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Capitellidae (Annelida: Polychaeta) from the Pacific Coast of Costa Rica

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Abstract: Eleven species of Capitellidae (Annelida: Polychaeta) belonging to eight genera are reported from the subtidal and intertidal of the Pacific Coast of Costa Rica. Three species, *Mediomastus ambiseta*, *M. californiensis* and *Notomastus hemipodus*, are found in highest abundances and are widespread in subtidal and intertidal environments. A taxonomic key to these species is included.

Key words: Polychaeta, Capitellidae, Costa Rica, Eastern Pacific, Tropical.

The Capitellidae are a family of polychaetes found in many sediment types, often in high abundance, from the intertidal to the deep-sea. Most live in mucous-lined tubes or burrows (Blake 2000) and they are generally regarded as non-selective deposit feeders. There is evidence, however, that at least a few species may exhibit some selection of food material (Fauchald & Jumars 1979). Many species (for example the *Capitella capitata* species complex) are opportunistic and have been recommended in the past as indicator organisms for environmental disturbances such as pollution (Reish 1957, 1979; Grassle & Grassle 1974, 1976). Pearson & Rosenberg (1978) as well as Warren (1991) point out, however, that rich abundances of such opportunists as *C. capitata* may reflect high organic enrichment, regardless of its cause.

The capitellids appear outwardly similar to earthworms due to their simple morphology and lack of protruding parapodial lobes. The prostomium is quite simple, lacking appendages and having small pigmented eyespots or ocular fields only in a few species. The peristomium is variable being either well-developed with or without setae, only partially visible, or totally hidden. Immediately behind the prostomium and/or peristomium there may be up to two achaetous segments or these may be lacking. The first setiger may be complete, with capillary setae in both the notopodium and neuropodium, or incomplete, with capillary setae present only in the notopodium. There is much variation in the number of setigers bearing only capillary setae and this is the most important character utilized in the differentiation of genera. The number of thoracic segments is quite stable within each genus while the number of abdominal segments is variable. One problem in the identification of species is the difficulty in recognizing the transition from the thorax to the abdomen. This transition may be quite apparent with an abrupt change in the size or morphology of the segments in each region. In many cases, however, the only indication of this transition between body regions is a changeover from capillary setae in the thoracic neuropodia (and perhaps notopodia) to hooks

in the abdominal region or perhaps an abrupt increase in the number of setae (capillaries or hooks) in the neuropodial fascicle. The abdominal region is usually uniform throughout although some capitellids possess thin-walled branchial structures or have modified setae in far posterior segments (i.e. *Mediomastus ambi-seta* (Hartman 1947), the genus *Scyphoproctus* Gravier). The pydidium is usually not an important taxonomic character with the genera *Scyphoproctus* and *Pulliella* Fauvel being no-table exceptions.

Fauchald (1977) listed 36 genera within the family Capitellidae and several new genera have since been described (*Amastigos* Piltz (1977); *Dodecaseta* McCammon & Stull (1978); *Nonatus* Amaral (1980); *Octocapitella* Brown (1987); and *Paracapitella* Carrasco (1987)). Ewing (1984a) estimated there to be 140 species of capitellids known to that time. Concerning the Pacific Ocean, Hartman (1947) reviewed 19 species of capitellids from the northeast Pacific and later reported 25 taxa (including 4 subspecies of *Capitella capitata*) from Cali-fornia (Hartman 1969). Fauchald (1972) later recorded an additional 9 species of capitellids from deep waters off Mexico. De León González (1994) and Hernández-Alcántara & Solís-Weiss (1998) reported 34 known species of capitellids from the Gulf of California, Mexico, although Hernández-Alcántara (1992) indicated that, despite the high number of species, the capitellids were not particularly abundant. Further south in the eastern Pacific, Carrasco (1977) and Carrasco & Gallardo (1987) have found five species of capitellids from the Chilean coast while Hartmann-Schröder (1962) has reported two species from the Peruvian coast.

There have been few species of Capitellidae reported from the Pacific coast of Central America. Hartmann-Schröder (1959) reported a single species, *Mediomastus setosus* (probably *M. ambiseta* (Warren *et al.* 1994)), from the mangroves of El Salvador. Molina-Lara & Vargas-Zamora (1995) resampled Hartmann-Schröder‘s study site about 30 years later and again found the species described as *M. setosus* but also found the capitellid *Dasybranchus lumbricoides* Grube 1878 as one of the numerical dominants. On the Pacific coast of Panama Monro (1933) recorded two species belonging to the genus *Dasybranchus* and Fauchald (1973) later described a species of *Notodasus* from intertidal sands. Dean (1996a & b) listed three species of capitellids collected subtidally from the Gulf of Nicoya and also listed three subtidal species from Golfo Dulce in Costa Rica for a total of five separate species. Vargas (1987, 1988, 1989) has sampled intensively at an intertidal site at Punta Morales in the Gulf of Nicoya and reported *Mediomastus californiensis* to be one of the numerically dominant benthic species. This paper reviews eleven species of Capitellidae collected either subtidally or intertidally from the Gulf of Nicoya and Golfo Dulce on the Pacific coast of Costa Rica.

MATERIALS AND METHODS

Subtidal material was collected in the Gulf of Nicoya using a modified Smith-McIntyre bottom grab. Subtidal station sites and sediment characteristics may be found in Maurer & Vargas (1984). Intertidal specimens were collected in the Gulf of Nicoya by the author during a series of collecting trips partially supported by the Universidad de Costa Rica’s Centro de Investigación en Ciencias del Mar y Limnología (CIMAR). J. A. Vargas (CIMAR), provided material from his study site at Punta Morales and from the intertidal of Golfito and H. Buttner (Center for Tropical Marine Ecology (ZMT), Bremen, Germany), kindly provided specimens from several mangrove sites in the Gulf of Nicoya. Voucher specimens of most of these species have been deposited in the Museo de Zoología, Universidad de Costa Rica or the Museum of Comparative Zoology (MCZ), Harvard University, Cam-bridge, MA, USA.

