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Polychaeta from the Vicinity of Deep-sea Hydrothermal Vents in the Eastern Pacific. II. New Species and Records from the Juan de Fuca and Explorer Ridge Systems[1]

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ABSTRACT: A total of 15 genera and species distributed in 10 families of Polychaeta is reported from hydrothermal vent sites on the Juan de Fuca and Explorer ridges off British Columbia and Washington. One genus and 10 species are new to science. New taxa include *Protomystides verenae* (Phyllodocidae), *Nereis piscesae* (Nereididae), *Hesiodeira glabra* and *Amphiduros axialensis* (Hesionidae), *Sphaerosyllis ridgensis* (Syllidae), *Ophryotrocha globopalpata* and *Parougia wolfi* (Dorvilleidae), *Orbiniella hobsonae* and *Leitoscoloplos pachybranchiatus* (Orbiniidae), and *Nicomache venticola* (Maldanidae). The hesionid *Hesiospina vestimentifera* and the ampharetid *Amphisamytha galapagensis*, previously reported from other eastern Pacific vent sites, are newly recorded. The scalibregmatid *Axiokebuita millsi*, previously known from deep-sea locations in the North Atlantic and Antarctic, is new to the northeastern Pacific. Additional records of the recently described alvinellid, *Paralvinella pandorae*, are reported.

THE DISCOVERY OF DIVERSE faunal assemblages at hydrothermal vent sites at the Galápagos Rift and other areas in the eastern Pacific has led to a proliferation of taxonomic papers on marine invertebrates. For the Polychaeta, 50 previously unknown species belonging to 15 families have already been described from hydrothermal vent locations (Desbruyères and Laubier 1980, 1982, 1986, Maciolek 1981, Fauchald 1982, Pettibone 1983, 1984*a*,*b*, 1985*a*,*b*,*c*, 1986, 1988, 1989*a*,*b*, Zottoli 1983, Blake 1985, ten Hove and Zibrowius 1986, Detinova 1988).

The hydrothermal vents on the Juan de Fuca and Explorer ridges in the northeastern Pacific were originally discovered by the joint Canadian American Seamount Expedition (CASM) (Tunnicliffe and Juniper 1983, Harman 1984, CASM 1985). These initial programs have been augmented by additional surveys on the Juan de Fuca Ridge (Tunnicliffe et al. 1985, Tunnicliffe and Fontaine 1987) and on the Explorer Ridge (Tunnicliffe et al. 1986). Studies on the Juan de Fuca Ridge have focused on the hydrothermal ventfields on the Endeavour Segment, the Axial Seamount, and the Southern Segment. The Axial Seamount is by far the most extensively studied, with three major ventfields (ASHES, CASM, and South Rift). Details of the ventfields on the Juan de Fuca Ridge may be found in Tunnicliffe et al. (1985), Normark et al. (1987), and Murphy and Fox (in press). Some of the polychaetes collected as part of these studies have been described by Desbruyères and Laubier (1986) and Detinova (1988) (Alvinellidae) and by Pettibone (1988) (Polynoidae). The remaining families of polychaetes are described in this paper. A brief summary of some of these findings has been reported by Tunnicliffe (1988).

Collections were made as part of research dives by the manned submersibles DSRV *Pisces IV* and *Alvin* during the summers of 1983, 1984, and 1986. Manipulator arms equipped with claws and suction devices were used to collect samples. Polychaetes were obtained from vestimentiferan worm clumps, pieces of volcanic rock, or intact smoker chimneys and sorted from a variety of rock

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and debris collected at or near active vents. Samples were washed on deck and preserved in 10% formalin. Specimens were sorted to family and shipped to us for identification. High-quality microscopes equipped with phase contrast and Nomarski differential interference optics were used for observations.

The types and some additional specimens are deposited in the National Museum of Canada, Ottawa (NMCA), and at the National Museum of Natural History, Smithsonian Institution (NMNH). Selected voucher specimens have been kept by the authors (JAB/BH).

Ten families of Polychaeta, including 15 genera (one new) and 15 species (10 new), are covered in this report. They were collected as part of dives by the DSRV *Alvin* during August and September–October 1984 on the Juan de Fuca Ridge and by the DSRV *Pisces IV* in August 1983; June, July, and August 1984; and July and August 1986 from the Explorer and Juan de Fuca ridges. The location of stations where collections were made during these dives is provided in Table 1.

The following polychaete species are covered in this report:

Family Phyllodocidae
  Protomystides verenae, new species
Family Nereididae
  Nereis piscesae, new species
Family Hesionidae
  Hesiospina vestimentifera Blake, 1985
  Hesiodeira glabra, new genus, new species
  Amphiduros axialensis, new species
Family Syllidae
  Sphaerosyllis ridgensis, new species
Family Dorvilleidae
  Ophryotrocha globopalpata, new species
  Parougia wolfi, new species
Family Orbiniidae
  Orbiniella hobsonae, new species
  Leitoscoloplos pachybranchiatus, new species
Family Spionidae
  Prionospio (*Minuspio*) sp.
Family Scalibregmatidae
  Axiokebuita millsi Pocklington & Fournier, 1987
Family Maldanidae
  Nicomache venticola, new species
Family Ampharetidae
  Amphisamytha galapagensis Zottoli, 1983
Family Alvinellidae
  Paralvinella pandorae Desbruyères & Laubier, 1986

SYSTEMATIC ACCOUNT

Family PHYLLODOCIDAE

Genus *Protomystides* Czerniavsky, 1882

Protomystides verenae Blake & Hilbig, new species

Figures 1, 2

Protomystides n. sp.: Tunnicliffe, 1988:352.

MATERIAL EXAMINED: Hydrothermal vents of the northeastern Pacific, dives by *Pisces IV* (P) and *Alvin* (A): Explorer Ridge, Upper Magic Mountain, Crab Vent, P-1494-2319, holotype (NMCA 1989-0053), 32 paratypes (NMCA 1989-0052; NMNH 122686); Magic Mountain, P-1497-2307, paratype (NMCA 1989-0054). Juan de Fuca Ridge, Axial Seamount, ASHES Ventfield: Devil Vent, P-1720-2332, 6 paratypes (NMCA 1989-0055); Southern Vent, P-1726-2335, 4 paratypes (NMCA 1989-0056); Miserable Vent, P-1733-2328, 30+ paratypes (NMCA 1989-0057); Not-So-Miserable Vent, P-1733-2334, 3 paratypes (NMCA 1989-0058). Juan de Fuca Ridge, Endeavour Segment, Vent 1, A-1439-2324, 2 paratypes (NMNH 122687); Lt. Obo Vent, A-1447-2310, 4 paratypes (NMNH 122688).

DESCRIPTION: Large species, up to 27 mm long and 2.1 mm wide for approximately 75 segments. Body dark brown to light tan, with dark brown spots on dorsal and ventral cirri, lighter spots on tentacular cirri, prostomium, and body segments.

Prostomium trapezoidal, as wide as long, broadly rounded on anterior margin, broadly V-shaped posteriorly; 4 cirriform antennae with anterior pair shifted ventrolaterally, each nearly as long as prostomium; eyes lacking

TABLE 1

STATION LOCATIONS OF SUBMERSIBLE DIVES ON THE JUAN DE FUCA (JdF) AND EXPLORER RIDGE (ER) SYSTEMS, 1983–1986

VEHICLE DIVE NO.	DATE	LOCATION	POSITION	DEPTH (m)	COMMENTS
DSRV *Pisces IV*					
P-1327	17 Aug. 1983	Axial Seamount, JdF CASM Ventfield	45°59.5′ N, 130°01.7′ W	1,575	Taylors Vent
P-1492	23 June 1984	Magic Mtn., ER	49°45.5′ N, 130°16.2′ W	1,853	Pogo Peaks
P-1494	1 July 1984	Magic Mtn., ER	49°45.6′ N, 130°16.1′ W	1,818	Gulati Gusher, Crab Vent
P-1495	2 July 1984	Magic Mtn., ER	49°45.6′ N, 130°16.2′ W	1,808	Lunch Hour Vent
P-1497	4 July 1984	Magic Mtn., ER	49°45.5′ N, 130°16.1′ W	1,812	Crab Vent; Son, Magic Mtn.
P-1505	19 Aug. 1984	Explorer Ridge	49°45.7′ N, 130°16.1′ W	1,823	Busted Thruster
P-1720	14 July 1986	Axial Seamount, JdF ASHES Ventfield	45°55.9′ N, 130°00.8′ W	1,545	Hell Vent; Devil Vent
P-1722	18 July 1986	Axial Seamount, JdF ASHES Ventfield	45°55.9′ N, 130°00.8′ W	1,545	Mushroom Vent
P-1723	19 July 1986	Axial Seamount, JdF ASHES Ventfield	45°55.9′ N, 130°00.8′ W	1,545	Hell Vent; Hillock Vent
P-1724	20 July 1986	Axial Seamount, JdF ASHES Ventfield	45°55.9′ N, 130°00.8′ W	1,545	Hell Vent
P-1725	25 July 1986	Axial Seamount, JdF ASHES Ventfield	45°55.9′ N, 130°00.8′ W	1,545	Hell Vent; Goblin Vent
P-1726	27 July 1986	Axial Seamount, JdF ASHES Ventfield	45°55.9′ N, 130°00.8′ W	1,545	Southern Vent
P-1728	29 July 1986	Axial Seamount, JdF ASHES Ventfield	45°55.9′ N, 130°00.8′ W	1,545	Bouquet Vent; Demon Vent
P-1731	31 July 1986	Axial Seamount, JdF CASM Ventfield	45°59.5′ N, 130°01.7′ W	1,575	Lamphere Chimneys; Taylors Vent
P-1732	2 Aug. 1986	Axial Seamount, JdF ASHES Ventfield	45°55.9′ N, 130°00.8′ W	1,545	Hillock Vent; Limbo Vent
P-1733	3 Aug. 1986	Axial Seamount, JdF ASHES Ventfield	45°55.9′ N, 130°00.8′ W	1,545	Miserable Vent; Not-So-Miserable Vent
DSRV *Alvin*					
A-1439	25 Aug. 1984	Endeavour Seg., JdF	47°57′ N, 129°05′ W	2,190	Hole in the Ground
A-1446	2 Sept. 1984	Endeavour Seg., JdF	47°57.1′ N, 129°06.3′ W	2,216	TLC Vent
A-1447	3 Sept. 1984	Endeavour Seg., JdF	47°57′ N, 129°05′ W	2,195	Lt. Obo Vent
A-1451	6 Sept. 1984	Endeavour Seg., JdF	47°57′ N, 129°06.0′ W	2,199	Dual Smoker
A-1452	7 Sept. 1984	Endeavour Seg., JdF	47°57′ N, 129°06.0′ W	2,208	Lt. Obo Vent
A-1455	24 Oct. 1984	Southern Seg., JdF	44°39.25′ N, 130°22′ W	2,200	Vent 1
A-1461	24 Oct. 1984	Southern Seg., JdF	44°38.5′ N, 130°22.3′ W	2,200	Plume

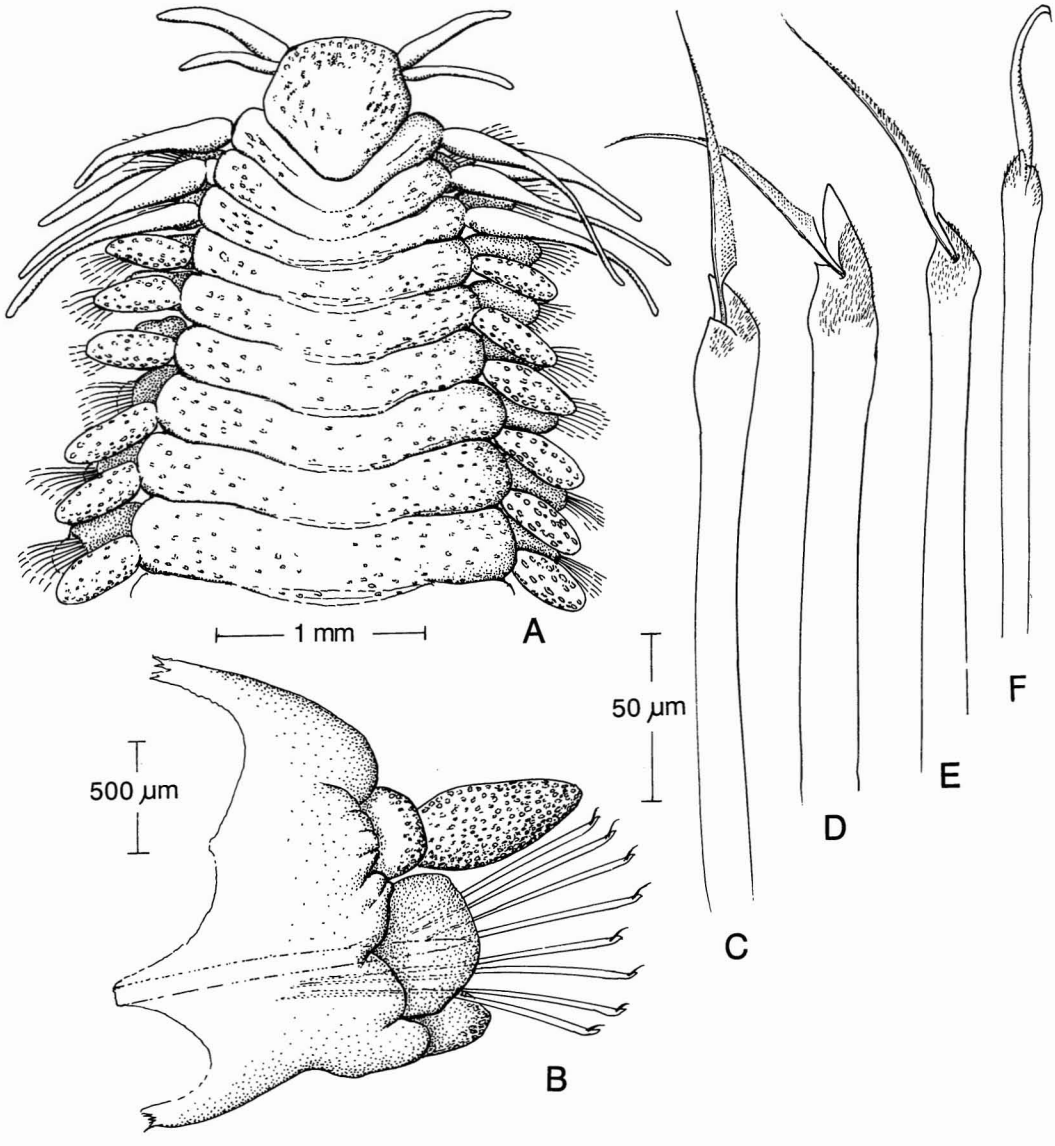

FIGURE 1. *Protomystides verenae* (paratype, NMNH 122686): *A*, anterior end in dorsal view; *B*, right middle parapodium, posterior view; *C–F*, composite setae.

