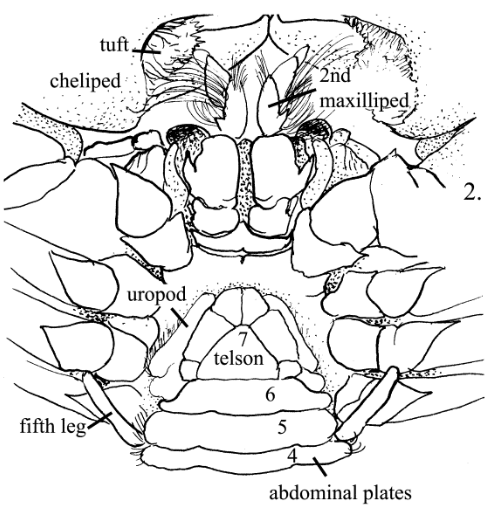
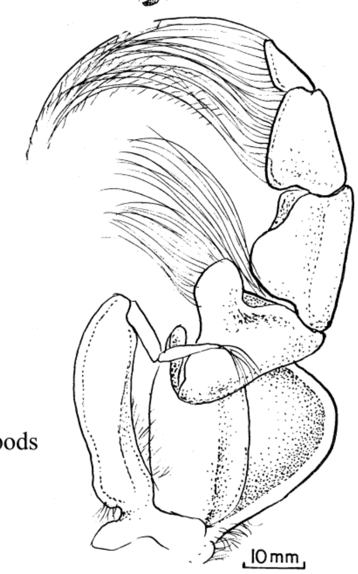
Petrolisthes cinctipes



1. *Petrolisthes cinctipes* x4.5:
actual carapace width 14 mm; body flat, smooth, crab-like; carapace round, abdomen folded under; color blue-brown, iridescent, 2nd maxillipeds red-orange; walking legs striped, merus naked; fifth legs small, elevated.



2. Ventral view x4.5:
folded abdominal plates (4-7 shown); telson, uropods visible; chelipeds with.



3. Second maxilliped x12:
highly developed articles; long, fine hairs; bright red-orange.

Pinnixa faba

A pea crab (Dana, 1851)

Phylum: Arthropoda
Class: Crustacea, Malacostraca
Division: Eucarida
Order: Decapoda, Reptantia
Section: Brachyura
Family: Pinnotheridae

Description

Size—female much larger than male: about 2 cm wide; male 1 cm wide (fig. 1): average first true crab size 1.54 mm (Pearce 1966).
Color—grayish tan, orange or rust markings; variables; immature crabs white (Pearce 1966), eggs orange; female cheliped tips white. Crabs bright orange just after molting (Pearce 1966).
Carapace—female: smooth, rounded, swollen, oblong; no strong poster- or antero-lateral ridges, but sides truncate, slope steeply, meet at an angle; no antero-latral teeth (fig. 1). Male: about 11/2 times wider than longs; same general shape as female, but sometimes has vertical, compressed lobe at anterolateral angle (fig. 4).
Eyes—orbits oval, eyestalks very short; male: eyes fill orbits (fig. 4) (Rathbun 1918).
Mouthparts—(not figured) external maxilliped has large, separate merus and ischium; carpus articulates at outer angle of merus; palp articulates at inner proximal end of merus; exognath with several joints, hidden (Rathbun 1918).
Frontal Area—narrow, slightly advanced, (male); strong medial groove (female) (figs. 4, 1).
Chelipeds—pollex straight, a little shorter than movable dactyl; dactyls of female white-tipped, not gaping (Rathbun 1918). Male: manus almost oblong, widening at tip, pollex shorter than dactyl, which is curved, and has a tooth at its base; dactyl hairy within (fig. 3a, b).
Walking Legs—merus of third walking leg of male more than twice as long as wide (fig. 4); dactyli of both sexes short, strongly curved; third walking legs longest; legs similar in shape, except merus of first leg of male, which is concave above, not convex as are others; female legs more alike than male's.
Abdomen—seven jointed, both sexes; male's narrow, last segment rounded, next to last segment constricted in middle (fig. 5b); female abdomen very wide, to hold egg mass (fig. 5a).

Possible Misidentifications

The pea crab group is one of the most difficult to identify Each species is specific to its host, however. The closely related *Pinnixa littoralis*, for instance, is often found in the clam *Tresus capax*, as is *P. faba*. *P. littoralis* is distinguishable by its carapace, which is pointed at the sides; the merus of its third walking leg (male) is twice as long as wide, not longer as in *P. faba*. The female fingers gape, her walking legs are rather unlike; the male pollex is deflexed (bent down) and the movable finger (dactyl) has no tooth at its base. The two species are different in color: *P. littoralis* females are greenish-yellow. Both these species are found in pairs, not singly as with most pea crab (Pearce 1966).

Other *Pinnixa* species are *P. longipes*, with exceptionally large third walking legs, commensal with tube worms; *P. barnharti*, from a holothurian; *P. occidentalis*, with cylindrical fourth and fifth walking legs, in echiurid worm burrows and P. franciscana, *P. tubicola*, and *P. schmitti*, also from worm burrows and tubes.

The *Pinnixa* can be distinguished from other genera of pea crabs by the very wide carapace, large third legs and by differences in the external maxilliped. Other local genera are *Pinnotheres* (with oysters), *Fabia* (with bivalves, especially Mytilus) *Opisthopus* (from various molluscs including *Tresus*, and from holothurians). *Scleroplax granulata*, found usually with mud and ghost shrimp, has a wide carapace like *P. faba*, but its antero- and postero- lateral margins curve gradually, not forming an angle.

Ecological Information

Range—Alaska to Humboldt Bay, California. Type locality: Puget Sound.

Distribution—in clams in bay mud, or mud and sand.
Habitat—heavily infests Tresus capax, the gaper clam, (with P. littoralis, nearly 100% in Puget Sounds); but adult pinnixids never found in Tresus nuttalli; also found in Saxidomus, Mya (Rathbun 1918), Tapes, Macoma, and as immature crabs, in Clinocardiuml. P faba inhabits Tresus in pairs. The large female clings to the visceral fold in the mantle cavity of the clam; it remains there immobile and permanently, close to the food supply. The smaller male and immature crabs are found throughout the mantle cavity and around the incurrent siphon, although they are often close to the female. The young crabs seem to be free-living. The clam, Tresus, is found in mud or sandy mud, 25-60 cm below the surface.
Salinity— host Tresus capax found at 30.5-33.5 ‰ (Humboldt Bay).
Temperature—
Tidal Level—
Associates—as the female is never free-living, and the males and immature move abut only occasionally, the pea crab is always found living parasitically in a bivalve. Very occasionally an immature crab of another species (P. littoralis) will inhabit the same clam (Pearce 1966). Blisters and irritation of the clam's viscera are noticeable, where the female has lodged (Kozloff 1974a). The crab is parasitic, not commensal: it steals food from the clam, and apparently gives nothing in returns.

Quantitative Information
Weight—
Abundance—can be very prevalent in certain clam populations: almost 100% infestation (by two species) (Pearce 1966); percentage varies with season.

Life History Information
Reproduction—ovigerous twice a year (and a month later than *P. littoralis*), with winter period being most successful (Pearce 1966). Copulation occurs within the clam, as the female is sessile. The male and resident immature are usually found on or next to the female. One to five immature crabs of both sexes have been found resident in the clam (particularly in summer and falls). Apparently they are waiting to assume adult roles at the death of either of the adult pair. Unusual in this species is the presence of the male; this could insure that at the death of the female, a new female would be *P. faba*, not another species (Pearce 1966).
Growth Rate—molting occurs in summer; 23-- 24 molts to average size (19.7 mm): female, 15 molts for average male (Pearce 1966), (13.1 mm).
Longevity—
Food—female steals food from host (diatoms, etc.) by use of mucus strings; food of male not known (Kozloff 1974a).
Predators—
Behavior—young (first true crab stage) crabs infest young *Tresus* when they have just settled out, and remain in this habitation permanently. Other immature crabs may be found later with this pair. Neither sex is adapted for perrnanent free-living, nor is the immature crab, which is white, thin, and fragile (Pearce 1966).

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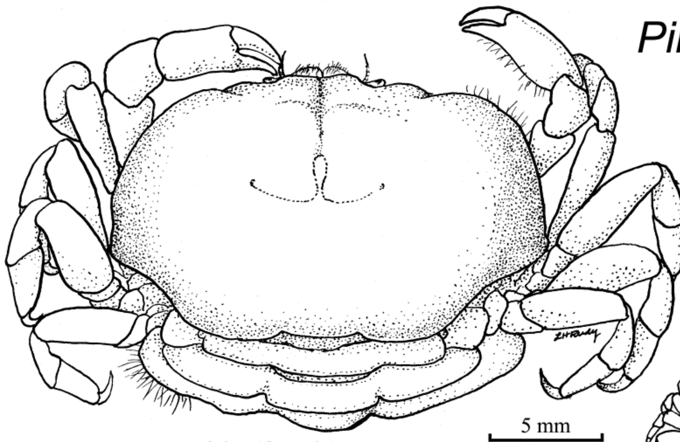
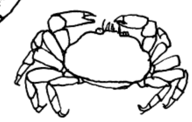
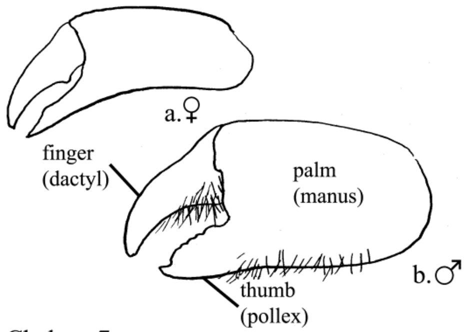
Pinnixa faba



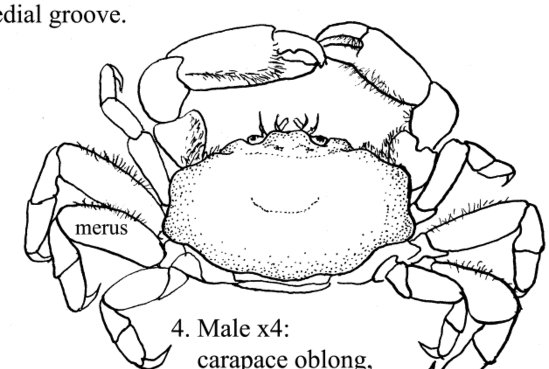
1. *Pinnixa faba* (female) x4:
actual size 2 cm; carapace rounded, swollen; eyes, orbits small and oval; frontal area: medial groove.



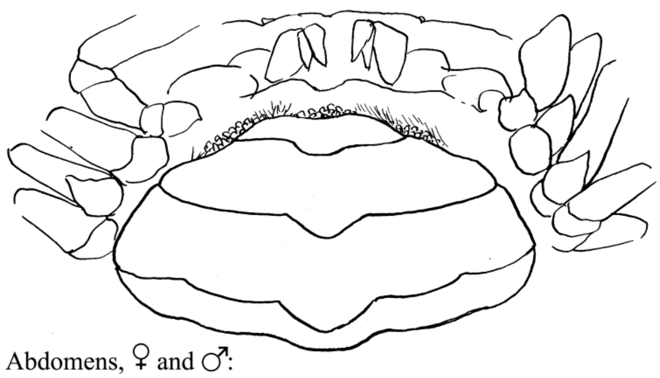
2. Immature x4

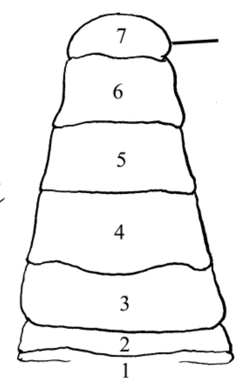


3. Chelae x7:
a. female: white, not gaping
b. male: thumb straight; dactyl curved, toothed; fingers hairy; palm widens distally.



4. Male x4:
carapace oblong, firm, 1.5 times wider than long; sides slope sleeply, antero- and post-lateral margins meet at angle; merus long (third walking leg).





5. Abdomens, ♀ and ♂:

a. female: seven-jointed, very wide

b. male: narrow; last segment rounded.

Pugettia producta (=*Epialtus productus*)

A kelp crab (Randall, 1839)

Phylum: Arthropoda
Class: Crustacea, Malacostraca
Division: Eucarida
Order: Decapoda, Reptantia
Section: Brachyura
Family: Majidae (Inachidae)

Description

Size—largest on record 93 mm wide, 107 mm long; largest of the kelp crabs (Kozloff 1974a); Oregon specimens larger than southern California animals.
Color—dark brown or olive green, sometimes with red or orange; ventral surface often bright red. Exterior smooth, rarely with attached seaweeds, bryozoans, etc., although wharf specimens do have attached barnacles, anemones (Rathbun 1925); mature specimens practically hairless (Garth 1958).
Rostrum—bifid (two-branched) small, with horns separated by sinus (Garth 1958), (figs. 1, 2).
Carapace—sides almost parallel; prominent posterolateral (branchial) teeth: genus *Pugettia* (Carlton and Kuris 1975); surface smooth; small pre- and post-orbital teeth (fig. 2); large anterolateral (hepatic) teeth; posterior margin convex (Garth 1958); carapace decidedly longer than wide (Kozloff 1974a).
Eyes—distance between eyes less than one third width of carapace (adults) (Carlton and Kuris 1975); eyes small.
Abdomen—seven segments (fig. 4).
Chelipeds—large and well developed, especially in mature males, where they can be longer than walking legs; chelae enlarged; manus (palms) swollen, dactyls (fingers) gaping (males) (fig. 3) (Rathbun 1925).
Walking Legs—almost cylindrical (Rathbun 1925); decreasing in length posteriorly; dactyls slender (fig. 1) (Garth 1958); legs shorter, stouter than in other *Pugettia* species.
Juveniles—small specimens (about 3 mm long) can be constricted at the sides like *P. richii* (Garth 1958).

Possible Misidentifications

Pugettia gracilis and *Pugettia richii* are two smaller species found in the northwest. Both have a greater distance between the eyes than does *P. producta* (about half the carapace width). Neither has the smooth surface or straight carapace sides of *P. producta*: both have tuberculate carapace surfaces and constrictions between the hepatic and branchial teeth (Garth 1958). Both have long walking legs. *P. gracilis* can be similar in color to *P. producta*, but *P. richii* is usually red. Other majid crabs (*Oregonia, Scyra, Loxorhynchus, Mimulus*, etc.) lack posterolateral spines.

Ecological Information

Range—Alaska to Asuncion Point, Baja California (Garth 1958); type locality, "California" Replaced below Pt. Conception, Calif., by *Taliepus nuttalii*.
Local Distribution—Oregon: various protected outer shores; Coos Bay; South Slough; probably estuaries where salinities are high.
Habitat—up off the substrate in eelgrass, and in kelp *Egregia* (Ricketts and Calvin 1971); in tidepools on *Fucus*; in kelp, outer coast; on pilings in bays, especially in winter; in *Enteromorpha*, but prefers *Zostera* (juveniles) (Morris et al. 1980).
Salinity—collected at 30 ‰. Does not tolerate brackish water; does not osmoregulate (Morris et al. 1980).
Temperature—somewhat tolerant, considering its range.
Tidal Level—to 40 fathoms, but most common intertidally (Garth 1958).
Associates—sometimes has parasitic barnacle, *Sacculina*, eggs parasitized by nemertean worm *Carcinonemertes epialti* (Morris et al. 1980).

Quantitative Information

Weight—
Abundance—most common kelp crab in Coos Bay estuary.

Life History Information

Reproduction—gravid females in Coos Bay, June and July (Garth 1958); copulation by hard-shelled pairs; yellow to red orange eggs.
Growth Rate—
Longevity—
Food—a vegetarian, scraping brown algal growth off *Zostera* (Kozloff 1974a); eats barnacles, mussels, hydroids and bryozoans when algae is not available; keen visual sense (Knudsen 1964).
Predators—fishes (on young). Few predators as adult, as crab is aggressive, and has strong pinch.
Behavior—nocturnal feeder (Kozloff 1974a); active, particularly those in rocky tidepools (Rathbun 1925).

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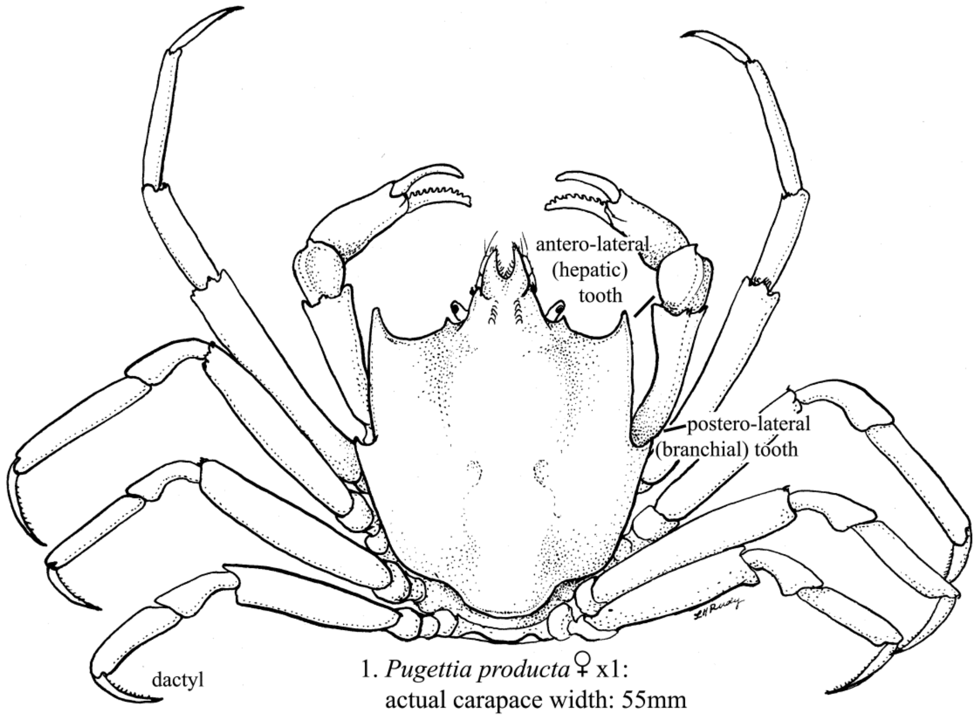
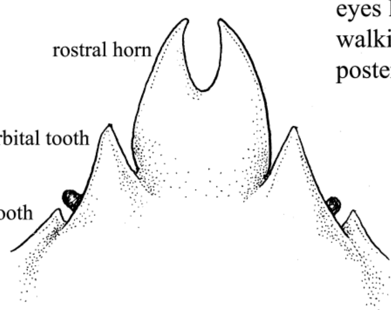
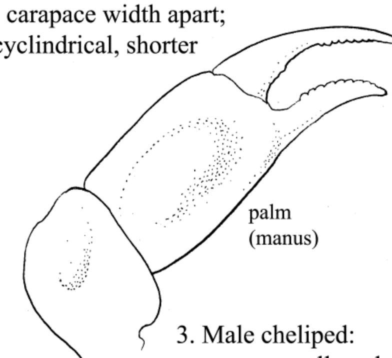
Pugettia producta



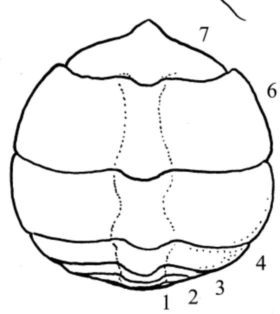
1. *Pugettia producta* ♀ x1:
actual carapace width: 55mm
carapace smooth, sides subparallel;
strong hepatic and branchial teeth;
eyes less than 1/3 carapace width apart;
walking legs subcyclindrical, shorter posteriorly.



2. Frontal area:
rostrum bifid: two horns;
small pre- and post- orbital teeth.



3. Male cheliped:
manus swollen, dactyl gaping;
often long, stout.



4. Abdomen ♀ (ventral view):
seven segments.

Rhithropanopues harrisii

A mud crab (Gould, 1841)

Phylum: Arthropoda
Class: Crustacea, Malacostraca
Division: Eucarida
Order: Decapoda, Reptantia
Family: Xanthidae

Description

Size—type: 19 mm (Rathbun 1930); Coos Bay specimens: the greatest number of both sexes measured 6 mm (36%) (Pisciotto 1977); males larger than fernales (Ryan 1956).
Color—dull green; white underside; whitish dactyl (Rathbun 1930).
Carapace—almost trapezoidal; wider than long; sides con-verge slightly; front truncate, posterior broad; greatest width at fourth lateral tooth (Ryan 1956); prominent horizontal dorsal ridges (Rathbun 1930) or "rows of granules" (fig. 1) (Ryan 1956).
Eyes—frontal; fill orbits.
Frontal Area—front truncate; less than a third as wide as carapace; edge straight; channeled, thick: double-edged margin; a triangular median notch (figs. 1, 2).
Carapace Teeth—five, but first two coalesced; last three dentate, pointing forward; last tooth smaller (fig. 2).
Chelipeds—whitish, unequal, heavy; smooth in the old, but with lines and granules in the young (fig. 4); no large basal tooth on dactyl (Ryan 1956).
Walking Legs—long, slender compressed; fine hairs.
Abdomen—male five segmented, narrow; third segment not contiguous with coxa of last pair of legs (fig. 3); terminal segment a rounded rectangular (Rathbun 1930).
Juveniles—have granulated chelae.

Possible Misidentifications

R. harrisii is the only member of the genus world-wide. It can be mistaken for a small *Hemigrapsus oregonensis*, but for the strong dorsal ridges and three side spurs (Ricketts and Calvin 1971) (last three pointed anterio-lateral teeth) and its slightly convergent sides and long, slender legs. *R. harrisii* sometimes competes for food with *H. oregonensis* in the lower parts of bays, and their territories can overlap.

Ecological Information

Range—east coast of America, New Brunswick to N. E. Brazil; also Holland, northern Europe; west coast: San Francisco to Yaquina Bay.
Distribution—probably introduced to San Francisco with eastern oyster spat (*Crassostrea virginia*) 1940 (Carlton and Kuris 1975); since found in Coos Bay: South Slough (by Dr. James McNab, 1950), Haynes Inlet, Coos River (Pisciotto 1977), Netarts Bay (Stout); Yaquina Bay (Pisciotto 1977 1977).
Habitat—sloughs, under rocks in mud banks of estuaries, where it burrows (Carlton and Kuris 1975); under many diverse conditions; likes some kind of shelter, including oyster beds, debris, (Chesapeake Bay) (Ryan 1956).
Salinity—euryhaline; range: 0-1.6 (Pisciotto 1977); usually brackish to fresh (Rathbun 1930); larval development normally (in lab) at salinities of 5-35 ‰; at 1 ‰ no larvae survived (Costlow et al. 1966). Salinity seems to be the limiting factor which keeps this crab in the upper reaches of estuaries, where salinity is reduced; it can lower its water permeability in conditions of lowered external salinity (Smith 1967).
Temperature—can tolerate a range of from 7° to 35° C (Vernberg and Vernberg 1972), "eurythermic" (adults) (Vernberg and Vernberg 1972); also larvae (Costlow et al. 1966); upper and lower temperature (and salinity) limits unknown for larvae in plankton (Costlow et al. 1966). Found Coos Bay at from 9 to 16 ° (October to December) (Pisciotto 1977).
Tidal Level—intertidal and above: not found in lower reaches of bays or in deep water (Pisciotto 1977); to 30 feet (Chesapeake Bay) (Ryan 1956).
Associates—none known; in similar but separate niche: *Hemigrapsus oregonensis*

(Pisciotto 1977). But: in Coos River: some overlap.

Quantitative Information

Weight—rarely over 4 grams (San Francisco Bay) (Smith 1967).
Abundance—can be the dominant species (upper bay) and is found in nearly every arm of Chesapeake Bay, but is only in widely scattered patches in upper Oregon estuaries (Ryan 1956).

Life History Information

Reproduction—does not migrate to more saline waters to shed larvae (Costlow et al. 1966); zoeae found in salinities of 4-23.5 ‰, greatest number at 15 ‰ (Bousfield 1955). Females ovigerous in summer, early fail (Chesapeake Bay) (Ryan 1956).
Growth Rate—maturity probably reached second summer, total number of "instars" (moults) not known (Ryan 1956).
Longevity—
Food—algae; small crabs, including its own young; a nocturnal feeder; in Chesapeake Bay, it lives in oyster beds, where it probably feeds.
Predators—
Behavior—hides under rocks; seems less active than *Hemigrapsus oregonensis* with which it is found.

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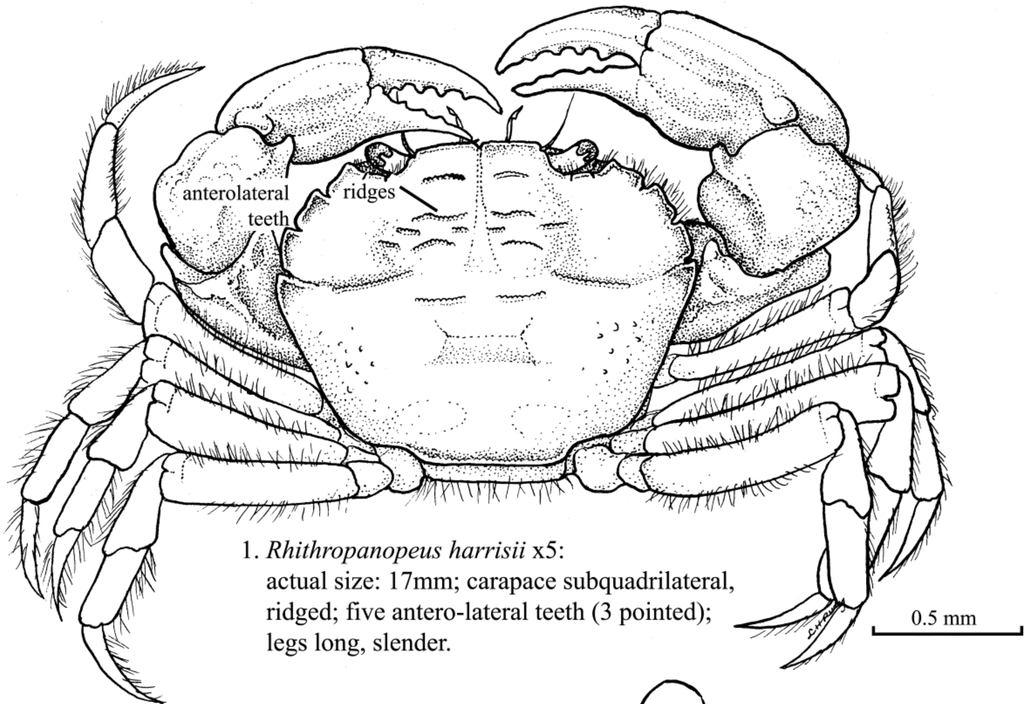
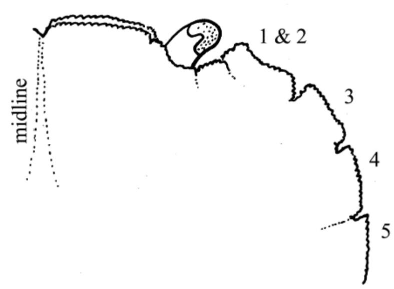
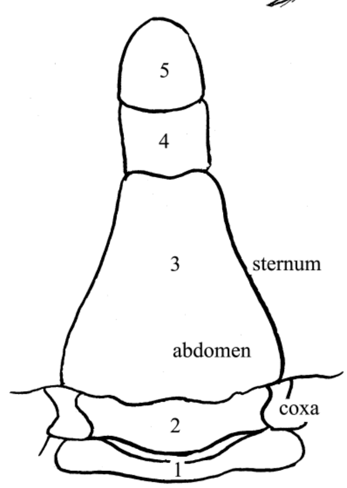
Rhithropanopeus harrisii



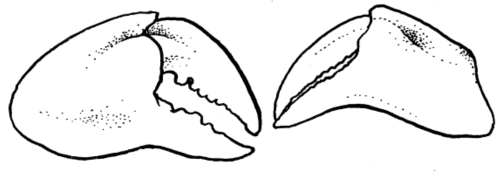
1. *Rhithropanopeus harrisii* x5:
actual size: 17mm; carapace subquadrilateral, ridged; five antero-lateral teeth (3 pointed); legs long, slender.



2. Carapace (right frontal):
frontal edge straight, double-edged; triangular median notch; eyes fills orbit; teeth 1,2 coalesced; 3,4,5 dentate.



3. Abdomen (Male):
narrow; segment three not contiguous with coxae of legs.



4. Chelae (Male):
heavy, unequal; white, smooth (after Benedict, Rathbun).

Scleroplax granulata

A burrow-dwelling pea crab (Rathbun, 1893)

Phylum: Arthropoda
Subphylum: Crustacea
Class: Malacostraca
Superorder: Eucarida
Order: Decapoda
Family: Pinnotheridae

Description

Size—to 11 mm wide (males), 12.9 mm (females): California (Morris et al 1980). This specimen (female) 5.5 mm. Males can be larger than females (MacGinitie and MacGinitie 1949) (unusual in pea crabs).
Color—female (this specimen, Coos Bay) dark gray, light outlines, red eyes. Male from Bodega Bay harbor, CA, light tan, orange (Morris et al 1980)
Eyes—oval, small; eyestalks very short and thick; orbits small: Pinnotheridae.
Mouthparts—outer maxillipeds with 3-jointed palp; 3rd article joined to 2nd proximally, not distally (fig. 3); winged extension on merus (Rathbun 1918).
Carapace—rounded: Pinnotheridae. Oval, smooth, hard, convex; granular but not aerolated. Male smoother than female. Hardness typical of free-living pea crabs. Carapace width almost 1 ½ x length (Kozloff 1974a); antero- and posterolateral edges rounded, curving to meet gradually, not forming angles: genus *Scleroplax* (Rathbun 1918). Frontal area entire, blunt, slightly convex; no teeth between eyes.
Chelipeds—Female: small, feeble, thumb horizontal, tip acute, fingers not gaping (fig. 1). Male: prominent, large, very wide; dactyl curved, smooth, gaping; propodus with granulate surface, convex margins; thumb shorter than wide (fig. 2).
Walking Legs—(legs 2 - 5) - vary little in length (Rathbun 1918); slender, somewhat rounded (Carlton and Kuirs 1975), dactyls slender. 1st walking legs smaller than 2nd; 3rd longest (slightly); 4th not greatly smaller than others (figs. 1, 4).
Abdomen—Female: wide, smooth, fringed with hair; not reaching beyond sternum (Schmitt 1921). Male: narrow, tapering gradually (Schmitt 1921). Abdomen not figured; see *Pinnixa faba.*

Possible Misidentifications

All the Pinnotheridae are small, have a wide, rounded carapace, small eyes, and short eyestalks. There are 6 genera:

Pinnotheres and *Fabia* have a small palp on the outer maxilliped and a carapace about as wide as long (Kozloff 1974a). No *Pinnotheres* are included in *Light's Manuals,* although there are two in Kozloff (Kozloff 1974a) - *P. taylori,* and *P. pugettensis,* both found with ascidians.

Parapinnixa is a southern California genus with a wide carapace, and legs that diminish greatly in size (unlike those of *Scleroplax*).

Pinnixa, Opisthopus and *Scleroplax* all have a large maxillipedal palp, and a wide carapace. *Pinnixa* has 3rd walking legs markedly longer than the others (not just slightly longer as in *Scleroplax* (Carlton and Kuirs 1975)). Its carapace is membranaceous, not hard; it has a distinctive angle where the antero- and postero-lateral carapace margins meet - in contrast to the rounded margins of *Scleroplax.*

Opisthopus has a carapace just a little wider than high (it is almost 1 ½ x wider in *Scleroplax). Opisthopus'* walking legs are subequal, the 2nd being slightly longer than the others. Its hosts are nearly always molluscan (Morris et al 1980). It has not been reported north of Monterey, California (Schmitt 1921). Pea crabs are very particular as to habitat and/or host (see *Pinnixa faba).* Other Pinnotheridae which could be found in *Callianassa* or *Upogebia* burrows with *Scleroplax* include *Pinnixa franciscana* (Rathbun, 1918), a large (to 22 mm wide) crab, with a broad carapace with pointed sides, a sharp line of granules on the cheliped propodus, and a widened merus on the 3rd walking legs (Morris et al 1980).

Pinnixa schmitti (Rathbun, 1918) occurs from Alaska to San Francisco Bay (Morris et al 1980); it could occur in our area. It lives in well-drained loose beach material, not with any particular host (Wells 1940), but in tubes, cavities or burrows within 5 cm of the surface. It has a low tooth on the inner margin of the cheliped dactyl (Kozloff 1974a); the dactyls of its 4^{th} walking legs are longer than those of the 3^{rd} pair (Kozloff 1974a). Its carapace is about 1 ¾ x wider than long, and tapers laterally, unlike that of *Scleroplax,* which is rounded.

The genus *Scleroplax* is monotypic.

Ecological Information

Range—north end of Vancouver Island, B.C., to Ensenada, Baja California (Morris et al 1980).
Local Distribution—Coos Bay, several stations – this specimen from Jordan Cove (north spit); other Oregon estuaries.
Habitat—sandy mud, mudflats of protected bays (Morris et al 1980). Free-living in burrows with *Callianassa* or *Upogebia,* etc. (see associates, below), where it uses protection of burrow, and food and oxygen circulating there. Males migrate between burrows (Morris et al 1980).
Salinity—with *Callianassa,* which is found at from 35 - 30 ‰ (Coos Bay).
Temperature—
Tidal Level—mid - low intertidal (Morris et al 1980).
Associates—in burrow of *Callianassa* or *Upogebia* (and *Urechis caupo* farther south). Among those least intimately associated with its host (Wells 1940): commensal, not parasitic. Goby *Clevelandia ios* can be present; polynoid polychaete *Hesperonoe* clings to burrow walls to escape *Scleroplax* (MacGinitie and MacGinitie 1949). Bryozoan *Walkeria* lives on legs of *Scleroplax;* bryozoan *Triticella elongata* is on its carapace, appendages and in gill cavities (Morris et al 1980). *Scleroplax* also found with *Mya arenaria,* Friday Harbor, WA (Rathburn 1918).

Quantitative Information

Weight—
Abundance—up to 6/burrow; most prevalent of all commensals with *Upogebia* (Morris et al 1980).

Life History Information

Reproduction—egg-bearing females in January in Humboldt Bay (MacGinitie and MacGinitie 1949); later further south (Morris et al 1980).
Growth Rate—
Longevity—
Food—flesh that falls into burrow, and particles brought by goby *Clevelandia.* Also screens material with 2^{nd} maxillipeds (Morris et al 1980).
Predators—
Behavior—males move around among burrows. Can play "possum" for up to 2 minutes if disturbed (Morris et al 1980).

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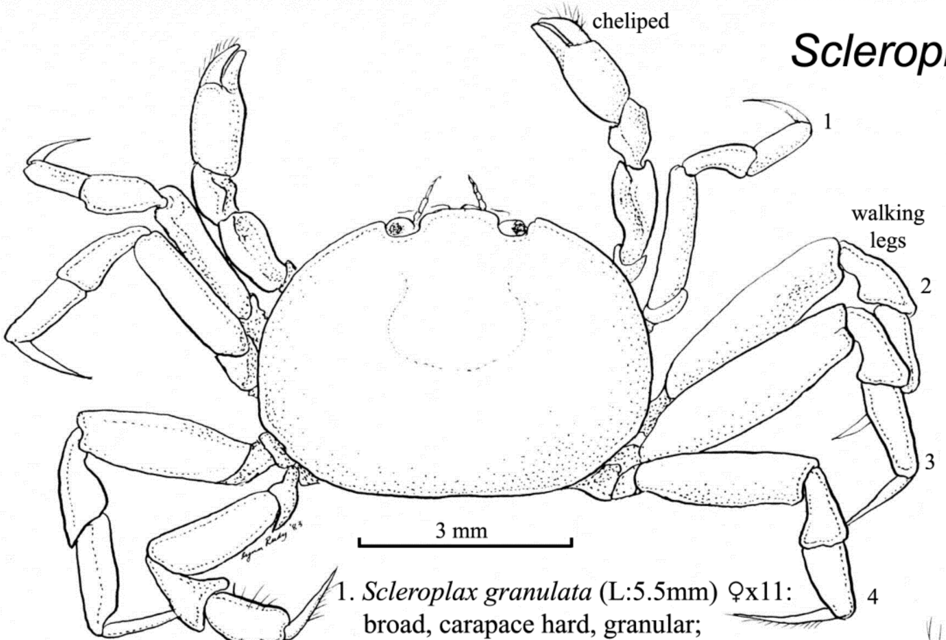
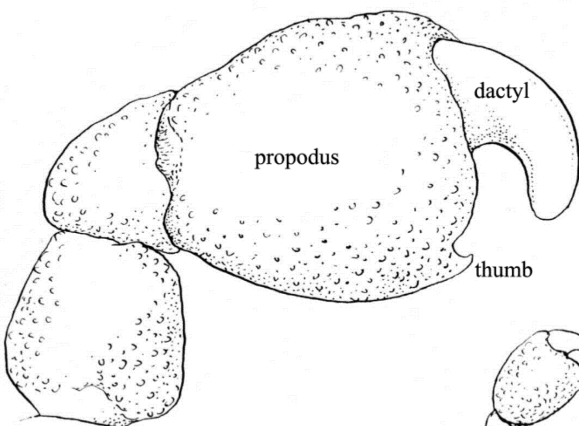
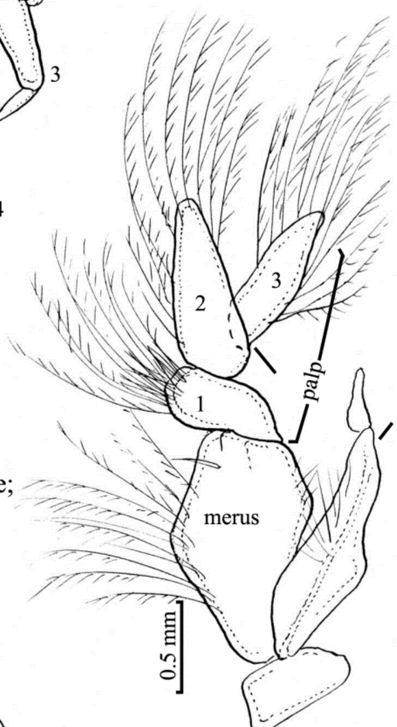
Scleroplax granulata



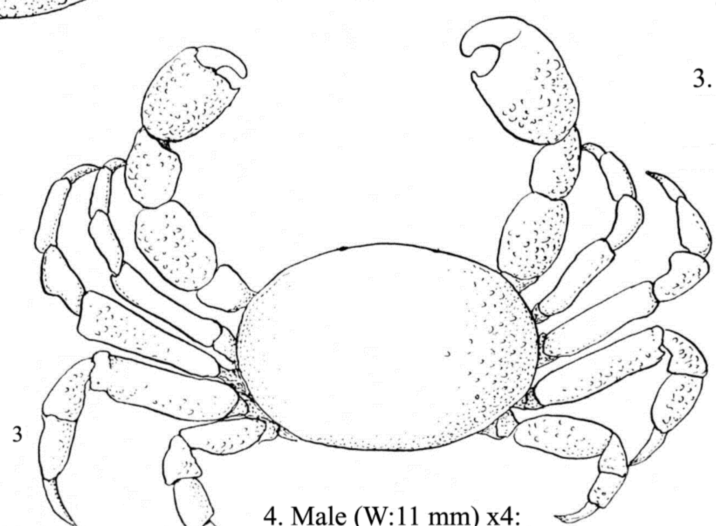
1. *Scleroplax granulata* (L:5.5mm) ♀x11: broad, carapace hard, granular; frontal area entire, blunt; eyes small; antero- and posterolateral edges rounded; chelipeds feeble, walking legs slender, rounded, similar.



2. Cheliped ♂ x40: dactyl curved, fingers gape; propodus margins convex; thumb short.



3. Outer maxilliped x28: palp: 3rd article joined to 2nd proximally; winged extention on merus.



4. Male (W:11 mm) x4: chelipeds large; carapace hard, oval, granular; 3rd walking slightly longest (from Morris et al 1980, Pl. 186).

Semibalanus cariosus (=*Balanus cariosus*)

A thatched barnacle (Pallas, 1788)

Phylum: Arthropoda
Class: Crustacea, Cirripedia
Order: Thoracica, Balanomorpha
Family: Archaeobalanidae

Description

Size—largest: to 75 mm diameter (Henry 1940), 80 mm high; variable, especially in cylindrical specimens on vertical surfaces. Can grow to 100 mm high and only 15 mm wide (Puget Sound) (Pilsbry 1916).
Color—dirty white, gray: round or uncrowded specimens chalky white: tergum beak can be purple (Pilsbry 1916); cirri brown to almost black.
Shape—normally conical (fig. 2); can be cylindrical if crowded.
Base—membraneous, in contrast to most barnacles which have calcareous bases (and the only North American Balanus thus) (Cornwall 1951). Base forms starry pattern (fig. 3), especially in juveniles (Ricketts and Calvin 1971).
Plates—six, unequal. calcareous, with narrow longitudinal spines, giving it a unique thatched appearance (fig. 1). Crowded, cylindrical specimens often lack spines (Cornwall 1977). Rostrum overlaps adjacent lateral plates: family Balanidae (Pilsbry 1916). Radii narrow (Cornwall 1951).
Wall—forrned by plates (parietes): thick when normal, thin when crowded; internal surface usually with faint ribs, or wrinkled (Cornwall 1951) (fig. 4).
Orifice—small in conical specimens. large in cylindrical ones (Henry 1940); can be deeply toothed (fig. 1).
Longitudinal Tubes—in walls: irregular (fig. 4); with cross-septa.. sometimes filled with powder (Pilsbry 1916).
Opercular Plates (Tergum, Scutum)—thin (Henry 1942) (figs. 5, 6):

Scutum-exterior with low growth ridges, the lower ridges fringed with membrane, usually with a weak longitudinal striation. Interior a small, well-reflexed articular ridge, which is continued as a sharp, high, curved adductor ridge (in some specimens, adductor ridge is very weak). Depressor muscle pit deep and rather large, often divided by one or two ridges: occludent margin with 3-5 oblique coarse teeth (Henry 1940) (fig- 5a, 6a).

Tergum--very narrow, beaked; furrow narrow; articular ridge long and acute, spur very narrow and long (Pilsbry 1916), continuing as a raised ridge on the inside: strongly developed depressor muscle crests (figs. 5b. 6b).
Body—six pairs of feeding cirri. brown or almost black.
Juveniles—usually up to 10 mm: star-shaped; 2-3 prominent ribs on carina, 1 on carinolateral, 3 or 4 on lateral and rostrum. orifice very small (Henry 1940).

Possible Misidentifications

The southern thatched barnacle, *Tetraclita*, is superficially much like *B. cariosus*, but it has only four plates, and is found only in warm seas: one species, *T. squamosa*, lives as far north as San Francisco (Newman 1975).

In its 'normal' form. and in an isolated specimen, *B. cariosus*, with its splinter-like spines, is not likely to be confused with another barnacle. However, where it is crowded or eroded these spines may be worn off or not developed, and the barnacle would have to be identified by its tergum and Scutum, and by its unusual membraneous base, which is unique. *B. cariosus* is often found with *B. crenatus*, and especially with *B. glandula*, as well as with *Chthamalus dalli*.

Juvenile *B. cariosus* will show a typical heavy ribbing and starry outline, which would distinguish it from young *B. crenatus* or *B. glandula*. Adult *B. cariosus* have terga with a long pointed spur, quite different from either *B. crenatus* or *B. glandula*. Generally, these latter two species are found higher in the intertidal than is *B. cariosus*, which occurs mostly subtidally.

The giant barnacle, *Balanus nubilus*, would be most likely to be confused with *B. cariosus* at subtidal levels. Both species.

as juveniles, have strong ribs: *B. cariosus* has the characteristic starry border, however, that *B. nubilus* lacks. Both species have a tergal plate with a long spur, but that of *B. cariosus* is pointed, *B. nubilus'*s is truncate. The cirri of *B. cariosus* are conspicuous for being almost black.

Ecological Information

Range—Bering Sea south to Morro Bay, California (Morris et al. 1980); Japan. Type locality: Kuril Islands.
Local Distribution—outer rocky coast and protected sites in Oregon Bays; Coos Bay: floating docks near Charleston.
Habitat—hard surface needed for attachment: ie. rock, shell, wood. Southern specimens prefer protected spots: deep crevices, overhanging ledges, but like strong current (Ricketts and Calvin 1971).Puget Sound animals live exclusively in oceanic conditions; Coos Bay floating docks (under water). Maintains itself under nearly identical conditions everywhere (Ricketts and Calvin 1971).
Salinity—collected at 30 ‰; prefers full sea water.
Temperature—occurs in temperate waters.
Tidal Level—from high in splash zone in outer bay with wave action (Coast Guard Boat House, Coos Bay) to more protected areas farther up bay: also found in low zone and subtidally. Predation by sea stars may determine lower limit of range (Cochran et al. 1968); possibly incapable of handling dessication at higher tide levels (Cochran et al. 1968).
Associates—commonly grows below *B. glandula*, but this barnacle often found growing on *B. cariosus*- Often grows on *Mytilus californianus*, with *Littorina scutulata* (outer coast); with *B. crenatus* and goose barnacle *Lepas pectinata pacifica*: also with *Chthamalus dalli* and goose barnacle *Pollicipes polymerus* (outer coast) (Henry 1942). In Coos Bay, with masses of tube worm *Eudistylia*.

Quantitative Information

Weight—
Abundance—commonest barnacle of estuarine low zone (Ricketts and Calvin 1971): 'lead pencil' (tall, crowded) variety can be as dense as 15,000/m^2 (Ricketts and Calvin 1971): highest density at Coast Guard Boat House, Coos Head: 270 20/cm^2 (Holden 1968).

Life History Information

Reproduction—breeding mostly spring and summer; hermaphroditic. cross-fertilization occurs in usual crowded sites: self-fertilization probably occurs in isolated individuals (Newman 1975). Young released as nauplii, which have six stages, developing into the nonfeeding cyprid larvae, which settle and attach, then develop into adults (Newman 1975).
Growth—
Longevity—may live to 10-15 years (Morris et al. 1980) about three years at low intertidal (Ricketts and Calvin 1971).
Food—plankton, detritus, strained by cirri.
Predators—heavily preyed upon by sea star *Pisaster*, particularly in its lower range (Cochran 1968): other predators include gastropod *Thais*, nemertean *Emplectonerna gracilus*; birds.
Behavior—unusual life cycle for a crustacean: building a calcareous shell, settling on its head and kicking food into its mouth with its feet.

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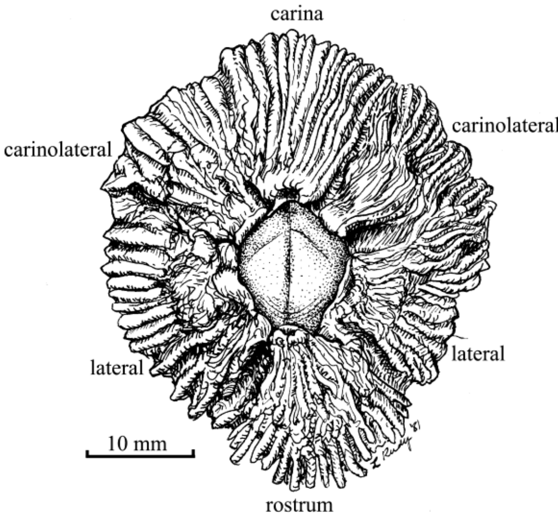
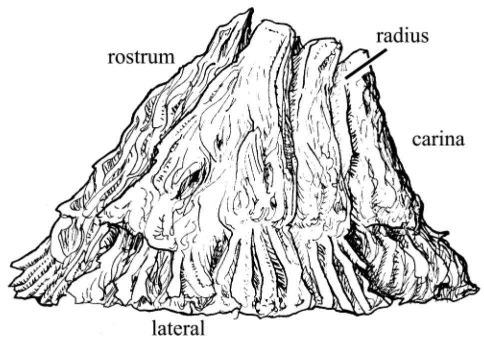
Semibalanus cariosus

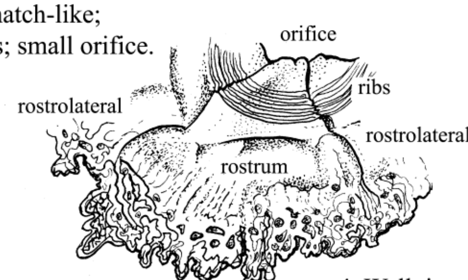


1. *Semibalanus cariosus* (dorsal view, L:40mm W:35mm) x2: many long spines: thatch-like; six plates: rostrum overlaps laterals; small orifice.

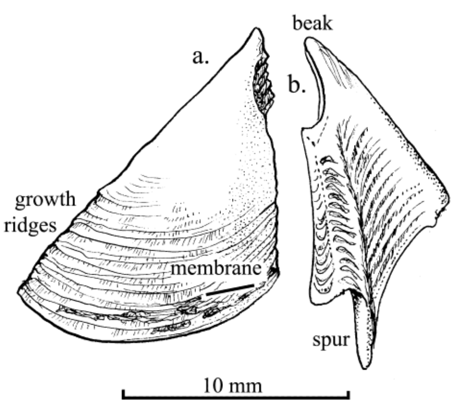


2. Lateral view: conical shape; thick wall; narrow radii.

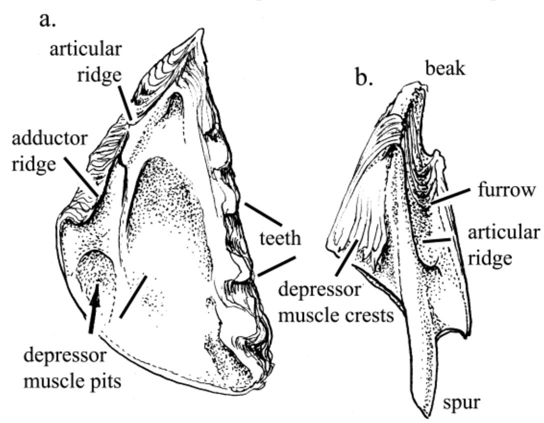
3. Young (dorsal view) x2: star-shaped border; prominent ribs, few in number.



4. Wall, interior (posterior view): basal edges: rostral and lateral plates.



5. Opercular valves, exterior right x4:
   a. scutum: low growth ridges, lower ones membranous; weak longitudinal striations
   b. tergum: narrow, beaked; long spur.



6. Opercular valves, interior x4:
   a. scutum: small, reflexed articular ridge; sharp, high adductor ridge; deep depressor muscle pit; coarse teeth on occludent margin
   b. tergum: narrow furrow; long, acute articular ridge; spur a raised ridge; strong depressor muscle crests.

Traskorchestia traskiana

A beach hopper (Stimpson, 1857)

Phylum: Arthropoda
Class: Crustacea
Order: Amphipoda, Gammaridea
Family: Talitridae

Description

Color—pale brown, orange antennae; dull green or gray-brown, slight blue legs (Ricketts and Calvin 1971).
Size—2 cm (South Slough of Coos Bay); 1/2 inch or a little more (Barnard 1975).
First Antenna—very short, five articles (fig. 1). (Stebbing 1906).
Second Antenna—peduncle not thickened; short; flagellum or 16 articles; (16: male, 12: female) (Stebbing 1906); both antennae less massive than in those beach hoppers of the more open coast (Ricketts and Calvin 1971).
Head—rostrum simple, eyes large, oval (fig. 1).
Mouthparts—mandible without palp (fig. 2): Talitridae; maxilliped with four articles, fourth not developed (fig. 4) (Barnard 1954).
First Gnathopod—dactyl slender, subchelate, not simple as in *Orchestoidea*, especially in mature males: *Orchestia*: translucent process on article four (fig. 5).
Second Gnathopod—smooth convex palm; no spine at hinge of articles 6 & 7 (fig. 6).
Coxae—plate one about half as large as plate twos (fig. 1).
Pleonites—five and six not fused, (fig. 1) (Barnard 1975).
Pereopods—seven longer than six: *Orchestra* (Barnard 1975).
Pleopods—"strong", biramous; first three about equal in size; branches with 7-10 segments, (not figured) (Barnard 1975).
Telson—puffy, split, with several spines: Talitridae (fig. 3) (split not visible in lateral view) (Barnard 1975).
Uropods—third uniramous: Talitridae (Barnard 1954); ramus narrowing distally, shorter than peduncle (Barnard 1975) (fig. 3).
Sexual Dimorphism—males larger than females, have larger gnathopods.

Possible Misidentifications

Orchestoidea sp. are larger than *Orchestia* and found on ex-posed beaches. *Talitroides* are small introduced species of high water drift line. Two other *Orchestia* species can occur in Oregon: *O. chiliensis* is an introduced species found under debris on sandy beaches; it has a long, inflated second antenna, and the second gnathopod has a sinuous dactyl and a triangular tooth near the hinge. *O. georgiana* has weak pleopods with 4-6 segments on the rami; its first gnathopod lacks the process on the fourth article (male) found on *O. traskiana*.

Ecological Information

Range—Washington to Magdalena Bay, Baja California (Barnard 1954).
Local Distribution—several locations in Coos Bay, and at North Bay, Cape Arago (Barnard 1954).
Habitat—rocky beaches, sandy beaches with algae, salt marshes (under debris and boards) (Barnard 1975); in driftwood, on high protected beaches; inner *Salicornia* marsh, Metcalf Preserve, Coos Bay (Kozloff 1974a).
Salinity—from brackish slough (Ricketts and Calvin 1971), high beaches of salty bays (Kozloff 1974a), outer coast (Barnard 1954)-
Temperatures—
Tidal Level—usually along the wrack line, but also found more than 20' above tidewater (Ricketts and Calvin 1971).
Associates—in Metcalf Preserve. Coos Bay: other amphipods, sphaeromid isopods, and the gastropod, *Ovatella*.

Quantitative Information

Weight—
Abundance—often in hundreds under debris.

Life History Information

Reproduction—some females ovigerous March, (Coos Bay).
Growth Rate—
Longevity—
Food—scavenges in debris for detritus.
Predators—
Behavior—probably completely nocturnal (Kozloff 1974a).

