NOTE
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FEEDING BEHAVIOR OF *Scolelepis* sp. (POLYCHAETA: SPIONIDAE)

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Scolelepis sp., is abundant in the intertidal zone of sandy beaches along the coast of the state of São Paulo (Amaral *et al.,* 1995). It is morphologically very similar to *Scololepis squamata* and may be part of a species complex, because some morphological variations (probably induced by changes in environmental factors such as salinity, temperature, or different sediment types) can be found in individuals from the same locality. Individuals can reach lengths of about 80 mm. The acuminate prostomium has 4-5 eyes arranged in a row, a prominent caruncula, and two long tentacular palps which are occasionally lost. According to Dauer (1983), who studied *Scolelepis squamata*, in contrast to most spionids this species has no sulcus along the palps, but the palps are provided with two compact rows of immovable cilia of unknown function. Next to these cilia are cells that secrete mucus to trap food particles. At the base of each palp there is a simple row of movable cilia, which appear to play no role in feeding (Dauer, 1983). Like other spionids, *Scolelepis* sp. feeds at or just above the water-sediment interface, using its multifunctional palps to search for, grasp, transport, and/or reject food particles (Taghon *et al.,* 1980; Dauer *et al.,* 1981; Dauer, 1983, 1994).

Although the feeding biology of the spionids is well studied (Taghon *et al.,* 1980; Dauer *et al.,* 1981; Dauer, 1983, 1985, 1991, 1994, 1997; Muschenheim, 1987; Dauer & Ewing, 1991; Taghon & Greene, 1992; Shimeta, 1996; Bock & Miller, 1997; Qian & Chia, 1997; Shimeta & Koehl, 1997; Williams & McDermott, 1997; Ferner & Jumars, 1999), only one study was done on the feeding behavior of *Scolelepis squamata* (Dauer, 1983). The note presents study analyzed the feeding behavior of *Scolelepis* sp., especially food capture and ingestion.

The individuals of *Scolelepis* sp. measured about 18 mm long and 1 mm in diameter. They were collected from Cabelo Gordo Beach, located in São Sebastião, state of São Paulo (23°49.614”S and 45°25.298”W). Cabelo Gordo Beach, on the mainland side of São Sebastião Channel, is a small, low-energy beach with narrow intertidal zone and moderate slope. The upper 10 cm of the sediment is very fine sand, with coarser sand below.

Scolelepis sp. is abundant in the upper mid-littoral zone of sandy beaches, where collections were made, during low tide, between September 1997 and September 1998. Sand samples were dug with a shovel to about 20 cm in depth, and were then washed with seawater through a 0.5 mm-mesh screen. The worms were placed in sediment from the collection site held in small transparent plastic pots (“aquaria”) of 200 ml capacity (diameter 65.2 mm, height 60 mm). The pots were covered with a nylon mesh (0.03 mm mesh size) to allow for water circulation and prevent the animals from escaping. The aquaria were then placed in a plastic cube (length 45 cm, width 28 cm, height 16 cm), with seawater piped in directly from the channel, in the laboratory of the University of São Paulo Marine Biology Center (CEBIMar - USP). By this method the animals were maintained under optimum conditions during the observations.

During the different study periods, 5 aquaria were set up, each with 5 individual worms. After 24 hours of acclimation, as recommended by Dauer (1983), the aquaria were removed from the system and observations were begun. The worms were observed by means of a stereoscopic microscope and the light covered with a transparent red paper filter, to reduce the light intensity. The description of their feeding behavior is based on 19 sessions, totalling 30 hours of observation, with notations made every 5 minutes. In order to observe possible variations in the feeding habits, live plankton was offered as food and also particles on the surface of the sediment were suspended by a fine jet of water from a pipet.

After the acclimation period, resting individuals extended about a third of their bodies out of their galleries, keeping their palps extended in the water above the prostomium, perpendicular to the sediment and initially forming a 90° angle (Fig. 1A).

