

An Analysis on Reproduction and Growth of polychaetas



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Abstract

Review of spioniform polychaetes' reproduction and larval growth. Only eight species of the genus *Pygospio* and a few polydorids have been recorded to reproduce asexually. It is known that there are minor species of *Pseudopolydora* (also known as *Polydorella*) and one species of *Polydora* that only exhibit paratomy. In *Pygospio elegans*, architomy is frequently the major method of reproduction, which helps to maintain huge populations. Spioniforms have two types of oogenesis (extraovarian and intraovarian), three types of eggs (thin egg envelopes, thick egg envelopes, smooth or reticulated, and thick egg envelopes, honeycombed), and two types of sperm (ect-aquasperm and introsperm). Specific clades only have certain egg and sperm types. Eggs with thickened egg envelopes seem to be unique to spioniforms, but eggs with thin egg envelopes are present in other polychaete groups. This suggests that spionids have plesiomorphic thin egg envelopes. Spermatophores develop in the male nephridia of the spionid subfamily Spioninae. Spioniforms display a variety of reproductive and larval patterns, such as broadcast spawning, external egg masses, female capsule brooding, and female body brooding. In the Spionidae, poecilogony is unusually prevalent. A phylogenetic analysis shows that reproductive and larval traits, together with a few adult characters, offer a more comprehensive database than only adult morphology for assessing systematic and phylogenetic links. The Spionidae are paraphyletic, according to preliminary parsimony studies, hence the definition of the family and the status of related spioniform polychaetes need to be revised with relation to family level classification.

Keywords: polychaetes, larval growth, Spioniforms, Internal anatomy and physiology

Introduction

Polychaetes exhibit a remarkable array of reproductive characteristics. Congeneric species frequently have significantly diverse reproductive strategies. One maldanid species, *Axiothella mucosa*, develops masses of gelatinous eggs that are connected to the female tube. Sibling species of *A. rubrocincta* both free spawn demersal eggs and rear their young inside their tubes, respectively. Their success in the marine environment has probably been aided by the versatility of polychaete life cycles. Despite a sizable body of work on polychaetes' reproductive characteristics, no attempt has been made to study the distribution of reproductive modes throughout orders and families. Fauchald (1983) categorized polychaetes usually into three reproductive life modes, despite the existence of many intermediate species that are challenging to categorize. My method classifies reproductive modes more precisely. Each session includes two reproduction-related topics. The first one is about what happens to the eggs, namely whether they are spawned freely into the ocean or are protected or enclosed as brood. The second factor has to do with the kind of larval development: direct (no free-swimming larval phase), planktotrophic (planktonic feeding larvae), or lecithotrophic (planktonic, non-feeding larvae). Using information from 306 species, the distribution of these modes within the orders and families of the Polychaeta is studied.

Numerous polychaete groups have been identified as sponge companions, either residing on or within the tissue of the sponges that serve as their hosts (Martin and Britayev, 1998). All *Polydorella* Augener, 1914 members of the family Spionidae are associated with sponges and build mud tubes on the surface of their hosts. In the Indo-West Pacific, the genus *Polydorella* now has four species: *Polydorella novaegraegiae*, another species from the Solomon Islands reported by Gibbs in 1971, actually belongs to the genus *Pseudopolydora*, according to Radashevsky in 1996. This is the conclusion that is used in this article. Some authors have placed the genus *Polydorella* in synonymy with *Pseudopolydora* Czerniavsky, 1881. However, according to Tzetlin and Britayev (1985), *Polydorella* constitutes a separate group based on morphology, and provided evidence to support this conclusion with studies on the ecology and reproduction. As a result, there are currently nine polydorid genera—an informal classification within the Spionidae—that have a global distribution and are recognized from a variety of maritime settings. Within the Spionidae, paratomy is a rather uncommon method of asexual reproduction; just five species have been identified. All *Polydorella* species reproduce through paratomy, a process in which a growth zone forms after segment 10 or 11 and eventually results in the development of a new individual (stolon) connected to the parental (stock) individual. Thus, a chain can be joined by up to five people before being divided. Single *Polydorella* species have a minimal and relatively consistent number of segments due to this type of asexual reproduction (14–16 segments). The best research on paratomic division has been done on *P. dawydoffi* and *P. smurovi*, however *Dipolydora tetrabranchia* has also been noted. For the spionid *Pygospio elegans* Clapare'de, 1863, asexual reproduction by architomy (production of offspring through fragmentation of a parental organism into segments followed by subsequent regeneration) has been well studied. Six spionids' architomy and regeneration were described by Stock (1965).

