COMMON HAWAIIAN POLYCHAETE LARVAE

Linda A. Ward

WORKING PAPER NO. 32

May 1978

SEA GRANT COLLEGE PROGRAM

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ABSTRACT

An 18-month study (February 1975 to July 1976) was conducted to identify the larval stages of polychaetes frequently encountered in plankton samples off Oahu, Hawaii. A fixed plankton net (125-μ mesh) was used to sample the plankton in the Ala Wai Canal (McCully Street bridge area) bimonthly and occasional plankton tows were made by boat in Kaneohe Bay and off the south shore of Oahu. In the laboratory, live polychaete larvae were separated from the plankton and maintained in petri dishes. Representative specimens were preserved for future study. Descriptions and drawings of the larvae and taxonomic keys to the families of polychaetes and species of Polydora *and* Pseudopolydora *(family Spionidae) were made. A list of references dealing with polychaete larvae from other locations throughout the world is included.*

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INTRODUCTION

Polychaetes (worms with paired segmental appendages and with setae) are important constituents of tropical reef communities. They are vital as: (1) a food source for other organisms, (2) predators, and (3) borers and foulers of hard substrata. Polychaetes frequently occur in very high densities: Kohn and Lloyd (1973) found 49,000 polychaetes/m^2 on the shallow reefs of the Indian Ocean; Brock and Brock (1977) recorded 50,000 to 127,900 polychaetes/m^2 in samples of coral rubble collected from Kaneohe Bay, Oahu, Hawaii. At such high densities they are often important links in the trophic chain.

The diet of some reef fishes and invertebrates is known to consist almost exclusively of polychaetes. Hiatt and Strasburg (1960) found that in the Marshall Islands polychaetes are highly utilized as food items by certain reef fishes, including members of the families Holocentridae, Dussumieridae, Hemiramphidae, and Priacanthidae. Polychaetes are the most common food organism for seven species of Caribbean reef fishes including *Chaetodon striatus* and *Halichoeres maculippina*, comprising 58.7 percent and 47.1 percent of their diet, respectively (Randall, 1967). Kohn (1959) observed that of the 16 species of *Conus* ("cone shells") collected from the reef platforms of the Hawaiian Islands, 10 species feed exclusively on polychaetes. In addition, polychaetes comprise a lesser, but significant part of the diet of three additional species of *Conus*. Together these thirteen species of *Conus* prey on at least 23 different species of mobile and sedentary polychaetes.

The feeding methods of polychaetes are varied, ranging from filtration and suspension feeding to active predation. The common families are characterized by particular feeding types. Syllids feed by piercing the bodywall and extracting the internal fluids of the prey. Nereids, which are omnivores, use their mouth parts to grasp such prey as amphipods and other polychaetes or to rasp algae from hard substrata. Spionids select food particles from the substratum using a pair of prostomial palps. Filter-feeders such as the serpulids use their ciliated branchial crown to strain particles from the surrounding water (Day, 1967).

Many polychaetes are of economic importance because of their ability to settle on or bore into various substrata. Serpulids are calcareous tube-building worms. Some, such as *Hydroides elegans* and *Hydroides dirampha*, are of interest because they foul ship hulls, pier pilings, water intake pipes, and other marine structures (Bailey-Brock, 1976). Some spionids of the genera *Polydora* and *Boccardia* (Blake and Evans, 1973) and the cirratulid *Dodecaceria* sp. (Blake, 1969b) are known to bore into the shells of mollusks. Of particular concern to oyster culturists in Hawaii and throughout the world is the spionid *Polydora websteri* which bores into the shells of a number of species of oyster. While the worm does not eat or directly harm the oyster, it does weaken the shell. The worm can also render the oyster unmarketable by lining its tube with mud and fecal pellets which are collected from the surrounding area and which may contain high concentrations of bacteria such as *Escherichia coli*.

In order to understand the geographic distribution of adult worms and the polychaete communities typical of tropical reefs and temperate seas, a study of the larval forms is necessary. Seasonal plankton collections in a study area can provide data on the polychaete larvae present, as well as on their spatial and temporal distribution. This is useful for population studies and for monitoring species occurrence. To date most of the work on larval polychaetes has been concerned with fouling types, particularly the sedentary tube-builders (Serpulidae and Sabellariidae) in temperate waters.

There is no previous literature available on Hawaiian polychaete larvae. The greatest portion of work on polychaete larvae has been conducted in Europe and deals with temperate species--their development, settlement behavior, and metamorphosis.

British investigators of polychaete larvae include D.P. Wilson who has studied the larval development of sabellariids (1929, 1968a, 1968b, 1970a, 1970b, 1976) and other worms such as the spionids, *Polydora ciliata* and *Polydora hoplura* (1928); the nereid, *Nereis pelagic* (1932); and the capitellid, *Notomastus latericeus* (1933). Wilson also investigated the influence of substrate type on the settlement and metamorphosis of the capitellid, *Notomastus latericeus* (1937), and the opheliid, *Ophelia bicornis* (1948, 1953, 1954, 1955). Other British researchers (e.g., de Silva, 1962; Gee, 1965; Knight-Jones, 1951, 1953; Knight-Jones et al., 1971; Stebbing, 1972; Williams, 1964; Wisely, 1960) have studied the chemical stimuli for, and behavior during, the settlement of serpulid larvae. Many of the references dealing with the larvae of temperate water polychaetes have been included in this paper for taxonomic purposes.

Although tropical polychaetes are important on reefs, there has been little research on their larval development, reproductive seasonality, and settlement behavior. Marsden (1960) described eight species of polychaete larvae from the Caribbean, and Eckelbarger (1975, 1976) investigated the development of two species of sabellariids from the reefs off the eastern coast of Florida. These papers are among the few relevant works on tropical or near tropical polychaetes and their larvae. Additional research on tropical species is necessary to establish the effects of year-round warm water temperatures and continuous productivity on the reproductive biology of polychaetes.

Because of the rapid development of aquaculture in tropical regions and because of the economic importance of polychaetes as pests of aquaculture organisms, further investigation of tropical polychaetes is needed. Before detailed studies can be conducted, however, it is necessary to be able to identify the larvae.

The following articles, which contain descriptions and illustrations of a broad range of polychaete larvae, have been utilized during the course of this study and are included here for their general usefulness: Bhaud, 1967; Blake, 1975a; 1975b, 1975c; Fewkes, 1883; Dawydoff, 1959; Hannerz, 1956, 1961; Marsden, 1960; Nolte, 1942; Thorson, 1946; and Vannucci, 1959.

This paper is intended as a compendium of information on polychaete larvae with particular emphasis on those most frequently encountered in Hawaiian plankton, including a taxonomic key to the families. This paper, and the references cited in it, provides a starting point for any future investigations of Hawaiian polychaete larvae.

MATERIALS AND METHODS

Polychaete larvae were obtained by two methods: tows with a plankton net (mesh aperture 125μ); and laboratory fertilization of gametes from ripe adults.

A fixed plankton net was used to sample the plankton in the Ala Wai Canal (McCully Street bridge area) bimonthly. Occasional plankton tows were made by boat in Kaneohe Bay and at 0.5 mile off the south shore of Oahu. The plankton near Kewalo Basin was sampled by hand-pulling the plankton net through knee-deep water.

Larvae were cultured in 60 x 15 mm disposable petri dishes with a maximum of 10 larvae per dish. Seawater collected from the Ala Wai Canal (McCully Street bridge area) at a depth of 1 m was used for maintaining the larvae; it was changed every three days. Upon death of a larva, or development of bacterial or protozoan cultures, surviving larvae were transferred to a new dish with clean water. The food source and tube-building material for the larvae consisted of organic material collected from the bottom of a saltwater aquarium.

Larvae were retained in petri dishes during observation under low magnification (10 to 30x) with a Binolux dissecting microscope; each larva was transferred to a depression slide with water and a cover slip for observation at higher magnification (50 to 100x) with a Monolux compound microscope. Free-hand drawings were made of both live and preserved specimens at 100x and 400x magnification. For the description of the chaetopterid larva only preserved specimens were used. Larvae were observed only for short periods of time to prevent desiccation and death.

When possible, representative larvae were presented for future study. They were prepared for fixation by adding magnesium sulfate crystals to the petri dish until the larvae were relaxed (became motionless). They were then preserved in either 75 percent ethanol or 10 percent formalin. Whole mounts of the larvae were made using polyvinyl lactophenol in order to render the tissue transparent and the setae readily visible under the compound microscope.

THE IDENTIFICATION OF HAWAIIAN POLYCHAETE LARVAE AND KEY TO FAMILIES

The important morphological characteristics of polychaete larvae are: the number of setigers (segments with setae); types of setae; number and color of eyespots; color and pattern of chromatophores or other pigmentation; presence or absence of dorsal, ventral, or anal cirri, or prostomial antennae; and tentacular cirri. Taxonomic keys for the identification of adult polychaetes are seldom useful for the identification of larvae because of the changes that occur during metamorphosis.

How to Use a Taxonomic Key

A taxonomic key is a useful tool for the classification of plants and animals; in this case, for the worms. Each step of the key gives two alternative sets of characteristics for the worm after which there is either identification or referral to a number. If a number follows the set of characteristics that applies to the worm, then proceed to the next step and continue on in this manner until identification is made. Next to the identification a page number is given where a description of the larva may be found. If after reading the description it is found to be incorrect, reread the key checking both alternative sets of characteristics. The number in parentheses after each step number provides a means for backtracking through the key to find where the error was made.

