WEST COAST SPECIES OF THE PHYLUM PHORONIDA

The following seven species of phoronid adults are known from southern and central California:

Phoronis architecta
Phoronis muelleri - deep 30-50m
Phoronis pallida
Phoronis psammophila
Phoronis vancouverensis
Phoronopsis californica
Phoronopsis harmeri

With the exception of *Phoronis muelleri* the larvae of the above are also well known here.

An additional nearly cosmopolitan species *Phoronis ovalis* occurs in Washington and two additional widely distributed species *Phoronis australis* and *Phoronis hippocrepia* are reported from our east coast.

Two further "larval species" occur in southern California, a third such form is known from Hawaii, and there may be at least two additional unidentified larvae from east coast waters. There are no described adults to match with these larval forms, so additional adult forms await discovery and description.

Two additional species names may be familiar to California workers: *Phoronopsis viridis* is now considered a synonym of *Phoronopsis harmeri* and *Phoronis pacifica* has never been identified since the inadequate type description

The Genus *Phoronis*

Members of this genus lack the epidermal fold known as the collar which is located at the base of the lophophore in members of the only other genus *Phoronopsis*. Although inconsequential and sometimes inconspicuous, the collar is the only morphological feature separating the genera. Adults of the genus *Phoronis* are usually smaller than those of *Phoronopsis*

Phoronis ovalis: Not yet described from southern California, but probably here. Positive identification is easy since species is **diminutive** (usually less than 1 cm in length), with only about **24 tentacles** which are arranged **in a slightly indented circle**. **Burrows within calcareous substrates** (limestone, mollusc shells, barnacles) in which it forms aggregations by asexual budding.

(gonochoristic?; no spermatophoral or nidamental glands; 125 µm eggs brooded in tube; composite muscle formula 7-21|7-19, **mean muscle formula 29 = 15|14)**

* 2 Dr. Zimmer ided from local specimens

Phoronis pallida Another species that can be identified with great confidence, this is the second smallest species, usually **about 1 cm in length** (not 15 cm as reported by Emig!) with tubes usually less than 2 cm in length. Three obvious **constrictions caused by sphincter muscles subdivide the muscular region of the trunk into distinctive zones**; such zonation is found in no other phoronid. The tube is densely sand-encrusted except for a short distal portion that is largely sediment-free. A third diagnostic feature is that this species is always (to the best of my knowledge) a **commensal within the burrow walls of thalassinid "ghost" shrimps**. In southern California the host is usually ~~*Callianassa pugettensis*~~ Upogebia sp so this species is usually collected only in shallow water from muddy or sandy embayments.

(gonochoristic; large spermatophoral glands with fleshy lips, no nidamental glands; 60 µm eggs freely spawned; composite muscle formula 17-19 = $\frac{5\text{-}6 \mid 5}{4 \mid 3\text{-}4}$, **mean muscle formula 18** = $\frac{\mathbf{5} \mid \mathbf{5}}{\mathbf{4} \mid \mathbf{4}}$)

The four following species -- *Phoronis architecta, P. muelleri, P. psammophila* and *P. vancouverensis* -- all occur in southern California and are difficult to separate when alive, much less when preserved. All are of intermediate size (about 5-10 cm long when extended), with tentacle numbers around 100 plus. Some of the most critical taxonomic features involve reproductive features and/or internal details so positive identification is always difficult and sometimes impossible. I'll take them in reverse alphabetical order, in part because *Phoronis vancouverensis* has a distinctive habitat and is the only one of the four to occur in clumps, rather than more or less singly.

Phoronis vancouverensis is the only local species which regularly has **tubes made only of chitin** without attached sand grains (*Phoronis australis*, *P. hippocrepia*, and *P. ovalis* are others). This lack of sand grains is associated with their habit of growing **embedded within or attached to limestone outcroppings in shallow, muddy embayments or suspended either from the undersides of logs in bays or floats in marinas**. The individuals commonly occur in **dense tangles**. During the reproductive season (spring and summer), this hermaphroditic species retains its early developmental stages in a **pair of conspicuous embryo masses** within the lophophore, but **lacks conspicuous spermatophoral glands**.

(gonochoristic; small spermatophoral glands, nidamental glands inconspicuous; 100 µm eggs retained in paired egg masses; composite muscle formula 42-59 = \F(12-19 | 5-10,18-26 | 5-10), **mean muscle formula 51** $= \frac{16 \mid 22}{7 \mid 6}$)

Phoronis psammophila:: This species, *Phoronis architecta* and *P. muelleri* are gonochoristic and mature males have a **paired, large, fleshy spermatophoral glands** within their lophophore during the spring and summer breeding seasons. The latter two species spawn their eggs freely, but *P. psammophila* is a brooder like *P. vancouverensis*, but , but in contrast to it, the **embryos are all of one stage** rather than a full sequence of stages from zygotes to early actinotrochs and are **brooded in one mass;** the nidamental glands that hold the embryos are formed by the **fusion of almost all members of the inner ring of tentacles**. In living specimens, the lophophore has white flecks and **may have yellow, red or green pigmentation.** The species is found from the **intertidal to about 20 m**, usually occuring as single isolated tubes, but sometimes attached with others to shells or rocks.