Internal anatomy and physiology

The outer surface of the body wall consists of a simple columnar epithelium covered by a thin cuticle. A thin layer of connective tissue, a layer of circular muscle, a layer of longitudinal muscle, and a peritoneum enclosing the body cavity are all found underneath this. Added oblique muscles are used to move the parapodia. The bodily cavity is often segmented into distinct compartments by sheets of peritoneum, however in some species it is more continuous.

Since polychaetes include predators, herbivores, filter feeders, scavengers, and parasites, their mouths vary in shape and are situated on the peristomium, the portion of the body behind the prostomium. However, they often have a set of jaws and a quickly everting pharynx that enable the worms to seize food and draw it into their mouths. The pharynx of some species has been transformed into a long proboscis. The digestive tract is a straightforward tube that typically has a stomach halfway down it.

The tiniest species and those that are best suited for digging lack gills and simply have surface-based breathing. The majority of other species have parapodia-associated external gills. The circulatory system is normally simple but well-developed. The parapodia and the gut are supplied

by lesser vessels from the two major blood vessels. The dorsal vessel, located above the gut, carries blood forward, and the ventral vessel, located beneath the gut, carries blood back down the body. Most species do not require a heart because the blood arteries themselves can contract and move the blood along. However, in a few instances, the system contains multiple locations where muscular pumps similar to a heart can be detected. In contrast, some animals have a minimal or nonexistent circulatory system, relying instead on the coelomic fluid that fills their body cavities to deliver oxygen.

Any one of three distinct respiratory pigments, or neither, may be present in the blood. The most prevalent of them is hemoglobin, although certain groups also have hamemerythrin or chlorocruorin, which has a green color. The nervous system is made up of ganglia and a number of tiny nerves in each segment of a single or double ventral nerve cord that runs the length of the body. The brain is located at the top of the head and is relatively large when compared to the brains of other annelids. The ventral posterior surface of the brain is home to an endocrine gland that is believed to play a role in reproduction. Along with the sensory organs on the head, the body also has photosensitive eye spots, statocysts, and countless other sensory nerve endings that are probably related to touch.

For excreting waste, polychaetes have a variable number of protonephridia or metanephridia, some of which can have a quite complex structure. A greenish "chloragogen" tissue found in the body that resembles that of oligochaetes and appears to operate in metabolism similarly to the liver of vertebrates is also present. Collagen cross-linked fibers form the cuticle, which can range in thickness from 200 nm to 13 mm. Their setae and jaws are made of sclerotized chitin and collagen, respectively.

Conclusion

More thoroughly than is possible for most families of polychaetes, phylogenetic and systematic relationships can be tested using the substantial literature on reproduction and development of spioniforms. The Sabellidae represent the best attempt to date (Rouse & Fitzhugh, 1994). These studies also allow for the testing of more general hypotheses, including those that have been established regarding the evolution of invertebrate life histories, the evolution of reproductive processes, and general beliefs regarding the primitive origins of sperm, eggs, modes of spawning, brood protection, and larval nutrition. Phylogenetic approaches for evaluating life history attributes may render many enduring ideas erroneous, according to a recent overview of these subjects. Without a doubt, this is the route future spioniform research must go. The preliminary phylogenetic synthesis presented here implies that current ideas about systematic relationships need to be changed and makes extensive use of data gathered over the previous century. However, there will need to be much more data developed than what is now available on only four species in order to test more general conceptions of evolutionary orientations in oogenesis, vitellogenesis, and egg morphology among the spioniforms.