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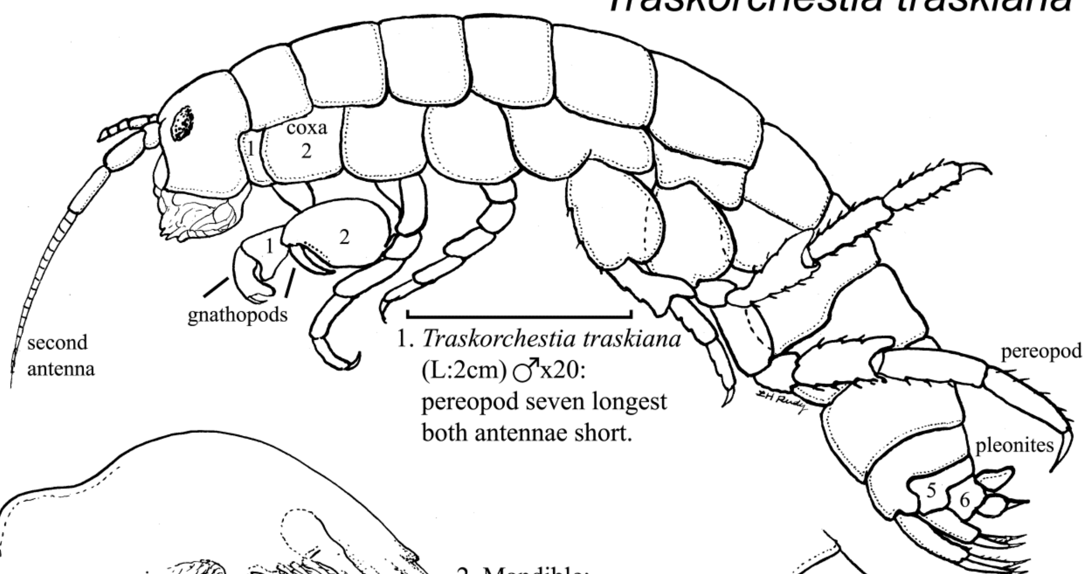
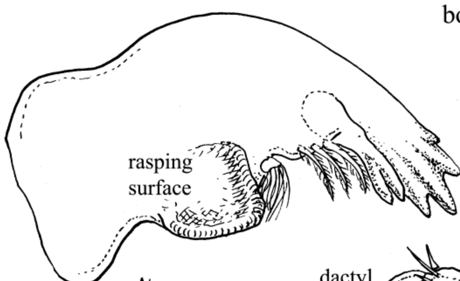
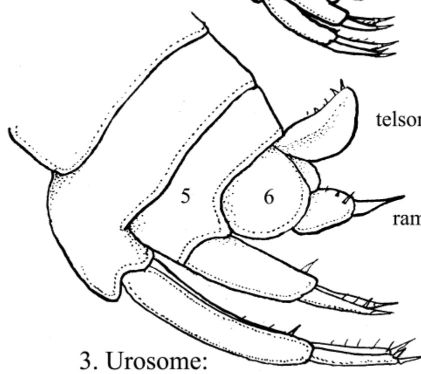
Traskorchestia traskiana



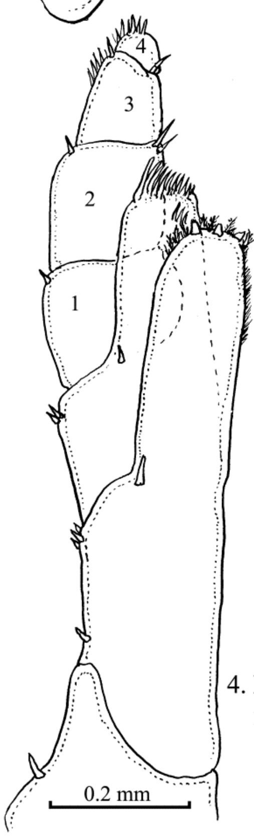
1. *Traskorchestia traskiana* (L:2cm) ♂x20: pereopod seven longest both antennae short.



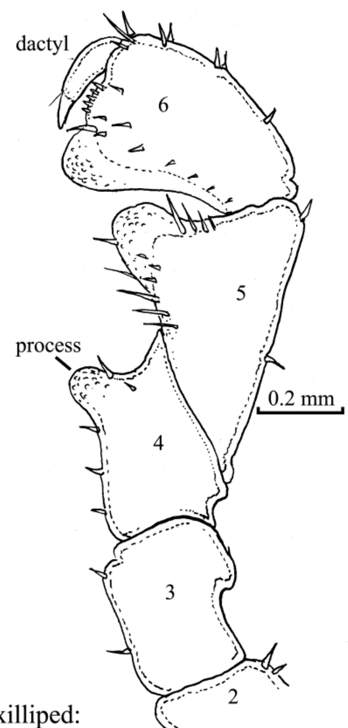
2. Mandible: no palp.



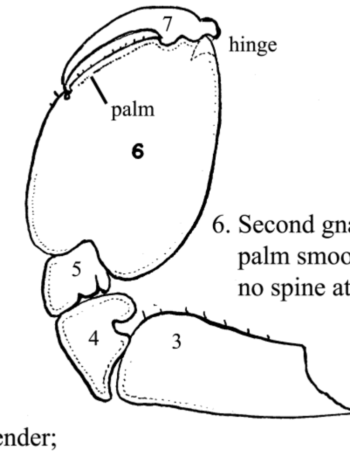
3. Urosome: Telson: several spines, puffy; third uropod:ramus narrowing, shorter than peduncle.



4. Maxilliped: four articles.



5. First gnathopod ♂: subchelate, dactyl slender; process on fourth segment.



6. Second gnathopod ♂: palm smooth, convex; no spine at hinge.

Upogebia pugettensis

The blue mud shrimp (Dana, 1851)

Phylum: Arthropoda
Class: Crustacea, Malacostraca
Division: Eucarida
Order: Decapoda, Reptantia
Section: Macrura
Family: Thalassinidea, Upogebii

Description

Size—type: 50.8 mm; figured specimen, ovigerous female South Slough of Coos Bay 90 mm; often larger: to 10 cm (four inches) (MacGinitie and MacGinitie 1949); northern animals larger than those of southern California (*ibid*).
Color—light blue green, brown fringes on pleopods and pleuron.
Rostrum—good sized, tridentate, rough, and hairy (Schmitt 1921).
Eyes—peduncle cylindrical (Schmitt 1921), corneas terminal (Carlton and Kuris 1975).
First Legs (Chelipeds)—approximately equal, subchelate (fig. 1).
Walking Legs—(2-5) simple.
Body—shrimplike.
Abdomen—elongate, not reflexed, but extended; symmetrical, externally segmented: Callianassidae.
Pleopods—four pairs, fan-like (fig. 1).
Tail-Fan—formed by telson, uropods: fan-like, adapted for swimming.

Possible Misidentifications

The ghost shrimps, *Callianassa* sp., do occur in the same general territory as *Upogebia*, but their coloration is very different, being white to red, never bluish. They have only three pairs of pleopods, a reduced rostrum, and one very large cheliped. Upogebia is "firmer, larger and more vigorous than *Callianassa*" (Powell 1974).

Ecological Information

Range—Alaska to Baja California, including Gulf of California; type locality, Puget Sound.
Local Distribution—Oregon estuaries and sloughs: Alsea, Nestucca, Netarts, Yaquina, Coos.
Habitat—estuarine mudflats, substrate: mud or sandy mud, often with some gravel, "on muddy beaches free from *Zostera*" (Stevens 1928). Survives anoxia less well than *Callianassa* (Morris et al. 1980).
Burrows—U or Y-shaped, firm; permanent, little branched; vertically about 18 ", then horizontally 2-4 feet and to surface (Ricketts and Calvin 1971), often the entrance will have a gravel plug if the tide is out (Stevens 1928); walls smooth, mucus lined (MacGinitie and macGinitie 1949).
Salinity—collected at 30 0/00; lower lethal limit: 10‰ sea-water; a strong hyper-osmotic regulator below 75‰ seawater (Morris et al. 1980).
Tidal Level—mid to lower intertidal of bays (Carlton and Kuris 1975); usually lower than *Callianassa*; occasionally small ones quite high (north) (Ricketts and Calvin 1971), "at about mean low tide" (Stevens 1928).
Associates—many commensals, as with *Callianassa*: *Hesperonoe*; pinnotherid crabs; copepods *Hemicyclops*, *Clausidium*; shrimp *Betaeus*; isopod *Phyllodurus abdominalis*; clams *Orobitella rugifera* and *Cryptomya*; goby *Clevelandia ios*. Ghost shrimp *Callianassa* can live nearby.

Quantitative Information

Abundance—can be locally common (Carlton and Kuris 1975).

Life History Information

Reproduction—each burrow inhabited generally by one pair; ovigerous females found January and February, Elkhorn Slough. California (MacGinitie and MacGinitie 1949); early April, South Slough. Eggs carried under abdomen on pleopods.
Growth Rate—
Longevity—"probably moderately long lived" (Ricketts and Calvin 1971).
Food—detritus, obtained by filtering water through the burrow as it sits near an entrance: it makes a "basket" with its first and second pereopods, which are long-haired.
Predators—man, for fish bait (adults); larvae food for plank-ton eating fishes.

Behavior—can occasionally be found walking about mudflat; like *Callianassa*, a prodigious digger, and a menace in oyster beds, where its disturbance of the surface buries the oysters. Pesticide Sevin tried, Willapa Bay, WA.

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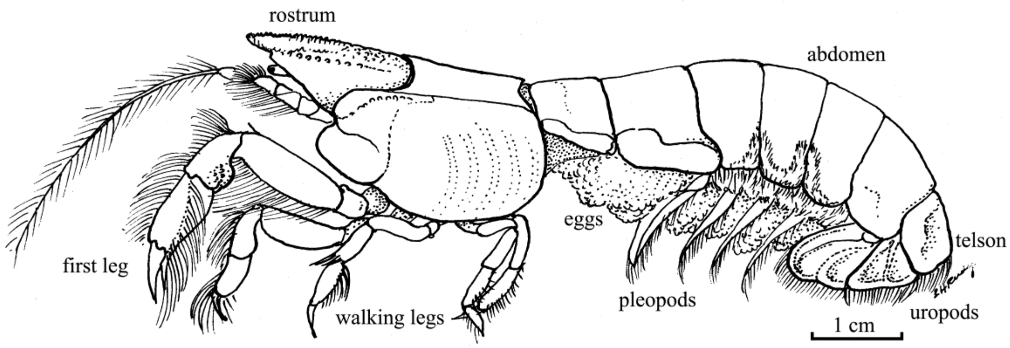
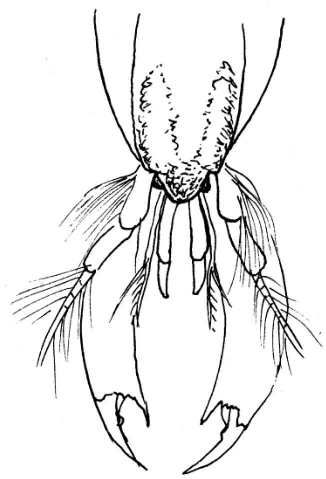
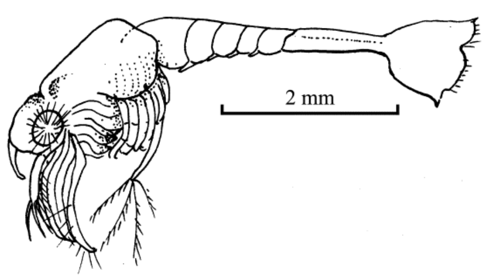
Upogebia pugettensis



1. *Upogebia pugettensis*, ovigerous ♀ x1 1/2: actual size: 9 cm; first legs equal and subchelate; legs 2,3,4,5 simple; four pairs of fan-like pleopods.



2. Head (dorsal view): hairy surface; rostrum: three teeth, eyestalks cylindrical, short; corneas terminal.



3. A larval form x15: first stage, about 5 mm.

Adula californiensis

Basket of heart cockle (Conrad, 1837)

Phylum: Mollusca
Class: Bivalvia, Heterodonta
Order: Veneroida
Family: Cardiidae

Description

Size—up to 72 mm (Packard 1918), but often grows to greater size, particularly on northern beaches (Keen and Coan 1977); up to 100 mm (Lough and Gonor 1971).
Color—warm brown when young, mottled; adults light brown.
Exterior—shell as high as long (Morris et al1980), or higher; longer than wide during first year (Keen and Coan 1977) (Length: anterior to posterior). Valves alike; shell inflated, triangular, with rounded corners (Lough and Gonor 1971); end profile heart-shaped (fig. 3). About 35 strong, squarish, ridged ribs radiating from umbo (fig. 1). Shell thick, rather brittle (Kozloff 1974a); posterior end evenly rounded, smooth. Umbones prominent (Abbott 1968), beaks nearly central, directed anteriorly (Keep 1935) (fig. 2).
Interior—white, not pearly; anterior and posterior muscle scars equal in area; pallial line simple. Known for its great foot, short siphon.
Hinge Area—hinge central, with 1 strong cardinal tooth, a posterior and an anterior lateral tooth in each valve (fig. 2); ligament entirely dorsal, not internal.
Eyes— numerous, tiny, on optical tentacles on mantle margin (Oldroyd 1924).

Possible Misidentifications

There are at least 2 other species of *Clinocardium* in the Puget Sound area, although other members of the family have not been reported from Oregon. Both species are longer than high, subtidal, and less than 4 cm high. *C. ciliatum* has 40 ribs, *C. californiense* has 45-50, or more (Morris et al1980). Several other species are listed by older authors, but most are subtidal, arctic or southern species.

No family other than Cardiinae family has such an inflated shell and central beaks (Soot-Ryen 1955).

Ecological Information

Range—Japan, Alaska and south along Pacific coast to San Diego.
Local Distribution—near bay mouths on tideflats in most Oregon estuaries; also on exposed beaches in the south.
Habitat—beaches of uniform, not very coarse sand (Keen and Coan 1977); "corn meal" sand (Packard 1918). Often exposed. Diverse habitats: can be found in fine sand (Keen and Coan 1977), and large populations often found in eelgrass/mud areas (Lough and Gonor 1971).
Salinity—not found in upper bays where salinities vary greatly.
Temperature—
Tidal Level—from high intertidal to deep waters.
Associates—small specimens often infested with young *Pinnixa faba* or *P. littoralis* (Coan and Carlton 1975), (pea crabs).

Quantitative Information

Weight—
Abundance—not as abundant as *Saxidomus*, *Protothaca*, (formerly *Paphia*), at least in British Columbia where they are most common (Keen and Coan 1977). This species is the most abundant of its family on the west coast (Kozloff 1974a).

Life History Information

Reproduction—hermaphroditic; ova and sperm shed during much the same period: June and July (British Columbia) (Keen and Coan 1977); spawning time varies with current, temperature, free-swimming larvae probably settle sublittorally, and move inshore as they grow Fraser (Coan and Carlton 1975). Animals mature at two years.
Growth Rate—regular; relative rate falls throughout postlarval life; "northern forms, in contrast to southern, show a slower initial but more sustained growth, and reach the greater

age and larger size". Annual growth rings obvious, especially in northern specimens with cold winters, when growth is very slow.
Longevity—none found over seven years (Keen and Coan 1977); but: maximum 15 years.
Food—they strain material through their gills: suspension feeder.
Predators—sea stars (*Pycnopodia*), birds, man; easy prey, as it often is found on the surface of the tideflat. As larvae, preyed upon by planktonic predators and suspension feeders.
Behavior—can be very active: flips itself with large muscular foot; digs quickly but does not burrow deeply or laterally.

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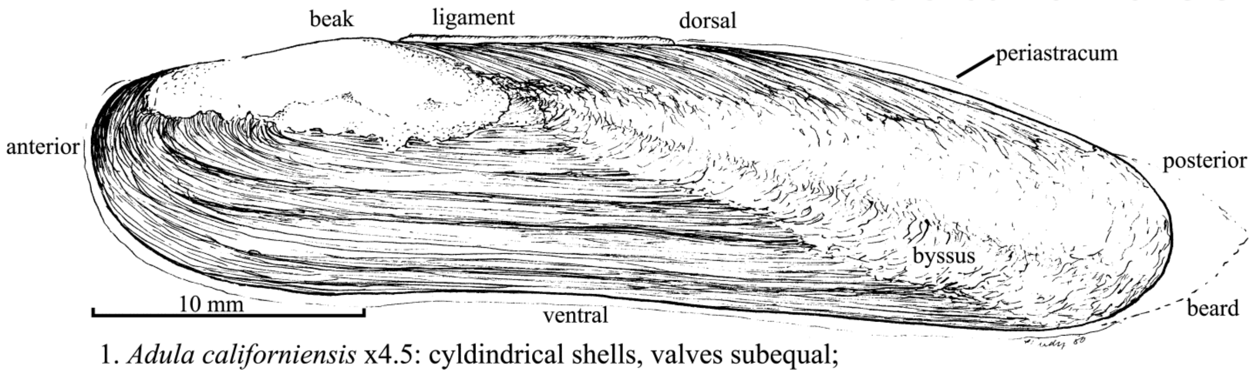
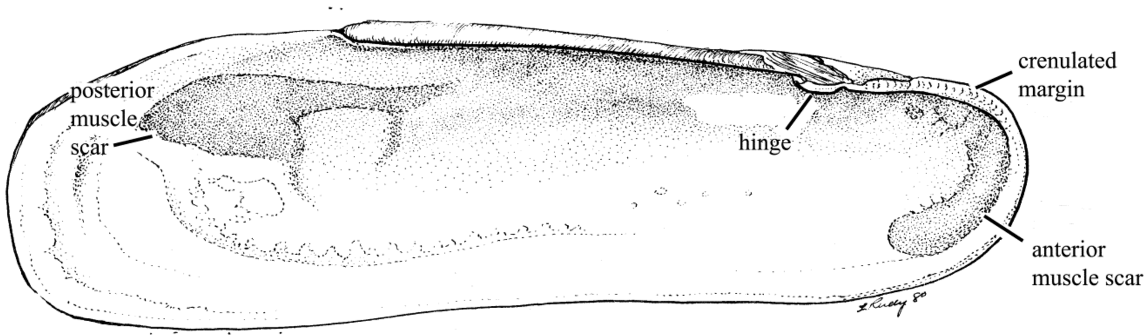
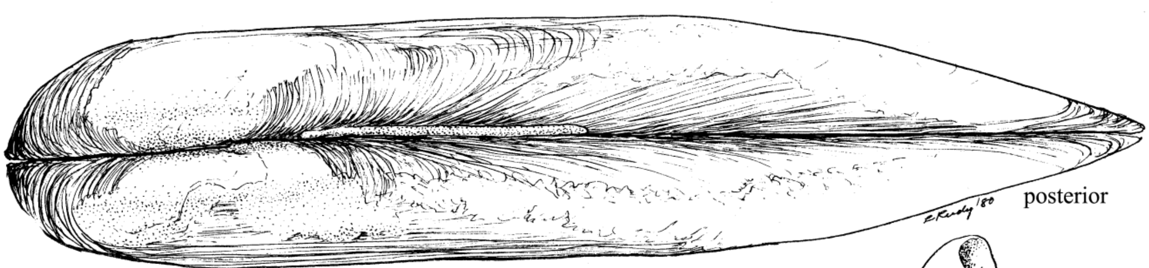
Adula californiensis



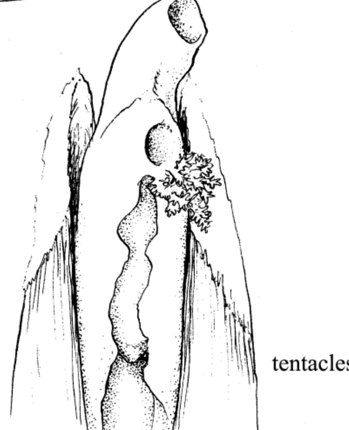
1. *Adula californiensis* x4.5: cyldindrical shells, valves subequal; dorsal and ventral margins roughly parallel; smooth periostracum; posterior slope hairy; worn beaks 1/4 of way from rounded anterior; ligament external; radial sculpture.



2. Left valve, interior: posterior muscle scar much larger than anterior scar; color white; sub-nacreous, posterior tinged with blue; anterior margin slightly crenulate; hinge without teeth.



3. (Doral view): posterior pointed; beaks not prominent



4. Siphons:
white, fused almost to ends;
incurrent siphon with oak-leaf
like tentacles.

Alderia modesta

A sacoglossan sea slug (Loven, 1844)

Phylum: Mollusca
Class: Gastropoda, Opisthobranchia
Order: Sacoglossa: “shield tongue”
Family: Hermaeidae

Description

Size—to 8 mm long; Coos Bay specimens to 5 mm.
Color—greenish- to yellowish-tan, black markings, base ivory.
Body—'aeolid': changing; an oblong, flat-bottomed form without tentacles or tail (figs. 1, 2).
Rhinophores—reduced, rolled not solid (fig. 1)7; (Kozloff calls these cephalic projections 'dorsolateral tentacles,' not rhinophores) (Kozloff 1974a).
Foot—no parapodia (lateral flaps that could fold over dorsum); foot extends laterally beyond body (Kozloff 1974a).
Cerata—dorsal projections, about 18 (fig. 1), in 2 loose branches on both anterior and posterior halves of dorsum (Kozloff 1974a).
Gills—none.
Eyes—small, black (figs. 1, 2).
Anus—a long tube originating on a medial line, resembling posterior ceratum (McDonald 1975).
Eggs—light yellow, in clear skein (fig. 3).

Possible Misidentifications

Sacoglossans are a little known group of few species and small size, but which can occur in large numbers. *Alderia modesta*, like others of the order, feeds on a specific alga, has a wide distribution, and could probably not be confused with other Opisthobranchs.

Sacoglossans resemble superficially the more well known nudibranchs, but unlike them, most do not have a circlet of gills, solid rhinophores, or oral tentacles. (One exception, *Stiliger fuscovittatus*, has solid rhinophores; it is tiny (3 mm), transparent white with reddish brown patterns, and lives in *Polysiphonia*, a red alga.)

Other Sacoglossans with dorsal cerata and rolled rhinophores include, also in the family Hermaeidae

Aplysiopsis smithi (=*Hermaeina*), greenish to brownish black with white edges, bulbous cerata, up to 22 mm long; it lives in *Chaetomorpha, Rhizoclonium* (its preferred food), or *Enteromorpha* (Gonor 1961). It has prominent rhinophores and a tail.

Aplysiopsis oliviae (= *Hermaea*) has a Y-shaped mahogany line from the rhinophores to the head midline; it is pale yellow with a pink spot behind the eyes.

Hermaea vancouverensis is a small (to 5 mm) brown and white slug, more common in Puget Sound than in the south; its habitat is eelgrass (Zoctera); its food the diatom *Isthmia* (Williams and Gosliner 1973).

Placida dendritica (=*Hermaea ornata)* has a long, obvious tail, long cerata, and is pale yellow with dark green lines. It is usually on algae *Bryopsis* or *Codium* in the rocky intertidal, and is found in California and Puget Sound (Williams and Gosliner 1973).

Olea hansineensia (family Oleidae) has only about 10 elongate cerata on its posterior dorsum; it is gray, and is found commonly in bays in Puget Sound and probably not in California.

None of these is yellowish tan with small black markings, a tubular anus, and living in *Vaucheria*.

Ecological Information

Range—San Juan Island to Elkhorn Slough, Calif.; Europe (Steinberg 1963).
Local Distribution—Coos Bay: South Slough.
Habitat—found only in mats of alga *Vaucheria* in *Salicornia* marshes.
Salinity—prefers 16-17 ‰ seawater; cannot survive in normal seawater or fresh water (Hyman 1967), although eggs develop in either seawater or brackish water. Cerata pulsation rate varies with salinity (Hyman 1967).
Temperature—
Tidal Level—at higher levels of marsh (Coos Bay): about 4.0'.

Associates—insects; alga *Vaucheria*.

Quantitative Information

Weight—

Abundance—common in its particular microhabitat, *Vaucheria* (McDonald 1975).

Life History Information

Reproduction—hermaphroditic; eggs laid in September, Coos Bay (this specimen).

Growth Rate—to early veliger two days in lab (this specimen).

Longevity—

Food—alga *Vaucheria*, exclusively.

Predators—some sacoglossans emit nasty repellents (Hyman 1967).

Behavior—

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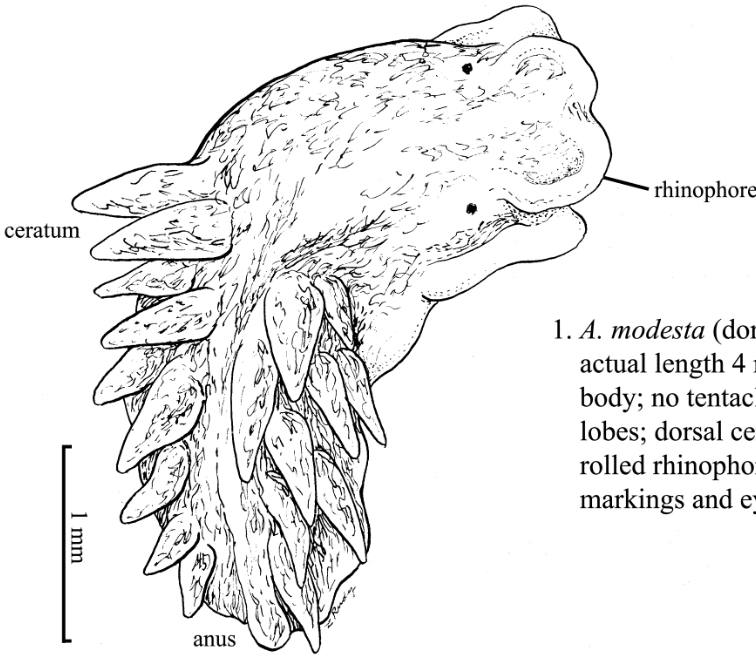
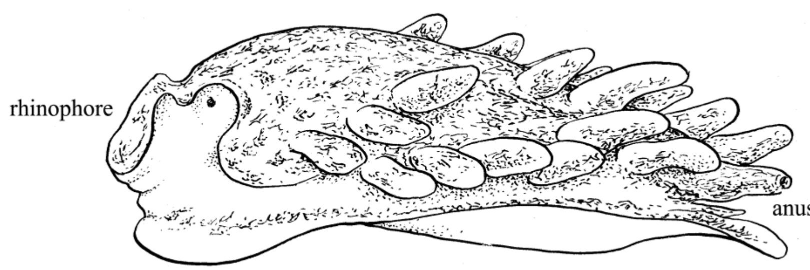
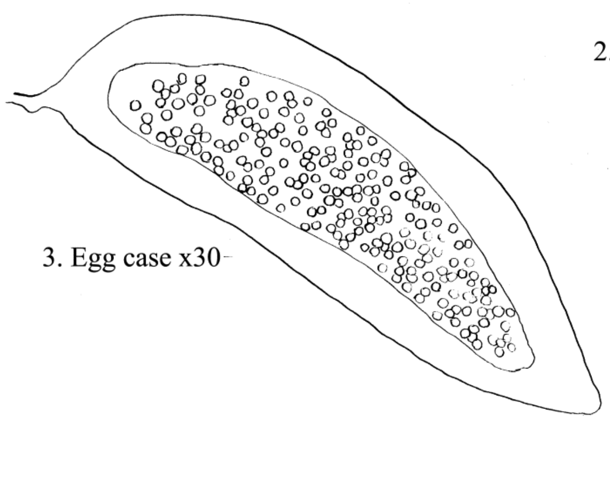
Alderia modesta



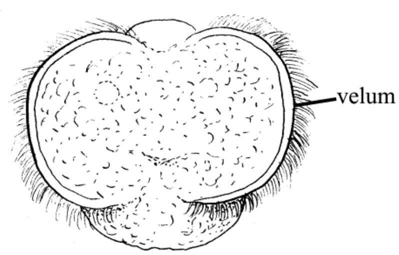
1. *A. modesta* (dorsal view) x30:
actual length 4 mm; oblong, changeable body; no tentacles, tail, or parapodial lobes; dorsal cerata; anal tube; small rolled rhinophores; light tan, black markings and eyes.



2. *A. modesta* (lateral view)



3. Egg case x30



4. 2-day veliger

Aplysiopsis enteromorphae (=A. smithi)

Smith's unwashed-looking sacoglossan (Cockerell and Eliot, 1905)

Phylum: Mollusca
Class: Gastropoda
Order: Sacoglossa
Family: Hermaeidae

Description

Size—to 25 mm long (Behrens 1980); most are 10 mm (Goddard 1985), some to 15 mm (Gonor 1961). Illustrated specimen (Coos Bay) 15 mm long.
Color—yellowish white, with greenish black patches; animal can be almost black: much local variation (Gonor 1961). Head uniform in color, dorsal cerata white or yellow tipped; rhinophores uniform in color, not veined.
Body—"aeolid", oblong, flat bottomed; no oral tentacles or parapodial lobes, but with prominent tail (fig. 1). No circlet of external gills: order Sacoglossa.
Rhinophores—prominent; rolled, not solid: order Sacoglossa (fig. 1). (Basal part rolled, distal part simple (Kozloff 1974a)). Color uniform, without system of lines.
Foot—no parapodial lobes (which fold over body in some species); foot extends to form tail (Gonor 1961).
Cerata—(singular = ceras): dorsal processes: spindle shaped, inflated, white tipped; 8 - 15 rows of 2 to 4 each row (Gonor 1961) (fig. 1).
Gills—none: order Sacoglossa.
Eyes—black, small, but conspicuous; deep set, at bases of rhinophores (fig. 1).
Genital Openings—2, on right behind rhinophore (fig. 1).
Anus—slightly raised, near 2nd and 3rd cerata, with black spot and renal opening near it (Gonor 1961) (fig. 1). Anus on midline at "shoulders" not on a long tube.
Eggs—yellow to white, in "C" shaped string 14 mm x 15 mm; eggs become paler as they develop (Goddard 1984; Gonor 1961). Eggs average 66 µ in diameter (fig. 3).

Possible Misidentifications

Sacoglossans differ from most Nudibranchia in their lack of a circlet of gills, and by their rolled, rather than solid rhinophores. They also lack oral tentacles, and have a uniseriate radula (Thompson 1976). Sacoglossans are herbivorous. There are other sacoglossans with dorsal cerata and rolled rhinophores, in 3 families - Alderiidae, Hermaeidae, and Stiligeridae. (The 1st 2 have been removed from the 3rd Kozloff 1974a)).

Among the Alderiidae, *Alderia modesta* (which see) has reduced rhinophores and an anus on a long posterior tube like a ceras. It lives in *Salicornia* marshes.

In the family Hermaeidae is *Hermaea vancouverensis*, a bay form like *Aplysiopsis*, but very small (5 mm). It has a triangular brown patch anterior to the rhinophores, and a brown collar anterior to the cerata. Its habitat is in the sea grass *Zostera*.

The Stiligeridae are represented locally by at least 3 species:

Placida dendritica (=*Hermaea ornata*) has long rhinophores and an elongate tail (like *Aplysiopsis*), but its cerata are long and not lumpy, and its ground color is pale yellow with a distinct veining of olive. It is quite small (to 8 mm), and if often found in the green algae *Bryopsis* and *Codium* in the rocky intertidal.

Olea hansineensia (formerly in Oleidae) is greenish brown. It has only 10 or fewer white tipped cerata; its rhinophores are short.

Stiliger fuscovittatus differs from most sacoglossans in having solid simple rhinophores; it is small (to 3 mm) and whitish, with rust markings. It lives in the red alga *Polysiphonia*.

In the genus *Aplysiopsis* is *A. oliviae*, a rare and probably more southern species than *A. enteromorphae*. It is up to 10 mm long, and has a Y-shaped dorsal mahogany line running back from the rhinophores.

Ecological Information

Range—San Juan Island, Washington to San Diego, California; also in Gulf of California (Behrens 1980).
Local Distribution—Coos Bay: South Slough, in Metcalf Preserve.

Habitat—Sacoglossans are typically restricted to certain algae species (Gonor 1961; Thompson 1976). In bays *Aplysiopsis* is commonly found on the green filamentous algae *Rhizoclonium* and *Enteromorpha.* It also likes quiet, shallow mud-bottomed bays which have *Zostera* at low tide level and bare mudflats above (San Juan Island). In Coos Bay it is found on bare mudflats near *Enteromorpha* beds. Also found seasonally on green algae *Cladophora* and *Chaetomorpha* in high to mid intertidal pools on open coast rocky shores, as well as in kelp holdfasts (Goddard 1984; Goddard 1985; Keen and Coan 1974).
Salinity—collected at 30 ‰
Temperature—10-15 °C.
Tidal Level—on San Juan Island, found at 0.0 tide level; in Coos Bay at +5.0 ft. MLLW. Intertidal to 10 m subtidally (Keen and Coan 1974) .
Associates—in Coos Bay, amphipods *Ampithoe valida, Grandidierella japonica,* alga *Enteromorpha.*

Quantitative Information

Weight—
Abundance—probably the most abundant sacoglossan of this coast (Goddard 1985; Gonor 1961) seasonally common (Goddard 1984; Goddard 1985; Steinberg 1963).

Life History Information

Reproduction—hermaphroditic; (illustrated) eggs found July (Coos Bay). Lays eggs on *Enteromorpha* strands continuously in lab; larvae emerge as free swimming veligers and apparently have long planktonic feeding phase (Gonor 1961). Embryonic period 7 days at 15-17 °C.; larvae without eyespots at hatching; newly hatched veligers have shell about 113 µ long (Goddard 1984).
Growth Rate—
Longevity—
Food—prefers *Rhizoclonium, Urospora*: rejects *Enteromorpha* (Gonor 1961). Feeds by slitting each filament cell with a radula tooth, then moving on to next cell (Gonor 1961) (fig. 4).
Predators—
Behavior—some sacoglossans emit unpleasant repellants from cerata to repel predators (Thompson 1976).

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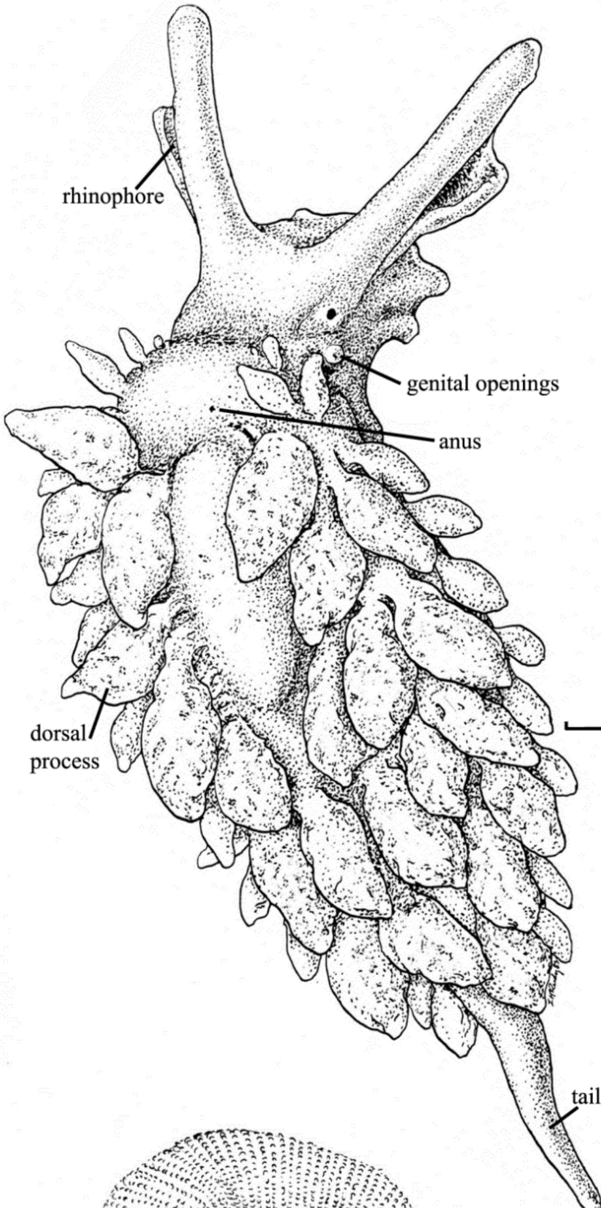
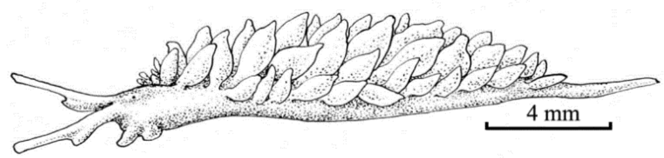
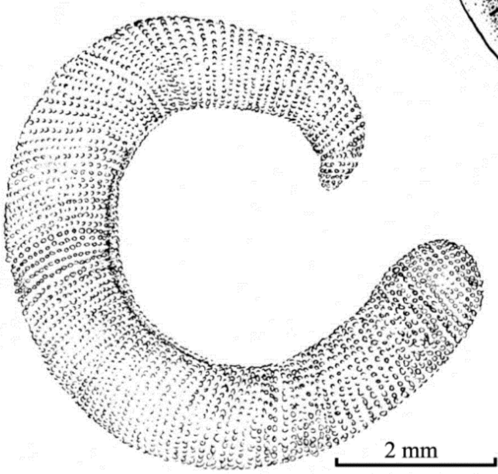
Aplysiopsis enteromorphae



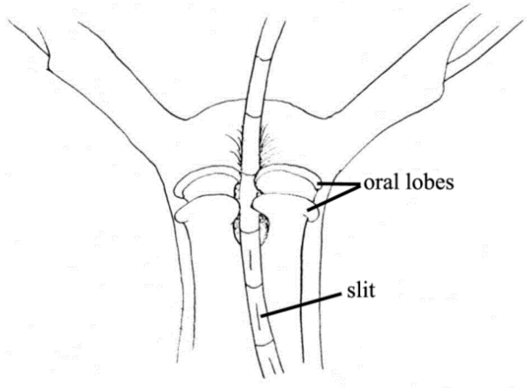
1. *Aplysiopsis enteromorphae* (L:15mm) x12: dolioliform, no tentacles or gills; large, rolled rhinophores; yellowish white with greenish black patches; dorsal processes inflated, lumpy, white-tipped; no parapodial lobes but a prominant tail.



2. Lateral view x6



3. Egg string x12: actual size 14 x 1.5mm string "C" shaped; pale yellow eggs 66 μm in diameter.



4. Head, feeding animal (ventral view): oral lobes grasp stem; radular tooth (within mouth); slits filamentous algal cells (from Gonor 1961).

Assiminea californica *(=Syncera ranslucens)*

A small salt marsh snail (Tryon, 1865)

Phylum: Mollusca
Class: Gastropoda, Prosobranchia
Order: Mesogastropoda
Family: Assimineidae

Description

Size—less than 4 mm high; most specimens collected near 3 mm.
Color—glossy chestnut (Keen 1971), smooth, transparent (largest whorl); interior porcelain-like, not pearly; spire often almost black (Coos Bay specimens); animal white with black markings (fig. 4).
Shell Shape—5 whorls: rounded, convex; globose to turbinate (Keen and Coan 1974), taller than wide; aperture subcircular, without notch or canal; inner lip spread out as a small thickened callus (Keen and Coan 1974) (fig. 3).
Columella—continuous with inner lip: no shelf, no folds, appressed to whorl. Spreads into callus. (fig. 3).
Animal—eyes on short ocular peduncles, no tentacles: family Assimineidae (Keen 1971) (fig. 4). Radula with 3 basal cusps on both sides of central plate: genus *Assiminea* (not figured).
Operculum—very thin, transparent, subspiral, convex (fig. 2).

Possible Misidentifications

Assiminea californica is one of a small association of salt marsh snails. Within our range it is often found with or near *Littorina (Algamorda) newcombiana*. This is a slightly larger littorine (to 6 mm) with 4 whorls, a nearly circular aperture, and with a simple chink between the large whorl and inner lip. The general shape and appearance of the two gastropods is quite similar. *L. (A.) newcombiana* does not have ocular peduncles.

A 2nd snail common found in salt marshes is *Ovatella myosotis*, a pulmonate of rather olive shape, up to 8 mm long. It is subcylindrical, not turbinate, with a short spire, three columellar folds, and no operculum. (See plate)

Littorine snails are larger than *Assiminea*, but can be superficially similar: *Littorina sitkana*, often found in this association, is globose, almost as wide as long, and has either heavy striated sculpture or dark horizontal lines. The animal has long tentacles, not *Assiminea*'s unusual ocular peduncles. *Littorina scutulata*, the checkered littorine, is occasionally found in the saltier parts of marshes. It is quite a bit larger than all the preceding snails, and is patterned on its exterior and purple inside.

Ecological Information

Range—Vancouver Island, British Columbia, to Cabo San Lucas, Baja California (Keen 1971).
Local Distribution—Coos Bay, many stations: South Slough, Haynes Inlet.
Habitat—under driftwood, debris, *Salicornia*, in mud.
Salinity—generally a wide toleration of salinities: to 2.4 ‰ seawater; possibly to 16 ‰ (Matthews 1979).
Temperature—varied (salt marsh temperatures).
Tidal Level—family Assimineidae are intertidal[4]; all live above the low tide level; this species likes upper, usually dry parts of the marsh, about 3-4 feet (South Slough, Coos Bay).
Associates—littorines *L. sitkana*, *L. (A.) newcombiana*, pulmonate *Ovatella myosotis*, amphipod *Traskorchestia traskiana*; plants: *Salicornia, Distichilis, Fucus*.

Quantitative Information

Weight—
Abundance—common in Salicornia marshes (Smith and Carlton 1975).

Life History Information

Reproduction—
Growth Rate—
Longevity—
Food—

Predators—fish: many snails found in gut content analysis (Coos Bay) (Matthews 1979).

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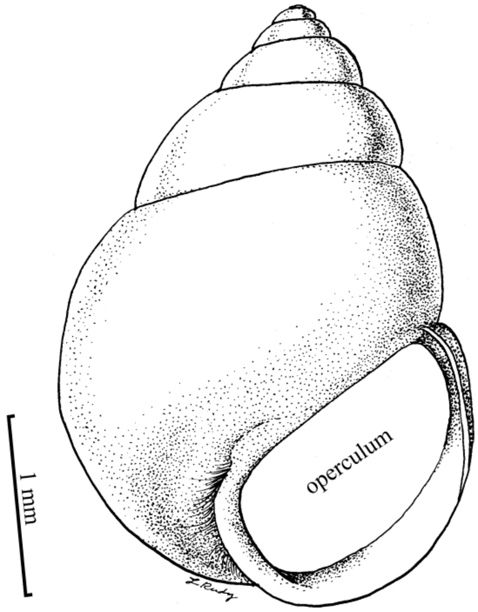
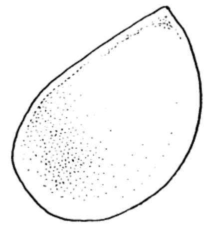
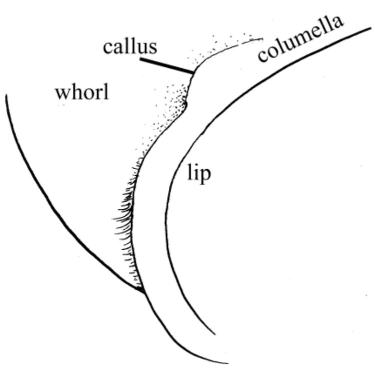
Assiminea californica



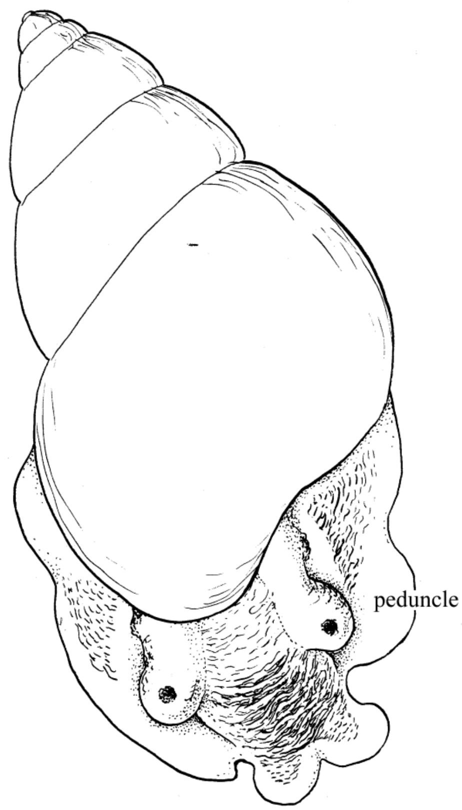
1. *Assiminea californica*
(anterior view, H:3.3 mm) x30:
5 convex whorls, taller than wide.



2. Operculum x30



3. Inner lip x50:
columella continuous with lip,
with no shelf, and a thick callus,
lip appressed to whorl.



4. Animal (dorsal view) x30:
note eyes on ocular peduncles; no tentacles.

Bankia setacea (=Xylotrya setacea)

The northwest shipworm (Tryon, 1863)

Phylum: Mollusca
Class: Bivalvia; Heterodonta
Order: Myoida
Family: Teredinidae

Description

Size—the largest of the shipworms, its burrows can be 1” in diameter, 3 feet long in uncrowded conditions, 976 mm in length, 15 mm diameter (Haderlie and Miller 1973); present specimens small: shell diameter, 5 mm.
Color—white. with brownish tinges.
Shell—bizarrely modified bivalve: reduced, sub-globular, gaping widely in front for the foot, and behind for the body (Hill and Kofold 1927); each small valve with 3 lobes: anterior, median (with 3 separate areas), and posterior, or auricle (figs. 4a, b, c). In *Bankia*, the anterior lobe is fairly small, and has rnany numerous, close-set ridges; auricle medium sized, rounded. Apoohysis (fig. 4b); attachment for some foot muscles (*ibid*). Articulating condyles (pivots) on ventral margins (not shown) (Morris et al 1980).
Body—can vary greatly, to 1m; a long soft whitish tube connecting the calcareous shell and pallets (fig. 1) (Morris et al 1980).
Pallets—2 calcareous, feather-like structures, attached to the animal's posterior end under a fleshy collar (fig. 1); used to close the burrow when animal is disturbed; symmetrical, compound structures: come-in-cone segments with margins drawn out into slender projections connected by a membrane: (fig. 2). Visible pallets are those of dead animals (Hill and Kofold 1927).
Burrow—sinuous, showing pattern of shell's grinding surface; sometimes with calcareous tube (made when animals stop boring); burrows deep into wood, not just along surface (Haderlie and Miller 1973).

Possible Misidentifications

Teredo navalis, the common cosmopolitan shipworm, was introduced to San Francisco around 1910 (Hill and Kofold 1927). It is rare in Puget Sound, and probably also in Oregon. Teredinidae are distinguished almost entirely by their pallets, there being such variation in shell shape. *Teredo* sp. has simple pallets, without the separate conical elements of *Bankia. Teredo* causes more damage than *Bankia*, being much more adaptable to extremes of temperature and salinity. *Teredo navalis* is usually much smaller than *Bankia setacea*; its burrows are nearer the surface: Other *Bankia* species are warm water animals, and do not range north of San Diego (Hill and Kofold 1927).

Ecological Information

Range—Kodiak Island to San Diego: type locality: San Francisco Bay.
Local Distribution—Oregon's coasts and estuaries; Coos Bay: Charleston boat basin.
Habitat—wood: floating or piles: great efforts have been made to discourage settlement; some of man's repellents slow, but do not completely deter the shipworm. Does not burrow in buried wood (Morris et al 1980).
Salinity—prefers full strength sea water of open oceans. Doesn't tolerate reduced salt conditions (Ricketts and Calvin 1971). Can live in waters above 50‰ seawater (Morris et al 1980).
Temperature—likes cold; eggs laid during coldest months; limits (Puget Sound): 7-12°C (Johnson and Miller 1935).
Tidal Level—sea level down to "mudline"; as deep as 200 feet (Monterey Bay); densest 1’ above mudline (Haderlie and Miller 1973).
Associates—small isopods: *Limnoria*, a borer, and non-boring species; sphaeromids, asellota; *Ianiropsis kincaidi derjugini* was found in Charleston harbor with *Bankia*.

Quantitative Information

Weight—
Abundance—as many as 240 ft^2 at 200 ft. deep; fewer in shallower water (Hill and Kofold 1927).

Life History Information

Reproduction—all young are 1st males; about half develop into females later (Morris et al 1980). Eggs laid and fertilization occurs outside burrows during coldest temperatures; planktotrophic larvae have long pelagic life (can swim up to four weeks) (Quayle 1953); many eggs, few larvae (Hill and Kofold 1927). Larvae (0.25 mm long and looking like typical clams) must settle on wood or perish (Morris et al 1980).

Growth Rate—settlement greatest in fall. begins again in spring (Friday Harbor) (Johnson and Miller 1935); in Monterey settlement greatest in February, numbers never high in any one month: initial boring done by larva; pin-sized hole enlarged within as animal grows. Growth rate temperature dependent: slowest under 10°C (av. 50 mm/mo.), fastest at over 10°C. (av. 100 mm/mo.); greatest individual growth: 610 mm/5 mos; greatest burrow diameter, 12 mm, 56, 59 (see Quayle in Haderlie and Miller 1973).

Longevity—longest lived individuals 8-14 months in Monterey Bay study (Hill and Kofold 1927).

Food—wood: shipworms are able to digest cellulose. Also eats plankton (Morris et al 1980).

Predators—

Behavior—young *Bankia* follow grain of wood. Burrows are parallel and do not intersect. Can destroy untreated soft wood in less than a year (Morris et al 1980).

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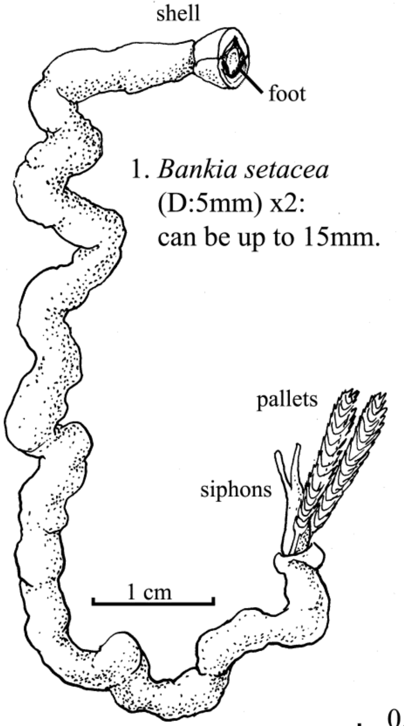
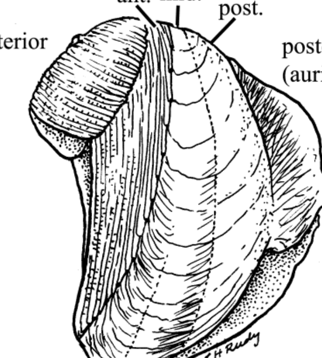
Bankia setacea

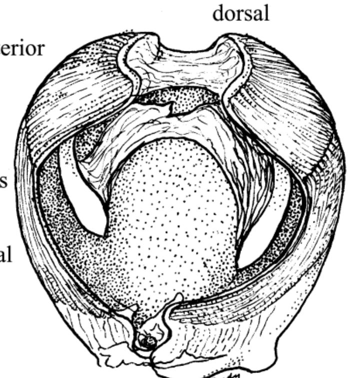


1. *Bankia setacea* (D:5mm) x2: can be up to 15mm.

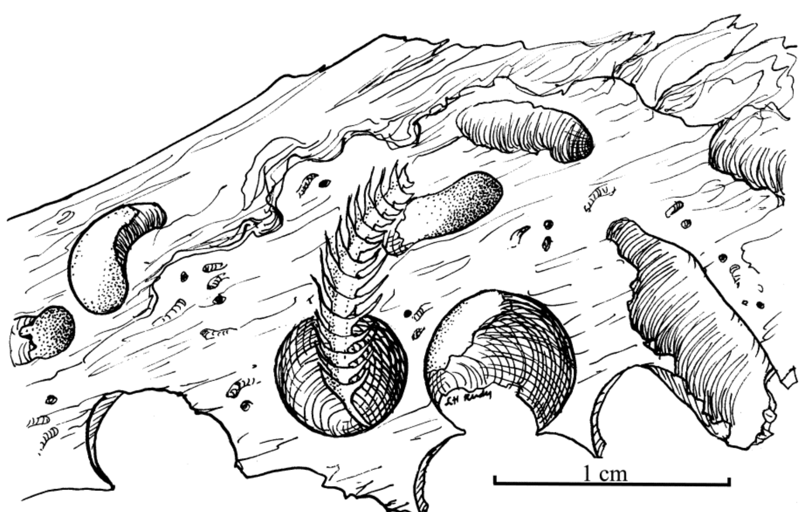
2. Pallet x12: cone-in-cone segments with slender projections, connecting membrane.



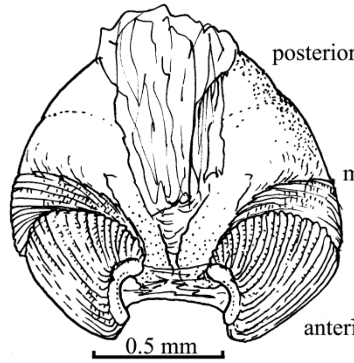
a. Left lateral, showing lobes



b. Frontal



3. Shipworm burrows x4: several sizes, some calcareous; pallet of dead animal.



c. Dorsal

4 a.,b.,c., Shell x11

Callianax biplicata (=*Olivella biplicata*)

The purple olive (Sowerby, 1825)

Phylum: Mollusca
Class: Gastropoda
Order: Neogastropoda (=Stenoglossa)
Family: Olividae

Description

Size—large for family: to 30 mm long (Carlton and Roth 1975); mature at 16 mm (Edwards 1968); males larger than females. Width usually about twice as high as wide (Kozloff 1974a). This specimen 18 mm high, 9 mm wide.
Color—gray, purple fasciole (band) at base offset with dark line (fig. 1); faint vertical striations, but surface otherwise polished, unsculptured: genus *Olivella (Callianax)* (Carlton and Roth 1975).
Shell Shape—stout, robust, sub-cylindrical; spire only slightly elevated; 5-6 whorls. Body whorl convex, nearly flat near thin straight outer lip; aperture elongate, triangular, with anterior notch (fig. 2).
Columella—strong callus, with a fold of 2 incised spiral lines or plications in lower portion: sp *biplicata* (fig. 2).
Operculum—small, horny, thin, half ovate, apical nucleus (not figured).
Animal—eyeless; foot plow-shaped, for burrowing (McLean 1969). Long siphon for water intake (fig. 3). Radula with 3 teeth to the row: Neogastropoda (not figured).
Eggs and Young—egg like a dome-shaped hat, about 0.5 mm diameter (fig. 4a). Veliger 0.2-0.3 mm (fig. 4b) (Edwards 1968).

Possible Misidentifications

Callianax species are the only genus of the family Olividae in our north temperate waters; the larger *Oliva* is a warm water genus. The genus *Callianax* may be distinguished by its smooth surface, slight spire, elongate, notched aperture, clean sand habitat, and in *C. biplicata* by its columellar folds. At least 3 *Callianax* are found on the west coast:

Callianax baetica, slenderer than *C. biplicata* (2 ½ x as high as wide), shell tan or cream with red, brown or purple markings and lines: it can be found on protected beaches and subtidally. It is smaller than *C. biplicata*-only up to 19 mm It is found in Puget Sound as well as in California (Kozloff 1974a; Carlton and Roth 1975).

Callianax pycna, another small olive (to 19 mm), is stout, and has brownish zig-zag lines on its whorls (Carlton and Roth 1975). It is not found in Puget Sound, but is a more southern species.

Characteristics of the family Olividae include a polished shell (indicating that the mantle often covers it), a subcylindrical, spired shell with an aperture greater than ½ the shell length. They are usually sand dwellers.

Ecological Information

Range—Vancouver Island to Magdelena Bay, Baja California: Oregonian and Californian shallow water marine faunal provinces.
Local Distribution—outer, marine portions of most bays and estuaries, including Coos Bay, Netarts (Stout 1976).
Habitat—sandy beaches and spits of bays, as well as outer coast. Can concentrate metals in tissues, apparently without harrn (Morris et al 1980).
Salinity—full sea water.
Temperature—
Tidal Level—low intertidal to subtidal waters: lives in quite a wide band (Kozloff 1974b); found higher than and associated with the razor clam: *Siliqua patula*.
Associates—*Siliqua patula*; parasitic nematodes (Edwards 1969): in southern California, hydroids on spire.