Key to species of Capitellidae collected from the Pacific coast of Costa Rica

1. First four thoracic setigers with capillary setae…….2
1a. More than four thoracic setigers with capillary setae……..3

2. Spinous bifid hooks in abdominal notopodia. Capillary setae in posterior notopodia …….……*Mediomastus ambiseta*
2a. Spine-like notopodial hooks and posterior capillary setae absent, thoracic and abdominal hooks morphologically similar, body more robust in appearance…….……. ……. *Mediomastus californiensis*

3. Five thoracic setigers with capillary setae ……*Heteromastus filiformis*
3a. More than five thoracic setigers with capillary setae……..4

4. Thorax with 9 segments, 7 thoracic setigers with capillary setae (when mature) ……...
…..……*Capitella capitata*
4a. More than nine thoracic segments ……5

5. Ten thoracic setigers with capillary setae, first setiger incomplete; with patches of pale orange eyespots ….……*Decamastus nudus*
5a. More than ten thoracic setigers with capillary setae ……6

6. Eleven thoracic setigers with capillary setae …….7
6a. More than 11 setigers with capillary setae ……...10

7. At least first two abdominal notopodia with mixed fascicles of both capillary setae and hooks, first setiger incomplete……...
…….……...*Mastobranchus variabilis*
7a. Capillary setae lacking in abdominal setigers …… *Notomastus* …8

8. A pair of elongate fields of eyespots present, first setiger incomplete ……*Notomastus tenuis*
8a. Fields of eyespots lacking …….9

9. First setiger with capillaries in both the noto- and neuropodia ……..*N. lineatus*
9a. First setiger incomplete ……*N. hemipodus*

10. Twelve thoracic setigers with capillary setae ……...*Leiochrides* cf. *pallidior*
10a. Thirteen thoracic setigers with capillary setae …….*Dasybranchus lumbricoides*

Species Descriptions

Capitella capitata (Fabricius 1780).
Fig. 1-3

Lumbricus capitata Fabricius 1780: 279.
Capitella capitata. --Hartman 1969: 361.
--Maurer *et al*. 1988: 46. --Warren 1991: 276 -282.
Paraheteromastides sp. --Dean 1996b: 83.

Material examined: --Gulf of Nicoya, Subtidal: *Sta*. *4*, 9º53'40" N, 84º46'10" W, 40 m, mud, Jul 1980, (1, USNM 80410). Intertidal: Jicaral, 9º58' N, 85º06' W, intertidal, mangrove roots, Jan 1996 (1)(coll: H. Buttner).
--**Golfo Dulce**, Subtidal: *Sta* GD-09 (León-Morales & Vargas 1998), 8º39' N, 83º26' W, 43 m, grey mud, Dec. 1993, (1). Intertidal: Golfito Bay, 8º38' N, 83º10' W, 2 Km west of main dock, muddy sand, Sep 1986;(8) (coll: J.A. Vargas).

Remarks: *Capitella capitata* is a medium-sized species with 9 thoracic segments and no visible peristomium or achaetous segments, thus segments 1-7 bear capillary setae only (Fig. 1). Two individuals had mixed fascicles in both the notopodia and neuropodia of setigers 6 and 7. Warren (1976) found that juvenile individuals of this species may exhibit mixed fascicles in anterior segments beginning as early as setiger 4. Mature males possess genital spines on setigers eight & nine while the females have hooded hooks on these last two thoracic segments. This setal arrangement is in agreement with the description for this species given by Warren (1991, Fig 1 A) in her review of the genus. The genital setae of the males is made up of three stout, posteriorly directed spines on setiger eight and a deeply embedded, thin spine projecting anteriorly from setiger nine. The hooded hooks of the abdominal segments have a main fang with many small teeth in several rows (Fig. 2 & 3).

Warren (1991) indicated that *C. capitata* is cosmopolitan but with equatorial submergen-

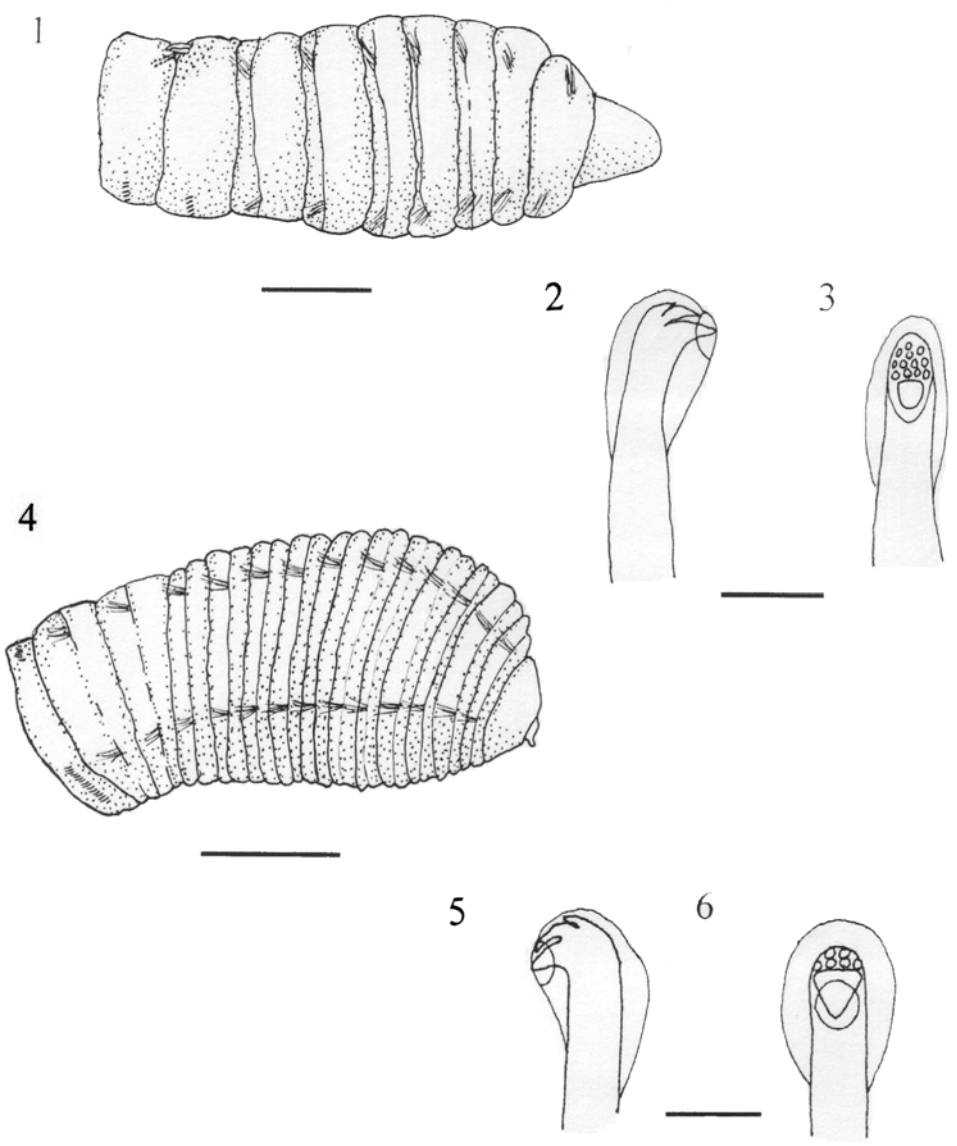

Fig. 1-6. Fig. 1-3 *Capitella capitata*: Fig. 1, anterior end of male, lateral view (scale bar = 0.3 mm); Fig. 2, hooded hook from abdominal setiger, lateral view; Fig. 3, hooded hook from abdominal setiger, frontal view (scale bar, Fig 2-3 = 0.02 mm). Fig. 4-6 *Dasybranchus lumbricoides*: Fig. 4, anterior end, lateral view (scale bar = 0.5 mm); Fig. 5, hooded hook from abdominal setiger, lateral view; Fig. 6, hooded hook from abdominal setiger, frontal view (scale bar, Fig 5-6 = 0.02 mm).

