SPECIES OF *MUNIDOPSIS* (CRUSTACEA, GALATHEIDAE) OCCURRING OFF OREGON AND IN ADJACENT WATERS

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ABSTRACT

Twelve species of *Munidopsis* (Decapoda: Crustacea: Galatheidae) were collected from the continental slope, Cascadia Basin, and Tufts Abyssal Plain off Oregon and in adjacent waters. Three new species are described: *Munidopsis cascadia, M. tuftsi,* and *M. yaquinensis*. One specimen, *Munidopsis* sp., closely related to *M. bairdii*, is described but unnamed, pending capture of more specimens. *Munidopsis chacei* is synonymized with *M. bairdii* and *M. geyeri* is synonymized with *M. subsquamosa*. The ranges of seven previously described species are now extended to Oregon and Washington: *M. aries, M. bairdii, M. beringana, M. ciliata, M. latirostris, M. subsquamosa,* and *M. verrucosus*. The 12 species occurred between 950 and 4,194 m; 3 species were found on the continental slope (950-2,189 m); 9 species were found on Cascadia Basin (1,900-3,025 m); and 3 species were found on Tufts Plain (3,390-4,194 m). Species composition on Cascadia Basin differed from east to west. The highest densities (number of specimens per trawl) occurred at the base of the continental slope and 40 miles farther west. One species, *M. latirostris*, contributed 73.0% of the total number of specimens, and three other species (*M. bairdii, M. ciliata*, and *M. subsquamosa*) contributed an additional 20.2%. The species collected also occur in the Atlantic (*M. bairdii, M. aries*), tropical Pacific and Indian (*M. ciliata*), tropical Pacific (*M. latirostris*), Arctic (*M. beringana*), southern temperate Pacific (*M. verrucosus*), or are cosmopolitan (*M. subsquamosa*), or are endemic on Cascadia Basin (*M. cascadia, M. yaquinensis*), and on Tufts Plain (*M. tuftsi*).

Species of *Munidopsis* are found from intertidal waters to the abyssal plains of the deep sea. *Munidopsis polymorpha* is found in saltwater lakes in caverns connected to the sea in the Canary Islands (Dinkins 1969). *Munidopsis crassa*, the deepest known species, was found at 4,700 m in the Bay of Biscay (Sivertson and Holthuis 1956). Recently, an unidentified *Munidopsis* sp. has been found near submarine hot springs near the Galapagos (Corliss and Ballard 1977). In general, the genus is found in the deep sea with about half of the known species occurring deeper than 800 m (Doflein and Balss 1913).

In the eastern Pacific Ocean, the first *Munidopsis* species were collected off Chile by the *Challenger* (Henderson 1888) and in the eastern tropical Pacific by the *Albatross* (Faxon 1895). Benedict (1902) described additional new species collected by the *Albatross* off southern California and the Galapagos, and in the Bering Sea. Since then, Bahamonde (1964) and Khodkina (1973) have found new species off Chile, and Pequegnat and Pequegnat (1973) described a new species off Baja California and Costa Rica from the *Albatross* and *Galathea* collections. Little work has been done on *Munidopsis* occurring off the west coast of the United States. Schmitt (1921), in a key to *Munidopsis* species found off California, included *M. verrilli, M. hystrix, M. aspera*, and *M. quadrata*. Haig (1956) modified this key to include *M. depressa*.

This paper discusses the taxonomy and distribution of 12 *Munidopsis* species collected mainly off Oregon from 950 to 4,194 m. These depths include the lower slope and the abyssal plains of Cascadia Basin and Tufts Plain (Figure 1). Among species found off Oregon, only *M. quadrata* has previously been collected from the west coast of the United States. Three new species are described: *M. cascadia, M. tuftsi,* and *M. yaquinensis*. One species, *Munidopsis* sp., is described but left unnamed until more specimens become available to elucidate its relationship to *M. bairdii*. The ranges of seven previously described species are extended to Oregon: *M. bairdii, M. beringana, M. ciliata, M. aries, M. verrucosus, M. latirostris,* and *M. subsquamosa*.