(Figure 1*A*). Anterior segments distinct, free from one another, not fused to prostomium; first segment with pair of long tentacular cirri; second segment with long dorsal and ventral tentacular cirri; third segment with long dorsal tentacular cirrus and normal ventral cirrus; all tentacular cirri cirriform, not flattened, tapering distally; setal fascicles beginning on segment 2 (Figure 1*A*). Tentacular formula $= 1 + S_1^1 + S_v^1$. Dorsal cirri from segment 4; each dorsal cirrus short, oval, thickened, covered with brown pigment spots, about 2–3 times as long as wide (Figures 1*A*,*B*; 2*A*); dorsal cirri extending well beyond podial lobe in anterior segments (Figure 1*B*); podial lobes elongate in middle setigers, with

dorsal cirri located higher on body wall (Figure 2*A*); ventral cirri oval, shorter than dorsal cirri throughout body, bearing brown pigment spots mostly on tip (Figure 1*B*). Podial lobes simple, with broad, smoothly rounded distal border with single imbedded aciculum and spreading fascicle of 8–12 compound spinigers; setae of two types: (1) large, heavy, brown in color, (2) small, thin, noncolored; both types with large, pointed, terminal tooth and subapical notch from which thin blade emerges (Figure 1*C–F*); end of shaft covered with fine bristles; blade with fine teeth along one edge (Figure 1*C–E*). Pygidium bearing 2 long, cirriform anal cirri.

ETYMOLOGY: This species is named for Dr. Verena Tunnicliffe, University of Victoria, in recognition of her work on the ecology of the hydrothermal vent communities of the Juan de Fuca and Explorer Ridge systems.

REMARKS: This species is referred to the genus *Protomystides* on the basis of free tentacular segments and a tentacular cirrus on segment 3. *Protomystides verenae* is very closely related to *P. hatsushimaensis* Miura, recently described from cold-seep communities off Japan. Both species have distinctive compound setae with short, aristatelike blades and very similar prostomial and parapodial features. However, the examination of two paratypes of *P. hatsushimaensis*, deposited in the Smithsonian Institution (NMNH 120916, 120918), revealed that *P. verenae* differs from *P. hatsushimaensis* in the length and shape of the dorsal cirri, shape of the podial lobes, and the compound setae. In *P. verenae,* the elongate podial lobes of middle body segments are broadly rounded and bear dorsal cirri that are 2–3 times as long as wide (Figure 2*A*), whereas in *P. hatsushimaensis* the elongate podial lobes are apically pointed and bear dorsal cirri that are as wide as long (Figure 2*B*). Two types of compound setae have been observed in *P. verenae*, but the compound setae observed in the paratypes of *P. hatsushimaensis* are of a uniform size. In addition, the characteristic aristatelike compound setae of *P. verenae* and *P. hatsushimaensis* are very similar, differing chiefly in fine details of the denticle patterns (Miura 1988: figs. 1*i–j*; this study: Figures 1*C–F*) and the occasional presence of a second apical tooth in *P. hatsushimaensis*. The close similarity between these two species suggests a pattern of incipient speciation between populations that occur on opposite sides of the North Pacific.

The aristatelike compound setae in *P. verenae* and *P. hatsushimaensis* more closely resemble those of *Galapagomystides aristata* Blake, 1985 from hydrothermal vents at the Galápagos Rift, rather than those of other *Protomystides* species, suggesting a closer relationship between vent- and seep-dwelling species of supposedly different genera than between congeners. These facts suggest that the characters used to differentiate species presently assigned to *Protomystides, Mystides*, and related genera should be reviewed.

Family NEREIDIDAE

Genus *Nereis* Linnaeus, 1758

Nereis piscesae Blake & Hilbig, new species

Figures 3, 4

MATERIAL EXAMINED: Hydrothermal vents of the northeastern Pacific, dives by *Pisces IV* (P) and *Alvin* (A): Juan de Fuca Ridge, Axial Seamount, ASHES Ventfield: Hell Vent, P-1720-2333, 1 juvenile (NMCA 1989-0059); P-1720-2353, 3 paratypes (NMCA 1989-0060); P-1723-2339, 3 paratypes (NMCA 1989-0061); P-1723-2355, 2 paratypes (NMCA 1989-0062); P-1724-337, paratype (NMNH 1989-0065); P-1724-2351, 1 juvenile (NMCA 1989-0064); Southern Vent, P-1726-2347, paratype (NMNH 122689); Bouquet Vent, P-1728-2357, 3 paratypes (JAB); P-1728-2364, 7 paratypes (NMNH 122690); CASM Ventfield: Lamphere Chimneys, P-1731-2336, on settling plates, 2 paratypes (NMNH 122691); P-1731-2343, holotype (NMCA 1989-0066); P-1732-2361, Limbo Vent, 3 paratypes (NMNH 122692); P-1733-2369, Not-So-Miserable Vent, 2 paratypes (NMCA 1989-0067).

DESCRIPTION: Holotype 35 mm long and 4 mm wide for 74 segments; largest complete paratype 75 mm long and 7 mm wide for about 100 segments (P-1731-2336); largest incomplete paratype 5 cm long and 1 cm wide with 33 segments (P-1721-2337). Parapodia

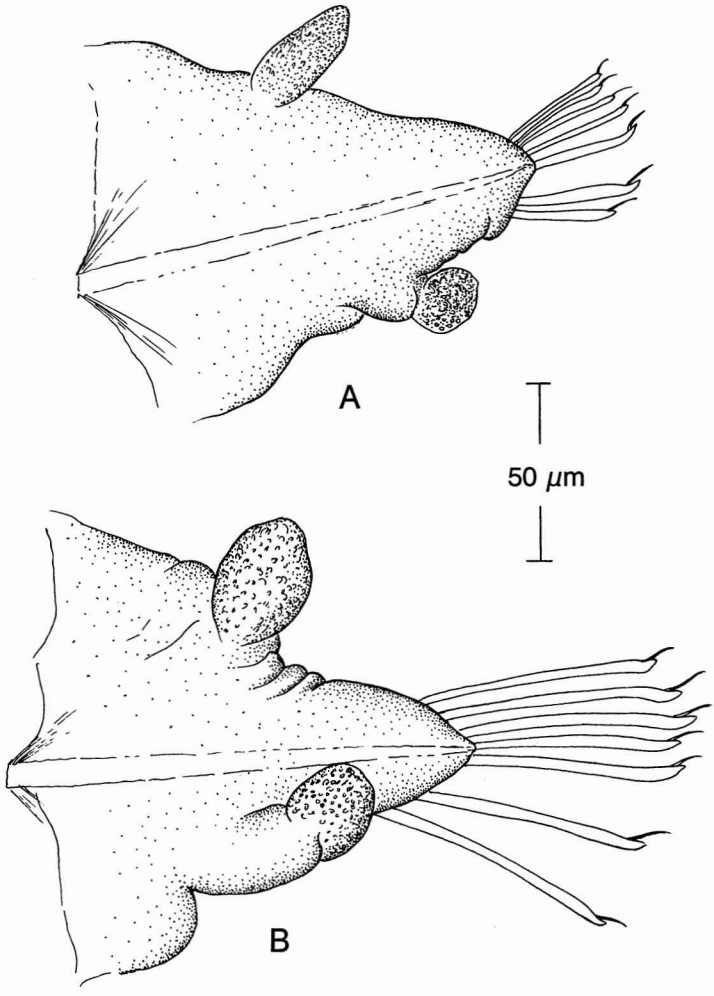

FIGURE 2. *Protomystides verenae* (paratype, NMNH 122686): *A*, middle body parapodium, posterior view. *Protomystides hatsushimaensis* (paratype, NMNH 120918): *B*, middle body parapodium, posterior view.

extremely long in posterior segments, providing tattered or ragged appearance to worm. Body terminating in 2 long anal cirri. Color in alcohol: light tan to dark brown.

Prostomium triangular, narrowing anteriorly to rounded tip bearing 2 short antennae; eyes absent, but 2 pairs of sunken depressions representing positions of missing eyes present; palps thickened, fleshy, each bearing 2 finger-like palpostyles (Figure 3*A*,*B*). Peristomium enlarged, inflated, surrounding prostomial structures; 4 pairs of tentacular cirri; ventral ones shortest, slightly longer than palps; dorsal ones longer, approximately 2.5 times as long as palps (Figure 3*B*).

Jaws golden, pointed, each with 7–8 teeth. Paragnaths all conical, arranged as follows: I: 2 large cones in vertical row; II: 12 large cones in nearly circular arc; III: 21–22 small and large cones in cluster; IV: 19–20 small and large cones in 3 distinct clusters arranged in 3 transverse rows; V: 0; VI: 4–6 large pointed cones; VII: 2 small cones; VIII: 2 groups of 2 small cones.

Parapodia of setigers 1–2 uniramous, with neuropodial lobe with single aciculum, and

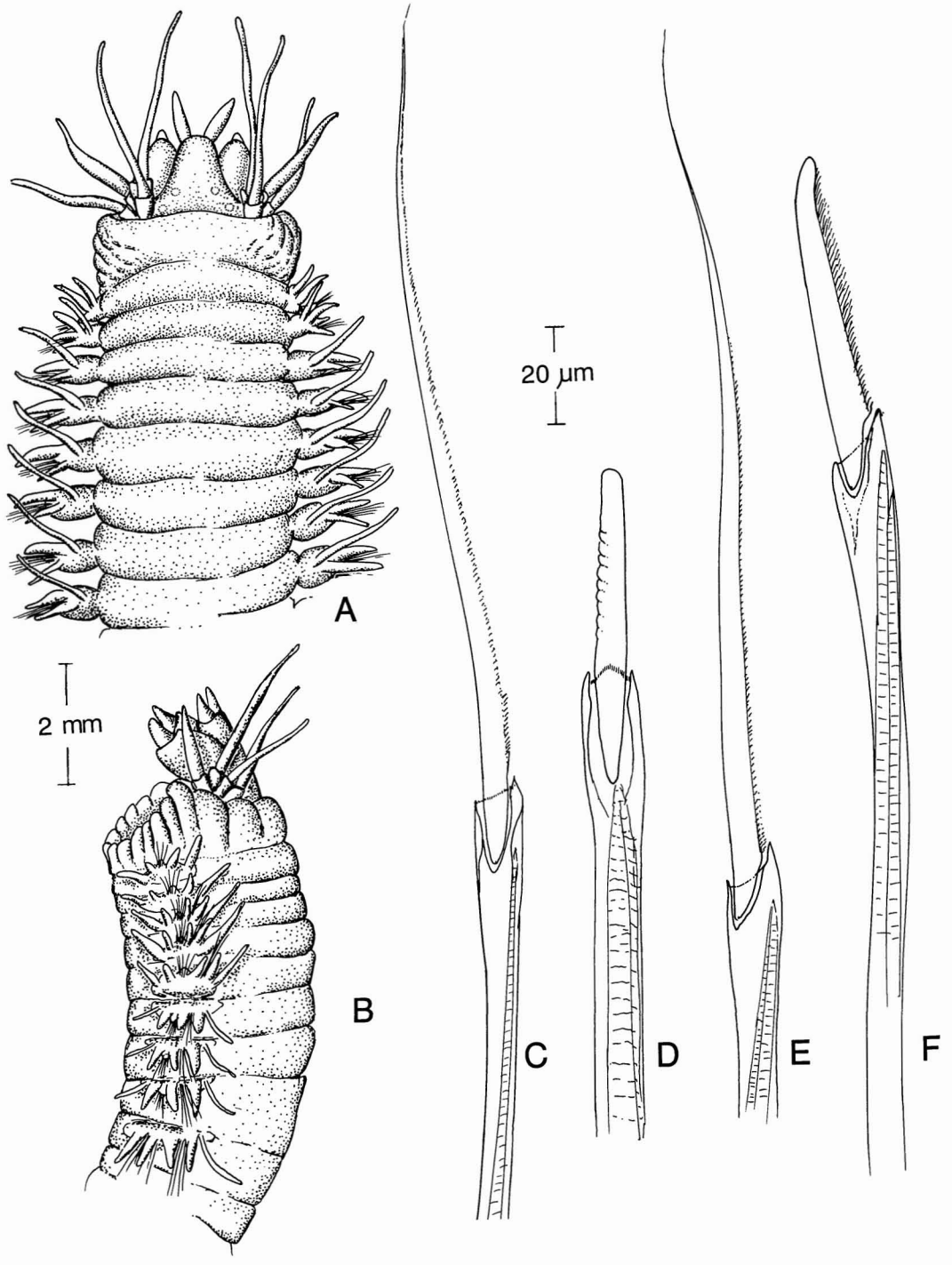

FIGURE 3. *Nereis piscesae* (paratype, NMNH 122691): *A*, anterior end, dorsal view; *B*, anterior end, lateral view; *C*, homogomph spinigerous notoseta; *D*, notopodial homogomph falciger from posterior parapodium; *E*, heterogomph neuropodial spiniger; *F*, heterogomph neuropodial falciger.

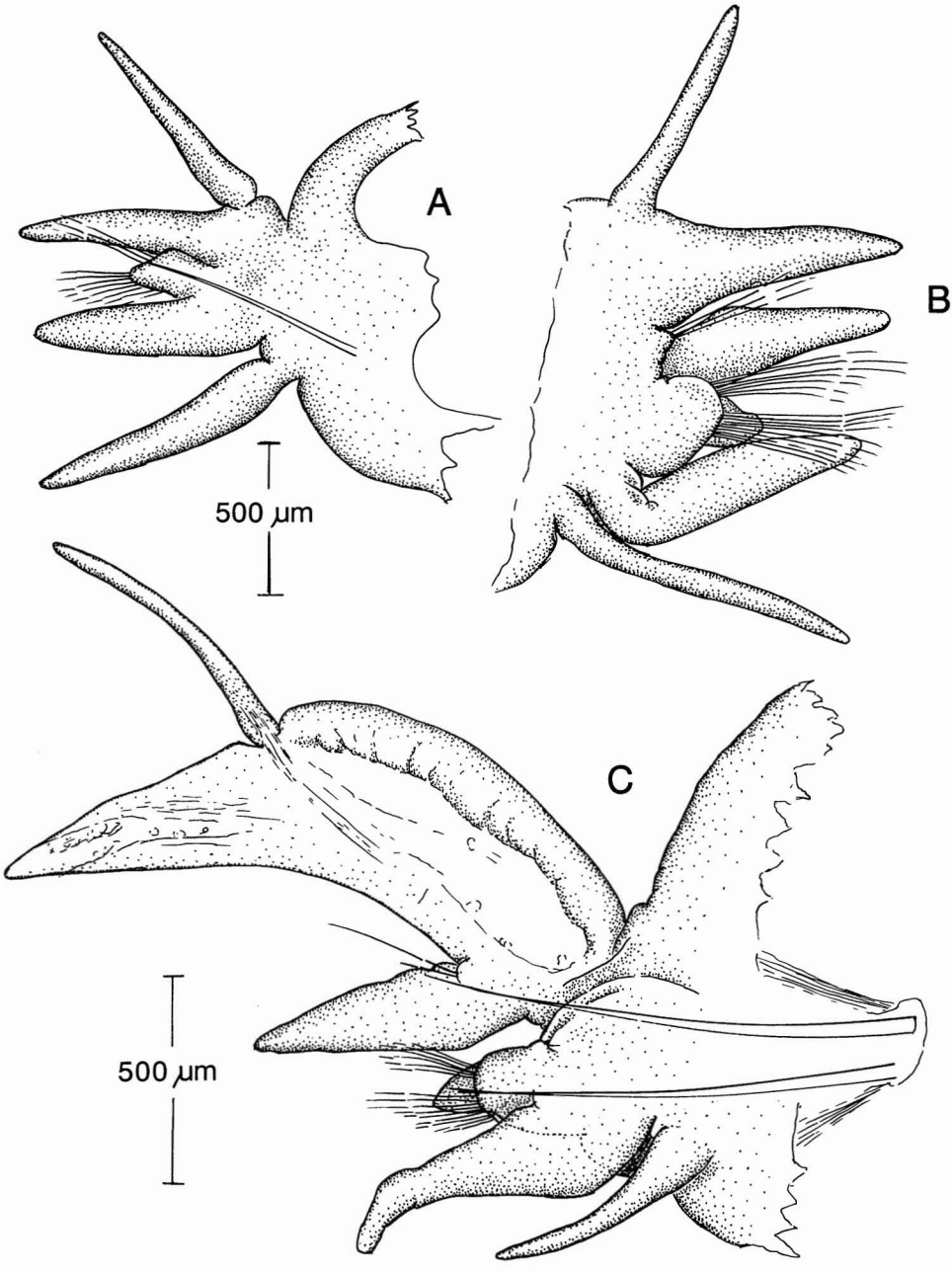

FIGURE 4. *Nereis piscesae* (paratype, NMCA 1989-0066): *A*, left setiger 1, posterior view; *B*, left setiger 10, anterior view; *C*, right posterior setiger, anterior view.

notopodial and neuropodial ligules equal in size; dorsal cirrus slightly shorter and narrower than ventral cirrus (Figure 4*A*). Following parapodia biramous, with 2 black acicula; neuropodial ligule, upper and lower notopodial ligules subequal, ventral cirrus becoming thinner, more elongate (Figure 4*B*). Parapodia of middle and posterior segments with upper notopodial ligule becoming enlarged and flattened, with distinct dorsal curvature and tapering triangular tip, with thickened glandular border, bearing thin dorsal cirrus; lower notopodial ligule tapering, not enlarged; neuropodial ligule thickened basally, tapering distally; ventral cirrus narrow, cirriform (Figure 4*C*). Notopodial acicular lobes small in both anterior and posterior segments (Figure 4*B*,*C*). Neuropodial acicular lobes conical throughout (Figure 4*A*–*C*).