Feeding behavior did not vary much as a rule. In most cases, during feeding a worm positioned itself with about a third of its body outside the gallery and its palps held at a 60° angle above the sediment (Fig. 1B). In this position, it alternately touched the sediment surface with the tips of its palps, with 360° rotary movements, as if it were sweeping the sediment (Fig. 1C). Some of the particles captured were discarded and/or lost, and others were brought to the mouth and ingested. After a particle

was captured, the palp was coiled helicoidally toward the mouth (Fig. 1D), and the partly everted pharynx engulfed the food. During this extremely rapid process, one palp at a time was brought to the mouth.

The activity of sweeping the sediment and ingesting the particles lasted for 2 to 3 minutes. Following this period, the animal retreated within the gallery for about 5 minutes. After this interruption, it again returned to the sediment surface with about a third of its body extending out of the gallery, but facing the other side, having turned around inside the gallery. It then resumed sweeping the sediment with its palps. This reversal in body position inside the gallery effected a 360° turn with respect to its surroundings, enabling the worm to sweep the entire surface of the sediment around the gallery opening. In most instances, a depression (concavity) in the sediment surface around the gallery opening could be seen (Fig. 1D). Individuals were also observed with only the prostomium visible, capturing sand particles at the gallery opening directly with the mouth, partly everting the pharynx.

When sediment particles were suspended by a fine jet from the pipet, or even by a slight movement of the aquarium, the animals became more active and moved their palps more rapidly. However, instead of capturing the surface particles, they moved their palps in the water column (Fig. 1E), taking the suspended particles with the tips of the palps. The palps were then coiled helicoidally and brought to the mouth, the pharynx being partly everted. The same behavior could be seen when plankton was offered, diatoms being ingested whole.

Sometimes the worms expelled previously ingested particles from the mouth, everting the pharynx and expelling the particles, which appeared to be agglutinated by a small thread of mucus. These threads were frequently seen on the sediment surface around the gallery openings.

In the laboratory, *Scolelepis* sp. feeds on suspended particles and, in still water, is a deposit-feeder. The same suspension-feeding habit was observed in *Scolelepis squamata* by Dauer (1983), who studied it using a system of different current velocities. Studies of the feeding behavior of spionids have revealed the existence of several modes of feeding with the palps (Taghon *et al.,* 1980; Dauer *et al.,* 1981). The pattern of movement of the palps varies from species to species, according to its size, the type of habitat, and the presence of suspended particles (Taghon *et al.,* 1980). The species studied by Dauer *et al*. (1981) fed on suspended or deposited particles, and increased their feeding rate in the presence of currents.

Scolelepis sp. showed two main types of behavior: in still and in moving water. According to Dauer (1983) in still water only 40% of the individuals of *S. squamata* came to the surface to feed and kept their palps coiled helicoidally, capturing particles deposited on the sediment and touching the surface only with the distal ends of the palps. The helicoidal coiling of the palps during food ingestion may be an essential element in the feeding of *Scolelepis* sp. According to Dauer (1994), *S. squamata* and *S. hutchingsae* do not have a sulcus on their palps, and the cilia on the palps are non-motile and are only indirectly useful to transport the particles to the pharynx.

The behavior of beating the tips of the palps on the sediment surface may be interpreted in two ways: to collect the particles directly, bringing them to the mouth and to suspend the surface particles in order to collect them from the water column. According to Self and Jumars (1978), sweeping the sediment with the palps may efficiently resuspend the finer particles (which have higher nutritional value).

The behavior of ingesting particles directly with its mouth showed by *Scolelepis* sp. may indicate that the animal has adapted to the deposit-feeding habit, but uses it less often than when it is exposed to currents. According to Dauer *et al.* (1981), changes in the environment can greatly modify foraging behavior in some species of spionid polychaetes. Taghon *et al.* (1980) suggested that animals which are able of changing their feeding behavior are typical of environments where there are rapid changes in water flow, such as in the intertidal zone. This behavior may also be related to the evolution of the family. According to Dales (1963), the spionids belong to a group of polychaetes in evolutionary transition between those that feed directly on the sediment with the proboscis, and those that use tentacles (palps), as well as others in the order Spionida.