Quantitative Information

Weight—
Abundance—common intertidaily (Carlton and Roth 1975).

Life History Information

Reproduction—dioecious (two sexes); mating behavior observed at every low tide,

all year: no ‘year classes' in Oregon waters. Mate selection by chemosensory means; internal fertilization. Only sexual dimorphism observable is larger size of males. Sterility rate may be as high as 50% due to trematode infestation. Single egg cases deposited usually on empty shells; egg development time variable: 10-28 days (Edwards 1968). Veligers nonpelagic: swim near substrate (Edwards 1968).
Growth Rate—to maturity (16 mm) in one year. Males grow faster than females and are larger. Growth rate varies from 0.1 mm to 9.7 mm/year (Stohler 1969). Few young reach maturity; mostly populations of older animals, which have a low mortality rate (Edwards 1969).
Longevity—possibly several years: as many as ten (Edwards 1968).
Food—family is carnivorous; scavengers animal matter; large *Callianax* will eat polychaetes (Edwards 1969).
Predators—*Pisaster brevispinus* (Coos Bay, North Spit) (Edwards 1969): small *Cancer antennarius* and *C. magister*; shorebirds, particularly gulls; fish; man, for ornament (Stohler 1969). In southern California: mollusks *Octopus, Polinices, Conus*, echinoderm *Astropecten (*Stout 1976).
Behavior— reacts to predator *Pisaster brevispinus* by crawling or by rapid upside down swimming (Edwards 1969). Trails near surface. shell partly exposed. Larger animals active at night and hide from predators during the day.

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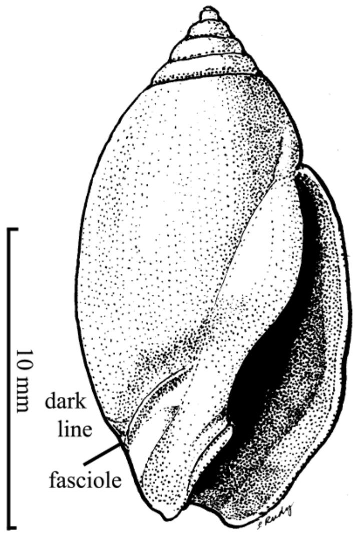
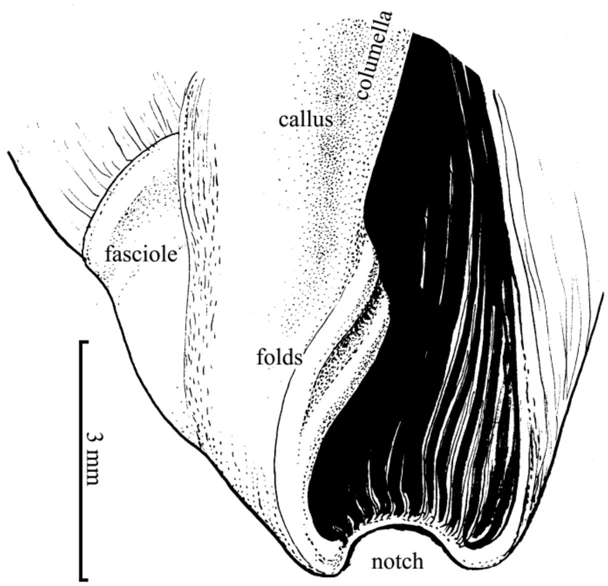
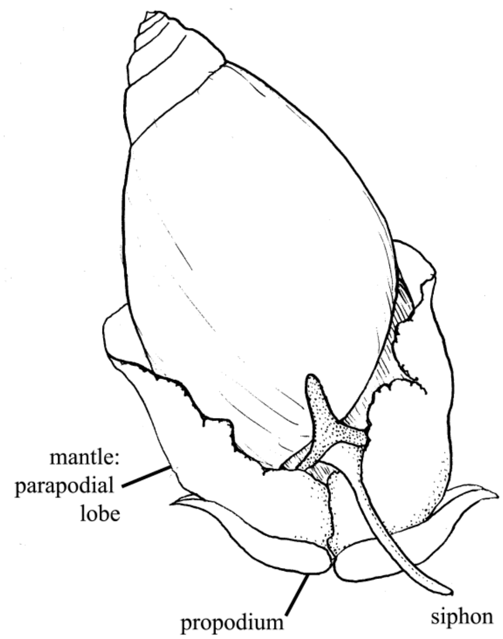
Callianax biplicata



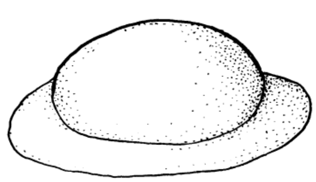
1. *Callianax biplicata* (anterior view, H:18mm) x4.5: about twice as high as wide; polished surface: gray with purple fasciole; stout, subcylindrical; slight spire; 5-6 whorls; long aperture.



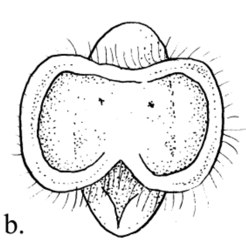
2. Columella and aperture x12: columella with strong callus, two fold; aperture notched.



3. *C. biplicata* (dorsal view)



a.



b.

4. Egg and larva x100:
   a. egg case
   b. veliger (frontal view)
   (Edwards, 1968)

Chlorostoma funebralis (=Tegula funebralis)

The black turban or top shell snail (A. Adams, 1855)

Phylum: Mollusca
Class: Gastropoda, Prosbranchia
Order: Archeogastropoda
Family: Trochidae, Monodontinae

Description

Size—to 50 mm or more high (Carlton and Roth 1975), usually less than 25 mm (Keep 1935); this specimen 20 mm diameter, 17 mm high.
Color—exterior purplish-black, not shiny; with white eroded apex. Gray when dry. Interior white with a black margin; a pearly or "rainbow" deep interior patch. White around columella (McLean 1969) (fig. 1)
Shell Shape—strong; 4 inflated whorls; rather top-shaped, (conical) with a flat base; round aperture, nearly round, horny operculum: family Trochidae (Griffith 1975). Small snails are about as high as wide (figs. 1, 2); older ones become higher than wide (Frank 1965b).
Sculpture—below the suture is an impressed line (Oldroyd 1924), or a scaly band (Carlton and Roth 1975): "foliaceous incremental lamellae" (Oldroyd 1924) (figs. 1. 2). Whorls "spirally lirate," i.e. having up to 17 thread-like spiral lines (figs. 1, 2); sometimes smooth except for base, or strongly sculptured above (fig. 2).
Umbilicus—covered by a callus, nearly always closed (Carlton and Roth 1975) (fig. 3). Specimens with an open umbilicus do not have a flange between umbilicus and aperture.
Columella—spirally twisted (Oldroyd 1924), with 2 denticles (nodes) near base (fig. 3), lower node worn or indistinct.
Aperture—round, complete; no anterior notch or canal (fig. 3): aperture length less than $^3/_4$ shell length.
Outer Lip—smooth, black-rimmed, without sculpture (fig. 3).
Operculum—thin; round, numerous spiral lines; horny, not calcareous (fig. 4).
Radula—with a single central tooth; 5-7 pointed lateral teeth, 8-10 marginal teeth (fig. 6).
Foot—long, relatively narrow; with epipodal tentacles along sides: family Trochidae (4 on each side: species funebralis (fig. 5).

Possible Misidentifications

The Trochidae are herbivorous, conical snails, pearly within, with round, entire apertures and thin horny circular opercula (Griffith 1975). The Turbinidae, a similar family, are also conical, but they have a calcareous operculum, and are represented here only by *Astraea*, a large subtidal and offshore species.

The other common genus of the Trochidae is *Calliostoma*, a conical top shell, which is distinguished from *Chlorostoma* chiefly by its lack of denticles or nodes on the columella. Its whorls are not inflated like *Chlorostoma*'s. *Calliostoma* is found on the outer shores, not in bays; it has many spiral ribs, no umbilicus, and various distinctive colorations.

Snails of the genus *Chlorostoma* have strong columellar nodes, a round, thin, horny operculum with many spiral lines, and a pearly interior. They sometimes have a periostracum. The 3 other species of *Chlorostoma* found on the Pacific coast are not known to be estuarine:

Tegula montereyi probably does not occur above Bolinas Bay, north of San Francisco; it occupies the low intertidal off-shore zone, often in kelp beds. This species is brown, with a strong, open umbilicus and a strictly conical (not inflated) profile.

Tegula pulligo, the dusky turban, occurs in the low intertidal in California; it is the dominant *Tegula* in Puget Sound (Griffith 1975), where it occurs in open coasts and in protected situations (Kozloff 1974a). *T. pulligo* has an open umbilicus with the inner lip produced into a flange (it is closed in *T. funebralis*). It has a brown (not purple or black) periostracum; its basic color is brown or gray, sometimes with orange, white or brown spots on the edge. Its habitat is open rocky beaches (Griffith 1975).

Chlorostoma brunnea, the brown turban, is the closest to *C. funebralis* in Oregon; it does not seem to occur in Puget Sound (Kozloff 1974a), and is very common on the outer shores in Oregon and around San Francisco (Packard 1918). It has only one node on the columella, as opposed to *C. funebralis'* two; its shell is brown or orange brown, and it lacks the scaly subsutural band of *funebralis* (Carlton and Roth 1975). *C. brunnea* is found lower in the intertidal than *funebralis*, or in off-shore kelp beds near the surface; probably never in estuaries.

Tegula gallina, the speckled tegula, is gray to green, lacks the scaly subsutural band, and is found south of Santa Barbara. It is closely related to *C. funebralis*; the radulae are quite similar (Merriman 1967).

Ecological Information

Range—Vancouver, B.C., to central Baja California (McLean 1969).
Local Distribution—marine portions of large Oregon. estuaries; Coos Bay: Pigeon Point.
Habitat—avoids exposed outer coast situations although it is found in rocky protected outer tidepools (Carlton and Roth 1975); marine portions of estuaries in rocky situations amongst seaweed (Griffith 1975). Strongly built: can withstand surf. Females found in more exposed places than males at low tide (Frank 1975). Species is negatively phototactic: seeks the light (Morris et al 1980).
Salinity—collected at 30 ‰ salt. Cannot withstand continued exposure to low salinity.
Temperature—found in temperate waters only. With black color can get quite warm during exposure to sun at low tides.
Tidal Level—on outer shores, most common at high inter-tidal (2-0 m) (Frank 1975); found in midintertidal as well." In estuary found at 0-+1 ft. Small snails settle high, live there 5-6 years, then migrate to lower levels (to +0.6- -0.2 m) (Paine 1979).
Associates—on outer coast: slipper shell *Crepidula* and several limpets (*Collisella*), which can be predatory. Empty shells used by hermit crabs.

Quantitative Information

Weight—this specimen 4g wet, with shell.
Abundance—most abundant mid-intertidal grazer (Frank 1975).

Life History Information

Reproduction—dioecious; eggs and sperm exuded into water. Sexes can be determined by color of foot sole: males are light, females darker; female gonad bright green from egg yolk. Egg masses gelatinous, about 3 mm diameter; several hundred eggs, about 0.19 mm diameter. Breeding probably once a year (Paine 1979); reproductive size of snails 14 mm (Paine 1971). Planktonic veliger larvae emerge on 7th day, settle 12th day. Long life of *T. funebralis* ensures increased lifetime reproductive effort (Frank 1975).
Longevity—lives up to 30 years; average age may be 10 years (Frank 1975).
Growth Rate—young snails grow rapidly: from 4-5.6 mm and 27 mg average weight (June) to 5.6-9.8 mm. 177.3 mg (following March) (Morris et al 1980). California snails do not show growth rings of Oregon snails, which in older animals reveal an annual winter cessation of growth (Frank 1975).
Food—"a catholic feeder" (Frank 1975): almost any common alga. Prefers *Macrocystis integrifolia, Nereocystis luetkeana, Rhodoglossum affine, Gigartina canaliculata*: i.e. fleshy forms. If not available, will eat encrusting green alga, *Ralfsia pacifica*, detritus (Abbott et al 1964).
Predators—*Pisaster ochraceus* in low intertidal. Although *Chlorostoma* is not its preferred prey, *Pisaster* can consume over ¼ the available snails (Frank 1965b). Possibly limpet *Collisella*; carnivorous snail *Nucella*; crab *Cancer antennarius*.
Behavior—larger animals migrate to lower intertidal. Species is sedentary, aggregates at low tide, moves up to rock tops at nighttime high tides (not diurnal ones) (Morris et al 1980). Territory: tends to live in a radius of about 1.5 m for months; a daily movement of about 1m (Frank 1975). Snails move well on rocks, are clumsy on sand. They place pebbles on the foot to alter balance (Morris et al 1980). Escape predators by sensory perception (seastars), or by crawling onto top of predator's shell (carnivorous snails).

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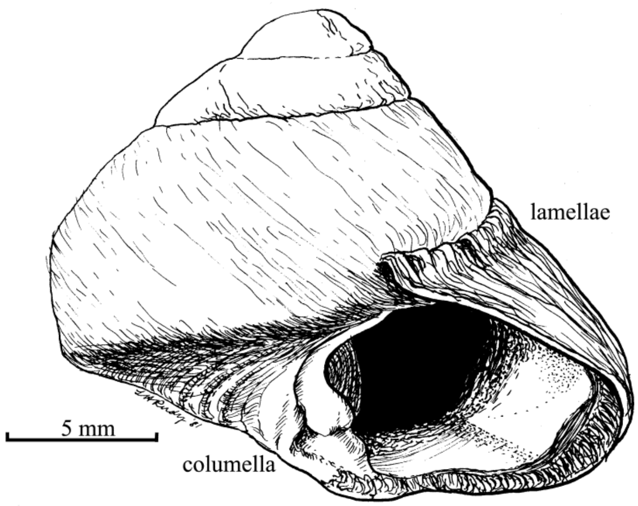
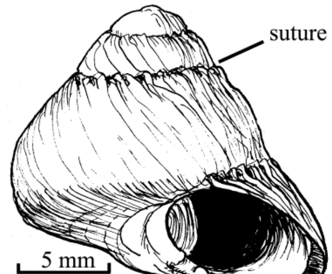
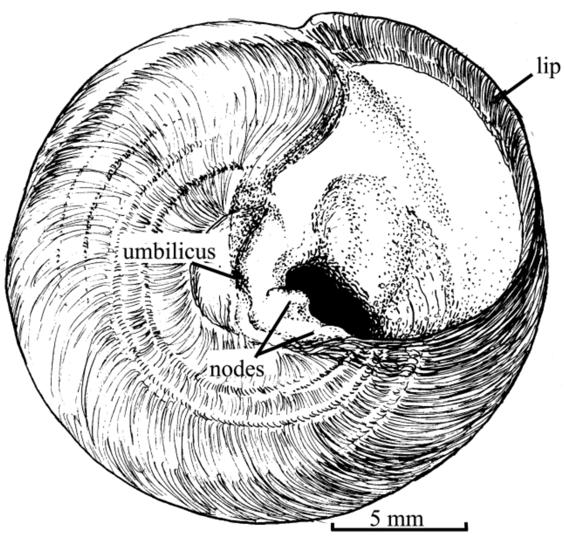
Chlorostoma funebralis



1. *Chlorostoma funebralis* (ventral view, H:17mm, D:20mm) x5: four whorls, inflated; eroded spire; elevated lamellae below suture; thread-like spiral sculpture on whorls; base flat.

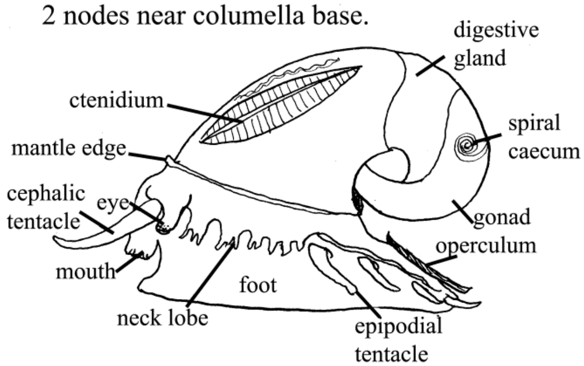


2. Variation x3: strong sculpture on sutures and on whorls.

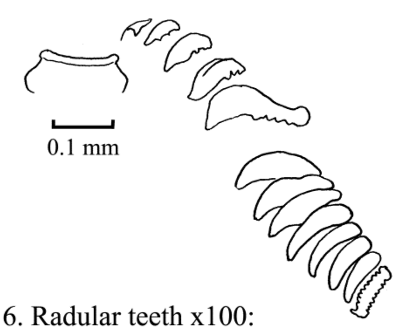


3. (Anterior view) x4.5: aperture rounds, complete; columella white, interior pearly; umbilicus closed; 2 nodes near columella base.

4. Operculum x4: round, horny, thin; many spiral lines.



5. Schematic dissection, left side (Abbott et al, 1964).



6. Radular teeth x100: one large central tooth; 5-7 pointed lateral teeth; 8-10 marginal teeth, last ones serrated (Fritchman, 1965).

Clinocardium nuttallii

Basket of heart cockle (Conrad, 1837)

Phylum: Mollusca
Class: Bivalvia, Heterodonta
Order: Veneroida
Family: Cardiidae

Description

Size—up to 72 mm (Packard 1918), but often grows to greater size, particularly on northern beaches (Fraser 1931); up to 100 mm (Kozloff 1974b).
Color—warm brown when young, mottled; adults light brown.
Exterior—shell as high as long (Kozloff 1974a), or higher; longer than wide during first year (Length: anterior to posterior) (Fraser 1931). Valves alike; shell inflated, triangular, with rounded corners (Kozloff 1974b); end profile heart-shaped (fig. 3). About 35 strong, squarish, ridged ribs radiating from umbo (fig. 1). Shell thick, rather brittle (Keep and Longstreth 1935); posterior end evenly rounded, smooth. Umbones prominent (Abbott 1968), beaks nearly central, directed anteriorly (Keen and Coan 1974) (fig. 2).
Interior—white, not pearly; anterior and posterior muscle scars equal in area; pallial line simple. Known for its great foot, short siphon.
Hinge Area—hinge central, with 1 strong cardinal tooth, a posterior and an anterior lateral tooth in each valve (fig. 2); ligament entirely dorsal, not internal.
Eyes— numerous, tiny, on optical tentacles on mantle margin (Morris et al 1980).

Possible Misidentifications

There are at least 2 other species of *Clinocardium* in the Puget Sound area, although other members of the family have not been reported from Oregon. Both species are longer than high, subtidal, and less than 4 cm high. *C. ciliatum* has 40 ribs, *C. californiense* has 45-50, or more (Kozloff 1974a). Several other species are listed by older authors, but most are subtidal, arctic or southern species.

No family other than Cardiinae family has such an inflated shell and central beaks (Coan and Carlton 1975).

Ecological Information

Range—Japan, Alaska and south along Pacific coast to San Diego (Weymouth and Thompson 1931).
Local Distribution—near bay mouths on tideflats in most Oregon estuaries; also on exposed beaches in the south (Weymouth and Thompson 1931).
Habitat—beaches of uniform, not very coarse sand (Fraser 1931); "corn meal" sand (Packard 1918). Often exposed. Diverse habitats: can be found in fine sand (Fraser 1931), and large populations often found in eelgrass/mud areas (Kozloff 1974b).
Salinity—not found in upper bays where salinities vary greatly.
Temperature—
Tidal Level—from high intertidal to deep waters.
Associates—small specimens often infested with young *Pinnixa faba* or *P. littoralis* (pea crabs) (Ricketts and Calvin 1971).

Quantitative Information

Weight—
Abundance—not as abundant as *Saxidomus*, *Protothaca*, (formerly *Paphia*), at least in British Columbia where they are most common (Fraser 1931). This species is the most abundant of its family on the west coast (Keep and Longstreth 1935).

Life History Information

Reproduction—hermaphroditic; ova and sperm shed during much the same period: June and July (British Columbia) (Fraser 1931); spawning time varies with current, temperature, free-swimming larvae probably settle sublittorally, and move inshore as they grow Fraser (Ricketts and Calvin 1971). Animals mature at two years.

Growth Rate—regular; relative rate falls throughout postlarval life; "northern forms, in contrast to southern, show a slower initial but more sustained growth, and reach the greater age and larger size" (Weymouth and Thompson 1931). Annual growth rings obvious, especially in northern specimens with cold winters, when growth is very slow.
Longevity—none found over 7 years (Fraser 1931); but maximum 15 years (Weymouth and Thompson 1931).
Food—they strain material through their gills: suspension feeder.
Predators—sea stars (*Pycnopodia*), birds, man; easy prey, as it often is found on the surface of the tideflat. As larvae, preyed upon by planktonic predators and suspension feeders.
Behavior—can be very active: flips itself with large muscular foot; digs quickly but does not burrow deeply or laterally.

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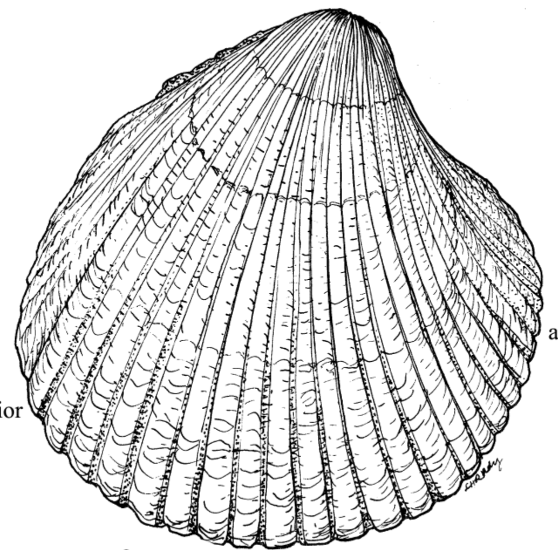
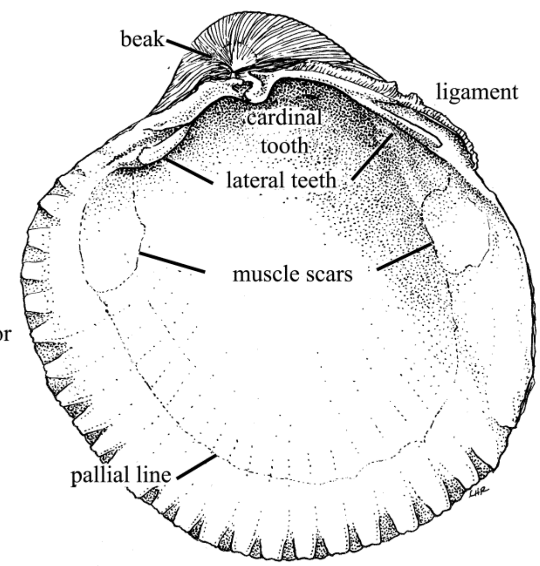
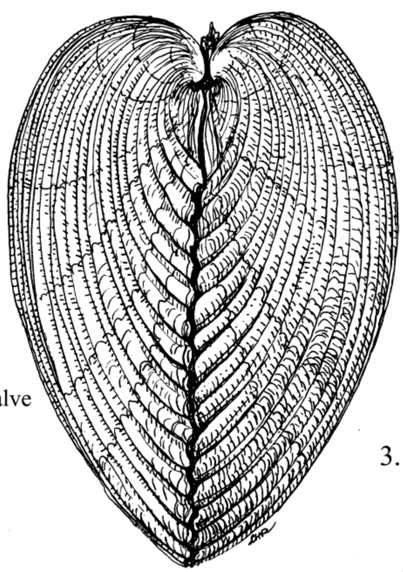
Clinocardium nuttallii



1. *Clinocardium nuttallii*, right valve 1.5x: 5.8cm, about 35 strong radial ribs; height greater than width; shell inflated, rounded.



2. Interior, right valve: beaks nearly central, directed anteriorly; surface white; scars equal, pallial line simple; one cardinal, two lateral teeth; ligament external.



3. Profile (anterior end): heart-shaped.

Corbicula fluminea *(= manilensis)*

The Asian clam (Muller, 1774)

Phylum: Mollusca
Class: Bivalvia
Subclass: Heterodonta
Order: Veneroida
Family: Corbiculidae

Description

Size—from less than 1" to 2 ½" long (Ward and Whipple 1963); rarely over 50 mm (2") (Ward and Whipple 1963), but often over 40 mm in canal bottoms (Eng 1979). Illustrated specimen 14 mm (Columbia River).
Color—exterior tannish; periostracum (in canal specimens only; specimens from earth-lined habitats lack periostracum (Eng 1979)). Interior white, smooth, polished, sometimes with purple markings (Britton and Morton 1979).
Shell Shape—triangular (Coan and Carlton 1975) to subcircular; valves regular, similar; shell thick.
Sculpture—heavy concentric ridges and faint growth rings (Britton and Morton 1979)(fig. 1).
Hinge Area—very elongate, with anterior and posterior serrate lateral teeth: family Corbiculidae (Burch 1975) (fig. 3).
Hinge Teeth—3 in each valve: "divergent, pseudocardinals" (Clarke1981) (fig. 3). A long row of serrate hinge teeth both anteriorly and posteriorly (fig. 3): family Corbiculidae (Burch 1975). Note: Ward and Whipple 1963 lists 2 teeth in each valve, a possible error.
Beaks—subcentral (Ward and Whipple 1963); heavy, inflated (Britton and Morton 1979). Umbones often eroded, especially in acidic waters (Britton and Morton 1979).
Ligament—thick and strong; entirely on dorsal surface posterior to beaks; not internal (fig. 2).
Adductor Muscles—muscle scars approximately equal (Coan and Carlton 1975) (fig. 3).
Pallial Line—incomplete anteriorly; consistent in family Corbiculidae (Britton and Morton 1979).
Byssus—small, present only in first year (Morton 1979) (not figured).
Reproductive Organ—anterior testis and posterior ovary both discharge into common gonoduct (Britton and Morton 1979) (not figured).
Siphons—similar (Britton and Morton 1979) (not figured).

Foot—large (Clarke 1981) (not figured).

Possible Misidentifications

The Corbiculidae, of which *Corbicula* is the only North American genus (Burch 1975), are noted for a heavy shell, strong concentric sculpture, and regular triangular to subcircular valves. There are 3 other freshwater bivalve families in the Pacific northwest:

The Unionidae are represented by 2 genera: The monotypic *Gonidea (angulata)* has a smooth but irregular elongate subtriangular shell, with a distinctive high sharp ridge. *Anodonta,* the 2nd genus, has a thin smooth elliptical inflated shell, sometimes winged at the posterior end. It has fine parallel ridges (not deep heavy ones as in Corbiculidae). Its hinges lack teeth.

The 3rd family, the Sphaeriidae, belongs to the same superfamily (Sphaeriacea) as the Corbiculidae (Burch 1975). There are several genera, including *Sphaerium, Musculium,* and *Pisidium.* Sphaeridae can have regular valves, subcentral beaks and radial sculpture as do Corbiculidae. The lateral hinge teeth in Sphaeriidae are smooth, however, not serrate as in *Corbicula.*

A great number of species of *Corbicula* have been named world-wide, many of them superfluous. The taxonomy of the genus is very confused, and there is still uncertainty as to how many species have been introduced into North America from Asia and elsewhere (Britton and Morton 1979). It is possible that only *C. fluminea* exists here: M.H. Smith et al 1979 have suggested, on the basis of electrophoresis, that specimens from 5 major U.S. populations (California, Texas, Arkansas, Tennessee and South Carolina) are all of the same species. There is, however, a great deal of variation in shell shape, sculpture, etc.

C. fluminea has been called by some authors C *manilensis;* this is not now considered to be a separate species, although there are still a few questions about its reproductive habits and longevity (Morton 1979). *C. fluminalis,* probably a synonym for *C*. *manilensis,* may be larger than *C*. *fluminea,* could live longer (to 8 years (reference needed)), and seems to occupy river mouths rather than streams (Britton and Morton 1979).

Ecological Information

Range—introduced to North America from the Orient in 1930s; now in all major U.S. drainages, Pacific and Atlantic, below 40° lat. (Britton and Morton 1979). Reaches its northern limit in Pacific Northwest: Washington, Idaho, Oregon to northern California. Also occurs in Imperial Valley, California, and in Arizona.

Local Distribution—Columbia River system; Siuslaw River at Florence; possibly in Umpqua River (Carlton 1979).

Habitat—an “opportunist” *Corbicula* can live in quiet or fast moving water, in streams, rivers, canals, lakes and reservoirs. It can utilize either an "r" or a "k" reproductive strategy; its only limiting factor seems to be space (Britton and Morton1979). It has spread very successfully in 50 years, especially into irrigation canals in northern California, where it is a serious pest. In canals, it finds a nursery in the incrustation formed of corophiid amphipod tubes and colonial hydroids on the concrete walls. Here the densely packed clams accumulate as a solid layer (sometimes to 3’ thick) composed of clams, fine silt and mucus. They become so dominant that they change their environment radically. In the Columbia system they live in stream bottoms. *Corbicula* is used as a bioassay for lead contamination (Clarke et al 1979); it is adversely affected by excess potassium (Daum *et al* 1979). Exposure to air for many days can cause death by accumulation of metabolic wastes (before desiccation occurs; the clam has a tight shell). Mean survival: 26.8 days at 20 °C., at high relative humidity (r.h.); 13.9 days at 20 °C., at low r.h.; 8.3 days at 30 °C., at high r.h.; 6.7 days at 30 °C., at low r.h. Thus exposure to air could be used to kill clams (McMahon 1979).

Salinity—considered a freshwater species. Can survive a gradual increase of salinity, i.e. to 22% salinity for 80 days. In shock tests, however, mortality was 50% within 10 days of over 10% salinities; animals' sodium uptake measured 50% Na at 4.5% salinity (72 mM Na/1) (Evans *et al* 1979).

Temperature—cannot survive cold: one severe winter can kill a population (Horning and Keup 1964). Short warm water periods seem to be limiting factor in northern range (Eng 1979). Growth occurs only at temperatures over 14 °C., spawning takes place only at 13 - 16 °C. (in California: Eng, 1979).

Tidal Level—usually a shallow water or near-shore species.

Associates—becomes very dominant, and competes with native Spaeridae and Unionidae within whose communities it can live (Morton 1979). In canals, the amphipod *Corophium spinicorne* provides tubes that harbor recently set clams; the colonial hydrozoan *Cordylophora lacustris* also provides habitat (Eng 1979). Oligochaete *Chaetogaster limnaei* can sometimes be found in clam's mantle cavity (Eng 1976).

Quantitative Information

Weight—

Abundance—maximum densities (Delta-Mendota Canal, California): fall - winter, summer at downstream sites (Eng 1979): up to 4500 clams/ft^2 (Eng 1979).

Life History Information

Reproduction—early reproduction, high fecundity contribute to species' success. Both a protogynous and a protandric consecutive hermaphrodite (Britton and Morton 1979), it can also function as a simultaneous hermaphrodite, making it highly successful reproductively. *Corbicula* incubates its young (about 1 month) in the inner demibranch of each ctenidium (Morton 1979). Larvae (as juveniles) are released into the plankton, the only freshwater bivalve that does this (Eng 1979). Juveniles settle; this flexibility greatly aids dispersal. There are 2 reproductive peaks in California, April to May and in August to September. (In Kentucky, a cooler climate, there is but 1 peak per year.)

Growth Rate—rapid growth is one of the successful strategies of *Corbicula:* clams grow from March to October, when temperatures are over 14 °C. (Eng 1979). In central California, outside canals, clams grow to a mean of 12 mm the 1st season, and 15 mm the next (Heinsohn 1958). Two growth rings are formed per annum (Britton and Morton 1979). Growth varies with depth that clam lives: specimens at 8m deep are longer than those at 12m (Abbott 1979). Larvae and small juveniles overwinter.
Longevity—2 to 4 years (Britton and Morton 1979); large animals in canal bottoms live longest.
Food—probably diatoms (Hanna 1966); possibly flagellates. High population doesn't seem to cause too much competition for food (Eng 1979).
Predators—man, for fish bait, occasionally for food; fish and waterfowl (Sinclair and Isom 1963).
Behavior—a burrower; serious pest in dredged sands used to make concrete (Morton 1979).

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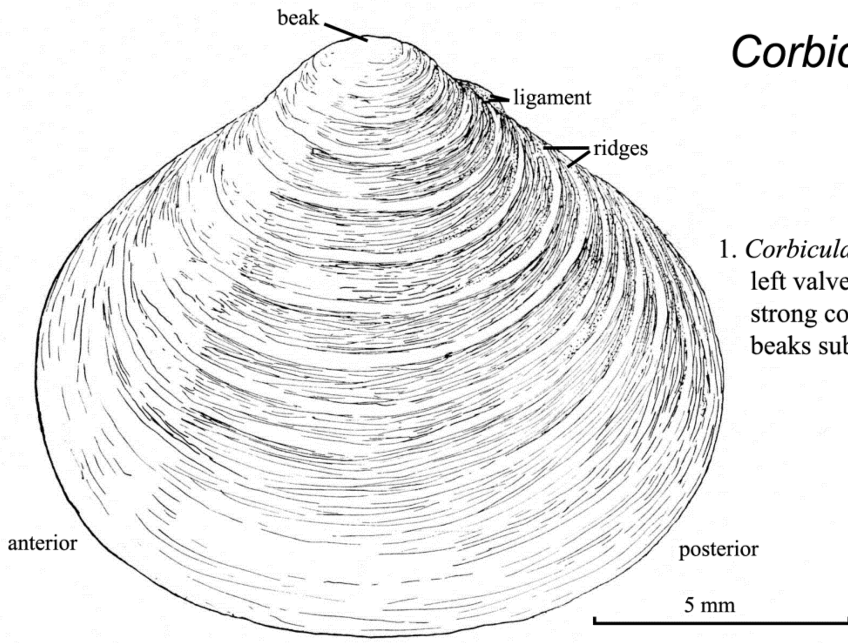
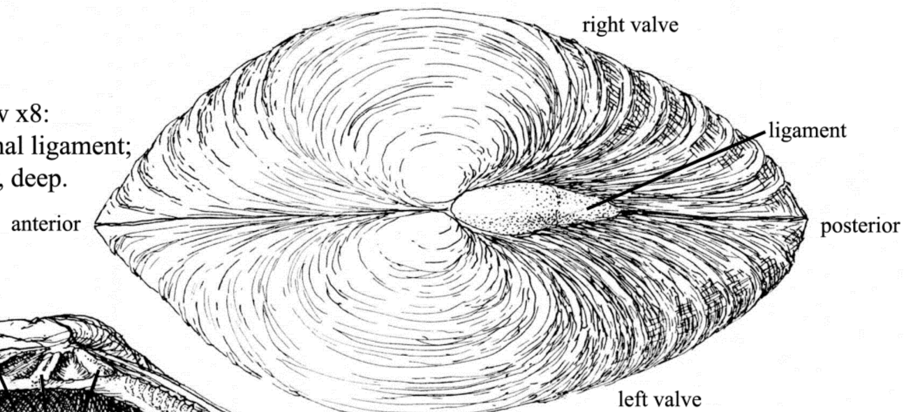
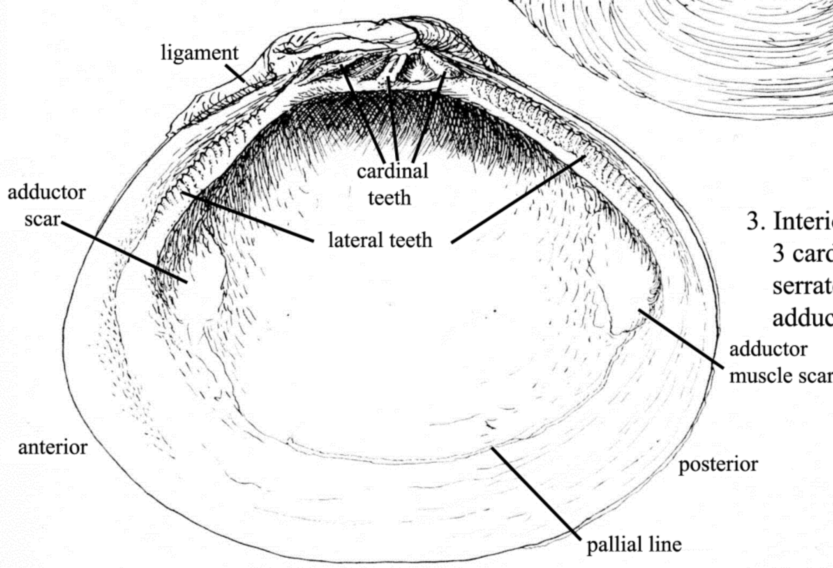
Corbicula fluminea



1. *Corbicula fluminea* (14x12x5.5mm) x8: left valve; regular, thick, triangular valves; strong concentric ridges; external ligament beaks subcentral.

2. Dorsal view x8: large external ligament; shell heavy, deep.





3. Interior, left valve: 3 cardinal teeth (each valve); elongate hinge, serrate lateral teeth; chalky surface; subequal adductor muscle scars.

Cryptomya californica

False Mya (Conrad, 1837)

Phylum: Mollusca
Class: Bivalvia; Heterodonta
Order: Myoida
Family: Myidae

Description

Size—to 30 mm long; this specimen 21 mm.
Color—exterior chalky and white, with dull reddish brown periostracum. Interior glossy white with spoon-shaped tooth (right valve): orange.
Shell Shape—oblong, gaping posteriorly. Right valve more convex than left (McLean 1969). Shell thin, fragile, with external thick periostracum and light concentric sculpture (Quayle 1970). Beaks central, fairly prominent (fig. 1).
Ligament—internal; in right valve, orange, leathery, corresponds with chondrophore in left valve. Ligament seated in a shallow resilifer (pit) (figs. 3, 4).
Interior—adductor muscle scars equal: family Myidae.
Pallial Line—entire, forms a right angle posteriorly (fig. 3).
Pallial Sinus—absent (or inconspicuous): genus *Cryptomya* (fig. 3) (Coan and Carlton 1975).
Hinge Area—no true teeth or hinge plate, except for chondrophore and resilifer: family Myidae (McLean 1969).
Chondrophore—broad, horizontal, projecting; in left valve only. Right valve with resilifer to receive chondrophore.
Siphons—short, oval, surrounded by tentacles (incurrent). Excurrent siphon a short vase-like siphon (fig. 6).

Possible Misidentifications

Cryptomya can be distinguished from other small white clams (*Macoma*, for instance) by its lack of any external ligament, the fragility of its shell, and internally, by its lack of hinge teeth, and presence of the chondrophore in the left valve. Mactridae, including the gaper clam, have a chondrophore in both valves. Mactridae adults are large, gape widely, and have small hinge teeth (which Myidae lack); their posterior edges are truncate, not rounded, and their siphons are leather-like at the tips.

The genus *Mya*, closely related, is quite common in the northwest, and be immediately distinguished internally by the presence of a deep pallial sinus (*Cryptomya* has no sinus). There is only one local species:

Mya arenaria, the soft-shelled clam in our area, grows to 120 mm. Like *Cryptomya*, it is thin-shelled, white and fragile, and lives in sandy mud. It is longer than *Cryptomya* (Keen 1971) however, and is found down to 30 cm deep, and not necessarily near *Callianassa* burrows.

Ecological Information

Range—Gulf of Alaska to northern Peru (Keen 1971).
Local Distribution—in bays where *Callianassa* or *Upogebia* beds are found: Coos Bay, airport extension site, Pigeon Point, South Slough, etc.; Tillamook Bay; Netarts; Nestucca (Hancock et al 1979); also offshore.
Habitat—sand and sandy mud, nearly always within its siphons' reach of the burrow of *Callianassa*, the ghost shrimp (which in turn often inhabits oyster beds).
Salinity—collected at 30 ‰ salt.
Temperature—occurs over a wide range of water temperatures geographically.
Tidal Level—can be found down to 20” below surface (Quayle 1970); as well as the upper to mid-intertidal range.
Associates—the well-known association of *Callianassa* can include as well the polynoid polychaete *Hesperonoe*, 3 different pinnotherid (pea) crabs, and the goby *Clevelandia ios*. (Farther south the clam is found next to *Urechis* burrows) (McLean 1969). It has also been found near the burrow of the mud shrimp *Upogebia*.

Quantitative Information

Weight—
Abundance—can be very common: in some parts of Coos Bay, it is the most abundant

bivalve (airport mudflat, North Bend) (Gonor et al 1979).

Life History Information

Reproduction—
Growth Rate—
Longevity—
Food--filters material from water pumped in by *Callianassa* in the burrow. (Both *Upogebia* and *Urechis* are more effective detritus filterers than *Callianassa*, and *Cryptomya* does better, at *Callianassa*'s table (MacGinitie and MacGinitie 1949).
Predators—protected by the burrow.
Behavior—stays not just below the surface as a short-siphoned clam of its size normally would, but deep in the substrate, where it burrows into *Callianassa* burrows.

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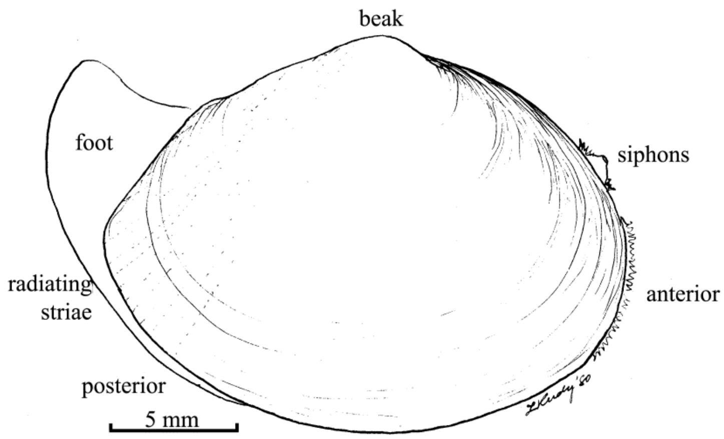
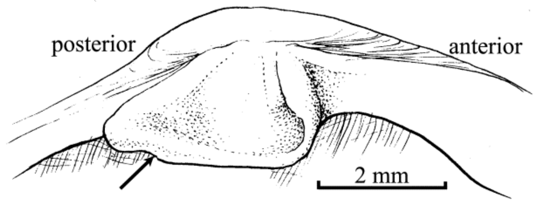
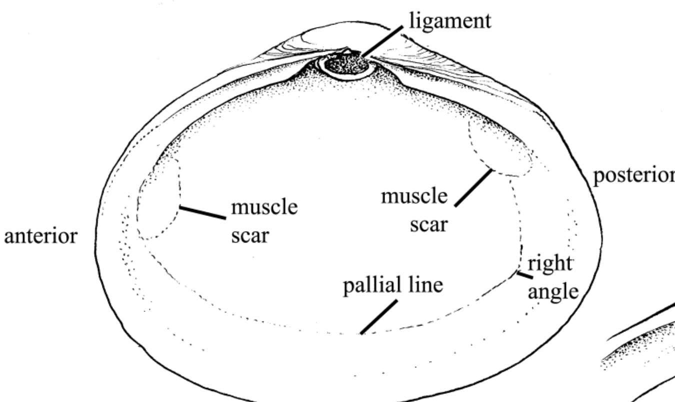
Cryptomya californica



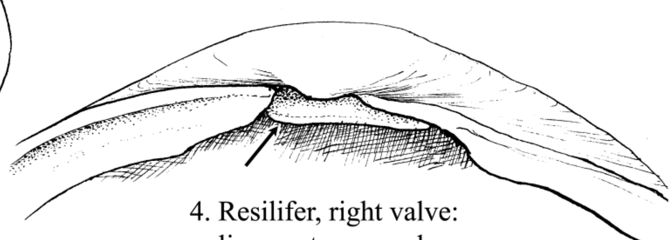
1. *Cryptomya californica*, exterior, right valve (L:2.1mm) x4.25: beaks central; anterior rounded, posterior truncate, gaping, concentric sculpture, same radial striae; shell thin, fragile, chalky white; siphons very short.



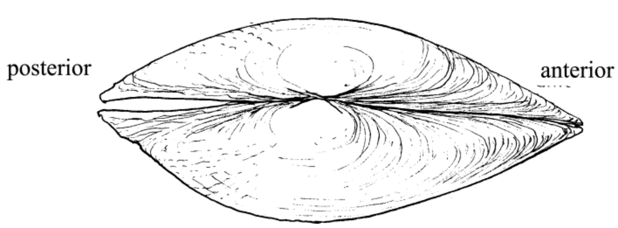
2. Chondrophore, left valve x11: spoon-shaped, broad, horizontal.



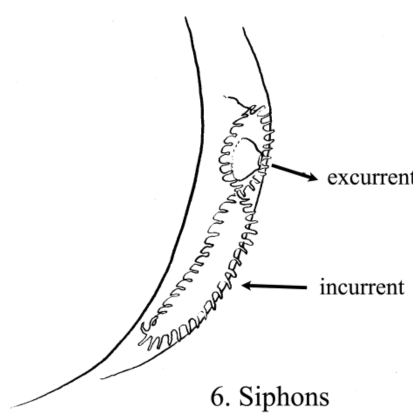
3. Interior, right valve: glossy white; anterior and posterior muscle scars equal; no cardinal or lateral hinge teeth; no pallial sinus, pallial line entire, forms a right angle posteriorly.



4. Resilifer, right valve: ligament removed.



5. (Dorsal view): posterior gapes slightly; no external ligament.



6. Siphons

Entodesma navicula

The rock-dwelling entodesma (A. Adams and Reeve, 1850)

Phylum: Mollusca
Class: Bivalvia; Anomalodesmata
Order: Pholadomyoida
Family: Lyonsiidae

Description

Size—to 150 mm (6 inches) (Quayle 1970); largest of family (Dail) (Oldroyd 1924); (this specimen 60 mm long, 40 mm wide).
Color—exterior white but covered with abundant brown, transversely striated periostracum. Interior pink, nacreous (pearly): family Lyonsiidae (Coan and Carlton 1975).
Shell Shape—oblong (valves longer than high); posterior gaping, truncated; shells strongly deformed by nestling habit. Exterior rough, with concentric striations, coarse or irregular ribs (Keen and Coan 1974), or not radial ribs (Kozloff 1974a). Ventral margins flex, gape; left valve slightly larger than right (Oldroyd 1924). Shell brittle, breaks easily.
Beaks—large, incurved (Oldroyd 1924); close to anterior end (fig. 2); urn-bones do not touch (Keen and Coan 1974) (fig. 2).
Interior—pearly and iridescent; pallial line solid, not in patches (Coan and Carlton 1975); pallial sinus obscure, angular (Oldroyd 1924); 2 adductor muscle scars of equal size (different shapes) (fig. 3).
Hinge Area—no true teeth or chondrophore (fig. 3).
Ligament—internal: family Lyonsiidae (Coan and Carlton 1975). Ligament is small, reinforced with a large lithodesma or ossicle, a calcareous plate (fig. 3).
Periostracum—coarse, heavy, does not extend beyond shell posterior (not shown). Periostracum often cracks shell as it dries; this can be prevented in collecting by applying a lubricant like Vaseline (Keen 1971).
Siphons—short, not red-tipped (not shown).
Byssus—(attachment threads): species characteristic (Coan and Carlton 1975) (not shown).

Possible Misidentifications

Of the nestling or burrowing clams of our estuarine rocky intertidal, most of the pholads can be immediately distinguished from *Entodesma* by their file-like denticulations anteriorly, and by the 2 distinct sections of each valve (see *Penitella, Zirfaea*). The nestling habit of some clams can distort shell shape and make identification difficult: i.e. *Protothaca staminea* var. *orbella*).

Hiatella arctica (=*Saxicava*) is a very similar, often deformed nestling clam. It can be most easily told from Entodesma by its white, porcelain-like interior (Keen and Coan 1974) (not pink and pearly), and by its broken pallial line. It also has very distinctive red-tipped siphons, which *Entodesma* does not.

Petricola carditoides has an external ligament and 2-3 cardinal hinge teeth, as well as some radial sculpture. It is chalky white, with purple-tipped siphons (Kozloff 1974a), and usually is narrower posteriorly than anteriorly. It lives in pholad burrows.

A myid clam, *Platyodon cancellatus*, is another rock dweller, but it is a burrower, not a nestler (Quayle 1970; Coan and Carlton 1975). It has a chondrophore and tooth in its hinges, fine, almost lamellar concentric exterior sculpture, and a white interior with a well-developed pallial sinus (Kozloff 1974a).

Of *Entodesma's* family, Lyonsiidea, *Lyonsia* sp. is not distorted by nestling, and has fine radial lines and a pearly exterior. Two species, *L. californica* from mud and a northern one, *L. pugettensis* from sand, could be present.

There is another species of *Entodesma, E. inflatum*, smaller (up to 25 mm) and lighter in color than *E. saxicola*. It lives in compound ascidians or in sponges (called *L. (E.) inflata* by Kozloff) (Coan and Carlton 1975).

Ecological Information

Range—Aleutian Islands to San Diego, California.
Local Distribution—Coos Bay: Fossil Point.
Habitat—among rocks in crevices and abandoned pholad burrows; also attached by byssus to floats, pilings.
Salinity—collected at 30 ‰.
Temperature—

Tidal Level—intertidal; subtidal to 45 fathoms (Keen and Coan 1974).
Associates—other nestling and burrowing molluscs: *Hiatella, Zirfaea*, *Penitella*, etc.

Quantitative Information

Abundance—common (Puget Sound); present but not common in Oregon (Quayle 1970).

Life History Information

Reproduction—hermaphroditic, with external fertilization: eggs and sperm emitted alternatively (Quayle 1970).
Food—suspension feeder.
Behavior—adapts to its particular rocky niche by changing its shell shape as it grows.

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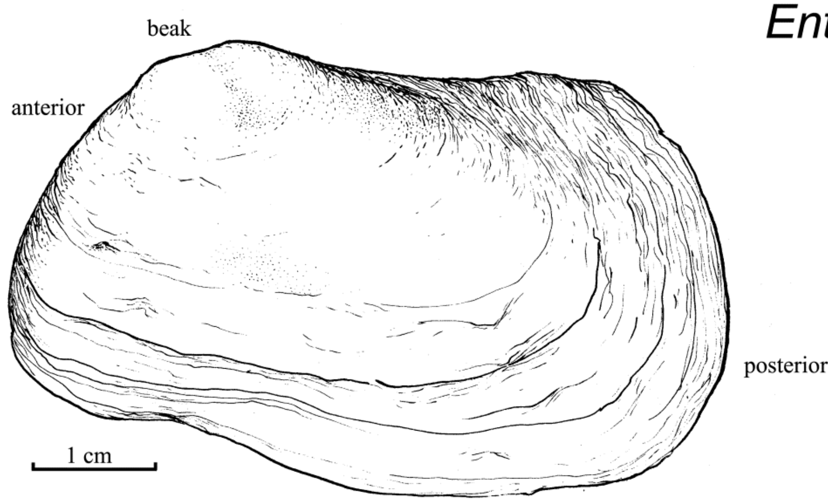
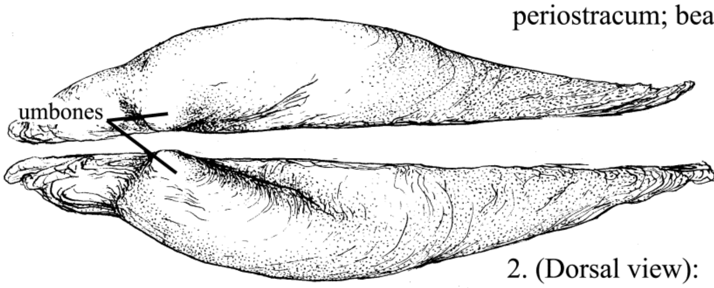
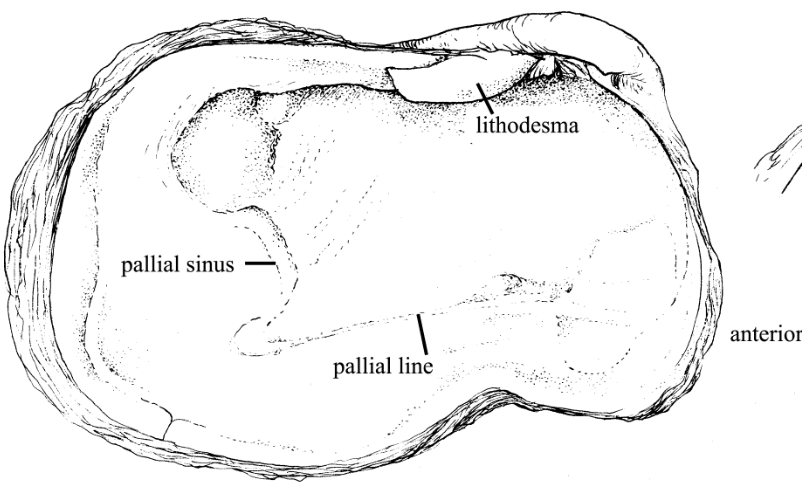
Entodesma navicula

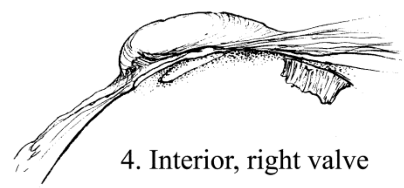


1. *Entodesma navicula* (L:60mm) x2:
shell oblong, deformed; concentric striations, rough periostracum; beaks near anterior end, posterior truncate.



2. (Dorsal view):
beaks large, incurved; umbones not touching; posterior gaping.





4. Interior, right valve

3. Interior, left valve:
pearly, iridescent; hinge area without teeth of chonrophore; lithodesma reinforces internal ligament, pallial line solid, pallial sinus present but obscure.

Hermissenda crassicornis

An opalescent aeolid nudibranch (Eschscholtz, 1831)

Phylum: Mollusca
Class: Gastropoda
Order: Nudibranchia
Family: Facelinidae

Description

Size—30 mm to 80 mm long (Beeman and Williams 1980); this specimen (Coos Bay) 50 mm.
Color—ground color often white, transparent, but can be yellow or green (MacFarland 1966), with opalescent white or blue line around foot, down each oral tentacle, and down back, where it is double and encloses 2 orange spots (McDonald 1975). Line can form diamond shape between first cerata. Cerata cores (digestive glands) brown or reddish; cerata tips orange, except for clear very tip: typical (Beeman and Williams 1980). These specimens with vertical white stripe on cerata. Many cerata color variations: rust, red, black, brown, green (Keen 1971).
Body—"aeolid"; an oblong, flat-bottomed form, with rhinophores, cerata, tail. but without posterior plume of branched gills (fig. 1).
Rhinophores—long; with 8 - 24 slanted, faint "leaves" or rings (Farmer 1980); "weakly perfoliate" (McDonald and Nybakken 1980) or annulate, otherwise solid (fig. 1). Color: as ground.
Foot—split in front ("anteriorly bilabiate") (Farmer 1980); lateral angles produced into horns (fig. 1); foot extends posteriorly into long, pointed tail. Foot corners or horns also called "pedal tentacles" (Kozloff 1974a).
Cerata—large, conical, in 11 clusters of transverse rows (Farmer 1980) covering animal's back. Cerata begin posterior to rhinophores (Beeman and Williams 1980), are longest in median region of 1st 2 groups (Behrens 1980). Each ceras with a core of digestive gland (fig. 1), and at tip a cnidosac, which collects nematocysts from cnidarian prey (MacFarland 1966).
Oral Tentacles—usually present, order Nudibranchia (McDonald 1975). Long, white, pointed (fig. 1).
Gills—none (fig. 1). Cerata serve as gills.
Eyes—small, black; posterior to bases of rhinophores (fig. 1). With only 5 large cells: used in neurological studies (Beeman and Williams 1980).