METHODS

A total of 803 specimens were collected from 146

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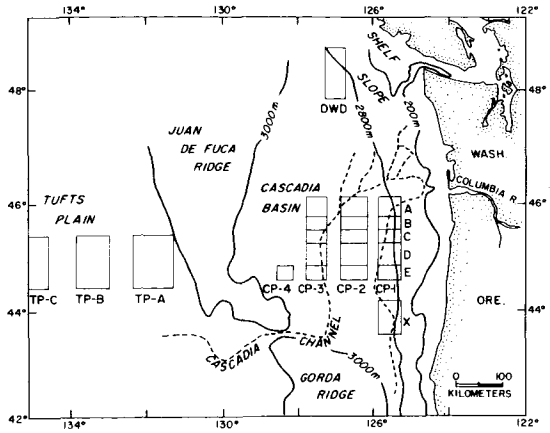

FIGURE 1.—Stations sampled in Cascadia Basin and Tufts Plain, off Oregon and Washington.

benthic otter trawls (OTB, OT) and beam trawls (BMT) during 13 yr of sampling by Andrew G. Carey, Jr., School of Oceanography, Oregon State University. On Cascadia Basin, samples were collected on three north-south lines ranging from the CP-1 line (Figure 1) at the base of the continental slope to the CP-3 line 80 mi farther offshore. The base of the continental slope varies from 1,900 m on the Astoria Fan at CP-1-A to 2,816 m at CP-1-E. At the base of the continental slope farther south, between lat. 43° and 44° N, a small trench occurs in which depths reach 3,000 m. Stations become deeper both to the south and to the west in Cascadia Basin. One sample was taken from Gorda Ridge off California, south of Cascadia Basin. Ten tows were made in northern Cascadia Basin on Nitinat Fan off Washington, during a study of deepwater dumpsites (Carey et al. 1973). Three areas (TP-C, TP-B, TP-A) were sampled on Tufts Plain. Station abbreviations are as follows: NAD = Newport hydrographic line, mainly slope stations; CP = Cascadia Basin, off Oregon; TP = Tufts Plain; and DWD = Deepwater dumpsite, northern Cascadia Basin, off Washington.

The beam trawl is a semiquantitative sampler (Carey and Heyamoto 1972), with a rigid frame of steel skids connected by a 3 m aluminum pipe, with a collecting net of 4.1 cm stretch mesh lined with 1.3 cm mesh net. The otter trawl is a 7 m semiballoon Gulf of Mexico shrimp trawl with 4.1 cm stretch mesh with a 1.3 cm mesh liner. Samples were preserved at sea in 10% formaldehyde and sorted in the laboratory.

The specimens were examined through a dissecting microscope and measured with vernier calipers usually to the nearest millimeter. The following measurements were used (Figure 2):

Carapace length (CL) = tip of rostrum to middle of posterior margin of carapace.

Anterior width of carapace = width between anterolateral spines.

Posterior width of carapace = width at posterior margin of carapace.

Rostrum length = tip of rostrum to rostrum base, which lies on an imaginary line between the bases of the ocular peduncles.

Cheliped length = tip of chela to articulation between ischium and sternum.

Chela length = tip of chela to articulation between chela and carpus, on the ventral side.

Eyespine length = tip of eyespine to proximal end of cornea.

Incomplete synonymies are given for each species. References include original description, first redescription if the original description was very short, first figure, and all synonyms.

The specimens from Oregon State University (OSU) were compared with those borrowed from the U.S. National Museum (USNM), the Museum of Comparative Zoology at Harvard (MCZ), and from Texas A&M University (TAMU). Specimens of each species are cataloged in the Oregon State University Benthic Invertebrate Museum (OSUBI). The holotypes and a few paratypes of the new species were deposited at the U.S. National Museum.

MUNIDOPSIS WHITEAVES 1874

Munidopsis Whiteaves 1874:212 (original description); Smith 1885:493 (synonomy with *Galacantha*); Milne-Edwards and Bouvier 1894:271, 1897:63 (redescriptions); Faxon 1895:81-83 (synonomy with *Orophorhynchus, Elasmonotus, Galathodes,* and *Anoplonotus*); Chace 1942:69 (synonomy with *Galacantha*).

Galathodes Milne-Edwards 1880:53 (original description); Milne-Edwards and Bouvier 1894:276, 1897:94 (redescriptions).

Orophorhynchus Milne-Edwards 1880:58 (original description); Milne-Edwards and Bouvier 1894:283, 1897:110 (redescriptions).