(gonochoristic; large spermatophoral glands with fleshy lips, nidamental glands involving most of inner tentacles; 60 µm eggs retained in single mass all at same stage; composite muscle formula 25-53 = \F(7-9 | 7-17,4-11 \ 4-11), **mean muscle formula 34** $= \frac{11 \mid 11}{6 \mid 6}$)

Phoronis architecta : This species is so similar to the previous species that it has been synonymized with it, but in fact is more closely related to *Phoronis muelleri* with which it shares numerous similarities (both are gonochoristic with females that shed their eggs freely, and with males that have large fleshy spermatophoral glands during the breeding season; the larvae of the two are nearly identical, both possessing an otherwise unknown second set of tentacles; the lophophore of the juvenile and of both species and of the adults of P. *muelleri* (and of regenerating individuals of these and many other species) produces new tentacles on both sides of the mouth (ventral and dorsal not left and right) , resulting in an unusual "oral" notch opposite the indentation of the lophophore on the anal side; as a consequence of this pattern of tentacle formation, the tentacles near the anus are significantly longer that those near the mouth so that the lophophore of fully formed adults appears trapezoidal in side view). In *P. architecta* the translucent lophophore has white flecks in a characteristic pattern, but is otherwise unpigmented. *P. architecta* occurs in shallow water in sandy sediment so that the tubes are usually encrusted with closely fitted sand grains (hence the name *architecta*).

(gonochoristic; large spermatophoral glands with fleshy lips, no nidamental glands; 60 µm eggs freely spawned; composite muscle formula 17-19 = $\frac{5\text{-}6 \mid 5}{4 \mid 3\text{-}4}$, **mean muscle formula 18 =** $\frac{\mathbf{5} \mid \mathbf{5}}{\mathbf{4} \mid \mathbf{4}}$)

Phoronis muelleri: As noted above this species shares many features with *P.architecta*. The lophophore, **which may be red to violet**, usually **has only 50-100 tentacles of which those on the oral side are very short.** The species is usually **much more slender** and is found much deeper **(10-50 m)** than either *P. architecta* or *P. psammophila*. Because it it normally occurs deeper and therefore in finer sediment than *P. architecta* or *P. psammophila*, the **tubes** usually are more **poorly encrusted with sand grains**. 30-50 m. left lateral [illegible] missing

(gonochoristic; large spermatophoral glands with fleshy lips, no nidamental glands; 60 µm eggs freely spawned; composite muscle formula 18-30 = $\frac{5\text{-}13 \mid 5\text{-}11}{2\text{-}6 \mid 3\text{-}6}$, **mean muscle formula 24 =** $\frac{\mathbf{9} \mid \mathbf{9}}{\mathbf{3} \mid \mathbf{3}}$)

The Genus *Phoronopsis*

As indicated above, phoronids provided with an epidermal collar at the distal end of the trunk region are placed in the genus *Phoronopsis.*

Phoronopsis californica: Originally described from the intertidal at Newport Bay, this spectacular species is locally common from about 5-35 meters off a number of the Channel Islands. Although the tubes are highly variable, depending on the substrate, specimens can be identified with great confidence: 1. the lophophore (and body) is (are) usually a bright **tangerine or orange color**, varying from red to pale peach, with some white flecks (especially the anal papilla) and 2. the lophophore consists of some **1500 tentacles** that are arranged **in a complex double helix of 4-9 coils**. The body is reported to be up to 5 mm in diameter, which is true, and to reach nearly a half meter in length which is an exaggeration, although the tubes may be that long. The tube may have a distinctive nipple at the proximal end and often contains abundant mucoid material.

(gonochoristic; large spermatophoral glands with membranous lips, no nidamental glands; 60 µm eggs freely spawned; composite muscle formula 180-243 = $\frac{53\text{-}81 \mid 56\text{-}79}{35\text{-}54 \mid 29\text{-}40}$, **mean muscle formula 211 =** $\frac{\mathbf{66} \mid \mathbf{66}}{\mathbf{44} \mid \mathbf{35}}$)

Phoronopsis harmeri (Phoronopsis viridis): This species forms dense aggregations at Morro and Bodega Bays (in these regions, the lophophore is often greenish, hence the original trivial name), but is commonly found locally either intertidally or subtidally. All "collared" phoronids which don't key out as *P. californica* are now assigned to this species, but the considerable variation in form, especially between specimens from different localities, may reflect greater taxonomic complexity.

(gonochoristic; large spermatophoral glands with membranous lips, no nidamental glands; 60 µm eggs freely spawned; composite muscle formula

$$75\text{-}145 = \frac{14\text{-}33 \mid 15\text{-}33}{7\text{-}20 \mid 7\text{-}16}$$, **mean muscle formula**

$$\mathbf{72} = \frac{\mathbf{23} \mid \mathbf{23}}{\mathbf{14} \mid \mathbf{12}}$$)

Potential Problems for the Would-be Taxonomist:

need for sections
morphological variability in muscle formulae, tentacle numbers, tubes, etc.
autotomy and possible confusion with segmentation or body regionation
regeneration with loss of important parts
seasonal reproduction with evanescent accessory sex organs
undescribed species

Bibliography

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Marsden, J. C. 1959. Phoronidea from the Pacific coast of North America. Can j. Zool. **37**: 87-111.

Emig placed *Phoronis architecta* in synonymy with *Phoronis psammophila* on the basis of tentacle number, muscle formulae, and other morphological congruences, but the latter species broods its young and the former does not.

Marsden placed *Phoronis vancouverensis* in synonymy with *Phoronis hippocrepia* , but Emig argued against this and placed *P. vancouverensis* in synonymy with a Japanese form *P. ijimai*, retaining *P. hippocrepia* as a valid species I consider both interpretations incorrect and recognize all three species as valid.