ce; however, most of these specimens from Costa Rica were collected intertidally. Grassle and Grassle (1976) have shown that this species often exists as a complex of sibling species which are very difficult to differentiate so, until a simple means of recognition of these subspecies is established, local populations of this species are usually referred to as the *C. capitata* spp. complex. Most of the Costa Rican specimens of *C. capitata* were collected at Golfito, the only major port in Golfo Dulce. This species has often been regarded as indicative of organically polluted environments (see Pearson & Rosenberg (1978) for a

discussion) and such pollution would be expected at this site due to the many ships and boats using this port (Spongberg & Davis 1998).

Dasybranchus lumbricoides Grube 1878.
Fig. 4-6

Dasybranchus caducus Grube, var. *lumbricoides* Grube. --Monro 1933: 1059-1060.
Dasybranchus lumbricoides Grube 1878: 190-191. --Hartman 1947: 431-432; 1969: 373-374. --Ewing 1984a: 14.38-14.41. --Fauchald 1977: 52.

Material examined: --Gulf of Nicoya, Intertidal: Punta Morales, South side, Lagartos Point, muddy sand, Aug 1996 (1).

Remarks: *D. lumbricoides* is a medium-sized species with an enlarged thoracic region relative to the abdominal region. It has an achaetous peristomium and thirteen thoracic segments all with capillary setae in both the notopodium and neuropodium (Fig. 4). The thirteenth thoracic setiger of the single Costa Rican specimen has hooks as well as capillary setae in the neuropodium which I interpret as a juvenile character. Warren (1976) and Fredette (1982) have both shown in *Capitella capitata* and *Heteromastus filiformis*, respectively, that anterior segments may possess hooks in young individuals with the hooks being progressively replaced by capillaries with age. In the first few abdominal segments the notopodia are situated dorsally, almost touching one another as described previously by Monro (1933). The hooded hooks of the abdomen have six smaller teeth above the main fang, four in a lower row and two above this (Fig. 5 & 6). The number and distribution of these small teeth is apparently quite variable as Hartman (1969) described the hooks of *D. lumbricoides* as having only 3 small teeth above the main fang while Ewing (1984a) reported 3-4 rows of small teeth in specimens from the Gulf of Mexico. Retractable branchiae were not seen as most of the posterior end of this specimen was regenerating but the enlarged neuropodial tori of the last two thoracic segments and lateral organs, similar to those described by Ewing (1984a), were observed.

D. lumbricoides has been reported from the eastern and western Pacific as well as the western Atlantic and Gulf of Mexico. It has been collected in the eastern Pacific from California to Panama as well as the Galapagos Islands in intertidal or shallow waters. Here a single specimen was collected intertidally in the Gulf of Nicoya.

Decamastus nudus Thomassin 1970.
Fig. 7-9

Decamastus nudus --Thomassin 1970: 81-82. -- Hernández-Alcántara & Solís-Weiss 1998: 709.
Notomastus tenuis Moore --Maurer *et al.* 1988: 46 (in part). --Dean (1996a): 71 (in part).

Material examined --Gulf of Nicoya, Subtidal: *Sta*. *3*, 9º52'00" N, 84º48'10" W, 33 m, sandy mud, Jul 1980, (2, USNM 80383). *Sta*. *4*, 9º53'40" N, 84º46'10" W, 40 m, mud, Jul 1980, (1, USNM 80384). *Sta*. *6*, 9º45'20" N, 84º46'25" W, 42 m, mud, Jul 1980, (1, USNM 80385). *Sta*. *22*, 9º48'25" N, 84º52' 40" W, 22 m, muddy sand, Jul 1980, (5, USN M 80406 & 15, USNM 80392). *Sta*. *23*, 9º48'35" N, 84º 43'50" W, 35 m, mud, Jul 1980, (1, USNM 80407). *Sta*. *24*, 9º49'25" N, 84º41' 20" W, 11 m, sand, Jul 1980,(16); Jan 1981, (4); Apr. 1981,(2); Jun 1981,(5) Aug 1981,(8). *Sta*. *27*, 9º51'57" N, 84º50'50" W, 12 m, muddy sand, Jul 1980, (1, USNM 80408). *Sta*. *29*, 9º54'55" N, 84º45'15" W, 18 m, muddy sand, Jul 1980, (1 & 1, USNM 80396); Aug 1981,(3). *Sta*. *30*, 9º54'40" N, 84º45'50" W, 18 m, muddy sand, Jul 1980,(2); Apr 1981,(3). *Sta*. *31*, 9º44'00" N, 84º59'25" W, 20 m, mud/sand, Jul 1980, (1). Intertidal: Punta Morales, Playa Blanca, lower intertidal muddy sand, Sep. 1994, (1). --**Golfo Dulce**, Intertidal: Golfito Bay, 2 Km west of main dock, 8º38' N, 83º10' W, muddy sand. Sep 1986, (9) (coll: J. A. Vargas).

Remarks: The anterior segments of *D. nudus* are weakly tessellated and the small prostomium possesses patches of small, orange pig-