Radula and Jaws—ribbon of horseshoe-shaped teeth; each central cusp with a single row of up to 28 teeth; 4-6 sharp spines on either side of middle cusp, whose under surface has up to 15 small points (MacFarland 1966) (fig. 4).
Mouth—jaw border with up to 50 denticles (MacFarland 1966). (Mandibles not figured.)
Genital Openings—genital apertures on low posterior part of 1st group of cerata (MacFarland 1966) (not visible as drawn, but see arrow, fig. 1).
Anus—tubular, on right, between 2nd and 3rd groups of cerata (fig. 1) (MacFarland 1966). Concealed anus: tribe Cleioprocta (MacFarland 1966). Anus more anterior than in Aeolididae (Keen 1971).
Renal Pore—lateral, between 1st and 2nd troup of cerata (not visible, but see arrow, fig. 1).
Eggs—in pink sausage-like string; each 1 mm diameters, attached through much of its length to substrate. String makes tight counterclockwise spiral. Each capsule can have 1 – 4 eggs (Beeman and Williams 1980) (fig. 5).

Possible Misidentifications

Nudibranchs can be separated from other apparently shell-less opisthobranchs by their radulae and jaws (they are carnivorous), and by their rhinophores, which are not rolled as they are in sacoglossans. Nudibranchs also have oral tentacles. In addition, they have lost all shell and opercula (as adults) as well as mantle cavity and gills. (Some may have secondary gills on their backs (McDonald and Nybakken 1980)). Nudibranch genital openings are on the right side.

The nudibranchs in *Hermissenda's* suborder, Aeolidiacea, are relatively small, long, and narrow, gill-less, and have cerata. They feed partly on cnidaria, and are able to store nematocysts in their cerata (Keen 1971).

The nudibranchs in the other major suborder, Doridacea, are larger, with a large flat foot, thick mantle and obvious gills (McDonald and Nybakken 1980). *i.e. Onchidoris, Triopha.*

Another suborder, Dendronotacea, resemble aeolids, but have sheaths for their rhinophores and a mid-lateral anus. Examples are *Tritonia, Tethys, Melibe,* and especially *Dendronotus* spp.

The Arminacea are a very diverse group lacking rhinophore sheaths and usually lacking oral tentacles; the anus is anterior. Some have cerata, some do not: *Janolus fuscus* has cerata very like *Hermissenda's* (orange and white tipped), but also has a red cockscomb between the rhinophores, which are colored like the cerata. Cerata begin anterior to the rhinophores and fall off easily; they are found only on the periphery of the dorsum (McDonald and Nybakken 1980). *Janolus* also lacks the blueish lines on the body found on *Hermissenda.* This species was formerly called *Antiopella barbaren*sis (Cooper, 1863).

Hermissenda's suborder, Aeolidacea, includes 2 superfamilies, Protoaeolidoidea, with one family, Notaeolidiidae, and Euaeolidoidea, with 21 families. Only a few species from this latter superfamily could be confused with *Hermissenda:*

Fiona pinnata is similar in morphology to *Hermissenda,* but has smooth rhinophores and sail-like flaps on its cerata. The cerata are dense along the margins; a large part of the back is clear (Keen 1971); it has no blue lines or orange spots. Cosmopolitan.

The Coryphellidae have produced foot corners, but not angular ones as in Facelinidae (Keen 1971). Their numerous cerata are clustered and elongate, as in *Hermissenda. Coryphella trilineata* has 3 white (not blue) lines on a white body, but there are no orange spots within them. The cerata can look much like *Hermissenda*'s*,* but have cadmium yellow tips. The rhinophores are annulate and colored yellow or orange.

Aeolidia papillosa, the shag rug nudibranch found with anemones, is white with gray to brown spots. It has sharp pedal tentacles like *Hermissenda,* but its cerata begin anterior to the rhinophores and are lanceolate, i.e. broad-based and sharp-tipped, not conical as in *Hermissenda.*

Spurillidae (genus *Spurilla)* have rhinophores with quite oblique leaves, and have orange head markings. The cerata of *S. olivae* are quite like *Hermissenda*'s*:* orange, white tipped brown cores. Both this species and *S. chromosoma* are found only from central California south however (McDonald and Nybakken 1980).

There are 2 other nudibranchs in the family Facelinidae (was Phidianidae (McDonald and Nybakken 1980)), of the genus *Phidiana;* both are found only from central California south: Both *P. hiltoni (=pugnax)* and *P. (Emarcusia?) morrowensis* have orange markings on the head and on the rhinophores. These 2 are closely related, but not likely to be confused with each other or with *Hermissenda.*

Several other nudibranchs of diverse families could resemble *Hermissenda* superficially in color, so care must be taken to observe carefully the rhinophores, foot tentacles, and especially the blue/white lines of *Hermissenda.*

Ecological Information

Range—Sitka, Alaska to Baja California (Beeman and Williams 1980).
Local Distribution—Coos Bay: small boat basin, Charleston, seasonally, especially in summer.
Habitat—varied: rocky tidepools as well as floats, mud and sand flats (Beeman and Williams 1980; Goddard 1985); eelgrass beds (Puget Sound); bare rock.
Salinity—collected at 30 ‰ (Coos Bay)
Temperature—annual range 9-18 degrees (Beeman and Williams 1980).
Tidal Level—low intertidal; subtidal down to 35m (Beeman and Williams 1980).
Associates—copepod *Hemicyclops thysanotus* often found on its back (Beeman and Williams 1980). Found on fouling panels regardless of presence of other organisms. Sea pen *Ptilosarcus* (Puget Sound (Birkeland 1974). Also see "Food".

Quantitative Information

Weight—5-8 grams (Harrigan and Alkon 1978).

Abundance—one of the most common aeolids in northeastern Pacific, especially in middle of range; but its occurrence is temporally variable at any one part of the range (Ricketts and Calvin 1971). Dominant littoral opisthobranch in abundance and geographical distribution, Humboldt Bay, California (Jaeckle 1984). Occurs in Puget Sound sea pen beds at densities up to 2-3/m^2 (Birkeland 1974).

Life History Information

Reproduction—hermaphroditic, but self-fertilization probably unlikely (Harrigan and Alkon 1978). Mating animals and egg masses found all year (Puget Sound) (Beeman and Williams 1980). Eggs on algae or *Zostera* blades. Egg-laying begins when animal is 45 days old, continues until death (in lab) at 128+ days (Harrigan and Alkon 1978). Motile sperm found in 34 mg animals, egg laying by 73 mg wild animals (in lab (Harrigan and Alkon 1978)). Violent lunging and biting behavior once thought to be aggressive only is now known to be part of brief mating sequence (Rutowski 1983); many attempts at copulalion unsuccessful. Sperm from one copulation enough to fertilize most eggs in about 3 egg masses (Rutowski 1983).
Growth Rate—obligatory veliger stage of at least 34 days; veligers hatch in 5-6 days in lab at 13-15 °C (Harrigan and Alkon 1978). Metamorphosis occurs when veligers are at least 300 µ and possess eyes, foot and enlarged propodium (Harrigan and Alkon 1978). Veligers can swim.
Longevity—average life span in lab 163 days (35 veliger + 128 day adult): a subannual species (Harrigan and Alkon 1978).
Food—a generalist: carnivore and scavenger. Eats hydroids, particularly in eelgrass; *Tubularia, Eudendrium, Sarsia* (Goddard 1985). Also small sea anemones, bryozoans, colonial ascidian *Aplidium,* botyrllid ascidians, annelids, small crustaceans and clams, dead animals. Will eat other *Hermissenda* (but probably only when other food not available Goddard 1985)). Subtidally in Puget Sound: sea pen *Ptilosarcus* (Birkeland 1974). In Humboldt Co., California, prey include anthomedusae, leptomedusae and chondrophore *Velella velella* (Jaeckl 1984). Veligers crawl on *Obelia,* a probable food (Harrigan and Alkon 1978).
Predators—-in rocky areas below Monterey, California, the large opisthobranch *Navanax inermis* (Beeman and Williams 1980). Seastar *Crossaster* (Puget Sound (Birkeland 1974)) prefers *Hermissenda* as summer food. Eggs eaten by sacoglossan *Olea hansineensis* (Crane,1971).
Behavior—very aggressive toward other nudibranchs and other *Hermissenda.* Head-on “combats” with the latter probably often part of mating sequence (see *Reproduction).* Small *Hermissenda* have a swimming escape response to seastar predator *Crossaster* (Birkeland 1974).

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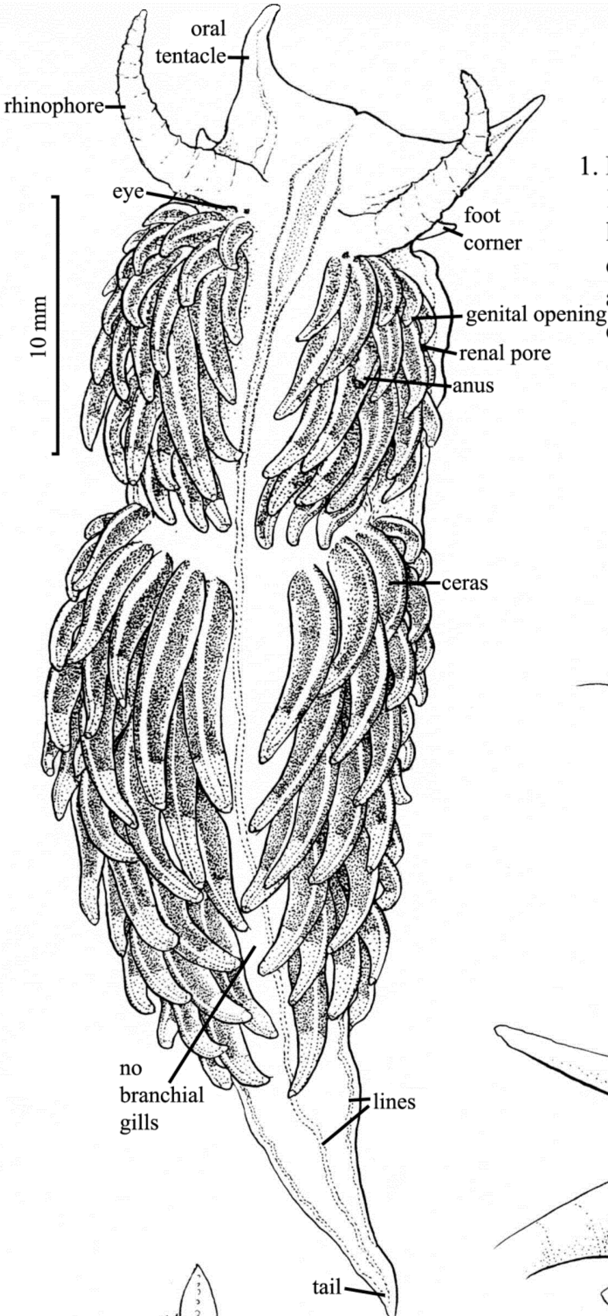
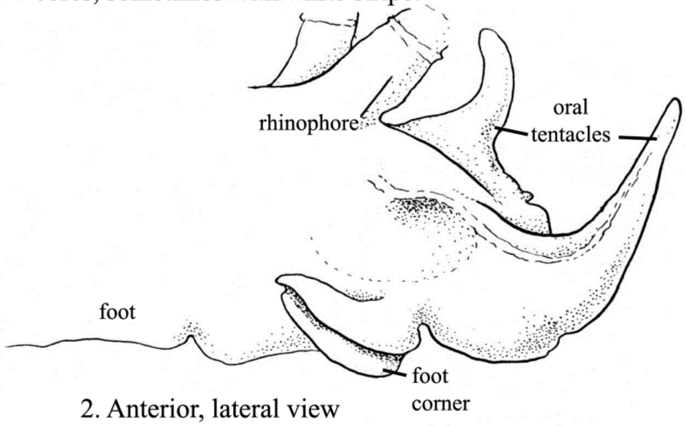
Hermissenda crassicornis

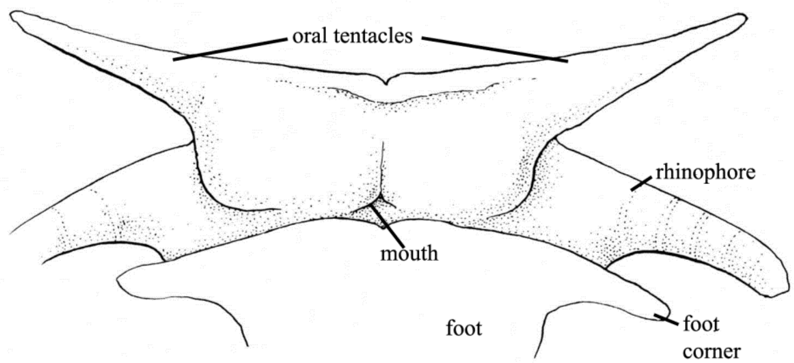


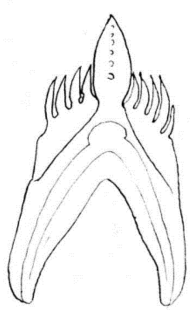
1. Dorsal view (L:50mm) x4:
long oral tentacles; prolonged foot corners; bluish-white line down oral tentacles, around dorsal edge along midline, doubling to enclose orange stripe. Rhinophores weakly annulate; cerata long, white tipped, with orange bands, brown cores, sometimes with white stripe.



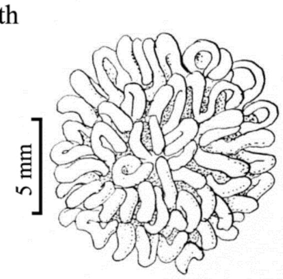
2. Anterior, lateral view

3. Anterior, ventral view





4. Radular tooth:
large middle cusp with 4-6 spines either side (from Marcus 1961).



5. Egg mass (D:12mm) x3:
sausage-like ribbon of pink capsules in counter-clockwise coil.

Hiatella arctica (=*Saxicava arctica*)

The nestling saxicave (Linnaeus, 1767)

Phylum: Mollusca
Class: Bivalvia
Order: Myoida
Family: Hiatellidae

Description

Size—to 50 mm (2"); this specimen (Coos Bay) 38 mm long (Quayle 1970).
Color—exterior white, chalky, granular, with tan, thin, ragged periostracum: genus *Hiateila* (Keen and Coan 1974); interior porcelain-like, white: family *Hiatellidae* (Hunter 1949).
Shell Shape—variable: distorted by nestling habit. Valves equal, oblong, gaping: posterior and broader, more square than anterior end, broadly truncated (fig. 1). Elongate, boring specimens have been reported as *H. pholadis* (Coan and Carlton 1975) (fig. 1a).
Sculpture—concentric only
Interior—pallial line faint, broken into discontinuous scars (fig. 3): family Hiatellidae (Coan and Carlton 1975). Adductor muscle scars approximately equal in size (not shape). No pallial sinus (Kozloff 1974a).
Hinge Area—adult without hinge teeth (or worn) (fig. 3); young clams have 1-2 weak, peg-like cardinal teeth.
Umbones—depressed, nearer anterior end than middle; do not touch each other (fig. 2).
Ligament—external (figs. 2, 3): family *Hiatellidae* (Coan and Carlton 1975).
Byssus—(attachment threads), present in nestling specimens, not in boring ones (*H. pholadis*); not figured. Long, single byssal thread spun by post-larval clams allows them to be moved by weak water currents (Morris et al 1980).
Siphons—fused; red tipped: genus *Hiatella* (fig. 1) (Kozloff 1974a).
Periostracum—light tan, thin: genus *Hiatella* (figs. 1, 2) (Keen and Coan 1974).

Possible Misidentifications

Burrowing and nestling clams, of which there are many genera, can be difficult to separate by shell shape; they tend to be variable and often quite distorted from the "norm." Useful characteristics are the hinge teeth, pallial line and siphons. Most Pholadidae can be distinguished by their two distinct shell sections (see *Penitella, Zirfaea*); all pholads have file-like denticulations and (except for *Netastoma*) an internal myophore.

The venerid clam *Protothaca staminea* var. *orbella*, like *Hiatella*, is white with an external ligament, and can be found nestling in old pholad burrows. It has radial as well as concentric striations, however, and interiorly has 3 cardinal hinge teeth and a strong pallial line and sinus.

Petricola carditoides is a nestling clam which (like *Hiatella*) has an external ligament and a chalky white shell. It has hinge teeth in the adult (2-3), not just in the young. *P. carditoides* has purple-tipped siphons, not red ones, and its shell has some radial sculpture.

Two myid clams could be confused with *Hiatella: Platyodon cancellatus* is a white borer with a heavy shell with fine, almost lamellar concentric exterior sculpture. Inside it has a chondrophore and tooth in its hinges, and a well-developed, deep pallial sinus. *Cryptomya californica* can nestle among rocks, although its usual habitat is sand or mud. It is small (to 30 mm), thin-shelled and has a chondrophore. Interiorly it has an entire pallial line, and an inconspicuous pallial sinus (Coan and Carlton 1975).

Entodesma saxicola is probably most likely to be confused with *Hiatella*: it is of a comparable size, shape and habitat. *Entodesma* has a dark, rough periostracum, not a pale, thin one, an external ligament like *Hiatella*'s, and short, fused siphons, but without red tips. Inside the shell is very pink and pearly. *Entodesma* has no hinge teeth, but does have a large internal ligament and lithodesma; its pallial line is entire and there is a small pallial sinus.

The nomenclature of *Hiatella* sp. is rather confused: *Hiatella pholadis* is a large (to 50 mm), often very elongate, boring species strictly resident in pholad burrows and without hinge teeth or red-tipped siphons (Kozloff 1974a). It has a prominent ridge from the beaks to the lower posterior angle (Oldroyd

1924). Coan and Carlton believe this name to be a probably synonym for a form of *H. arctica* (Coan and Carlton 1975).

Hiatella gallicana is a small (to 25 mm) species which may be the same as *H. arctica* (Ricketts and Calvin 1971; Quayle 1970).

Other northwest Hiatellidae include *Panopea generosa*, the geoduck, which is large, quadrate and not distorted. It has one cardinal tooth in either hinge. *P. generosa* is a very deep bur-rower with very long siphons; it is rarely found in Oregon.

Ecological Information

Range—Arctic Ocean to Panama (Oldroyd 1924); circumpolar.
Local Distribution—Coos Bay: Pigeon Point.
Habitat—nestles in old pholad burrows, or bores into smooth soft homogenous rocks; also found in *Mytilus* beds, on pilings, and on open coasts in algal holdfasts. On hard, crevice, surfaces it will attach byssally (Hunter 1949).
Salinity—found in Coos Bay in lower, more saline parts of estuary: collected at 30 ‰.
Temperature—
Tidal Level—intertidal to 120 m deep; collected at 0.0 ft.
Associates—other nestling and boring molluscs: *Entodesma, Penitella, Zirfaea*.

Quantitative Information

Weigth—
Abundance—not common.

Life History Information

Reproduction—
Growth Rate—
Longevity—
Food—suspension feeder.
Predators—tooth snails (*Nucella*, etc.) can prey on small nestling clams.
Behavior—boring is mechanical, not chemical (Hunter 1949).

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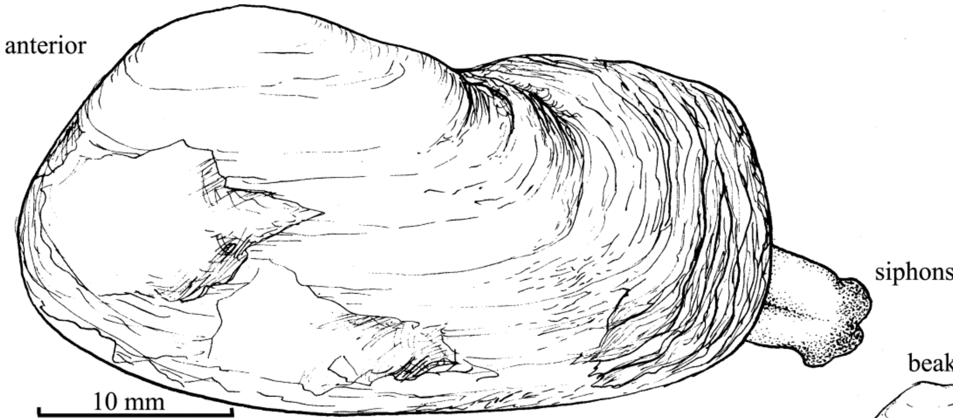
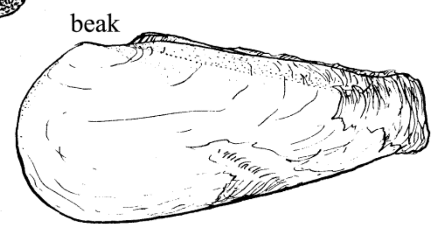
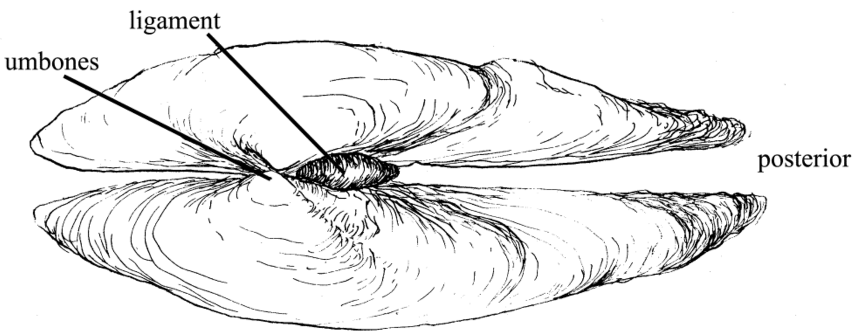
Hiatella arctica



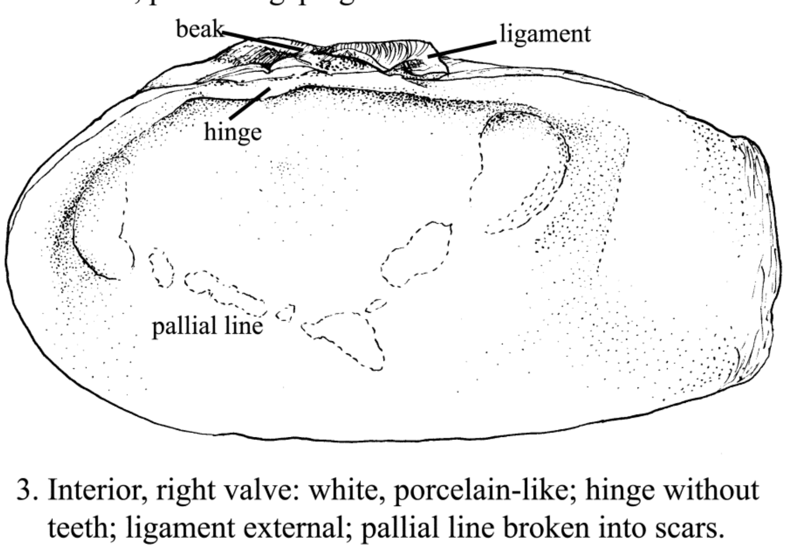
1. *Hiatella arctica*, exterior, left valve (L:38mm) x3: shell oblong, distorted; posterior truncate, beaks nearer anterior end than middle; concentric striations on rough, white surface, thin tan periostracum.



1a. *H. pholadis*, left valve x2: elongate; beaks near anterior end.



2. (Dorsal view): umbones depressed, not touching; ligament external, posterior gaping.



3. Interior, right valve: white, porcelain-like; hinge without teeth; ligament external; pallial line broken into scars.

Juga plicifera

Graceful keeled horn snail (Lea, 1838)

Phylum: Mollusca
Class: Gastropoda
Order: Mesogastropoda
Family: Pleuroceriadae

Description

Size—"small to medium", to 35 mm long (Clarke 1981). Illustrated specimen, (Columbia River), (incomplete as drawn): 16 mm long (fig. 1).
Color—shell pale dusky grey; animal with dark transverse stripes on head and tentacles (not shown) (Clarke 1981). Periostracum blackish or brown.
Shell Shape—turriform (many-whorled, slender spired), dextrally coiled. About 15 whorls; early ones usually corroded (Clarke 1981).
Sculpture—10 to 12 axial plicae (raised ribs) on each whorl. (Plicae also described as sigmoid (C-shaped) growth rests, or as varices.) Fine collabral cords (i.e. conforming to shape of outer lip at an earlier growth stage (Clarke 1981)) (fig. 1).
Aperture—rounded below, acutely angled above (Clarke 1981); outer lip simple, entire, not notched (figs. 1, 2).
Columella—smooth (not twisted); with broad canal below it (Clarke 1981) (fig. 2).
Operculum—typical of Prosobranchia: ovate, corneous (horny), with spiral growth lines; "paucispiral," i.e. with few whorls - about 3 (Clarke 1981) (fig. 3).
Radula—(not shown); central tooth without basal denticles (Ward and Whipple 1966): family Pleuroceridae. 7 teeth/row, in pattern of 2-1-1-2, each multicuspid.
Animal—(not shown); mantle border not fringed (Ward and Whipple 1966); tentacles long, very narrow, tapering, with dark stripes; boot short, wide. Males lack penis (Clarke 1981).
Eggs—single or in small groups (Clarke 1981) (not shown).

Possible Misidentifications

The superfamily Cerithiacea includes many common marine snail genera - *Bittium, Cerithiopsis, Metaxis, Cerithidea,* etc. These are also turriform, with a smooth, unfolded columella. *Cerithidea californica,* the California horn snail, is quite similar to *J. plicifera,* but is no longer found north of Tomales Bay, California (McDonald 1969). This species occurs in estuaries and bays, in mud, and under boards and debris. It has low axial ribs, not high C-shaped plicae; its operculum has multiple spirals, not just a few. It tolerates brackish water, but not fresh water.

The genus *Juga* is distinguished by its lack of the apertural notch common to many of the Cerithiacea genera. *Juga* is separated from *Goniopsis* and *Pleurocera* partly by its eggs, which are single or in small groups, not massed, and by its genitalia (the males have no penis) (Clarke 1981). *Pleurocera,* found in the eastern U.S., has a twisted columella, not a smooth one (Ward and Whipple 1966). *Goniobasis,* to which *J. plicifera* belonged until recently (Taylor 1966), is shorter than *Juga,* and has fewer whorls (Clarke 1981). *J. pficifera* is the only species of the genus in the northwestern U.S. (Clarke 1981). Also synonymized with *J. plicifera* is *J. sificula,* which was formerly believed to be a different species because it is stouter, with stronger ribs and a wider apical angle (Henderson 1929).

J. acutifilosa Stearns, the sharp lined river shell of northern California lakes, has strong spiral keels (Keep 1935), and is probably extinct (Clarke 1976).

Ecological Information

Range—Olympic Peninsula, Washington; Columbia River and other drainages south to California. Possibly Vancouver Island.
Local Distribution—Columbia River, lower reaches; also Tahkenich Lake, near Florence, Oregon (Douglas Co.).
Habitat—muddy-sand bottoms of small and medium lakes; also slow flowing streams

(Clarke 1981). Likes cool clear water, green algae (Keep 1935).
Salinity—considered a freshwater species, it is also found in the lower Columbia River.
Temperature—
Tidal Level—
Associates—

Quantitative Information
Weight—
Abundance—

Life History Information
Reproduction—family is oviparous (Henderson 1929); no external verge (male organ).
Growth Rate—
Longevity—
Food—most of family are bottom feeders; some feed on plants, algae, dead vegetation (Clench and Turner 1956).
Predators—
Behavior—

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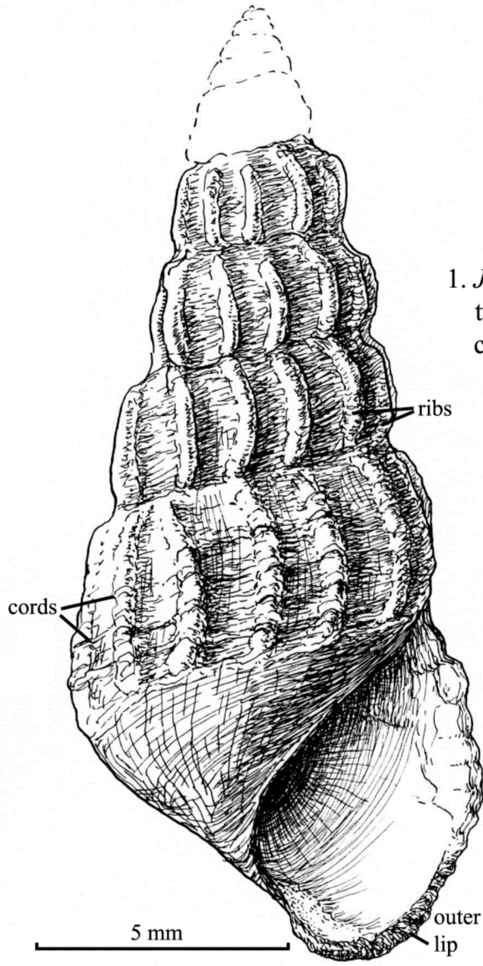
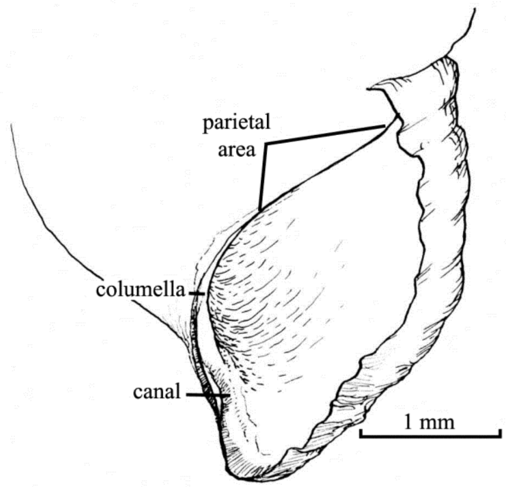
Juga plicifera



1. *Juga plicifera* x8:
turriform; axial ribs, spiral cords, dusky grey.



2. Aperture x12:
rounded below, acutely angled above; parietal area attenuate, imperforate; columella smooth, canal below it.

3. Operculum x12:
ovate corneous; a few spiral growth lines.

Lacuna porrecta

The wide chink shell (Carpenter, 1863)

Phylum: Mollusca
Class: Gastropoda
Order: Mesogastropoda
Family: Lacunidae

Description

Size—2-4 mm high; $^{1}/_{4}$ to $^{1}/_{2}$ size of *Littorina*.
Color—white to golden brown, with some spiral marking; surface wrinkled, with fine, wavy spiral striae (figs. 1, 4). No white band on inside of aperture, no carina (keel) on largest whorl.
Shell Shape—broad, compact, globose, only 3 whorls (fig 1); shell thin, outer lip 'effuse' (extended); aperture semi-lunar.
Umbilicus—chink is large, with a sharp ridge (fig 3); this groove between whorl and columella is an important key character of the genus *Lacuna*.
Columella—flattened (fig 4): genus *Lacuna*.
Operculum—'paucispiral'; flattened on one side (fig 2).
Animal—Lacuna species have metapodial tentacles, which *Littorina* lack (fig 5).

Possible Misidentifications

Adult Lacunidae can be differentiated from Littorinidae by their much smaller size, metapodial tentacles, and chiefly by their umbilical fissure or chink which Littorinidae lack. (Littorinidae have a columella flush with the large whorl). *Lacuna* are often found in eelgrass; *Littorina* almost never are.

There are several species of *Lacuna* on the Pacific coast:

Lacuna unifasciata is more turbinate than globose, and has a sharp carina or keel around its largest whorl. It is a southern species, its northern boundary being probably at Monterey Bay, California (Carlton and Roth 1975).

Two Puget Sound species have been identified. Both are larger than our Oregon species: *Lacuna vincta* (= *carinata*, = *solidula*) (Carlton and Roth 1975), is large, about 10 mm long, with 3-4 strong, smooth whorls, a small umbilicus, a white columella, and a strong carina on the last whorl. *Lacuna variegata* is a tall, high-spired form, up to 6 mm high, found in eelgrass (*Zostera*); not described in California keys (Ricketts and Calvin 1971). *L. variegata* has a spreading outer lip, a wide chink, and zig zag markings (Keep 1935).

The species most like *L. porrecta* and often found with it is *Lacuna marmorata*, the marbled chink shell, usually brown and white, but with a carina on the large whorl, a narrow columeilar groove, and often with a white stripe inside the base of the aperture (Carlton and Roth 1975). It has been found in Coos Bay (Keen et al 1942), and hybridizes with other *Lacuna* spp., (Friday Harbor) (Morris et al 1980).

Ecological Information

Range—Bering Sea to San Diego, California (Packard 1918).
Local Distribution—Coos Bay, several stations: South Slough (Keen and Doty 1942).
Habitat—in algae, eelgrass (*Zostera*), or around its roots; in tidepool algae at lower littorine level (Keen et al 1942).
Salinity—
Temperature—genus *Lacuna* essentially a cold water form; few tropical species.
Tidal Level—mid- and low intertidal levels and subtidally; never in upper reaches (Kozloff 1974b).
Associates—hermit crabs, amphipods, littorine snails; en-crusted with bryozoans.

Quantitative Information

Weight—
Abundance—not common.

Life History Information

Reproduction—*Lacuna variegata* has eggs like life preservers: yellow, about 5 mm diameter (Kozloff 1974b).
Food—family is herbivorous.

Predators—in eelgrass: seastar *Lepasterias*. Few fishes eat *Lacuna* (Morris et al 1980).
Behavior—it waddles as it moves one side of foot, then the other.

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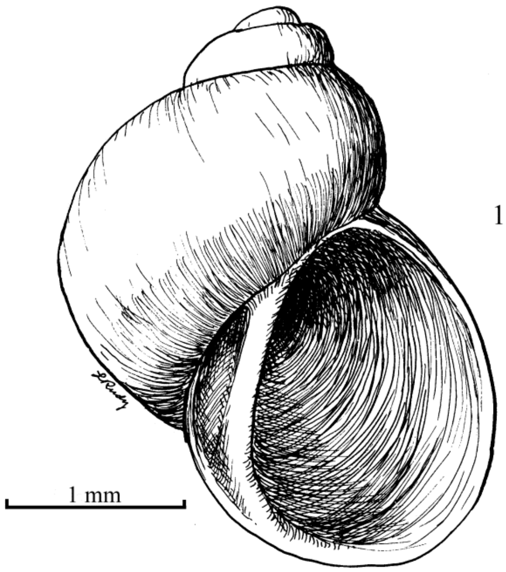
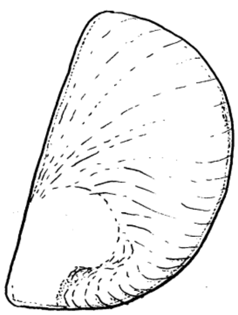
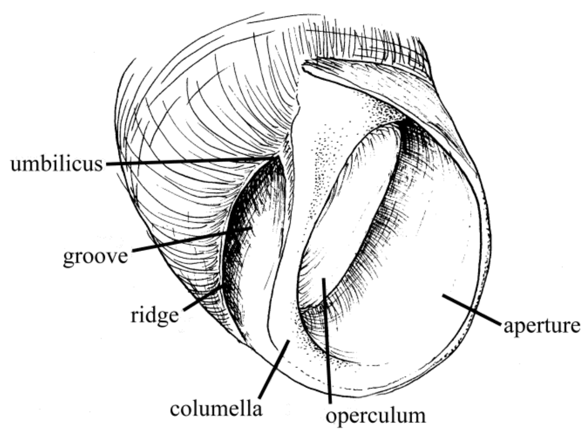
Lacuna porrecta



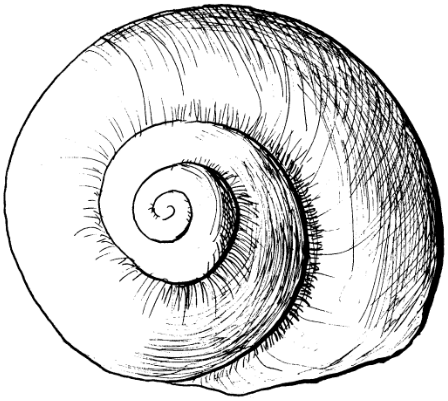
1. *Lacuna porrecta* (anterior view, H:4mm,W:3mm) x30: 3-whorled, thin, globose shell with fine, wrinkled striae; chink between whorl and columella; outer lip extended..



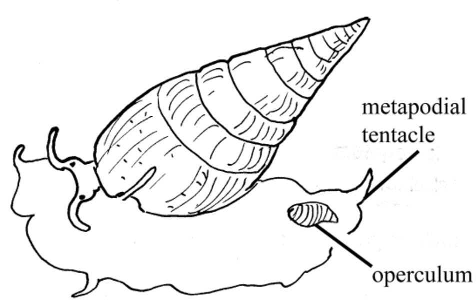
2. Operculum x30



3. Close-up of shell aperture: umbilicus with sharp ridge, large groove; flattened columella .



4. (dorsal view)



5. *Nassarius* with metapodial tentacle

5 redrawn from Hyman 1967, Adams 1858

Lithoglyphus virens (=*Fluminicola virens*)

Giant Columbia River spire shell (Lea, 1838)

Phylum: Mollusca
Class: Gastropoda
Order: Neotaenioglossa
Family: Hydrobiidae

Description

Size—to 11mm long (Clarke 1981); illustrated specimen (Columbia River) 7.5 mm.
Color—"virens" = green; periostracum chestnut brown to yellowish brown or olive green. With or without dark collabral or spiral bands (Clarke 1981) (this specimen without, fig. 1). Interior white.
Shell Shape—thick, solid, ovate, imperforate; 4 to 5 inflated whorls, nuclear whorl flatly coiled, then decurrent (turning down). Early coils often corroded (fig. 1); following whorls enlarge rapidly, are convex and separated by deep sutures. Body whorl large and constitutes most of shell (fig. 1).
Sculpture—coarse growth rests, fine collabral lines, obscure spiral striation (fig. 1).
Aperture—subcircular; rounded below, acute above. Simple lip; thickened peristome reflexed over columella region, obscuring umbilicus (fig. 1); sometimes exposing a tiny slit (Clarke 1981) (not in this specimen).
Operculum—thin, pale brown; almost transparent in this specimen (fig. 3); corneous, paucispiral (only three turns) (Clarke 1981). Strong radial wrinkles, fine spiral lines.
Radula—with 7 teeth (2-1-1-2), each with many cusps (Clarke 1981) (not shown).
Animal—tentacles long, cylindrical; gills internal; male with external winged verge behind right tentacle (Clarke 1981) (not shown).
Eggs—round or oval, attached singly to stones or vegetation; family Hydrobiidae (Clarke 1981) (eggs not shown).

Possible Misidentifications

Lithoglyphus spp., known until recently as *Fluminicola,* doesn't seem to have any close relative or obviously similar associates. Its family, the Hydrobiidae, or spire shells, is worldwide, and may be marine, brackish or freshwater (Clarke 1981). The genus has formerly been placed in the family Amnicolidae (as *Fluminicola* (Henderson 1929)), and also in Bulimidae (also as *Fluminicola* (Ward and Whipple 1966)). The present family designation is by Taylor 1966. One species of the genus, (*Fluminicola) seminalis*, is found far inland, in the Steens Mountain and Klamath Falls areas of Oregon (Henderson 1929). Another, *F. nuttalliana* Lea, now considered a species synonym (Clarke 1981), was formerly differentiated because of its more cylindrical, less inflated shape (Henderson 1929). *L. columbiania* Hemphill (Pilsbry, 1899) is a dark species, once found in the Columbia River to its mouth, and now only at Hanford, in a last bit of free-flowing river. It was listed as an endangered species in 1976 (Clarke 1976). *Lithoglyphus hindsi* (Baird, 1863) is also a synonym for *L. virens,* being simply an older name (Clarke 1981).

Ecological Information

Range—Idaho, Wyoming, Utah, Washington and Oregon. Kootenay, Wigwam and Columbia Rivers of British Columbia (Clarke 1981).
Local Distribution—Columbia, Siuslaw Rivers (Clarke 1981); N. Umpqua at Winchester Bay; mouth of Deschutes River; Yaquina River at Eddyville; Santiam River (Henderson 1929).
Habitat—on and under rocks and among vegetation in large and medium lakes, rivers, creeks; in rapid to slow currents (Clarke 1981).
Salinity—considered a freshwater species, it is found in lower reaches of Oregon's rivers.
Temperature—
Tidal Level—
Associates—

Quantitative Information

Weight—

Abundance—

Life History Information

Reproduction—dioecious (separate sexes); lays eggs which are attached singly to stones or to vegetation (Clarke 1981).
Growth Rate—
Longevity—
Food—
Predators—
Behavior—

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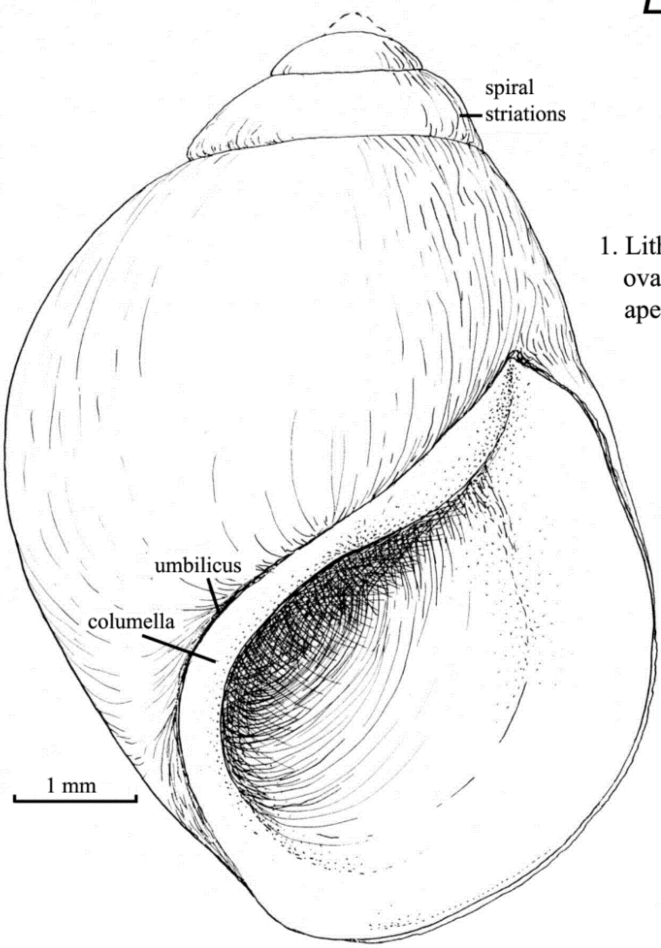
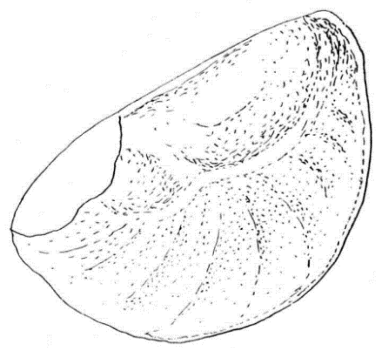
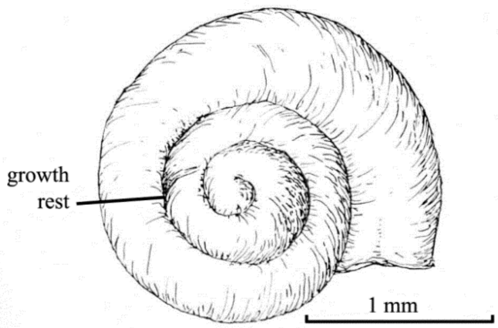
Lithoglyphus virens



1. Lithoglyphus virens (L:7.5mm) x20:
ovate, smooth; large body whorl;
aperture subcircular, lip simple.



3. Operculum x30:
(from small specimen, 4.2 mm)
thin, pale, transparent;
few spirals; radial wrinkles.



2. Dorsal view x30
(small specimen, 2.5 mm).

Littorina scutulata/Littorina plena
(two species separated in 1979--- awaiting clarification)

Gould, 1849

PHYLUM: *Mollusca*
CLASS: *Gastropoda, Prosobranchia*
ORDER: Mesogastropoda
FAMILY: *Littorinidae*

Description

SIZE—2-9 mm high, rarely over 10 mm. This specimen 9 mm (fig. 1).

COLOR—pattern of checks: dark brown, purple or black and white, on 'perfect' specimens; but many are eroded or encrusted with algae, etc. Pattern may be of checks, splotches, zig-zags or fine vertical and/or horizontal etched lines. Never with strong spiral sculpture. Interior nearly always purple.[8]

SHELL SHAPE—shell solid, not thin; taller than wide[10]; conical, four whorls, No columellar groove (inner lip) or chink: growth lines of whorl come right to edge of inner lip (fig. 1).

OPERCULUM—horny, solid trap door, with spiral lines, covering aperture (fig. 1a).

ANIMAL—dissection, (fig. 3); *Littorina* sp. lack posterior or metapodial tentacles, have only cephalic tentacles.[16]

Possible Misidentifications

A similar but smaller genus of another family is *Lacuna*, the small 'chink' shell, which has a groove, or chink, between the large whorl and the columella; *Littorina* lacks this groove. The Lacunidae are often found in eelgrass, (*Littorina* is not), and are never in the upper intertidal area, as *Littorina* often is.[9]

Other species of the genus *Littorina*, sharing the solid shell, and the absence of columellar groove, include at least three other species:

Littorina planaxis is an inhabitant of the outer intertidal rocks, although found in Puget Sound, and occasionally in more marine parts of Oregon's estuaries. It is stout and globose, and usually larger than *L. scutulata*,[2] with a broad, flat, polished columella.[8] *L. planaxis* is essentially a southern form, although it does occur occasionally in Puget Sound,[10] and its niche is generally taken over northwards at about Cape Arago, Oregon, by *Littorina sitkana*.[15]

Littorina sitkana, a fat, globose littorine, has a rounded columella, and strong spiral ridges on its whorls; it can be white to black, but is often a yellowish brown.[8] A smaller variety was formerly called *L. rudis*. It can be strongly striped, or rough and striated. It is fairly common in salt marshes, and can be up to 15 mm high.[9] (See plate).

Littorina (Algamorda) newcombiana (= subrotundata) is a small, rare salt marsh littorine originally thought to be a freshwater snail. It is light colored, with four rounded whorls, usually striped; the shell is smooth, thin and covered with a brown periostracum; the aperture is almost circular. It is only about 5 mm long, and has a simple gap, (not a groove) between the whorl and the columella.[7] It is found quite high in the intertidal area of the marsh.

Littorina littorea, is an Atlantic species introduced into California bays 100 years ago; it is quite thick-shelled, globose and colored brown to black, with fine dark spiral bands.[1] It has not yet been reported from Oregon.[16]

Ecological Information

RANGE—Sitka, Alaska to Cabo San Lucas, Baja California.

LOCAL DISTRIBUTION—outer coast and bays; Coos Bay: South Slough; Siuslaw River, near Florence.[11]

HABITAT—rocks, pilings; this specimen on rock on muddy beach; occasionally in salt marshes, but rarely if ever in eelgrass.[9] Very tolerant of near-terrestrial conditions.[2]

SALINITY—found near full sea water on the open coast, as well as in conditions of somewhat reduced salinity.[16] Doesn't penetrate upper (and fresher) parts of estuary (Coos Bay): tolerance level about 22-24 o/oo seawater.[11]

TEMPERATURE—found over a wide range.

TIDAL LEVEL—never more than a few feet above high tide line; found at higher levels in salt marshes[10]; "just above the reach of the waves, along the shores of the entire bay" (San Francisco).[14]

ASSOCIATES—barnacle *Balanus*.

Quantitative Information

WEIGHT—

ABUNDANCE—relatively common in rocky areas[2]; probably the most common littorine in bays, as well, at least in more open coastal habitats.

Life History Information

REPRODUCTION—dioecious (separate sexes); most copulation occurs in spring and summer—en masse. A similar European species (*L. littorea*) will lay up to 5000 eggs; one month later the fertilized eggs will be seen in small single or double capsules.[15] Egg cases are pelagic—gelatinous capsules float easily.

GROWTH RATE—

LONGEVITY—

FOOD—herbivorous; littorines rasp microscopic, and particularly macroscopic, algae from rocks.[3] Macro: *Cladophora, Pelvetia, Rhodoglossum;* micro: *Endocladia;* unicellular green and blue green algae; diatoms.[4]

PREDATORS—

BEHAVIOR—live in a 'home territory': they stay in a small area near a certain pool. "Emerge by night, and submerge by day."[12]

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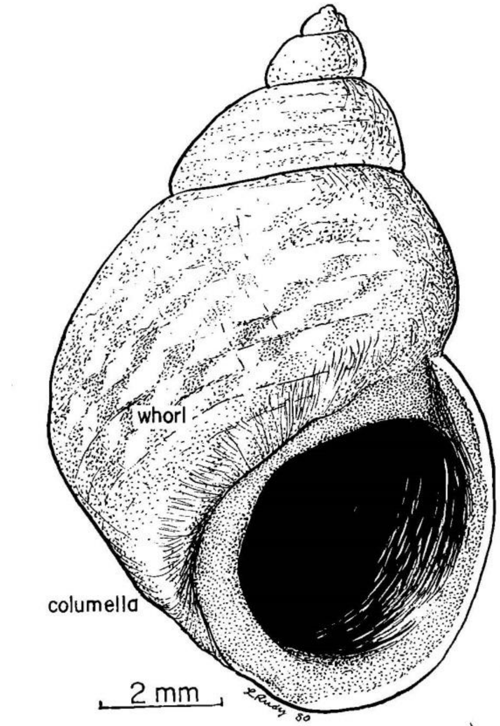
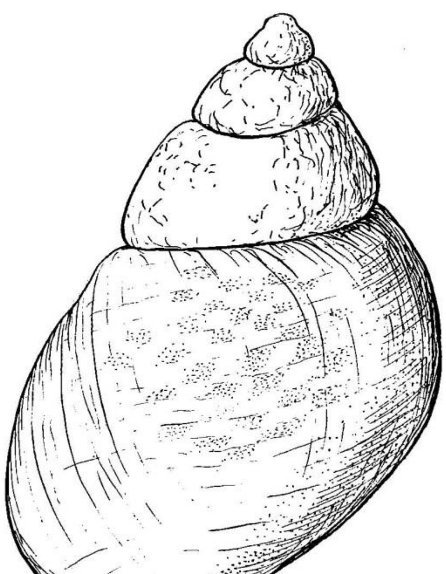
Littorina scutulata



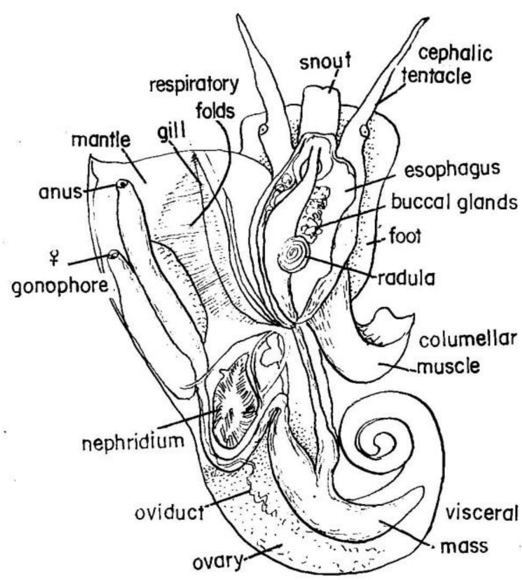
1. *Littorina scutulata* anterior view x 12
actual height 9 mm
conical, four whorls;
no columellar groove
surface checkered, interior purple

actual size

1a. operculum



2. posterior view, x12



3. dissection of a ♀ *Littorina* sp.
(from Hyman, 1967, after Souleyet, 1852)
mantle cut, turned over.

Littorina sitkana (=rudis, sitchana, saxatalis)

The Sitka littorine (Philippi, 1845)

Phylum: Mollusca
Class: Gastropoda, Prosobranchia
Order: Mesogastropoda
Family: Littorinidae

Description

Size—to 15 mm (Kozloff 1974b); but usually under 12.5 mm (Ricketts and Calvin 1971); Coos Bay specimens: 4-9 mm, average about 7 mm.

Color—rough variety (fig 1) can be solid colored: plain buff or gray. A smoother variety (figs 2, 3), has strong spiral sculpture appearing as horizontal bands, especially on the largest whorl-brown to yellow or orange: these bands can be visible inside aperture and are usually fainter on upper whorls. Animal white, with black on tentacles and snout (fig 4).

Shell Shape—turbinate, thick, pointed, few-whorled (3-4); aperture rounded, outer lip acute: genus *Littorina* (Oldroyd 1924). This species stout, globose, almost as wide as high (in contrast to *L. scutulata*, for instance).

Operculum—oval (paucispiral); a solid, horny, trap door (fig 1).

Columella—rather flattened inner lip, not perforated: genus *Littorina*; rounded, upper columella is flush with 4th whorl (fig 2a): no gap between columella and whorl: genus *Littorina*.

Animal—white, with cephalic tentacles only (fig 4), no metapodial, or foot tentacles (see *Lacuna porrecta*, fig 5).

Possible Misidentifications

Littorines are turbinate, thick, pointed and few-whorled, with a rounded aperture and an acute outer lip. The columella is rather flattened but flush (appressed) with 4th whorl, and lacks a columellar groove. There are 3 other species of genus that might be confused with *L. sitkana* in Oregon estuaries:

Littorina scutulata is taller than wide, with a purple interior and often with a checkerboard pattern on its whorls (never with a strong spiral sculpture). It is found on wrack, and rarely in saltmarshes, where *L. sitkana* predominates.

Littorina planaxis is stout, like *L. sitkana*, and usually quite a bit bigger; its surface is plain, without spiral sculpture; it has a white band inside the aperture, and a characteristic flat, roughened area between the columella and the 4th whorl. It is an outer coast, rocky shore species.

The introduced European periwinkle, *Littorina littorea*, has been found in San Francisco and Trinidad Bays. It is thick shelled, smooth, dark brown to black, with many very fine horizontal lines.

Littorina (Algamorda) newcombiana belongs to an unusual subgenus with a simple chink between the columella and the largest whorl. It is very small: to 6 mm, but averaging 3.5 mm, tall, with a smooth shiny surface covered with a brown periostracum. Its color is tan or white, with brown or black horizontal stripes at times on the largest whorl. Small specimens of *L. sitkana* can look very like *L. (A.) newcombiana*; the important differences are the simple chink next to the columella, the taller profile, small size and lighter base color of *L. (A.) newcombiana*. This latter, like *L. sitkana*, is a salt marsh inhabitant, although it is found very high in the tidal zone.

Another similar genus is *Lacuna*, the chink snail, quite tiny (2-4 mm) and distinguished from *Littorina* sp. chiefly by a definite groove or gutter between the columella and the whorl. Two species, *L. porrecta* (which see) and *L. marmorata*, have been found in our area, but usually in eelgrass, not in *Salicornia* marshes.

Ecological Information

Range—southern limit seems to be about Cape Arago, near Coos Bay. North to Bering Sea (Oldroyd 1924). Not included in California keys.

Local Distribution—Coos Bay: South Slough.