References

1. Allen, E. J., 1904. The anatomy of *Poecilochaetus* Claparède. *Q. J. Micr. Sci.*, n. ser. 48: 79–151.
2. Anger, V., 1984. Reproduction in *Pygospio elegans* (Spionidae) in relation to its geographical origin and to environmental conditions: a preliminary report. In Fischer, A. & H.-D. Pfannenstiel (eds), *Polychaete Reproduction: Progress in Comparative Reproductive Biology*. *Fortschr. Zool.* 29: 45–51.
3. Armitage, D. L., 1979. The ecology and reproductive cycle of *Pygospio elegans* Claparède (Polychaeta: Spionidae) from Tomales Bay, California. M.S. Thesis, University of the Pacific, Stockton, California. 81 pp.
4. Augener, H., 1914. Polychaeta II, Sedentaria. *Fauna SüdwestAustraliens* 5(1): 1–170.
5. Berkeley, E. & C. Berkeley, 1961. Notes on Polychaeta from California to Peru. *Can. J. Zool.* 39: 655–664.
6. Bhaud, M. R., 1967. Étude du développement de quelques larves d'Annélides Polychètes à Banyuls-Sur-Mer. *Vie Milieu* 18: 531–558.
7. Blake, J. A., 1965. Spionid polychaetes from Morro Bay, California: A Taxonomic and Biological Study. M.A. Thesis, California State University, Fresno. 55 pp., 10 pls.
8. Blake, J. A., 1969. Reproduction and larval development of *Polydora* from northern New England (Polychaeta: Spionidae). *Ophelia* 7: 1–63.
9. Blake, J. A., 1983. Polychaetes of the family Spionidae from South America, Antarctica and adjacent seas and islands. *Biology of Antarctic Seas XIV*. *Antarct. Res. Ser.* 39: 205–288.
10. Blake, J. A., 1993. Life history analysis of five dominant infaunal polychaete species from the continental slope off North Carolina. *J. mar. biol. Ass. U. K.* 73: 123–141.
11. Blake, J. A., 1994. Chapter 3. Introduction to the Polychaeta. In Blake, J. A. & B. Hilbig (eds), *Taxonomic Atlas of the Benthic Fauna of the Santa Maria Basin and Western Santa Barbara Channel*. Vol. 4. The Annelida Part 1. Oligochaeta and Polychaeta: Phyllodocida (Phyllodocidae to Paralacydoniidae) Santa Barbara Museum of Natural History: 39–114.
12. Blake, J. A., 1996. Chapter 4. Family Spionidae. In Blake, J. A., B. Hilbig & P. H. Scott (eds), *Taxonomic Atlas of the Santa Maria Basin and Western Santa Barbara Channel*. Vol. 6. Annelida Part 3. Polychaeta: Orbiniidae to Cossuridae. Santa Barbara Museum of Natural History, 81–223. Blake, J. A. & J. D.
13. Kudenov, 1978. The Spionidae (Polychaeta) from southeastern Australia and adjacent areas, with a revision of the genera. *Mem. nat. Mus. Victoria* 39: 171–280.
14. Blake, J. A. & J. D. Kudenov, 1981. Larval development, larval nutrition and growth for two *Boccardia* species (Polychaeta: Spionidae) from Victoria, Australia. *Mar. Ecol. Progr. Ser.* 6: 175–182.
15. Blake, J. A. & L. Watling, 1994. Life history of deep-sea benthic infauna: Studies on Polychaeta, Aplacophora, and Cumacea from the continental slope off Massachusetts. In