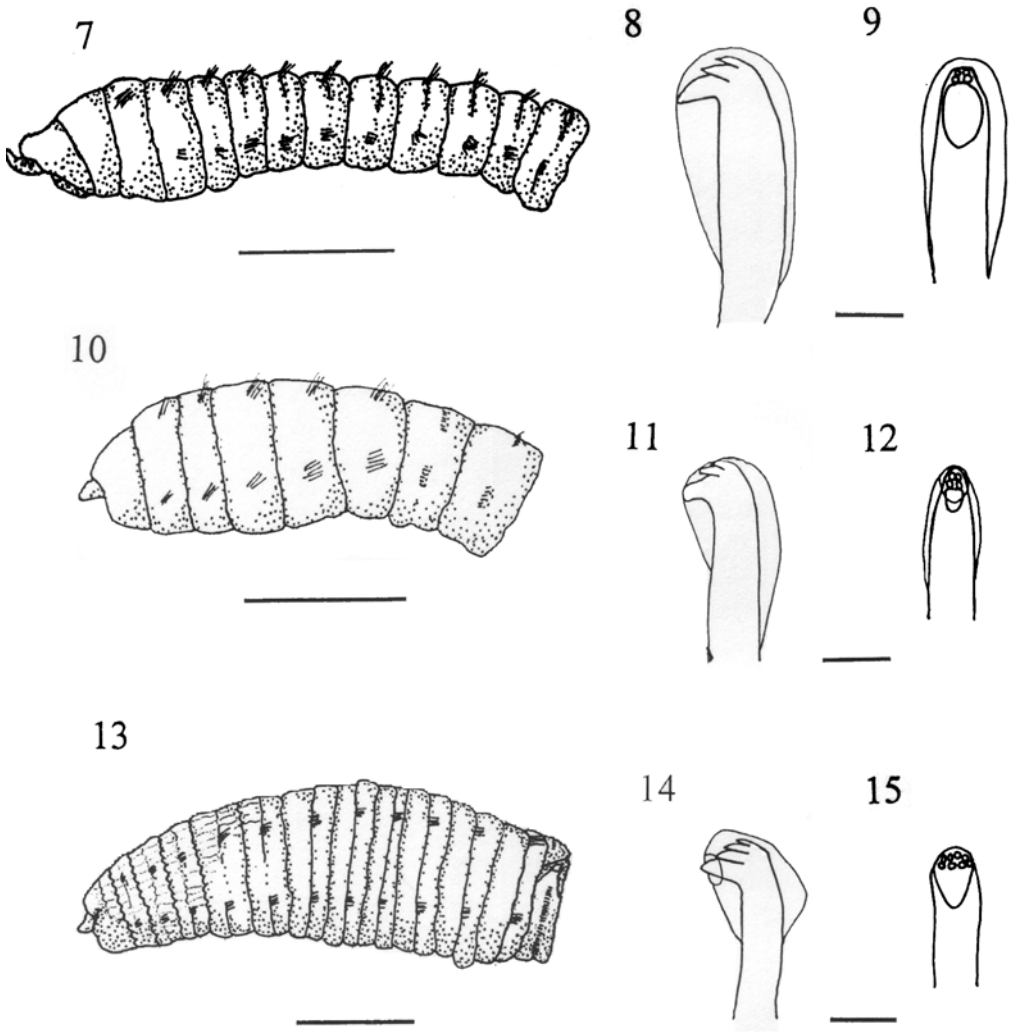

Fig. 7-15. Fig 7-9 *Decamastus nudus*: Fig. 7, anterior end, lateral view (scale bar = 0.05 mm); Fig. 8, hooded hook from abdominal setiger, lateral view; Fig. 9, hooded hook from abdominal setiger, frontal view (scale bar, Fig. 8-9 = 0.02 mm). Fig. 10-12 *Heteromastus filiformis*: Fig. 10, anterior end, lateral view (scale bar = 0.05 mm); Fig. 11, hooded hook from abdominal setiger, lateral view; Fig. 12, hooded hook from abdominal setiger, frontal view (scale bar Fig. 11-12 = 0.02 mm). Fig. 13-15 *Leiochrides ?pallidior*: Fig. 13, anterior end, lateral view (scale bar = 1.0 mm); Fig. 14, hooded hook from abdominal setiger, lateral view; Fig. 15, hooded hook from abdominal setiger, frontal view (scale bar, Fig. 14-15 = 0.02 mm).

ment spots. This species is of medium body size relative to other capitellid species. There are 11 thoracic segments, with the first achaetous followed by ten setigers with only capillary setae, the first setiger is incomplete (Fig. 7). The hooded hooks have a main fang with two sets of small teeth above that (Fig. 8 & 9). Complete specimens from Golfito possessed two pairs of digitate branchial processes inserted dorso-laterally on the posterior edge of each setiger in far posterior segments. Such branchiae were not observed by Thomassin (1970) or Ewing (1984a) for specimens belonging to this genus probably because, in both cases, their material was incomplete. It is also possible that development of branchial

lobes in speci-mens of the Golfo Dulce population is an adap-tation to low oxygen conditions in the sediments. Nonetheless, this is the first report of branchiae in the genus *Decamastus* and necessitates a revision of the original genus description by Thomassin (1970) indicating that branchiae may be present in posterior setigers.

Thomassin described this species from coral-line sands in Madagascar but Hernández-Alcántara and Solís-Weiss (1998) later reported the same species from fine and silty sands at depths of 32-106 m in the Gulf of California, Mexico. In Costa Rica, *D. nudus* was collected subtidally from sand or muddy sand at 11-42 m depth as well as from intertidal muddy sands in both the Gulf of Nicoya and Golfo Dulce.

Heteromastus filiformis (Claparède, 1864).
Fig. 10-12

Heteromastus filiformis --Hartman 1947: 427-428; 1969: 377.

Material examined --Gulf of Nicoya, Intertidal: Punta Morales, North side, lower to mid intertidal, sand and muddy sand, Jul. 1996, (8); Aug, 1996 (2). South side, Lagartos Point, lower intertidal, muddy sand, Jul. 1996, (1).

Remarks: This is a medium sized species with 11 thoracic segments, the first being achaetous, followed by 5 setigers with capillaries only and the remaining thoracic segments possessing hooks (Fig. 10). In posterior setigers there is a single short branchial process inserted dorsal to each notopodia, but there was no indication of the multi-filamentous branchiae described for *H. filobranchus* Berkeley & Berkeley 1932 by Hartman (1969). Fredette (1982) demonstrated that *H. filiformis* could be confused with *Mediomastus ambiseta* (Hartman 1947) as during development the juveniles pass through stages in which there may only be three or four setigers with capillary setae prior to reaching the adult complement of five setigers. Com-plete specimens of *M. ambiseta* may be differ-enttiated from these juveniles by their posse-ssion of capillary setae in posterior setigers. Hooded hooks from far posterior segments have a main fang surmounted by two rows of two small teeth each (Fig. 11 & 12).

H. filiformis is a widespread species found in all types of sediments, especially intertidal muds. In Costa Rica it was found in the Gulf of Nicoya on fine or muddy sands in the intertidal.

Leiochrides cf. *pallidior* (Chamberlin 1918).
Fig. 13-15

Notomastus pallidior. --Chamberlin 1918: 179; Berkeley & Berkeley 1942: 198.
Leiochrides pallidior. --Hartman 1947: 429-430; 1969: 382-384.

Material examined --Gulf of Nicoya, Subtidal: *Sta*. *29*, 9º54'55" N, 84º45'15" W, 18 m, muddy sand, Jul 1980, (2, USNM 80398). Apr 1982 (1).

Remarks: This species has a very large, robust body possessing 13 thoracic segments, the first an achaetous peristomium followed by 12 complete setigers bearing capillary setae only. The Costa Rican material was incomplete with the largest fragment having 37 segments and there were no branchiae observed. The hooded hooks on posterior setigers possess a main fang and 8-10 small teeth in 2 irregular rows. The descriptions of *L. pallidior* by Chamberlin (1918) and Hartman (1947, 1969) are very incomplete and some of its characteristics can only be inferred making it difficult to establish a definitive identification of the present material. This species can be differentiated from *L. hemipodus* Hartman 1960 previously reported from the Gulf of California, Mexico (Hernández-Alcántara & Solís-Weiss 1998) by having a complete first setiger, apparently lacking palmate branchiae in abdominal setigers and having more numerous small teeth on the hooded hooks.

