

Pygospio elegans

A spionid polychaete worm

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

Taxonomy: Several subjective synonyms (synonyms based on individual opinion) are indicated for *Pygospio elegans*, but rarely used (*Spio inversa*, *S. rathbuni*, *S. seticornis* and *Pygospio mimutus*).

Description

Sexual Dimorphism: Males may have small pair of elongated dorsal cirri (sometimes called "auxiliary gills") on setiger two (*Pygospio*, Blake 1975) which are often lost in collection.

Size: Individuals range in size from 10–15 mm in length, having 50–60 segments (Light 1978). This specimen (from Coos Bay) is 5 mm in length, 0.3 mm in width and has 36–37 segments (Fig. 1).

Color: Light, almost white with black markings on anterior segments (Fig. 2), but not on proboscis (Light 1978).

General Morphology: Body slightly flattened dorsolaterally. Fifth setiger normal and not strongly modified as is common among spionids.

Body: The body can be divided into four major regions (from anterior to posterior) including the anterior or head, the thorax and abdomen and, finally, the tail or posterior (Gibson and Harvey 2000).

Anterior: Anterior with two massive short dorsolaterally grooved palps (Figs. 1, 5), which are often lost during collection. Prostomium is without horns, is blunt anteriorly, with lateral swellings and is slightly bi-lobed in some specimens. Anterior is not conical but taper slightly (sp. *elegans*) (Fig. 2). Paired nuchal organs present (Gibson and Harvey 2000, Fig. 1).

Trunk: Thorax with 10–12 abranchiolate setigers where each setiger has a dorsal ciliary band and a lateral tuft of cilia. The abdomen is composed of 25–35 setigers where

each segment has paired branchiae, a ciliary band (single or double) and two bands of tufted cilia (Gibson and Harvey 2000).

Posterior: Pygidium with four pigmented conical cirri (sp. *elegans*) (Fig. 3), each possessing inner tufts of cilia (Gibson and Harvey 2000).

Parapodia: Biramous, with cirriform lobes beginning on the second setiger, and diminishing posteriorly. Neuropodia without interramal pouches.

Setae (chaetae): Notopodia with capillary setae only. Neuropodia with simple capillary setae on setigers 1–8 and spoon-like hooded hooks beginning on setigers eight and nine (sp. *elegans*) (Fig. 4).

Eyes/Eyespots: Four eyes present. Anterior pair widely separated and lighter in color than distal pair (Fig. 2). Some individuals have 2–8 eyespots, irregularly arranged along segments (Light 1978).

Anterior Appendages: Two thick grooved palps antero-laterally are used in feeding. They are relatively short and thick as compared to the palps of other spionids.

Branchiae: Numerous branchial pairs, first appearing on setigers 11–13. No branchiae on posterior-most segments.

Burrow/Tube: Tube morphology is species-specific. It is long, papery, clear, covered with fine sand grains and approximately 1 mm in diameter (Bolam 2004) (Fig. 5).

Pharynx: Bears proboscis with a partially eversible conical sac.

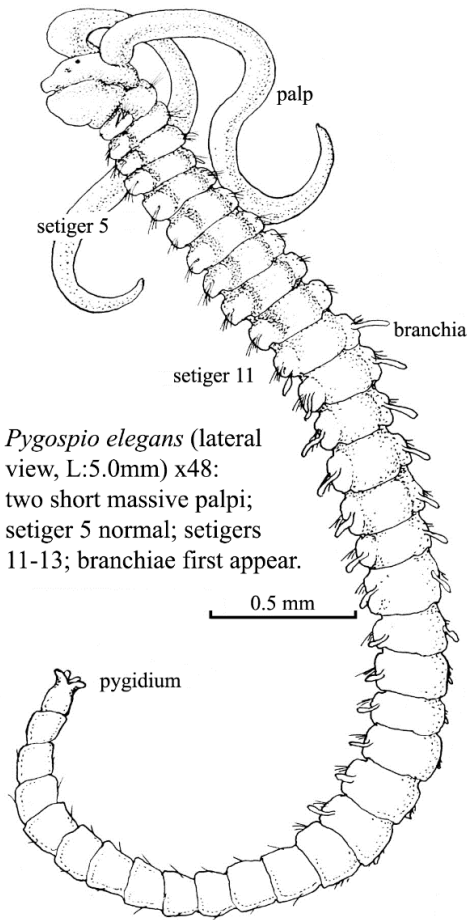
Genitalia:

Nephridia:

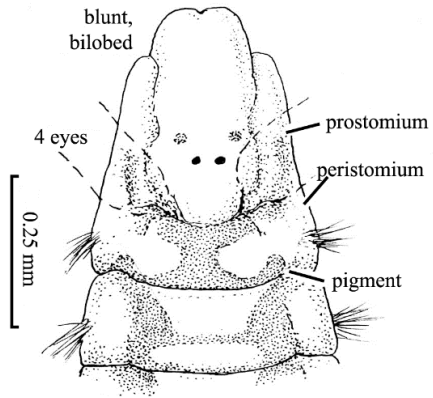
Possible Misidentifications

Spionidae can be distinguished by a pair of long prehensile grooved palps which arise from the posterior peristomium (Blake

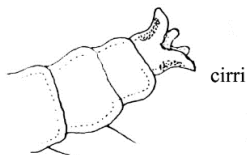
Pygospio elegans



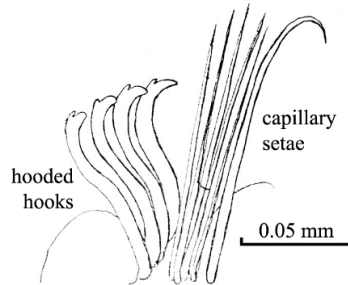
1. *Pygospio elegans* (lateral view, L:5.0mm) x48: two short massive palpi; setiger 5 normal; setigers 11-13; branchiae first appear.



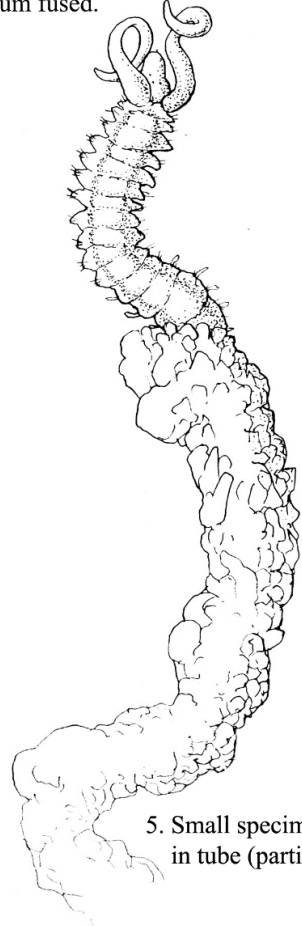
2. Prostomium, anterior segments x100: strong pigment pattern; prostomium, peristomium fused.



3. Pygidium x75: conical cirri.



4. Setae from midsection neuropodium x350.



5. Small specimen in tube (partial) x48.

1996). Two other polychaete families have long palps: the Magelonidae, with adhesive palps (not long and flowing) and with flattened spade-like prostomiums and the Chaetopteridae, which have palps, but their bodies are very obviously divided into three quite different regions, which is not the case in spionids. The similar family Cirratulidae, may also have a large pair of palps, but they have tentacular filaments, which are lacking in the spionids. Spionids also have hooded hooks in posterior segments, may or may not have prostomial appendages or branchiae, the prostomium is well developed and fused with peristomium, the pharynx is without jaws and the setae are mostly simple (Blake 1975). Often certain segments are highly modified and have special setae, for example prostomial horns are present in some genera. Spionid parapodia are biramous, with acicula (see *Leitoscoloplos pugettensis*) and sometimes have stout saber setae. There are 19 local spionid genera (Blake and Ruff 2007).

The genus *Pygospio* is characterized by branchiae beginning posterior to setiger 10 and species lack the dramatically modified fifth setiger of some spionids. *Pygospio californica* is the most closely related species to *P. elegans*. It is green in life and is twice the size of *P. elegans* (Hartman 1969). *Pygospio californica*'s prostomium has a tapered conical tip and is not bi-lobed. Furthermore, *P. californica* has a narrow caruncle that reaches to the first setiger, where *P. elegans* has no caruncle. Brown spots exist on the proboscis in *P. californica* and 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 and the only record in Oregon is from Umpqua estuary, it is currently only reported from central California (Blake and Ruff 2007).

Other small tube dwelling spionids include the genus *Polydora*, whose tubes are mucoid (Hartman 1969), and *Pseudopolydora kempii*, which also has a mucoid tube, a J-shaped row of falcigers on setiger five and a cup-shaped pygidium.

Ecological Information

Range: Known range includes the northern Atlantic, northern Pacific and western Canada to California (Light 1978).