Habitat—quiet areas of *Salicornia* marshes under debris and marsh weed. Seems to need less protection than other thinner snails

(Matthews 1979). In Puget Sound, found with barnacle/mussel association on or under rocks, as well as in marshes (Kozloff 1974b).
Salinity—Littorinidae generally can withstand salinity changes well (Keen et al 1942): conditions that can prevail in salt marshes. Prefers salinity of 24 ‰ or saltier; found at 23-30 ‰ (Matthews 1979).
Temperature—intertidal saltmarsh temperatures can vary greatly: *L. sitkana* adapts well.
Tidal Level—near the high-tide mark (Kozloff 1974b).
Associates—sphaeromid isopods, amphipod *Traskorchestia traskiana*, pulmonate snail *Ovatella myosotis*, tiny snail *Assiminea californica*, other littorines, *L. scutulata, L. (A.) newcombiana*. On rocks (Puget Sound): *Balanus, Mytilus*.

Quantitative Information
Weight—
Abundance—often the dominant small gastropod in salt marshes.

Life History Information
Reproduction—dioecious (separate sexes); small egg capsules can be seen about one month after copulation (*Littorina* sp.) (Ricketts and Calvin 1971).
Growth Rate—
Longevity—
Food—herbivorous; scrapes algae from substrate with radula.
Predators—
Behavior—

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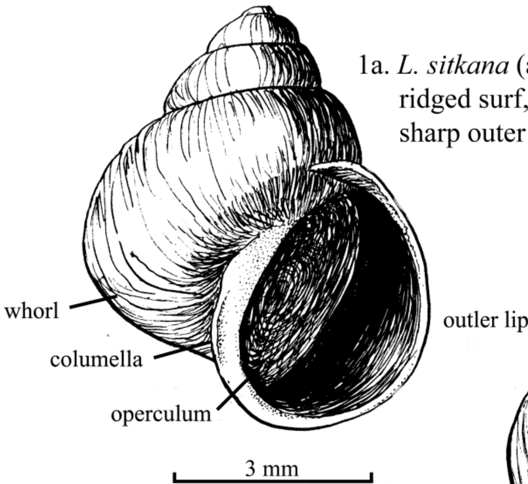
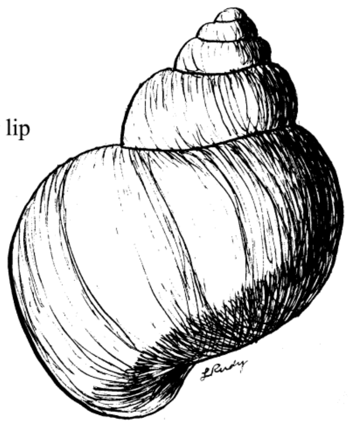
Littorina sitkana

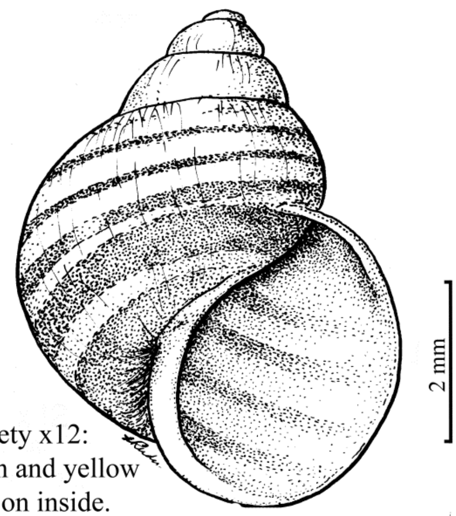
1. *Littorina sitkana* (H:6mm,W:5mm) x10:
solid, rough variety, almost as high as wide .



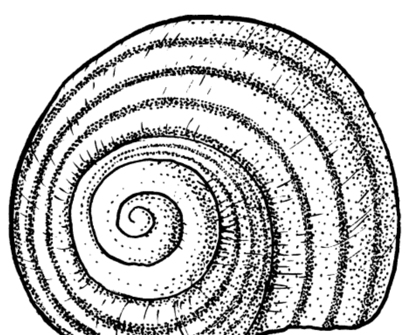
1a. *L. sitkana* (anterior view): solid color, ridged surf, rounded aperture; oval operculum; sharp outer lip; columella oppressed to fourth whorl.



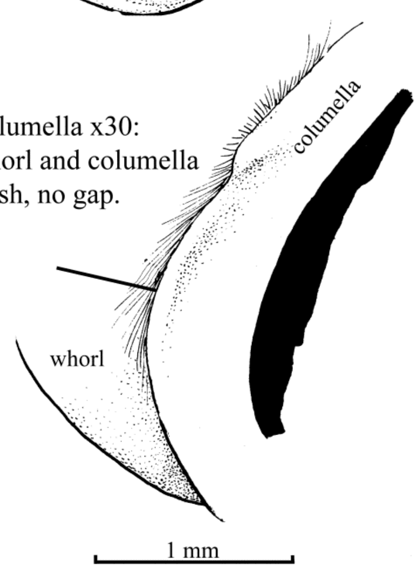
1b. *L. sitkana* (posterior view): shell thick, turbinate, 3-4 whorls.



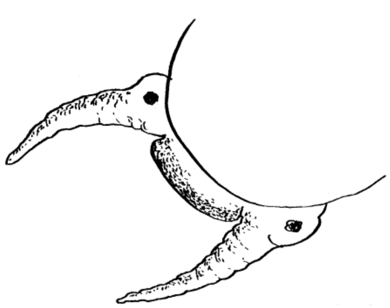
2. Smooth variety x12: strong brown and yellow lines visible on inside.



3. Shell (dorsal view)



2a. Columella x30: whorl and columella flush, no gap.



4. Animal (dorsal view)

Lottia digitalis (=*Acmaea*)

A fingered limpet (Rathke, 1833)

Phylum: Mollusca
Class: Gastropoda, Prosbranchia
Order: Archeogastropoda, Patellacea
Family: Lottidae

Description

Size—about 25 mm (one inch); largest 30 mm (Haven 1971); average under 15 mm; this specimen 20 mm (Ricketts and Calvin 1971).
Color—greenish gray to dull brown; large solitary animals sometimes more brilliantly marked (Ricketts and Calvin 1971); ribs usually not lighter than spaces between them (Carlton and Roth 1975); always a solid brown spot 'owl-shaped' inside shell on the apex (fig 3); a horseshoe-shaped muscle scar open at the anterior end (fig. 3) (Keen 1971).
Shell Shape—oval, caplike, fairly high elevation (but not all as high as this specimen, fig. 2); apex above or even overhanging anterior margin, forming hook. Strong rough ribs on posterior slope, forming moderately scalloped edge (fig 1), may be absent on anterior slope. Posterior convex, anterior concave (fig 2).
Body—no dark spots on head or sides of foot: species characteristic; a pair of uncini (flap-like structures) on basal plate of radula (inside mouth), a remnant of marginal teeth (Keen 1971): genus *Lottia*. This characteristic observable only by a drying and staining lab preparation (not figured).

Possible Misidentifications

There may be as many as 16 species of rocky intertidal limpets on our coast; few are as adaptable as *L. digitalis* in tolerating different habitats, especially in estuaries. (*L. digitalis* and *L. pelta* are the only limpets that penetrate very far into Coos Bay's estuary).

Lottia pelta, sometimes estuarine, has heavy ribs like *L. digitalis*, but lacks the concave anterior slope of the latter (its anterior slope is convex). Its apex is subcentral, not near the anterior margin; its ribs are usually equally developed on all slopes, and it is smoother than *L. digitalis*. It can have a pattern of radial bands or of white checks. It occurs at lower tidal levels than does *L. digitalis*.

The above limpets of the family Acmaeidae differ from the Patellidae in having only a single ctenidium (feather-shaped gill) (figure 4). Other genera of Acrriaeldae besides *Lottia*, above, cannot be keyed by shell alone: differences in radula are important as well (Keen 1971). General ways of distinguishing them by shell include the following:

Acmaea sp. have a nearly central apex, the shell is white to pink-rayed, and the radula is adapted for browsing on coralline algae. They are chiefly sublittoral. (The name *Acmaea* once en-compassed those limpets now called *Lottia* and *Notoacmea*. These have now been divided: *Lottia* sp. have uncini (marginal teeth) on the radula; they have fine to heavy radial ribs and an apex anterior to the center as well as a convex posterior slope. *Notoacmea* lack the uncini on the margin of the radula; they are not heavily ribbed, the apex can be subcentral to quite anterior.) *Notoacrnea persona*, a nocturnal limpet preferring shade and caves as a habitat, has an anterior apex directed anteriorly, and a straight anterior slope; the posterior slope is convex. The surface has fine regular striae, not strong ribs. *N. persona* can be large (53 mm) and is found above *Lottia* in the tidal zone (Fritchman 1961). It is chiefly an inhabitant of the open coast, but has been found in quiet waters in Puget Sound (Kozloff 1974b).

Notoacmea scutum is a thick shelled, rather flat limpet with a subcentral apex, a coarse sculpture of flat ridges (actual radial lines). It is occasionally found in bays (Puget Sound) (Kozloff 1974b).

Two other species of *Lottia* have heavy ribbing, and could be confused with *L. digitalis*; they also inhabit similar territory, at least on the outer coast. The chief inhabitant of the high splash zone is the rough limpet *L. scabra*, with strongly projecting ribs, a strongly scalloped margin, low profile, and both posterior and anterior slope being convex. It has distinctive black spots on its head and on the sides of its foot. It prefers gently sloping or horizontal surfaces. Its range is generally too far south for Oregon.

L. strigatella, formerly *C. paradigitalis*, was once thought to be a 'hybrid' of *L. digitalis* and *L. pelta* (Carlton and Roth 1975). It is the closest species to L*. digitalis*, but is smoother, has fine radial lines, but no ribs; a convex posterior, slightly concave anterior slope, and is only to 20 mm in length. Its apex is often eroded. The interior is glossy, bluish white with brown stains, and with the outside pattern showing through (Keen 1971). The animal is completely white. This species is found with *L. digitalis* at Coos Head, just inside the bay entrance, under marine conditions (Frank 1965a).

Ecological Information

Range—Unalaska Island south to Guadalupe Island, Baja California.
Local Distribution—outer coast; bays: Coos Bay-Coos Head, lower South Slough.
Habitat—prefers steep slopes in upper (splash) zone (Haven 1971); pilings (in bays); tolerates 'variable and hazardous' conditions (Frank 1965c); mud, swirling sand, debris, industrial pollution, sewage, strong wave action. In lower levels (zone 2 in Ricketts and Calvin 1971) lives among barnacles, algae on flat surfaces. This specimen on a log. Avoids dessication but tolerates and requires aerial conditions (Haven 1971). Found on 'virtually all hard substrates' (Haven 1971).
Salinity—tolerates a wide range, from concentrated sea water to fresh water (Wolcott 1973).
Temperature—a cold water species; tolerates high temperatures less well than does *L. scabra* (Wolcott 1973). Found more commonly in winter than summer (central California) (Haven 1971).
Tidal Level—oldest and largest animals are found highest; found from higher high tides up into splash zone (zone 1 in Ricketts and Calvin 1971); adapted to dessication better than most limpets, and is never found permanently submerged: lower limit: zone 2, at about mean high water (Frank 1965c; Keen 1971).
Associates—in flat areas of zone 2: algae, barnacles, amphipods *Orchestoidea*, *Orchestia*; gribble *Limnoria*, littorine snails, insects (springtails). On vertical rock surfaces, Coos Head: *L. paradigitalis* (strigatella), *Balanus glandula*, *Littorina scutulata*, *L. pelta* (at lower limit) (Frank 1965c). On pilings: *Balanus*. In California: *L. scabra*, *L. gigantea* (at lower limit) (Haven 1971).

Quantitative Information

Weight—
Abundance—most common upper intertidal limpet in Oregon (Frank 1965c); within its range, common from Monterey north (Ricketts and Calvin 1971). Tends to aggregate (Millard 1968).

Life History Information

Reproduction—separate sexes; eggs and sperm shed into sea; length of planktonic life unknown (Haven 1971). Spawning winter and spring; peak recruitment: spring (Fritchman 1961).
Growth Rate—very consistent (Frank 1965c), fastest fall and winter, stopped in summer; growth decreased by crowding.
Longevity—occasionally 6 years (Frank 1965a).
Food—encrusting microalgae: blue greens, diatoms (Frank 1965c).
Predators—sea stars, oyster catchers; shorebirds, *Pachygrapus* (Morris et al 1980).
Behavior—does not 'home' precisely like *L. scabra*, but has a home range (Haven 1971). Has a seasonal vertical migration: higher in winter (with higher waves). Secretes mucus sheet between itself and substrate to aid in slowing dessication and because it doesn't fit precisely into the rock. Can accumulate large concentrations of lead (*ie*. animals under Golden Gate Bridge) (Morris et al 1980).

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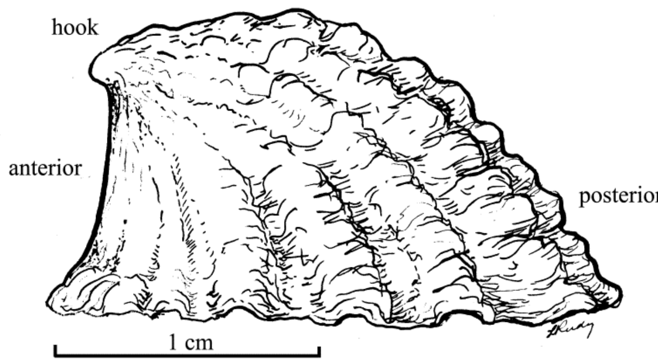
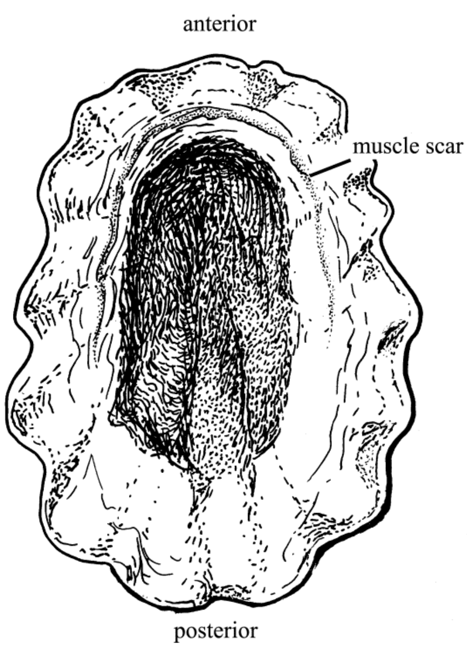
Lottia digitalis

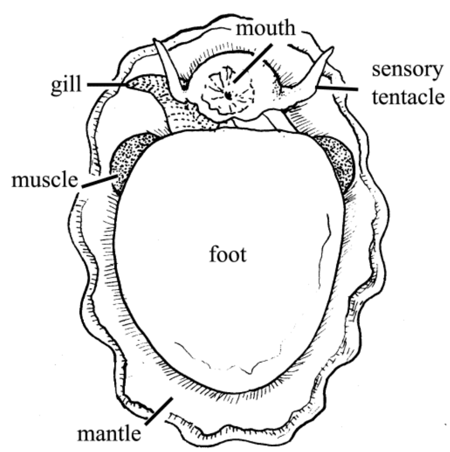
1. *Lottia digitalis* (dorsal view, L:2cm) x4: strong ribs; scalloped edge; rough surface.



2. (Lateral view) x4: moderate elevation; apex hook-like, near anterior end; anterior slope concave; posterior slope convex.



3. Shell interior x4: solid brown spot at apex; horse-shoe shaped muscle scar.



4. Schematic of animal (ventral view)

Lottia pelta (=*Acmaea*)

The shield, or helmet limpet (Rathke, 1833)

Phylum: Mollusca
Class: Gastropoda, Prosbranchia
Order: Archeogastropoda, Patellacea
Family: Lottidae

Description

Size—25mm (Brusca and Brusca 1978); can reach 40 mm farther north (Kozloff 1974b); this specimen, 32.5 mm.
Color—extremely variable; called the brown and white shield limpet by Ricketts (Ricketts and Calvin 1971); gray, slightly raised ribs with white between them; some specimens without ribs, but with a checkered or striped pattern. Slightly hooked apex eroded.
Shell Shape—elevated (height usually greater than $^1/_3$ length (Carlton and Roth1975); surface with fine regular ribbing, anterior space straight or very slightly concave; apex subcentral, very slightly directed anteriorly (fig 2); posterior slope slightly convex, nearly straight (Kozloff 1974a). Margin slightly scalloped.
Interior—blue gray to white, with subapical brown spot (fig 3), and horseshoe-shaped muscle scar joined by a thin, faint line (fig. 3) (Keen and Coan 1974).
Young—some subadults (over 6 mm) with dark brown exterior, lustrous, smooth and with fine radial sculpture, living on alga *Egregia*. Interior light brown to gray, with postapical brown spot. (*Notoacmaea insessa*, of which subadult *pelta* is so similar, is dark brown inside.)

Possible Misidentifications

Although a very many species of limpets of the family Acmaeidae occur on our coast; only about 4 are found in estuarine conditions. Some of these belong to the genera *Notoacmea*, which like *Lottia* have a horseshoe-shaped muscle scar on the shell interior, joined by a thin curved line; an apex anterior to the center; and various coloration, but not pink-rayed or white. These two genera differ mainly in that *Lottia* has a pair of uncini or teeth on the radula (not figured), while *Notoacmea* does not. Also, *Notoacmea* sp. are usually not heavily ribbed, while *Lottia* species are (Keen 1971).

Lottia digitalis, the common fingered limpet, differs from *L. pelta* in having an apex very close to or even overhanging the anterior margin, which forms a strong hook; its anterior slope is concave. This species has strong raised ribs and a moderately scalloped edge; its rough ribs may show only on the posterior slope. It occurs higher in the tidal range than does *L. pelta*.

Lottia strigatella, once thought to be a hybrid of *Lottia digitalis* and *L. pelta*, has been found just inside Coos Bay. Like *L. digitalis*, it has a hooked apex near the anterior margin, and a slightly concave anterior slope. It is small, growing only up to 20 mm, and smooth, with fine radial lines but no ribs.

A bay dwelling form of *Lottia limatula*, *L. l. moerchii*, has a higher elevation than the usual form of that species. It has buff and dark mottling, or greenish brown with white bands; its ribs are imbricated (set like tiles); its edges are serrated. It has not been found as far north as Oregon.

Notoacmea scutum, found only occasionally in bays, is thick shelled, rather flat, with a coarse sculptured surface (Brusca and Brusca 1978). It sometimes has radial lines quite like those of *L. pelta*. It has a subcentral apex and a low elevation and is often filmed with algae.

Notoacmea persona is also found in bays. It is large, nocturnal and smooth. It has an anterior hooked apex and is dark brown with white checked edges.

Young *L. pelta* can resemble the limpet *Notcacmea insessa* which lives only on the marine alga *Egregia*. *N. insessa* adults are brown, translucent and smooth. (See young, above).

Ecological Information

Range—Aleutian Islands to Punto Santo Tomas, Baja California (Ricketts and Calvin 1971).

Local Distribution—Coos Bay. South Slough.
Habitat—on rocks (locally), also with various algae in mussel beds (Carlton and Roth 1975); 'eurytopic'; South Slough: on floats, under rocks.
Salinity—collected at 30 ‰ seawater.
Tidal Level—just below *L. digitalis* and *N. persona* (Puget Sound); on rocks usually uncovered by the tide. On outer coast-upper mid- to lower mid-intertidal (Brusca and Brusca 1978).
Associates— *Lottia digitalis*; in mussel/barnacles association on pilings. With. algae *Egregia, Postelsia Laminaria, Endocladia*.

Quantitative Information
Weight—
Abundance—not common in bays; relatively common on outer coast (Brusca and Brusca 1978).

Life History Information
Reproduction—separate sexes; eggs and sperm shed into sea; length of planktonic life unknown (Frank 1965a). Active throughout year; spawns at sea temperatures of 48.5°-60°F (Fritchman 1962).
Growth Rate—probably grow faster than C. digitalis, to 30 mm in 3 years (Morris et al 1980).
Longevity—
Food—a grazing herbivore, especially on red and brown algae (Morris et al 1980).
Predators— seastars: *Pisaster ochraceus*, for which it has developed an escape mechanism (Margolin 1964).
Behavior—

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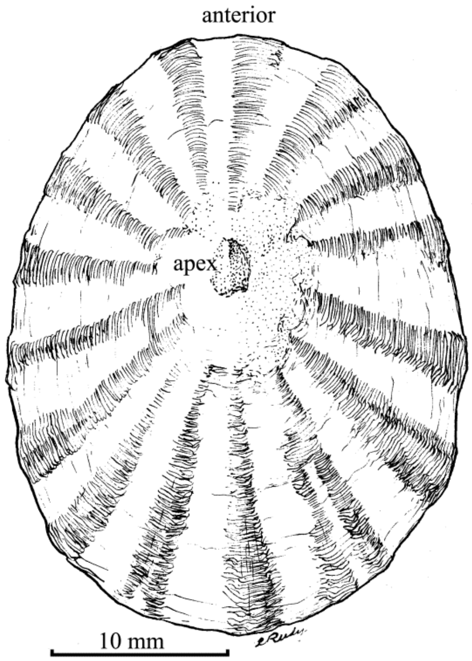
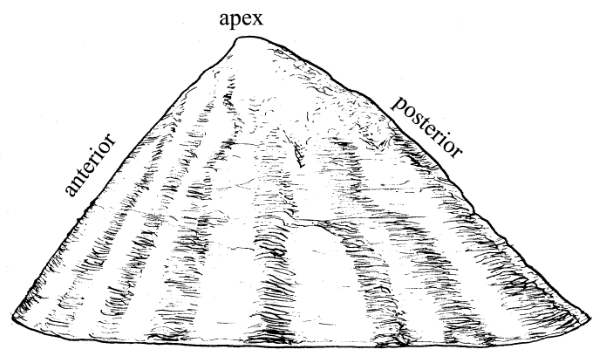
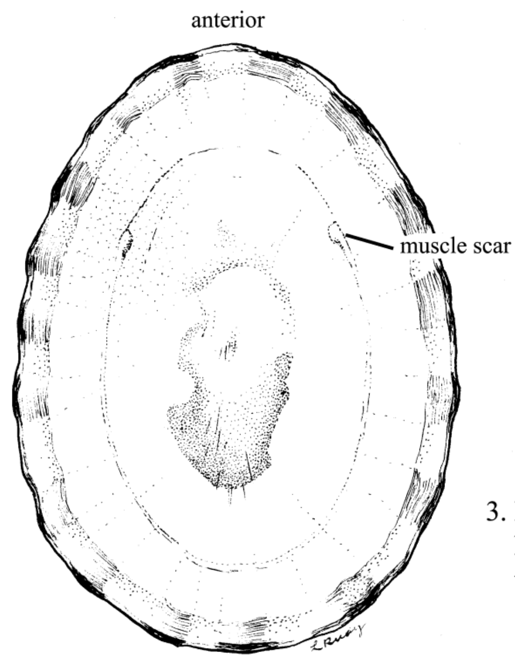
Lottia pelta



1. *Lottia pelta* (L:32.5mm, W:24mm) x3:
uniform gray, low ribs; apex subcentral;
margin slightly scalloped.



2. (Lateral view, H: 17mm) x3:
anterior slope straight, posterior slope
slightly convex; apex subcentral, slightly
hooked.



3. Interior:
horseshoe-shaped muscle scar joined by
thin line; subapical brown spot.

Macoma balthica (=*inconspicua*)

(Linnaeus, 1758)

Phylum: Mollusca
Class: Bivalvia; Heterodonta
Order: Veneroida
Family: Tellinidae

Description

Size—30-35 mm long (Oldroyd 1924); usually under 30 mm (Coan 1971). Proportions: length 27, height 22, diameter 11 mm (Oldroyd 1924). Rarely to 45 mm (Coan 1971); smallest adults 2 mm (Caddy 1969). This specimen (Coos Bay) 17.5 mm long.
Color—reddish, pale rose or white (Oldroyd 1924); sometimes bluish or yellow (Puget Sound, British Columbia). Coos Bay specimens pink inside and out; British Columbia pink or yellow interiors (Quayle 1969). (Genus *Macoma*, generally white inside) (Keen and Coan 1974). Late veligers with yellow shells, red umbones (Caddy 1969).
Periostracum—thin, silky, not shiny (Coan 1971); visible only as a ventral trace.
Shell Shape—regularly oval, rather round, thick, with a thick epidermis; valves equal, umbos low, almost central, usually worn (fig. 1). Sculpture. fine concentric growth lines only (Dunnill and Ellis 1969). Dorsal margin arched, ventral margin slightly contracted (Oldroyd 1924); no posterior dorsal flange (posterior to ligament). Valves do not gape: family *Tellinidae* (Keen 1971). Posterior end rounded. Shell usually heavy, but bay specimens sometimes thin (Coan 1971).
Ligament—short, but strong, partially sunken, seated on a stout callus (Dunnill and Ellis 1969), but not on a nymph: family Tellinidae (Coan and Carlton 1975).

Pallial Line—narrow, faint.

Pallial Sinus—large (Keen and Coan 1974), equal (valves); sinus ends ¾ of way to anterior adductor muscle scar in both valves (figs. 2a, 2b); pallial sinus does not reach muscle scar (fig. 2b) (Coan and Carlton 1975).

Hinge Area—no lateral teeth: genus *Macoma* (Coan and Carlton 1975). Cardinal teeth: 2 in each valve (figs. 4a, 4b): one stout, bifid, the other single, fragile (Dunnill and Ellis 1969).

Animal—siphons long, separate, mobile. Inhalant siphon when extended, 4x shell length. Exhalant siphons held vertically above surface 1.5 cm. Large palps, for sorting fine particles (Yonge 1949) (fig. 5).
Veligers—early veligers indistinguishable from other bivalves, but late veligers and early post-larval *M. balthica* have characteristic yellow shells and red umbones.

Possible Misidentifications

Tellinidae can be distinguished from other small or young bay clams (ie. MactrIdae-*Tresus*, Veneridae. *Protothaca*, *Saxidomus*: Myidae. *Mya, Cryptomya*) by their external ligament (never on a nymph or chondrophore), their cardinal hinge teeth (2 in each valve), their wide sinuous pallial lines (Keen 1971),and because their shells never gape. Lateral teeth may or may not be present in the Tellinidae (Coan 1971). Myidae have a hinge with a spoon-shaped chondrophore (left valve) and a projecting tooth (right valve) (see *Mya arenaria*). Veneridae have 3 cardinal teeth in each valve; MactrIdae have an internal ligament, A-shaped cardinal teeth, and gaping valves (Coan and Carlton 1975). Semelidae have a resilifer, a socket-like chondrophore holding the ligament. Mature *Macoma balthica* are rarely over 25 mm long (Dunnill and Ellis 1969), but could be confused with the young of some of these larger clams.

Other genera of Tellinidae (ie. *Tellina* sp.) have lateral hinge teeth (at least in the right valve); *Macoma* do not. *Macoma* are generally more rounded. more inflated than *Tellina*; *Macoma* are smooth, white and chiefly northern. (Species characteristics in these clams can tend to be gradational, and are not always quantitative) (Coan 1971). Most *Tellina* are elongate, relatively compressed, conspicuously sculptured, brightly colored, and usually warm water dwellers (Coan 1971). There are 4 *Tellina* species in our area.

Of the almost 30 species of *Macoma* identified in the eastern North Pacific (Dunnill and Ellis 1969). we need to consider only seven:

Macoma nasuta, the bentnosed clam is easily told (in the adult) by its bent posterior valves (see *M. nasuta*). It is white in-side and out, with some dark periostracum; its pallial sinus reaches the anterior adductor muscle in the left valve but not in the right (that of *M. balthica* does not).

Macoma inquinata (=*irus*) is a common mud clam, with slightly inflated but not bent valves in which the pallial sinus almost reaches the anterior adductor muscle scar (see *M. inquinata*). The shell is chalky white with a fibrous olive green periostracum it is never pinkish as *M. balthica* often is.

Macoma secta, the sand clam, has a squared off, flanged posterior, although it is not bent like *M. nasuta*'s posterior. It is white, with a yellowish epidermis; its right valve is more inflated than the left, and it can be large (to 120 mm). Its pallial sinuses meet the pallial lines at about a right angle (Coan 1971). It is found in clean sand, not in bay mud. Closely related to *M. secta* are *Macoma expansa*, a rare, usually offshore species (to 50 mm) whose pallial sinuses are perpendicular to the pallial line; *Macoma indentata* found from Trinidad, California, south, and elongate, pointed posteriorly and with very unlike muscle scars. *Macoma elimata* is found only in 15-476 meters of water.

Macoma acolasta is a rare, sand-dwelling clam, elongate and occurring from Bodega Bay south.

Macoma yoldiformis is also elongate, inflated, and thin, with the pallial sinus detached from the pallial line. Although the range of this clam is from Vancouver south to Baja California, it is not included in Puget Sound or British Columbia work (Dunnill and Ellis 1969). It can be found in silt in low intertidal of protected bays (Coan and Carlton 1975).

Macoma incongrua is a generally northern species which can be found to 33°N latitude and intertidally to 20 fathoms. It has somewhat inflated valves, is usually 30-40 mm long, and almost round in outline (Dunnill and Ellis 1969).

Macoma calcarea is found from 20 fathoms and lower, and from 37°N. Other northern subtidal species include *elimata* and the large *M. brota* and *M. lipara* (Dunnill and Ellis 1969).

Macoma balthica is the name of the Atlantic species Our west coast clam was originally called *M. inconspicua* (Broderip and Sowerby, 1829); they are now considered by most to be the same species.

Ecological Information

Range—circumarctic: Alaskan coast to San Francisco, rarely to San Diego (Coan 1971). Possibly introduced to San Francisco from Atlantic coast (Coan and Carlton 1975)

Local Distribution—Coos Bay: South Slough channel, air-port spoil islands, etc., Siletz, Nestucca, Siuslaw, Netarts, Tillamook Bays (Hancock 1979): bays that front on open coast (Kozloff 1974b).

Habitat—offshore and bay mud, often very fine; sometimes black, foul mud. Coarseness of soil not determining factor in distribution (various authors) (Vassalio 1969). Currents determine distribution, as they affect sediment settlement and degree of shelter. Clams do not penetrate clay layer.

Salinity—collected at 30 ‰ salt; found also in brackish water (Vassalio 1969).

Temperature—cold to temperate waters.

Tidal Level—found at + 0.3 m (Coos Bay, Coastal Acres) and down to 37m (Coan 1971); correlation between clam size and depth: smallest animals closest to surface (Vassalio 1969) (distance from surface determined by siphons length) (Vassalio 1971).

Associates—San Francisco Bay: whelk *Busycotypus*; gastropod *Nassarius*; polychaetes: capitellids, nereids', amphipod *Ampelisca*; bivalves *Gemma, Mya* (Vassalio 1969).

Quantitative Information

Weight—

Abundance—most abundant in the upper zone (1-3 to 2.6 m) (San Francisco Bay) (Vassalio 1969), where they compose 55% of animals in invertebrate community. Juvenile densities to 5000/m^2 (June, Thames estuary, England) (Caddy 1969). Density determined by currents. fineness of deposits and density of micro-organism populations and their surface area (Morris et al 1980). Not very common in Puget Sound (Kozloff 1974b). Coos Bay. Quite common, many stations.

Life History Information

Reproduction—spring spawning (March), and another in autumn with larger animals (England) (Caddy 1969). Planktonic life probably 2-5 weeks; spatfall 300-330µ.
Growth Rate—
Longevity—
Food—suspension feeder on plankton when tide is in (Braefield and Newell 1961); deposit feeder on bacterial film and diatoms and other microorganisms in 'organic debris' (Vassalio 1969; Oldroyd 1924). Competes with amphipod *Ampelisca*; each clam feeds in a 4 cm area (Braefield and Newell 1961).
Predators—*Ampelisca*, on spat (Vassalio 1969): shorebirds, on small clams within reach of their beaks (8"), starry flounder (Vassalio 1969).
Behavior—essentially static; a slower burrower than some other *Macomas* (Yonge 1949), takes 2½ minutes to bury itself (Braefield and Newell 1961). U-shaped tracks in mud show movement toward and away from sun (Braefield and Newell 1961).

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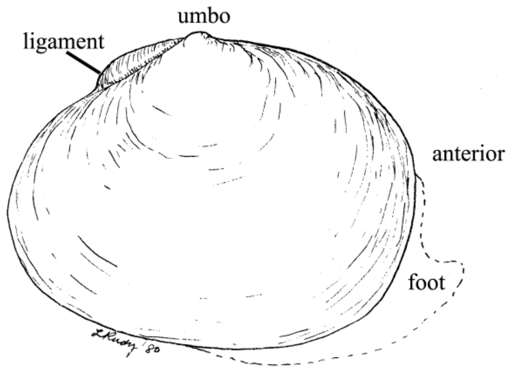
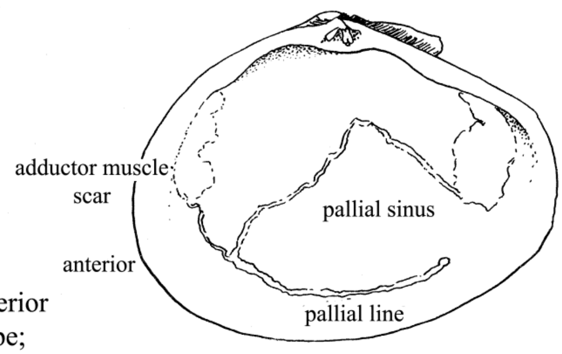
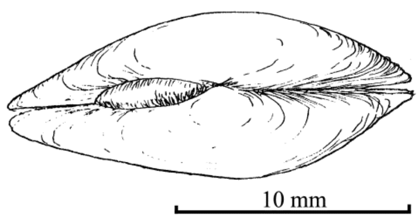
Macoma balthica



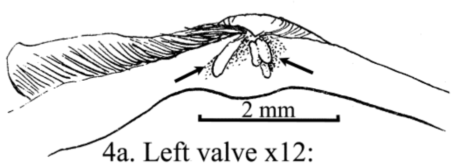
1. *Macoma balthica*, exterior, right valve (L:17.5mm,D:7.5mm,H:14mm) x4: shell regular, oval; valves equal; umbos low, almost central; anterior and posterior ends rounded: no flange, bend or gape; exterior color pink; ligament external, short, strong.



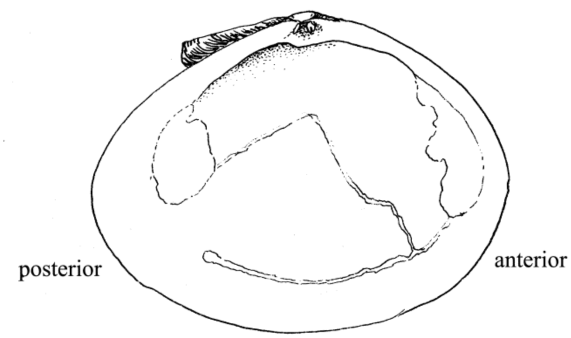
2a. Interior, right valve: pallial line narrow, faint; pallial sinus ends 3/4 of way to anterior adductor muscle scar; sinuses in both valves similar; interior pink.



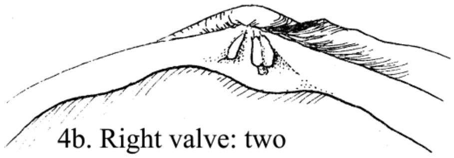
3. (Dorsal view) x4: valves not bent.



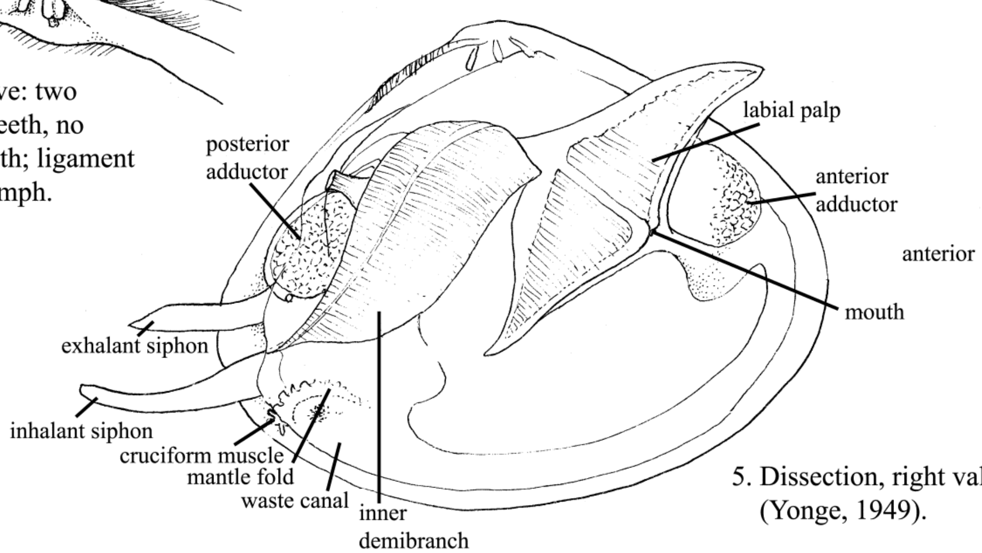
4a. Left valve x12: two cardinal teeth, no lateral teeth.



2b. Left valve



4b. Right valve: two cardinal teeth, no lateral teeth; ligament not on nymph.



5. Dissection, right valve: (Yonge, 1949).

Macoma inquinata (=*irus*)

Irus clam (Deshayes, 1854)

Phylum: Mollusca
Class: Bivalvia; Heterodonta
Order: Veneroida
Familv: Tellinidae

Description

Size—up to 55 mm long (Coan 1971); this specimen 44 mm long, 35 mm high, 18 mm diameter.

Color—dull white, dark opaque periostracum (not shiny). Interior porcellanous white, feebly polished (Dunnill and Ellis 1969).

Shell Shape—ovate or subovate, not circular. Posterior end narrower, less rounded than anterior end (Kozloff 1974a). Shell heavy, not fragile. Inflated, equivalve, umbones subcentral. Can have slight gape and flex to right (posterior end) (Dunnill and Ellis 1969); conspicuous con-centric sculptural undulations (fig. 1).

Ligament—long, strong, narrow, prominent (figs. 1, 4). Not seated on nymph, but entirely external: family Tellinidae (Coan and Carlton 1975).

Interior—

Pallial Line— not detached from anterior ventral end of pallial sinus (fig. 2). Pallial line longer in left valve (fig. 3).

Pallial Sinus—reaches almost to anterior adductor scar, or just to its base in left valve (fig. 3) (Coan 1971); pallial sinuses similar in the 2 valves.

Hinge Area—2 cardinal teeth in each valve, no lateral teeth: genus *Macoma* (fig. 5).

Siphons—completely separate: family Tellinidae (Quayle 1970); barely yellowish in color (fig. la).

Possible Misidentifications

As *Macoma inquinata* can bend slightly posteriorly, it could be confused with the thinner *M. nasuta*, the bent-nosed clam. *M. nasuta* is not as round and heavy as *M. inquinata*; its pallial sinus reaches and joins the anterior adductor scar above its base (left valve). (Its right valve may be more like *M. inquinata*'s). Its siphons are orange (see plate, *M. nasuta*).

Macoma incongrua is the species closest to *M. inquinata*. It is quite circular in outline; its pallial sinuses are higher than in *M. inquinata*, and different in its 2 valves. (They are similar in *M. inquinata*'s valves). *M. incongrua* is generally a northern species, and averages 30-40 mm in length (Dunnill and Ellis 1969).

The name *Macoma irus* is more often used with the Japanese species (Coan 1971; Keen 1962).

A shorter variety of *M. inquinata*, *M. i. arnheimi*, described by Dail. probably does not represent a true subspecies (Coan 1971).

See *Macoma balthica* for a complete comparison on *Macoma* species, genus and family characteristics.

Ecological Information

Range—Siberia, Aleutian Islands, British Columbia, south to Oregon; rare south of Santa Barbara, California (Coan 1971).

Local Distribution—Oregon bays: particularly Tillamook, Coos, Siuslaw, Yaquina; rarer in Alsea, Nestucca, Netarts (Hancock 1979).

Habitat—usually in soft muddy sand (Dunnill and Ellis 1969); in protected areas. Have been found also in coarse sand with shell, intertidal sand, and in fine sediment overlying flat rocks (British Columbia) (Dunnill and Ellis 1969). Also in eelgrass (Puget Sound) (Kozloff 1974b).

Salinity—full seawater.

Temperature—cold to temperate waters.

Tidal Level—intertidally to 48 m offshore (Coan 1971).

Associates—*Macoma nasuta* (South Slough of Coos Bay).

Quantitative Information

Weight—

Abundance—common in bays (Coan and Carlton 1975); can be locally abundant: over

6 million at one small Coos Bay site (Gaumer 1978).

Life History Information

Reproduction—separate sexes; eggs and sperm discharged into water through exhalant siphon; fertilized eggs develop into veliger larvae which swim, metamorphose and settle as small clams.
Growth Rate—
Longevity—
Food—chiefly a deposit feeder, cleaning film of diatoms, etc. from surface with siphon.
Predators—shorebirds.
Behavior—

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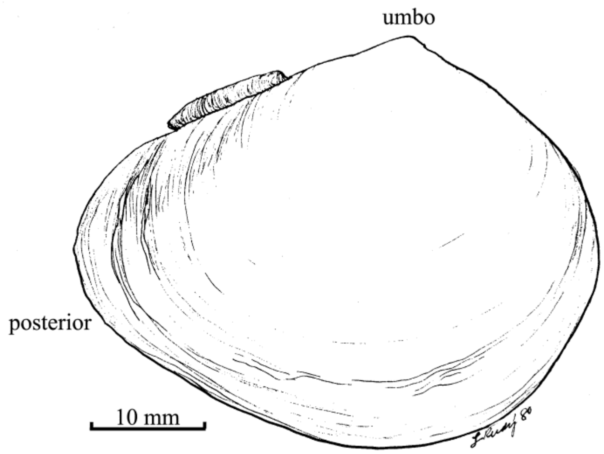
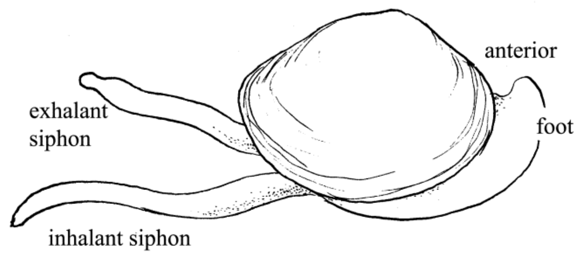
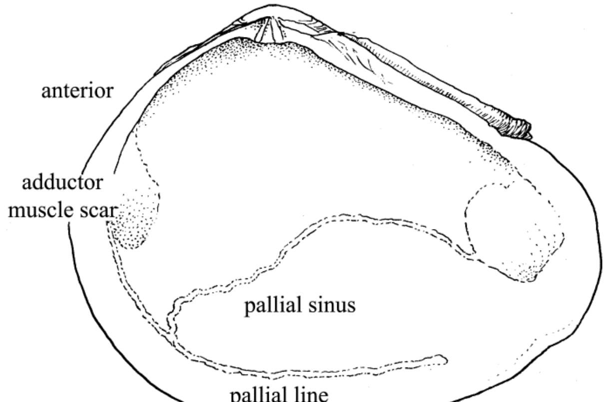
Macoma inquinata



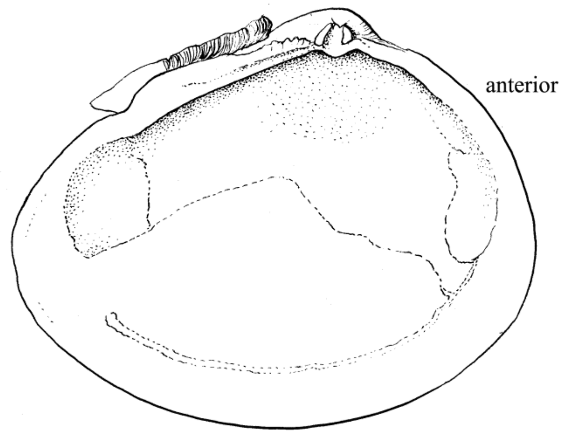
1. *Macoma inquinata*, right valve (L:44mm,D:18mm, H:35mm) x2: shell subovate, posterior narrow; valves equal, inflated; umbones subcentral; color dull white.



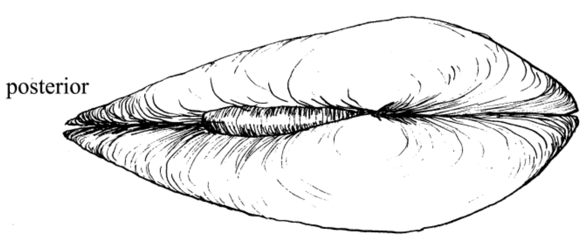
1a. Live clam x1: siphons separate.



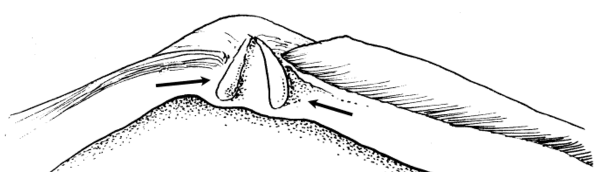
2. Interior, right valve: pallial sinus reaches almost to base of anterior adductor muscle scar.



3. Interior, left valve: pallial sinus as in right valve.



4. (Dorsal view): ligament external; valves slightly bent right posteriorly.



5. Dorsal, right valve: two cardinal teeth in each valve, no lateral teeth.

Macoma nasuta

The bent nosed clam (Conrad, 1837)

Phylum: Mollusca
Class: Bivalvia; Heterodonta
Order: Veneroida
Family: Tellinacea; Tellinidae

Description

Size—"3 to 70 mm" (Macginitie and Macginitie 1949); "seldom reaching 21/2 inches" (Packard 1918); in Coos Bay, largest are about 2¼ (57.5 mm) which would classify it as a "medium" sized shell (Keen and Coan 1974).
Color—white; chalky where eroded (Kozloff 1974b); dark brown parchment periostracum especially near lower edge and near siphons on valves; often with black markings (Brusca and Brusca 1978); no interior shell color (Keen and Coan 1974), (though siphons can be orange) (Kozloff 1974b).
Exterior—valves thin, smooth, but not polished; shells ovate; "posterior portions of valves distinctly bent to the right" (Kozloff 1974a) (fig. 4); shells thin, radial lines fine, sometimes blackish; anterior end rounded, posterior wedge-shaped, truncate not "flanged".
Interior Right Valve—(hold closed shell in both hands with the hinged area up, the ligaments toward you: the right valve is in the right hand) (Keen and Coan 1974); pallial sinus doesn't reach anterior adductor scar; (fig. 3) (Coan and Carlton 1975); adductor and posterior muscle scars similar in shape in both valves and overlaps but sinus patterns differ.
Interior Left Valve—pallial sinus reaches anterior adductor muscle scar, fuses and overlaps with it (fig. 2) (Coan and Carlton 1975); clam lies on its left (rounded) side in the mud (MacGinitie and MacGinitie 1949).
Hinge—with ligament, entirely external (Coan and Carlton 1975); cardinal hinge teeth: 2 (right valve) (fig. 5), 1 (left valve) (fig. 2); no lateral teeth (beneath ligament), (fig. 5).
Ligament—entirely external end dorsal not on a "nymph" or projection (fig. 5).
Beaks—"central, slightly prominent" (Packard 1918) (fig. 5).
Siphons—completely separate; orange-coloreds.

Possible Misidentifications

There are 4 common species of *Macoma* in our area: *M. balthica*, often colored inside, is small; *M. inquinata (= irus)* is whitish and also small (only up to 5 cm); *M. secta*, the sand clam, has a quadrate, flanged posterior. None of them has a noticeably bent posterior. *M. identata*, a rare, small (to 2.5 cm) form, has a strongly produced posterior projection. *Macoma yolditormis*, small and found in sand or mud, has a long anterior end and a produced and expanded posterior (Coan and Carlton 1975).

The genus *Macoma* can be told from the similar *Tellina* by its lack of lateral teeth in either valve (Coan and Carlton 1975). *Macoma* are "more rounded than *Tellina*, more inflated, smooth, white, often chalky" (Coan 1971).

Ecological Information

Range—Kodiak, Alaska to Baja California (Ricketts and Calvin 1971).
Local Distribution—in bays as well as offshore below surf zone (Coan and Carlton 1975).
Habitat—substrate; mud and muddy sand, about 10-15 cm below the surface. Very adaptable, it can live better in soft mud than any other *Macoma* species, and in the extremely stale waters of small lagoons (Ricketts and Calvin 1971); also found in eelgrass beds (Kozloff 1974b).
Salinity—adapted to a wide range of conditons.
Temperature—temperate and cold waters; not found in the Panamic province to the south.
Tidal Level—most common in bays at mid-tide (Coan and Carlton 1975); low tide in California (communication Van Veldhuizen).
Associates—occasionally infested with encysted larvae of the tapeworm

Anthobothrium sp (MacGinitie and MacGinitie 1949). Also pea crabs *Pinnixa*, commensal nemertean *Malacobdella* (Morris et al 1980).

Quantitative Information

Weight—

Abundance—on "every possible mud flat" (Ricketts and Calvin 1971); often most common clam, (i.e. Elkhorn Slough), being replaced by immigrant, *Mya arenaria*.

Life History Information

Reproduction—typically pelecypodan: separate sexes, eggs and sperm discharged into the water through excurrent siphon. fertilized egg develops into veliger larva which swims, metamorphoses, and settles as a small clam (MacGinitie and MacGinitie 1949). Oregon spawning reportedly spring, early summer (Morris et al 1980).

Growth Rate—

Longevity—

Food—primarily a suspension feeder; also sucks surface film from mud surface with siphon, blows out coarse, inedible material (MacGinitie and MacGinitie 1949).

Predators—small clams are fed upon by crabs. Snail *Polinices* (Morris et al 1980).

Behavior—unusual feeding mechanism (fig. 6).

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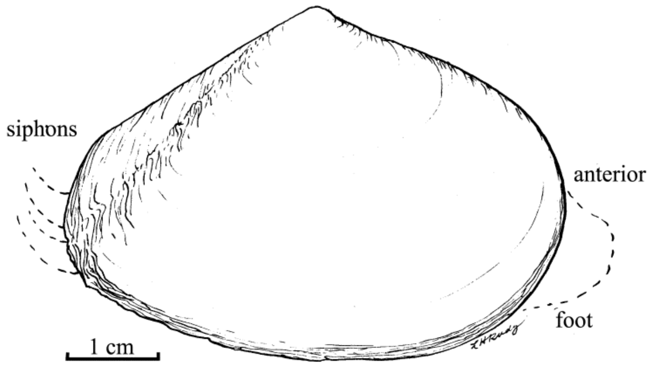
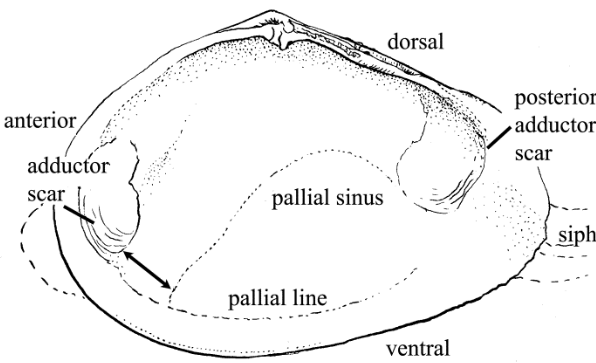
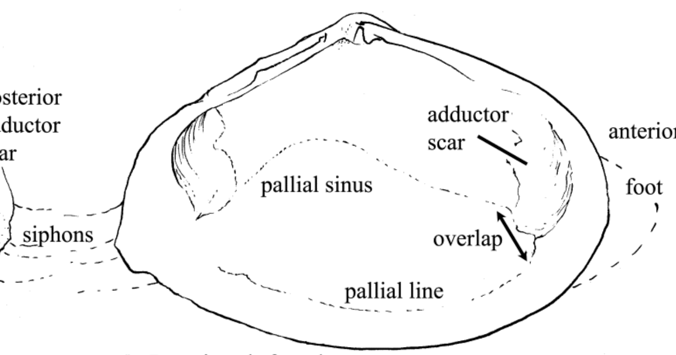
Macoma nasuta



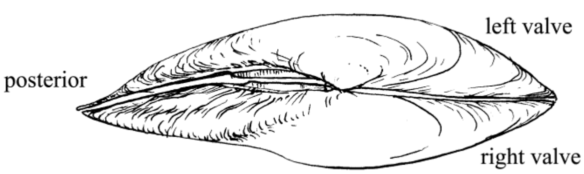
1. *Macoma nasuta*, external, right valve x1.63:
thin, white shell; bent right posteriorly; fine, radial lines; anterior rounded; posterior truncate



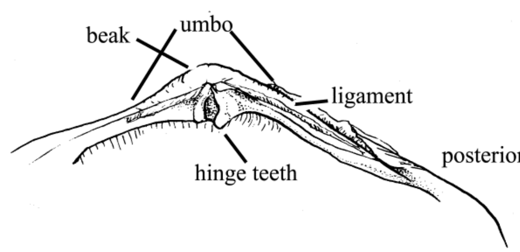
2. Interior, right valve:
pallial sinus doesn't reach anterior adductor scar; muscle scars similar.



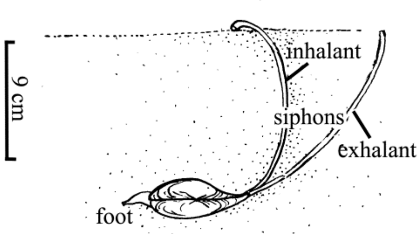
3. Interior, left valve:
pallial sinus overlaps anterior adductor scar.



4. Exterior (dorsal view):
posterior valves bent right.



5. Dorsal region, right valve:
two cardinal hinge teeth; hinge external; no lateral teeth; ligament dorsal, external, not on nymph; back central, slightly prominent.



6. Clam burrowing x0.33
(MacGinitie, 1949).

Mya arenaria

Soft-shelled clam (Linnaeus, 1758)

Phylum: Mollusca
Class: Bivalvia; Heterodonta
Order: Myoida
Family: Myidae

Description

Size—2-110 mm (Jacobson 1975); averages 5-10 cm (2-4 inches); can be up to 125 mm in some areas (Umpqua, Siuslaw estuaries).
Color—white with gray or dark periostracum (rough outermost layer).
Exterior—valves similar: long, egg shaped, shell convex, thin, brittle; low concentric growth striae anterior and posterior ends different: both rounded, but anterior blunter; posterior pointed: both ends gaping (Packard 1918): beaks small, bent back, slightly anterior of center; siphons large, fused, non-retractible.
Interior—white; strong internal ligament: deep pallial sinus; spoon-shaped chondrophore (support for ligament); adductor muscle scars same size but very different in shape (fig. 2).
Hinge Area—valve areas dissimilar: spoon-shaped chondrophore in left valve, projection almost as great as width (Kozloff 1974a); right valve with tooth in opposition to chondrophore. No hinge plate teeth (cardinal or lateral); ligament entirely internal, not visible from exterior.

