Polyorchis penicillatus

Red-eye jellyfish, penicillate jellyfish

Phylum: Cnidaria
Class: Hydrozoa, Hydroidolina
Order: Anthoathecata, Capitata
Family: Corynidae

Taxonomy: *Polyorchis penicillatus* was originally identified as *Melicertum penicillatum* by Eschscholtz in 1829. It was re-described by Arai and Brinckmann-Voss in 1980 based on the lateral branches on its radial canals and its simple gonads. *P. minuta*, *P. montereyensis*, *P. campanula*, and *P. pinnatus* are all synonyms for *P. penicillatus* (Schuchert 2015c). Higher classification of this species has also undergone revision. The family Polyorchidae was determined to be a synonym of family Corynidae in 2010 (Schuchert 2015b). The order Hydroida was determined to be synonymous with subclass Hydroidolina in 2004 (Schuchert 2015a).

Description

General Morphology: The only known form of *P. penicillatus* is the gelatinous hydromedusa, with a deep bell and many tentacles. Within the bell are radial canals that run from the top of the bell to the bell margin, where they are connected by a ring canal (Fig. 1).

Medusa:

Size: *Polyorchis penicillatus* is higher than it is wide. Individuals can reach 60 mm in height (Mills et al. 2007) and average 20 mm in width (Ricketts et al. 1985).

Color: Most *P. penicillatus* are transparent white with purple-red eyespots. The color of the gonads (sausage-shaped and hanging from each radial canal, see Gonads) and other organs is variable and ranges from yellow brown to purple (Ricketts et al. 1985).

Body:

Bell: The bell is higher than it is wide. The membrane is thin, delicate, and not gelatinous.

Radial Canals: There are four radial canals, each with 15–25 pairs of short diverticula (blind side branches). The diverticula are longer than twice the width of the radial canal (Fig. 1) (Mills et al. 2007).

Ring Canals: The ring canal is simple (i.e., un-branching) and contains the tentacles. The ocelli are on extensions at the bases of the tentacles (Fig. 2).

Ocelli: Ocelli are pigment-cup eyespots suspended from the ring canal (fig. 2). The ocelli can measure gradients in light intensity (Martin 2002), which is thought to facilitate diel migration in *P. pencillatus*.

Mouth: The manubrium extends from a short, pronounced gelatinous gastric peduncle (Fig. 1), and is as long as the bell cavity. It has four oral lips densely armed with nematocysts that form a distinct marginal band (Fig. 1).

Tentacles: *Polyorchis penicillatus* can have up to 160 tentacles, set in a single whorl along the bell margin on the ring canal. The tentacles are not in clusters, and they are unbranched (Mills et al. 2007). The number of tentacles increases rapidly with age (Skogsberg 1948).

Velum: The velum is a thin layer inside the bell rim and contracts during swimming.

Gonads: There are four to eleven sausage-shaped gonads (with an average of eight) hanging from each radial canal as it joins manubrium (Fig. 1). They produce either eggs or sperm (dioecious).

Cnidae: Stinging cells, characteristic of all cnidarians, (Fig. 4) are found on the manubrium and tentacles. Each contains a poison sac and a stinging thread. According to Arai and Brinckmann-Voss (1980), the cnidoblasts (Fig. 3) are microbasic p-mastigophores in juveniles, and stenoteles and desmonemes in adults. However, there is variation in cnidoblast naming schemes between researchers.