Key to the Families of Common Hawaiian Planktonic Polychaete Larvae

1	Dorsum bears elytra (scales) (as in Figure 1)	Aphroditidae (p. 5)
	Elytra lacking	2
2(1)	Parapodium with a paddle or leaf-shaped dorsal cirrus (as in Figure 2)	Phyllodocidae (p. 5)
	Cirrus otherwise or lacking	3
3(2)	Compound setae present (as in Figure 3); jaw present (as in Figure 3)	Nereidae (p. 7)
	Simple setae only; jaw absent	4
4(3)	Two to three pairs of black eyespots; simple capillary setae may be smooth or serrate (as in Figure 5); pair of grooved prostomial palps of variable length may be present (as in Figures 6 and 7); dorsal melanophores present (as in Figures 5, 6, and 7)	Spionidae (p. 8)
	Setae, head structures, and pigmentation otherwise	5
5(4)	Simple hooded hooks present (as in Figure 14b); eyespots red; prostomial and anal projections lacking	Capitellidae (p. 15)
	Hooded hooks absent; eyespots red or black	6

6(5)	Three black eyespots; setae capillaries; anal cirri present (as in Figure 15)	Opheliidae (p. 17)
	Eyespots red; setae limbate, acicular or modified spines or geniculate; anal cirrus may be present	7
7(6)	Two to three pairs of red eyespots; setae are limbate, acicular, and modified spines (as in Figure 18); prostomial palps and anal cirrus may be present (as in Figure 17)	Chaetopteridae (p. 17)
	One pair of red eyespots; setae are geniculate (as in Figure 21); prostomial palps and anal cirrus absent	Serpulidae (p. 20)

Descriptions of the Families of Hawaiian Polychaete Larvae

Family: Aphroditidae (scale worms)

Description of larva. A six-setiger stage larva (Figure 1) has a total of three pairs of clear dorsal elytra (scales), a kidney-shaped prostomium with two pairs of black eyespots which may be fused, five antennae, and a pair of prostomial palps. The setae are serrated capillaries; each segment without an elytra bears a dorsal cirrus. There is a pair of anal cirri on the pygidium; these are easily lost and so may not be visible on the specimen. The number of palps, antennae, and cirri are difficult to determine in live specimens because of rapid movement and because they are often obstructed by the elytra.

Remarks. Larvae were collected from Kaneohe Bay and near Kewalo Basin.

Selected references for additional information. Blake, 1975c; Cazaux, 1968; Daly, 1972; Thorson, 1946.

Family: Phyllodocidae

Description of larva. An eight-setiger stage phyllodocid larva is illustrated in Figure 2. Each setiger has a paddle-shaped dorsal cirrus and compound setae. The prostomium is rounded with a pair of anterior antennae and one pair of red eyespots. There are two pairs of tentacular cirri and a pair of anal cirri.

Remarks. Larvae were collected from Kaneohe Bay and near Kewalo Basin.

Thorson (1946), in his study of Danish plankton, stated that the position and number of tentacular cirri can be used as a taxonomic characteristic for the larvae as it is for the adults. This appears to be an age-dependent characteristic, however, and is only useful in identifying older larvae, such as those ready to metamorphose.

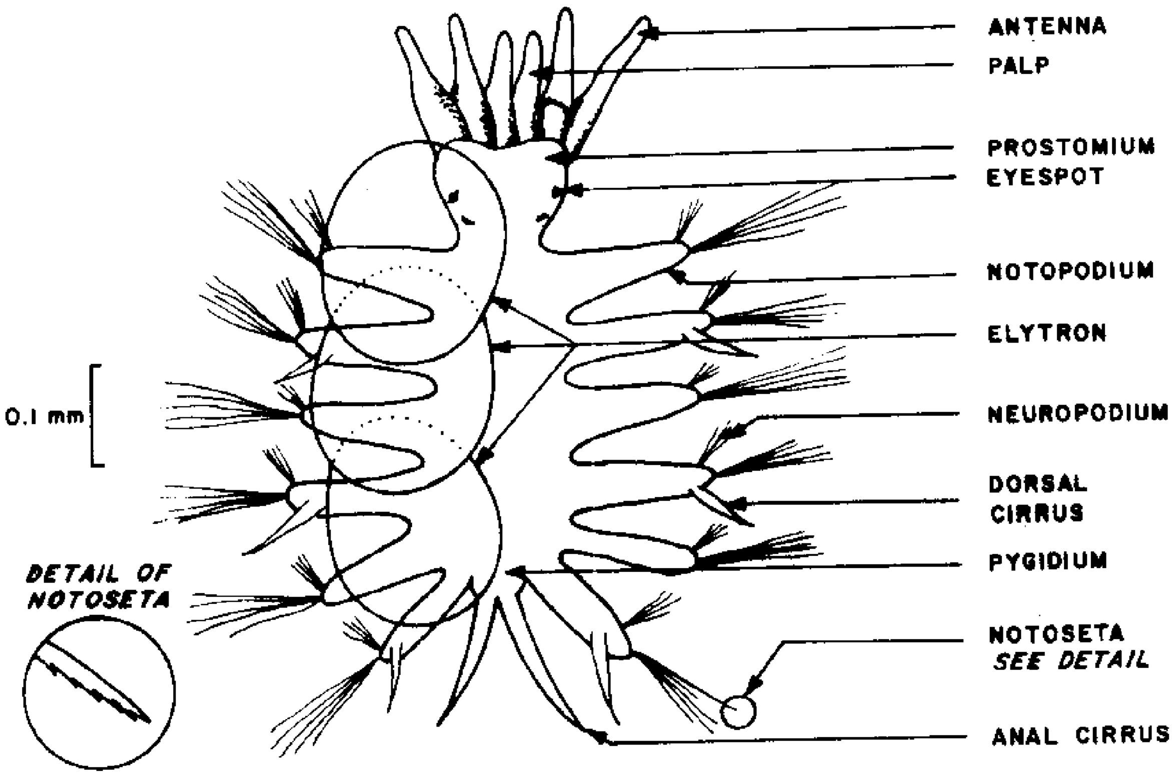

Figure 1. Aphroditidae: six-setiger stage, dorsal view

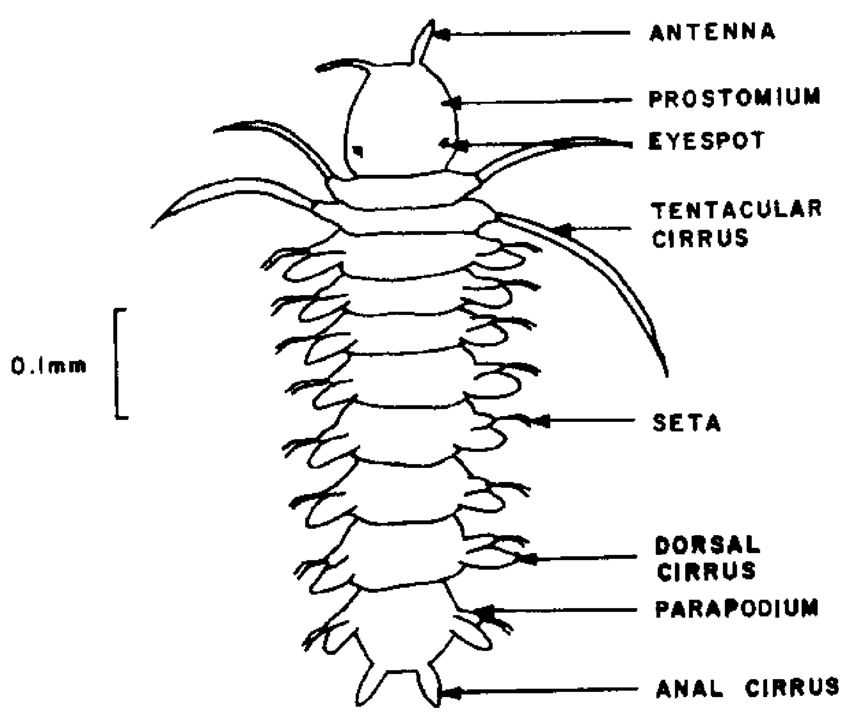

Figure 2. Phyllodocidae: eight-setiger stage, dorsal view

Selected references for additional information. Bhaud, 1967; Cazaux, 1969, 1975; Olive, 1975; Thorson, 1946.

Family: Nereidae

Description of larva. The three-setiger stage nereid larva (Figure 3) has a blunt prostomium with a pair of palps, a pair of antennae, and a pair of red eyespots. Also present are a rudimentary jaw, the gut, and a pair of anal cirri. The most noticeable characteristic of this larval stage is the length of the compound setae (Figure 4) which is approximately one-half as long as the entire body and spread out in a fan-like fashion.

Remarks. Larvae were collected from Kaneohe Bay and near Kewalo Basin.

Reish (1957) in his review of the reproduction of the family Nereidae stated that nereids reproduce in a number of ways, such as laying the eggs in a jelly mass (*Ceratonereis costae*), viviparity (*Neanthes lighti*), and epitoky (*Nereis succinea*).

Epitokous reproduction has been observed in Hawaiian specimens of the genus *Ceratonereis* (personal observation, 1975).