Elasmonotus Milne-Edwards 1880:60 (original description); Milne-Edwards and Bouvier 1894:279, 1897:98 (redescriptions); Henderson 1888:165 (synonomy with *Galathopsis*).

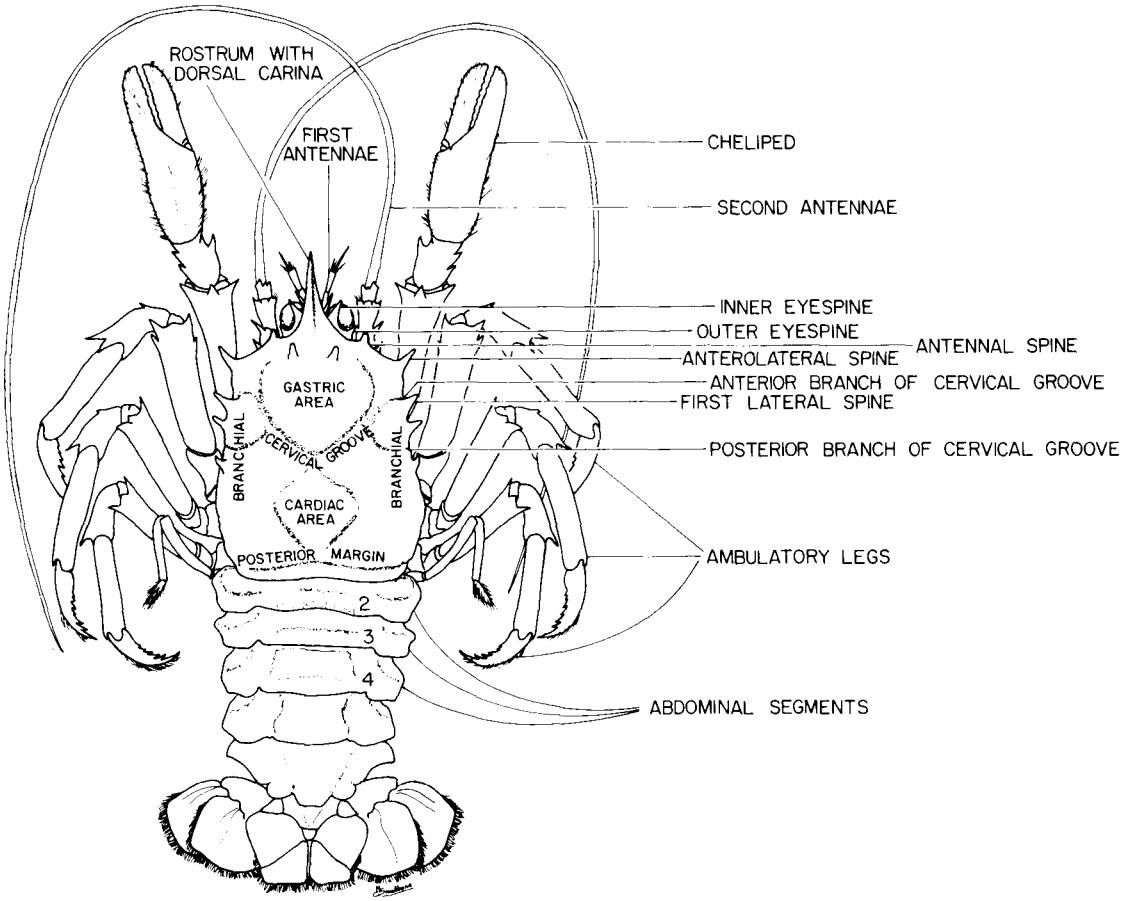

FIGURE 2.—Generalized drawing of the genus *Munidopsis*.

Anoplonotus Smith 1883:50 (original description).
Galathopsis Henderson 1885:417 (original description).
Galacantha Milne-Edwards 1880:52 (original description); Henderson 1888:166 (redescription, argues for separate genus); Milne-Edwards and Bouvier 1894:268, 1897:55 (redescriptions).