L. pallidior has been reported from intertidal and shallow subtidal waters in California by Hartman (1947, 1969) and Berkeley & Berkeley (1942) who collected it at 89 m. In Costa Rica it occurred on muddy sand at a

single station of 18 m depth. This extends the known range of this species from California, USA to Pacific Costa Rica.

Mastobranchus variabilis Ewing 1984.
Fig. 16-18.

Mastobranchus sp. A. --Ewing 1984a: 14.34-35.
Mastobranchus variabilis. --Ewing 1984b, 793 -796.
Mastobranchus ?variabilis. --Hernández-Alcán-tara & Solís-Weiss 1998: 710.

Material examined --Gulf of Nicoya, Subtidal: *Sta*. *29*, 9º54'55" N, 84º45'15" W, 18 m, muddy sand, Apr 1982 (3).

Remarks: *M. variabilis* possesses a thorax with a large achaetous peristomium and 11 setigers with capillary setae only (Fig, 16). The first setiger is incomplete. The transition from thorax to abdomen is marked only by the presence of both capillary and hooded hooks (mixed) in the notopodia and hooks in the neuropodia of the abdominal segments. The three specimens collected from Costa Rica were all anterior fragments (the longest was 28 setigers long) so the digitate branchial filaments (beginning at setiger 67 in the holotype) were not seen. Hernández-Alcántara & Solís-Weiss (1998) identified their specimens of *Mastobranchus* from western Mexico as *M. ?variabilis* since they too worked with incomplete material and were unable to confirm the presence of branchiae in posterior segments. As noted by Ewing (1984b) and Hernández-Alcántara & Solís-Weiss (1998), however, the other two described species in this genus possess a complete first setiger. The Costa Rican material also agrees with Ewing's (1984b) species description of *M. variabilis* in several other characters which further supports its identification as this species. Nephridial apertures described for *M. variabilis* were visible as a pair of small pores in the groove between segments in the last five thoracic and the remaining abdominal segments. Additionally, the paired pores seen in *M. variabilis* (termed "lateral organs" by Ewing 1984b) were visible on thoracic segments between the notopodium and neuropodium, increasing in size towards the posterior of the thorax. In abdominal segments these organs appear as raised, oval structures between the notopodium and neuropodium. Finally, the structure of the hooded hooks, a large fang with 5 or 6 teeth in two or 3 irregular rows, agrees quite closely with those described for *M. variabilis*. While branchial segments are missing in these incomplete specimens it is clear they agree closely with the description of *M. variabilis* in other respects.

M. variabilis was first described from coarse to fine sand in the northern Gulf of Mexico (Ewing 1984b). Hernández-Alcántara & Solís-Weiss (1998) later identified this species from the Gulf of California, Mexico, in sandy sediments at 30 to 50 m depth. In Costa Rica specimens were collected at a single station in the Gulf of Nicoya at 18 m depth on a muddy sand substrate.

Mediomastus ambiseta (Hartman 1947).
Fig. 19-20

Capitata ambiseta Hartman 1947: 409-410.
Mediomastus ambiseta --Hartmann-Schröder 1962: 143. --Warren *et al.* 1994: 234-236.
Mediomastus ambiseta? --Dean 1996b: 83.
Mediomastus californiensis Hartman --Dean 1996a: 71 (in part).

Material examined --Gulf of Nicoya, Subtidal: *Sta*. *22*, 9º48'25" N, 84º52'40" W, 22 m, muddy sand, Jul 1980, (52). *Sta*. *24*, 9º49'25" N, 84º41'20" W, 11 m, sand, Jul 1980, (90); Jan 1981,(26); Apr 1981,(37); Jun 1981,(12) Aug 1981,(63). *Sta*. *28*, 9º52'16" N, 84º45'30" W, 26 m, mud, Jul 1980, (1); Jan 1981 (1); Apr 1981 (3); June 1981, (7); Aug 1981, (8). *Sta*. *29*, 9º54'55" N, 84º45'15" W, 18 m, muddy sand, Jul 1980, (9); Jan. 1981, (139); Apr. 1981, (10); June 1981, (14); Aug. 1981, (54); Apr. 1982, (20). *Sta*. *30*, 9º54'40" N, 84º 45'50" W, 18 m, muddy sand, Jul 1980, (14); Jan 1981, (53); Apr 1981, (2); June 1981, (7); Aug. 1981, (13). Intertidal: Jicaral, 9º58' N, 85º06' W, mangrove roots, Jan. 1996 (1) (coll: H. Buttner). Punta Morales, North side, muddy sand, Aug. 1986 (1). **--Golfo Dulce**, Subtidal: *Sta* GD-08 (León-Morales & Vargas 1998),

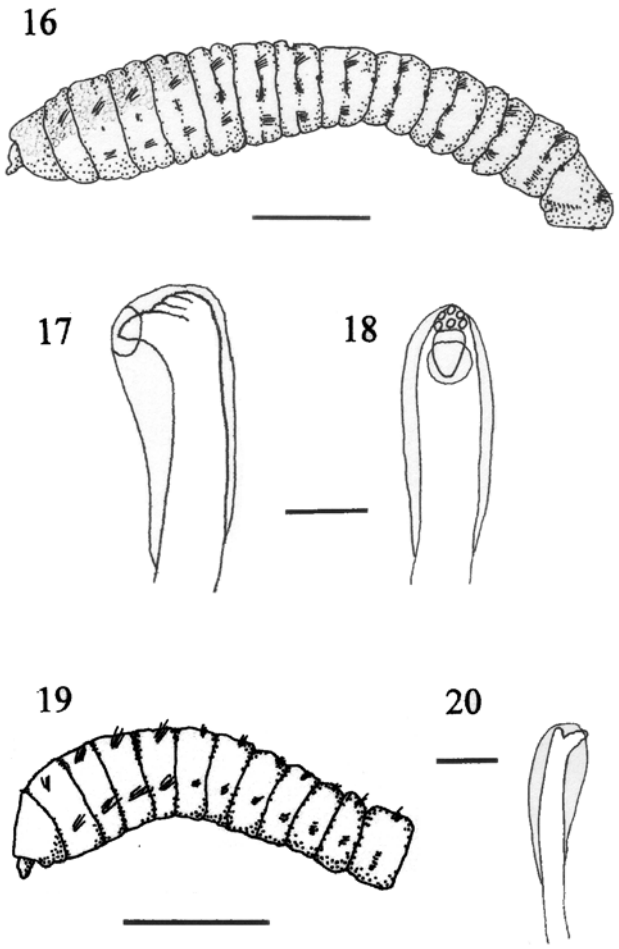

Fig. 16-20. Fig. 16-18 *Mastobranchus variabilis*: Fig. 16, anterior end, lateral view (scale bar = 1.0 mm); Fig. 17, hooded hook from abdominal setiger, lateral view; Fig. 18, hooded hook from abdominal setiger, frontal view (scale bar, Fig. 17-18 = 0.02 mm). Fig. 19-20 *Mediomastus ambiseta*: Fig. 19, anterior end, lateral view (scale bar = 0.05 mm); Fig. 20, spine-like notopodial hook from abdominal setiger, lateral view (scale bar = 0.02 mm).