Four types of setae present. Anterior notosetae all homogomph spinigers (Figure 3*C*) replaced from segments 30–35 by 1–2 heavy homogomph falcigers with elongated blades bearing 6–8 blunt denticles (Figure 3*D*); upper neurosetae including heterogomph spinigers (Figure 3*E*) and heterogomph falcigers (Figure 3 *F*); lower neurosetae include homogomph spinigers and heterogomph falcigers; blades of all spinigers with thin denticles on cutting edge; falcigers with thin, pointed denticles; shafts of all setae smooth; internally ornamented with dark brown to black camerations.

ETYMOLOGY: The species is named for the DSRV *Pisces IV*.

REMARKS: *Nereis piscesae* belongs to a group of six deep-sea nereidids characterized by having prolonged notopodial ligules in posterior parapodia. These species were reviewed by Blake (1985:85). *Nereis piscesae* is superficially similar to *N. sandersi*, described from the hydrothermal vent sites at the Galápagos Rift, 21° N, and Guaymas Basin by Blake (1985). Both species have depressions on the prostomium where the eyes should be located. The major differences between the two species are details of the jaws, paragnath distribution, and the structure of the posterior notopodial falcigers. In *N. sandersi* the jaws have 10–12 teeth, while in *N. piscesae* there are 7–8 teeth.

TABLE 2

COMPARATIVE CHARACTERISTICS OF THE PROBOSCIS IN TWO SPECIES OF *Nereis* FROM HYDROTHERMAL VENT ECOSYSTEMS

AREA	*N. sandersi*	*N. piscesae*
I	4–6 in vertical cluster	2 in vertical row
II	ca. 30 in small arc	ca. 12 in arc
III and IV	85–100 in dense field	ca. 21–22 in cluster in III, 19–20 in 3 distinct clusters arranged in 3 transverse rows in IV
V	0	0
VI	4–5 in large cluster	4–6 in cluster
VII	20 in 2 rows	2 small
VIII	1–2 large, 3–4 small	2 groups of 2

The posterior notopodial homogomph falcigers of *N. sandersi* have short, blunted blades, while in *N. piscesae* the blades are elongate, thickened, with blunt teeth. The paragnath distributions of *N. sandersi* and *N. piscesae* are compared in Table 2. The paragnath distribution of all six previously known Pacific deep-sea species were summarized by Blake (1985: table 3).

Family HESIONIDAE

Genus *Hesiospina* Imajima & Hartman, 1964

Hesiospina vestimentifera Blake, 1985

Hesiospina vestimentifera Blake, 1985:78–81, figs. 7–8.—Desbruyères et al., 1985:104, table 1.—Tunnicliffe, 1988:352.

MATERIAL EXAMINED: Hydrothermal vents of the northeastern Pacific, dives by *Pisces IV* (P) and *Alvin* (A): Explorer Ridge, Magic Mountain, Crab Vent, P-1494-2320, 2 specimens (NMCA 1989-0068); P-1494-2600, 2 specimens (NMCA 1989-0069). Juan de Fuca Ridge, Axial Seamount, ASHES Ventfield: Hell Vent, P-1724-2351, 2 specimens (JAB); Demon Vent, P-1728-2364, 2 specimens (NMCA 1989-0070); CASM Ventfield: Lamphere Chimneys, P-1731-2345, 1 specimen (NMCA 1989-0071). Juan de Fuca Ridge, Endeavour Segment, TLC Vent, A-1446-2322, 1 specimen (NMNH 122693);

Lt. Obo Vent, A-1447-2311, 2 specimens (NMNH 122694); A-1452-2309, 2 specimens (NMNH 122695).

REMARKS: These specimens agree well with the original description and represent a significant range extension. *Hesiospina vestimentifera* is one of only five polychaete species to be found throughout the various eastern Pacific vent systems, ranging from the Galápagos Rift to the Juan de Fuca and Explorer ridges.

Genus *Hesiodeira* Blake & Hilbig, new genus

TYPE SPECIES: *Hesiodeira glabra* Blake & Hilbig, new species. Gender, feminine.

DIAGNOSIS: Prostomium with 2 frontal antennae; without medial antenna; without eyes; ventral palps short, fingerlike, attached to thickened basal palpophores; proboscis unknown. Tentacular cirri 8 pairs on 4 fused segments (2 + 2 + 2 + 2). Parapodia biramous, notopodia with dense fascicles of capillaries; neuropodia with thick compound falcigers.

ETYMOLOGY: The name is coined from *Hesione*, type genus of the Hesionidae, and *deiras*, from the Greek for ridge of a hill, to commemorate the Juan de Fuca Ridge.

REMARKS: *Hesiodeira* is closely related to *Hesiolyra* Blake, 1985 in having 8 pairs of tentacular cirri, two antennae, and biramous parapodia. *Hesiodeira* has a simple array of setae consisting of capillaries in the notopodia and compound falcigers in the neuropodia. In contrast, *Hesiolyra* has three types of notosetae including pointed setae with notched tips, bifid-tipped spines, and lyrate setae; neurosetae are large, darkly colored compound falcigers. In addition, *Hesiolyra* has large, foliaceous pre- and postsetal notopodial lamellae that fully enclose the setal fascicle, while in *Hesiodeira* the notopodial lamellae are inconspicuous.

Hesiodeira glabra Blake & Hilbig, new species

Figure 5

MATERIAL EXAMINED: Hydrothermal vents of the northeastern Pacific, dives by *Pisces IV*: Juan de Fuca Ridge, Axial Seamount, ASHES Ventfield: Bouquet Vent, P-1728-2358, holotype (NMCA 1989-0072), paratype (NMNH 122696); CASM Ventfield: Post Taylors Vent, P-1731-2367, paratype (NMCA 1989-0073).

DESCRIPTION: Small, fragile species, all specimens broken, fragmented; holotype with 10 setigers, 3.5 mm long and 2 mm wide with parapodia; slightly smaller paratype from same station, with 12 setigers, 2.8 mm long and 2 mm wide; paratype from P-1731 with 17 setigers, 5.6 mm long and 2.4 mm wide. Body smooth, color of type specimens from P-1728 opaque white in alcohol; paratype from P-1731 light brown with granular black pigment spots on prostomium and first 10 setigers. Pygidium unknown.

Prostomium wider than long, notched on anterior margin, with 2 anterior antennae long, narrow, fingerlike (Figure 5*A*); medial antenna and eyes lacking; palps not visible dorsally, short, fingerlike, arising from thickened basal palpophores. Proboscis not visible externally, structure unknown.

Tentacular cirri 8 crowded pairs arranged on 4 fused achaetous segments; 4–5 individual muscular bands binding tentacular cirri together (Figure 5*A*); individual segmental divisions not visible dorsally; dorsum with smooth shield on tentacular segments; dorsal tentacular cirri robust, larger, 3–4 times longer than ventral tentacular cirri; tentacular cirri smooth, arising from thick basal cirrophores.

Parapodia of setiger 1 rudimentary with few setae and poorly developed dorsal and ventral cirri. Parapodia of following segments biramous, well developed (Figure 5*D*); notopodia with elongated pre- and postsetal lamellae; neuropodia with elongated, slightly flattened pre- and postsetal lamellae; dorsal cirri long, smooth, with very weak annulations, extending well beyond setal fascicles; ventral cirri short, fingerlike, bearing weak pseudoannulations about half as long as setal fascicle (Figure 5*D*).

Notosetae thin capillaries, numbering about 40, arranged in spreading fascicles; neurosetae including 15–18 thick compound falcigers, with serrated edge and hooked tip (Figure

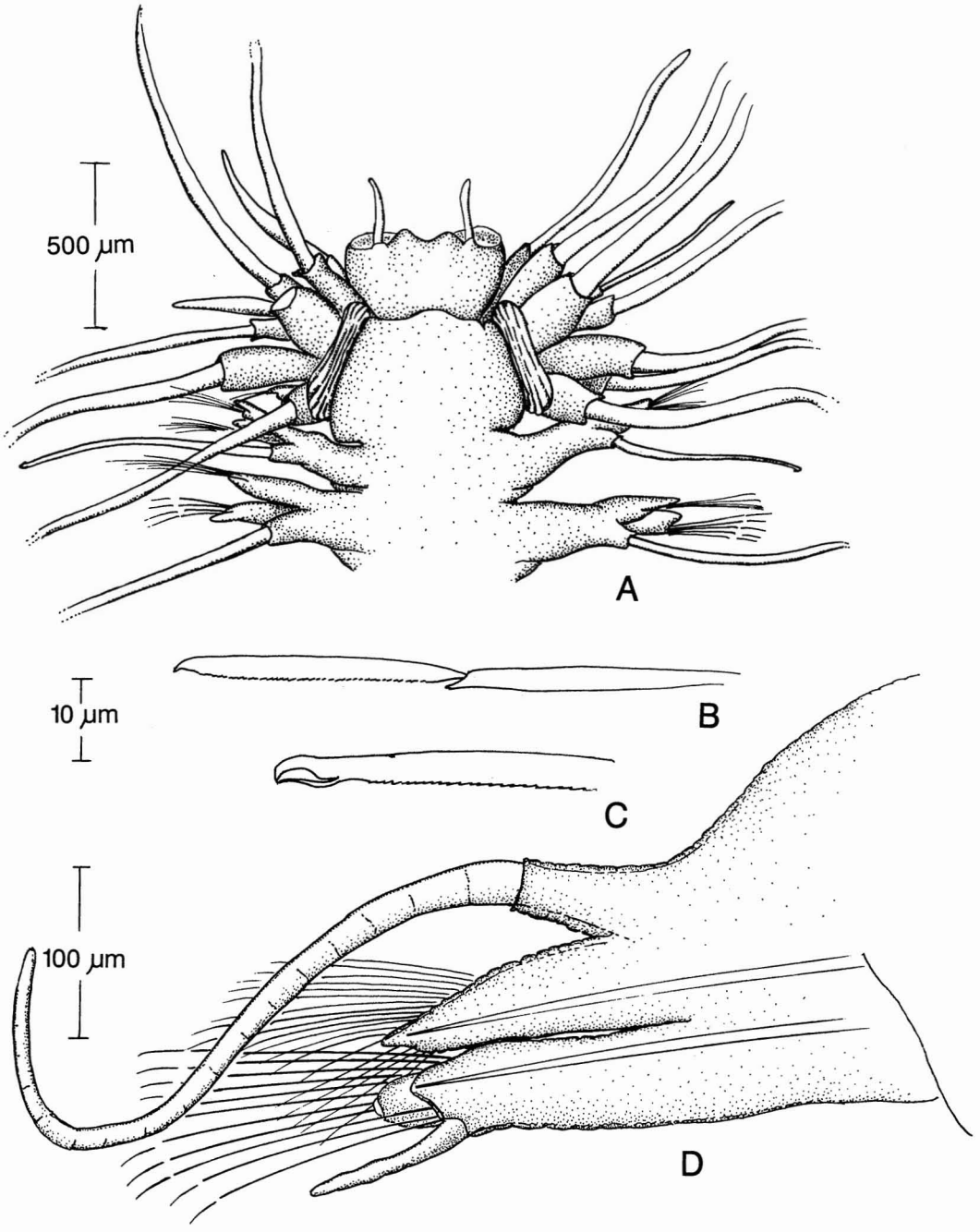

FIGURE 5. *Hesiodeira glabra* (holotype, NMCA 1989-0072): *A*, anterior end, dorsal view; *B*, compound falciger; *C*, detail of same; *D*, right parapodium from middle segment, anterior view.

5*B,D*); blades increasing in length from ventral to dorsal in fascicle.

ETYMOLOGY: The species name, *glabra*, is Latin for smooth, referring to the relatively smooth appearance of the integument of this species.

REMARKS: *Hesiodeira glabra* is readily recognized by the heavy crowding of the tentacular cirri, joined together by a ring of 4–5 muscular bands.

Genus *Amphiduros* Hartman, 1959

Amphiduros axialensis Blake & Hilbig, new species

Figure 6

MATERIAL EXAMINED: Hydrothermal vents of the northeastern Pacific, dives by *Pisces IV*: Juan de Fuca Ridge, Axial Seamount, ASHES Ventfield: Hell Vent, P-1724-2351, holotype (NMCA 1989-0074), paratype (NMCA 1989-0075).

DESCRIPTION: Holotype and paratype both incomplete; holotype 3.1 mm long with proboscis everted, 1 mm wide, with 8 setigers; paratype 3 mm long and 1 mm wide, with 11 setigers. Color in alcohol: opaque white.

Prostomium wider than long, with smooth anterior margin bearing 2 long, thin lateral antennae and 1 shorter medial antenna; palps cirriform, arising from short palpophore; eyes absent; proboscis smooth, lacking papillae or teeth (Figure 6*A*). Tentacular cirri numbering 8 pairs on 4 fused segments; dorsal tentacular cirri thicker and longer than ventral tentacular cirri; cirri with wrinkled cuticle, arising from thickened basal cirrophores.

Parapodia biramous, similar throughout body; notopodia short, triangular, with pointed presetal lobes; neuropodia elongate, with pointed presetal lobes (Figure 6*B*); dorsal cirri long, arising from short, thick basal cirrophores; ventral cirri thin, arising from basal cirrophores (Figure 6*B*). Notosetae simple, long, thin capillaries, numbering about 40–45 per fascicle; neurosetae including 25–30 very thin compound falcigers (Figure 6*C*) and spinigers (Figure 6*D*); shaft with single terminal tooth; blade narrow, short, either ending abruptly as short, pointed falciger or as longer spinigers.

ETYMOLOGY: The specific name represents the Axial Seamount, from which this species was collected.