Possible Misidentifications

One of the areas where *Mya* is abundant is in upper reaches of estuaries where salinity is reduced, and where *Saxidomus* and *Tresus*, which are slightly similar superficially, usually are not found. Neither of these, nor *Tellina* nor *Macoma* sp., has an internal ligament or a chondrophore in both valves. Small *Tresus* can otherwise be mistaken for *Mya*. Small Tellinid clams have an external ligament without a nymph, and lateral hinge teeth, which *Mya* lack. *Macoma* are very like *Tellina*, but their shells are always a bit flexed, they have no lateral teeth, and no internal coloration.

Cryptomya, the false *Mya* (which see) is a smaller (to 30 mm), less elongate clam. It is usually found close to the ghost shrimp *Callianassa*. Unlike *Mya*, *Cryptomya* has an inconspicuous pallial sinus.

Ecological Information

Range—Vancouver Island to San Diego. Probably introduced with oyster spat in 1869 in San Francisco, although it appears in the fossil record (Pliocene) (Ricketts and Calvin 1971), in California and Vancouver (Packard 1918). Common on the Atlantic Coast and Europe, it has crowded out the native *Macoma* on the Pacific coast in some areas (Keep and Longstreth 1935).
Local Distribution—Coos Bay, Yaquina Bay; Suislaw, Umpqua, Tillamook, Aisea and Columbia estuaries, and possibly others.
Habitat—mud and sand of bays (Coan and Carlton 1975); often in upper reaches where salinity is reduced; requires complete protection, as it cannot burrow or maintain itself in a shifting substratum (Ricketts and Calvin 1971); very tolerant of extreme conditions: anaerobic or foul mud, brackish (though not stagnant) water, temperatures below freezing (Ricketts and Calvin 1971).
Salinity—tolerates brackish water and reduced salinity, as well as full salt water (can live at 23% seawater) (Morris et al 1980).
Temperature—range limited to cool areas; can also tolerate temperatures below freezing.
Tidal Level—found from 15-30 cm in the mud: "littoral or adlittoral" (Packard 1918).
Associates—can be parasitized by *Pinnixa faba* (see Pearce, 1966 under *Pinnixa*) (Ricketts and Calvin 1971).

Quantitative Information

Weight—
Abundance—abundant in Yaquina, Siuslaw. Umpqua estuaries, and in some parts of Coos Bay.

Life History Information

Reproduction—dioecious (separate sexes); two periods of sexual maturation and spawning: fall, when temperatures - fall (primary maturation period) and spring (secondary maturation): Chesapeake Bay; continuous period from April to October New England (Pfitzenmeyer and Shuster 1960). Eggs 60-80 pm diameter (Morris et al 1980).
Growth Rate—clams as small as 25 mm have been found to have mature gametes (Pfitzenmeyer and Shuster 1965).
Longevity—
Food—a suspension feeder.
Predators—birds. man, and as larvae, preyed upon by plank-tonic predators and suspension feeders.
Behavior—does not burrow as adult.

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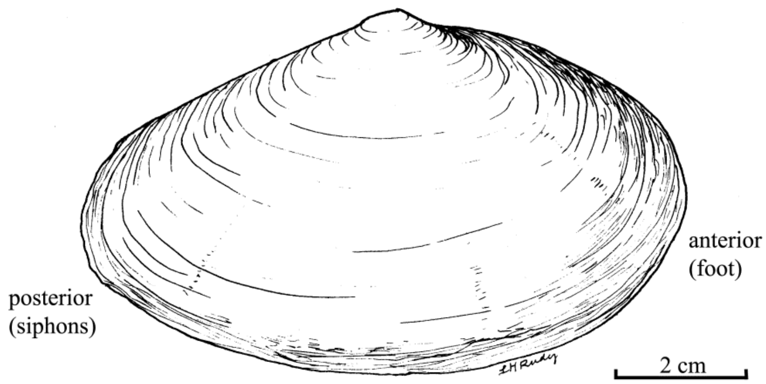
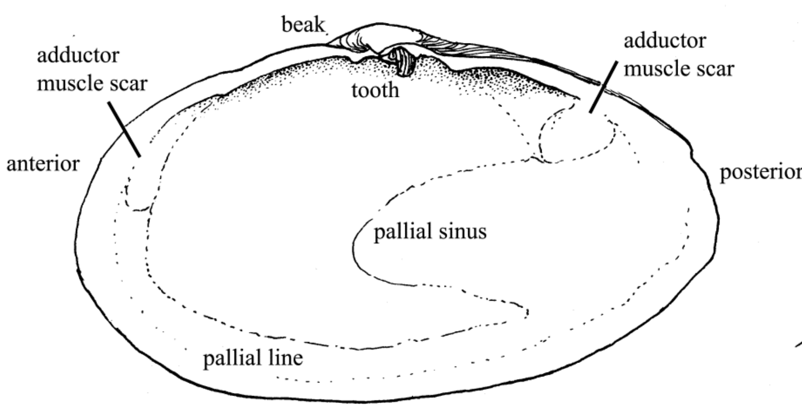
Mya arenaria

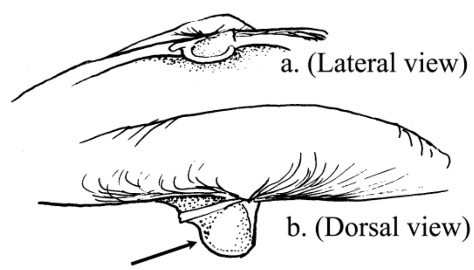


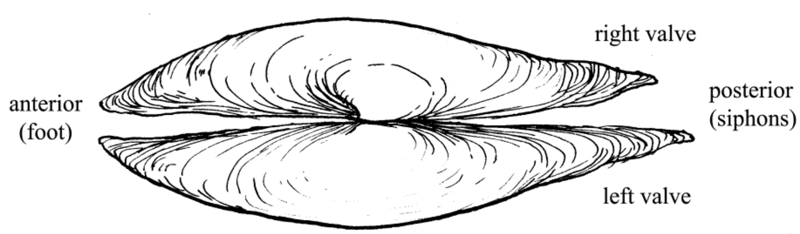
1. *Mya arenaria*, exterior, right valve x1:
shell egg-shaped, thin, brittle; concentric growth rings, small beaks; both ends rounded, slightly gaping.



2. Interior, right valve:
white; muscle scars unlike; pallial sinus deep, no cardinal teeth; ligament all internal; tooth opposing chondrophore.

3. Hinge area, left valve:
chondrophore spoon-shaped.





4. (Dorsal view)

Myosotella myosotis *(=Phytia setifer, Cooper, 1872)*

A bristle-bearing ear shell (Draparnaud, 1801)

Phylum: Mollusca
Class: Gastropoda, Pulmonata
Order: Basommatophora
Family: Melampidae
(=Ellobiinae)

Description

Size—to 8 mm; this specimen, 4 mm.
Color—variable: chestnut, purplish or yellowish brown; black with striations. Interior porcelain-like (Carlton and Roth 1975).
Shell Shape—rather olive-like; higher than wide, no spiral ridges; spire pointed, elevated; five or more whorls (fig. 1). Aperture rounded, ear-shaped, about ½ shell length.
Columella—3 folds above anterior end, one weakly developed (fig. 3).
Eyes—at bases of cephalic (and only) tentacles: order Basommatophora (fig. 2) (Carlton and Roth 1975).
Operculum—lacking in pulmonates.
Juveniles—with small hairs on edges of sutures, disappear in adult (fig. 4); juveniles wider than adults (shells) (Hedgepeth 1962).

Possible Misidentifications

Of the other salt marsh gastropods, Littorinidae and Lacunidae are stouter and larger than *Myosotella*, turbinate and without elevated spires. The somewhat similarly shaped *Olivella* sp. is much larger (to 30 mm) and has an anterior canal in its aperture; it lives in clean sand, not in salt marshes (see plate).

Assiminea californica is a tiny (about 3 mm) brown gastropod sometimes found with *M. myosotis*. It resembles *Littorina* in shape, being stout and convex; its inner lip is a small thickened callus, without folds.

The many species of the tiny Opisthobranch *Odostomia* spp. resemble *Myosotella* superficially, but lack columellar folds and a radula. They are parasitic.

None of the preceding snails is closely related to *Myosotella*.

Snails of the subclass Pulmonata, which includes the land snails, have a vascularized mantle cavity serving as a lung, in place of gills. There are no other similar pulmonates known in northwestern salt marshes. (*Melampus olivaceus* is found farther south) (McLean 1969).

Ecological Information

Range—Puget Sound to Anaheim Bay, California (McLean 1969). Probably introduced from the Atlantic coast in the 19th century (Carlton and Roth 1975). (*Myosotella myosotis* is the Atlantic name; *Phytia setifer* or *myosotis* is a west coast equivalent name used by some authors) (Keen and Coan 1974, Kozloff 1974a).
Local Distribution—Coos Bay: South Slough, many stations (Matthews 1979).
Habitat—*Salicornia* marshes, among debris, mud, crevices of docks, pilings.
Salinity—brackish water: about 16 ‰ seawater; avoids immersion (Matthews 1979). Tolerates all salinities including freshwater; well adapted: an air breather.
Temperature—
Tidal Level—near high tide line (Keen and Coan 1974); at levels which are rarely inundated: it is often the only invertebrate at this high level (Kozloff 1974a). South Slough (Coos Bay): found at + 6.0' MLLW.
Associates—ciliates in mantle cavity (Kozloff 1945); prosobranch gastropods *Assiminea california, Littorina sitkana, L. (A.) newcombiana, L. scutulata*; pulmonate. *Melampus olivaceus* farther south. Amphipod *Orchestia*, isopods. Plants *Spergularia canadensis, Distichlis, Carex.*

Quantitative Information

Weight—
Abundance—very common in marshes: often only invertebrate found at its tide level.

Life History Information

Reproduction—hermaphroditic.
Growth Rate—
Longevity—
Food—

Predators—
Behavior—avoids immersion: an air breather, possessing a lung.

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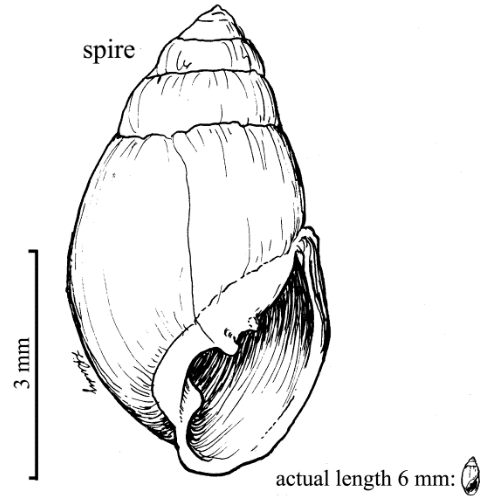
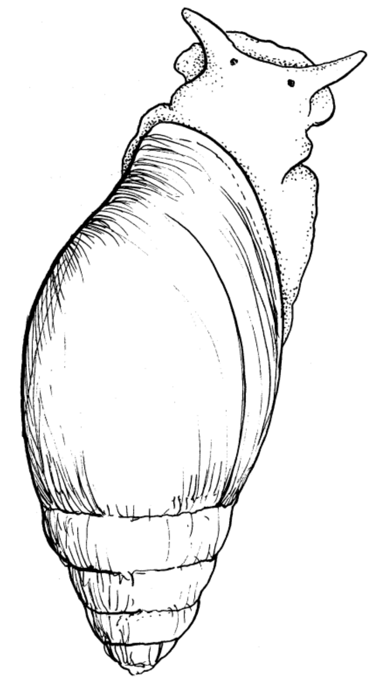
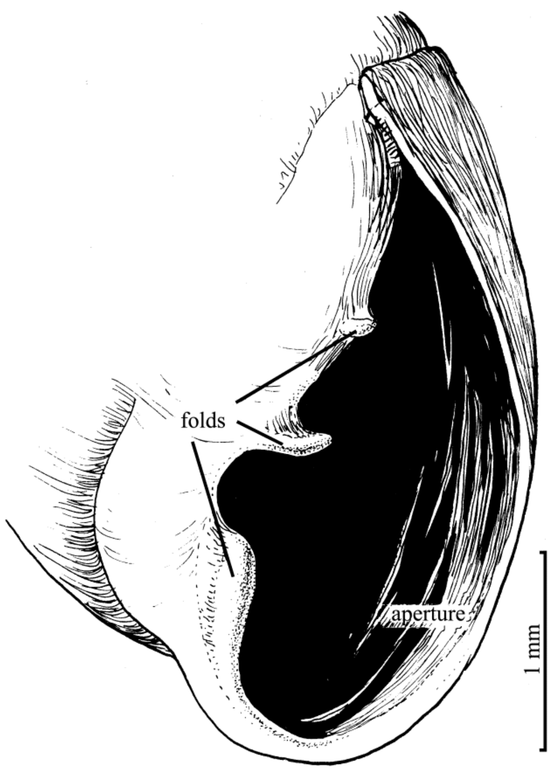
Myosotella myosotis



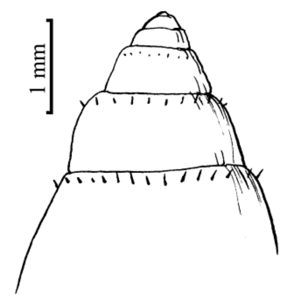
1. *Myosotella myosotis* (anterior view) x12: higher than wide; 5 or more whorls; elevated spire; aperture rounded, ear-shaped and half length of shell.



2. *M. myosotis* (dorsal view) x12: note eyes at tentacle bases.



3. Columella and aperture (anterior view) x32: three columellar folds, one weak; no operculum.



4. Juvenile x15: hairs on sutures.

Mytilus trossulus *(Gould, 1851)* (*M. edulis*)

The bay mussel (Linnaeus, 1758)

Phylum: Mollusca
Class: Bivalvia, Pteriomorpha
Order: Mytiloida
Family: Mytilidae

Description

Color—blue violet and white, shiny brown-black periostracum; animal more tan than orange.
Size—about two inches: (7 cm)(Kozloff 1974a); largest found 11.4 cm (Coe 1945).
Exterior—variable, valves similar: wedge shaped longer than high, tapering to pointed anterior; regular, smooth, with concentric growth lines, but no radial ribs (fig. 1); fine byssal threads attach to substrate; beaks terminal (anterior); no siphons, but openings between mantle edges (posterior); foot reduced (and internal).
Interior—large posterior muscle scar, small anterior scar near beak on anterior ventral margin (fig. 2); blue-black color around ventral (posterior) margin; pit-like byssal gland at base of foot produces liquid which hardens into byssal threads, visible on ventral edge (fig. 1).
Hinge Area—no hinge teeth or chondrophore but small denticles near beak; no shell-like septum (or shelf) at anterior end; beaks terminal, (fig. 4).

Possible Misidentifications

Mytilus trossulus is often found with *Mytilus californianus*, the larger, coarser "common mussel" of the West Coast. Internally *M. californianus* is orange. Externally, the most dependable distinguishing characteristic is the presence of radial ridges, particularly posteriorly, in *M. californianus*, lacking entirely on the smoother *M. trossulus*. When small, the two are more difficult to distinguish. *M. trossulus* has sharper edges, a thinner profile (fig. 3), finer byssal threads, more delicate concentric rings than does *M. californianus*. It also can be found higher in the intertidal, in more protected spots, not on exposed rocks with heavy surf and turbulence.

Other rarer mussels include *Modiolus sp.,* the horst mussel, It has subterminal beaks, largely subtidal, brown and hairy and found in clumps in the mud. It has external beaks; *Septifer bifurcatus* is found under rocks, black

outside, purple within, and with definite radiating ribs and shell-like septum across the anterior end.

Ecological Information

Range—north temperate waters; Arctic Ocean to lower California on Pacific west coast.
Local Distribution—probably all Oregon estuaries as well as on outer coast (with *M. californianus*).
Habitat—extremely adaptable: will attach to rock, wood and fiberglass, firm mud; likes pilings (especially if harbor is polluted) (Ricketts and Calvin 1971); quiet waters. An excellent indicator for lead in environment (Morris et al 1980).
Salinity—larvae can't survive at over 45 ‰ or under 17 ‰ (Field 1922); adults prefer 2.30-33.92 ‰; needs periods of desiccation; requires less oxygenation than does *M. californianus*.
Temperature—a temperate and cold-water animal, it be-comes more abundant farther north (Ricketts and Calvin 1971). Optimum temperature for growth: 10-20 C (Morris et al 1980).
Tidal Level—from mean low low to mean higher low (0-3), but can be from -1. to 5 ft.; found around the edges and both higher and lower than *M. californianus* (Ricketts and Calvin 1971).
Associates—in bays it is the dominant member of a community (of which it's the climax animal and longest lived) and which can include the barnacle, *Balanus glandula* (on the shell); nematodes: Sabellid, Serpulid, Nereid, and Syllid worms, the limpet *Acmaea*, ectoproct *Bugula*, anemone *Metridium senile*; the gastropod *Nucella,* red algae; tunicates; bryozoans; hydrozoans. Some *Mytilus trossulus* is found in all *M. californianus* beds

which constitute a well-studied community (Ricketts and Calvin 1971). Parasites which can be present in *M. trossulus* include the copepod *Modiolicola gracilis* (gills), *Myticola orientalis* (rectum). Not parasitized by pea crabs (Ricketts and Calvin 1971).

Quantitative Information

Weight—adjusted mean-dry body weight: 7 gm (Harger 1968).
Abundance—become more abundant farther north (Ricketts and Calvin 1971); a community can reestablish in three years and is subject to greater fluctuations in numbers than is *M. californianus*: Hoshia (Ricketts and Calvin 1971).

Life History Information

Reproduction—eggs and sperm discharged into water and fertilized there (Field 1922); spawns N. California in April (MacGinitie and MacGinitie 1949): "dioecious", (separate sexes); colonization over wide area: planktonic phase long, distances moved can be great (Harger 1968).
Growth Rate—grows fastest first five months (Coe 1945), especially second and third months after settling; growth fastest when water warmest (to July) when dinoflagellate population high; growth lower after 2-3 years (Coe 1945). Animals highest in the intertidal grow slowest. Animals continuously submerged are larger and grow faster than those exposed by tides (Morris et al 1980).
Longevity—longest lived animal in its community (Southern California) (Reish and Ayers 1968).
Food—eats organic detritus more than phyto- or zooplankton (Coe 1945); eats by continual intake of ciliary currents, selective feeding with mucus secretions (Fox 1936); digestion intracellular (Coe 1945).
Predators—"preferred" by *Pisaster*, *Nucella*, *Ancanthina*, *Ocenebra*, *Ceratostoma*, *Cancer antennarius*, and *Pachygrapsus crassipes*; also birds; man for bait and food (found in Pleistocene midden) (Coan 1975). Gastropod Nucella emarginata elicits escape response (Wayne 1980).
Behavior—"crawls" to outside of community clump, to avoid silt deposits (Harger 1968), Considerably more mobile than *M. californianus*. More byssal threads formed at night, when crowed or with certain temperatures and salinities (Morris et al 1980).

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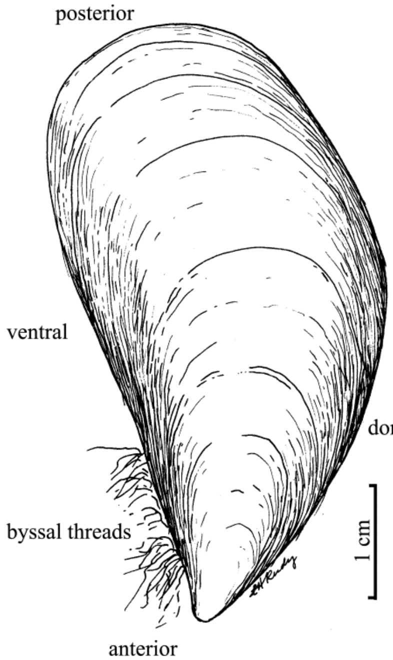
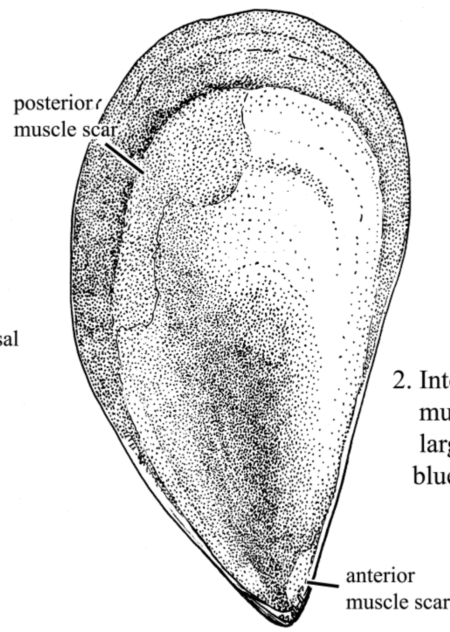
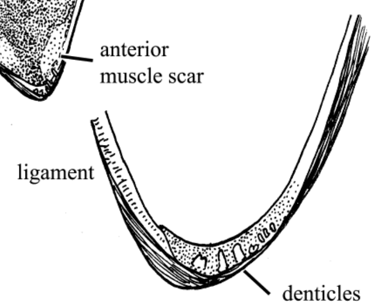
Mytilus trossulus



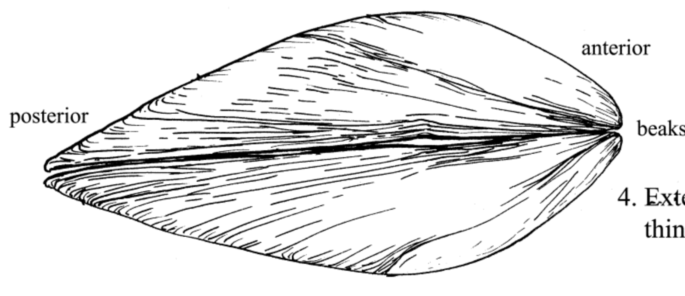
1. *Mytilus trossulus*, right valve, exterior x2: smooth, tapering, like valves; concentric lines only;beaks terminal.



2. Interior, right valve: muscle scars unequal: posterior large, anterior small, near beak; blue-black around margin.



3. Hinge area: no teeth, only small denticles; no shell-like septum.



4. Exterior (lateral, ventral view): thin profile; terminal beaks.

Nucella lamellosa *(= Thais)*

The wrinkled or frilled dogwinkle (Gmelin, 1791)

Phylum: Mollusca
Class: Gastropoda, Prosobranchia
Order: Neogastropoda
Family: Thaisidae

Description

Size—to 50 mm (California)(Morris et al. 1980), 100 mm Puget Sound and north (Kozloff 1974a); largest specimen figured, 54 mm (fig. 1). Largest of the *Nucella*.
Color—white to brown, some are pink, lavender or orange tan; not highly polished. Inside whitish, sometimes with color showing through.
Shell Shape—shell heavy, solid, strong; spirally coiled, fusiform (spindle-shaped). 5-7 whorls; nuclear whorl small, in-conspicuous. Spire usually high; siphonal canal relatively long for genus; aperture ovate, almost 1/2 shell length.
Sculpture—extremely variable. Spire and base have similar sculpture: genus *Nucella* (Smith and Carlton 1975, Keen and Coan 1974). Axial ribs present (fig. 1). Three chief variations with many gradations): lamellar variety with strong axial ribs, developed in quiet water specimens into frilly ruffles (fig. 4); (2) *Nucella* from rough conditions are smooth, with only faint axial sculpture (figs. 1, 3); and (3) strongly sculptured spirally with one to two strong horizontal ribs at top of each whorl and smaller ribs below; axial sculpture only between ribs. This variety has flattened and angled whorls (fig. 2) (Kozloff 1974a).
Outer Lip—thickened, smooth, without denticles on posterior portion of aperture (near anal notch)[6]; no single strong tooth on edge near anterior canal (see Possible Misidentifications). Outer lips rounding smoothly to anterior end of shell. At least one row of denticles within lip (fig. 1).
Columella—(central pillar): without folds (Kozloff 1974a); incrusted, smooth.
Suture—(between whorls): Impressed, distinct, but not a deep groove.
Anterior (Siphonal) Canal—short, but longer than other *Nucella* species; narrow, slot-like, not spout-like (i.e. with edges touching, making a closed tube: see **Possible Misidentifications**). Not separated from large whorl by revolving groove (fig. 1).
Aperture—almost 1/2 length shell; ovate to quadrate in outline, with a siphonal notch, but no anal notch (fig. 1). Widest part of aperture (generally near its middle) at least half as wide as shell (Kozloff 1974a).
Umbilicus—small, often closed (fig. 1).
Operculum—usually large enough to close aperture; conspicuous, with strong spiral lines; with nucleus on one side (fig. la).
Eggs—vase-shaped, yellow, about 10 mm long; in clusters on underside of rocks (Morris et al. 1980); called "sea oats"; (fig. lb).

Possible Misidentifications

Nucella can be distinguished from other predatory estuarine snails by its sculpture, which is the same on the whorls and spire, by the large last whorl and by the ovate aperture (about 1/2 the shell length). Unlike *Nassarius*, it has no distinct revolving furrow setting off the body whorl from the anterior canal (Keen and Coan 1974). It has no single strong tooth on the anterior margin of the outer lip, as in *Acanthina*. There are no columellar folds as in *Olivella*, *Buccinus*, etc. The siphonal canal is not spout-like, as in *Ocenebra*, and *Ceratostoma*.

There are several species of *Nucella* in the northwest:

Nucella lima, the file dogwhelk, is a subtidal snail with about 16 alternating large and small file-like spiral ridges on the large whorl. It is fairly rare, is whitish to brown in color, short-spired and somewhat smaller than *N. lamellosa* (to 43 mm).

Nucella canaliculata, the channeled dogwhelk, is white to or orange, sometimes banded. It has a high spire, a prominent shoulder below the deep suture, and rounded spiral ridges of equal size with axial lamellae between them. It is small, to just over 30 mm. Usually found in mussel beds, it is rare in bays (Kozloff 1974a).

Nucella emarginata (which see) is the other *Nucella* most often to be found in estuaries; it usually occurs in heavier surf than *N. lamellosa*. Called the rock-dwelling dogwinkle, it is generally only up to 20 mm long. This snail has alternately large and small, often

nodulose, spiral ridges over most of the shell. (These ridges are often obscure). It has no noticeable axial sculpture. Found in the mid- and high intertidal in mussel beds, it is easily confused with variation of *N. lamellosa* (fig. 2).

Nucella was previously called *Thais*. This name is now re-served for subtropical and tropical species.

Ecological Information

Range—Bering Strait to central California (Morris et al 1980).
Local Distribution—Coos Bay: Pigeon Point, Empire; Umpqua estuary: Ziolkouski Beach (1/2 mile from mouth).
Habitat—on rocks with mud, sand substrate; often in protected bays (Carlton and Roth 1975); below mussel beds on outer shores.
Salinity—collected at 30 ‰ salt: lower, more marine parts of bays with more constant saline concentrations.
Temperature—cold to temperate waters: geographic distribution would indicate a preference for cool temperatures. Lower part of bay does not generally have high temperatures. Smallest individuals have highest thermal limits; snails active at 0-30 °C (Bertness 1977).
Tidal Level—found at low intertidal, below other species of the genus. Largest animals lowest in tidal range (Bertness 1977).
Associates—its primary prey: barnacle *Balanus*; the under-rock community: porcelain crab *Petrolisthes*, brachyuran crabs *Hemigrapsus* and *Cancer oregonensis*, chiton *Mopalia*, isopod *Idotea*, anemones *Anthopleura elegantissima* and *A. artemesia*, nudibranch *Onchidoris,* gastropod *Tegula; Pisaster ochraceus*. Discarded *N. lamellosa* shells are often inhabited by the hermit crab *Pagurus hirsuitusculus*.

Quantitative Information

Weight—largest collected (including shell) 28 gr. (wet).
Abundance—one of the most abundant intertidal snails of the northwest; becomes less abundant in California. By far the most common *Nucella* species in the Coos Bay estuary.

Life History Information

Reproduction—breeding in winter and spring (California) by aggregations of snails; individuals become sexually mature in 4th year, when they often return to their hatching site and join a breeding group (Morris et al. 1980); individuals tend to breed with same group. Egg capsules deposited synchronously by females; development varies with temperature: snails emerge after 140 days (at 6.8°C), after 67-91 days (9.6-11 °C). Capsules rarely contain "nurse eggs" (sterile eggs to be consumed by the developing snail larvae): nearly all eggs are fertile (Lyons and Spight 1973). Just over half of eggs reach hatching stage; high mortality among young snails: of 1000 eggs (from one female, one year), probably fewer than 10 grow to 1 year of age.
Growth Rate—varies greatly with food supply. Shell growth, type, dependent on food: barnacle diet produced heavy, stout shells.
Longevity—sexually mature at four years (Morris et al. 1980).
Food—primarily barnacles: *Balanus glandula* and *B. cariosus*, on which it is the primary predator (Puget Sound) (Kozloff 1974a). Mussels (outer shores), periwinkles and other mollusks. Radula penetrates shell of prey with aid of secretions from boring organ on foot (Morris et al. 1980).
Predators—egg capsules and young snails heavily preyed upon by other *Nucella*.

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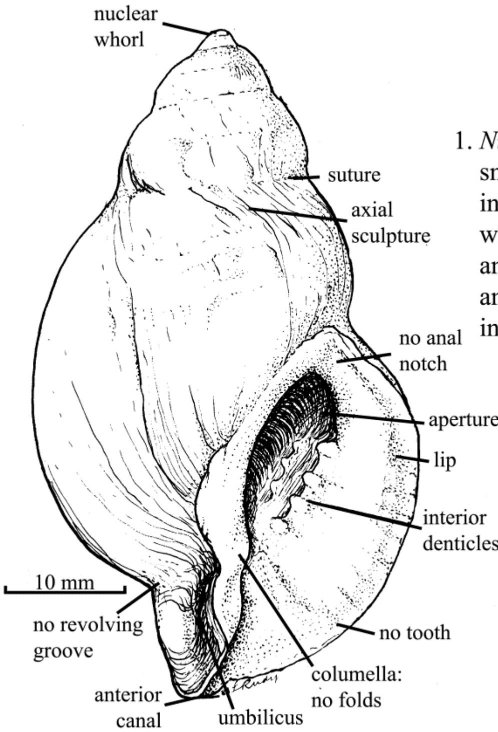
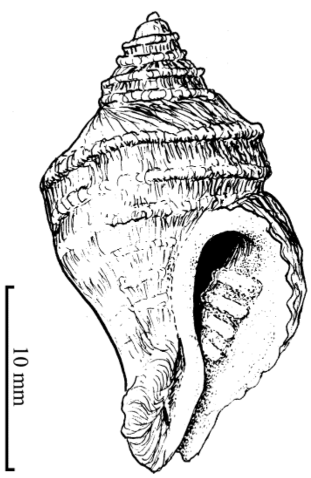
Nucella lamellosa



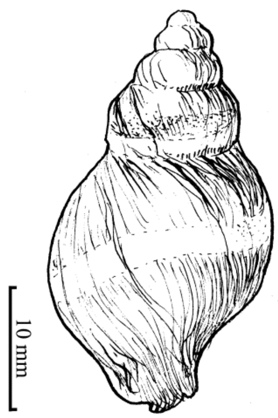
1. *Nucella lamellosa* (posterior view, H:54mm) x2: smooth variety; fusiform; 5 whorls (nuclear whorl inconspicuous); axial sculpture on both spire and body whorl; ovate aperture almost 1/2 shell length; narrow anterior canal; smooth outer lip without posterior denticles, anal notch or marginal tooth; columella without folds; interior rows of denticles, umbilicus closed; suture not deep.

1a. Operculum x2

1b. Egg cluster x1



2. Spiral ribbed variation x2: 1-2 strong horizontal ribs at top of each whorl, smaller ribs below; fine axial sculpture between ribs; whorls angled, flattened.



3. Smooth, banded variation x2

4. Frilly, lamellar variation x1: axial sculpture strong.

Nucella ostrina (Gould, 1852) *(Nucella emarginata)*

The rock-dwelling emarginated dogwinkle (Deshayes, 1839)

Phylum: Mollusca
Class: Gastropoda, Prosobranchia
Order: Neogastropoda
Family: Thaisidae

Description

Size—rarely over 30 mm (Kozloff 1974a), usually up to 20 mm (Puget Sound); up to 40 mm, but rarely over 30 mm (California) (Morris et al. 1980); this specimen (Coos Bay) 20 mm. Females slightly larger than males (average 18.9 and 17.8) (Houston 1971).
Color—exterior brown and dingy white, dirty gray, yellow or almost black (if diet of mussels); yellow, black or gray periostracum in grooves between ridges; ridges sometimes white (black in this specimen). Interior: aperture and columella chestnut brown or purple.
Shell Shape—fusiform; short spire, expanded whorl. Shell thin, not heavy. 3-4 whorls; nuclear whorl inconspicuous.
Sculpture—base and spire with similar sculpture: genus *Nucella* (Carlton and Roth 1975); alternating large and small spiral ridges over most of shell, can be nodulose; sometimes ridges are obscure and surface is fairly smooth. Axial sculpture wrinkled, not prominent.
Outer Lip—thin, crenulate, not thick and layered: species *ostrina* (Oldroyd 1924). No denticles or anal notch on posterior (upper) end, no single strong tooth near anterior canal. No row(s) or denticles within lip.
Columella—excavated (ibid), arched and flattened below: species *ostrina*; no folds, (fig. 1).
Sutures—not deep (fig. 1).
Anterior (Siphonal) Canal—short: less than V aperture length: species *ostrina* (Kozloff 1974a) (fig. 1); canal narrow, slot-like, not spout-like; not separated from large whorl by revolving groove.
Aperture—wide; length more than 1/2 shell length (Oldroyd 1924). Ovate in outline, with a short anterior canal but no posterior notch (fig. 1).
Umbilicus—closed: species *ostrina* (Carlton and Roth 1975).
Operculum—dark brown with nucleus on one side (fig. 2).
Eggs—pale yellow, vase-shaped, about 6 mm high, in clusters of up to 300 capsules (Morris et al. 1980) (fig. 4). Each capsule with 500-600 eggs. Each capsule with a longitudinal suture and a hard clear escape aperture.
Veliger—4 stages: advanced shell measures 775µ long (LeBoeuf 1971) (fig. 5).

Possible Misidentifications

Snails of the genus *Nucella* can be distinguished from other carnivorous estuarine gastropods by their sculpture (the same on both spire and whorls), by the large body whorl and by the large ovate aperture. Other genera with a siphonal notch, and generally fusiform shape include

Olivella and *Buccinum*, which have columellar folds;

Ocenebra and *Ceratostoma* which have a spout-like siphonal canal, not a narrow-slot-like one as in *Nucella*;

Nassarius and *Searlsia* which have a distinct revolving fur-row or fossa setting off the anterior canal from the body whorl; (Searlsia has spiral sculpture only on the body whorl; the spire has both spiral and axial ribs);

Acanthina (also from the family Thaisidae), which has a strong tooth on the anterior end of the outer lip.

There are three other species of *Nucella* in our area. Two are not likely to be found in estuarine conditions, but they do look quite a bit like *No. ostrina*:

Nucella lima, the file dogwinkle, is subtidal, short-spired, and fairly rare. It is whitish to brown, with about 15 alternating large and small file-like spiral ridges on the large whorl. It can be up to 43 mm, somewhat larger than *N. ostrina*.

Nucella canaliculata, the channeled dogwhelk, has a high spire and a prominent shoulder below the deep suture. It is light (white to orange), and sometimes banded. Its 14-16 spiral ridges are very evenly shaped and spaced. It is an inhabitant of outer shore mussel beds. Larger than *N. ostrina*, it averages 26.5 mm (male) and 24.8 mm (female) (California) (Houston 1971).

The third species of *Nucella* is quite likely to be found in bays: *N. lamellosa* (which see) is the most common dogwinkle in the northwest, and one of its many variations is very like *N. ostrina*. *N. lamellosa* can have strong axial ruffles, be quite smooth, or have strong horizontal ribs. In this last case, it must be carefully separated from *N. ostrina*. *N. lamellosa* has a higher spire (usually 5-7 whorls, including the tiny nuclear whorl); it is heavy, with a thick layered lip, not a thin crenulated one. There is usually at least one row of denticles inside the lip in *N. lamellosa*; its anterior canal is longer than that of *N. ostrina* (more than 1/4 aperture length). While *N. lamellosa* can have strong spiral ridges, the body whorl in this species is then often flattened and angled, not expanded as in *N. ostrina*, and the horizontal ridges themselves are not alternating large and small (compare fig. 2, *N. lamellosa*). *Nucella lamellosa* inhabits much quieter waters, as a rule, and a lower tidal range than does *N. ostrina*. Its color is usually lighter; it is rarely blackish.

Ecological Information

Range—Bering Sea south to northern Baja California, but rare below Pt. Concepction (Morris et al. 1980).
Local Distribution—Coos Bay: marine portions, i.e. near bay mouth up to Fossil Point.
Habitat—almost entirely on rocky shores; in fairly heavy surf (Ricketts and Calvin 1971); also in semi-protected areas (Houston 1971). Outer shores in mussel beds, on jetties.
Salinity—full seawater; collected at 30 0/00.
Temperature—cold to temperate waters: small animals high in tidal range show great thermal resistance active at range of 0-30°C (Bertness and Schneider 1976).
Tidal Level—
Associates—its primary prey, barnacles. especially *Balanus*; mussel *Mytilus*; *Pisaster ochraceus*. Commensal flatworm *Nexilis epichitonius* found in specimens on Coos Bay entrance jetty (Holliman and Hand 1962).

Quantitative Information

Weight—1.5 gm (wet).
Abundance—common to abundant (Carlton and Roth 1975); much less common in inner bay than *N. lamellosa* (Coos Bay).

Life History Information

Reproduction—spawn throughout the year (Bodega Bay, Calif.), but most activity is in November-February. Little hermaphroditism (Houston 1971). Spawning not salinity, photoperiod- or temperature-related (Houston 1971). Females gregarious (groups to 20), deposit egg capsules in clusters. Each female lays 8-9 capsules; stalked capsules have about 200-300 eggs each (ibid), many of which may be sterile nurse eggs which are consumed by developing larvae. Veligers swim in capsule fluid and metamorphose into snails about 1.1 mm long, emerging from plug at top of capsule (ibid). Pacific northwest hatchlings number about 10-20 per capsule average; Bodega Bay about 5% hatch (10-15) (ibid): 11.
Growth Rate—Pacific northwest: 2.5-3 months from egg deposition to hatching; possibly more rapid development farther south (Morris et al. 1980).
Longevity—
Food—prefers mussels *Mytilus edulis and M. californianus*; also barnacles *Balanus*, *Pollicipes*, *Chthamalus*; limpets *Collisella*, as well as herbivorous gastropods *Tegula funebralis* and *Littorina*. Feeding is by drilling with the radula. inserting the proboscis, and feeding on the soft body within. Species *N. ostrina* shows a wide food preference, but individuals seem to be consistent in diet (Morris and Abbott et al 1980).
Predators—adult snails prey on eggs.
Behavior—presence of *N. ostrina* elicits several escape responses from prey *Mytilus edulis*: gaping, spontaneous valve closure, foot activity, byssal fixing (Wayne 1980).

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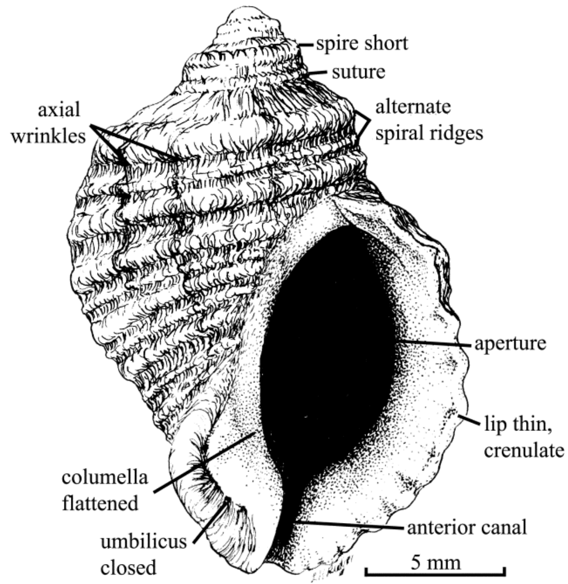
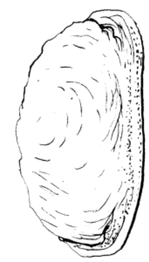
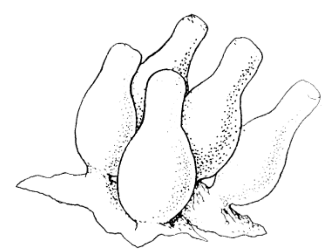
Nucella ostrina



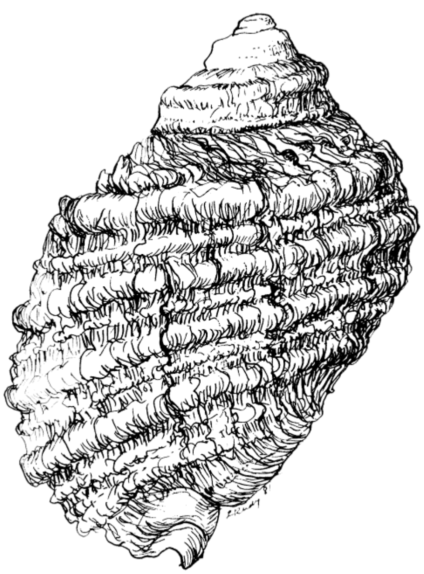
1. *Nucella ostrina* (ventral view, H:21mm) x4:
Shell ovate, body whorl expanded, spire short; aperture ovate, wide; sculpture: alternating large and small nodulose spiral ridges, wrinkled axial folds; columella flattened, unfolded; umbilicus closed; outer lip crenulate, thin, no denticles, short anterior canal .



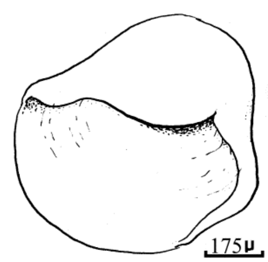
2. Operculum



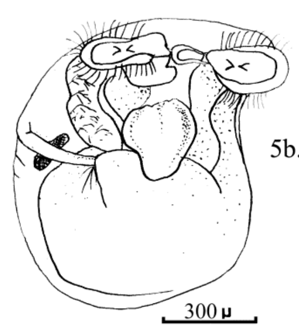
4. Egg capsules x4



3. *Nucella ostrina* (dorsal view) x4



5a. Advanced veliger shell (Le Boeuf 1971).



5b. Advanced veliger larva - fourth stage (Le Boeuf 1971).

Nutricola tantilla (*Transennella tantilla*)

(Gould, 1852)

Phylum: Mollusca
Class: Bivalvia; Heterodonta
Order: Veneroida
Family: Veneridae (Meretricinae)

Description

Size—to 6 mm long (1/4 "); this specimen 3.5 mm long, 3.0 mm high, 1.6 mm diameter (figs. 1, 2).
Color—cream, with one third of shell a purple brown at posterior end, radiating from beak (fig. 1). Interior creamy white with same purple or brown coloration; occasionally a radial strip anteriorly (Oldroyd 1924) (figs. 3, 4).
Shell Shape—a rounded isosceles triangle (Kozloff 1974b): elongate or oval; heavy, solid, slightly longer than high, but definitely triangular. Anterior and posterior dorsal margins straight. Beaks almost central. barely anterior to midline, often eroded (Kozloff 1974a). Surface with fine concentric grooves only, no other sculpture (ibid). Valves equal, not gaping. No rough periostracum, but byssal attachments may cover part of surface.
Interior—ventral margin smooth, not crenulated. (Margin with a few oblique grooves on inner ventral margin, but these are visible only with very high magnification).
Ligament—external: no resilifer or internal ligament (fig. 2).
Hinge Area—three divergent cardinal teeth in each valve (figs. 3, 4); lateral teeth conspicuous; anterior teeth in both valves: genus Transennella. Socket for lateral tooth in right valve (fig. 3).
Pallial Sinus—rounded, bent anteriorly, parallel to ventral margin, not bent sharply upward: genus Transennella, (fig. 3).
Byssus—byssal threads for attachment to substrate (sand grains); rare in Veneridae; fine, clear (fig. la); byssal threads also join young in brood pouch. Byssal gland in middle of foot.
Siphons—short, sensitive, extend only a few mm from body. Excurrent and incurrent siphons fused proximally; tentacles long, flexible: 9-12 in excurrent, 10-14 in incurrenti (Maurer 1967b): species tantilla (fig. 1b).
Foot—large, can bury quickly.
Young—development takes place in parent's mantle cavity; up to 300 young per adult. Size of adult determines number of young. Young

without velum, or pelagic stage (Hansen 1953).

Possible Misidentifications

Transennella is much smaller than most adult bivalves, but juveniles of other clams might be confused with it. Some other Veneridae have concentric sculpture, like *Transennella*, but have predominately radial sculpture:

Mercenaria mercenaria (= Venus), the round, inflated introduced Atlantic quahog;

Protothaca tenerrima, flattened, with sharply ridged concentric rings, and inconspicuous beaks;

Protothaca staminea (= Venerupsis), (= Paphia), the rock cockle, with fine radiating ribs and weak concentric ridges, a crenulated inner margin and entirely fused siphons; (neither of the *Protothacae* has anterior lateral teeth),

Tapes japonica, the introduced Japanese cockle, with strong radial ribs and a prominent ligament,
elongate oval shell and, like *Transennella*, a purple stain in the interior,

Saxidomus nuttalli and *Saxidomus giganteus*, the Washington clams, are ovate, with heavy concentric rings and a pronounced gape to the valves; both have anterior lateral teeth. *S. nuttalli* has an interior marked with purple, but is rare as far north as Oregon.

Two small venerid clams are quite close to *Transennella*:

Gemma gemma, the small (about 2.5 mm) purple-marked Atlantic bivalve, can be common in bay mud. It is triangular, and no longer than high; its left hinge lacks the characteristic anterior lateral tooth of *Transennella*; its ventral margin is finely crenulate, not smooth; its pallial sinus is bent sharply upward, not rounded and angled anteriorly. Like *Transennella*, it has 3 cardinal teeth in each valve. *Gemma* often has *Enteromorpha* attached to its posterior; it can be found in the same habitat as *Transennella* (Puget Sound) but in California (Tomales Bay) it occupies a different niche (Norchi 1971).

Psephidia, the pebble shell, is a subtidal inflated venerid clam of the same size and same general appearance as *Transennella*. It has three cardinal hinge teeth, but no anterior lateral teeth in either valve, as *Transennella* does. Its beak is more prominent than *Transennella*'s, and its internal ventral margin, under magnification, is finely crenulated. It can be white or olive, but has no purple posterior third. There are two species, *P. ovalis* and *P. lordi*.

Mysella (= *Rochefortia*) is a small white clam with the beaks near the anterior end, and no cardinal teeth. It is found in Puget Sound, but has not been reported from Oregon.

Current confusion exists about the two species of *Transennella* (Coan and Carlton 1975). *T. tantilla* has purple markings, an eroded beak, clearly marked concentric lines on its shell. Its hinge plate is wide, its anterior tooth well-developed. It has split siphons (for 1/s their length), with flexible tentacles (9-12 on the excurrent, 10-14 on the incurrent siphon).

*Transennella*____________, the other species, is all white, without purple on the posterior, with only an occasional brown slot anterior to its beaks (Marelli); the beaks are prominent, not eroded; the shell sculpture is faint, of numerous fine lines. The hinge plate is narrow, the anterior tooth thin and lamellar. This species has siphons fused for almost their whole length, short stiff siphon tentacles, with 10-14 tentacles on the excurrent siphon, 11-16 on the incurrent one (Maurer 1967b). The two species some-times occur together.

Ecological Information

Range—Sitka, Alaska, to Lower California (Oldroyd 1924).

Local Distribution—Coos Bay: South Slough channel edge (Coastal Acres).

Habitat—sand or sandy mud in protected bays this specimen in clean sand at channel edge (Smith and Carlton 1975); often in other shells, where it attaches by its byssal threads. (Presence of byssus may limit its ability to spread geographically"). Also found in eelgrass roots (*Zostera, Phyllospadix*) (Obreski 1968), and in firm mud, or sandy gravel (Smith 1960). Nearly always in top cm of substrate (Smith 1960). Can tolerate turbidity, remain shut for long periods to avoid deleterious effects of some substrates, *ie*. clay, or simply ingest clay and process through its system (Maurer 1967b)

Salinity—full seawater, collected at 30 ‰ salt.

Temperature—cold to temperate waters, as indicated by geographical range.

Tidal Level—low intertidal as well as offshore down to 35 m (Keen and Coan 1974).

Associates—*Macoma inquinata*. Heavily infested by trematode *Telolecithus pugetensis*, for which it is the first intermediary and sometimes the second intermediary host. *T. tantilla* ingests trematode eggs, which as sporocysts destroy much of its visceral mass and gonads; infected adult then becomes sterile Tomales Bay (DeMartini and Pratt 1964): infested by trematode *Parvaterma* (Obreski 1968).

Quantitative Information

Weight—mean dry weight of largest-sized individuals: 30.2 mg (Pamatmat 1966). Weight can be determined by length of clam. log weight (mgs) = -0.85598+3.09033 log length (mm) (ibid).

Abundance—densest at mean lower low water in troughs between sandbars. where they are one of the numerically dominant animals (Puget Sound) (ibid). Density 1500-2500/mm^2 (South Slough, Coos Bay) (Asson, pers com.).

Life History Information

Reproduction—protandrous hermaphrodite. viviparous. Broods young within shelf. eggs and young of all stages can be found in adult brood chamber between inner gill and body walla nearly all large clams (which are mostly female) will have young at all times of year. No clear spawning period, but young leave mother only in summer. Among smallest clams, males and females are found in equal numbers (Hansen 1953). Fecundity affected by sterilizing effect of trematode sporocysts (DeMartini and Pratt 1964).

Growth Rate—to 4 mm in four months From 2.6 mg (van.) to 30 mg (Sept.): total weight gain/animal 0.953 mg/mo (Hansen 1953, Pamatmat 1966). Ripe egg diameter 0.25 mm; oldest stage of young, 0.65 mm (Hansen 1953); smallest adults with eggs, 3.2 mm (Pamatmat 1966).
Longevity—probably a little over one year (Hansen 1953).
Food—a suspension feeder on small particles, without special adaptations (Norchi 1971); not a deposit feeder. Diatoms *Navicula bidulphia*, *Coscinodiscus*, as well as *Nitzschia* and *Melosira* (Maurer 1967b). Probably feeds at night (Obreski 1968).
Predators—fish. *Cymatogaster* (surf perch) is the host to the adult trematodes (DeMartini and Pratt 1964), also shorebirds, some gastropods (Obreski 1968).
Behavior—can bury itself in less than a minute if disturbed (Norchi 1971): but is on or near surface when feeding.

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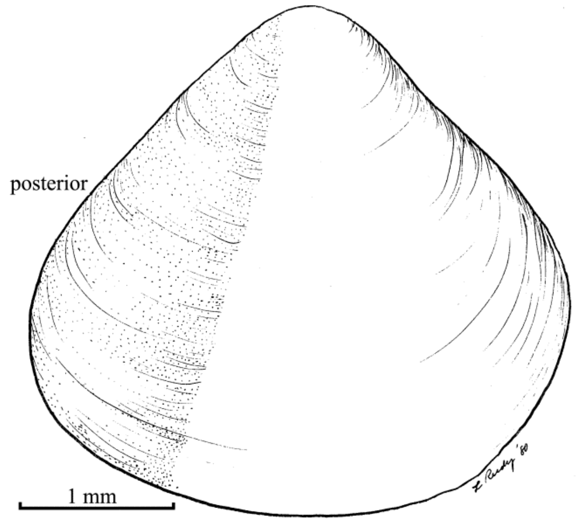
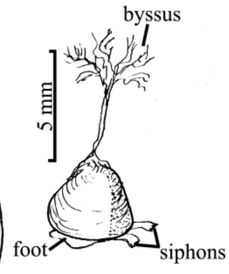
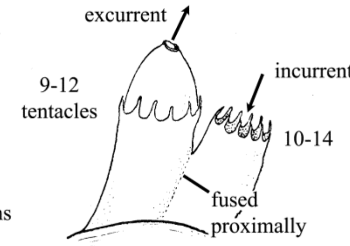
Nutricola tantilla



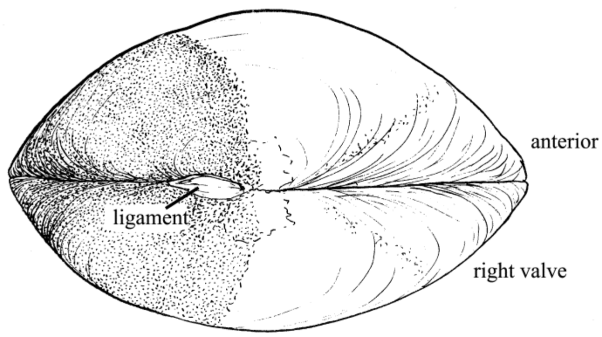


1a. Live clam x4

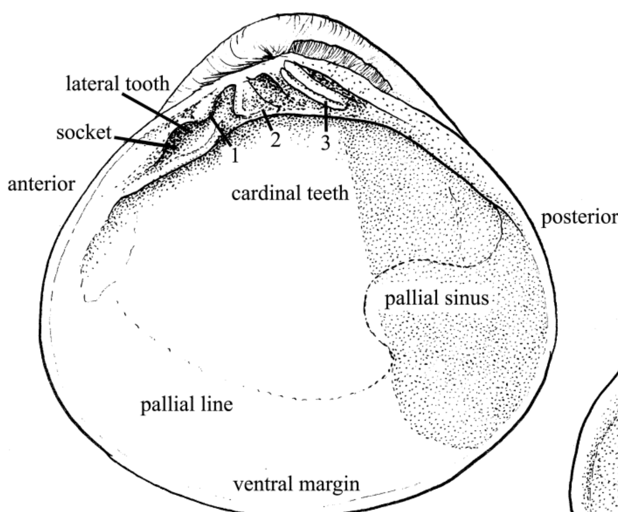


1b. Siphons

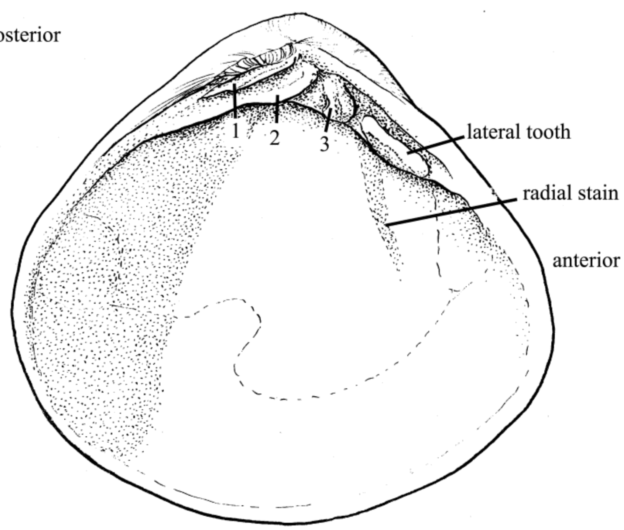
1. *Nutricola tantilla*, right valve (L:3.5mm, D:1.6mm, H:3.0mm) x28: shell solid, triangular; posterior third purple; fine concentric sculpture; no periostracum



2. Exterior (dorsal view): valves equal; beaks almost central; ligament external; no gape to valves.



3. Interior, right valve: three divergent cardinal teeth, one anterior lateral tooth, socket; pallial sinus rounded; purple stain posteriorly; smooth ventral margin.