8º43' N, 83º29' W, 50 m, brown mud, Dec 1993, (1). Intertidal: Golfito Bay, 8º38' N, 83º10' W, 2 Km west of main dock, muddy sand, Sep. 1986; (1154) (coll: J. A. Vargas).

Remarks: *M. ambiseta* has a thin, thread-like body with an achaetous peristomial segment followed by a thorax with 10 setigers, the 10th being shorter than the rest and perhaps considered transitional (Fig. 19). Capillary setae only are present in setigers 1-4 of the thorax, the remaining thoracic segments with hooded hooks only. Abdominal hooded hooks of the neuropodia short with a main fang surmounted by several small teeth, hooded hooks of the notopodia bidentate, long and spine-like (Fig. 20). Posterior notopodia of abdomen with long capillary setae. Methyl green staining resulted in setigers 6-9 being darkly stained dorsally. This agrees fairly well with the results obtained by Warren *et al.* (1994) on intertidal and shallow water specimens from California and Massachusetts (USA) but is dissimilar to the methyl green staining patterns

seen by Blake, (2000
material from the San
western Santa Barbara Cl

M. ambiseta is know
and West coast of Nortl
the Gulf of Mexico anc
from mud & muddy sar
shallow subtidal (Warren
Rica this species was
subtidal stations with r
bottoms. It was also co
mud or muddy sand from
the Gulf of Nicoya and v
abundance, along with
Golfito in Golfo Dulce.

Mediomastus californien
Fig. 21-23

Mediomastus californiens
265; 1947: 408; 196
1984a: 14.14-14.16. -
239-241. --Vargas 19
1989: 1909. --Maurer e
1996a: 71, 1996b: 8
Vargas 1998: 85. --He
Solís-Weiss 1998: 710

Material examined --G
tidal: *Sta*. *1*, 9º57'30" N,
mud, Jul 1980, (13, USN
55'28" N, 84º52'05" W, 1
1980, (2, USNM 80358
84º48'10" W, 33 m, sand
USNM 80359). *Sta*. *7*, 9
W, 15m, muddy sand,
80360 & 9, USNM 803
N, 84º43'50" W, 26 m,
80361& 2, USNM 8036
N, 84º45'30" W, 9 m, sar
USNM 80363). *Sta*. *15*,
W, 15 m, sandy mud,
80364). *Sta*. *17*, 9º57'52" N, 84º59'00" W, 9
m, mud, Jul 1980, (3). *Sta*. *22*, 9º48'25" N, 84º
52'40" W, 22 m, muddy sand, Jul 1980,(6; 2,
USNM 80365). *Sta*. *23*, 9º48'35" N, 84º43'50"
W, 35 m, mud, Jul 1980, (1, USNM 80366).
Sta. *24*, 9º49'25" N, 84º41'20" W, 11 m, sand,
Jul 1980,(84); Jan 1981,(23); Apr 1981,(23);
Jun 1981,(13) Aug 1981,(62). *Sta*. *27*, 9º51'
57" N, 84º50'50" W, 12 m, muddy sand, Jul

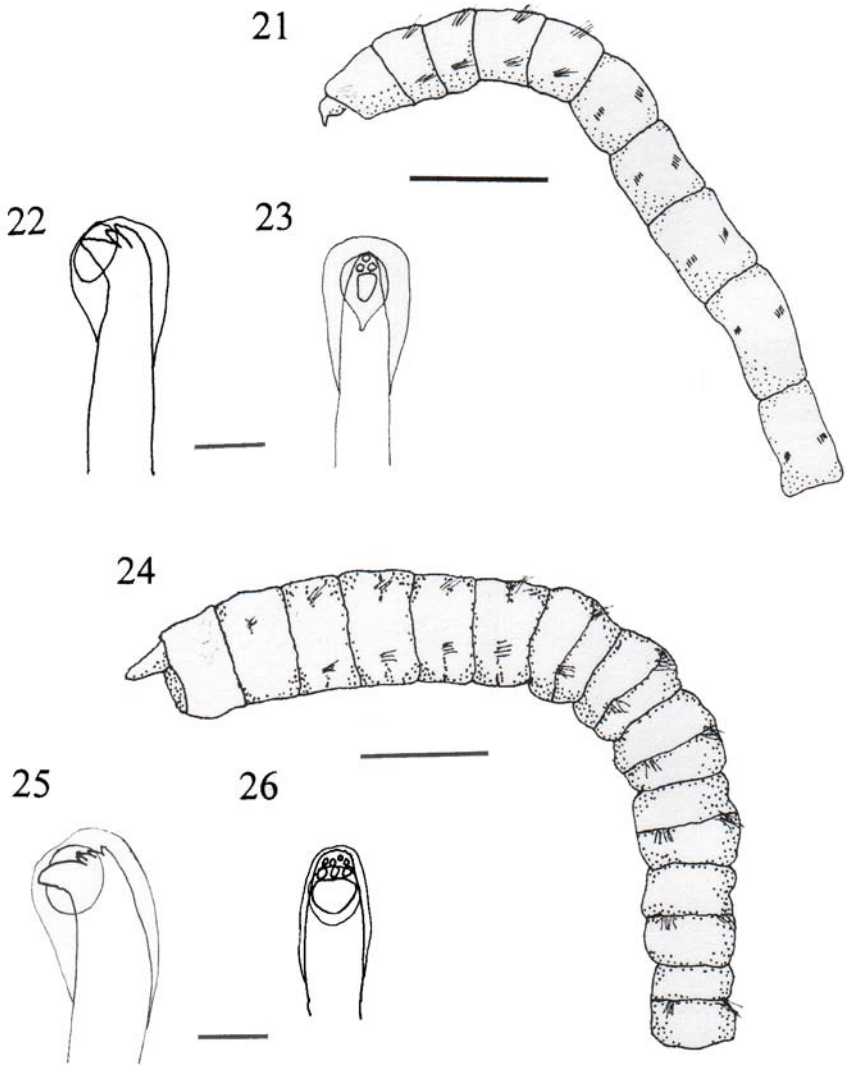

Fig. 21-26. Fig. 21-23 *Mediomastus californiensis*: Fig. 21, anterior end, lateral view (scale bar = 0.05 mm); Fig. 22, hooded hook from abdominal setiger, lateral view; Fig. 23, hooded hook from abdominal setiger, frontal view (scale bar, Fig. 22-23 = 0.05 mm). Fig. 24-26 *Notomastus hemipodus*: Fig. 24, anterior end, lateral view (scale bar = 1.0 mm); Fig. 25, hooded hook from abdominal setiger, lateral view; Fig. 26, hooded hook from abdominal setiger, frontal view (scale bar, Fig. 25-26 = 0.02 mm).