REMARKS: *Amphiduros axialensis* is the first species of the genus to be described as lacking eyes and having blades of compound neurosetae unidentate instead of bidentate.

Family SYLLIDAE

Genus *Sphaerosyllis* Claparède, 1863

Sphaerosyllis ridgensis Blake & Hilbig, new species

Figure 7

Sphaerosyllis n. sp.: Tunnicliffe, 1988:352

MATERIAL EXAMINED: Hydrothermal vents of the northeastern Pacific, dives by *Pisces IV* (P) and *Alvin* (A): Explorer Ridge, Magic Mountain, Lunch Hour Vent, P-1495-540, paratype (NMCA 1989-0076). Juan de Fuca Ridge, Endeavour Segment, TLC Vent, A-1446-2322, holotype (NMNH 122698) and 3 paratypes (NMNH 122697); Dual Smoker, A-1451-2308, paratype (NMNH 122699); A-1451-2325, paratype (NMCA 1989-0272); Lt. Obo Vent, A-1452-2309, paratype (NMCA 1989-0273).

DESCRIPTION: Small species, holotype 1.76 mm long, 0.26 mm wide with parapodia, with 23 setigerous segments; 2 complete paratypes from same sample 1.86 mm long, 0.29 mm wide for 21 setigers and 1.31 mm long, 0.19 mm wide for 19 setigers, respectively. Paratype from station A-1451 with large, ventrally attached eggs measuring 150 × 112.5 μm. Color in alcohol: light tan with rusty brown pigment spots scattered over body.

Prostomium weakly notched on anterior margin, about as long as wide, clearly fused with tentacular segment; medial antenna inserted at point of folded merger of tentacular segment with prostomium; lateral antennae inserted nearly in line with medial antennae; antennae glandular, with bulbous bases and narrow, tapering tips. Eyes lacking (Figure

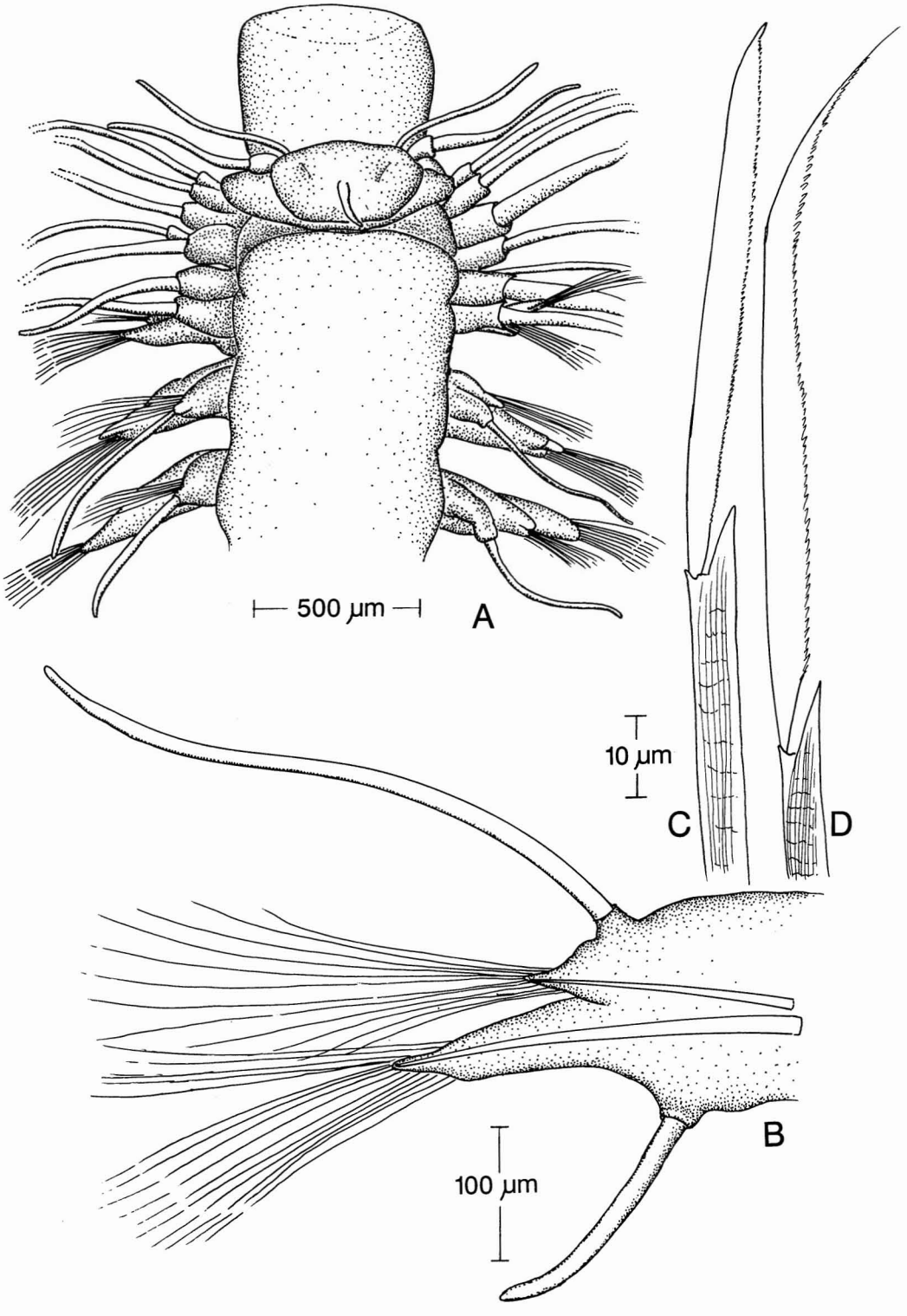

FIGURE 6. *Amphiduros axialensis* (holotype, NMCA 1989-0074): *A*, anterior end, dorsal view, pharynx extended; *B*, parapodium from middle segment, anterior view; *C*, compound falciger; *D*, compound spiniger.

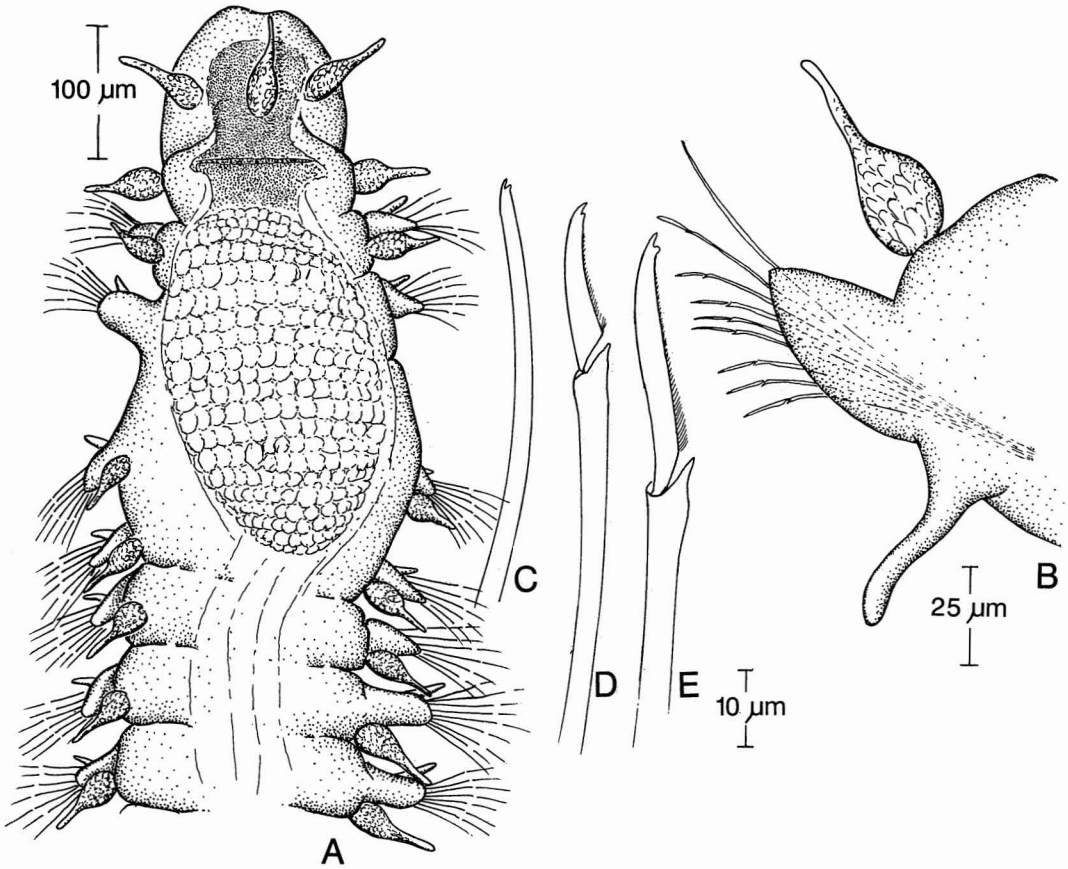

FIGURE 7. *Sphaerosyllis ridgensis* (paratype, NMNH 122697): *A*, anterior end, dorsal view; *B*, parapodium from middle segment, anterior view; *C*, dorsalmost simple seta; *D–E*, compound falcigers.

7*A*). Tentacular cirri present laterally on tentacular segment similar to antennae (Figure 7*A*); parapodia similar throughout body, conical, with single imbedded aciculum lacking papillae; dorsal cirri glandular, with bulbous bases and narrow tapering tips; without dorsal cirri on setiger 2; ventral cirri long, cirriform (Figure 7*B*). Setae including single, long dorsalmost simple seta with bidentate tip (Figure 7*C*) and 8–10 compound falcigers with bidentate tips and conspicuous serrations on blade (Figure 7*D,E*). Pharynx red in color, occupying tentacular segment, and bearing single middorsal tooth sometimes emerging from oral opening; proventriculus occupying setigers 1–4, tan colored, with about 20 rows of muscle cells (Figure 7*A*).

ETYMOLOGY: The specific name is derived from the word "ridge" and refers to the distribution of the species.

REMARKS: Species of the genus *Sphaerosyllis* are frequently distinguished from one another by the form and arrangement of the eyes (e.g., Perkins 1981:113). *Sphaerosyllis ridgensis* is unusual in lacking eyes. The only species previously reported to lack eyes are *S. renaudi* Hartmann-Schröder (1958) from coastal groundwater in the Bahamas, *S. subterranea* Hartmann-Schröder (1965) from coastal groundwater in northern Chile, and *S. hystrix anoculata* Hartmann-Schröder (1980) from coastal groundwater in the West Indian island of Tortola. *Sphaerosyllis ridgensis* differs

from those species and most other described *Sphaerosyllis* in having both bidentate-tipped simple setae and compound falcigers. *Sphaerosyllis ridgensis* is similar to *S. bilobata* Perkins, 1981 from shallow subtidal sands in Florida and *S. bidentata* Hartmann-Schröder (1974) from intertidal habitats of West Africa. All three species have bidentate compound falcigers, but only *S. ridgensis* has bidentate simple setae and lacks eyes.

Family DORVILLEIDAE

Genus *Ophryotrocha* Claparède & Metschnikow, 1869

Ophryotrocha globopalpata Blake & Hilbig, new species

Figures 8, 9

Ophryotrocha n. sp.: Tunnicliffe, 1988:352.

MATERIAL EXAMINED: Hydrothermal vents of the northeastern Pacific, dives by *Pisces IV* (P) and *Alvin* (A): Juan de Fuca Ridge, Endeavour Segment, Dual Smoker, A-1451-2308, 7 paratypes (NMNH 122701); Axial Seamount, ASHES Ventfield: Hell Vent, P-1720-2373, 4 paratypes (NMCA 1989-0077); Mushroom Vent, P-1722-2372, 1 paratype (NMCA 1989-0078); Hell Vent, P-1723-2355, 1 paratype (NMCA 1989-0079); Hillock Vent, P-1723-2362, holotype (NMCA 1989-0080) and 5 paratypes (NMCA 1989-0081); Southern Vent, P-1726-2370, 2 specimens (BH); Demon Vent, P-1728-2364, 3 paratypes (NMNH 122700). Southern Juan de Fuca Ridge, Vent I, A-1447-2311, 2 paratypes (NMNH 122702).

DESCRIPTION: Holotype 5.8 mm long, 0.7 mm wide for 42 setigers; other complete specimens 1.8–7.0 mm long, 0.4–1.0 mm wide for 14–18 setigers. Body wide, dorsoventrally compressed, blunt anteriorly and tapering towards pygidium, with long, prominent parapodia. Color in alcohol: opaque white. Ciliation reduced; prostomium with ciliary tufts at bases of palps and on antennae and palps; peristomial rings, segments and pygidium with dorsolateral tufts and ventral bands at posterior margin.

Prostomium rounded, twice as wide as long; with 2 relatively long cirriform antennae inserted on ends of dorsal prostomial ridge; with 2 biarticulate palps with wide, globular palpophores and slender palpostyles; palpophores in large specimens sometimes not distinctly separated from prostomium; eyes lacking. Peristomium with 2 apodous, asetigerous rings about as long as following setigers; anterior ring in large adults often fused dorsally with prostomium (Figure 8*A*).

Parapodia uniramous, with triangular acicular lobe, low presetal lobe, and retractable ventral setal lobe; dorsal and ventral cirri absent (Figure 8*D*). In gravid specimens parapodia elongated and distally flared, setal lobe not visible. Setae of three kinds: (1) supraacicular fascicle with up to 10 (usually 3–6) long, flat capillaries with fine subdistal serration, easily overlooked if seta not properly oriented (Figure 8*E*); (2) subacicular fascicle with up to 15 (usually 5–8) heterogomph falcigers with distally serrated shaft (serrations difficult to see) and smooth, narrow, distally blunt blades of varying lengths (Figure 8*F*); (3) in inferiormost position of subacicular fascicle, supporting ventral setal lobe, single very fine, smooth capillary (Figure 8*G*). Pygidium rounded, half as wide as anterior segments, with 2 long dorsolateral anal cirri, often coiled, and unpaired ventromedian stylus densely ciliated on ventral side (Figure 8*B*).

Mandibles elongate, rodlike, with short, rounded, serrated cutting edge and large, unsclerotized lateral wings, giving mandible a triangular outline (Figure 9*A*). Maxillae with P-type forceps and 8 pairs of free denticles; forceps with 18–25 subequal teeth with fine serrations on lower edge; outer half of forceps transparent, unsclerotized. Posterior denticles (D1–D4) oval plates with distal main fang and alternating coarse and fine teeth; anterior denticles (D5–D8) more delicate, triangular to round plates with finely serrated cutting edge; D7 and D8 with distal fold or indentation on cutting edge (Figure 9*B*).