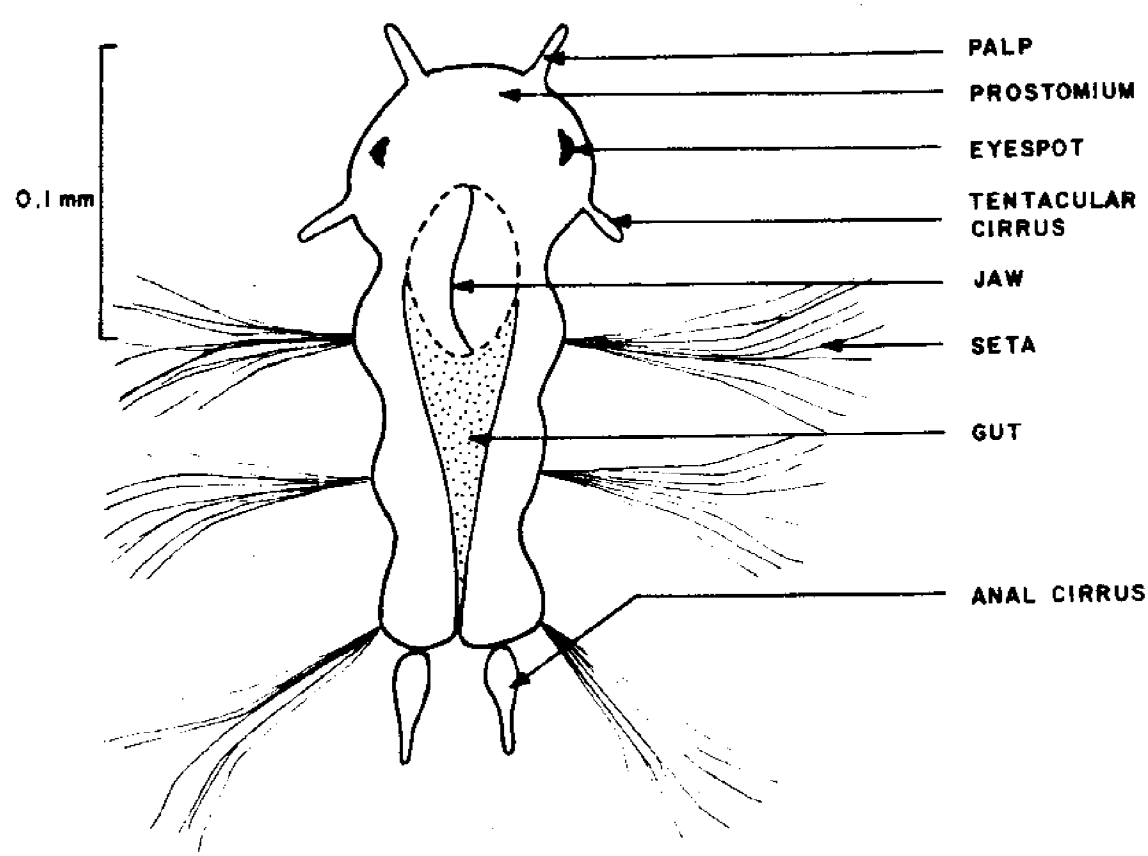

Figure 3. Nereidae: three-setiger stage, dorsal view

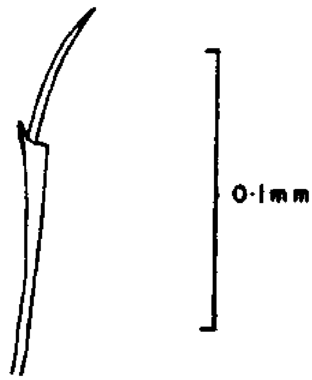

Figure 4. Nereidae: compound seta

Selected references for additional information. Bass and Brafield, 1972; Berkeley and Berkeley, 1953; Blake, 1975c; Dales, 1950; Gilpin-Brown, 1959; Johnson, 1943; Mazurkiewicz, 1975; Read, 1974; Reish, 1957; Roe, 1975; Smith, 1950; Wilson, 1932.

Family: Spionidae

The spionids are the most frequently encountered polychaete larvae found among Hawaiian plankton. The important characteristics to look for in members of this family are the number of eyespots and the color and pattern of pigmentation. Taxonomic keys, descriptions, and illustrations for many of the spionids may be found in works of Hannerz (1956, 1961) which contain useful reviews of the family.

The descriptions of the larvae that follow do not include all stages that one might find in the plankton; rather, a characteristic stage, or stages, are described. For a more detailed description of a particular species see the list of selected references at the end of this section.

A key to the species of the Hawaiian *Polydora* and *Pseudopolydora* follows.

1	Bar-shaped dorsal melanophores present; two pairs of black eyespots (as in Figure 7)	*Polydora websteri* (p. 9)
	Bar-shaped dorsal melanophores absent; three pairs of black eyespots	2
2(1)	Dorsal melanophores consist of small spheres forming a random pattern (as in Figure 8)	*Polydora socialis* (p. 9)
	Dorsal melanophores are large and stellate (as in Figure 9) and form rows with an anterior-posterior orientation	3

3(2)	Yellow-white pigment absent; two dorsal melanophores per setiger (as in Figure 9)	*Pseudopolydora paucibranchiata* (p. 12)
	Yellow-white pigment visible under reflected light present; two to four dorsal melanophores per setiger	4
4(3)	Two dorsal melanophores per setiger (as in Figure 11)	*Pseudopolydora antennata* (p. 13)
	Four dorsal melanophores per setiger (as in Figure 12)	*Pseudopolydora pulchra* (p. 13)

Descriptions of the species of Hawaiian *Polydora* and *Pseudopolydora* follow.

Polydora websteri

The three-setiger stage (Figure 5) is the youngest stage of this worm to be found among the Hawaiian plankton. The body is light brown with an orange gut. The prostomium is blunt with two pairs of dorsal black eyespots and a dorsal medial ridge. There is a single pair of dorsal bar-shaped melanophores on setiger three. The setae are serrated capillaries and extend from each segment to the pygidium. A prototroch and telotroch are visible.

By the twelve-setiger stage (Figure 6) the prostomium is more rounded and a pair of short prostomial palps may be present. There are two dorsal bar-shaped melanophores per setiger from setigers three to six, two spherical dorsal melanophores per setiger from setigers seven to twelve, and a medial dorsal circular melanophore on the pygidium.

In the fourteen-setiger stage, the prostomium is rounded, the lateral pair of eyespots are larger in size and are comma-shaped, the prostomial palps extend to setiger three, and the melanophores of setigers seven through fourteen are stellate rather than spherical (Figure 7).

Polydora socialis

The larva of this worm is transparent or white with a dorsal pigmentation consisting of randomly arranged small spherical melanophores. The fifteen-setiger stage larva (Figure 8) has three pairs of black eyespots and a pair of prostomial palps which extend to setiger five. The setae are smooth and irridescent, with those of setiger one extending beyond the pygidium.

Larvae of *Polydora socialis* are reported to have a yellow-brown pigment on the pygidium (Blake, 1969b); this was not seen on the Hawaiian specimens, but Blake (1976: personal communication) said that the Hawaiian species is either *Polydora socialis* or a close relative.