The depressions that appeared around the opening of the galleries were caused by the foraging activity of the animal, that turned 360° around the gallery opening, foraging completely around it and forming the depression. The absence of current must have intensified the feeding activity around the gallery.

The behavior of expelling threads with mucus-agglutinated particles has not been observed before in spionids. This may indicate that particles are selected after ingestion or they can be rejected during the digestive process, and that the feeding activities by the palps are only foraging. Dauer (1983) noted that *S. squamata* does not appear to select food particles, since he observed that all the particles that came in contact with the palps were taken up and transported to the mouth.

A summary of the feeding habits of some species of Spionidae is presented in Table 1. The majority feed on suspended or deposited particles, depending on the water movement. These observations

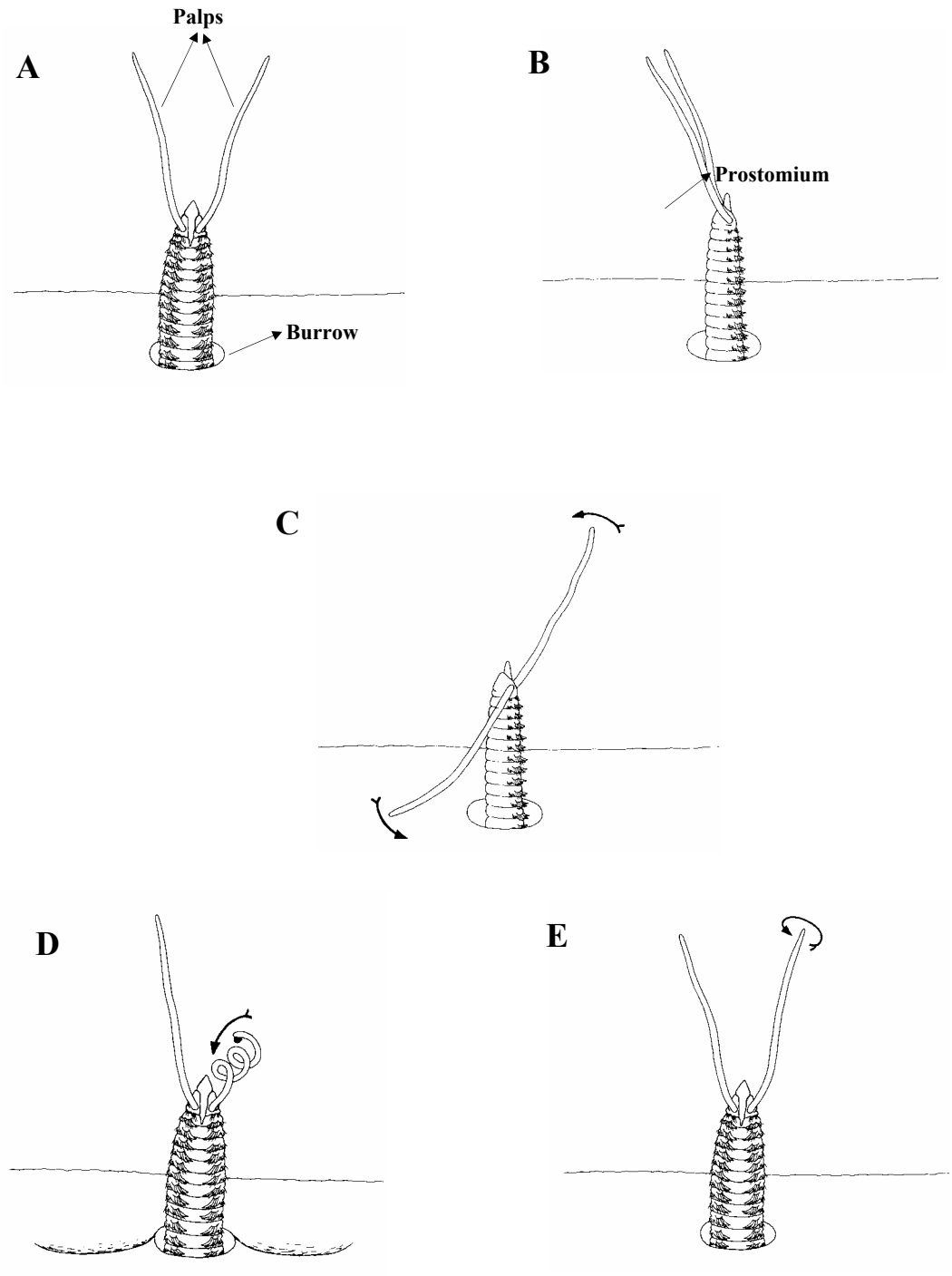

Fig. 1. *Scolelepis* sp. resting in the gallery (A - dorsal position), capturing food (B -D) and collecting suspended particles (E). (B and C - lateral position).

Table 1. Feeding habits of some species of Spionidae.

	Feeding habits		References
	Suspension feeder	Deposit feeder	
Boccardia proboscidea	Water flow	Still water or low water flow	Taghon, Nowell, Jumars (1980)
Boccardia pugettensis	Presence of suspended particles	Absence of suspended particles	Taghon, Greene (1992)
Dipolydora commensalis	Remove suspended particles from the branchial current of the host hermit crab	Remove particles attached to the setae on the legs host hermit crab	Dauer (1991); Williams, McDermott (1997)
Malacoceros indicus		Palps are held against the sediment surface	Dauer, Ewing (1991)
Marenzelleria viridis	Presence of suspended particles	It feed on deposits with 2 palps in the absence of suspended particles	Dauer, Maybury, Ewing (1981); Dauer (1997)