Mature females with eggs from setiger 3–5 (occasionally 1 or 7) to end of body; eggs numerous, about 6–8 in each parapodium

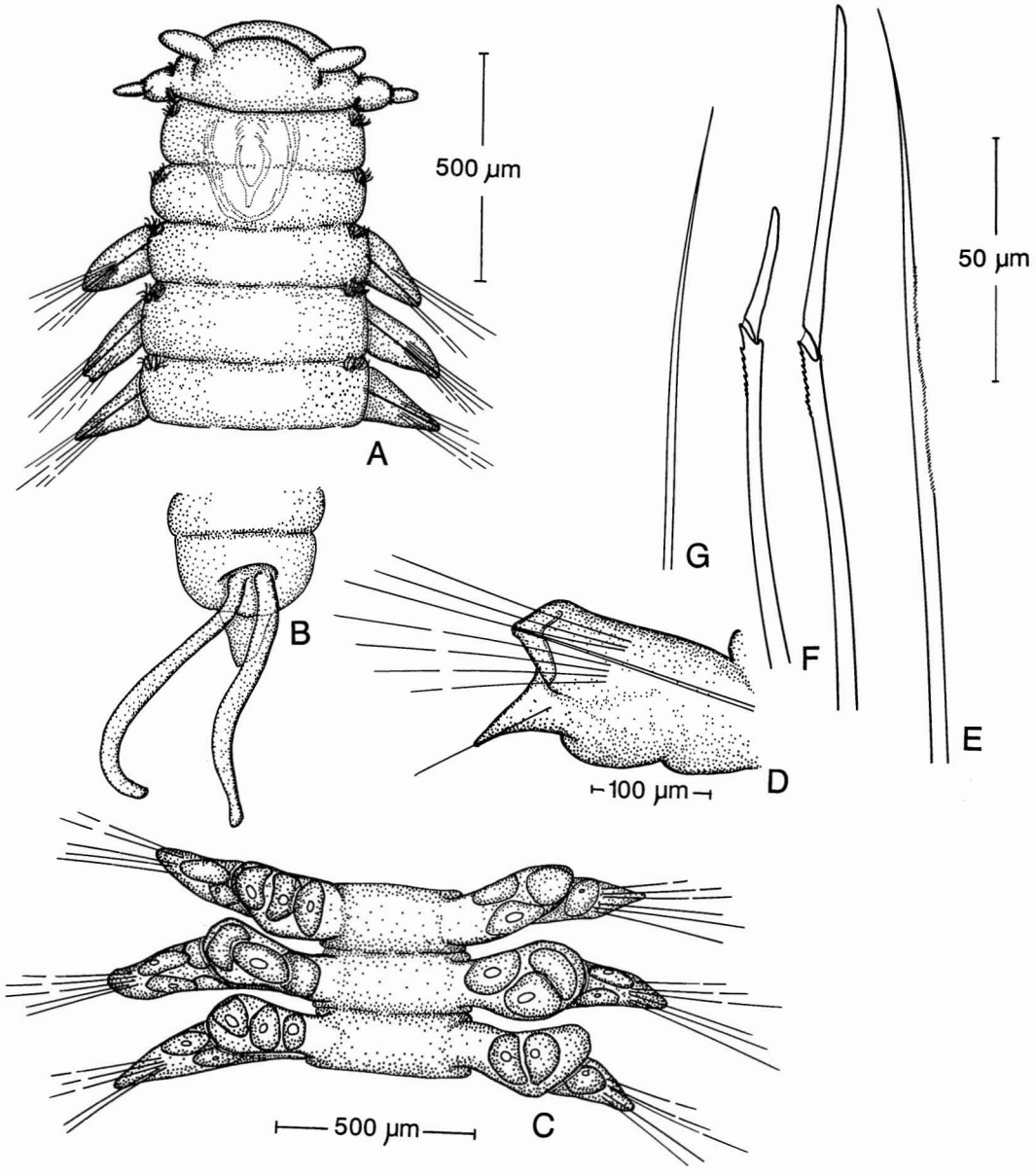

FIGURE 8. *Ophryotrocha globopalpata* (paratype, NMCA 1989-0081): *A*, anterior end, dorsal view; *B*, posterior end, dorsal view; *C*, middle setigers of ovigerous female with ventral pouches, ventral view; *D*, parapodium, anterior view; *E*, supraacicular seta; *F*, subacicular falcigers; *G*, ventralmost capillary.

and sometimes 3–4 additional ones in large ventral pouches formed from ventral body wall (Figure 8*C*); egg diameters ranging from 64 to 120 μm, those in pouches larger ($\bar{\chi}$ = 102 μm) than those in the parapodium ($\bar{\chi}$ = 81 μm).

Mature males with sperm from setiger 3 or 4 to end of body, visible in parapodia and under dorsal body wall.

ETYMOLOGY: The epithet is established from the Latin *globosus* for spherical and *palpa* for

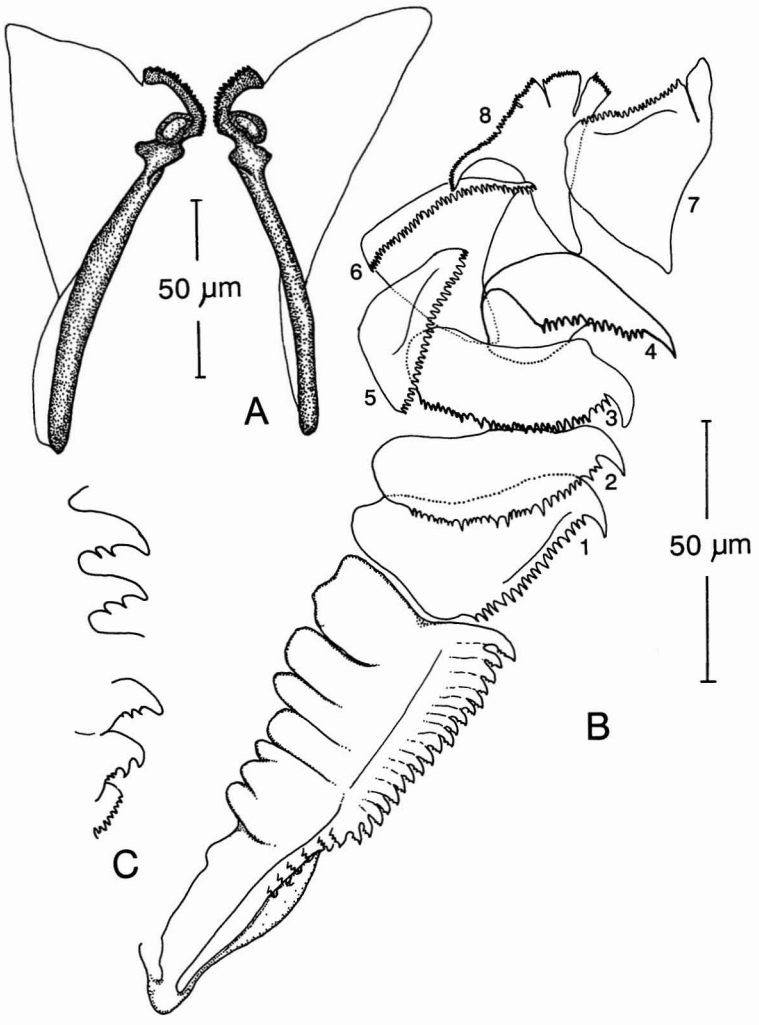

FIGURE 9. *Ophryotrocha globopalpata* (NMCA 1989-0077): *A*, mandibles; *B*, maxillae, right side, forceps twisted outward due to squeezing; 1–8, numbers of free denticles; *C*, detail of 2 distal and 3 proximal teeth of forceps, showing serrations.

touch (feeler), referring to the globular form of the palpophores.

REMARKS: *Ophryotrocha globopalpata* is the third species of this genus to be described from Pacific hydrothermal vents (Table 3) and superficially resembles *O. platykephale* Blake, 1985 in its overall appearance, but differs in having forceps with serrated teeth and lacking branchiae. The biarticulate palps with globular palpophores, the reduced ciliation, and the high number of setae as found in *O. globopalpata* were also described by Oug (1978) for *O. lobifera* and by Josefson (1975) for *O. longidentata*. However, these two species differ from *O. globopalpata* in all other characters, particularly in the shape of the setae and the maxillae.

Genus *Parougia* Wolf, 1986

Parougia wolfi Blake & Hilbig, new species

Figure 10

MATERIAL EXAMINED: Hydrothermal vents of the northeastern Pacific, dives by *Pisces IV* (P) and *Alvin* (A): Juan de Fuca Ridge, Axial

TABLE 3

TAXONOMIC CHARACTERISTICS OF THREE SPECIES OF *Ophryotrocha* FROM HYDROTHERMAL VENT ECOSYSTEMS

CHARACTERISTIC	*O. akessoni*	*O. platykephale*	*O. globopalpata*
palps	cirriform	cirriform	biarticulate
cilia			
prostomium	absent	absent	lateral tufts
segments	rings	absent	dorsal tufts, ventral bands
supraacicular	7–8 spines	7–8 spines	3–10 capillaries
setae	subdist. serrated	blunt, serrated	subdist. serrated
subacicular	14–16 falcigers	8–9 spinigers	5–15 falcigers
setae	blades short	serrated	blades short to long
inferiormost capillary	present	absent	present
dorsal cirri	cirriform	cirriform with bifid tip	absent
ventral cirri	papilliform	absent	absent
branchiae	absent	present	absent
mandibles			
shape	elongate-triangular	elongate-triangular	rodlike, with wings
cutting edge	serrated	smooth	serrated
forceps	with main fang subequal teeth	with main fang irregular teeth	without main fang subequal serrated teeth
free denticles	7 pairs D1 large; no main fangs	7 pairs D1–D4 with main fang D5–D7 finely serrated	8 pairs D1–D4 with main fang D5–D8 finely serrated

Seamount, ASHES Ventfield: base of Hell Vent, P-1720-2316, 1 paratype (NMCA 1989-0082); P-1720-2333, 4 paratypes (NMCA 1989-0083); P-1720-233, 1 paratype (NMCA 1989-0084); P-1720-2373, 2 paratypes (NMNH 122703); Hillock Vent, P-1723-2352, 1 paratype (NMNH 122704); P-1723-2355, 7 paratypes (NMCA 1989-0085); Hillock Vent, P-1723-2362, 1 paratype (NMCA 1989-0086); Hell Vent, P-1724-2351, 1 paratype (NMNH 122705); Southern Vent, P-1726-2347, 1 paratype (NMNH 122706); Bouquet Vent, P-1728-2357, 1 paratype (NMCA 1989-0087); P-1728-2358, 3 paratypes (NMCA 1989-0088); Not-So-Miserable Vent, P-1733-2369, 2 paratypes (NMCA 1989-0093) and 5 specimens (BH); CASM Ventfield: Lamphere Chimneys, P-1731-2345, 1 paratype (NMCA 1989-0089); P-1731-2371, 1 paratype (NMCA 1989-0092); Taylors Vent, P-1731-2367, holotype (NMCA 1989-0090), 4 paratypes (NMCA 1989-0091). Southern Juan de Fuca Ridge, Vent I, A-1455-1B-548, 1 paratype (NMNH 122707).

DESCRIPTION: Holotype 11.5 mm long, 0.9 mm wide for 47 setigers; other complete specimens 5.0–11.5 mm long, 0.6–1.0 mm wide for 37–56 setigers. Body long, cylindrical, with long parapodia, tapering within last 5–10 segments toward pygidium. Segmental ciliation absent. Color in alcohol: opaque yellowish white.

Prostomium rounded anteriorly, triangular to pear-shaped, with large, flattened palps, longer than greatest prostomial width; antennae unknown, all examined specimens with scars only. Peristomium consisting of 2 rings, as long as following setigers (Figure 10*A*). Parapodia in setiger 1 uniramous, following setigers all subbiramous; neuropodium with low, square presetal lobe and longer, conical postsetal lobe; notopodium with conspicuous aciculum in long basal part and short, conical distal article; ventral cirri short, cirriform (Figure 10*B*). Setae of supraacicular fascicle consisting of 5–7 simple setae with subdistal serrations and furcate tip; tines very close together, almost parallel, of equal length and blunt (Figure 10*C*); capillaries absent. Subacicular fascicle with 10–15 compound falcigers with subdistally serrated shaft and bifid, distally hooded blade (Figure 10*D*). Pygidium small, with terminal anus surrounded by heavily ciliated, rounded papillae.

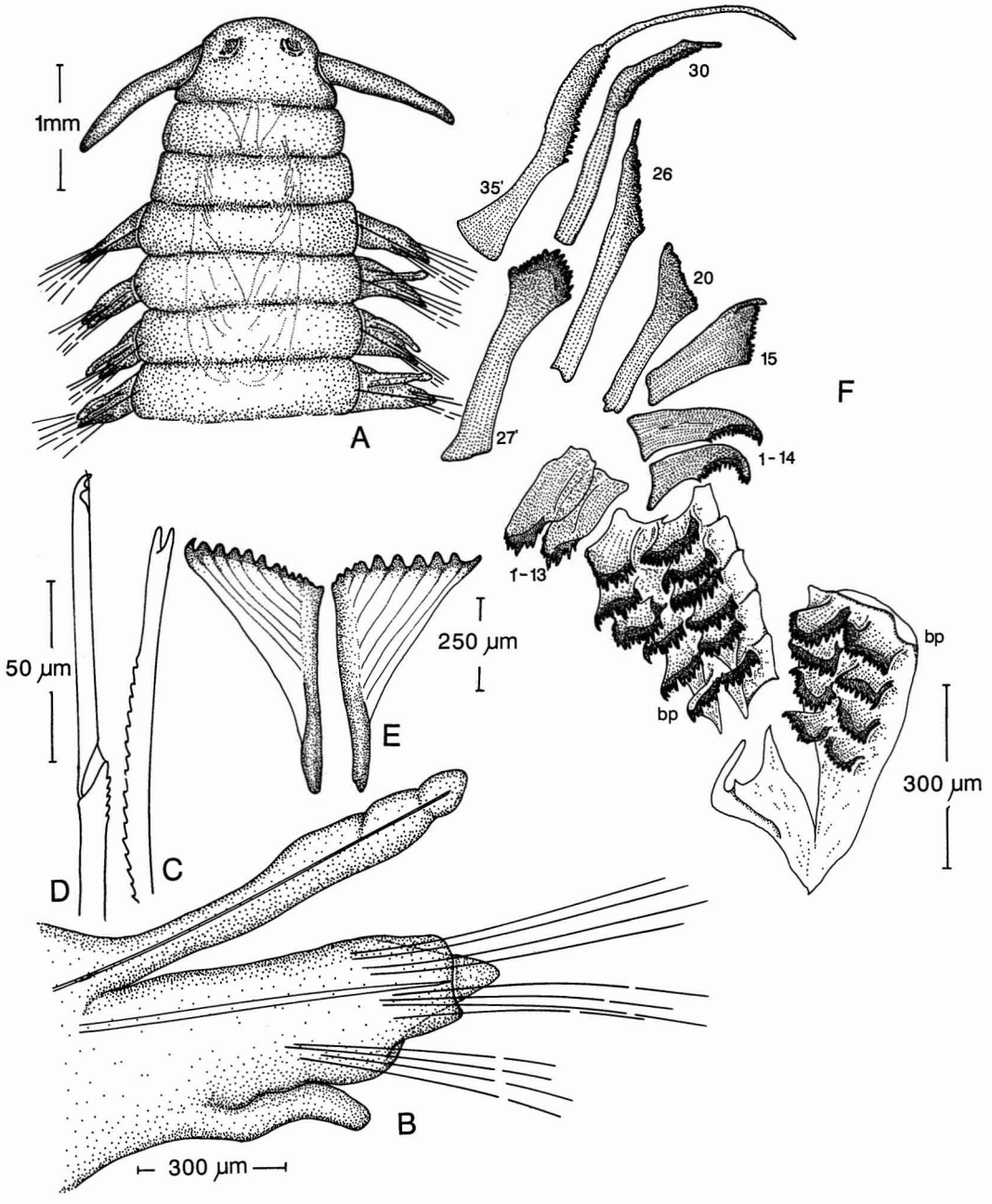

FIGURE 10. *Parougia wolfi* (paratype, NMCA 1989-0083): *A*, anterior end, dorsal view, scars of antennae only shown (missing); *B*, parapodium, anterior view; *C*, supraacicular seta; *D*, subacicular seta; *E*, mandibles; *F*, maxillae, basal plate (torn off unsclerotized proximal part due to squeezing) and free denticles from left side, proximal part of basal plate from right side; bp, basal plate; 1–30, free denticles of inferior row; 1′–35′, free denticles of superior row.