Diagnosis.—Integument heavily calcified; carapace longer than wide, covered with spines, sometimes with setae, and with rugae often in transverse rows; dorsal surface of carapace with well-defined cardiac and gastric areas, gastric area separated from branchial area by cervical groove; anterolateral borders of carapace usually spinose or dentate but occasionally entire; anterior border of carapace sometimes with small supra-antennal spine or tooth, never with a long supraorbital spine; eyes small, unfaceted, and devoid of pigment; ocular peduncle sometimes extended beyond cornea as a spine (eyespine); rostrum well developed, triangular or spatulate; antennular peduncle with short flagellum; antennal peduncle four jointed, usually with long flagellum; chelipeds either longer or shorter than next three ambulatory legs, epipodite present sometimes on chelipeds and occasionally on ambulatory legs; moderate number of large eggs, a few millimeters in diameter.

The genus *Munidopsis* (including *Galacantha*) has about 140 species with 112 of them covered in checklists by Doflein and Balss (1913) and 101 in a checklist by Benedict (1902). The genus has been divided into five groups called either genera, subgenera, or groups (Henderson 1888; Milne-Edwards and Bouvier 1894; Alcock 1901; Tirmizi 1966). Faxon (1895) and Chace (1942) recommended a single genus *Munidopsis* because many

species show characteristics intermediate between groups.

Several extensive keys exist. Benedict's (1902) key describes all specimens in the U.S. National Museum collection at that time. Chace (1942) wrote a key to the western Atlantic species, which has been updated by Pequegnat and Pequegnat (1970, 1971). Other extensive keys were constructed by Milne-Edwards and Bouvier (1894) and Alcock (1901).

Characteristics of Taxonomic Importance for Species

Although the antennular peduncle, antennal peduncle, and merus of the third maxilliped are usually drawn for new species, these characters are rarely used to identify species.

Carapace. Presence, absence, and number of spines on the anterior, lateral, and posterior margins and on the dorsal surface of the carapace. Presence of the antennal spine variable among specimens of the same species. The basic type of ornamentation (ridges, tubercles, crenulations, spines, setae) on the dorsal surface. Slight differences in ornamentation, size, and spacing found on specimens from different geographic locations are considered varietal differences.

Rostrum. The general shape: triangular or rounded. Lateral margins armed with spines or unarmed.

Eyespines. Presence or absence; length in relation to cornea; sharp or blunt.

Chelipeds. Length compared with carapace length; ornamentation, especially spines on segments.

Walking legs. Not as important as chelipeds. General ornamentation.

Epipodites on chelipeds and legs. Presence or absence.

Abdomen. Presence or absence of spines on dorsal surface.

Key to Species of *Munidopsis* off Oregon and Washington

1a. No epipods on chelipeds 2
1b. Epipods present on chelipeds 5

2a. Eyespines absent; one large spine on second, third, and fourth abdominal segments; frontal and lateral margin of carapace forms a right angle ..... *quadrata*
2b. Eyespines present; abdomen unarmed; spine or tooth present at anterolateral corner of carapace 3

3a. Wide, triangular rostrum; posterior margin of carapace unarmed ..... *aries*
3b. Narrow rostrum with or without lateral spines; posterior margin of carapace armed with 1 to 10 spines 4

4a. Rostrum with 2-6 lateral spines, posterior margin of carapace armed with 3-10 (usually 4-6) spines; chela with 2 inner spines ..... *bairdii*
4b. Rostrum with no lateral spines; posterior margin of carapace armed with one spine; chela without two inner spines ..... sp.

5a. Eyestalks extend beyond eye as definite, sharp spines 6
5b. Eyestalks extend beyond eye as blunt processes 11

6a. Two eyespines present, a longer inner spine and a short outer spine ..... *ciliata*
6b. Only inner eyespine present 7

7a. Rostrum wide, not triangular, with dorsal carina, rounded at end ..... *yaquinensis*
7b. Rostrum triangular, with dorsal carina and pointed at end 8

8a. Carapace and legs covered densely with setae; lateral margins of carapace without spines ..... *cascadia*
8b. Carapace and legs not covered densely with setae; spines on lateral margins of carapace 9

9a. Thin, unarmed rostrum strongly upturned ..... *beringana*
9b. Triangular rostrum armed with spines or teeth, not upturned 10

10a. Rostrum armed laterally with two to four small spines; carapace covered with crenulated (margin cut into rounded scallops) tubercles; eyespines long, anterolateral spine about same size as first lateral spine ..... *tuftsi*
10b. Rostrum armed laterally with minute teeth; carapace covered with semicircular scalelike tubercles with long setae; eyespines short; anterolateral spine larger than first lateral spine ..... *subsquamosa*