smaller teeth similar to those seen by Hartman (1969). As was pointed out by Warren *et al.* (1994), this species can be differentiated from *M. ambiseta* by the lack of capillary setae in posterior segments, a lack of spine-like notopodial hooks and the overall more "muscular" appearance of the anterior region. Additionally, Blake (2000) points out that the similarity of thoracic and abdominal hooded hooks in *M.*

californiensis could also be used to differentiate the two species as the hooks of *M. ambiseta* are dissimilar in the two body regions. Methyl green staining resulted in a pattern of transverse stripes on setigers 7-9 somewhat similar to the results of Warren *et al.* (1994). Blake (2000), however, reported variable methyl green staining patterns with his material from the intertidal of Murro Bay, California (USA).

M. californiensis has been reported from both coasts of North America and the Gulf of Mexico on fine to muddy sands from the intertidal and shallow subtidal waters (Ewing 1984a). Hernández-Alcántara & Solís Weiss (1998) collected *M. californiensis* from depths of 33-69 m in silty sands from the Gulf of California in Mexico and this species has often been reported from various sites in Pacific Mexico (De León-González 1994; Salazar-Vallejo 1981; Van Der Heiden & Hendrickx 1982; Arias-González 1984; Varela-Hernández 1993). It is one of the most common subtidal species in the Gulf of Nicoya being collected from numerous sites in sediments ranging from mud to sand. A few specimens have also been taken intertidally from mud and muddy sand in both the Gulf of Nicoya and Golfo Dulce.

Notomastus hemipodus Hartman 1945.
Fig. 24-26

Notomastus (Clistomastus) hemipodus --Hartman 1945: 38; 1947: 424; 1969: 393.
Notomastus hemipodus. --Ewing 1984a: 14.28. --Vargas 1987: 304. --Hernández-Alcántara & Solís-Weiss 1998: 711.
Notomastus luridis Verrill --Maurer *et al.* 1988: 46. --Dean 1996a: 71.

Material Examined --Gulf of Nicoya, Subtidal: *Sta*. *1*, 9º57'30" N, 84º53'00" W, 46 m, mud, Jul 1980, (USNM 80378). *Sta*. *2*, 9º55'28" N, 84º52'05" W, 18 m, muddy sand, Jul 1980, (2, USNM 80379; 1, USNM 80380 & 1, USNM 80381). *Sta*. *3*, 9º52'00" N, 84º48'10" W, 33 m, sandy mud, Jul 1980, (2, USNM 80382). *Sta*. *13*, 9º52'30" N, 84º43'50" W, 26 m, Jul 1980, (2, USNM 80387). *Sta*. *14*, 9º57'05" N, 84º45'30" W, 9 m, sandy mud, Jul 1980, (1, USNM 80388). *Sta*. *15*, 9º57'40" N, 84º47'00" W, 15 m, sandy mud, Jul 1980, (13, USNM 80389 & 3, USNM 80390). *Sta*. *20*, 10º01'40" N, 84º55'57" W, 14 m, sand, Jul 1980, (1, USNM 80391). *Sta*. *22*, 9º48'25" N, 84º52'40" W, 22 m, muddy sand, Jul 1980,(1). *Sta*. *23*, 9º48'35" N, 84º43'50" W, 35 m, mud, Jul 1980, (1, USNM 803*9*3). *Sta*. *24*, 9º49'25" N, 84º41'20" W, 11 m, sand, Jul 1980,(4); Jan 1981, (5); Apr 1981, (16); Jun 1981, (4) Aug 1981, (15). *Sta*. *27*, 9º51'57" N, 84º50'50" W, 12 m, muddy sand, Jul 1980, (9, USNM 80394). *Sta*. *28*, 9º52'16" N, 84º45'30" W, 26 m, mud, Jul 1980, (7; 16, USNM 80395); Jan 1981 (24); Apr 1981 (45); June 1981,(22); Aug 1981,(3). *Sta*. *29*, 9º54'55" N, 84º45'15" W, 18 m, muddy sand, Jul 1980, (7; 3, USNM 80396; 1, USNM 80397; 6, USNM 80398); Jan 1981, (15); Apr 1981, (3); June 1981, (7); Aug 1981,(14); Apr 1982, (35). *Sta*. *30*, 9º54'40" N, 84º45'50" W, 18 m, muddy sand, Jul 1980,(7; 1, USNM 80399); Jan 1981, (3); Apr 1981,(46); June 1981, (2). *Sta*. *31*, 9º44'00" N, 84º59'25" W, 20 m, mud/sand, Jul 1980, (3, USNM 80400). *Sta*. *32*, 9º53'47" N, 84º49'35" W, 24 m, mud/sand, Jul 1980, (1, USNM 80401). *Sta*. *35*, 9º55'42" N, 84º47'40" W, 13 m, sand, Jul 1980, (1, USNM 80403). *Sta*. *37*, 9º57'38" N, 84º48'20" W, 14 m, muddy sand, Jul 1980, (3, USNM 80404). *Sta*. 44; 9º59'17" N, 84º54'25" W, 24 m, muddy sand, Jul. 1980 (1). Intertidal: Punta Morales, North side, mid intertidal, muddy sand, Aug 1988 (1). Jicaral, 9º58' N, 85º06' W, mangrove roots, Jan 1996 (1) coll: H. Buttner.

Remarks: *N. hemipodus* has a relatively large, robust body with a peristomium which is visible only ventrally and a thoracic region with 12 segments. The first thoracic segment is achaetous and is followed by 11 setigers with capillaries in both rami except for the first which lacks capillaries in the neuropodia (Fig. 27). The first 4-6 thoracic segments are areolated dorsally. The transition from the thorax to the abdomen is apparent only by the changeover from capillary setae in the thorax to hooded hooks in abdominal segments and the increased length of the setal fascicles in both rami in abdominal segments. The hooded hooks of the abdomen have a main fang surmounted by 5 or 6 smaller teeth in a single row (Fig. 28-29).

