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 and Haderlie 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: un-segmented, 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 and Haderlie 1980); not threadlike (fig. 2a). In *P. pallida* there can be 50-140, but usually around 50 (Zimmer and Haderlie 1980), sometimes more (S.F. Bay specimens). Tentacles can be regenerated (MacGinitie and MacGinitie 1949).

Anus—dorsal to mouth (Hyman 1959); 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 2007) (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 2007). 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 harmeri, Phoronis vancouverensis,* and *P. pallida.* The main population of each of these species is likely subtidal (Zimmer 2007).

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 three Pacific representatives of this genus include:

Phoronopsis harmeri Pixell, 1912 (senior synonym of *P. viridis* (Hilton, 1930), a large common phoronid often found in great masses on the mudflats. Individuals can be green or white and up to 200 mm long, with up to 300 green tentacles with white spots (Hyman 1959, Zimmer 2007). *P. harmeri* is usually larger than *P. pallida* (up to 60 mm long), and has a collar, as in all *Phoronopsis* spp. It is also found in the Atlantic (Azores). This species is abundant on Oregon and Washington tidal flats, and is largely distinguished from *P. pallida* by its size, color and its collar.

P. pacifica (Torrey, 1901), found first in Humboldt Bay, and described from Puget Sound as well, is also considered a synonym of *P. harmeri* (Emig 1974).

The third *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 four 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 and Haderlie 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 has been synonymized with *P. architecta* (Emig 1982).*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. vancouverensis Pixell, 1912 (now senior synonym of *P. ijimai* Oka, 1897) is whitish, like *P. pallida.* It is larger, however, 20-50 mm long, and has 72-100 tentacles (average 90 according to 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.

P. hippocrepia (Wright), the European species, is considered to be separate from *P. 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. Commensal in *Upogebia pugettensis* burrows (Zimmer 2007)

Salinity—all phoronids are marine (Zimmer and Haderlie 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 at a number of locations worldwide (Zimmer 2007) down to 12m deep (Emig 1974). (Other phoronids can be found down to 140m.)

Associates—commensal in burrows of *Upogebia pugettensis,* though not often found with the sympatric mud shrimp *Neotrypaea californiensis* (Zimmer 2007).

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,

becoming the crown of tentacles. First tentacles show after two days. (Growth stopped in lab after six days (Silen 1954). The actinotroch progresses from four tentacles to metamorphosis in 12-14 days. It is active and moves quickly horizontally and vertically - dives, floats, and rushes. Details of larval development and phylogenetic implications are given by Santagata (2004a) and a key to larval stages is available in Shanks (2001). Mature larvae are photonegative; pre-settlement behavior is induced by a waterborne cue from *Upogebia pugettensis,* a shrimp species with which *P. pallida* is commensal (Santagata 2004b).

Metamorphosis is triggered by presence of proper substrate (mud, sand), and takes 15 minutes. The actinotroch takes a horizontal position, ventral side down, then evaginates metasomal sac. The transition is made from control by the larval neuromuscular system to that of the juvenile, resulting in the apoptosis of larval structures. This succession of events suggests lophotrochozoan affinities (Santagata 2002). Finally, a thin tube is formed, and the 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).

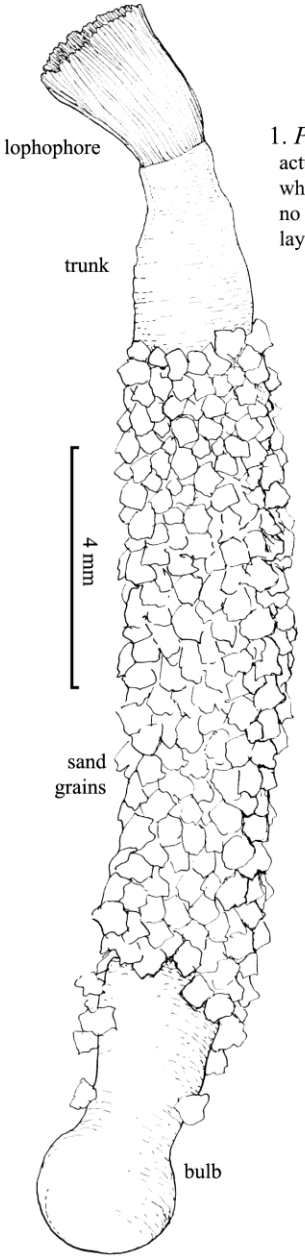
Predators—

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).