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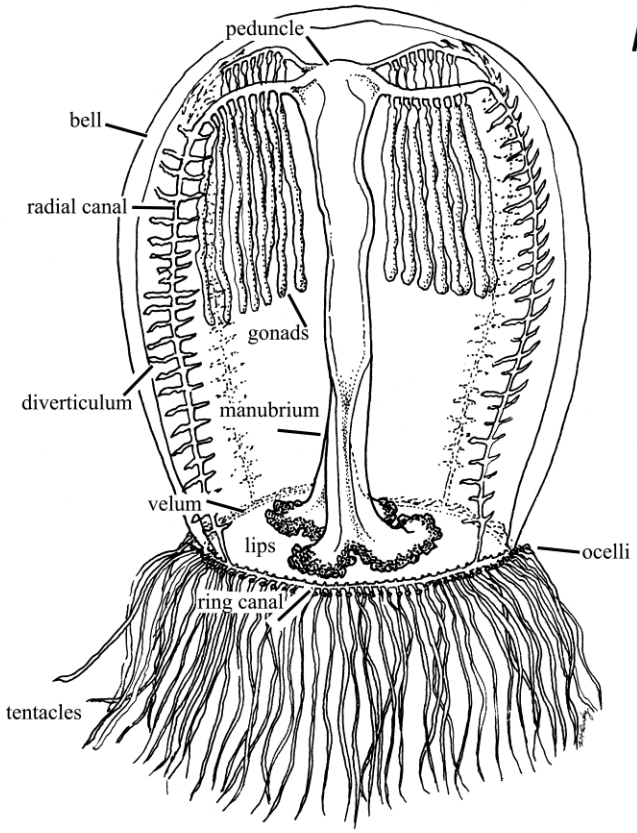
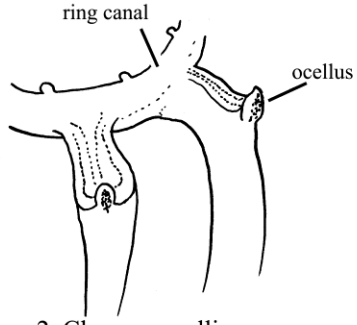
Polyorchis penicillatus



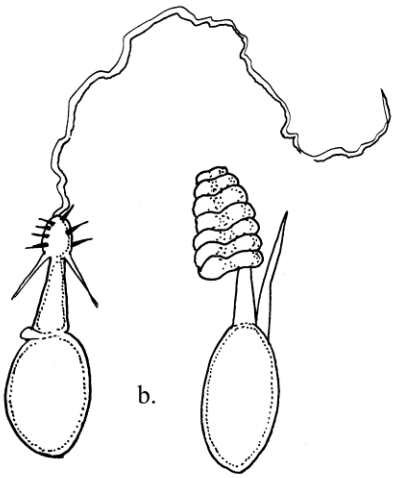
1. *Polyorchis penicillatus* x2: actual size of bell 5 cm high four radial canals, each with 15-25 pairs diverticula; long manubrium; nematocyst-banded lips; 4-11 sausage-shaped gonads; up to 160 tentacles on ring canal.



2. Closeup, ocelli.

3. Cnidoblast.

a.



b.

4. Generalized nematocysts:
a. undischarged.
b. exploded.

Polyp: The polyp form of *P. penicillatus* is unknown. All attempts to raise *P. penicillatus* larvae in the lab have failed. It is possible that the polyp form is symbiotic on or in another organism (Mills et al. 2007).

Possible Misidentifications

The family Polyorchidae includes bell-shaped anthomedusae with deep bodies. Juveniles lack a peduncle, which develops as they mature. Mature specimens also have four fringed oral lips, four radial canals, and gonads with either a sausage or spiral shape (Arai and Brinckmann-Voss 1980).

Two other species of Polyorchidae occur in our area. *Polyorchis haplus* is the smallest of the local Polyorchidae (up to 20 mm high), and has the fewest tentacles (up to 30). It also lacks knob-like diverticula on its radial canals (Mills et al. 2007). *Scrippsia pacifica*, the largest of the family (75 mm high), has a peduncle that reaches halfway down the bell (much longer than *P. penicillatus*). They also have many more tentacles (about 256) that are set in 7 whorls rather than one, and that can attach to the bell above, rather than just at, the radial canal.

Other tall, bell-shaped medusae are either very small (like *Aequorea*, this guide), or have greatly different tentacles or manubrium, as in *Coryne* or *Sarsia.* However, juveniles of *P. penicillatus* and *Sarsia bella* can be mistaken for one another. *Sarsia bella* has radial rows of two vertically aligned nematocyst patches while *P. penicillatus* has at least three patches per row. Additionally, the nematocysts are smaller in *S. bella* than they are in *P. penicillatus* (Brinkmann-Voss 2000).

