Phascolosoma agassizi

Pacific peanut worm

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

Taxonomy: The evolutionary origins of sipunculans, recently considered a distinct phylum (Rice 2007), is controversial. Current molecular phylogenetic evidence (e.g., Staton 2003; Struck et al. 2007; Dordel et al. 2010; Kristof et al. 2011) suggests that Sipuncula be placed within the phylum Annelida, which is characterized by segmentation. Placement of the unsegmented Sipuncula and Echiura within Annelida, suggests that segmentation was secondarily lost in these groups (Struck et al. 2007; Dordel et al. 2010).

Description

Size: Up to 15 cm (extended) and commonly 5–7 cm in length (Rice 1975b). The illustrations are from a specimen (Coos Bay) 13 cm in length. Young individuals are 10–13 mm in length (extended, Fisher 1950). Juveniles can be up to 30 mm long (Gibbs 1985). The illustrated specimen weighed approximately 5.3 g (wet weight).

Color: Dark pigment blotches, dark conical papillae, particularly at posterior end but also along introvert (Plate 120, Rice 2007). The trunk was brown in the illustrated specimen and the skin was thick and rough, the introvert was pale, shiny, smooth, and with dark bands and splotches. The tentacles were light tan (Fig. 1).

Papillae: Papillae are conical glandular structures, each with hard round center on a platelet (Fig. 1a). Papillae are thickest around the posterior end and mid dorsally, near the anus.

Body: Body divided into anterior introvert and posterior trunk regions and the introvert can be retracted entirely into the trunk (Fig. 3) (Rice 2007). Body wall divided into longitudinal bands that can be noticeable on outside (Fig. 4). No true segmentation.

Introvert: The introvert resembles a neck and is slender and can be extended to be longer than trunk (Fig. 1) (Stephen 1964). It is composed of an anterior oral disc, which can be surrounded by ciliated tentacles, a mouth and nuchal organ (Fig. 2) (Rice 2007). Along the introvert epidermis are spines or hooks.

Oral disc: The oral disc is bordered by a ridge (cephalic collar) of tentacles enclosing a dorsal nuchal gland. Inconspicuous, finger-like and not branched (Rice 1975b), the 18–24 tentacles exist in a crescent-shaped arc, enclosing a heart-shaped nuchal gland (Fig. 2).

Mouth: Inconspicuous and posterior to oral disc, with thin flange (cervical collar) just ventral to and outside the arc of tentacles (Fig. 2).

Eyes: A pair of ocelli at anterior end are internal and in an ocular tube (Fig. 4) (Hermans and Eakin 1969).

Hooks: Tiny chitinous spines on the introvert anterior are arranged in a variable number of dark, colored rings (usually 15–24 in this species) (Fig. 2). The first three rows can be small and colorless, while the last two can be incomplete (due to wear) (Fisher 1950).

Trunk: The trunk is bulbous, posteriorly pointed and can be divided into longitudinal bands (not always obvious exteriorly). When contracted, the trunk is peanut-shaped (Fig. 3).

Anus: Dorsal, and at anterior-most trunk (Rice 2007), the anus is recognizable as a light, raised area (Fig. 1). Intestinal tract is U-shaped (Fig.4).

Nephridiopore: Lateral and just posterior to anus (Fig. 1). Nephridia are two long structures lying freely within the coelom (Fig. 4).

Gonads: Occur at origin of ventral retractors (Fig. 4). Sexual products (gametes) extruded through nephridiopores (Fig. 1).

Possible Misidentifications

Sipunculans are fairly easily distinguished from other worms by their lack

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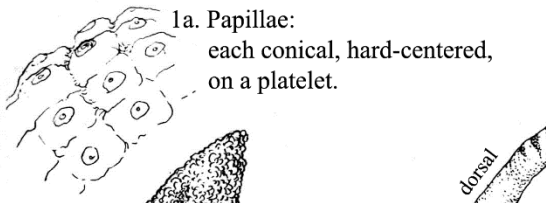
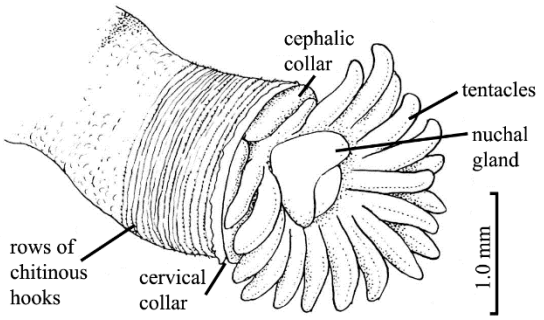
Phascolosoma agassizi

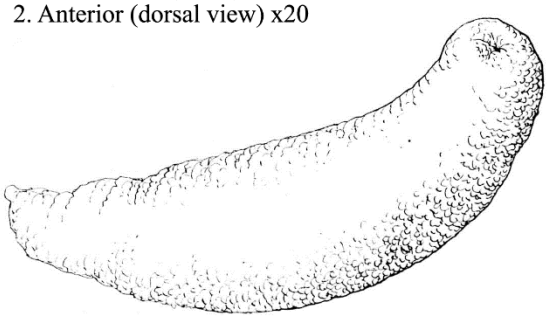


1a. Papillae:
each conical, hard-centered,
on a platelet.