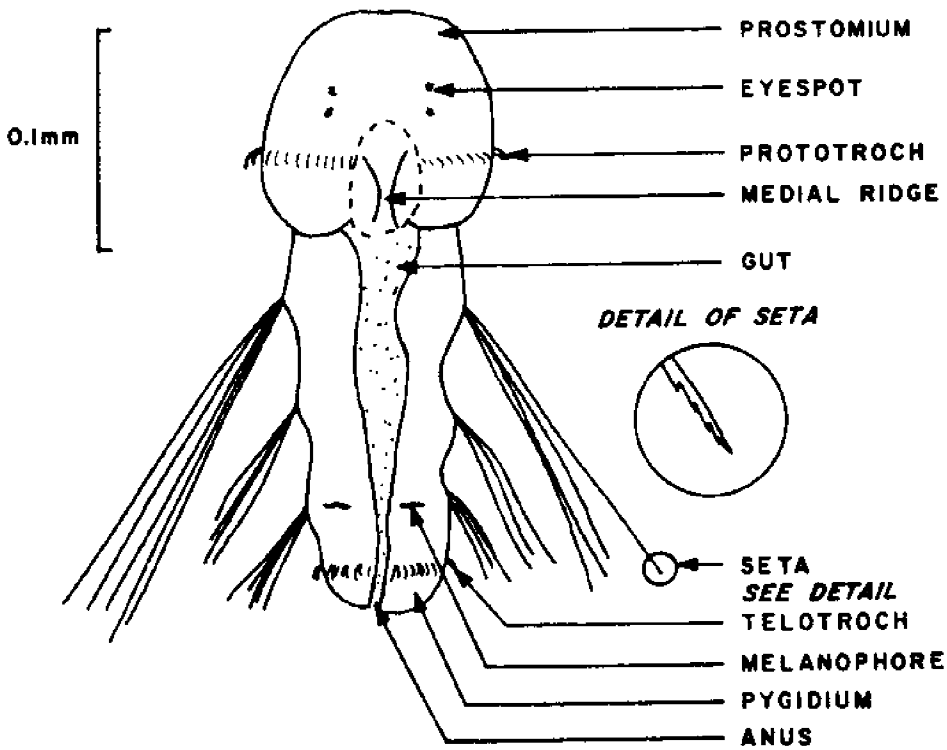

Figure 5. Spionidae: *Polydora websteri*, three-setiger stage, dorsal view

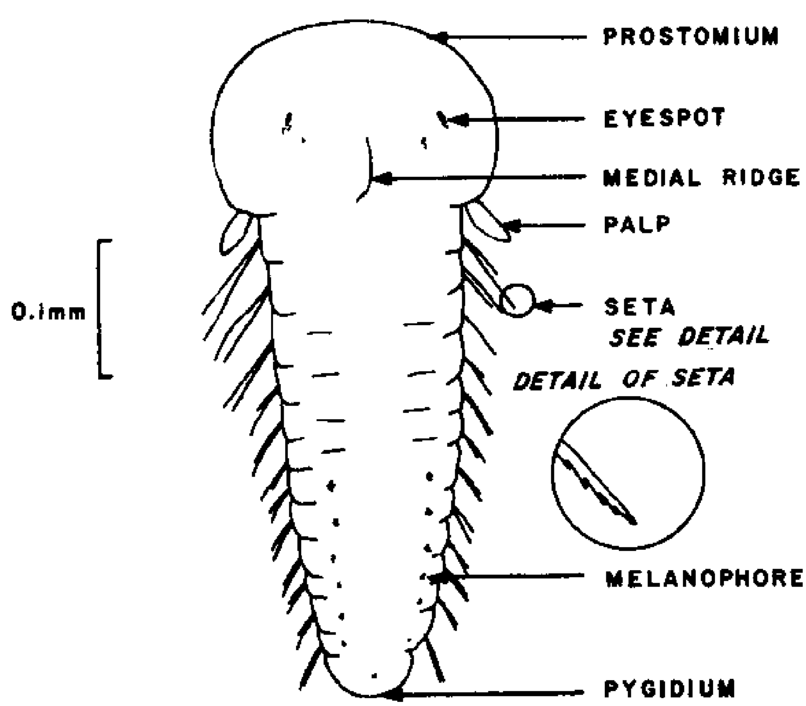

Figure 6. Spionidae: *Polydora websteri*, twelve-setiger stage, dorsal view

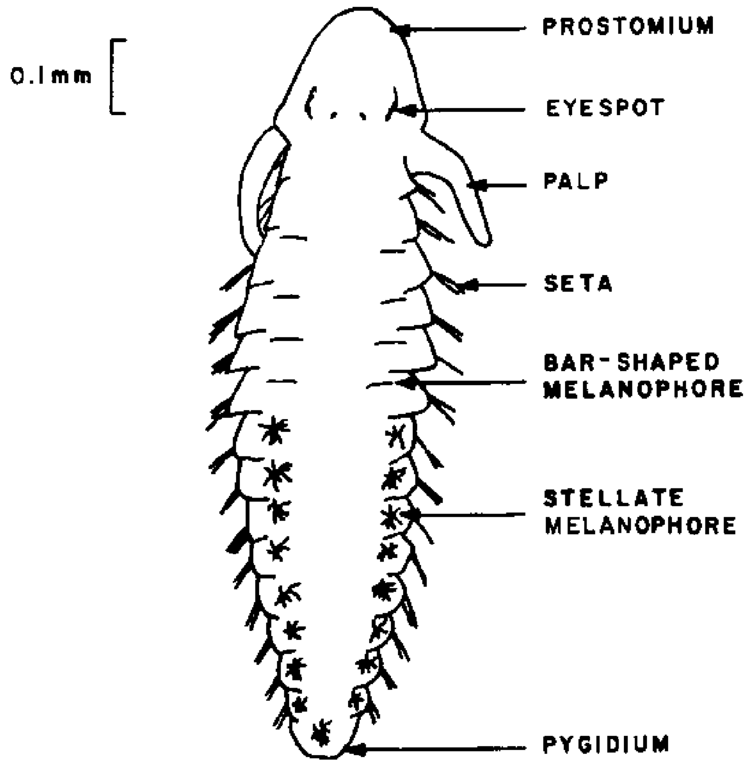

Figure 7. Spionidae: *Polydora websteri*, fourteen-setiger stage, dorsal view

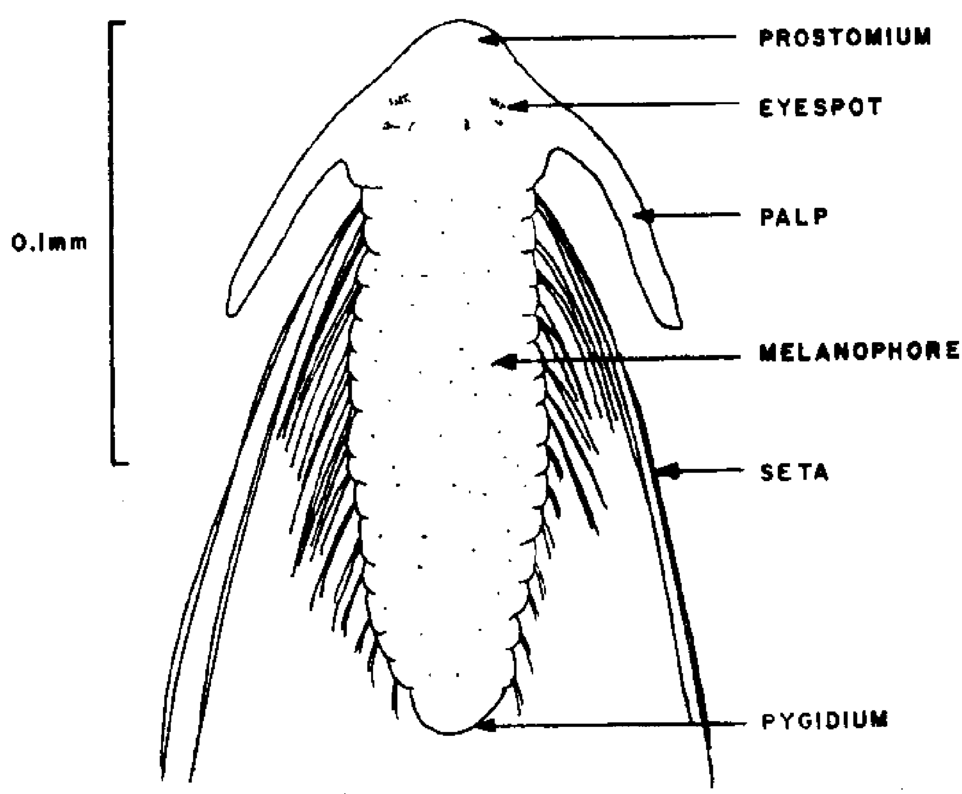

Figure 8. Spionidae: *Polydora socialis*, fifteen-setiger stage, dorsal view

Pseudopolydora paucibranchiata

The eleven-setiger stage larva of *Pseudopolydora paucibranchiata* (Figure 9) has a rounded prostomium with three pairs of black eyespots, a medial ridge, and a pair of short prostomial palps. At the junction of each palp with the prostomium is a dorsal stellate melanophore. There is a medial dorsal stellate melanophore on setiger one and the pygidium, as well as two lateral dorsal stellate melanophores per setiger from setigers two through eleven. The setae are serrated capillaries.

A typical fifteen-setiger stage larva (Figure 10) is approximately three times as long as it is wide. The body is tan; the prostomium is blunt with three pairs of black eyespots; and a pair of prostomial palps may be present. There is a single medial dorsal stellate melanophore on setiger one and the pygidium, and two lateral dorsal melanophores per setiger from setigers two through fifteen. On the ventral surface there is a single medial stellate melanophore on setiger six. Although not shown in Figure 10, yellow-white pigment (visible under reflected light) is present on the dorso-lateral region of the prostomium, setiger one, and the pygidium. On the palps are yellow pigment as well as small spherical melanophores which form a line across each palp. The larval setae are irridescent and serrated, with those of setiger one being the longest, extending to setiger fifteen.

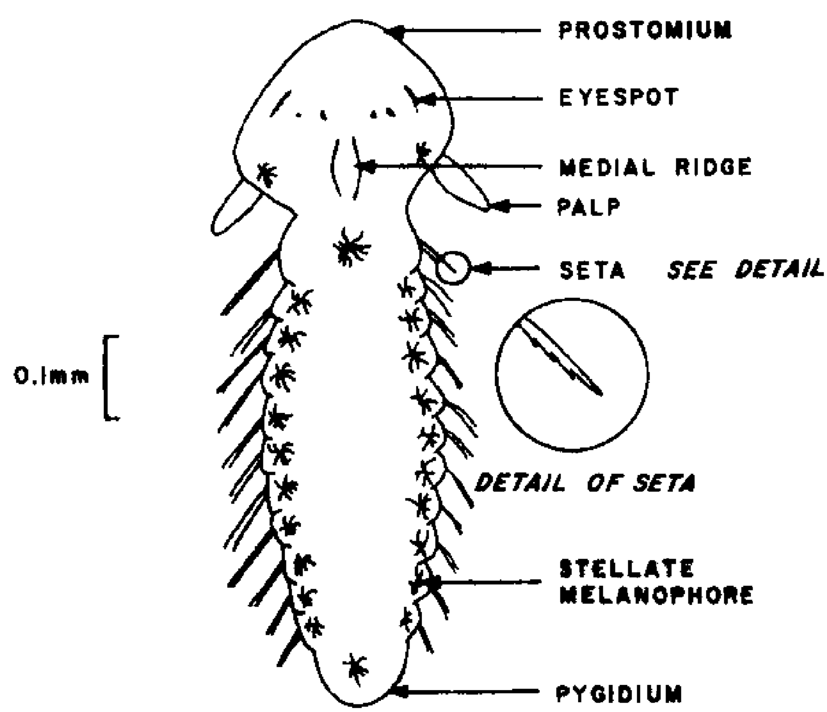

Figure 9. Spionidae: *Pseudopolydora paucibranchiata*, eleven-setiger stage, dorsal view