Mandibles in anterior peristomial segment, triangular, with heavily sclerotized handle and transparent lateral wings; cutting edge with outer hook-shaped tooth and about 5 large, rounded and 5 smaller, irregular teeth (Figure 10*E*). Maxillae extending through setiger 2, with superior basal plates and 30–35 superior and inferior free denticles; maxillary carriers and inferior basal plates absent (Figure 10*F*). Basal plates with double row of 6 teeth fused to each other and to horny base; cutting edges of teeth semicircular, pointing outwards; bases of teeth conical. Posterior 14–15 free denticles of inferior row delicate, elongate plates with long, pointed teeth and short, rounded main fang on cutting edge; plates up to twice as long as wide; middle 10 denticles increasing in length, at least twice as long as wide, with short, rounded teeth and rounded main fang on cutting edge; anterior 5–10 denticles of inferior row with cutting edge becoming longer and more and more slanted, with rounded teeth and main fang increasing in length. Superior row: posterior 15 denticles elongate plates with alternating long and short teeth along triangular cutting edge; middle 12–15 denticles increasing in length, up to 3 times as long as wide, less sclerotized, with cutting edge resembling that of posterior denticles; anterior 8–10 denticles with slanted, straight cutting edge and very long, whiplike anterior projection at least as long as denticle itself (Figure 10*F*). Entire jaw apparatus embedded in thick, muscular pharynx extending to setiger 4.

ETYMOLOGY: This species is named for Mr. Paul S. Wolf in recognition of his research on dorvilleid polychaetes.

REMARKS: *Parougia wolfi* is unique in the genus in having only furcate simple setae and for the shape of the anterior free denticles of the maxillary apparatus. The genus was established by Wolf (1986) and included *P. caeca* (Webster & Benedict, 1884), *P. nigridentata* (Oug, 1978), and *P. eliasoni* (Oug, 1978). *Parougia wolfi* agrees with Wolf's generic definition in the composition of the basal plates and absence of maxillary carriers, the dentate mandibles, and the presence of notopodia throughout. However, the genus has to be emended in some details to accommodate the new species. These details are the following: (1) supraacicular simple setae may be all furcate with parallel, short tines of equal length; (2) the palps may be simple, without palpostyles.

Family ORBINIIDAE

Genus *Orbiniella* Day, 1954

Orbiniella hobsonae Blake & Hilbig, new species

Figure 11

Orbiniella n. sp.: Tunnicliffe, 1988:352.

MATERIAL EXAMINED: Hydrothermal vents of the northeastern Pacific, dive by *Alvin*: Juan de Fuca Ridge, Endeavour Segment, TLC Vent, A-1446-2314, holotype (NMNH 122708) and 4 paratypes (NMNH 122709, NMCA 1989-0094).

DESCRIPTION: Small, threadlike species; holotype measuring 4.48 mm long and 0.24 mm wide for 25 setigers; paratypes smaller, up to 3.2 mm long and 0.22 mm wide for 22–23 setigers. Color in alcohol: opaque white.

Prostomium nearly circular in outline, distinctly rounded on anterior margin, with pair of lateral nuchal organs (Figure 11*A*). First achaetous buccal segment reduced, compressed between prostomium and larger second achaetous buccal segment. All segments similar, without apparent distinct abdominal or thoracic regions. Setigers 1–4 generally narrower and shorter, more compressed; middle setigers larger, more elongate (Figure 11*A*); posterior setigers becoming compressed again. Pygidium simple, without lobes or cirri. Parapodia reduced, without distinct podial or postsetal lobes; branchiae lacking (Figure 11*B*). Setae including 1–2 barbed acicular spines and 2–5 bristled capillaries in both noto- and neuropodia; bristles of capillaries arranged in uniform transverse rows (Figure 11 *B,C*).

ETYMOLOGY: The species is named for the late Kathryn D. Hobson, polychaete systematist and friend. Among the many species she discovered in her studies was the first species

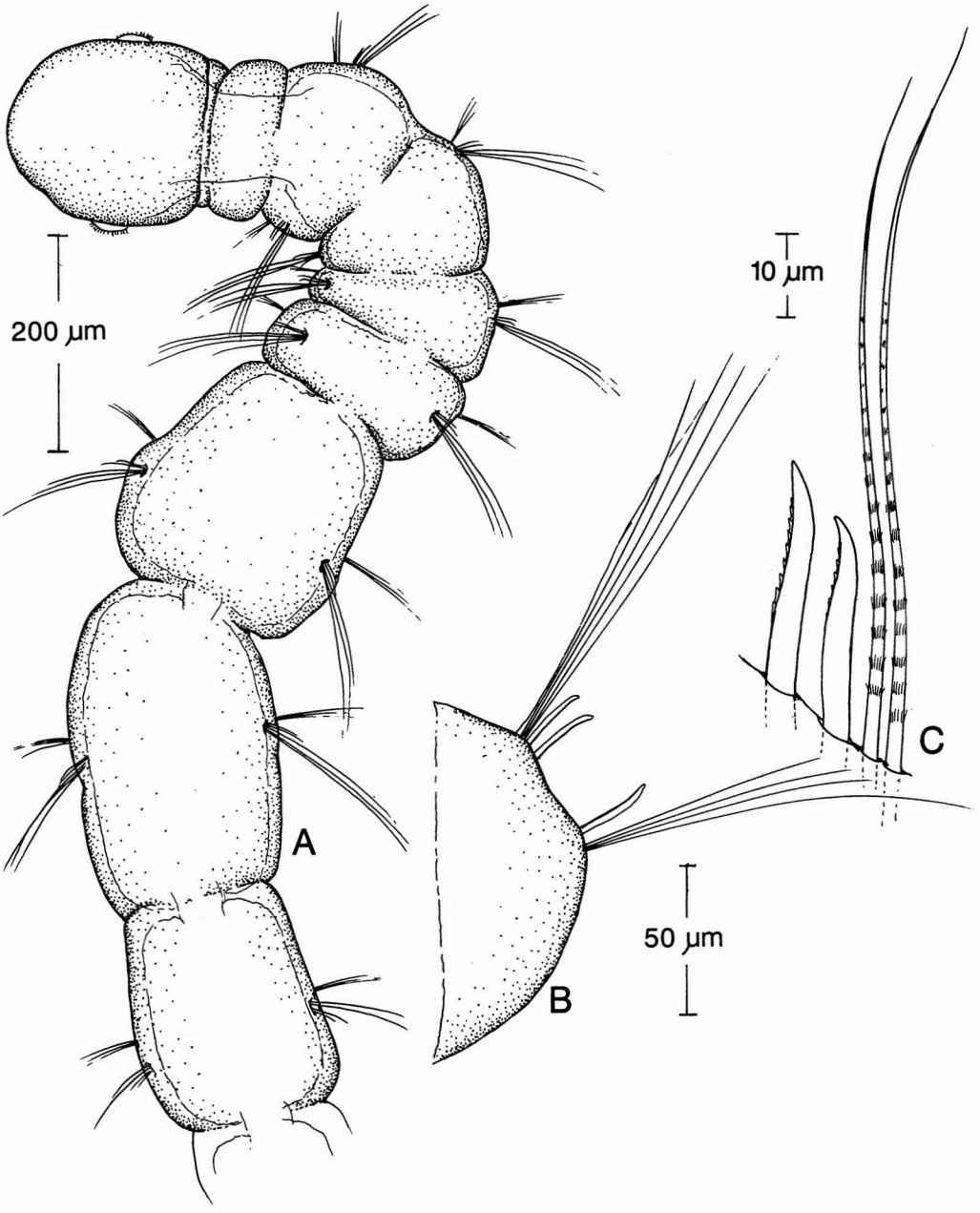

FIGURE 11. *Orbiniella hobsonae* (paratype, NMNH 122709): *A*, anterior end, dorsal view; *B*, parapodium from middle segment; *C*, fascicle of notosetae including 2 acicular spines and 2 bristled capillaries.

of *Orbiniella* to be reported from the Pacific Northwest (*O. nuda* Hobson, 1974).

REMARKS: *Orbiniella hobsonae* is the second species of this small genus to be reported from the vicinity of hydrothermal vents. The first species, *O. aciculata* Blake, 1985, was described from areas near the Galápagos Rift. Both species are distinguished from other species of the genus by having acicular spines in both noto- and neuropodia instead of only in the neuropodia. *Orbiniella hobsonae* is distinguished from *O. aciculata* by having barbed instead of smooth acicular spines and by having a long, thin body instead of a short, compact one.

Genus *Leitoscoloplos* Day, 1977

Leitoscoloplos pachybranchiatus Blake & Hilbig, new species

Figure 12

MATERIAL EXAMINED: Hydrothermal vents of the northeastern Pacific, dives by *Alvin*: Juan de Fuca Ridge, Endeavour Segment, TLC Vent, A-1446-2314, holotype (NMNH 122710) and paratype (NMNH 122711); A-1446-2322, 5 paratypes (NMNH 122712, NMCA 1989-0095).

DESCRIPTION: Small species, holotype 3.52 mm long and 0.48 mm wide for 33 setigers; paratypes larger, up to 9.0 mm long and 0.64 mm wide for 54 setigers. Color in alcohol: tan.

Prostomium conical, smoothly rounded on anterior margin, with small nuchal organs on lateral boundary of prostomium and peristomium (Figure 12*A*). Peristomium with 1 or 2 achaetous segments depending on size and state of preservation: both segments apparent in smaller specimens, vaguely apparent in larger specimens (Figure 12*A*).

Thorax with 9 similar setigers. Notopodia with thin, cirriform postsetal lobes; neuropodia with short, triangular-shaped postsetal lobes (Figure 12*A*,*B*), developing thickened base in abdominal region (Figure 12*D*); neuropodial lobe of abdominal segments becoming thicker, blunted (Figure 12*C*), then developing weak bilobed appearance in far abdominal segments (Figure 12*D*).

Notosetae camerated capillaries, without furcate setae; thoracic notopodia with 12–15 setae; abdominal segments with 5–8 setae. Thoracic neurosetae camerated capillaries; abdominal neurosetae including 2–3 capillaries and 1–2 thin acicular spines.

Branchiae from setiger 13–15; each branchia very thick in cross section, appearing glandular; anterior and posterior abdominal branchiae short, stubby in appearance, with broad base and narrow apex (Figure 12*D*); branchiae from middle abdominal segments, longer, but still with broad base. Pygidial segment broadly rounded, with 2 lateral cirri.

Two large eggs measuring ca. 100 μm in diameter observed in one specimen enclosed in chamber located on dorsum between setigers 6 and 7.

ETYMOLOGY: The epithet *pachybranchiatus* is derived from the Greek: *pachys* for thick; *branchos* for gill.

REMARKS: *Leitoscoloplos pachybranchiatus* belongs to the *L. kerguelensis* group in having branchiae present from anterior abdominal setigers. The presence of the very thickened branchiae readily separates this species from related forms. The division of the peristomium into 2 achaetous segments is generally considered to be the distinguishing feature between two orbiniid subfamilies (Orbiniinae, with 1 achaetous segment; Protoariciinae, with 2 achaetous segments). This relationship was established by Hartman (1957) and has been widely accepted (e.g., Day 1967, Fauchald 1977). However, as part of a forthcoming monograph on Antarctic and South American orbiniids, Blake (in prep.) has determined that some genera of the Protoariciinae contain species that are more than likely juveniles of species of the Orbiniinae. In these cases, it is believed that the 2 achaetous segments are well developed early in development, but later become modified so that only a single achaetous segment is finally apparent in fully developed adults. Such a situation is clearly apparent in *L. pachybranchiatus*. The 2 well-developed achaetous segments in smaller specimens appear to change into a larger, single achaetous segment, with only a vague lateral indentation.

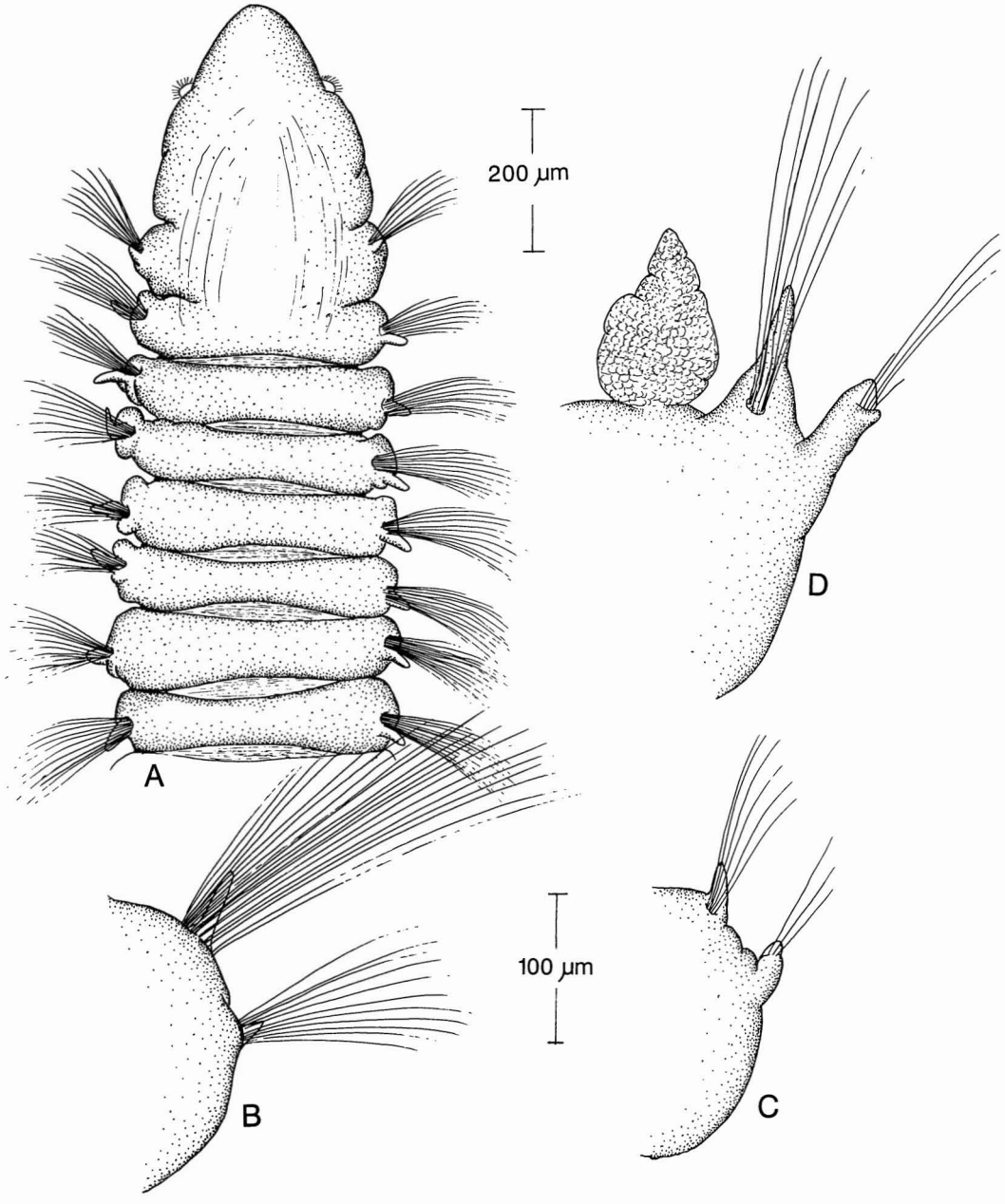

FIGURE 12. *Leitoscoloplos pachybranchiatus* (holotype, NMNH 122710): *A*, anterior end, dorsal view; *B*, thoracic parapodium, anterior view; *C*, anterior abdominal parapodium, anterior view; *D*, far posterior abdominal parapodium, anterior view.