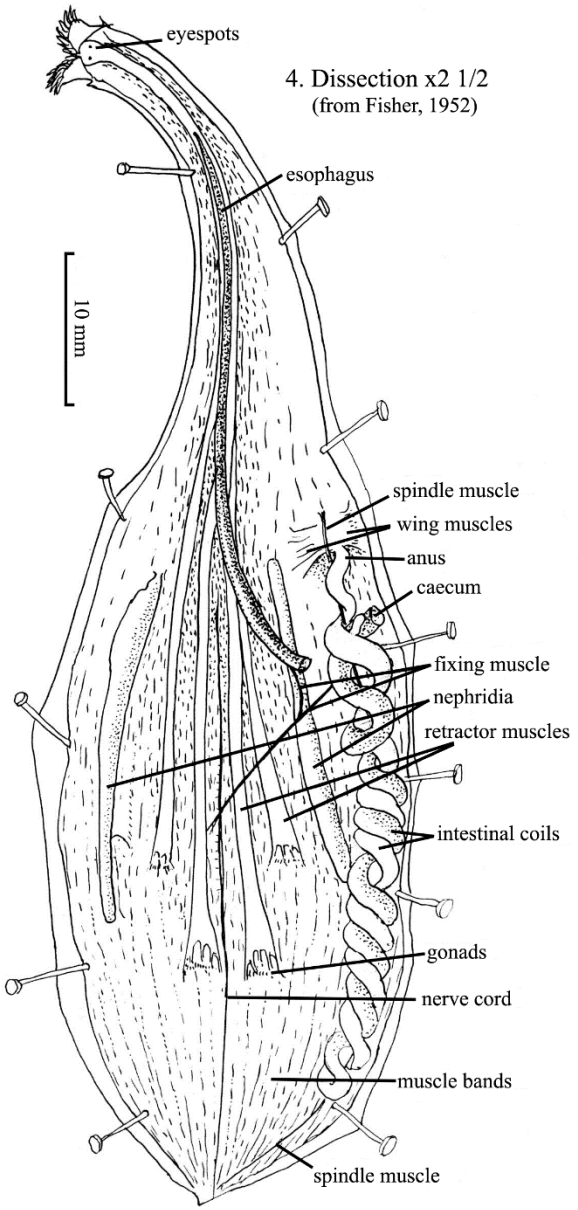
1. *Phascolosoma agassizi* x2:
peanut-shaped trunk with papillae, pigment spots;
anus dorsal, nephridiopores lateral; extrudable, pale
banded introvert with 18-24 short tentacles.



2. Anterior (dorsal view) x20



3. A contracted specimen x2



4. Dissection x2 1/2
(from Fisher, 1952)

of segmentation and by their peanut-like shape when contracted, hence, their common name: peanut worms. The echiurans, or spoon worms, are a similar group that are also unsegmented and of a similar size, shape and habitat. They have an extensible spoon-shaped proboscis, however, and a posterior anus (not mid-body, as in Sipuncula). Priapula is a small phylum of sausage-shaped non-segmented worms. Priapulids are predatory worms with a bulbous spiny proboscis, quite unlike any in Sipuncula. Local representatives in the Sipuncula are divided into four families: Sipunculidae, Golfingiidae, Themistidae and the Phascolosomatidae.

Phascolosoma agassizii and its family (Phascolosomatidae) 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 for the species *Apionsoma misakianum*, formerly *Golfingia hespera*). There are 60 species in the *Phascolosoma* genus and nearly all are distinguished by rings of single hooks on the introvert (Stephen and Edmonds 1972). Only *P. agassizii* occurs locally. *Phascolosoma japonicum*, a Japanese species, has been reported from Vancouver Island. Its trunk papillae have much larger platelets than those of *P. agassizii* (Fisher 1950). *Phascolosoma perlucens*, *P. rickettsi* (=*pectinatum*), and *P. puntarenae* are eastern Pacific species found from California southward. None of these are likely to be found in the Coos Bay area. *Phascolosoma agassizii* 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.

The Sipunculidae also have well defined longitudinal muscle bands in the body wall, but their oral tentacles completely surround the mouth (Stephen and Edmonds 1972; Rice 2007). Two species occur locally (*Siphonosoma ingens* and *Sipunculus nudus*) and both have a short introvert, numerous tentacles and tend to be larger than *P. agassizii* at 12–50 cm (*P. agassizii* is usually 5–7 cm) (Rice 2007).

Golfingiidae is another sipunculan family, characterized by continuous muscle tissue in the body wall (not bands). The tentacles surround the mouth (unlike the crescent shaped arc of tentacles in Phascolosomatidae). The locally occurring genus is *Golfingia*. *Golfingia* (*margaritacea*) *margaritacea*, a small and threadlike species that is only 25 mm long. It is known (so far) only from Monterey, California (Rice 1975b). *Golfingia pugettensis* (from Puget Sound) (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).