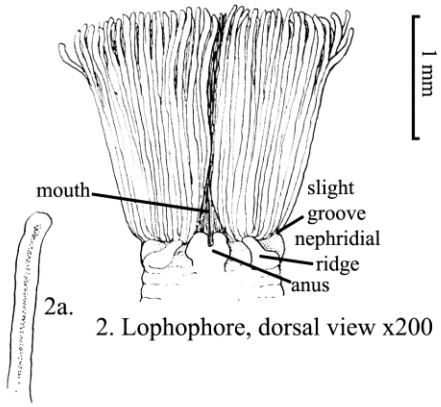
Literature Cited

1. EMIG, C. C. 1971. Remarques sur la systmatique des Phoronidea. Marine Biology. 8:154-159.
2. ——. 1974. The systematics and evolution of the phylum Phoronida. Journal of Zoological Systematics and Evolutionary Research. 12:128-151.
3. EMIG, C.C. 1982. The biology of Phoronida. Advances in Marine Biology. 19: 1-89.
4. HYMAN, L. H. 1959. Invertebrates: Smaller coelomate groups. McGraw-Hill, New York.
5. MACGINITIE, G. E., and N. MACGINITIE. 1949. Natural history of marine animals. McGraw-Hill Book Co., New York.
6. PIXELL, H. L. M. 1912. Two new species of the Phoronidea from Vancouver Island. Quarterly Journal of Microscopical Science. 58:257-284.
7. SANTAGATA, S. 2002. Structure and metamorphic remodeling of the larval nervous system and musculature of *Phoronis pallida* (Phoronida). Evolution & Development. 4(1): 28-42.
8. ---------- 2004a. Larval development of *Phoronis pallida* (Phoronida): Implications for morphological convergence and divergence among larval body plans. Journal of Morphology. 259: 347-358.
9. ---------- 2004b. A waterborne cue for the actinotroch larva of *Phoronis pallida* (Phoronida) produced by *Upogebia pugettensis* (Decapoda: Thalassinidea). Biological Bulletin. 207(2): 103-115.
10. SCHNEIDER, A. 1862. Uber die Metamorphose der Actinotrocha branchiata. Archiv fur Anatomie und Physiologie:47-65.
11. SHANKS, A.L. 2001. An identification guide to the larval marine invertebrates of the Pacific northwest. Oregon State University Press, Corvallis, OR.
12. SILEN, L. 1952. Researches on Phoronidea of the Gullmar Fiord Area (West coast of Sweden). Arkiv för Zoologi. 4:95-140.
13. ——. 1954. Developmental biology of Phoronidea of the Gullmar Fiord area (West coast of Sweden). Acta Zoologica. 35:215-257.
14. ZIMMER, R. L. 2007. Phylum Phoronida, p. 860-863. *In:* Light's manual; intertidal invertebrates of the central California coast. J. T. Carlton (ed.). U.C.Press, Berkeley.
15. ZIMMER, R. L., and E. C. HADERLIE. 1980. Chapter 7: Brachiopoda and Phoronida, p. 108-116. *In:* Intertidal invertebrates of California. R. H. Morris, D. P. Abbott, and E. C. Haderlie (eds.). Stanford University Press, Stanford, California.

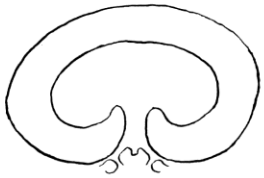
Phoronis pallida



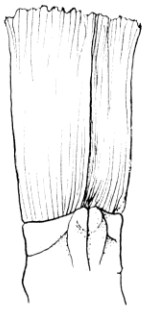
1. *Phonois pallida* x100:
actual size 20 x 2mm; lophophore of c. 50 white tentacles; truck white, unsegmented; no collar at base of lophophore; tube a single layer of sand grains



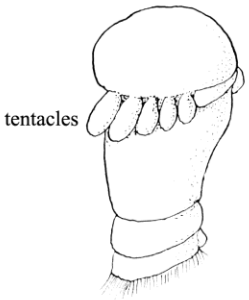
2. Lophophore, dorsal view x200



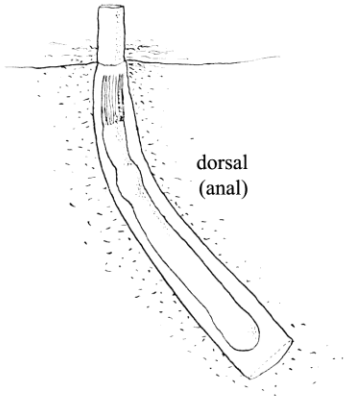
3. Schematic, lophophore:
dorsal view; a simple spiral
(from Emig 1971b)



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)