Family SPIONIDAE

Genus *Prionospio* Malmgren, 1867

Prionospio (*Minuspio*) sp.

MATERIAL EXAMINED: Hydrothermal vents of the northeastern Pacific, dive by *Pisces IV*: Explorer Ridge, Gulati Gusher, P-1494-2315, 1 specimen (NMCA 1989-2315).

REMARKS: The specimen is small, but complete. Nine pairs of apinnate branchiae are present. The prostomium is broad anteriorly with a single terminal peak. The species resembles *P. lighti* Maciolek, 1986, but differs in lacking eyes and in having only 1 prostomial peak instead of 3.

Family SCALIBREGMATIDAE

Genus *Axiokebuita* Pocklington & Fournier, 1987

Axiokebuita millsi Pocklington & Fournier, 1987

Figure 13

Axiokebuita millsi Pocklington & Fournier, 1987:108–110, figs. 1,2.

MATERIAL EXAMINED: Hydrothermal vents of the northeastern Pacific, dive by *Pisces IV*: Juan de Fuca Ridge, Axial Seamount, ASHES Ventfield: Hell Vent, slurp sample on basalt, P-1725-1199, 1 specimen (NMCA 1989-0097).

DESCRIPTION: Large specimen, measuring 13.5 mm long and 3.5 mm wide for 20 setigers. Body thick throughout, with posterior end distinctly inflated and terminating in 2 large lobes. Color in alcohol: light tan.

Prostomium trapezoidal, with straight frontal margin, bearing 2 long, laterally directed processes; without eyes and nuchal organs; proboscis soft, smooth, lacking papillae (Figure 13*A*). Parapodia reduced, similar throughout body, with setae arising from simple podial mounds; notopodium with short, globular postsetal lamella; neuropodium with narrow cirriform postsetal lamella (Figure 13*A*,*B*). Notosetae including 10–12 long capillaries; neurosetae including long and short pointed setae with slightly expanded tips and finely serrated shafts (Figure 13*C*).

REMARKS: The genus *Axiokebuita* was established by Pocklington and Fournier (1987) to include two species: *A. minuta* (Hartman, 1967) from the Antarctic and *A. millsi* Pocklington & Fournier, 1987 from off Nova Scotia north to the Davis Strait and from the Antarctic. The two species were distinguished from one another on the presence of a globular postsetal notopodial lamella in *A. millsi* and its absence in *A. minuta*. The present specimen from the Axial Seamount agrees very well with *A. millsi* in this character and in other features. One character that differs slightly from the original description is the structure of the neurosetae. The shorter, stouter serrate setae had very fine bifid tips (Pocklington and Fournier 1987:109). The neurosetae of the present specimen were examined under oil immersion (1000×) with phase-contrast optics and found to have a single, slightly inflated tip that is unidentate. Several specimens of *A. millsi* were collected and identified by us as part of the U.S. North Atlantic Slope and Rise Program conducted off New England in 1985–1986. They were taken from station N3 at 1350 m on the U.S.-Canadian boundary and at station N10 at 1220 m south of Georges Bank. Examination of these specimens has confirmed that the neurosetae of North Atlantic specimens are of the same unidentate structure as those of the specimen from the Juan de Fuca Ridge.

Axiokebuita millsi seems to be a widespread, deep-water species. The records are scattered, however, with only 12 specimens reported from the western North Atlantic, the Antarctic, and the northwestern Pacific: Davis Strait (1), Nova Scotia (1), off New England (6), Ross Sea (1), Weddell Sea (2), and Juan de Fuca Ridge (1). It is unlikely that *A. millsi* is a true vent species.

DISTRIBUTION: Western North Atlantic, Davis Strait to off New England, 532–1350 m; Antarctic seas, 608–3687 m.

Family MALDANIDAE

Genus *Nicomache* Malmgren, 1865

Nicomache venticola Blake & Hilbig, new species

Figure 14

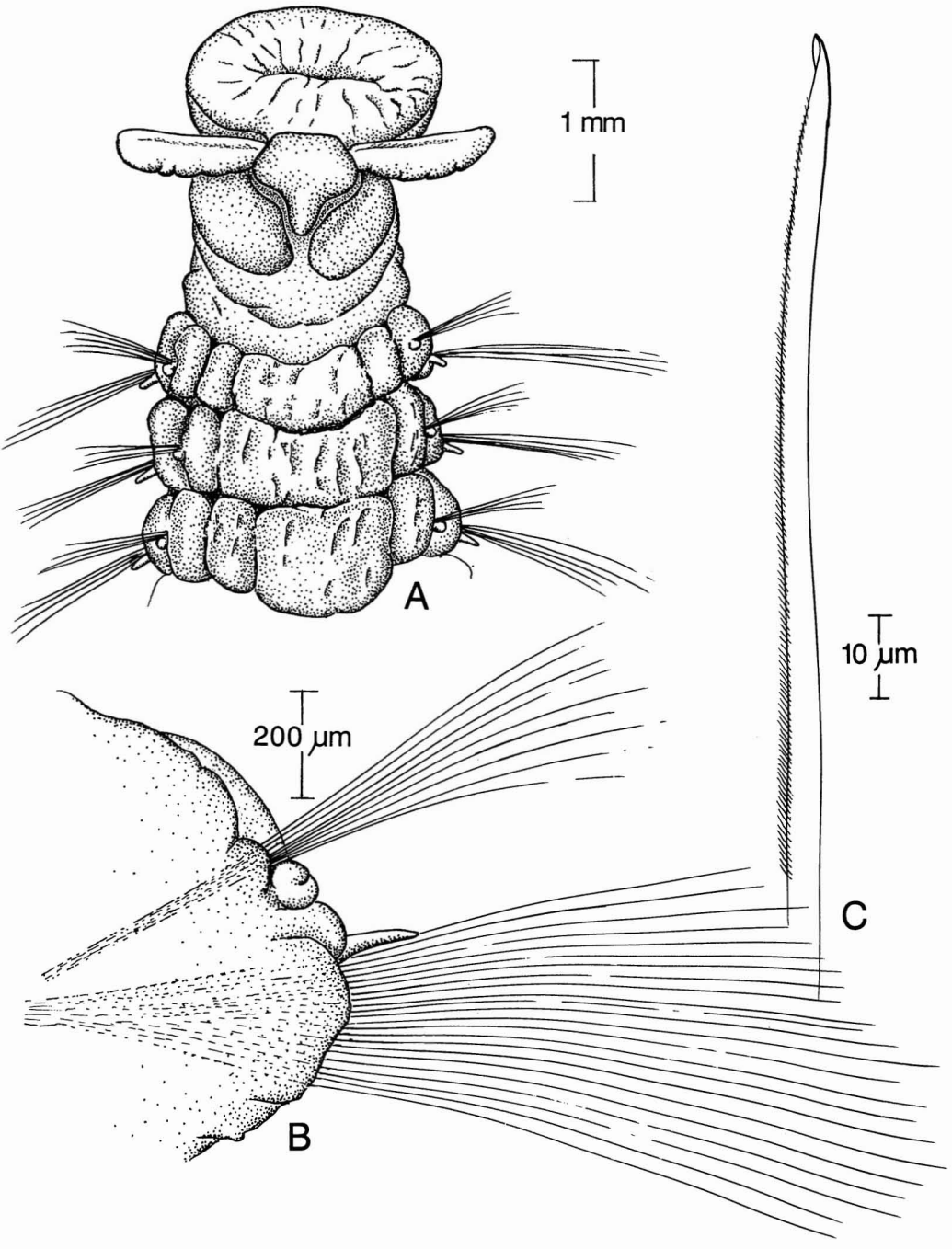

FIGURE 13. *Axiokebuita millsi* (NMCA, 1989-0097): *A*, anterior end, dorsal view, proboscis extended; *B*, middle parapodium, anterior view; *C*, neuroseta.

Nicomache sp.: Tunnicliffe et al., 1986:406.—Tunnicliffe, 1988:352.

MATERIAL EXAMINED: Hydrothermal vents of the northeastern Pacific, dives by *Pisces IV* (P) and *Alvin* (A): Explorer Ridge, Pogo Peaks, P-1492-562, paratype (NMCA 1989-0098); Upper Magic Mountain, Crab Vent , P-1494-567, 30 paratypes (NMCA 1989-0099; NMNH 122713); P-1497, 4 paratypes (NMCA 1989-0100); P-1497-552, 2 paratypes (NMCA 1989-0216). Juan de Fuca Ridge, Axial Seamount, ASHES Ventfield: Hell Vent, P-1720-2333, 2 paratypes (NMCA 1989-0217); on sulfide from base of Hell Vent, P-1723-572, holotype (NMCA 1989-0219) and 4 paratypes (NMCA 1989-0218); Southern Vent, P-1726-2370, 2 paratypes (NMCA 1989-0220). Southern Juan de Fuca Ridge, Vent I, A-1455-1B-558, 1 juvenile (NMNH 122714); TLC Vent, A-1446-565, fragment (NMNH 122715); A-1447-570, Lt. Obo Vent, paratype (NMNH 122716); A-1447-2310, paratype (NMNH 122717).

DESCRIPTION: Large species, measuring up to 130 mm long and 2.5 mm wide for 27–32 (usually 29–30) setigerous segments; achaetous pre-anal segments normally absent, except for developing transitional setiger; some incomplete specimens considerably larger, one with 16 setigers measuring 85 mm long and 3.5 mm wide and another with 18 setigers measuring 100 mm long and 3.5 mm wide. Holotype measuring 70 mm long and 2.6 mm wide for 32 setigers. Color in alcohol: greenish gray or light brown, with pigmented areas absent or sometimes present on body segments as dark patches, especially on neuropodia and other areas with concentrations of glands.

Prostomium rounded on anterior margin, continuing posteriorly as arched cephalic keel; cephalic plate lacking; nuchal grooves curved (Figure 14*A*). Anterior segments, except first 1 or 2, longer than wide, flared anteriorly, overlapping preceding segments, but not forming collars (Figure 14*A*). Few posterior segments crowded, with swollen parapodial lobes (Figure 14*E*).

Parapodia biramous. Notosetae simple capillaries with smooth shafts and clear narrow sheaths. Neuropodia of setigers 1–3 with 4–6 heavy, straight acicular spines (Figure 14*B*). Following neuropodia with 6–8 rostrate hooks in single rows, increasing to 9–10 in middle segments; hooks with main fang surmounted by 2–3 teeth and with numerous fibrils below main fang; unworn hooks with distinct tuft of fibrils emerging below main fang (Figure 14*C*); worn spines lacking tuft of fibrils (Figure 14*D*); rostrate hooks with prominent manubrium on shaft. Anus terminal, surrounded by irregular funnel bearing about 22 papillae (Figure 14*E*).

ETYMOLOGY: The species name refers to its proximity to hydrothermal vents.

REMARKS: *Nicomache venticola* is closely related to *N. arwidssoni* Blake, 1985 from the East Pacific Rise and Galápagos Rift hydrothermal vents. The two species differ from other described species of the genus in lacking the long filamentous capillary notosetae. *Nicomache venticola* differs most noticeably from *N. arwidssoni* in having 27–32 setigerous segments instead of 21–22 and in having 2–3 apical teeth on the rostrate spines instead of 4.

Family AMPHARETIDAE

Genus *Amphisamytha* Hessle, 1917

Amphisamytha galapagensis Zottoli, 1983

Amphisamytha galapagensis Zottoli, 1983: 379–391, figs. 1–3.—Desbruyères et al., 1985:103–116.—Grassle, 1985:714; 1986: 327.—Grassle et al., 1985:433–452.—Tunnicliffe et al., 1986:407.—Tunnicliffe, 1988: 352.

MATERIAL EXAMINED: Hydrothermal vents of the northeastern Pacific, dives by *Pisces IV* (P) and *Alvin* (A): Explorer Ridge, Pogo Peaks, P-1494-2319, 1 specimen (NMCA); Busted Thruster Vent, P-1505-2318, 2 specimens (JAB). Juan De Fuca Ridge, Axial Seamount, ASHES Ventfield: Hell Vent, P-1725-572, 8 specimens (BH); Not-So-Miserable Vent , P-1733-2334, 1 specimen (NMCA). Endeavour Segment, TLC Vent, A-1446-2314, 3 specimens (NMNH); Southern Juan de Fuca Ridge, Vent I, A-1445-1B-547, 1 specimen (NMNH).

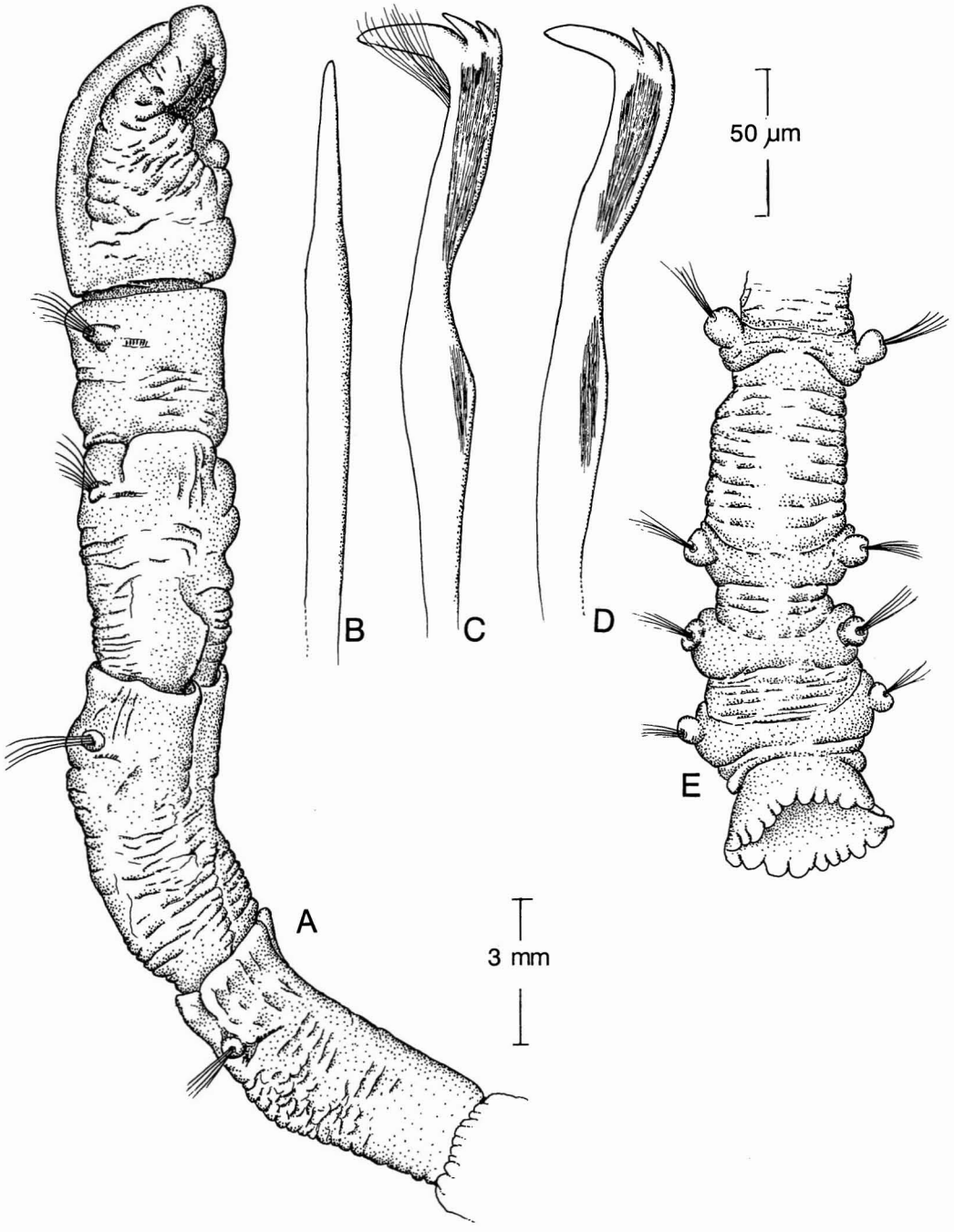

FIGURE 14. *Nicomache venticola* (paratype, NMCA 1989-0099): *A*, anterior end, lateral view; *B*, neuroseta from setiger 2; *C,D*, neuropodial rostrate spines; *E*, posterior end, dorsal view.