Members of the Themistidae are characterized by tentacles that are long, extending and branching (rather than filiform). Three species in the genus *Themiste* (formerly Dendrostomum) occur locally including *T. dyscrita*, *T. hennahi* and *T. pyroides*. *Themiste pyroides* has black or brown spines on the introvert and tentacles that form four main stems. *Themiste dyscrita* resembles *T. pyroides*, but the collar at the tentacle base is reddish purple in color. *Themiste hennahi* is similar to both species but has a cylindrical body and lacks collar pigment.

Ecological Information

Range: Type locality is Mendocino, California (Schulze et al. 2012). Known range includes Kodiak Island, Alaska, to Bay of San Quintin, Baja California. Also found in western Pacific (Adrianov et al. 2001), although see Schulze et al. (2012) for evidence that this large geographic range may include many separate and cryptic species**.**

Local Distribution: Coos Bay distribution includes Fossil Point, Clam Island and also on the outer coast, in the rocky intertidal at Cape Arago.

Habitat: Individuals nest or burrow in rock and gravelly mud (but without a permanent tube). Also found amongst shells, holdfasts, under rocks or in cracks with *Phyllospadix* roots and the hydrocoral, *Allopora,* in *Mytilus* beds and protected situations. Not found in shifting sediments (Fisher 1950).

Salinity: Collected at 30 in Coos Bay.

Temperature: Temperate to warm waters.

Tidal Level: From mid intertidal down to 60 m, but most common in the lower half of the intertidal zone and just below low tide (Fisher 1950).
Associates: Known associates include several polychaetes (*Thelepus* and *Glycera),* chitons, serpent stars, shore crabs, gastropod, *Nucella*.
Abundance: The most common sipunculan (California, Rice 1975b) from Alaska to Pt. Conception (Rice 1974).

Life-History Information

Reproduction: Separate sexes. Ripe individuals found with eggs January (Humboldt Bay, CA) (Fisher 1950), March–May (Monterey, CA), June–September (Puget Sound, WA) (Rice 1975a). Mature gametes can compose 37% dry mass of animal. Gametes are extruded from nephridiopores into seawater, where fertilization takes place. Of 200 specimens collected Humboldt Bay in January, all were female (Fisher 1950). Adults from Vostok Bay kept together in lab at 20–22ºC spawned after several hours (Adrianov et al. 2011). Frequently, nephridiopores in males and females will be visibly swollen when ready to spawn and may spawn following collection or water changes. Spawning typically occurs at night in the lab (Rice 1987).

Embryological development is holoblastic, spiral, unequal cleavage (Sipuncula). There is data on development from the eastern and western Pacific, but the western Pacific data may be from a different species. Development is faster and eggs are smaller in *P. agassizii* from the Sea of Japan than eastern Pacific populations (Adrianov et al. 2011; Rice 1967). Eggs spherical to elliptical, 100–140 µm in diameter in Humboldt Bay, 70–100 µm in diameter in Vostok Bay, and 140 x 110 x 91 µm at their longest, widest, and thickest points in Washington (Rice 1987). Mature eggs are orange-pink (Vostok Bay), bright yellow or orange (Washington). Eggs bear a small amount of yolk and develop in the lab (18–20ºC in Adrianov et al. 2011) with first cleavage, blastula, and gastrula at 2.5, 16, and 24 hrs respectively (12 °C, Rice 1987).
Larva: *P. agassizi* has two larval stages. First, an encapsulated, non-feeding (lecithotrophic) trochophore at 2.5 days with a thick egg envelope, followed by a planktotrophic pelagosphera, with the addition of a metatrochal band of locomotory cilia at terminal end of larva (Rice 1987; see Fig. 1, 2 in Johnson 2001; Fig. 19.1–19.11 in Jaeckle and Rice 2002). Larvae feed at 8–10 days (Rice 1987), can be teleplanic and develop for up to several months in the plankton (Rice 1980), however, in culture, larvae form attachment with dish soon after beginning to feed (9–10 days, Rice 1987). Some larvae were kept up to seven months, grew to 1 mm,

but did not metamorphose into benthic juveniles (Rice 1967; Adrianov et al 2011).
Juvenile: Post-metamorphosis, juveniles have enlarged papillae, especially in the pre-anal area. Pigment includes transverse bands on the introvert, but trunk pigment spots are rare. Introvert hooks include 12–25 rings (usually 15–16). 11–12 oral disc tentacles and a single nuchal organ are present (Fisher 1950).
Longevity: Sipunculans are estimated to live for up to 25 years (Rice1980).
Growth Rate:
Food: Individuals digest organic matter from large quantities of substrate. They can also ingest small particles by the ciliary action and mucus secretion of their tentacles.
Predators: Fish, gastropods. Humans, in tropical Indo-Pacific, utilize this species for food (Rice 1980).
Behavior: *P. agassizi* individuals are mostly sedentary and nestle or burrow into sediment by elongating and contracting their bodies. They are also commonly found in cracks or under rocks while their introvert searches actively for food.

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