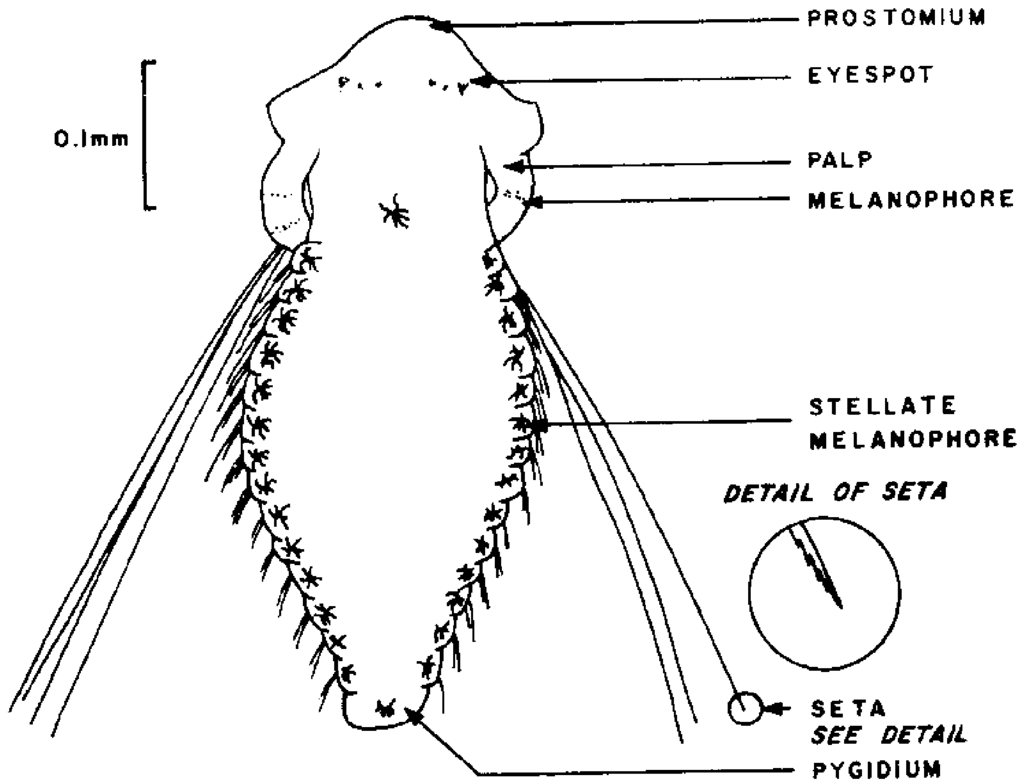

Figure 10. Spionidae: *Pseudopolydora paucibranchiata*, fifteen-setiger stage, dorsal view

<u>*Pseudopolydora antennata*</u>

The eight-setiger stage of this worm (Figure 11) is approximately twice as long as it is wide; the body is silver-grey. The dorsal pigmentation consists of two stellate melanophores per setiger from setigers three through eight and a medial stellate melanophore on the pygidium. (Later stages also have a medial stellate melanophore on the prostomium.) There is no yellow-white pigment as in *Pseudopolydora paucibranchiata*. The prostomium is rounded with three pairs of black eyespots; the lateral two pairs may fuse to form large compound eyespots. The setae are long, smooth, and irridescent, with those of setiger one being more numerous and longer than those in the succeeding setigers. The prostomial palps, when present, are short and do not extend beyond setiger two.

<u>*Pseudopolydora pulchra*</u>

The fourteen-setiger stage larva (Figure 12) is approximately twice as long as it is wide; the body is silver-grey in color with a blunt prostomium and three pairs of black eyespots. The prostomial palps do not extend beyond setiger three. There is a dorsal medial stellate melanophore on the prostomium and the pygidium as well as four dorsal stellate melanophores per setiger from setigers one through fourteen. Ventrally, yellow-white pigments appear on the prostomium, at the base of the palps, on the pygidium, and on the middle setigers (not shown in Figure 12). The larval setae are smooth and irridescent.

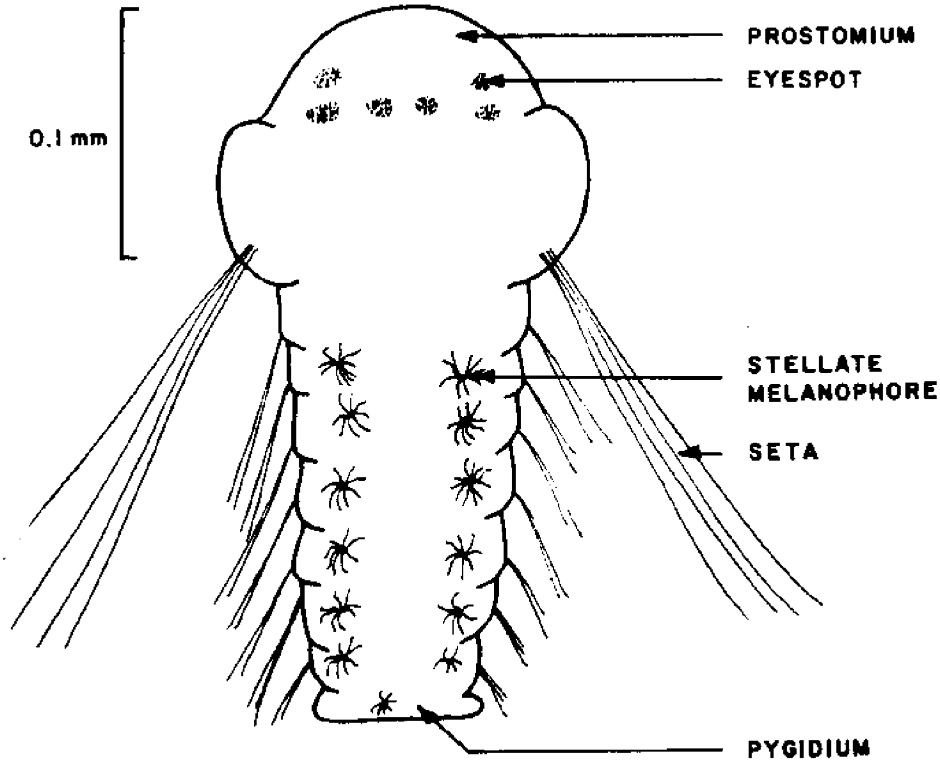

Figure 11. Spionidae: *Pseudopolydora antennata*, eight-setiger stage, dorsal view

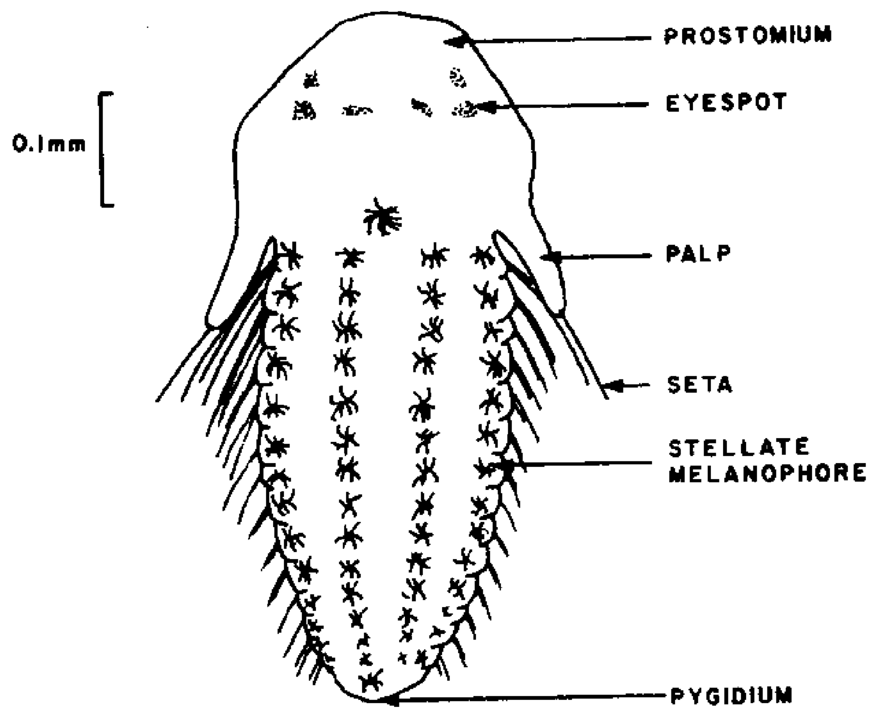

Figure 12. Spionidae: *Pseudopolydora pulchra*, fourteen-setiger stage, dorsal view

Remarks. All of the spionid larvae were collected from both Kaneohe Bay and the Ala Wai Canal.

Most members of the genus *Polydora* lay their fertilized eggs in some type of protective capsule (Hannerz, 1956). Blake (1969a), in his review of the New England *Polydora*, reported that *Polydora websteri* and *P. socialis* form similar strings of bead-like egg capsules which are deposited within the parent's tube, with each capsule partially connected to the tube wall. In Hawaiian specimens of *P. websteri* the egg capsules contain an average of 25 eggs and are attached to the wall of the parent's tube with the dorsal surface of the parent facing them. The larvae of both *P. websteri* and *P. socialis* are released from the egg capsule at the three-setiger stage (Blake, 1969a).

The type of egg capsule and age of release are the same for *Pseudopolydora paucibranchiata* as for the two species of *Polydora* (Blake and Woodwick, 1975).

The development and settlement behavior of *Polydora websteri* has received special attention because it bores into oyster shells, often making them unmarketable.

Selected references for additional information. Blake, 1969a; Blake and Evans, 1973; Blake and Woodwick, 1975; Casanova, 1952; Day, 1934; Dean and Hatfield, 1963; Guérin, 1970, 1972; Hannerz, 1956, 1961; Hatfield, 1965; Hopkins, 1958; Rullier, 1960, 1963; Simon, 1967, 1968; Thorson, 1946; Wilson, 1928; Woodwick, 1960.