Ecological Information

Range: The type locality is most likely San Francisco Bay. *Polyorchis penicillatus* has been found from the Aleutian Islands to the Sea of Cortez (Mills et al. 2007).
Local Distribution: Locally, *P. penicillatus* is found in the Coos Bay estuary.
Habitat: Medusae are found in the plankton near the surface of the water. They are often found in protected or shallow bays and around docks (Mills 1981; Mills et al. 2007), as well as in beds of *Zostera* species. (Mills and Strathmann 1987).
Salinity: Collected at salinities of 30.
Temperature: *Polyorchis penicillatus* is found in both cold (Vancouver, British Columbia, Canada) and temperate water (San Francisco, California). However, it has been found as far south as the Gulf of California (Rees and Larson 1980; Mills 2001; Mills et al. 2007).
Tidal Level: Individuals are found throughout the water column, though they spend most of their time within several meters of the bottom.
Associates: *Polyorchis penicillatus* is parasitized by larvae of the sea spider *Achelia alaskensis* in Japan (Russel and Hedgpeth 1990) and by the Hyperiid amphipod *Hyperia medusarum* in Puget Sound, Washington (Towanda and Thuesen 2006).
Abundance: These are the most common large Anthomedusa in our area, but are speculated to be less abundant across their distribution, possibly due to increased urbanization of coastal regions as well as heavy take by scientists for research (Mills 2001).

Life History Information

Reproduction: Like other hydrozoans, *P. penicillatus* has a two-phased reproductive cycle, involving both asexual and sexual stages. Its sexual (medusa) stage is dioecious. Efforts to raise *P. penicillatus* in the lab have produced planula larvae, but they would not settle (Rudy pers. obs.). A single colony of *P. penicillatus* has been described, but was later identified as *Sarsia bella* (Brinkmann-Voss 1977, 2000). The medusae are highly fecund and produce 10,000 eggs a day for much of their lives (Mills 2001). One function of their diel migration could be to synchronize spawning locations. *Polyorchis penicillatus* spawn in the hour immediately after dark, a process that usually lasts less than ten minutes (Arkett 1984). The resulting eggs are transparent and 100 µm in diameter (Mills and Strathmann 1987).
Larva: *Polyorchis penicillatus* produces planula larvae. Planulae are usually oval or club-shaped and ciliated evenly all over their bodies. These larvae are non-feeding and

free-swimming. They are armed with nematocytes, but lack an apical ciliary tuft and septa (see Fig. 3, Sadro 2001).

Juvenile: Juveniles have 24 small, distinct patches of cnidocysts on their exumbrella (the outer surface of the bell). There are six patches per quadrant, arranged in three rows of two and spaced evenly over the surface of the bell. There is a red or a black ocellus on each tentacle bulb. They only have four tentacles, and the bell apex is rounded. They are only 1-2 mm in diameter and have been found around marina floats and over eelgrass beds (Mills et al. 2007).

Longevity: The longevity of *P. penicillatus* is unknown.

Growth Rate: Individuals grow rapidly in the spring, when food is abundant (Larson 1986).

Food: *Polyorchis penicillatus* eats large demersal crustaceans and other planktonic organisms, especially copepods, caprellid and gammarid amphipods, and tanaids (Arkett 1984). They feed in both the water column and on the bottom, using different methods for each (Mills et al. 2007). On the bottom, they perch on their tentacles and eat benthic organisms by touching the sediment with their manubrium. Sometimes, they will hop on the sediment, likely to stir up possible prey or move to a new location (Mills 1981, 2001). In the water column, they use “sink fishing” to find their prey. During sink fishing, the medusae extend their tentacles out from their bell and let the distal ends sink downward. They either maintain their position in the water column or sink slowly and catch prey with their tentacles. When a prey item touches a tentacle, the medusa will use that tentacle to bring the prey to the manubrium, though large prey sometimes require more tentacles; this process causes cessation in swimming and crumpling (Arkett 1984).

Predators: Eaten by the hydromedusa *Aequorea*, as well as fishes, sea anemones (*Urticina* sp., *Pachycerianthus* sp.) and crabs (*Cancer productus*). Most of their predators are benthic (Arkett 1985).

Behavior: Individuals exhibit a small diel migration (based on dusk and dawn) concomitant with demersal plankters. During the day, nearly all the medusae stay within a meter of the bottom, but at night they diffuse throughout the water column, though even then they usually stay within several meters of the bottom. This migration is heavily food-driven (Arkett 1984). They also exhibit a shadow response, in which rapid changes in light trigger a burst of swimming and tentacle contractions. Though this reaction was initially thought to be an escape method (Martin 2002), further research suggests it may be related to their diel migration (Arkett 1985). Additionally, this response does not occur in young medusae (Arkett 1985).

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