4. Interior, left valve: three cardinal teeth, one anterior lateral tooth; anterior radial purple stain..

Onchidoris bilamellata *(=fusca)*

Many-gilled onchidoris nudibranch (Linnaeus, 1767)

Phylum: Mollusca
Class: Gastropoda, Opisthobranchia
Order: Nudibranchia
Family: Onchidoridae

Description

Size—usual length 15 mm (McDonald 1980); this specimen 15.5 mm long, 11 mm wide, 6 rnm high. Far northern and Atlantic specimens can reach 30 mm length (Marcus 1961).
Color—translucent brownish-white with irregular dark or rusty brown splotches, sometimes as irregular longitudinal stripes. Commonly a light spot between the dark rhinophores; gills dull white, underside a dull white. "No yellow pigment," but some specimens without brown color (Kozloff 1974a).
Body Shape—doridiform: oval; generally large, with a broad flat foot, thick fleshy mantle and conspicuous double circlet of ills dorsally (figs. 1, 2). Dorsum covered with many large round oapiilae, becoming smaller at edges. Surface firm. No large processes except rhinophores, gills, papillae.
Rhinophores—a single pair, perfoliate: genus *Onchidoris* (fig. 1). Rhinophores not especially long.
Gills—16-32 (or more: 36 this specimen); uniplnnate, almost erect branchial plumes arranged in two semicircles just anterior to anus: species *bilamellata* (McDonald and Nybakken 1978). Gills not completely retractible (Kozloff 1974a) (fig, 1).
Labial Tentacles—none; fused as an oral veil.
Papillae—mushroom-shaped, with protruding spicules (fig. 3).
Eggs—type A (Hurst 1967): a short, stout spiral ribbon attached along one edge (O'Donoghue and O'Donoghue 1922) (fig. 5); Capsules of 1-3 eggs, ribbons of 6,000 eggs (average).
Veliger—shell average iength 146.9 x 95 (Hurst 1967) (fig. 6).

Possible Misidentifications

There are other oval dorid nudibranchs of the same general coloration and shape as *Onchidoris: Discocordis, Anisodoris, Archidoris,* and especially *Acanthodoris brunnea* are all found in our area. None of these has 16-32 single, branchial plumes arranged in the unusual two semicircles. *Acanthodoris brunnea* can be distinguished immediately; by its very long rhinophores and conical papillae (not round ones), and by its but 7 branchial gills.

A pulmonate, resembling a small shell-less limpet, is colored quite like *Onchidoris*: it is *Onchidella borealis*. Close inspection reveals it to have stalked eyes, and only 20-24 papillae dorsally (Morris et al. 1980).

Ecological Information

Range—Aleutian Islands south to Morro Bay, California (McDonald 1980).
Local Distribution—Coos Bay: Pigeon Point.

Habitat—usually found with barnacle *Balanus*; at Pigeon Point on and under rocks; mudflats.
Salinity—collected at 30 ‰ salt.
Temperature—
Tidal Level—intertidal to 250 m (McDonald 1980); collected at mid-intertidal.
Associates—*Balanus*, chiton *Mopalia*, crabs *Hemigrapsus*, *Cancer oregonensis*, gastropods *Tegula*, *Nucella*, sea star *Pisaster ochraceus*, anthozoans *Anthopleura elegantissima*, *A. artemisia,* isopod *Idotea P. wosnesenskii*.

Quantitative Information

Weight—wet: 0.7 gr.
Abundance—"frequent" (McDonald 1980); seasonally common.

Life History Information

Reproduction—hermaphroditic but not self-fertilizing; internal fertilization. Eggs laid in ribbons during February-March, and October-December (Puget Sound) (Hurst 1967); May to mid-June: British Columbia (O'Donoghue and O'Donoghue 1922).
Growth Rate—
Longevity—most opisthobranchs live less than a year (Morris et al. 1980).
Food—barnacles, mostly *Balanus* (McDonald 1980).
Predators—many opisthobranchs are toxic or bad-tasting; predators are mostly other nudibranchs (Morris et al. 1980).
Behavior—

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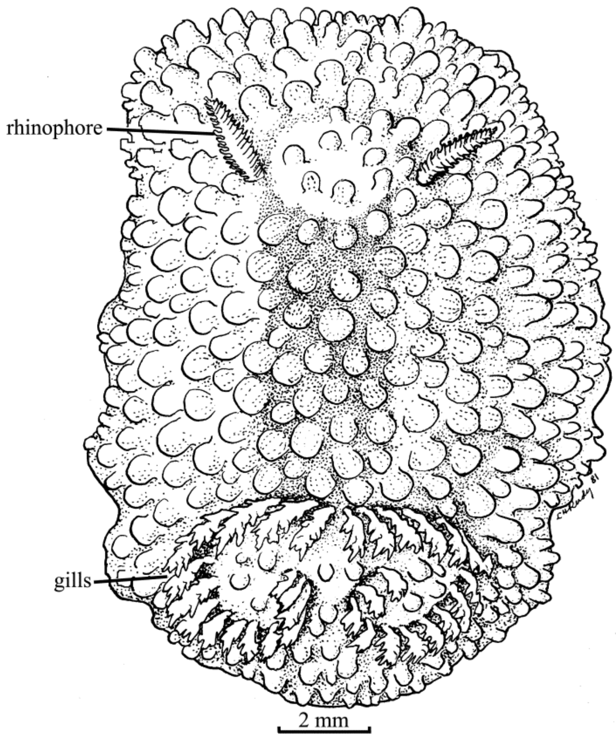
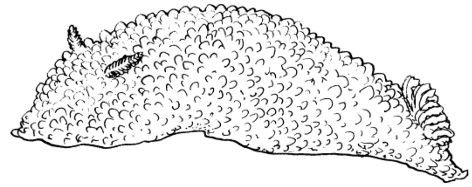
Onchidoris bilamellata



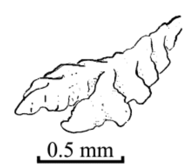
1. *Onchidoris bilamellata* (dorsal view) x8:
   actual lenth 15.5 mm; solid oval, dorid nudibranch; covered with round papilla; posterior double circle of 16-32 or more gills; bilamellate rhinophores.

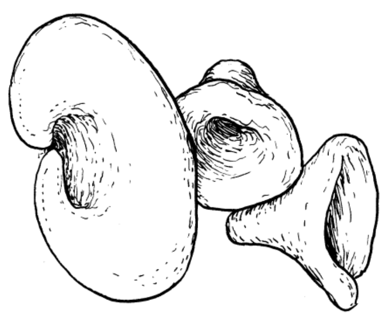


2. *O. bilamellata* (lateral view) x5

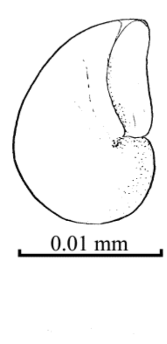
3. Single papilla x40:
   spicules protrude.

4. Single branchial plume x30:
   unipinnate gill.





5. Egg ribbon x2
   (O'Donoghue & O'Donoghue, 1922).



6. Veliger x250
   (Hurst, 1967).

Penitella penita (=*Pholadidea penita*)

Common piddock (Conrad, 1837)

Phylum: Mollusca
Class: Bivalvia, Heterodonta
Order: Myoida, Pholadina
Family: Pholadidae, Martesinnae

Description

Size—to 95 mm long; 50 mm high (Turner 1955). This specimen 40 rnm long, 18 mm high (fig. 1).
Color—white, inside and out.
Shell Shape—elongate, divided into two distinct parts:

- **Anterior**—rounded, bulbous, rasp-like radial and concentric striae of heavy file-like dentic:uiations on the triangular rasping section which covets less than 1/2 valve area (fig. 1) (Kozloff 1974a).
- **Posterior—**wedge-shaped, with regular concentric striations only, end truncate. Gapes at end only, not to middle of shell: genus *Penitella* (Keen and Coan 1974).
- **Callum** (calcareous accessory plate)---present in adult at anterior end (fig. 1). Not present in young (fig. 5).
- **Umbones—**not prominent. Umbonal reflection (where urn-bones turn back, fig. 1): closely appresed for entire length (Coan and Carlton 1975).
- **Mesoplax**—small accessory plate on dorsal edge (fig. 2); (no accessory plates, i.e. protoplax. metaplax, hypoplax, present). Mesoplax pointed posteriorly, truncate anteriorly, with swept back lateral wings: species *penita* (Turner 1955).
- **Siphons**—long, white, retractible; tips marked with small red spots, but not solidly red-tipped smooth: without warts or orange chitinous patches. No pallets on siphon tips (as in boring mollusc *Bankia*). Incurrent siphons with 6 large, and several small branched cirri around aperture (Turner 1955).
- **Siphonoplax—**brown, membranous, heavy, flexible flaps, not lined with calcareous granules: species penita (Coan and Carlton 1975).
- **Periostracum—**none.
- **Interior**—divided into three areas by pallial lines. Pailial sinus posterior; large posterior muscle scar- Anterior muscle scar and accessory unusually dorsal (fig. 4); ventral muscle scar present as well.

- **Hinge Area**—no hinge teeth or ligament.
- **Apophysis** (myophore)—short. narrow, spoon-shaped structure it each valve, which serves as an extra muscle attachment for powerful grinding muscles (Keen 1971 (fig. 4); "weakly blade-like" (Turner 1955).
- **Body—**foot and mantle white (Turner 1955).
- **Young—**anterior end soft (without callum), while animal is burrowing. Exposed foot circular. developed as a suction disc (fig. 5).

Possible Misidentifications

There are other burrowing clams in our area, i.e. *Hiatella. Entodesma, Barnea*, *Petricola, Bankia*- None of them have distinct body areas or the bulbous, denticulated anterior of *Penitella.* A similar pholad is *Zirfaea pilsbryi* (subfamily *Pholadinae*) a very large piddock to 150 mm; whose most noticeable characteristic is its lack of a callum protecting the anterior end; (it bores even as an adult). *Zirfaea* has very long, nonretractible siphons (and no siphonoplax), a posterior gape which extends to the middle of the animal; a broad apophysis, and a rasping surface which covers half the valve area (Kozloff 1974a).

Other northeastern Pacific Pholadidae include:

Netastoma rostrata (subfamily Jouannetiinae), a short, anteriorly truncate species without an internal apophysis, and with a tubular, calcareous siphonoplax. Its callum is only a fluted band, not a round enclosing plate.

Chaceia ovoidea (= *Pholadidea*) which bores into shale, has non-retractible siphons with orange chitinous patches and warty tips. It is oval, not elongate, and its callum does not completely cover the anterior aperture (Coan and Carlton 1975).

Paraphoias californica has no siphonoplax, and is divided in-to three well-marked regions, not two as is Penitella. It has two dorsal plates, a mesoplax and a metaplax, not one; it can bore into hard rock.

Three other species of Penitella can be present:

Penitella conradi is usually found in *Mytilus* or abalone (*Haliotis*) shells. It is very small, to 33 mm, its siphonoplax is lined with coarse calcareous granules and its mesoplax is truncate posteriorly, pointed anteriorly (the reverse of *P. penita*, see fig. 2). The mesoplax is large: almost equal in area to the rasping surface (Kozloff 1974a).

Penitella gabbi can be found with *P. penita*, but is much less common (Coan and Carlton 1975). It is a cleancut, oval shell with a creamy-lemon siphon," covered with warts. It has no siphonoplax; its callum extends very little beyond the beak, and the umbonal reflection is not attached anteriorly. *P. gabbi* can be up to 75 mm long and often has a gray-brown periostracum posteriorly (Quayle 1970).

A very closely related species, *Penitella turnerae*, was described from Coos Bay in 1966 (Evans and Fisher 1966).This is a much larger species than *P. penita*, (to 125 mm, Fossil Point, Coos Bay), stout and lacking a siphonoplax. Its siphons are white, long and red-tipped. Its mesoplax is reduced to a narrow crescent, rounded posteriorly and not sharply pointed as in *P. penita*.

Ecological Information

Range—Gulf of Alaska to Pta. Pequena, Baja California ; type locality San Diego. Calif (Turner 1955).

Local Distribution—Coos Bay, Pigeon Point, Fossil Point, Coos Head; Yaquina Bay, Netarts (Turner 1955).

Habitat—bores into mud and rock; burrows at least 3 x valve length. Prefers northeast surfaces, where algae and light are least (much like barnacles): also on cement jetties: an important animal in erosion and concrete destruction.

Salinity—collected at 30 ‰.

Temperature—geographical distribution is in cold to temperate waters.

Tidal Level—intertidal and subtidal (Evans 1967): found as high as 0.6 m (Coos Bay) (Evans 1968a); broad distribution vertically. Found as low as 91 m (Kofoid et al 1927).

Associates—other nestling and burrowing invertebrates; i.e. polychaetes *Thelepus, Halosydna, clams Hiatella, Entodesma, Zirfaea* (Coos Bay).

Life History Information

Reproduction—dioecious, oviparous; sexual maturity postponed until growth stops (Evans 1970).

Growth Rate—average time to maturity-33 months (Evans 1968b). Unusual in having determinate growth: at about 3 years metamorphoses into non-boring adult (about 55 mm long). Crowding may induce early metamorphosis (Evans 1968). Animals mature at smaller size in soft rock than in hard rock

Longevity—lives until burrow erodes enough to make it subject to predators (i.e. less than 3 x valve length); erosion rate varies with rock hardness: at Fossil Point, erosion process takes about 6 years.

Food—a suspension feeder, using long siphons to feed.

Predators—flatworms *Stylochoplana, Notoplana inquieta*. Worm enters the shell and eats the flesh, laying its eggs there (Evans 1967).

Behavior—pholads are the most efficient of the seven families of rock-boring bivalves (Evans 1968a). Boring is mechanical, not chemical, and in this species is done only by the young animal, after which it metamorphoses into a non-boring adult. Grinding assisted by keeping algae out of burrow with sea water, by loosening rock grains, and by ciliary currents which flush out cavity (Keen 1971). Makes cone-shaped burrow (Evans and Fisher 1966).

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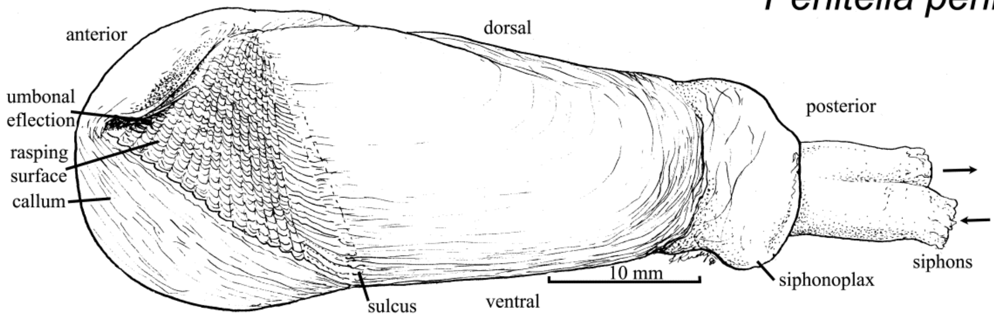
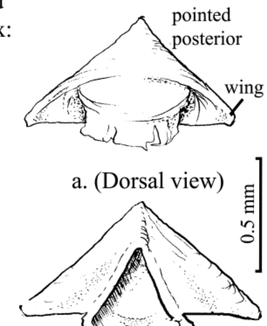
Penitella penita



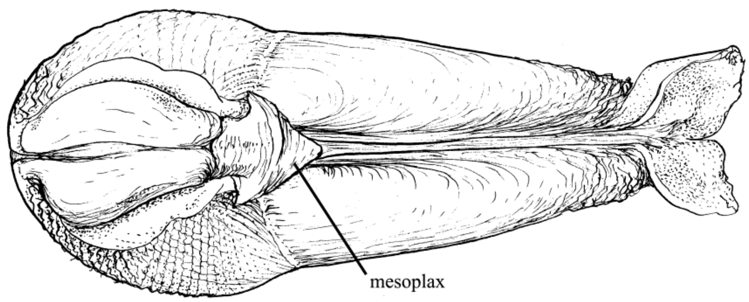
1. *Penitella penita* (L:40mm,W:18mm) x3: elongate shell divided into two distinct parts by umbonal-ventral sulcus; bulbous anterior with callum and rasping surface, posterior with concentric striae, truncate end; siphonoplax: heavy, brown flaps; siphons long, white, smooth.

2. Mesoplax x4.5

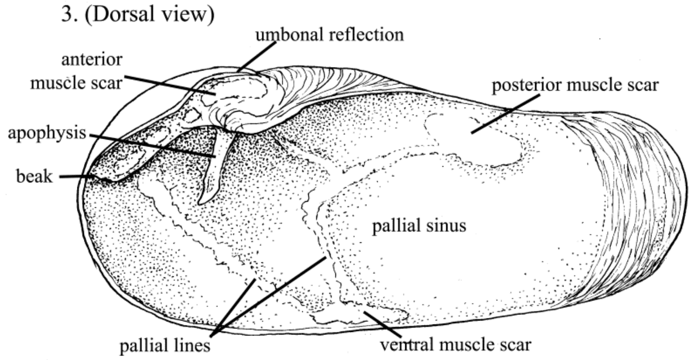


a. (Dorsal view)

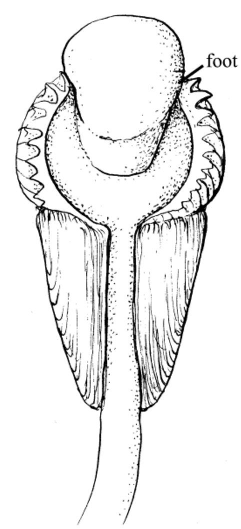
b. (Ventral view)



3. (Dorsal view)



4. Interior, right valve: white; divided into three sections by two pallial lines; three muscle scars; apophysis: long, spoon-shaped.



5. Young (dorsal view) x3: no callum: foot exposed.

Protothaca staminea

Phylum: Mollusca
Class: Bivalva; Heterodonta
Order: Veneroida
Family: Veneridae

Rock cockle, littleneck, or hardshell clam (Conrad, 1937)

(=*Vererupsis staminea, =Paphia staminea*); var. *ruderata* (Deshayes) and *orbella* (Carpenter)

Description

Size—2-75 mm; average 25-50 mm (1-2 inches). **Color**—variable; young with brown markings, adults uniform brown, pinkish, orange; interior white.
Exterior—shell suboval, heavy; fine, numerous radiating ribs as well as concentric ridges. Radial ribs are stronger in "nestling" forms, ie. those found in pholad borings (Coan and Carlton 1975), different shell shapes in different localities (Fraser and Smith 1928).
Interior—porcelaneous; ventral margin with fine crenulate sculpture (fig. 2); muscle scars almost equal, pallial line broken by deep pallial sinus (fig. 2); siphons short, fused.
Hinge Area—three compressed cardinal teeth, no lateral teeth; ligament external on nymph (projection); hinge plate wide, set at angle, (fig. 2).

Possible Misidentifications

A closely related Venerid*, Tapes japonica* (fig. la), has been introduced from Japan, and is common in mud of bays (Coan and Carlton 1975). It is elongate, oval, and has a prominently elevated ligament. Its radial ribs are quite strong and its color pattern distinctive. Its internal ventral margin is smooth, not crenulate, and its pallial sinus only moderately deep. Its internal color is yellowish with a purple stain. It lives at slightly higher elevations than does *Protothaca*. Tapes can grow to 50 mm long; it may hybridize with Protothaca (Washington) (Morris et al. 1980).

Other bay clams of the same size and habitat as *Protothaca* do not have both the radial and concentric sculpture which it has.

Ecological Information

Range—Aleutian Islands to Socorro Islands, Mexico (all varieties); north of San Francisco only: var. ruderata (on beaches), and orbella (in pholad borings).

Distribution—common in most of the larger Northwest estuaries and bays, and around rocky ocean outcrops.
Habitat—likes coarse sand; also found in fine gravel or with mud, stones or shell (Kozloff 1974a); seldom found in fine, pure sand (Fraser and Smith 1928). Sub-species *orbella* found in boring holes of pholad clams. As it is a poor digger, *Protothaca* does not do well in shifting sand, but prefers packed mud, clayey gravel (Ricketts and Calvin 1971). Usually found 3-8 cm below surface.
Salinity—collected at 30 ‰.
Tidal Level—from below half tide to lowest tideline (Puget Sound) (Kozloff 1974a); found 2.5-15 cm (1-6 inches) below surface of mud or sand': also found subtidally (Hancock et al. 1979).
Associates—often found with the cockle, *Clinocardium nuttallii*, and particularly with the butter clam, *Saxidomus giganteus*; a resident larval tapeworm is harmless to man (Morris et al. 1980); often bored by drilling gastropods.

Quantitative Information

Abundance—common; most abundant clam of the lower intertidal in Puget Sound (Kozloff 1974a). Coos Bay, 1975: estimate, 843,000 (genus); 32.6 metric tons (Hancock et al. 1979); Yaquina, 1977: 197 clams, 49 pounds. Also common in Tillamook Bay. Density light in Alsea, Siuslaw, Netarts (Hancock et al. 1979).

Life History Information

Reproduction—dioecious (separate sexes); some hermaphrodism occurs (Fraser and Smith 1928); probably half begin spawning their second year; eggs and sperm released February, March (Puget Sound); clams were in poor condition during this period (Fraser and Smith 1928).

Growth Rate—determined by examination of "rings" caused by winter "checks" or disturbance checks; different growth rates in different localities; often slow in early years on exposed beaches, due to movement, storms, etc.; and grow more quickly in later years. Reverse can be true in protected sites. Size at end of second year: 25 mm; end of third year: 35 mm (Fraser and Smith 1928).

Longevity—a few over seven years (Schmidt and Warme 1969); death rate greatest before sexual maturity (60%), and in old age (Schmidt and Warme 1969); few clams over ten years (Fraser and Smith 1928).

Food—a suspension feeder; short siphons necessitate feeding close to sediment surface.

Predators—birds, man, drilling gastropods. As larvae, preyed upon by planktonic predators and other suspension feeders.

Behavior—a poor digger, it does not burrow vertically; siphons and foot short: it stays close to surface of substrate Burrows easily horizontally: especially (in lab) small adults. juveniles (communication H. Van Veldhuizen).

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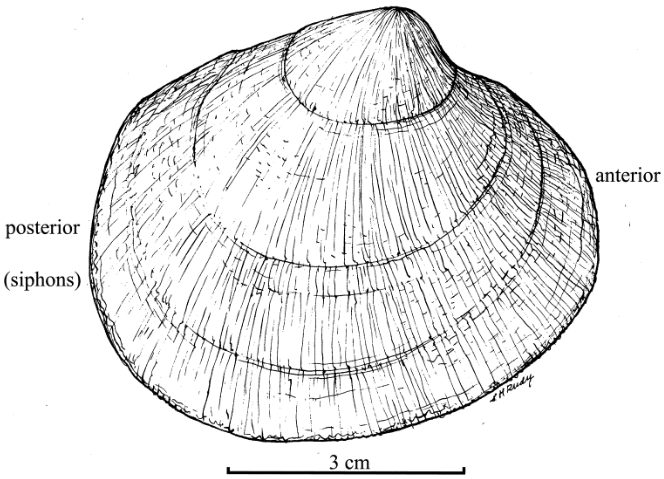
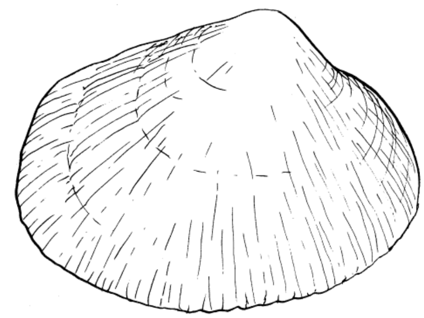
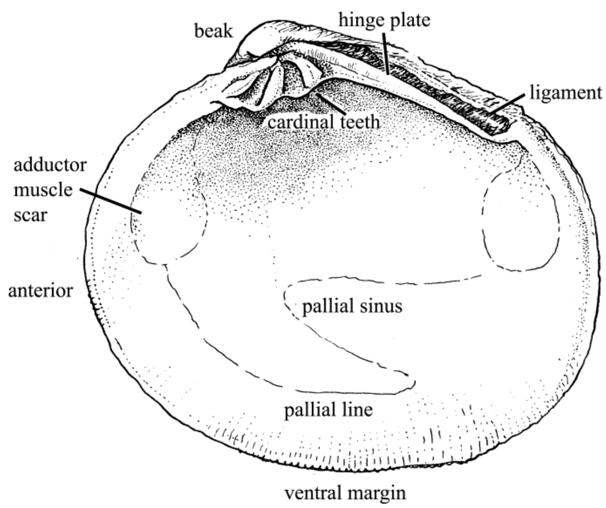
Protothaca staminea



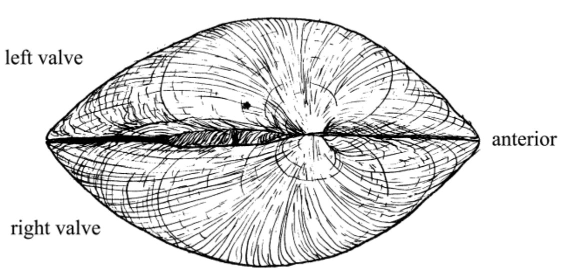
1. *Protothaca staminea*, exterior, right valve x1.5: many fine radiating ribs; concentric ridges also; shell suboval, heavy; posterior rounded.



1a. *Tapes japonica* x1.5: introduced clam; elongate, strong radial ribs.



2. Interior, right valve: chalky, parcelaneous; ventral margin crenulate; muscle scars subequal; pallial sinus deep; hinge plate angled, ligamental external, on nymph; three cardinal teeth, no lateral teeth.



3. (Dorsal view)

Saxidomus giganteus

Beefsteak clam, butter, or Washington clam (Deshayes,1839)

Phylum: Mollusca
Class: Bivalvia; Heterodonta
Order: Veneroida
Family: Veneridae

Description

Size—adults average 3 inches, can be 4 (10 cm).
Color—whitish; can have blackish discoloration; interior white; exterior sometimes tan, particularly young specimens.
Exterior—shell oval (Coan and Carlton 1975), posterior truncate (Keen and Coan 1974); concentric, rough ribs close together, no radial lines (fig. 1); valves gape only slightly at posterior end (gape less than 1/4 shell width) (Kozloff 1974a); can retract siphon, but not foots; valves very similar; shell thick, heavy: deep (fig. 2).
Interior—valves similar: inner ventral margin smooth (Keen and Coan 1974), inner surface white "porcelaneous"; with subequal darker muscle scars. Pallial line continuous, not a series of scars (Kozloff 1974a), (but broken by a sinus), fig. 3. Flesh often red: "beefsteak" clam.
Hinge—very heavy, posterior, external.
Ligament—external, seated on a long, massive nymph (or chondrophore) (fig. 4).
Teeth—three cardinal hinge teeth, flanked by long lateral tooth in each valve (fig. 4).

Possible Misidentifications

Saxidomus nuttalli, the larger, more southern species, is found in California in the same habitat as *S. giganteus*, but apparently does not extend into Oregon. (*S. nuttalli* is the only *Saxidomus* in Humboldt Bay, however.) Its shell is more elongate, the ribs heavier, rougher and more conspicuous (Coan and Carlton 1975); the interior is often marked posteriorly with purple. There are no other large ovate bivalves here with concentric ribs and without radial ribs.

Panopea generosa, the deep-burrowing geoduck, is quadrate, and gapes widely. *Tresus capax*, the gaper clam, (family Mactridae), is also quadrate, fairly smooth and chalky white outside. The truncated posterior gapes moderately. Its ligament is partly internal; its cardinal teeth are "A" shaped; the shell has a dark, eroded partial covering.

Ecological Information

Range—Aleutians to Monterey, California; but rare in the southern range.
Distribution—bays and estuaries, rarely on open coast or inlets with oceanic influence (Packard 1918).
Habitat—mud or sand (Coan and Carlton 1975); gravelly beaches (Puget Sound) (Kozloff 1974a); cigar-shaped or deflated figure eight-shaped hole, 1/2-3/4 inch long (Jacobson 1975) (1.2-2 cm).
Temperature—prefers colder waters (see range).
Tidal Level—can be found down to 30 cm, (about 12 inches) from surface, but frequently closer to surface (Kozloff 1974a).
Associates—occasionally infested wan Immature specimens of commensal pea crab *Pinnixa littoralis*; but usually free of parasites (Ricketts and Calvin 1971).

Quantitative Information

Abundance—the most abundant clam on suitable beaches of the Northwest" (Ricketts and Calvin 1971); exploited commercially (Puget Sound) (Kozloff 1974a).

Life History Information

Reproduction—pelagic larvae distributed by tidal currents much variation in spawning times, even in neighboring beds spawning water temperatures: 11.5°C-18°C: two weeks to veliger stage, four weeks to settle (Fraser and Smith 1928). Spawning in late summer. tali (Puget Sound) (Fraser 1929).
Growth Rate—little growth in young after settling, until following spring (Fraser and Smith 1928).
Longevity—lives to 20 years or more (Morris et al. 1980).
Food—feeds by straining material from the current of water that they pump through the gills: filter feeder.

Predators—sting rays, man, fishes, shore birds, drilling snails. Gulls will scavenge discards. Most important food clam in British Columbia (Morris et al. 1980).

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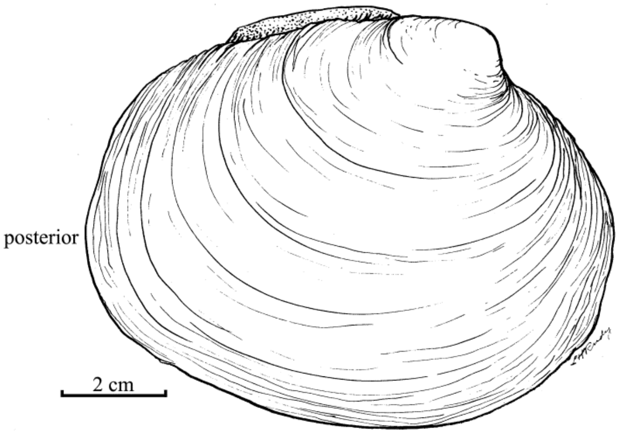
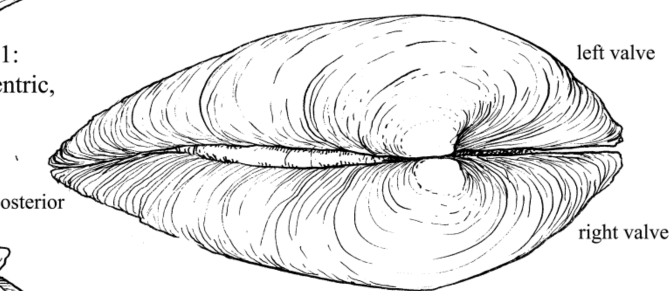
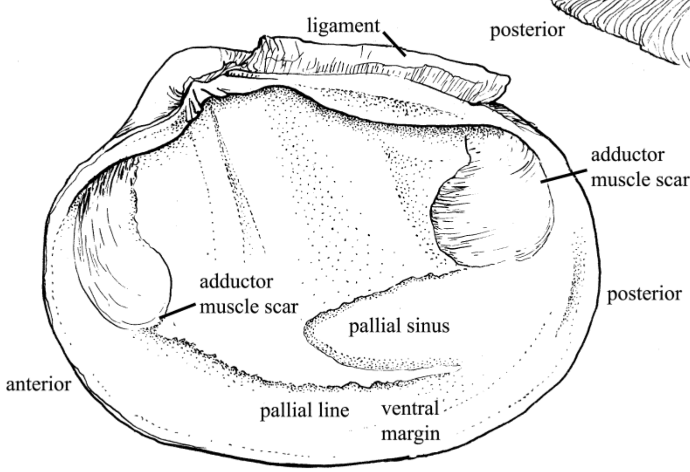
Saxidomus giganteus



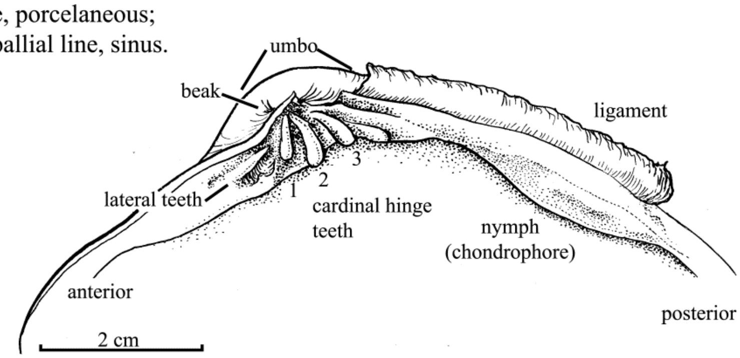
1. *Saxidomus giganteus*, exterior, right valve x1: shell whitish, oval; posterior truncate; concentric, rough ribs close together; valves similar, thick, heavy.



2. Exterior (dorsal view): valves similar, deep; hinge heavy, ligament external.



3. Interior, right valve: margin smooth, surface white, porcelaneous; muscle scars similar; strong pallial line, sinus.



4. Interior, right valve (dorsal region) x1.5: three cardinal hinge teeth; ligament seated on nymph; long lateral teeth.

Siliqua patula

The flat razor clam (Dixon, 1789)

Phylum: Mollusca
Class: Bivalvia; Heterodonta
Order: Veneroida
Family: Solenidae

Description

Size—to 150 mm (5 ¾”) (Morris et al. 1980); average size 41/2 x 2'1; adults over 40 mm (Coan and Carlton 1975).
Color—periostracum smooth, brown, shiny, lacquerlike. Exterior white, obscurely rayed, with faint violet coloration; interior white, tinged with violet and pink.
Shell Shape—"smooth within and without” (Dixon 1789); elongate, rather cylindrical; length about 2 1/2 times width. Valves similar, gaping at both ends. Beaks toward anterior end. family Solenidae (Coan and Carlton 1975), (beaks in Siliqua sp. are subcentral; toward the anterior, but not close to its). Posterior end round, shell very thin, sharp edged, profile thin (fig. 4).
Hinge Area—left valve with two cardinal and two lateral teeth; right valve with one cardinal and one lateral tooth (fig. 2); a vertical or radial rib projects downward and anteriorly from hinge in both valves: genus *Siliqua* (Keen and Coan 1974) (fig. 2).
Ligament—external, not on nymph (fig. 2).
Animal—siphons short, fused except at very tips (fig. 4); exhalant and inhalant openings ringed by tentacles.
Young—oval outline until about 2.5 mm long (Pohlo 1963): (with central beak, not elongate).

Possible Misidentifications

Solenidae are cylindrical, about 2 1/2 times as long as high, and gape at both ends. One other local giitilut.t has beaks quite near the anterior end, not subcentrally in Siliqua: *Solen* sp. have an almost straight dorsal margin, a terminal beak, and one cardinal tooth in each valve (Keen 1971). Solen sicarius, the blunt razor shell, is found occasionally in permanent burrows in mud or muddy sand, ie both intertiaally and sub-tidally (Kozloff 1974a). It is the species most likely. to be confused with *Siliqua patula*. It lacks *Silqua*'s interior vertical rib and multiple hinge teeth, and is 4 times as long as wide, not 21/2 times. (Keen and Coan 1974)

One other species of *Siliqua* is found farther south (to Monterey Bay): *Siliqua lucida*, a small (to 40 mm) razor clam, lives in protected bay sands, has a truncate posterior end, a vertical internal radial rib and concentric brown bands on its exterior. Old bookslist *S. patula* variation nuttalli, with a more oval shape, purple beaks and four hinge teeth in the left valve, not two (Oldroyd 1924).

There are other razor-shaped clams besides the Solenidae. The Mytiiidae (mussels) include some genera, Adula for instance, which are long and cylindrical. Adula is usually a boring species, however; it has a hairy posterodorsal slope (Coan and Carlton 1975), a very small anterior adductor scar, and no hinge teeth. (Keen and Coan 1974) Hiatellidae, including the geoduck, Panope, are large, quad-rate, gaping bivalves, without hinge teeth, and with nearly equal adductor muscle scars (Keen and Coan 1974).

One long, cylindrical bivalve of the family Psammobiidae, Tagelus californianus, the jackknife clam, could be confused with Siliqua. It too has nearly central beaks, is about 21/2 times as long as wide, and gapes at both ends. It never has the internal strengthening rib of Siliqua, however, and its ligament is seated on a nymph or projection (as in Protothaca staminea, see plate). Tagelus is gray, has no lateral teeth, and has short siphons (Coan and Carlton 1975). It is found below Humboldt Bay, California, in mudflats.

Ecological Information

Range—Aleutian Islands to Pismo Beach, California; but uncommon in California (Weymouth and Holmes et al 1931).
Local Distribution—Coos Bay: Pt. Adams spit near Bay mouth; usually on open coast.

Habitat—flat, open beaches with fine, clean sand; in strong surf zone with aeration (Anonymous 1968) No permanent burrow. Niche assumed farther south by the Pismo clam, Trivela stultorum (Ricketts and Calvin 1971).
Salinity—full seawater.
Temperature—lives in cold to temperate wsterc
Tidal Level—about - 1.0 ft. and lower (Kozloff 1974a).
Associates—olive snail *Olivella biplicata*, caprellid amphipods, polychaetes, including *Ophelia*. Commensal nemertean *Malacobdella grossa* occurs in up to 80% of the clams (fig. 1a).

Quantitative Information

Abundance—can be very abundant in certain local areas; populations move and fluctuate, due partly to storms, surf. Once harvested commercially along northwest coasts. Unrestricted digging severely harmed populations (Weymouth and McMillin 1931): down-ward trend began around 1925. Densest near mean low water (Anonymous 1968). 1976 Oregon total harvest 2,211,000 clams (Link 1977).

Life History Information

Reproduction—high fecundity, high mortality (Anonymous 1968). Separate sexes; eggs and sperm discharged into sea, fertilization by chance; 6-10 million eggs can be produced by a female. Spawning activated by minimum water temperature of 13°C (Fraser 1936). 86% of third year clams (10 cm long) mature or maturing (Queen Charlotte Island) (Fraser 1936). Mass spawning late May or June (Washington): occasionally huge sets of young. Larval stage 8 weeks; larvae free swimming but stay close to sand. After metamorphosis, size of wheat grain or smaller; to 1.5 cm by end of growing season (December, Washington) (Anonymous 1968).
Growth Rate—3½ years to legal size of 4 1/2" (11.5 cm) (Washington), where animals grow rapidly, do not reach a large final size or live as long as they do in Alaska (Weymouth and Holmes 1925). Growth rate slows after 10 cm size reached (Weymouth and Holmes et al 1925); growing seasons show as wide brown areas between rings, which are annual. Mortality in young probably 99%; greatest losses from storm movement (Anonymous 1968).
Longevity—
Food—a filter feeder of planktonic diatoms.
Predators—man probably the most highly prized food mollusk in the northwest; seagulls, ducks, perch, crab (Anonymous 1968).
Behavior—known for its quick, efficient digging ability: it can bury itself in less than 7 seconds, and moves especially rapidly in the second or "slosh" layer of sand (Anonymous 1968). Digging accomplished by ability of the anchor-shaped foot to change shape. Extra-ordinary muscle capacity and the displacement of body fluids are responsible for this (Pohlo 1963). Digging is vertical, sometimes angled toward the sea; very little horizontal movement.

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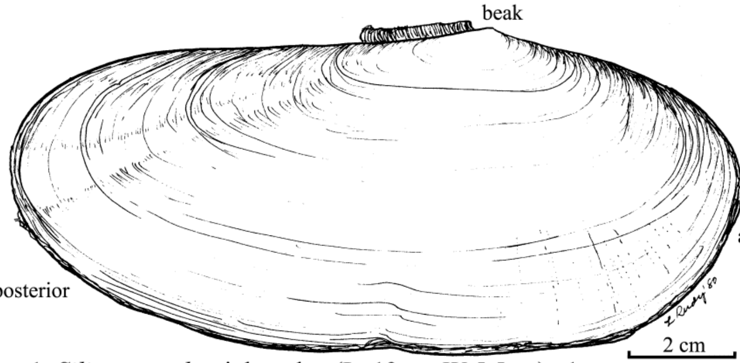
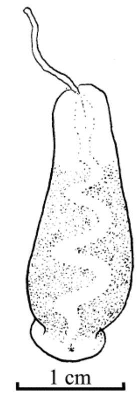
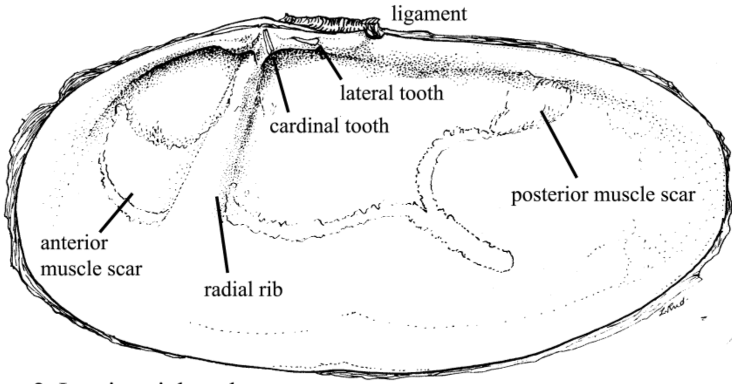
Siliqua patula



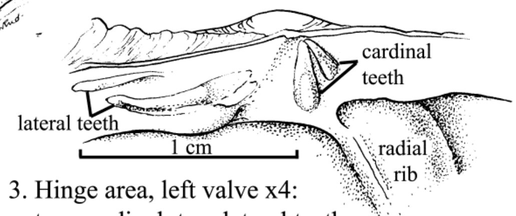
1. *Siliqua patula*, right valve (L: 13cm, W:5.5cm) x1:
length 2.5x width; shell cylindrical, shiny, brown; beaks subcentral, slightly anterior; posterior rounded.



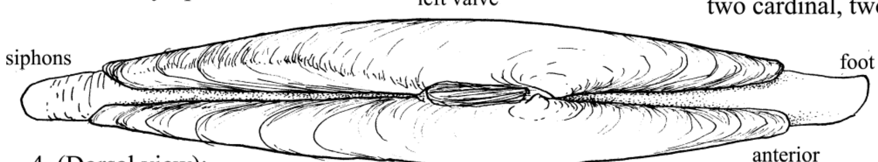
1a. *Malacobdella grossa* x2:
actural size 2.5 cm, commensal nemertean (Smith & Carlton, 1975).



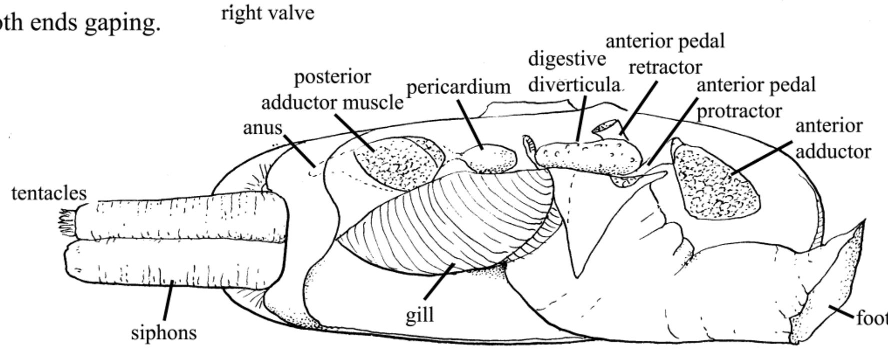
2. Interior, right valve:
one cardinal tooth, one lateral tooth; prominent radial rib; ligament external, not on nymph.



3. Hinge area, left valve x4:
two cardinal, two lateral teeth.



4. (Dorsal view):
profile thin; both ends gaping.



5. Dissection, right valve removed
(Pohlo, 1963)

Solen sicarius

The sickle razor clam, or blunt jacknife clam (Gould, 1850)

Phylum: Mollusca
Class: Bivalvia
Subclass: Heterodonta
Order: Veneroida
Family: Solenidae

Description

Size—to 125 mm (Morris et al 1980); this specimen (Coos Bay) 90 mm (3 ½") - same as type (Oldroyd 1924).
Color—shell very white, but covered with yellow green, glossy periostracum. (Periostracum present: family Solenidae (Quayle 1970))
Shell Shape—cylindrical: solen = channel pipe (Quayle 1970). Length about 4 x width; gaping at both ends (Coan and Carlton 1975). Shell thin, valves moderately inflated, beaks near anterior end, very weak (figs. 1, 4). Dorsal margin straight or slightly concave, not arched: genus *Solen* (Keen and Coan 1974) (fig. 1). Ventral margin arched (Oldroyd 1924); anterior edge truncate, posterior rounded.
Shell Interior—Adductor scars at opposite ends of shell; anterior scar enlongate, posterior scar oblong (Oldroyd 1924). Pallial sinus shallow (Coan and Carlton 1975); pallial line extends beyond anterior adductor scar; line is a strong rib in this specimen. No strong radial rib as in some Solenidae (fig. 2).
Hinge Area—Beaks at anterior end: genus *Solen* (Keen 1971). One cardinal tooth in each valve. Teeth "single, erect, recurved, triangular" (Oldroyd 1924).
Beaks—terminal, anterior end (figs 1, 2, 4).
Ligament—long, external, not seated on nymph (figs. 2, 4).
Animal—long dark, finger-like; end swells to form an anchor. Mantle fused along entire ventral margin (keeps out foreign material, restricts foot movement to anterior-posterior axis (Pohlo 1963)). Siphons joined (fig. 4a). Can be automatized if disturbed, and lost (i.e. *Solen rosaceous* (Pohlo 1963); authors have found *S. sicarius* in Coos Bay to lose siphon when disturbed, as well).
Burrow—permanent, vertical, 30-35 cm deep (Morris et al 1980).

Possible Misidentifications

The Solenidae are cylindrical, vary from 2 ½ to 4 x longer than wide, and gape at both ends. (The California jacknife clam, *Tagelus,* has central beaks - family Psammobidae.) There are 3 eastern Pacific genera of Solenidae. Of these, *Ensis* is not reported north of Monterey, California. The other genus is *Siliqua (*see *S. patula*), the flat razor clam, only 2 ½ x longer than wide. It has a strong radial rib in the interior, and 2 or more teeth in each valve. Its beak is almost central, not terminal as in *Solen*. Its profile is much more oval, and not as cylindrical as in *Solen.*

One other species of *Solen* occurs as far north as Humboldt Bay (Morris et al 1980): *Solen rosaceous* Carpenter, is as its name suggests, a pink shelled clam. It is smaller, straighter and more southern than S. *sicarius.* Its siphons are annulated (and it can regenerate them when disturbed (Pohlo 1963)). It lives in sandier situations than does *S. sicarius* (Coan and Carlton 1975).

Ecological Information

Range—Vancouver Island, B.C., to San Quintin Bay, Baja California.
Local Distribution—Coos Bay: Charleston mudflats.
Habitat—in permanent vertical burrow, protected areas of bays, in mud or muddy sand (Coan and Carlton 1975). Around eelgrass (Zostera) roots, in firm sediments (Ricketts and Calvin 1971).
Salinity—collected at 30‰ (Coos Bay)
Temperature—lives in cold to warmer temperate waters
Tidal Level—intertidal down to 75m^2. Coos Bay: intertidal.
Associates—pea crabs (Quayle 1970).

Quantitative Information

Weight—

Abundance—not common; becoming more abundant, Coos Bay.

Life History Information

Reproduction—
Growth Rate—
Longevity—
Food—a suspension feeder.
Predators—birds
Behavior—a good digger, it can bury itself in 30 seconds, and can both swim and jump (MacGinities 1935).

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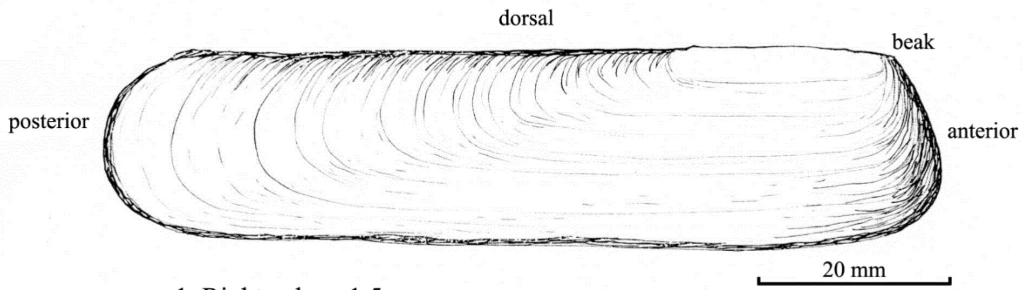
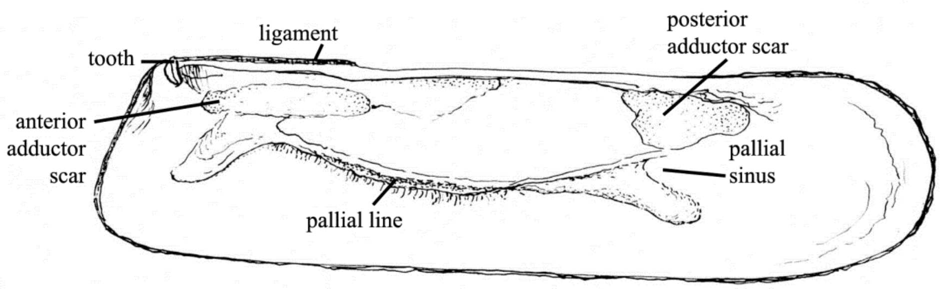
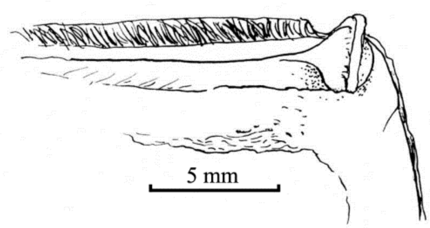
Solen sicarius



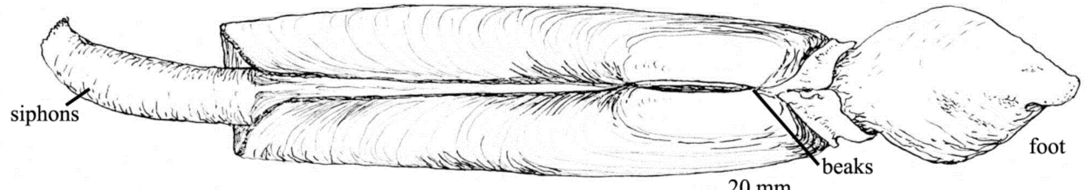
1. Right valve x1.5:
shell cylindrical; dorsal margin straight, anterior edge truncate; length 4x width; beaks terminal, very weak; shell white, periostracum yellow green, glossy.



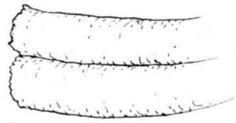
2. Right valve, internal:
adductor scars at opposite ends of shell; pallial line a strong edge; no radial rib.



3. Hinge area, left valve x4:
a large single tooth (each valve).



4. Dorsal view x1.5



4a. Siphons (lateral view)

Zirfaea pilsbryi (= *Z. gabbi*)

The rough piddock (Lowe, 1931)

Phylum: Mollusca
Class: Bivalvia; Heterodonta
Order: Myoida, Pholadina
Family: Pholadidae, Martesiinae

Description

Size—to 115 mm (41/2 ")(Ricketts and Calvin 1971); largest of the boring clams; to 150 mm (6") in hard clay (Keep 1911). Coos Bay (Fossil Point) specimens 75-125 mm (3-5 ").

Color—white exterior and interior. (Interior can be light salmon) (Turner 1954). Siphons gray-white to ivory, speckled with very swat (1.5-2 rnm) orange chitinous spots; dark red around siphonal openings and incurrent cirri. Foot and mantle Ivory (preserved) (Turner 1954).

Shell Shape—hard, solid, elongate, oval, not globose. Shells gape at both ends. Valves divided into two regions:

Anterior—triangular with rough file-like radial and concentric denticulations which can project Into spines on anterior margin (fig. 1). Rasping portion covers half total valve area (Kozloff 1974a). No callum (calcareous anterior accessory plate, see *Penitella*); only protective membrane. Umbonal reflection wide, attached for less than Y3 length: species *Zirfaea* (Evans and Fisher 1966). Anterior ventral edge of valve strongly angled (fig. 1).

Posterior—with concentric striations only: rounded to truncate (fig. 1). Gapes to the middle of the shell (Keen and Coan 1974).

Umbonal Ventral Sulcus—groove separating anterior and posterior sections of valve; conspicuous in juveniles, almost disappearing near ventral margin in older specimens (Kennedy 1974). (fig. 1)

Mesoplax—small accessory dorsal plate: only one present in this species. Weak and reduced (Evans and Fisher 1966); with transverse basal flange well-developed in juvenile (fig. 4a), becoming less obvious in adult (fig. 4b). (Mesoplax often lost in collecting).

Siphons—fused, very long (6-8 x shell length): species *Zirfaea*. Siphons non-retractible; covered with small chitinous discs, but without papillae or pustules. No siphonoplax (flaps around siphon, see *Penitella*). Periostracum extends from over 1/3 shell posterior to cover part of siphons (Quayle 1974).

Interior—strong muscle scars: no hinge or ligament: family Pholadidae (Quayle 1974). Pallial sinus broad and deep, nearly to urnbo (fig. 3).

Apophysis (Myophore)—broad, with rounded spoon-shaped end (fig. 3).

Body—foot round, truncate (Turner 1954).

Possible Misidentifications

There are several burrowing clams; the Pholadidae can be distinguished by their distinctively marked body areas. The genus closest to *Zirfaea*, and most likely to be confused with it, is *Penitella*. *Penitella*'s valves are also divided into two distinct sections; it differs in having a calcareous anterior callum, or accessory plate (in the adult); a posterior which gapes only at the end, not to the middle of the shell (it has no anterior gape); the apophysis is narrow, not broad. No *Penitella* species has a siphon longer than its body (Evans and Fisher 1966); all *Penitella* species have retract-able siphons. There are four species of *Penitella* in our area:

Penitella conradi is very small and is found in *Mytilus* or *Haliotus* (abalone) shells; it has a siphonoplax lined with coarse granules (*Zirfaea* has no siphonoplax) (Evans and Fisher 1966).

Penitella gabbi is also small (up to 75 mm) with a warty, creamy-lemon colored siphon; it is not common.

Penitella penita, the common piddock, has a heavy membraneous siphonoplax, a calcified callum and a distinctive mesoplax. Its anterior rasping surface covers less than half the valve area (Kozloff 1974a). It can be up to 70 mm long.

Penitella turnerae is larger than *P. penita* (to 125 mm), and less common. It is stout, and like *Zirfaea* lacks a siphonoplax. It has a distinctive, rounded mesoplax, however, and its long, white, retractable siphons are tipped with solid red. Like *Zirfaea*, it has a strongly angled anterior ventral edge; unlike *Zirfaea*, *P. turnerae* has a callum.

With adult specimens, it should be easy to tell *Zirfaea* from *Penitella* by its long, non-retractable siphon and by the membraneous covering of the anterior, instead of a calcareous callum. Small shells without the callum could be young *Penitella* as well as mature *Zirfaea*: size at maturity varies greatly with environmental condition.