Family: Capitellidae

Description of larva. The thirteen-setiger stage larva of *Capitella capitata* (Figure 13) is cylindrical with a conical prostomium and a rounded pygidium. A pair of red eyespots is located on the prostomium which lacks any antennae, palps, or other projections. The setae are simple capillaries (Figure 14a) in the anterior segments and hooded hooks (Figure 14b) in the posterior ones. There is a ciliary band (prototroch) at the junction of the prostomium with the body and another (teleotroch) at the junction of the pygidium with the body. These ciliary bands enable the larva to move rapidly within the water column. The body color of the larva is light brown and there may be red, black, or blue pigment spots on the prostomium and pygidium.

Remarks. *Capitella capitata* larvae were collected from the Ala Wai Canal and Kaneohe Bay.

The eggs of *Capitella capitata* float free in the coelom of the female; fertilization is internal (Thorson, 1946). The zygotes are extruded from the female and cemented with a gelatinous material to the surrounding mud tube. Thorson (1946) found in his investigation of Danish plankton that the larvae of *Capitella capitata* hatch at the thirteen-setiger stage.

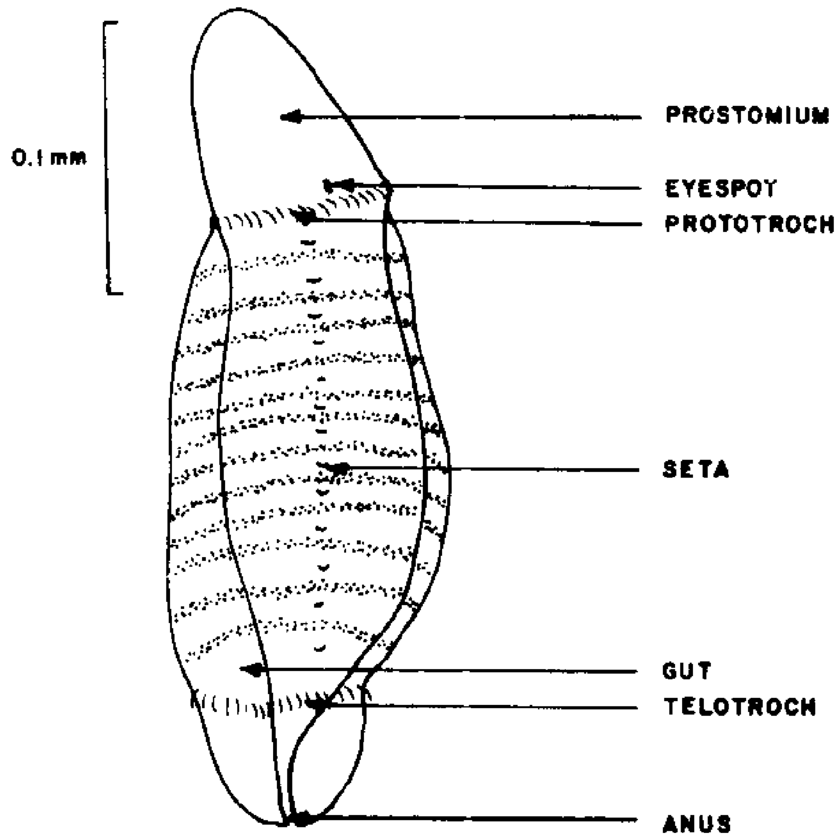

Figure 13. Capitellidae: *Capitella capitata*, thirteen-setiger stage, lateral view

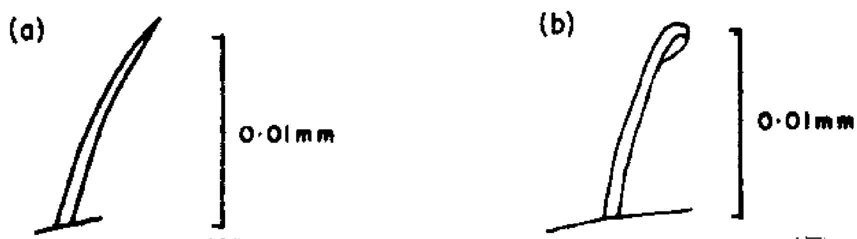

Figure 14. Capitellidae: setae of *Capitella capitata*, (a) simple capillary and (b) simple hooded hook

Grassle and Grassle (1976) investigated the electrophoretic patterns for eight enzymes of *Capitella capitata* larvae in Massachusetts and found a complex of six sibling species that lacked common alleles and had different life histories. In most cases the size of eggs and the brood size differed, and in all cases the time spent among the plankton varied.

Selected references for additional information. Guérin and Massé, 1974; Grassle and Grassle, 1976; Thorson, 1946; Wilson, 1933.

Family: Opheliidae

Description of larva. A ten-setiger stage larva of *Polyopthalmus pictus* (Figure 15) has a rounded prostomium with three black eyespots. Its parapodia are rounded and the setal bundles are composed of capillary setae with the central seta being the longest (Figure 15). The pygidium has three anal cirri.

Remarks. Ophelid larvae were collected from Kaneohe Bay.

Selected references for additional information. Guérin, 1971, 1973; Wilson, 1948, 1953, 1954, 1955.

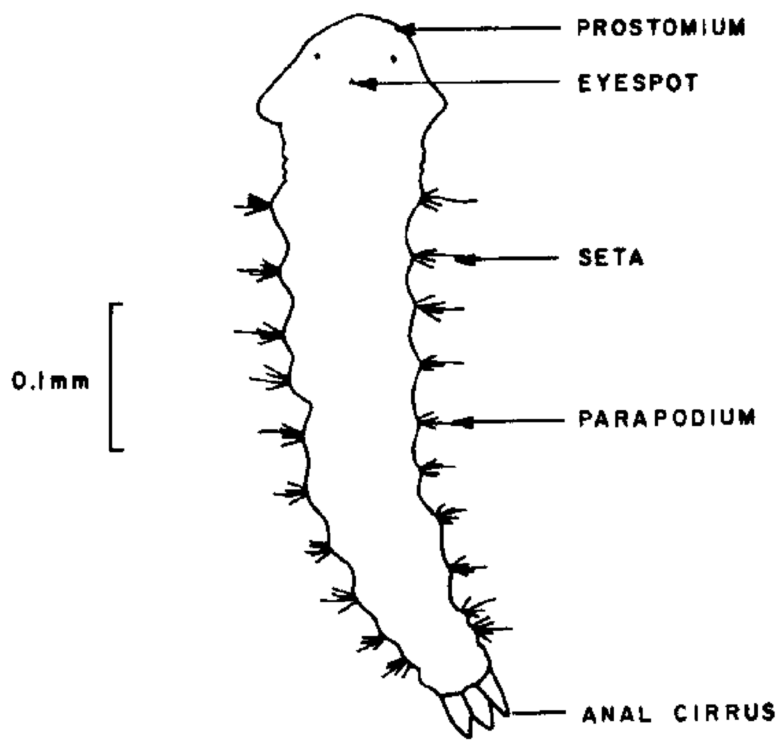

Figure 15. Opheliidae: *Polyopthalmus pictus*, ten-setiger stage, dorsal view

Family: Chaetopteridae

Description of larva. The eight-setiger stage chaetopterid larva is approximately 1.75-mm long and .82-mm wide (Figure 16). After preservation the larva became white and shaped like a barrel (Figure 17) with setae being the only discernible characteristic.

Lanceolate setae (Figure 18a) are present on all setigers. Acicular setae (Figure 18b) are present for setigers two through eight. A heavy modified spine (Figure 18c) is present on setiger four. Brush-topped setae (Figure 18d) appear on setigers five through eight.