- Young, C. M. & K. J. Eckelbarger (eds), *Reproduction, Larval Biology and Recruitment in the Deep-Sea Benthos*. Columbia Univ. Press, New York, 243–260.
15. Blake, J. A. & K. H. Woodwick, 1975. Reproduction and larval development of *Pseudopolydora paucibranchiata* (Okuda) and *Pseudopolydora kempfi* (Southern) (Polychaeta: Spionidae). *Biol. Bull.* 149: 109–127.
 16. Bochert, R., 1996a. An electron microscopic study of oogenesis in *Marenzelleria viridis* (Verrill, 1873) (Polychaeta: Spionidae) with special reference of large cortical alveoli. *Invert. Repro. Dev.* 29: 57–69.
 17. Bochert, R., 1996b. An electron microscopic study of spermatogenesis in *Marenzelleria viridis* (Verrill, 1873) (Polychaeta: Spionidae). *Acta zool.* 77: 191–199. Bochert, R., 1997. *Marenzelleria viridis* (Polychaeta: Spionidae): a review of its reproduction. *Aquat. Ecol.* 31: 163–175.
 18. Bochert, R. & A. Bick, 1995. Reproduction and development of *Marenzelleria viridis* (Polychaeta: Spionidae). *Mar. Biol.* 123: 763–773.
 19. Borowski, C., 1995. New records of Longosomatidae (Heterospionidae) (Annelida, Polychaeta) from the abyssal southeast Pacific, with description of *Heterospio peruana* sp. n. and general remarks on the family. *Mitt. hamb. zool. Mus. Inst. Ergänzungsband* 1, 92: 129–144.
 20. Bregenballe, F., 1961. Plaice and flounder as consumers of the microscopic bottom fauna. *Meddr. Dann. Fisk.-og Havunders.*, n. ser. 3(6): 133–182. Bridges, T. S., 1993. Reproductive investment in four developmental morphs of *Streblospio* (Polychaeta: Spionidae). *Biol. Bull.* 84: 144–152.
 21. Buzhinskaja, G. N. & L. L. Jørgensen, 1997. Redescription of *Trochochaeta carica* (Birula, 1897) (Polychaeta, Trochochaetidae) with notes on its reproductive biology and larvae. *Sarsia* 82: 69–75.
 22. Campbell, M. A., 1955. Asexual reproduction and larval development in *Polydora tetrabranchia* Hartman. Ph.D. Dissertation, Duke University. 67 pp. + 35 pls.
 23. Carpenter, J. M., 1988. Choosing among multiple equally parsimonious cladograms. *Cladistics* 4: 291–296.
 24. Carrasco, F. D., 1976. Larvas de la familia Spionidae (Polychaeta) en el plancton de la Bahía de Concepcion, Chile. *Gayana Zool.* 38: 1–63.
 25. Casanova, L., 1952. Sur le développement de *Polydora antennata* (Claparède). *Arch. Zool. exp. Gén.* 89: 95–101. Cazaux, C., 1971. Développement larvaire de *Microspio mecnikowianus*. In Crisp, D. J. (ed.), *Fourth European Marine Biology Symposium*. Cambridge University Press, Cambridge, 247–257.
 26. Cazaux, C., 1985. Reproduction et développement larvaire de l'annélide polychète saumâtre *Streblospio shrubsolii* (Buchanan, 1890). *Cah. Biol. mar.* 26: 207–221.
 27. Cerruti, A., 1908. Ricerche sulla anatomia e sulla biologica del *Microspio mecnikowianus* Claparède, con speciale riguardo di nefridi. *Atti della Reale Accademia della Scienze fisiche e matematiche Napoli, series 2, vol. 13(12): 1–35.*

28. Claparède, E. & E. Meczniow, 1869. Beiträge zur Kenntniss der Entwicklungsgeschichte der Chaetopoden. Z. wiss. Zool. 19: 163–205.
29. Clark, R. B., 1977. Reproduction, speciation and polychaete taxonomy. In Reish, D. J. & K. Fauchald (eds), Essays on Polychaetous Annelids in Memory of Dr Olga Hartman. Allan Hancock Foundation, University of Southern California, Los Angeles, 477–501.

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