11a. Rostrum triangular without dorsal carina; large spine on second, third, and fourth abdominal segments ..... *verrucosus*
11b. Rostrum wide at base, nearly parallel to eyestalks, with dorsal carina; abdomen with no large spines ..... *latirostris*

Munidopsis quadrata Faxon 1893

Munidopsis quadrata Faxon 1893:1888 (original description); Faxon 1895:97 (redescription), pl. 23, fig. 1, 1e.
Elasmonotus quadratus Milne-Edwards and Bouvier 1894:281-282 (under discussion of genus *Elasmonotus*, key to *Elasmonotus*).

Material.—OSUBI 00170, gravid female, 11 mm CL, stn NAD 11, 44°39.0′ N, 124°59.9′ W, BMT 312, 950 m; OSUBI 00171, male, 13 mm CL, stn Waldpt., 44°21.7′ N, 125°07.9′ W, OT 27, 1,000 m; OSUBI 00182, gravid female, 12 mm CL, male, 11 mm CL, stn NAD 12, 44°38.8′ N, 125°09.1′ W, OTB 360, 1,170 m; OSUBI 01580, 2 specimens, stn DWD 5, 48°38.1′ N, 126°58.1′ W, BMT 9, 2,189 m.

Distribution.—The range of *Munidopsis quadrata* extends from off Destruction Island, Wash., to Tres Marias Islands, Mexico, at depths usually between 620 and 1,571 m; it has also been found at 86 and 110 m, off Wilmington, Calif., and Los Coronados Islands, respectively (Rathbun 1904). These shallow records (86 and 110 m) seem unlikely when compared with the usual depth range of 620-1,571 m, although other species of *Munidopsis* do occur on the Continental Shelf. *Munidopsis quadrata* occurs on the continental slope off Oregon and on the Nitinat Fan off Washington at 950-2,189 m, which extends the known depth range.

Munidopsis aries (Milne-Edwards 1880)

Orophorhynchus aries Milne-Edwards 1880:58 (original description); Milne-Edwards and Bouvier 1897:111-113 (redescription), pl. 9.
Munidopsis aries. Benedict 1902:316 (genus changed to *Munidopsis*).

Material.—USNM 171346, female, 43 mm CL, stn CP-2-E, 44°38.4′ N, 126°42.0′ W, BMT 270, 2,850 m; OSUBI 00169, female, 29 mm CL, stn CP-3-E Channel, 44°44.4′ N, 127°22.1′ W, BMT 359, 3,025 m. The holotype was not examined.

Remarks.—This species is known from only three specimens—the type and two Oregon specimens (Table 1). *Munidopsis sundi* and *M. albatrossae*, both giant species, are most similar to *M. aries* in shape and ornamentation of the carapace.

The description of *M. aries* (Milne-Edwards and Bouvier 1897) fits the Oregon specimens except for the chelipeds. In the Oregon specimens, the merus of the cheliped has four small spines at the anterior border and a row of small spines along the dorsal ridge; the carpus has four or five small spines on the dorsal surface with two or three of these at the anterior border. Milne-Edwards and Bouvier (1897) described two denticles at the anterior border of the merus and the carpus. They did not describe the inner margin of the merus of the third maxilliped. In the Oregon specimens three

TABLE 1.—Morphometry of *Munidopsis aries*. Data on holotype from Milne-Edwards and Bouvier (1897).

Measurement (mm)	Holotype	USNM 171346	OSUBI 00169
Carapace length	20	43	29
Rostrum length	5.1	12	8
Anterior carapace width	9.7	18	14
Posterior carapace width	10.5	26	18
Width at widest part of carapace	14	29	19
Cheliped length	18	37	24
Rostrum length/carapace length	0.26	0.28	0.28
Cheliped length/carapace length	0.90	0.86	0.83

small spines occur along the posterior half of this inner margin.

Distribution.—*Munidopsis aries* appears to be a rare, deepwater species. The type is from near Bequia in the Caribbean Sea (lat. 13°N, long. 61.1° W) at 2,912 m. The Oregon specimens were collected at 2,850 m in Cascadia Basin and at 3,025 m in Cascadia Channel.