REMARKS: These specimens agree well with the original account from the Galápagos Rift. *Amphisamytha galapagensis* has now been recorded from all of the eastern Pacific vent locations from the Galápagos Rift to the Juan de Fuca and Explorer ridges. The species is one of five vent polychaetes now known to have such a wide range.

Family ALVINELLIDAE

Genus *Paralvinella* Desbruyères & Laubier, 1982

Paralvinella pandorae Desbruyères & Laubier, 1986

Paralvinella pandorae Desbruyères & Laubier, 1986: 2235–2239, figs. 16–17.

MATERIAL EXAMINED: Hydrothermal vents of the northeastern Pacific, dives by *Pisces IV* (P) and *Alvin* (A): Explorer Ridge, Upper Magic Mountain, Crab Vent, P-1497-543, 1 specimen (BH). Juan de Fuca Ridge, Axial Seamount, ASHES Ventfield: Not-So-Miserable Vent, P-1733-2334, 1 specimen (JAB). Strait of Juan de Fuca, Vent I, A-1455-1B-547, 9 specimens (BH).

REMARKS: These specimens represent additional records of the species to those reported from the same area (Desbruyères and Laubier 1986).

DISCUSSION

Polychaetes from Hydrothermal Vent Ecosystems in the Eastern Pacific

A total of 22 species representing 19 genera and 12 families of polychaetes has now been identified from the hydrothermal vents on the Juan de Fuca and Explorer Ridge systems (Table 4). Sixteen of these 22 species (73%) are endemic to the Juan de Fuca sites, whereas 5 species (22%) have also been found at other eastern Pacific vent locations, and 1 species (*Axiokebuita millsi*) has been reported from nonvent locations. The five nonendemic species that also occur at the East Pacific Rise vent sites include *Branchinotogluma grasslei* Pettibone, 1985*a*; *B. sandersi* Pettibone, 1985*a*; *Levensteiniella kincaidi* Pettibone, 1985*c*; *Hesiospina vestimentifera* Blake, 1985; and *Amphisamytha galapagensis* Zottoli, 1983.

The percentage of endemic species at the Galápagos Rift and 21° N sites is considerably lower (Table 4). Of 26 species of polychaetes reported from the Galápagos Rift, only 11 (42%) are endemic, with 15 species (58%) also present at 21° N. Of 23 species occurring at 21° N on the East Pacific Rise, only 8 (35%) are endemic.

The polychaete fauna of the Juan de Fuca and Explorer Ridge systems is thus highly endemic and largely isolated from the vent communities on the East Pacific Rise and Galápagos Rift. This isolation is undoubtedly due to the physical separation of the northwestern Pacific ridge systems from the East Pacific Rise by more than 2000 km (Grassle 1986, Tunnicliffe 1988). In contrast, the Galápagos Rift and East Pacific Rise are linked by interconnecting fracture zones that permit an easier faunal exchange.

A review of within-area distributions of the polychaete species now known from the Juan de Fuca and Explorer Ridge systems reveals that most species are widely distributed throughout the study area. Six species are limited to the Axial Seamount but this may be an artifact of the more extensive collections at that site. The five nonendemic species listed earlier are also the most widely distributed on the Juan de Fuca and Explorer ridges.

The mechanisms of dispersal of individual species between distant vent sites is not understood and it is apparent that only a few species have achieved wide distributions. It is likely that the five widely distributed species noted above undergo highly dispersive planktotrophic or lecithotrophic development, whereas species having more restricted distributions undergo nonplanktonic development. Both *Sphaerosyllis ridgensis* and *Ophryotrocha globopalpata*, for example, are restricted to the Juan de Fuca Ridge and/or the Explorer Ridge and exhibit evidence of brooding that would preclude the potential for long-distance transport of larvae. Some relevant aspects of larval development of vent faunas are reviewed by Lutz et al. (1984) and Van Dover et al. (1988).

TABLE 4

POLYCHAETA REPORTED FROM HYDROTHERMAL VENT ECOSYSTEMS

SPECIES	VENT SYSTEM						REFERENCES
	GALÁPAGOS	13° N	21° N	GUAYMAS	JdF/ER	MARIANAS	
Family Phyllodocidae							
Galapagomystides aristata	+	—	—	—	—	—	Blake 1985
Protomystides papillosa	—	—	+	—	—	—	Blake 1985
P. verenae	—	—	—	—	+	—	This paper
Family Polynoidae							
Bathykurila guaymasensis	—	—	—	+	—	—	Pettibone 1989*b*
B. burkensis	—	—	—	—	—	+	Pettibone 1989*a*
Branchinotogluma grasslei	+	—	+	—	+	—	Pettibone 1985*b*, 1988, 1989*b*
B. hessleri	+	—	+	—	—	—	Pettibone 1985*b*, 1989*b*
B. sandersi	+	—	+	—	+	—	Pettibone 1985*b*, 1988, 1989*b*
Opisthotrochopodus alvinus	+	—	+	—	—	—	Pettibone 1985*b*, 1989*b*
O. marianus	—	—	—	—	—	+	Pettibone 1989*a*
O. tunnicliffeae	—	—	—	—	+	—	Pettibone 1988
Branchiplicatus cupreus	—	?	+	+	—	—	Pettibone 1985*a*, 1989*b*
Branchipolynoe symmytilida	+	+	—	—	—	—	Pettibone 1984*a*, Desbruyères et al. 1985
Lepidonotopodium fimbriatum	—	+	+	—	—	—	Pettibone 1983, 1984*b*, Grassle 1986
L. minutum	—	—	—	—	—	+	Pettibone 1988
L. piscesae	—	—	—	—	+	—	Pettibone 1988
L. riftense	+	—	+	—	—	—	Pettibone 1984*b*, 1989*b*
L. williamsi	+	?	+	—	—	—	Pettibone 1984*b*, 1989*b*
Levensteiniella kincaidi	+	+	+	—	+	—	Pettibone 1985*c*, 1988, 1989*c*, Tunnicliffe 1988
L. raisae	—	—	—	—	—	+	Pettibone 1989*a*
Macellicephala galapagensis	+	—	—	—	—	—	Pettibone 1985*c*
Macellicephaloides alvini	—	—	—	+	—	—	Pettibone 1989*b*
Iphionella risensis	—	—	+	—	—	—	Pettibone 1985*c*, 1986
Harmothoe macnabi	+	—	—	—	—	—	Pettibone 1985*c*
Family Sigalionidae							
Neoleanira racemosa	—	—	—	+	—	—	Pettibone 1989*b*
Family Hesionidae							
Amphiduros axialensis	—	—	—	—	+	—	This paper
Hesiocaeca, undescribed species	—	—	—	—	—	+	Blake, unpublished observations
Hesiodeira glabra	—	—	—	—	+	—	This paper
Hesiospina vestimentifera	+	—	+	—	+	—	Blake 1985, this paper
Hesiolyra bergi	—	+	+	—	—	—	Blake 1985, Desbruyères et al. 1985
Nereimyra alvinae	+	—	—	+	—	—	Blake 1985
Orseis grasslei	—	—	—	+	—	—	Blake 1985

TABLE 4 (continued)

SPECIES	VENT SYSTEM						REFERENCES
	GALÁPAGOS	13° N	21° N	GUAYMAS	JdF/ER	MARIANAS	
Family Nereididae							
Ceratocephale pacifica	—	—	—	+	—	—	Blake 1985
Nereis sandersi	+	+	+	+	—	—	Blake 1985, Desbruyères et al. 1985
Nereis piscesae	—	—	—	—	+	—	This paper
Family Syllidae							
Sphaerosyllis ridgensis	—	—	—	—	+	—	This paper
Family Euphrosinidae							
Euphrosine rosacea	+	—	—	+	—	—	Blake 1985
Family Glyceridae							
Glycera profundi	—	—	—	+	—	—	Blake 1985
Family Dorvilleidae							
Exallopus jumarsi	—	—	—	+	—	—	Blake 1985
Ophryotrocha akessoni	+	+	+	+	—	—	Blake 1985
O. globopalpata	—	—	—	—	+	—	This paper
O. platykephale	—	—	—	+	—	—	Blake 1985
Parougia wolfi	—	—	—	—	+	—	This paper
Family Eunicidae							
Eunice pulvinopalpata	—	—	+	—	—	—	Fauchald 1982
Family Orbiniidae							
Leitoscoloplos pachybranchiatus	—	—	—	—	+	—	This paper
**Orbiniella aciculata*	+	—	—	—	—	—	Blake 1985
O. hobsonae	—	—	—	—	+	—	This paper
**Scoloplos ehlersi*	+	—	—	—	—	—	Blake 1985
Family Spionidae							
Laubieriellus grasslei	+	—	—	—	—	—	Maciolek 1981
Prionospio sandersi	+	—	—	—	—	—	Maciolek 1981
P. sp.	—	—	—	—	+	—	This paper
Xandaros acanthodes	+	—	—	—	—	—	Maciolek 1981
Family Maldanidae							
Nicomache arwidssoni	+	+	+	—	—	+	Blake 1985, unpublished observations; Desbruyères et al. 1985
N. venticola	—	—	—	—	+	—	This paper
Family Scalibregmatidae							
Axiokebuita millsi	—	—	—	—	+	—	This paper

TABLE 4 (continued)

SPECIES	VENT SYSTEM: GALÁPAGOS	13° N	21° N	GUAYMAS	JdF/ER	MARIANAS	REFERENCES
Family Ampharetidae							
Amphisamytha galapagensis	+	+	+	+	+	+	Zottoli 1983, Desbruyères et al. 1985, this paper; Blake, unpublished observations
Family Alvinellidae							
Alvinella caudata	—	+	+	—	—	—	Desbruyères and Laubier 1986
A. pompejana	—	+	+	—	—	—	Desbruyères and Laubier 1980, 1986
Paralvinella dela	—	—	—	—	+	—	Detinova 1988
P. grasslei	+	+	+	+	—	—	Desbruyères and Laubier 1982, 1986
P. pandorae	—	—	—	—	+	—	Desbruyères and Laubier 1986, this paper
P. palmiformis	—	—	—	—	+	—	Desbruyères and Laubier 1986
P. pandorae irlandei	—	+	—	—	—	—	Desbruyères and Laubier 1986
Family Serpulidae							
Laminatubus alvini	+	+	+	—	—	—	ten Hove and Zibrowius 1986
Protis hydrothermica	+	+	+	—	—	—	ten Hove and Zibrowius 1986

*Known only from inactive vents.

Systematic Relationships of Polychaetes from Hydrothermal Vents

The polychaete fauna of hydrothermal vent ecosystems includes families having very different morphologies and modes of life. Some families have evolved genera or species groups at vents and seep habitats that are distinct from nonvent taxa. Other families such as the Glyceridae, Sigalionidae, Syllidae, Eunicidae, Orbiniidae, Scalibregmatidae, and Ampharetidae do not seem to have evolved distinct vent faunas. It is therefore at the familial and generic level that systematic relationships must be examined. Numerous additional species await description, and more complete knowledge of the species composition will enable expansion or rejection of the generalizations proposed in this paper.

The only polychaete family to have evolved completely at hydrothermal vents is the Alvinellidae. Two genera and seven species of alvinellids have been described to date, and at least three additional species are known (Desbruyères and Laubier 1980, 1982, 1986, Detinova 1988; D. Desbruyères, pers. comm.).

The Polynoidae is the most diverse of the polychaete families occurring at hydrothermal vents, with three entirely new subfamilies having been described that are limited to vent or cold-seep habitats (Pettibone 1983, 1984*b*; 1985*b*). Twenty-one species of Polynoidae have been reported from hydrothermal vents (Table 4).

Among the three species of Phyllodocidae thus far discovered at hydrothermal vents, both *Galapagomystides aristata* and *Protomystides verenae* are unique in having a similar type of aristatelike compound seta. This type of seta has recently been reported for *P. hatsushimaensis* described by Miura (1988) from a cold-seep site off Japan. This species is very similar to *P. verenae* and along with *G. aristata* these three species form a distinct group of phyllodocids that are unique to vents and seeps.

The maldanid genus *Nicomache* is represented at hydrothermal vents and cold seeps by a species group that lacks the long spiral

notosetae that characterize their shallow-water relatives. To date, two species are known from hydrothermal vents (Blake 1985; this paper), and a third species is present at a cold-seep site on the Florida Escarpment (Blake, unpublished observations).

The unusual euphrosinid *Euphrosine rosacea* Blake is known only from the Galápagos Rift and Guaymas Basin hydrothermal vents. This species seems to represent a new direction in amphinomid/euphrosinid evolution and is being referred to a new genus (Kudenov, in press).

The Spionidae are represented by species of *Prionospio* that are related to other deep-sea and shallow-water congeners and by one species of *Laubieriellus* that has a shallow-water relative. One unique genus, *Xandaros*, is represented by a single species from the Galápagos Rift and has not been reported from nonvent locations (Maciolek 1981).

The Hesionidae, Nereididae, Dorvilleidae, and Serpulidae are represented at hydrothermal vents by species and genera that share common ancestors with the adjacent deep-sea faunas. For example, the closest relatives of *Hesiospina vestimentifera*, the most common vent hesionid at the eastern Pacific hydrothermal vents, are from upper slope depths off Japan and in the North Atlantic. The two common hydrothermal vent *Nereis* species are part of a larger deep-sea species group having enlarged parapodia in posterior setigers (Blake 1985; this paper). The same generalization can be made for the dorvilleids inhabiting the hydrothermal vent communities, although little is known about deep-sea dorvilleids from the Pacific Northwest. *Exallopus jumarsi* Blake from the Guaymas Basin hydrothermal ventfields belongs to a deep-sea dorvilleid genus now known to have five species (Jumars 1974, Blake 1985; Hilbig, in press; Hilbig and Blake, unpublished observations). Only two serpulid species in two genera have been described from hydrothermal vents, although other species are known. Both species are related to nonvent taxa (ten Hove and Zibrowius 1986).

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