Local Distribution: Coos Bay collection sites include South Slough. Individuals also collected in the Columbia River estuary.

Habitat: Lives in papery sandy tubes in mud or sand flats and is considered an indicator species for slight organic pollution (domestic sewage, Germany (Anger 1977)). Their ability to eat suspended as well as deposited matter increases survivability in variable environments (Taghon et al. 1980) (see **Food**).

Salinity: Found at salinities ranging from 30 to 28 in Coos Bay, but also tolerant of salinities as low as 2 (Bolam 2004; Blake 2006).

Temperature:

Tidal Level: Only occurring at high tide level in Coos Bay.

Associates: Associated species include the sabellid polychaete, *Chone ecuadata* (Blake and Ruff 2007).

Abundance: South Slough, June abundance was measured in cores (15 cm diameter x 13 cm depth) at three tidal heights. High intertidal core (1 m MLLW) produced 5–7 animals, mid intertidal (1 m MLLW) produced 6–16 animals and low intertidal (0.9 m MLLW), 13–20 animals. This species is most abundant in April (Posey 1985).

Life-History Information

Reproduction: Both sexual and asexual (by fragmentation or architomy) reproduction have been reported for *P. elegans* (Blake and Arnofsky 1999). Asexual reproduction has been shown to increase in frequency with warmer water temperatures (Armitage 1979; Rasmussen 1953). Spermatophores are mushroom-shaped and have a long tail (Blake and Arnofsky 1999). Eggs are released through nephridial pores into egg capsules within the adult tube (Soderstrom, (Hartman 1941)). Asexual reproduction occurs in March–October while sexual reproduction takes place in winter months (November–December) in False Bay, Washington (Fernald et al. 1987). However, sexual reproduction has been reported in Coos Bay in April. Larvae are adelphophagic, ingesting

the unfertilized nurse eggs with which they share a cocoon.

Larva: *Pygospio elegans* larval development proceeds in a variety of ways (as in *Pseudopolydora kempfi*) and has been confirmed to be variations across a single species (= poecilogony, Blake and Arnofsky 1999; Morgan et al. 1999; Blake 2006; Kesäniemi et al. 2012). Larvae can ingest nurse eggs and hatch from their capsule at the 3-setiger stage and live as planktonic larvae before settling at 17–20 setiger stage. On the other hand, larvae can remain in the egg capsule until they are large and hatch out as a non-pelagic larva (Blake 2006, Fig. 13.17). These varying developmental modes may correspond to season, where planktotrophic larvae are more common in spring (Rasmussen 1973; Fernald et al. 1987). Larval characters include, lack of modification on setiger five, prostomium not distally pointed, with frontal horns and branchiae limited to middle and posterior most setigers (except setiger two in males) (Crumrine 2001).

Juvenile:

Longevity: High mortality when disturbed by castings of polychaete *Abarenicola* (Wilson 1981).

Growth Rate: *Pygospio elegans* can fully regenerate their anterior including prostomium and palps in 9–12 days post ablation (Lindsay et al. 2007).

Food: A deposit, suspension and filter feeder, searching mud surface and water for food. Individuals can switch from deposit to suspension feeding when water flow velocity increases (Taghon et al. 1980). A most versatile feeder, *P. elegans* can filter feed by building a mucus net within or above its tube (Fauchald and Jumars 1979; Bolam 2004).

Predators: Fish and shorebirds are major predators because this species lives at high tide level.

Behavior: Moves tube when disturbed by activity of the large lugworm *Abarenicola* sp. (Wilson 1981). Dense patches or aggregations of *P. elegans* are ephemeral, but have a significant effect on the immediate infaunal community (Bolam and Fernandes 2003).