Paraprionospio pinnata	Presence of suspended particles	It feed on deposits with 2 palps in the absence of suspended particles	Dauer, Maybury, Ewing (1981); Dauer (1985)
Polydora ligni	Presence of suspended particles	It feed on deposits with 2 palps in the absence of suspended particles	Dauer, Maybury, Ewing (1981)
Polydora polibranchia	High water flow	Low water flow or still water	Qian, Chia (1997)
Pseudopolydora Kempi japonica	Water flow	Low water flow or still water	Taghon, Nowell, Jumars (1980)
Pseudopolydora paucibranchiatta	Water flow, with the aid of the palps	Still water, with the aid of the palps	Shimeta (1996)
Pygospio elegans	Water flow	Low water flow or still water	Taghon, Nowell, Jumars (1980)
Scolelepis squamata	Water flow	Still water, with the aid of the palps or directly with the mouth	Dauer (1983)
Spiophanes bombyx	Presence of suspended particles	In the absence of suspended particles, it did not feed very often	Dauer, Maybury, Ewing (1981)
Spio setosa	Presence of suspended particles	In the absence of suspended particles, it did not feed very often	Dauer, Maybury, Ewing (1981); Muschenheim (1987)
Streblospio benedicti	Presence of suspended particles	In the absence of suspended particles, only 1 palp is used	Dauer, Maybury, Ewing (1981)

combine to support the statement that feeding habit is a specific characteristic, which can vary according to environmental conditions. The present study and observations by Dauer (1983) established that *Scolelepis* sp. opportunistically changes its feeding behavior according to environmental conditions, and in the intertidal zone feeds predominantly on suspended matter. In these conditions the species shows an optimum foraging behavior. According to the theory of optimum foraging, the animal must, in linear fashion, increase the specific food in its diet which yields the highest energy return for the least time expended in searching and manipulation (Pyke, 1984).

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