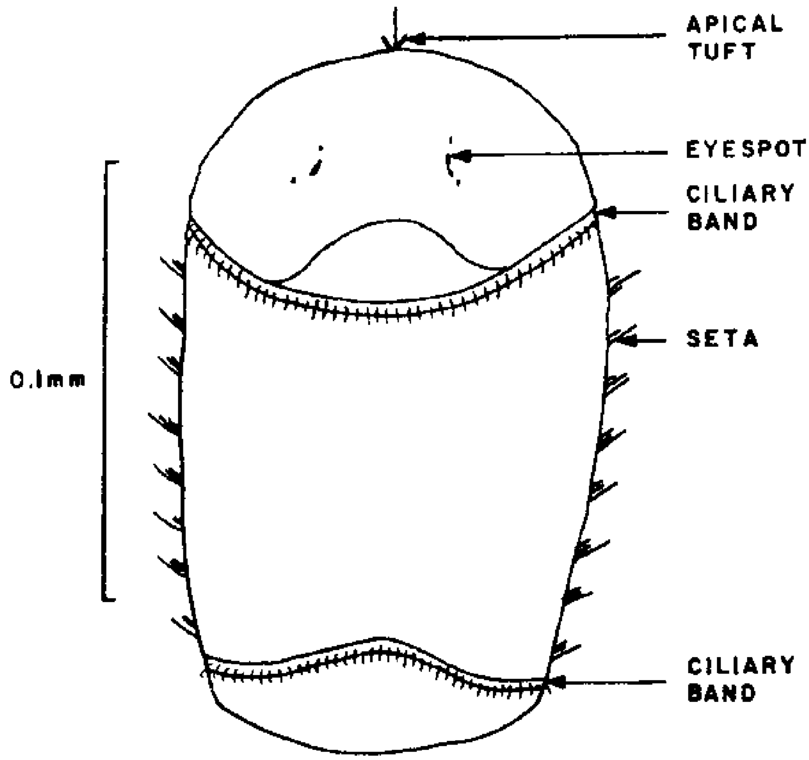

Figure 16. Chaetopteridae: eight-setiger stage, ventral view

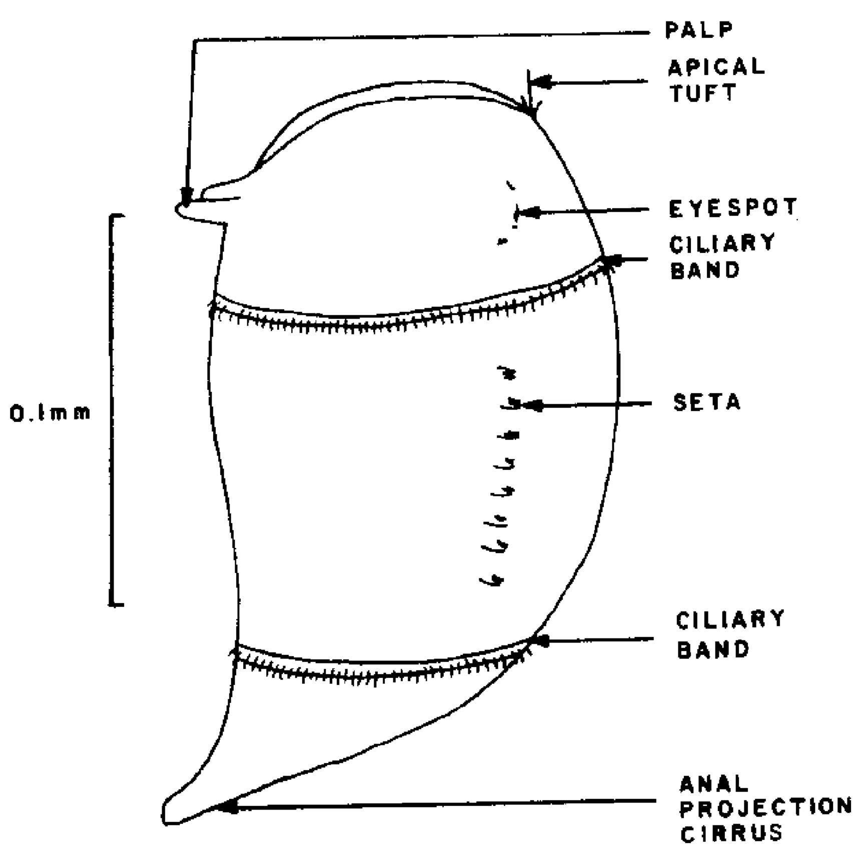

Figure 17. Chaetopteridae: eight-setiger stage, lateral view

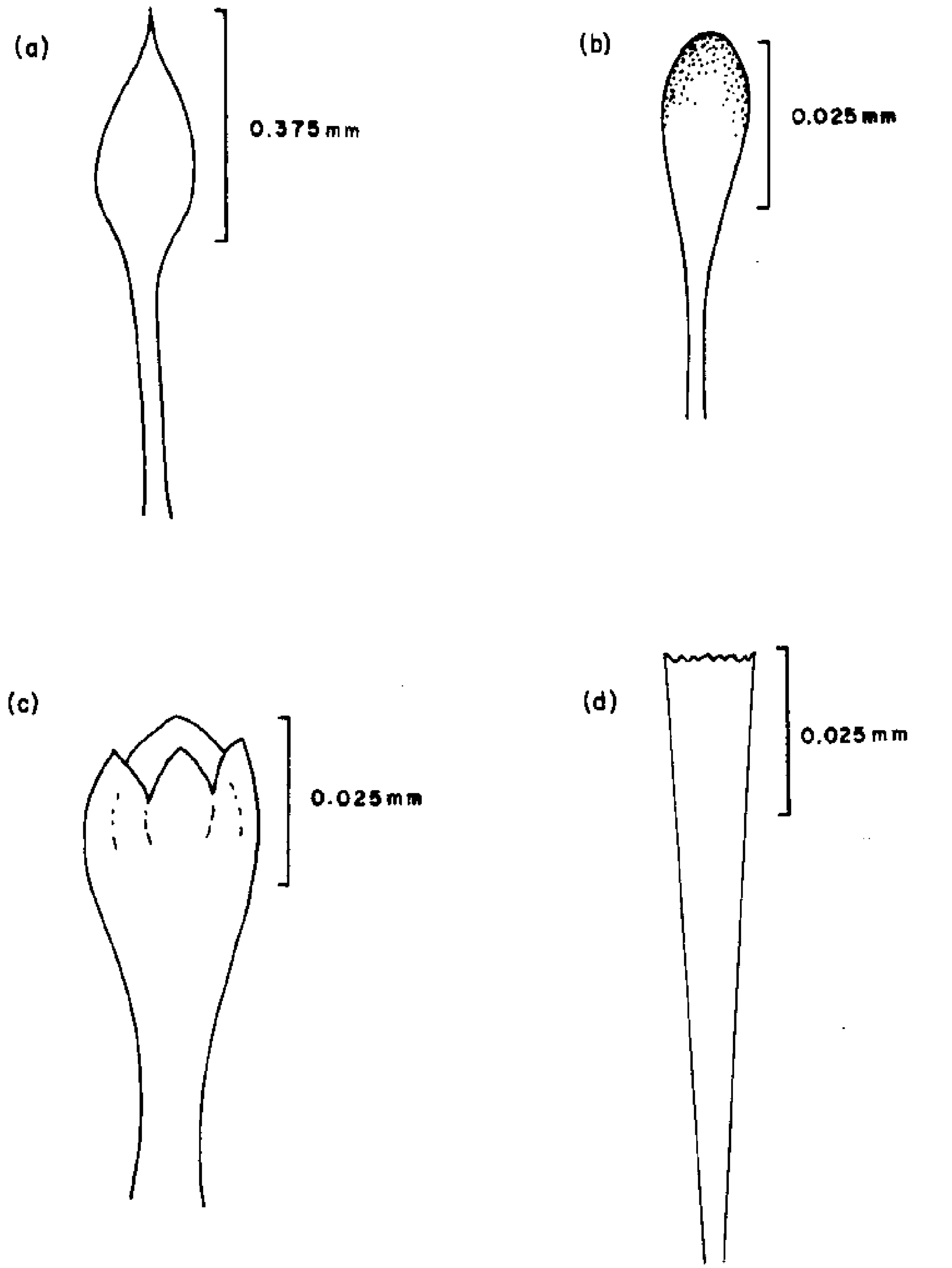

Figure 18. Chaetopteridae setae: (a) lanceolate seta, (b) acicular seta, (c) modified spine of setiger four, and (d) brush-top seta

Chaetopterid larvae have two ciliary bands which may appear as ridges (Figure 16), as well as an apical tuft, and three pairs of red eyespots.

A pair of short dorsal prostomial palps and an anal projection may be present (Figure 17).

Remarks. Chaetopterid larvae were collected from Kaneohe Bay and off the south shore of Oahu.

According to Thorson (1946), in Denmark, *Chaetopterus variopedatus* undergoes external fertilization and development of the larva takes place among the plankton. The length of time spent in the plankton depends on the amount of available food. After metamorphosis the worm becomes benthic and builds a mucous tube.

Selected references for additional information. Bhaud, 1966; Marsden, 1960; Thorson, 1946.

Family: Serpulidae

Description of larva. Trochophores and three-setiger stage larvae of serpulids are often found among Hawaiian plankton. It is seldom possible to identify these larvae to genus or species; it is necessary to raise them through metamorphosis for easier identification. The larva of *Spirobranchus giganteus* is typical of serpulid larvae and is used to illustrate the larvae of this family.

The early trochophore is shaped like a top with the pretrochal and posttrochal hemispheres of equal size (Figure 19). The prototroch and apical tuft are visible at this stage. Eight days after fertilization the posttrochal region starts to elongate and a pair of red eyespots is visible dorsally on the pretrochal hemisphere (Figure 20). The fourteen day old larva has three setigerous segments (Figure 21) and the posttrochal region is longer and may have an orange-brown pigmentation. From between 15 and 20 days of age the larva will settle out of the water column and form a transparent tube (J. White, 1975: personal communication). The larvae of *Spirobranchus giganteus* have not been reared beyond this early settlement stage (Marsden, 1960; J. White, 1975: personal communication).

Remarks. *Spirobranchus giganteus* larvae were obtained by in-lab fertilization of gametes from adults collected at Kahe Point, Oahu.

Serpulids display a fortnightly reproductive rhythm based on tidal cycles. Garbarini (1933) observed that *Spirorbis borealis* larvae on the Atlantic coast of France are released and settle during the moon's quarters and establish their tubes before the spring tides. Straughan (1968) found that the larvae of *Ficopomatus enigmaticus* settle during the spring tides in the Brisbane River, Australia.

Most members of this family have one radial of the branchial crown modified to form an operculum which is used to plug the tube when the worm is retracted. The operculum is also used as a brood pouch by some spirorbids. The methods of brood protection (i.e., egg-string, operculum incubation, and thoracic brood incubation) have been used as a basis for reclassifying the spirorbids (Bailey, 1969).

Selected references for additional information. Gee, 1962, 1965; Gee and Knight-Jones, 1962; Knight-Jones, 1951, 1953; Nott and Parkes, 1975; Quiévieux, 1962; Rothlisberg, 1964; Rullier, 1960; Sentz-Braconnot, 1964; Straughan, 1968; Wisely, 1958, 1960.