Bibliography

1. ANGER, K. 1977. Benthic invertebrates as indicators of organic pollution in the Western Baltic Sea. *Internationale Revue der Gesamten Hydrobiologie und Hydrographie*. 62:245-254.
2. ARMITAGE, D. L. 1979. The Ecology and reproductive cycle of *Pygospio elegans* Claparède (Polychaeta: Spionidae) from Tomales Bay, California: A Thesis. University of the Pacific.
3. 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.
4. —. 1996. Family Spionidae, p. 81-224. *In: Taxonomic atlas of the benthic fauna of the Santa Maria Basin and Western Santa Barbara Channel*. Vol. 6. J. A. Blake, B. Hilbig, and P. H. Scott (eds.). Santa Barbara Museum of Natural History, Santa Barbara, CA.
5. BLAKE, J. A. 2006. Spionida, p. 565-638. *In: Reproductive biology and phylogeny of annelida*. Enfield, Science Publishers. Vol. 4. Science Publishers, Enfield.
6. BLAKE, J. A., and P. L. ARNOFSKY. 1999. Reproduction and larval development of the spioniform polychaeta with application to systematics and phylogeny. *Hydrobiologia*. 402:57-106.
7. BLAKE, J. A., and E. R. RUFF. 2007. Polychaeta, p. 309-410. *In: Light and Smith manual: intertidal invertebrates from central California to Oregon*. J. Carlton (ed.). University of California Press, Berkeley, CA.
8. BOLAM, S. G. 2004. Population structure and reproductive biology of *Pygospio elegans* (Polychaeta: Spionidae) on an intertidal sandflat, Firth of Forth, Scotland. *Invertebrate Biology*. 123:260-268.
9. BOLAM, S. G., and T. F. FERNANDES. 2003. Dense

- aggregations of *Pygospio elegans* (Claparede): effect on macrofaunal community structure and sediments. *Journal of Sea Research*. 49:171-185.
10. CRUMRINE, L. 2001. Polychaeta, p. 39-77. *In: Identification guide to larval marine invertebrates of the Pacific Northwest*. A. Shanks (ed.). Oregon State University Press, Corvallis, OR.
 11. FAUCHALD, K., and P. A. JUMARS. 1979. Diet of worms: a study of polychaete feeding guilds. *Oceanography and Marine Biology*. 17:193-284.
 12. FERNALD, R. L., C. O. HERMANS, T. C. LACALLI, W. H. WILSON, JR, and S. A. WOODIN. 1987. Phylum Annelida, Class Polychaeta, p. 138-195. *In: Reproduction and development of marine invertebrates of the northern Pacific coast*. M. F. Strathmann (ed.). University of Washington Press, Seattle, WA.
 13. GIBSON, G. D., and J. M. L. HARVEY. 2000. Morphogenesis during asexual reproduction in *Pygospio elegans* Claparede (Annelida, Polychaeta). *Biological Bulletin*. 199:41-49.
 14. HARTMAN, O. 1941. Polychaetous annelids. Part III. Spionidae. Some contributions to the biology and life history of Spionidae from California. Allan Hancock Foundation of Scientific Research. Allan Hancock Pacific Expeditions. Reports. 7:299.
 15. —. 1969. Atlas of the sedentariate polychaetous annelids from California. Allan Hancock Foundation, University of Southern California, Los Angeles, CA.
 16. KESÄNIEMI, J. E., P. D. RAWSON, S. M. LINDSAY, and K. E. KNOTT. 2012. Phylogenetic analysis of cryptic speciation in the polychaete *Pygospio elegans*. *Ecology and Evolution*. 2:994-1007.
 17. LIGHT, W. J. 1978. Spionidae: Polychaeta, Annelida. Boxwood Press, Pacific Grove, CA.
 18. LINDSAY, S. M., J. L. JACKSON, and S. Q. HE. 2007. Anterior regeneration in the spionid polychaetes *Dipolydora quadrilobata* and *Pygospio elegans*. *Marine Biology*. 150:1161-1172.
 19. MORGAN, T. S., A. D. ROGERS, G. L. J. PATERSON, L. E. HAWKINS, and M. SHEADER. 1999. Evidence for poecilogony in *Pygospio elegans* (Polychaeta: Spionidae). *Marine Ecology Progress Series*. 178:121-132.
 20. POSEY, M. H. 1985. The effects upon the macrofaunal community of a dominant burrowing deposit feeder, *Callianassa californiensis*, and the role of predation in determining its intertidal distribution. Ph.D. University of Oregon.
 21. RASMUSSEN, E. 1953. Asexual reproduction in *Pygospio elegans* Claparede (Polychaeta sedentaria). *Nature*. 171:1161-1162.
 22. —. 1973. Systematics and ecology of the Isefjord marine fauna (Denmark) with a survey of the eelgrass (*Zostera*) vegetation and its communities. *Ophelia*. 11:1-507.
 23. TAGHON, G. L., A. R. NOWELL, and P. A. JUMARS. 1980. Induction of suspension feeding in spionid polychaetes by high particulate fluxes. *Science (New York, N.Y.)*. 210:562-4.
 24. WILSON, W. H. 1981. Sediment-mediated interactions in a densely populated infaunal assemblage; the effects of the polychaete *Abarenicola pacifica*. *Journal of Marine Research*. 39:735-748.