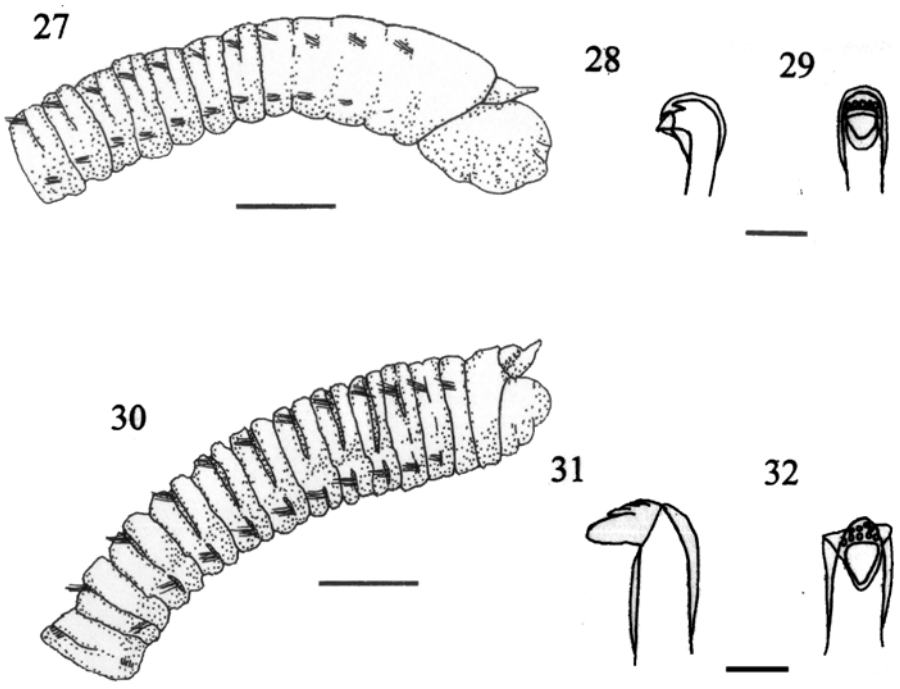

Fig. 27-32. Fig. 27-29 *Notomastus lineatus*: Fig. 27, anterior end, lateral view (scale bar = 0.05 mm); Fig. 28, hooded hook from abdominal setiger, lateral view; Fig. 29, hooded hook from abdominal setiger, frontal view (scale bar, Fig. 28-29 = 0.02 mm). Fig. 30-32 *Notomastus tenuis*: Fig. 30, anterior end, lateral view (scale bar = 0.05 mm); Fig. 31, hooded hook from abdominal setiger, lateral view; Fig. 32, hooded hook from abdominal setiger, frontal view (scale bar, Fig. 31-32 = 0.02 mm).

N. hemipodus is known from both coasts of North America and the Gulf of Mexico from the intertidal to 120 depth in muddy sands (Ewing 1984a). Hernández-Alcántara & Solís-Weiss (1998) collected this species from the Gulf of California, Mexico, at depths of 22-106 m on fine, medium and silty sands and muds. It has also been reported from the northern and central Gulf of California, Mexico (Varela-Her-nández 1993; González-Ortiz 1994). In Costa Rica, *N. hemipodus* was fairly widespread in the Gulf of Nicoya in muds, to muddy sands, to sands from the intertidal to 46 m depth.

Notomastus lineatus Claparède, 1870.
Fig. 27-29

Notomastus (Clistomastus) lineatus. --Hartman 1947: 419; 1969: 395-396. --Fauchald 1977: 52.

Notomastus lineatus. --Ewing 1984a: 14.23-14.26. --Hernández-Alcántara & Solís-Weiss 1998: 712.

Material Examined: --Gulf of Nicoya, Intertidal: Punta Morales, South side, mouth of Rio Morales, upper intertidal fine sand, Aug, 1996 (1).

Remarks: There are 12 segments in the thorax with 11 complete setigers bearing only capillary setae although the setal fascicle of the first setiger in this single specimen was very small with only a single short capillary setae. The transition from thorax to abdomen was well defined and the changeover from capillary setae to hooded hooks was also apparent. The hooded hooks from abdominal segments have a sharply bent main fang and 5 small teeth in a single row above. The branchial lamellae,

present as club-like extensions dorsal to the neuropodia, do not appear until far posterior setigers, unlike the specimens described from the Gulf of Mexico by Ewing (1984a, Fig. 14-18c) which possessed branchial lamellae starting on the first abdominal segment. Fine walled lateral organs located between the notopodial and neuropodial rami in abdominal segments are present in the Costa Rican specimen.

N. lineatus is a wide ranging species having been reported from the Mediterranean, the Gulf of Mexico, the eastern Pacific, and the Antarctic, usually from coarse sediments. Hernández-Alcán-tara & Solís-Weiss (1998) reported it from fine to coarse sands at depths from 29 to 78 m in the Gulf of California, Mexico. It had previous-ly been reported from Pacific Mexico by Salazar-Vallejo (1985) and Van der Heiden & Hendrickx (1982). A single specimen was col-lected from intertidal fine sand in the Gulf of Nicoya.

Notomastus tenuis Moore 1909.
Fig. 30-32

Notomastus (Clistomastus) tenuis. --Hartman 1947: 420; 1969: 387.
Notomastus ? tenuis. --Ewing 1984a: 14.26-14.28.
Notomastus tenuis. --Hernández-Alcántara & Solís-Weiss 1998: 712-713.

Material examined --Gulf of Nicoya, Subtidal: *Sta. 2*, 9º55'28" N, 84º52'05" W, 18 m, muddy sand, Jul 1980, (1, USNM 80405). *Sta. 29*, 9º54'55" N, 84º 45'15" W, 18 m, muddy sand, Jan 1981, (1). *Sta. 34*, 9º55'30" N, 84º50'05" W, 24 m, sand, Jul 1980, (1, USNM 80402; 1, USNM 80409). *Sta. 37*, 9º 57'38" N, 84º48'20" W, 14 m, muddy sand, Jul 1980, (1, USNM 80404).

Remarks: *N. tenuis* has 12 segments in the thorax with one achaetous segment and eleven setigers with capillary setae, the first setiger being incomplete (Fig. 30). It is a large species, similar to *N. hemipodus* in body size. *N. tenuis* differs from *N. hemipodus* in its possession of a pair of elongate patches of dark eyespots on the prostomium. The hooks have a main fang with about 4 small teeth seen from the side (Fig. 31). In frontal view there is a row of 5 teeth above the fang with about 4 small teeth in an irregular row above that (Fig. 32).

This species is commonly found in the eastern Pacific from Canada to Mexico although Ewing (1984a) also "questionably" identified this species from the Gulf of Mexico. Hernández-Alcántara & Solís-Weiss (1998) collected it from the Gulf of California, Mexico, in fine to silty sands from at depths of 39 to 120 m. It has previously been reported from western Mexico by Rioja (1962), De León-González (1994), Salazar-Vallejo (1981), Van Der Heiden & Hendrickx (1982) and Fauchald (1972). In Costa Rica it was taken occasionally in the Gulf of Nicoya from 14 to 24 m depth in muddy sand to sand stations.

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