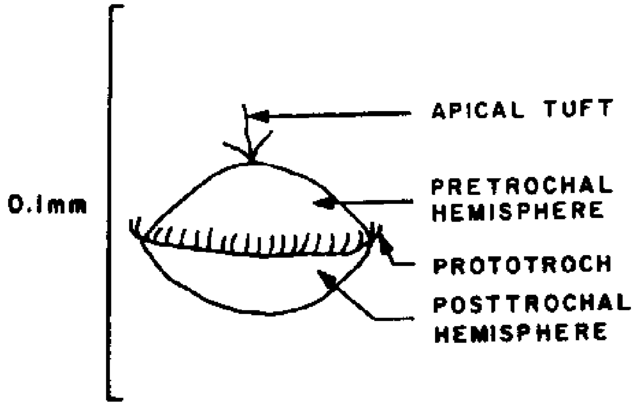

Figure 19. Serpulidae: *Spirobranchus giganteus*, trochophore, lateral view

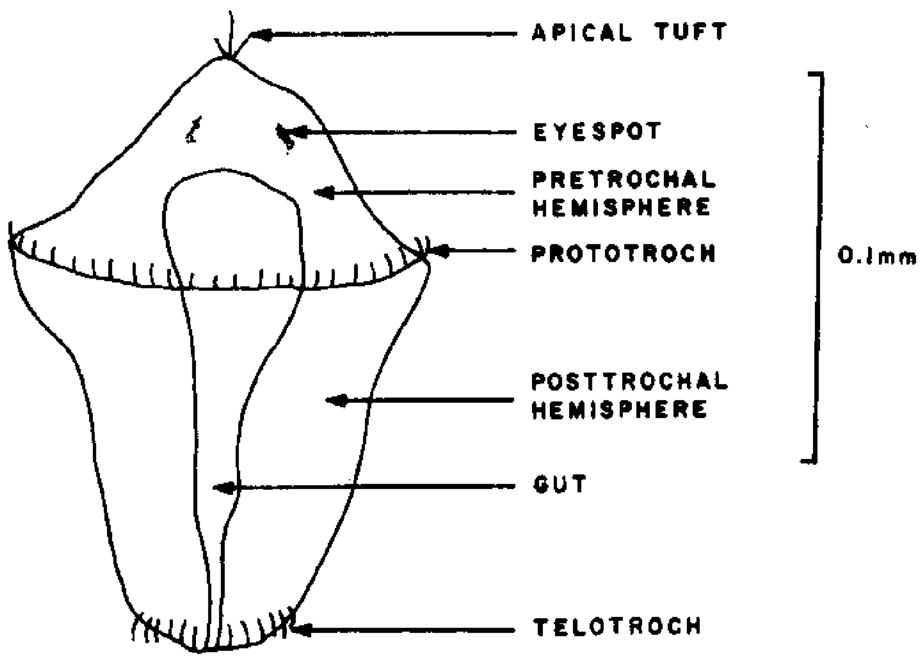

Figure 20. Serpulidae: *Spirobranchus giganteus*, eight day old larva, dorsal view

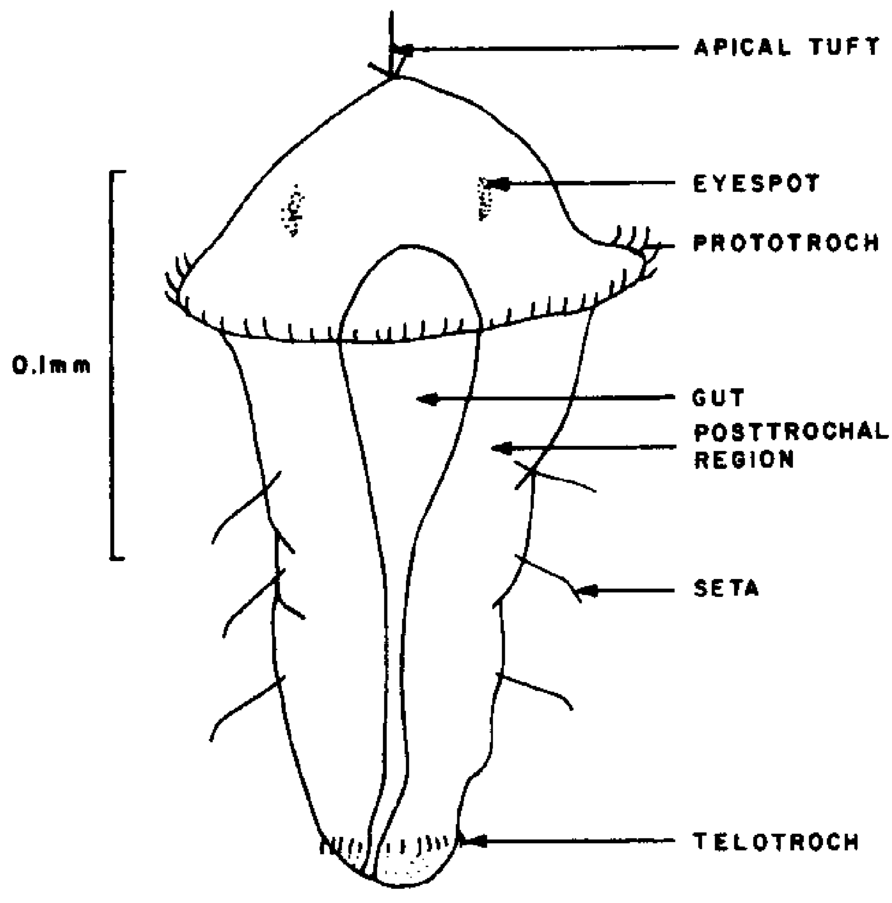

Figure 21. Serpulidae: *Spirobranchus giganteus*, three-setiger stage, dorsal view

SUMMARY

Polychaetes are important components of tropical reef communities both in terms of their abundance and as a food source for other marine organisms. They are economically significant as foulers of ship hulls, pier pilings, and other harbor structures and as borers of calcium carbonate substrata such as corals, coralline algae, and the shells of commercially valuable oysters. Although polychaetes are important on reefs, there has been little research on larval development, reproductive seasonality, and settlement behavior of tropical species. This information is needed for a better understanding of the polychaete assemblages of coral reefs.

To gain information on Hawaiian polychaetes, larvae from seven families were collected by plankton tows from four locations on Oahu, Hawaii: the Ala Wai Canal, the reef flat near Kewalo Basin, 0.5 mile off the south shore of Waikiki, and Kaneohe Bay. In addition, larvae of the serpulid *Spirobranchus giganteus* were obtained by fertilization of freshly spawned gametes in the laboratory. All larvae were maintained in disposable petri dishes within which they were observed with the aid of a microscope. From observations, taxonomic descriptions and free-hand drawings were made for each larval stage, as well as two dichotomous keys; one for the eight families of common Hawaiian polychaete larvae, and the second for the five species of *Polydora* and *Pseudopolydora* (Family Spionidae).

RECOMMENDATIONS

The larval descriptions and the taxonomic keys in this paper are intended only as a starting point for the study of the polychaete larvae off Oahu, Hawaii. A more thorough sampling of the plankton and benthos is needed to understand the temporal and spatial distribution of the polychaete larvae. Laboratory rearing of larvae from gametes of known species is also needed for a better understanding of polychaete life cycles.

ACKNOWLEDGMENTS

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GLOSSARY

Acicular seta	A stout projecting seta (Figure 18b)
Anal cirrus	Elongated projection arising from the (last segment or) pygidium (Figure 1)
Antenna	Sensory projection arising from the anterior or dorsal surface of the prostomium (Figure 2)
Apical tuft	Bundle or group of a few cilia projecting from the anterior-most portion of the larva (Figure 16)
Capillary seta	Hair-like bristle (term is often used to mean all long, slender, tapering setae) (Figure 14a)
Coelom	Body cavity
Chromatophore	Pigment cell or group of cells (see Melanophore)
Cirrus	Respiratory and tactile appendage of the setiger (Figure 2)
Compound seta	Jointed bristle (Figure 4)
Elytron	Dorsal scale (Figure 1)
Epitokous	The heteronereid stage of a nereid or other polychaete
Geniculate seta	Seta that is bent but not jointed (Figure 21)
Heteronereis	Free-swimming, dimorphic sexual stage
Hooded hook	Seta that is curved distally and is covered with a chitinous envelope (Figure 14b)
Limbate seta	A seta with a flattened margin to the blade (Figure 18a)
Melanophore	Black pigment cell or group of cells (Figure 7)
Neuropodium	Ventral section of the parapodium (Figure 1)
Neuroseta	Seta of the neuropodium (Figure 1)
Notopodium	Dorsal section of the parapodium (Figure 1)
Notoseta	Seta of the notopodium
Palp	Paired projections arising from the prostomium used for food gathering and tactile purposes (Figures 3 and 7)

Parapodium	Lateral, segmental foot-like projections bearing setae (Figure 2)
Posttrochal hemisphere	Region posterior to the prototroch (Figure 19)
Pretrochal hemisphere	Region anterior to the prototroch (Figure 19)
Prostomium	That part of the head anterior to the mouth (Figure 5)
Prototroch	Ring of cilia anterior to the mouth (Figure 18a)
Pygidium	Segment bearing the anus (Figure 5)
Serrated seta	Seta with one or more edges notched like a saw (Figure 5)
Seta	Bristle-like structure projecting from the parapodium used for locomotion and defense (Figure 1)
Setiger	Segment bearing seta (Figure 2)
Simple seta	Unjointed bristle (Figures 14 and 18)
Stellate	Radiating; star-shaped (Figure 9)
Telotroch	Ring, or tuft, of cilia near the anus (Figure 20)
Trochophore	Free-swimming pelagic stage of larva; usually shaped like a top (Figure 19)
Viviparity	Producing live young

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