Zirfaea crispata is a small Atlantic species without chitinous spots on the siphons. It may have been introduced into Humboldt Bay, California with eastern oyster spat Crassostrea (Turner 1954).

Ecological Information

Range—Eastern Pacific: Bering Sea to San Diego, California; holotype: Bolinas Bay, California (Turner 1954).Genus: Colder waters of northern hemisphere (*ibid*).

Local Distribution—Coos Bay: South Slough, Fossil Point, Tiilamook Bay, Netarts Bay, Yaquina Bay (Turner 1954), Siuslaw River (Hancock et al 1979),

Habitat—bores into shale, clay, sand or mud, as soft rock, to depth of 10-14" (Turner 1954). Found mostly in estuaries, not often on open coasts where soft substrates do not survive'. does riot fit tightly into burrow as do some pholads (Evans and Fisher 1966).

Salinity—

Temperature—cold to temperate waters.

Tidal Level—intertidal to keep water (Quayle 1974).

Associates—other nestling and burrowing clams: *Penitella*, *Hiatella, Entodesma, Adula*, etc. Pea crab *Opisthopus*, flat-worm *Cryptophallus magnus* (MacGinitie 1935).

Quantitative Information

Weight—

Abundance—can be quite dense in locally suitable conditions; third most abundant pholad at Fossil Point, Coos Bay, after *P. penita*, *P. gabbi* (Evans and Fisher 1966).

Life History Information

Reproduction—spawning (southern California) July (MacGinitie 1935).

Growth Rate—animals grow throughout life, unlike *Penitella* etc.

Longevity-7-8 years (MacGinitie and MacGinitie 1947).

Food—a suspension feeder.

Predators—flatworms.

Behavior—burrowing achieved by attaching food by suction, rotating shells 1/32 circumference of burrow, reattaching foot and scraping again. *Zirfaea* is unusual in pholads for its indeterminate growth: it grows and burrows during its entire lifetime (MacGinitie 1935). Makes pear- rather than cone-shaped burrow (Evans and Fisher 1966).

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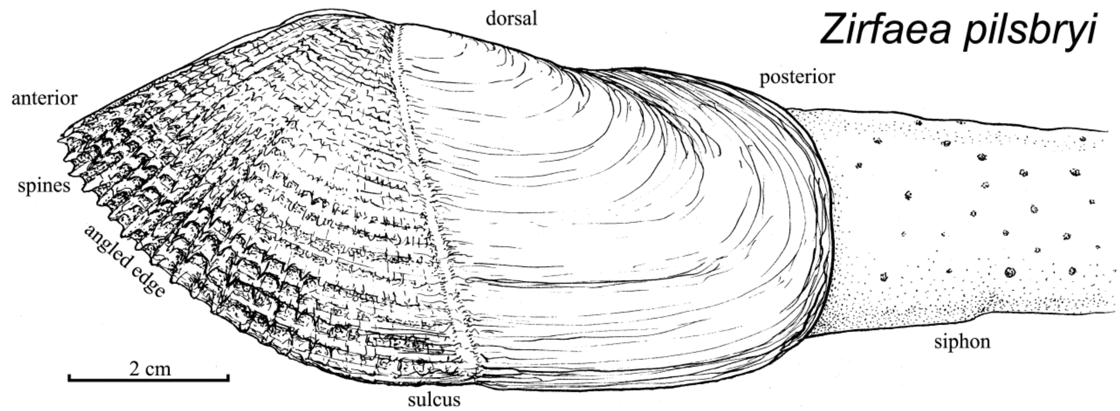
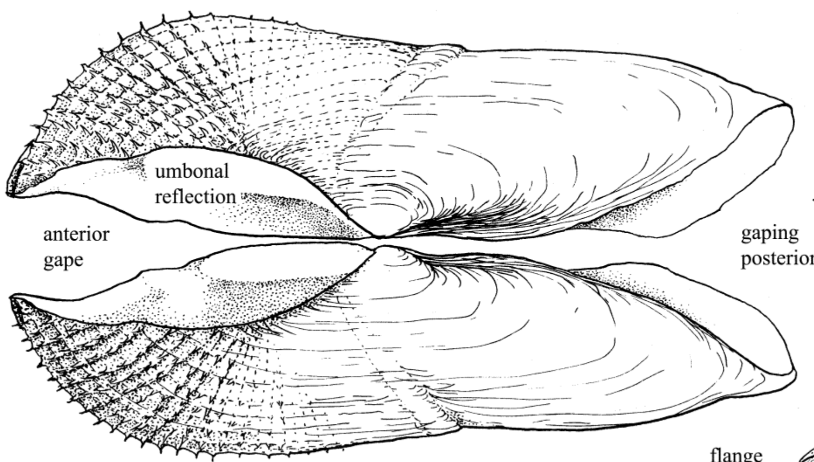
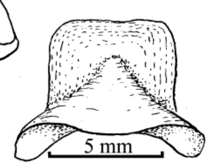
Zirfaea pilsbryi



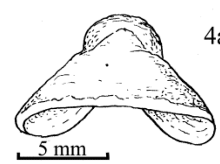
1. *Zirfaea pilsbryi* (L:93mm) x1.5:
elongate shell divided by umbonal ventral sulcus into anterior: triangular rasping surface, spined angled edge without callum; posterior truncate, with concentric striations only; siphons long, not retractible, with small chitinous patches.



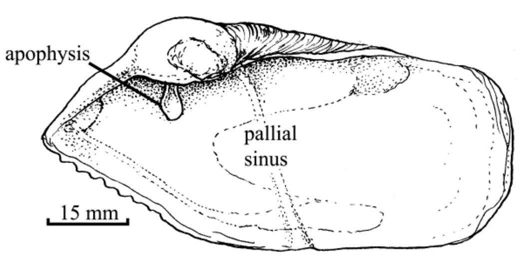
2. (Dorsal view)



4a. Mesoplax, juvenile x5.5:
strong, transverse basal flange.



4b. Mesoplax, adult x3.5:
flange obscure (Turner, 1954).



3. Interior, right valve x1:
pallial sinus broad, deep;
apophysis spoon-shaped.

Pisaster brevispinus

The pink, short-spined sea star (Stimpson, 1857)

Phylum: Echinodermata
Class: Asteroidea
Order: Forcipulata
Family: Asteriidae

Description

Size—one of the largest asteroids: to 320 mm diameter (2 ft.) (Hyman 1955); this specimen (Coos Bay) 190 mm diameter.
Color—always pink. Keys sometimes indicate mottling with gray-green or maroon-purple; Oregon specimens are pink.
Surface Pattern—spines do not usually form reticuiated pattern or crescentic arcs; there is at least one straight row of spires down each arm (fig. 1). Spines occur singly or in small groups of twos and threes or more, separated by areas of soft tissue: the spines in the center of the disc do not form a distinct star (fig. 1). Body is firm, not weak and flabby.
Spines-Dorsal Surface: short ("brevi-"), single or in groups of up to five on single plates, surrounded by areas of soft tissue (Smith and Carlton 1975) (fig. 3); large spines are often shaped like onion domes; a straight middorsal row (or rows) of spines down mid-die of each arm; species *brevispinus* (fig. 1).
Spines-Ventral (Oral) Surface: four rows of flattened (elliptical) blunt spines with small clustered pedicellariae at their bases, and one row of long thin spine-like adambulacral spines (fig. 4). A few clusters of pedicellariae occur at the bases of these spines, but there are no pedicellariae on the spines (Fisher 1930).
Central Disc—large, raised, but not set off from arms as in class Ophiuroidea (brittle stars); contains madreporite (fig. 1). Spines in disc center do not form a star.
Rays (Arms)—five, unless damaged. Tapering, broadest where they join disc. Not broad enough to give webbed appearance.
Ambulacral Grooves—long furrows on oral surface of arms, which contain tube feet; class Asteroidea (fig. 4). Adambulacral spines line the groove.
Pedicellariae—stalked or sessile appendages with pincers, used for cleansing surface of invaders. Two-jawed in Forcipulata.

- **Dorsal (Aboral) Surface**—very small pedicellariae cluster around spines (fig. 3); no large sessile pedicellariae visible;
-
- **Ventral (Oral) Surface**: two types: (1) small. clustered around bases of oral spines, and (2) a few strands of small clustered pedicellariae and large stalked pedicellariae on bases of adambulacral spines (fig. 4). No pedicellariae on the adambulacral spines: genus *Pisaster* (Fisher 1930, Hyman 1955).

Mouth—large, in center of ventral surface (fig. 2).
Madreporite—filter plate for water into the interior stone canal; raised, with channels, conspicuous on central disc (fig. 1).
Tube Feet—on ventral side; four rows, staggered down each ambulacral groove (fig. 4).

Possible Misidentifications

Pisaster brevispinus is readily identifiable by its pink coloration, its seemingly soft appearance, and its unusual (for sea stars) occurence on soft substrates.

There are other five-armed Asteriidae with thick, low papillate dorsal spines and pedicellariae:

Evasterias troscelli is slender like *P. brevispinus*, but is generally orange-red or blue-gray (Coos Bay), not pink. Its clusters of oral pedicellariae are on the adambulacral spines, not just at their bases as in *P. brevispinus* (fig. 4). Like *P. brevispinus*, it is subtidal (Ricketts and Calvin 1971). Its preferred range is Puget Sound, although it is known to northern California.

Orthasterias koehleri has large, sharp dorsal spines, each surrounded by a distinct ring of large *pedicellariae*. These spines are arranged in distinct radial rows. *Orthasterias* is often red with yellow mottling.

Two other species of *Pisaster* can be found:

Pisaster giganteus is bluish gray, with blunt, clubbed dorsal spines, each surrounded by a ring of blue flesh around which is a ring of pedicellariae. *P. giganteus* is a low intertidal sea star, and usually is more southern than Oregon. In spite of its name, it is smaller than *P. brevispinus* when fully grown.

Pisaster ochraceus is a common coastal sea star, and is only present in lower reaches of high salinity estuarine systems. It is red, brown, or ochre (juveniles are gray), never pink. It inhabits only hard substrates (rocks. pilings. etc.), not soft sand. The dorsal spines on *P. ochraceus* form reticulated patterns; the straight line(s) of spines down each arm typical of *P. brevispinus* are absent from *P. ochraceus*.

Fisher describes two forms of *P. brevispinus: P. b. brevispinus*, from Puget Sound to Crescent City with an abundance of abactinal (away from the mouth: dorsal) spines (Fisher 1930). These spines are in large groups, up to 8-10, and can form radial bands. *P. b. pacispinus* has few spines, standing singly or in 2s and 3s; the spines are usually stout with subconical acorn-shaped grooved tips; papulae (respiratory surfaces) are numerous and conspicuous in this form (fig. 3)

Ecological Information

Range—Sitka, Alaska, to Santa Barbara, California (Fisher 1930).
Local Distribution—typical form of offshore sand bottoms; also found in channel bottoms of large estuaries, i.e. Coos.
Habitat—only in quietest waters; also on wharf pilings, rocks; cannot tolerate exposure to air or to low salinities for long (Ricketts and Calvin 1971). Note: these sea stars are sometimes transported into harbors by fishermen cleaning their nets.
Salinity—collected at 30 ‰.
Temperature—found in cold to temperate waters.
Tidal Level—low intertidal to deep water: (many found at 60 fathoms, Monterey Bay, California) (ibid).
Associates—on low pilings: *Pisaster ochaceus*, anemone *Metridium*, tunicates, mussels, barnacles.

Quantitative Information

Weight—
Abundance—

Life History Information

Reproduction—reproductive cycle much like that of *P. ochraceus*. Separate sexes, breeding season January-May (Pacific Grove, California) (Farmanfarmaian et al. 1958); gonads ripe April. spawning soon after. Sexes indistinguishable during resting period.
Growth Rate—
Longevity—
Behavior—can apparently sense and dig out clams (*Saxidomus, Protothaca*) from gravel (Smith 1961). Sand dollars escape by quickly burying themselves when *P. brevispinus* appears (MacGinitie and MacGinitie 1949).

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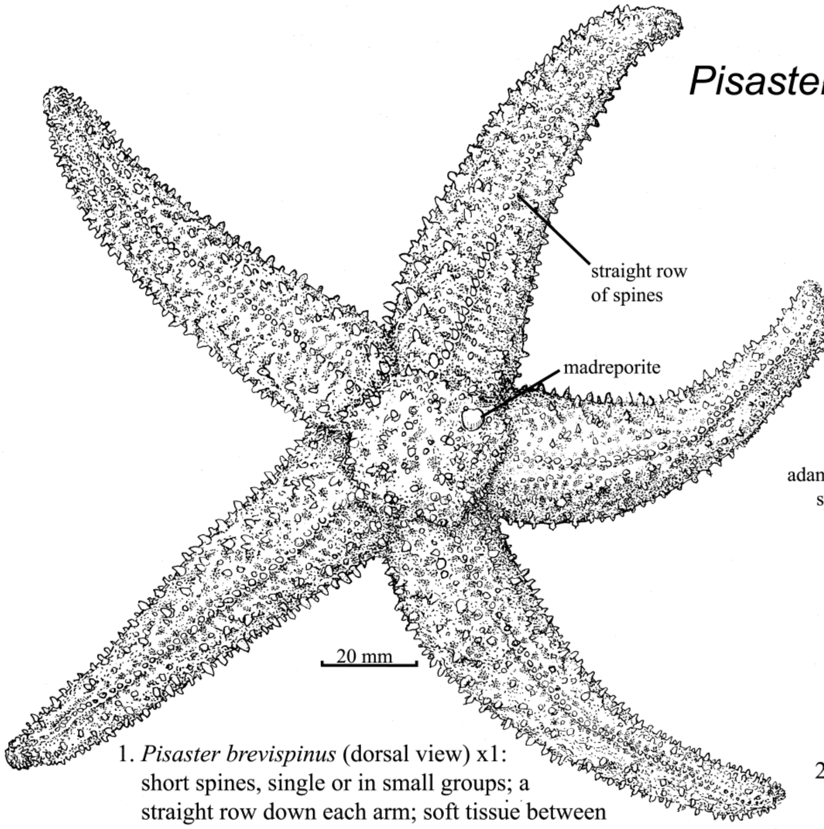
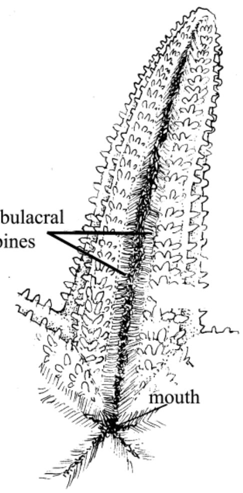
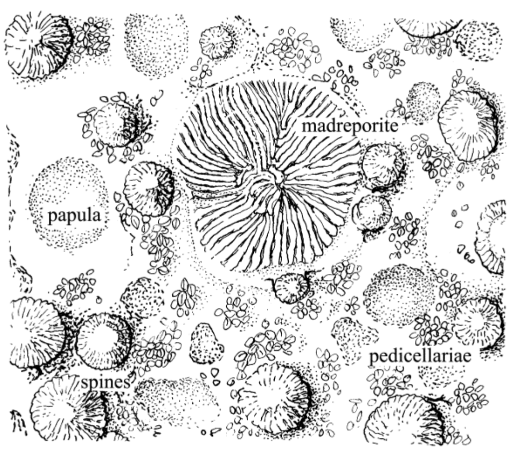
Pisaster brevispinus

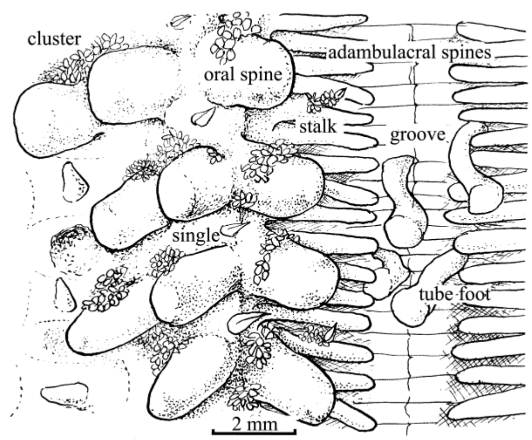




1. *Pisaster brevispinus* (dorsal view) x1:
short spines, single or in small groups; a straight row down each arm; soft tissue between spines; pink color; five tapering arms; large raised central disc.

2. One ray (ventral view) x1:
adambulacral groove with tube feet.





3. Dorsal spines, madreporite x8:
spines short, some "onion domes" or in small groups; rounded madreporite; pedicellariae small, clustered; dark papulae.

4. Ventral spines, groove x8:
oral spines blunt, eliptical; adambulacral spines along groove; pedicellariae clustered, single or stalked..

Pisaster ochraceus

Common Pacific sea star, ochre sea star (Brandt, 1835)

Phylum: Echinodermata
Class: Asteroidea
Order: Forcipulata
Family: Asteriidae

Description

Size—average (Monterey, California): 140 mm diameter, each ray (arm) 40 mm; width of ray base 40 mm (Fisher 1930). This specimen 150 mm diameter. Puget Sound, regularly 250 mm (Kozloff 1974a).
Color—aboral (dorsal) surface red, brown or ochre-the last especially on open coast; Puget Sound: purple; oral (ventral) surface ochre. Juveniles gray with brown aboral patches (Feder 1970).
Surface Pattern—lateral and dorsal spines form reticulated pattern; spines at arm tips form series of separate crescentic arcs (fig. 1): species *ochraceus* (Sutton 1975). No long straight rows of spines down arms. Dark centers of reticulated patterns are respiratory surfaces (papulae) (Roberts pers. comm.). Surface stiff, harsh (Kozloff 1974a).
Spines—dorsal: low, small, serrated, rounded, bead-like or papillate (figs. 1, 3); formed into crescentic arcs at arm tips. No straight middorsal row of arm spines. Spines in center of disc form a distinct star (fig. 1). Ventral: spines serrated, blunt and heavy, more spine-like than bead-like (fig. 4). Adambulacral spines: (lining odes of ambulacral grooves) articulated, long, thin (fig. 4).
Central Disc-large, convex, arched, not distinct as in Ophiuroidea (brittle stars); contains madreporite, anus. Diameter of disc less than 1/3, and more than 1/3 total diameter genus *Pisaster* (Kozloff 1974a).
Rays (Arms)—five, unless damaged; tapering, thick, large; not sharply demarcated from disc, but broadest where they join disc-Not broad enough to give a webbed appearance (Dyakonov 1950).
Ambulacral Grooves—long furrows on oral surface of arms, which contain tube feet; class Asteroidea (figs. 2, 4) (Boolootian 1966). Along each edge of groove are adambulacral spines intermixed with stalked clustered pedicellariae (fig. 4).
Pedicellariae—stalked or sessile appendages used for cleansing surface of invaders, *i.e.* barnacles larvae: two-jawed in *Pisaster* species

Ventral Surface: stalked, three types: (1) small, clustered around bases of oral spines (fig. 4); (2) small pedicellariae clustered on expandable strands between adambulacral spines (fig. 4); and (3) large pedicellariae on these same strands (fig. 4). There are no pedicellariae on the adambulacral spines: genus *Pisaster* (Fisher 1930, Hyman 1955).

Dorsal Surface: two types: (1) small, clustered around dorsal spines (but not in raised rings around them); and (2) a few solitary, large, sessile pedicellariae scattered over dorsal surface (fig. 3).

Mouth—large, in center of under or ventral side (fig. 2); *Pisaster* can extrude its stomach through this opening to engulf food.
Madreporite—(mad-rep-or-ite): a sieve-like structure which serves as the water intake into the stone canal (Roberts); conspicuous about 1/3 of radius from center of disc (fig. 1, between arms numbered 1 and 2).
Anus—inconspicuous, near center of aboral surface; probably not functional (Roberts); surrounded by small pedicellariae.
Tube Feet—for locomotion, and part of water vascular system; on ventral side in ambulacral grooves; staggered in pairs, four rows across down each ambulacral groove (fig. 4).

Possible Misidentifications

Among the large five-armed sea stars, *Pisaster* sp. are noted for their thick arms, low, papillate dorsal spines, and for their pedicellariae. Two other Asteriidae share these characteristics:

Evasterias troschelii is a rather rare, low intertidal species with a small disc and slender arms compared to Pisaster, and a varied, though generally oranged-red coloration (Sutton 1975). *Evasterias* has clusters of pedicellariae on its adambulacral spines, not just at their bases as in *Pisaster ochraceus*.

Orthasterias koehleri, another Asteriidae, has sharp dorsal spines, not blunt papillate ones; these spines are each surrounded by a distinct ring of large pedicellariae. *Orthasterias*' dorsal spines are arranged in distinct radial rows (those of *Pisaster* are not); *Orthasterias* is often red with yellow mottling; it occurs in the low intertidal and subtidally (Sutton 1975).

Two other species of *Pisaster* can be found: *Pisaster brevispinus* occurs not on rocks and pilings but on soft substrates, where it feeds on clams. Its aboral spines do not form reticulated patterns or arcs, but occur singly or in groups of 2 or 3, and are separated by areas of soft tissue. *P. brevispinus* appears to be weak; it is not. It has a straight, distinct row of middorsal spines on each arm. This sea star is nearly always pink: it can be mottled with gray-green or maroon-purple as well (Sutton 1975). It is one of the largest asteroids, growing to 320 mm (2 feet) in diameter (Hyman 1955).

Pisaster giganteus is bluish gray; its dorsal spines are blunt, clubbed, and each surrounded by a ring of blue flesh, and around that a ring of pedicellariae. It has tiny pedicellariae thickly scattered between the dense spines; its spines are not arranged in radial or concentric rows. *P. giganteus* is a low intertidal sea star usually found further south than Oregon. Despite its name, it is usually smaller than *P. ochraceus* (Ricketts and Calvin 1971).

Sea stars are extremely variable within species: Fisher listed three definite forms of *P. ochraceus* (Fisher 1930). Although these names are not used in systematics, it should be noted that the Puget Sound and Oregon outer coast variety of *P. ochraceus* has a flatter, smoother surface ornamentation than does our Oregon bay form (Roberts, pers comm.).

Ecological Information

Range—Sitka, Alaska south to near Pt. Concepcion, California (Ricketts and Calvin 1971).
Local Distribution—typical form of the open sea coast; in bays on jetties and pilings only in marine parts of large bays, i.e. Coos Bay.
Habitat—jetties, rocks, pilings, bay mussel beds: hard substrates. Larger individuals can stand exposure to air (Feder 1970).
Salinity—collected at 30 ‰ saltwater; cannot tolerate long-term reduced salinities.
Temperature—found in cold to temperate waters.
Tidal Level—a wide vertical distribution, being a hunter; intertidal to 3 meters deep (Monterey Bay) (Feder 1970). Large sea stars usually found at low tide mark in Puget Sound, probably for warmth: they do not move down in Monterey (ibid).
Associates—mussels, barnacles, limpets and other snails: its prey. Other inhabitants of the mussel bed can include polychaetes, anemones, nematodes, etc. Pilings in quiet waters: barnacles, anemone *Metridium senile*, tunicates (Ricketts and Calvin 1971).

Quantitative Information

Weight—(wet): range 37.8-834 gr. (28 animals) (Feder 1970).
Abundance—"the most conspicuous sea star of rocky inter-tidal areas" (Puget Sound) (Kozloff 1974a); the common predator of the lower *Mytilus* beds (Sutton 1975), where it is the most obvious member of the mussel community (Ricketts and Calvin 1971).

Life History Information

Reproduction—separate sexes (Fisher 1930); ten gonads like feathery tufts, two in each ray, next to disc. Definite spawning period: March to June (Feder 1956); eggs and sperm extruded from between rays and from dorsal surface into water. *Pisaster* does not brood its eggs or young as do some Asteriidae, i.e. *Lepasferias*(Sutton 1975). Embryos develop to swimming larvae, metamorphose and as new stars, measure less than 1 mm (Fisher 1930). Asexual regeneration of arms characteristic of the Asteroidea. (Regeneration of whole animal from an arm not possible without some of disc) (Fisher 1930).

Growth Rate—varies with food availability, roughness of waters, etc. With constant food supply, proper conditions, a sea star can feed continuously and increase its weight from 2 to 30 times in a year (Feder 1970). It can survive at least 20 months without feeding. Animal's size not related as much to age as to food availability. The more even conditions in a bay ensure greater opportunities for feeding than do open coast conditions (Feder 1970).
Longevity—
Food—favorite prey seems to by *Mytilus*, on which it grows fastest: also east barnacles, clams, crabs, chitons, eta: omnivorous.
Predators—seagulls (on adults); school children and thoughtless beachcombers.
Behavior—can right itself vigorously when oral surface is detached from substrate; can evert stomach to envelope prey. Some invertebrates, i.e. limpet *Collisella* can avoid *Pisaster* by a special escape mechanism (see *Collisella pelta*).

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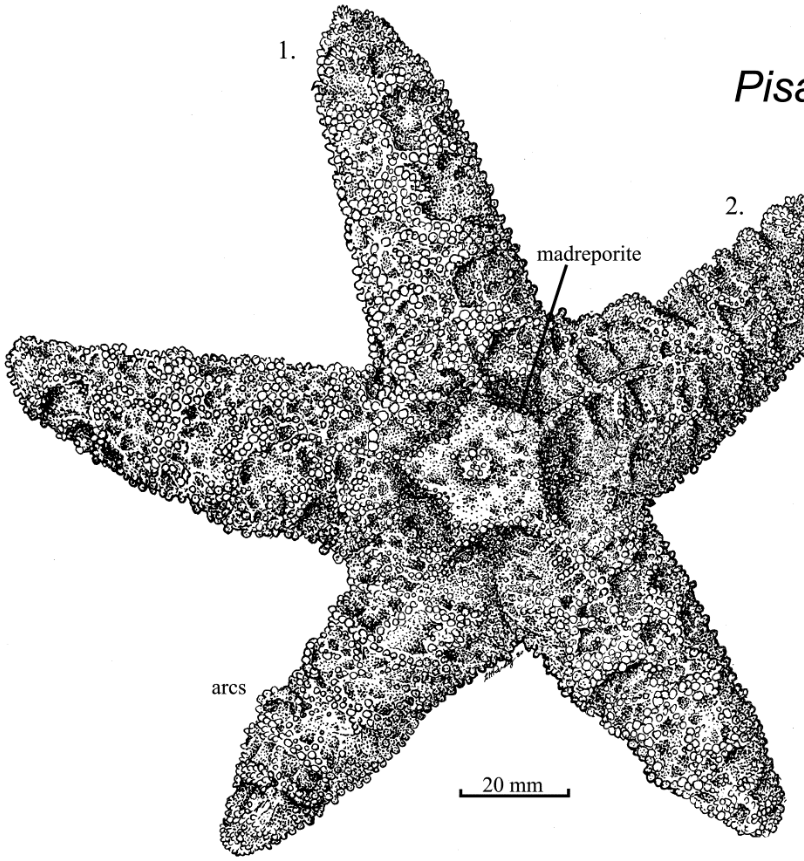
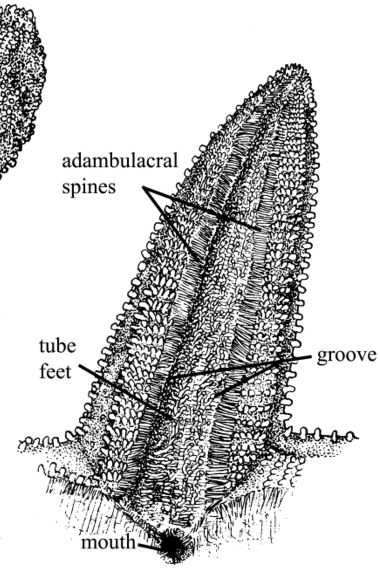
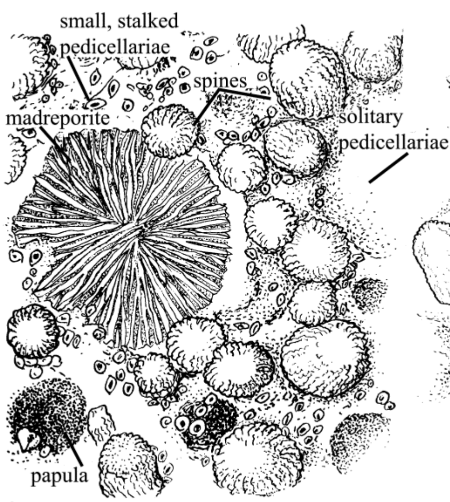
Pisaster ochraceus

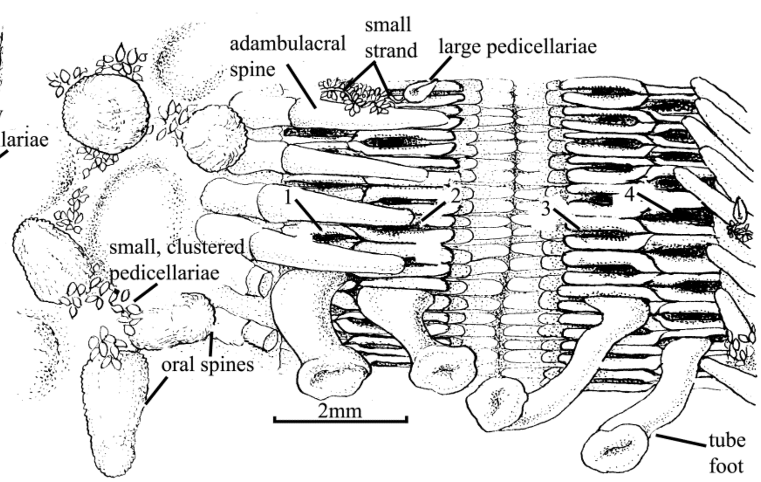




2. One ray (ventral view): ambulacral groove with tube feet; adambulacral spines.

1. *Pisaster ochraceus* (dorsal view) x1: stiff, harsh surface; reticulated pattern, spines in arcs; five thick, tapering arms; large arched central disc .





3. Madreporite, dorsl spines x12: madreporite large, flat, filter-like; dorsal spines short, rounded, bead-like; pedicellariae stalked, small, clustered; sessile, large, solitary.

4. Ambulacral groove (ventral view) x12: all tube feet removed except four, to show four rows across groove; adambulacral spines along groove; pedicellariae small, clustered on expandable strands with some large ones; small and clustered at bases of oral spines.

Phoronis pallida

Phylum: Phoronida
Family: Phoronidae

A lophophorate coelomate (Schneider, 1862; Silen, 1952)

Description

Size—one of the smaller phoronids: 15-30 mm long (Silen 1954): sp. *pallida.* Sand covered tube just a little larger (Silen 1952); expanded animal can be 25% longer than tube.
Color—trunk pale, white, posterior end light red. Internal organs visible as red (contain hemoglobin (Zimmer 1980). Tentacles white, without pigmented amoebocytes: sp. *pallida* (Silen 1954). Larva opaque yellow, tube yellow to brown-red (from secreted matter) (Silen 1954).
Trunk—wormlike: unsegmented, smooth and soft, but faintly annulated (Hyman 1959), no setae - all characteristic of phylum Phoronida. Can be faintly differentiated into several zones: sp. *pallida* (Silen 1954)*.* Trunk and whole tube curved toward anal side (Silen 1954) (fig. 6).
Lophophore—a horseshoe-shaped extension of the mesosome (Hyman 1959); includes mouth and consists of a crown of tentacles. Number of lophophore spirals, number of tentacles characteristic of sp *pallida* - a single row of 50-140 tentacles, in a simple spiral (Emig 1974)(fig. 3).
Tentacles—straight, finger-shaped: Phoronida (Zimmer 1980); not threadlike (fig. 2a). In *P. pallida* there can be 50-140, but usually around 50 (Zimmer 1980), sometimes more (S.F. Bay specimens). Tentacles can be regenerated (MacGinitie and MacGinitie 1949).
Anus—dorsal to mouth (Hyman 1969); digestive tract U-shaped (fig. 2).
Nephridiopores—lateral to anus (fig. 2): excretory and for emission of sex cells (Hyman 1959).
Collar—not present at base of lophophore: genus *Phoronis* (Zimmer 1975) (figs. 1, 2, 3). Lophophore base and trunk demarcation a slight groove; collar, (if present, as in genus *Phoronopsis),* extends all around trunk. (Do not confuse anus and nephridiopores on dorsal base of lophophore with a true collar.)
Bulb—(ampulla)-enlarged posterior end (fig. 1).
Internal Structure—much systematic work based on longitudinal muscle patterns, etc., not easily studied by casual field worker. *P. pallida* muscles have unusual longitudinal and circular patterns, and few bundles of muscles (18-19). Giant nerve fibers found in this phylum - except in *P. ovalis* - also vary in size and number. *P. pallida* has one giant nerve fiber, on the left side - usual position in phylum (Emig 1974). Nephridial structure is also important in systematics.
Tube—separate, vertical, chitinous, covered with thin layer of sand grains. Membranous distally (Zimmer 1975). Distinctly flexed 1/3 of way to base: sp. *pallida* (Silen 1954) (fig. 6). Tube flexible, tough, can't be easily broken. Basal end of tube open.
Larva—actinotroch (from which this species was first described (Schneider 1862)) is small: 0.6 mm long, active; found on water's surface. Mature larva found on substrate, has 5 pairs of tentacles (Silen 1954) (fig. 5). Young actinotrochs are photopositive and planktotrophic (Silen 1954).

Possible Misidentifications

Phoronids are worm-like, with an unsegmented, though slightly annulated trunk and a crown of tentacles on the anterior end. Some polychaetes also have this general form. Phoronids, however, have no setae or segmentation on their trunks. Phoronid tentacles are straight and finger-like, not branched or thread-like, as in polychaetes. The phoronid lophophore is circular - crescent shaped or a double spiral.

Only 2 genera of Phoronida and probably fewer than 20 species are known worldwide. Many of these can be found on the Pacific coast, but only 3 are common intertidally: *Phoronopsis viridis, Phoronis vancouverensis,* and *P. pallida* (Zimmer 1975).

Phoronopsis spp. can be distinguished from *Phoronis* spp. by the presence in the former of a collar at the base of the lophophore, lacking in *Phoronis* spp. The 3 Pacific representatives of this genus include:

Phoronopsis viridis (Hilton, 1930), a large common phoronid often found in great masses on the mudflats. Individuals can be up to 200 mm long, with up to 300 green tentacles (Hyman 1959). This species is abundant on Oregon and Washington tidal flats, and is largely distinguished from *P. pallida* by its size, color and its collar.

Phoronopsis harmeri (Pixell, 1912) was once thought to be a form of *P. viridis,* but is now a separate species because of spermatophore and larval differences (Zimmer 1975). This species has no green coloration; it is a common mudflat phoronid in Puget Sound. (*P. viridis* is not included in Puget Sound keys (Kozloff 1974a)) *P. harmeri* is usually larger than *P. pallida* (up to 60 mm long), and has a collar, as in all *Phoronopsis* spp. It is found in the Atlantic (Azores). *P. pacifica* (Torrey, 1901), found then in Humboldt Bay, and described from Puget Sound as well, is now considered a synonym of *P. harmeri* (Emig 1974).

The 3rd *Phoronopsis* species, *P. californica* (Hilton, 1930), is probably limited to southern California. It has a large bright orange lophophore with elaborate spirals; it is solitary, and can be up to 12" (300 mm) long (MacGinitie and MacGinitie 1949).

There are 4 other species of *Phoronis* reported from our coast:

P. architecta (Andrews, 1890) is an Atlantic species, also found subtidally from southern California to British Columbia, and occasionally intertidally (Zimmer 1980). Its lophophore is flesh-colored, or rarely reddish, with white bands and flecks. It has no collar, (like *P. pallida),* but is 2x the size of the latter; its sand encrusted tube is straight, not flexed.

P. psammophila (Cori, 1889) is found only rarely from central and southern California (Zimmer 1975). It is much like *P. architecta* above but its lophophore lacks white pigment. Its primary range is Atlantic (Emig 1969).

P. ovalis (Wright, 1856) is much smaller even than *P. pallida,* (only 6 mm long). It bores in shell and limestone and is not found living freely in the mud.

P. ijimai (Oka, 1897) *(=P. vancouverensis* (Pixell. 1912)) is whitish, like *P. pallida.* It is larger, however, 20-50 mm long - and has 72-100 tentacles (average 90 (Pixell 1912)), and grows in intertwined clusters of great density, often on pilings and on rocks. Its tubes are covered with detritus, not sand grains. (The Japanese and northeastern Pacific forms are synonymous.)

P. hippocrepia (Wright), the European species, is considered to be separate from *P. ijimai vancouverensis* above (Emig 1971).

Ecological Information

Range—Scandinavia; Pacific coast of North America.
Local Distribution—Coos Bay: Charleston mudflats.
Habitat—in soft sand, muddy sand (Emig 1974); on intertidal mudflats. Can extend tentacles into *Upogebia* burrows (Zimmer 1980)
Salinity—all phoronids are marine (Zimmer 1980). Only one species, *P. euxinicola,* is found in brackish water, in the Black Sea (Hyman 1959). These specimens collected at 30 ‰ (Coos Bay).
Temperature—phoronids are found in shallow waters of tropical and temperate ranges (Hyman 1959); most are temperate (Zimmer 1980). Some can regenerate after extremes of weather have left only fragments in tubes: in winter (Italy) and summer (Japan) (Hyman 1959).
Tidal Level—intertidal, also subtidal: found in dredge hauls (Zimmer 1980) and down to 12m deep (Emig 1974). (Other phoronids can be found down to 140m.)
Associates—can live close to many other invertebrates, but is without true symbiotic relationships, except for *P. australis* (Japan), which is found in anemone *Cerianthus* tubes. The anemone *Edwardsia* is an associate of *Phoronopsis* in Bodega Bay harbor, California. *P. pallida* could possibly be an obligatory commensal with *Upogebia* and other thalassinids (Zimmer 1980).

Quantitative Information

Weight—
Abundance—

Life History Information

Reproduction—a simultaneous hermaphrodite: eggs and sperm extruded into body cavity from reproductive organs, fertile eggs expelled into seawater via nephridiopores (MacGinitie and MacGinitie 1949). In some species, larvae live among tentacles of adult female, but not in *P. pallida,* which lacks nidamental (nesting) organs (Emig 1974). No asexual propagation, although regeneration of crown of tentacles possible (Silen 1952). Eggs laid on 2 - 3 successive summer nights (Sweden), 28 at a time (Silen 1954).

Growth Rate—fertilized egg immobile for 20 hours; to blastula stage in 20 hours more. After gastrulation begins, hood develops; in 25-30 more hours, a ciliated ridge appears, which becomes the crown of tentacles. First tentacles show after 2 days. (Growth stopped in lab after 6 days (Silen 1954).) Actinotroch progresses from 4 tentacles to metamorphosis in 12-14 days. It is active and moves quickly horizontally and vertically - dives, floats, and rushes. Mature larvae are photonegative; metamorphosis is triggered by presence of proper substrate (mud, sand), and takes 15 minutes: Actinotroch takes a horizontal position, ventral side down, then evaginates metasomal sac. A thin tube is formed immediately, and worm begins to burrow.

Longevity—

Food—all phoronids are ciliary mucus feeders, gathering suspended particles by tentacular currents (Hyman 1959). Actinotrochs eat peridinians, not diatoms (Silen 1952).

Predators—

Behavior—movement limited to emergence from anterior end of tube, and expansion of crown (in undisturbed conditions), and to withdrawal into tube if disturbed (Hyman 1959). Adults not light sensitive (Hyman 1959).

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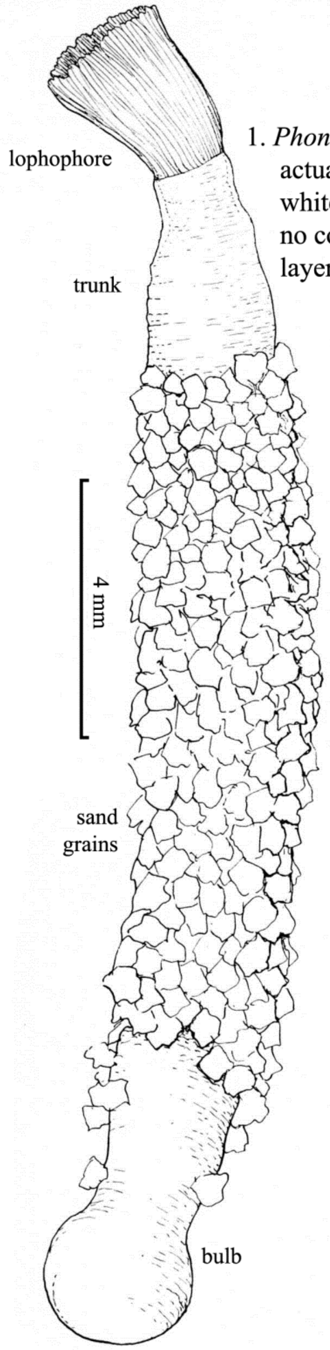
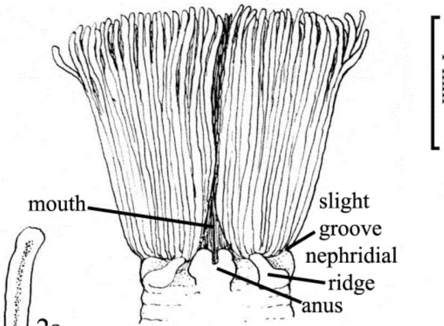
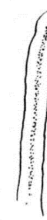
Phoronis pallida



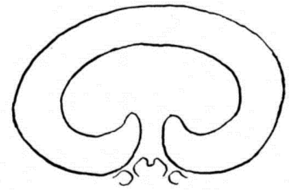
1. *Phonois pallida* x100:
actual size 20 x 2mm; lophophore of c. 50 white tentacles; truck white, unsegmented; no collar at base of lophophore; tube a single layer of sand grains.



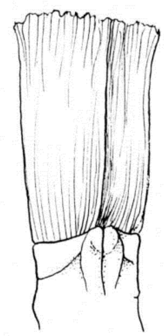


2a.

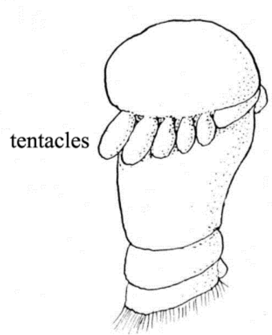
2. Lophophore, dorsal view x200



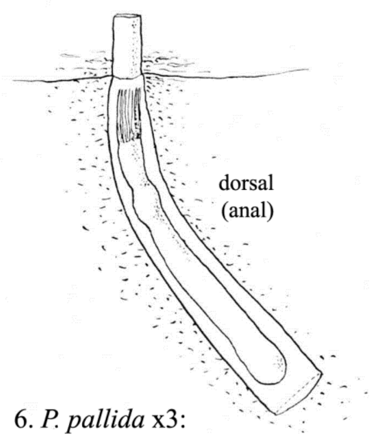
3. Schematic, lophophore:
dorsal view; a simple spiral (from Emig 1971).



4. Lophophore, *Phoronopsis harmeri*:
epidermal collar at base of lophophore (from Emig 1974).



5. Actinotroph (L: 0.6mm) x100:
mature larva: 5 pairs tentacles (from Silen 1954).



6. *P. pallida* x3:
withdrawn into tube; tube flexed 1/3 of way to base, toward anal side; bottom of tube open (from Silen 1952).

Botrylloides violaceus

A colonial ascidian, or tunicate (Oka, 1927)

Phylum: Chordata
Class: Ascidiacea
Order: Pleurogona
Family: Styelidae

Description

Size—colonies can be several cm across (Abbott and Newberry 1980); individual zooids 1-2 mm long (as seen from above); diameter about ½ length (fig. 1). Zooids arranged in rows or "systems: often ladderlike (unless crowded), with a common cloacal cavity between rows (fig. 1). Often with many dozen individuals in flat, encrusting colony.
Color—variable; these specimens (Coos Bay) light yellow-orange, or tan; can be gray, orange: possibly light dependent (Berrill 1947). "Test" (see below) clear.
Zooids—oblong, more or less free; each with raised oral aperture; cloaca is shared with zooids across "ladder". With one large ovary on each side of body: genus *Botrylloides* (Van Name 1945). Asexual buds develop on zooid walls or from ampullae (vascular buds) at colony edges (figs. 1a, 3). Incubating pouches develop from ovaries: genus *Botrylloides* (Abbott and Newberry 1980).
Tunic or Test—an external connective tissue; transparent in these specimens**.**
Mantle—the true body wall: a thin, sac-like membrane inside test, containing muscle and blood vessels, and enclosing the internal parts (Van Name 1945) (fig. 3a).
Ampullae—enlarged, blind, blood reservoirs around edges of tunic; finger-shaped. Can give rise to new zooids by vascular budding. Ampullae also have a respiratory function.
Oral Aperture—on anterior surface; round, smooth-edged, raised, with small simple tentacles inside; four-lobed siphon (fig. 1).
Tentacles—simple; 4 large (these specimens), several small ones (fig. 1).
Cloaca—common, between rows of zooids (figs. 1a, 2a). Atrial apertures of zooids (fig. 3) are below surface of colony (fig. 3a).
Pharynx—(branchial sac or pharyngeal basket); posteriorly it leads to esophagus, stomach, and intestine. This structure contains stigmata (stilts) and cilia for filtering food. It has 3 inner long vessels or bars, but no longitudinal folds separating stigmata (Berrill 1947) (fig. 3a). Species lacks an abdomen: body not divided as in some elongate solitary ascidians (fig. 3).
Endostyle—a deep groove on ventral side of pharynx (side opposite atrial siphon); contains long glandular bands (Berrill 1947), which produce mucus used for feeding (fig. 3a).
Dorsal Lamina—a membranous ridge, projecting inward from the dorsal midline of the pharynx (atrial siphon side) (fig. 3a). Dorsal lamina rolls mucus sheets into a cord, after receiving them from endostyle across sac walls (Goodbody 1974).
Stigmata—slits in pharynx walls, in groups between longitudinal vessels (figs. 1, 3, 3a).
Atrium—cavity surrounding pharynx. Water enters atrium via stigmata, and exits by atrial siphon (fig. 3a).
Gonads—genus characterized by a large ovary on each side of zooid (fig. 3a). Embryo develops in brood pouch in ovum. Testes mulberry-like, anterior to ovum (fig. 3a). (Not visible in zooid in fig. 3.)
Digestive Tract—to left of branchial sac, with narrow loop at base (Berrill 1947) (figs. 3, 3a.)
Larva— "tadpole" type, with long posterior tail containing notochord and slender neural tube. Body contains photolith, a balance and light organ near eye, and several ampullae (fig. 4a).

Possible Misidentifications

The family Styelidae contains both solitary and compound forms. Family characteristics include square or 4-lobed apertures, simple filiform tentacles, a continuous dorsal lamina (fig. 3a), and straight longitudinal stigmata. Some genera have 4 curved longitudinal folds in the pharynx, but *Botrylloides* and the closely related *Botryllus* and *Metandrocarpa* do not (Van Name 1945). 4 other genera also lack these longitudinal folds, but do not occur in our area: *Symplegma, Kukenthalia, Polyzoa* and *Alloeocarpa* (Van Name 1945).

Of the 3 local encrusting colonial Styelidae, *Metandrocarpa* (dura) is usually reddish, with large zooids (5-6 mm). It is not arranged in systems: each zooid has a separate atrial siphon. Zooids are more separate and distinct, being embedded in the tunic, but actually connected only basally. Zooids can seem to be in rows and laterally fused, however.

Botryllus spp., a cosmopolitan genus, is often found with *Botrylloides* on floats, and is difficult to distinguish from it. *Botryllus* always forms circular or star-shaped clusters or systems; it never has more than 20 zooids in a system. (*Botrylloides* forms systems composed of long double rows or clumps of zooids, and often has several dozen zooids in a system.) Because of the shape of the colony, *Botryllus* zooids tend to be tear-shaped, with a "languet" or tongue-shaped atrial end (Van Name 1945) (fig. 5); *Botrylloides* zooids are usually oval-shaped. *Botryllus* individuals lack the brood pouch of *Botrylloides*; their young develop in the atrium before being extruded. A further difference between the 2 species is that *Botryllus* has the ovaries anterior to the testes (the reverse of *Botrylloides*), and can have 1 or several ovaries; *Botrylloides* has 1 large ovary on each side.

There have been several named species of *Botrylloides*, but the species from our area have not yet been studied. Van Name 1945 discusses *Botrylloides magnum* from Alaska, but it is very large, and poorly described. *B. diegense* is a southern California form, with brown and purple zooids and test vessels. The European *B. leachi* and the Japanese *B. violaceus* have not been identified from our coast.

Ecological Information

Range—genus worldwide
Local Distribution—Coos Bay: Charleston small boat harbor.
Habitat—on floating docks, (Coos Bay); in bays and harbors (Abbott and Newberry 1980). Ascidians represent a significant percentage of the fouling organism community (Miller 1971).
Salinity—collected at 30 ‰ (Coos Bay).
Temperature—10-15 °C(Coos Bay).
Tidal Level—low intertidal and shallow subtidal (Abbott and Newberry 1980).
Associates—*Obelia*, caprellid amphipods, *Corophium* amphipods, nereid polychaetes, *Eudistylia.* Ascidians are commensal hosts to notodelphid copepods, amphipods, and host to some specific parasitic copepods (Miller 1971).

Quantitative Information

Weight—
Abundance—locally common on floating docks, especially in summer.

Life History Information

Reproduction—hermaphroditic, ovoviviparous. Asexual budding also occurs. Sexual fertilization internal; embryos develop in ovary (1 to a zooid), emerge as tadpoles. Larvae develop quickly, settle soon (in only a few minutes) and metamorphose to form new zooids (fig. 4). Sexual reproduclion in late spring, early summer. Larvae release determined by light. Buds can develop from parent (fig. 3), or from bases of vascular ampullae at colony's edge. (Numerous buds of all types abort during development.)
Growth Rate—colonies of *Botryllus* sp. reach maturity in 1-2 months' time (MacGinitie 1939).
Longevity—an ascidian colony may live more than 3 years; an individual zooid less than a year (Berrill 1947).
Food—ciliary mucus feeders, filtering plankton through the tentacles.
Predators—ascidians: probably fish, crab, polychaetes, sea stars; especially prosobranch molluscs, opisthobranchs, nudibranchs, turbellarian flatworms. Also grey seal (Scotland); man, for food, Japan. Mediterranean, Chile; bait, Australia, S. Africa. Destroyed as a pest in oyster beds, commercial fishing grounds (Miller 1971).
Behavior—zooids are sessile; tadpole larvae can swim, but tend to settle near parents, attaching with adhesive papillae.

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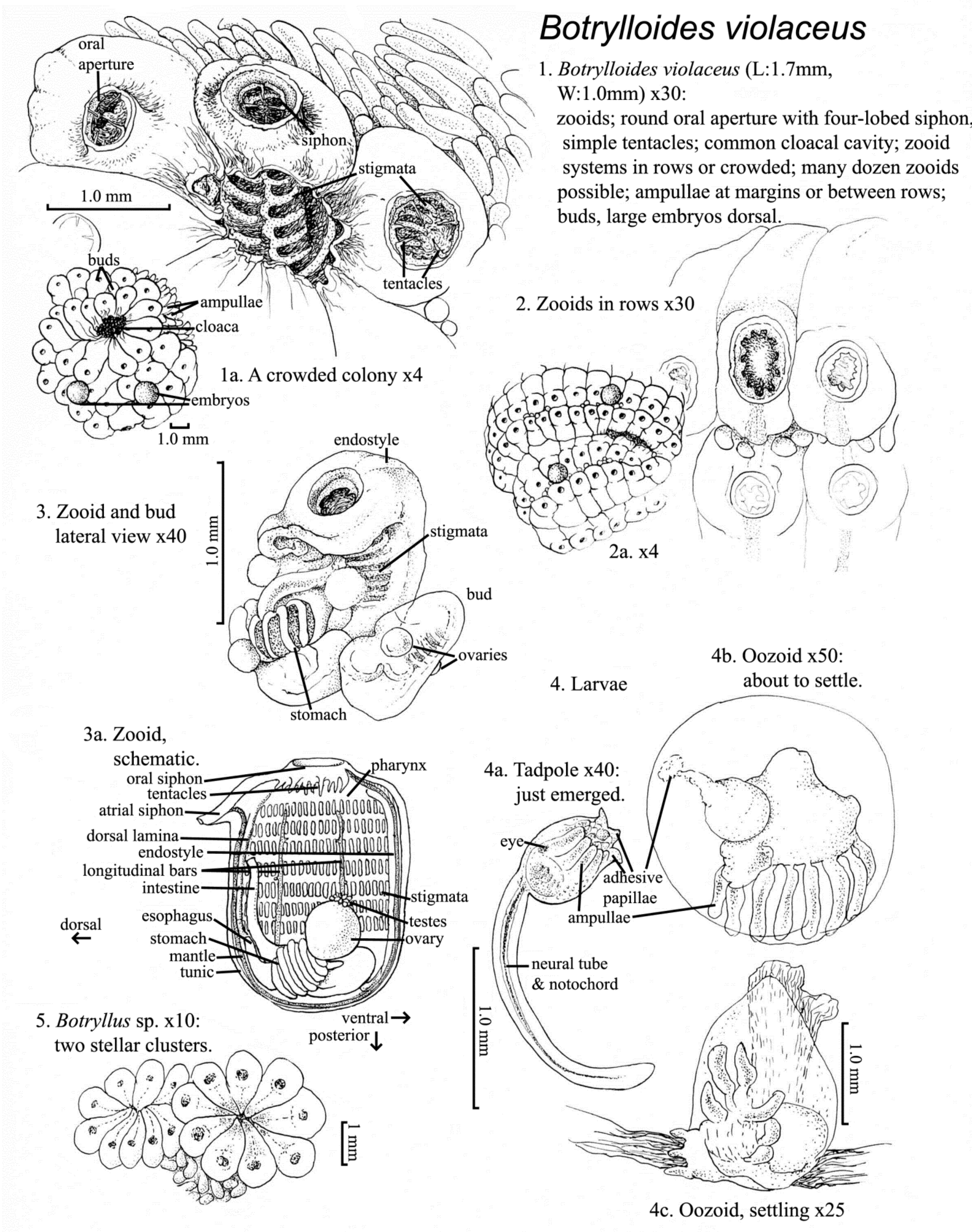
Botrylloides violaceus
1. *Botrylloides violaceus* (L:1.7mm, W:1.0mm) x30:
zooids; round oral aperture with four-lobed siphon, simple tentacles; common cloacal cavity; zooid systems in rows or crowded; many dozen zooids possible; ampullae at margins or between rows; buds, large embryos dorsal.
oral aperture
siphon
stigmata
1.0 mm
tentacles
buds
ampullae
cloaca
embryos
1.0 mm
1a. A crowded colony x4
2. Zooids in rows x30
2a. x4
endostyle
3. Zooid and bud lateral view x40
1.0 mm
stigmata
bud
ovaries
stomach
4. Larvae
4b. Oozoid x50: about to settle.
3a. Zooid, schematic.
oral siphon
tentacles
pharynx
atrial siphon
dorsal lamina
endostyle
longitudinal bars
intestine
stigmata
testes
ovary
dorsal
esophagus
stomach
mantle
tunic
ventral
posterior
4a. Tadpole x40: just emerged.
eye
adhesive papillae
ampullae
neural tube & notochord
1.0 mm
1.0 mm
5. *Botryllus* sp. x10: two stellar clusters.
1 mm
4c. Oozoid, settling x25