Munidopsis bairdii (Smith 1884)

Galacantha bairdii Smith 1884:356 (original description).

Munidopsis bairdii. Smith 1886:649 (redescription) pl. 5, fig. 2.

Munidopsis chacei. Kensley 1968:288 (original description) fig. 1.

Material.—Holotype, USNM 5717, female, 45 mm CL, *Albatross* stn 2106, 37°41.3′ N, 73°3.3′ W, 2,740 m; USNM 10801, male, *Albatross* stn 2573, 40°34.3′ N, 66°09′ W, 3,188 m; USNM 171344, male, 48 mm CL, male, 41 mm CL, stn CP-2-B, 45°34.5′ N, 126°18.5′ W, BMT 156, 2,661 m; OSUBI 00193, female, 28+ mm CL, stn CP-2-E, 44°43.4′ N, 126°27.5′ W, OTB 90, 2,772 m; OSUBI 00192, 6 specimens, stn CP-2-C, 45°20.8′ N, 126°37.7′ W, BMT 264, 2,750 m; OSUBI 00194, female, 22 m CL, stn CP-2-D, 44°53.7′ N, 126°33.4′ W, BMT 162, 2,774 m; 51 uncataloged specimens, smallest ovigerous female 43 mm CL.

Remarks.—The characteristics of *Munidopsis chacei* Kensley, are within the range of variation of *M. bairdii* and, therefore, *M. chacei* is here considered a synonym of *M. bairdii*. As noted by Kensley (1968), *M. chacei* and *M. bairdii* differ in the number of spines of the gastric and cardiac areas and on the posterior margin, and the ratio of dactyl to propodal length of the ambulatory legs. However, the range of variation of these characteristics in our specimens of *M. bairdii* includes those observed for *M. chacei* (Table 2).

Munidopsis columbiana Pequegnat and Pequegnat is a closely related species, with the following differentiating characteristics: antennal spines present in *M. columbiana*, absent in *M. bairdii*; abdominal segments with spines in *M. columbiana*, absent in *M. bairdii*; and inner margin of merus of third maxilliped with five to eight teeth in *M. columbiana*, three teeth in *M. bairdii*, and two to four teeth in our specimens.

TABLE 2.—Selected spine counts of *Munidopsis chacei* and *M. bairdii* from their type descriptions, compared with data from 46 Oregon specimens.

Item	Gastric area	Cardiac area	Posterior margin
M. chacei:			
Kensley (1968)	5	4	4
M. bairdii:			
USNM 5717	6	3	10
USNM 10801	5	3	4
Faxon (1895)	4	1	5
Oregon specimens	3-5	2-4	4-6

Pequegnat and Pequegnat (1971) mention two other characteristics, but these do not separate the two species. In their key, the presence of more than seven spines on the carapace separates *M. columbiana* from *M. bairdii*. In the Oregon specimens, the number of spines on the carapace ranges from 5 to 11. The number of lateral spines on the rostrum is not a distinguishing characteristic. *Munidopsis columbiana* can have from two to six lateral spines, but usually has four. The type of *M. bairdii* has six lateral spines. In the Oregon specimens the number of spines ranges from two to six, but usually is four.

Distribution.—*Munidopsis bairdii* occurs at depths of 2,377-2,940 m in Cascadia Basin. It has been previously collected in both the Atlantic and Pacific Oceans: Cape Sable to Cape May (Smith 1886); Cape Hatteras to Nantucket (Smith 1884); off Panama (Faxon 1895); and off the west coast of the Cape Peninsula or Cape Point, South Africa (Kensley 1968).

Munidopsis sp. (Figure 3)

Munidopsis sp. USNM 171345, male, 20 mm CL, stn NAD 17, 44°31.2′ N, 125°15.5′ W, OT 23, 1,829 m.

Remarks.—*Munidopsis* sp. closely resembles *Munidopsis bairdii*, but is distinctly different in some characters. More specimens are needed to verify species status. The form differs from *M. bairdii* in having no lateral spines on the rostrum, a shorter rostrum, only one spine on the posterior margin, rugae on carapace much less pronounced, hairs on carapace thicker, shorter eyespines extending just beyond the cornea, and the chelae not armed with two inner spines. However, *Munidopsis* sp. has four spines on the gastric area and three on the cardiac area, which are within the range found for *M. bairdii*.

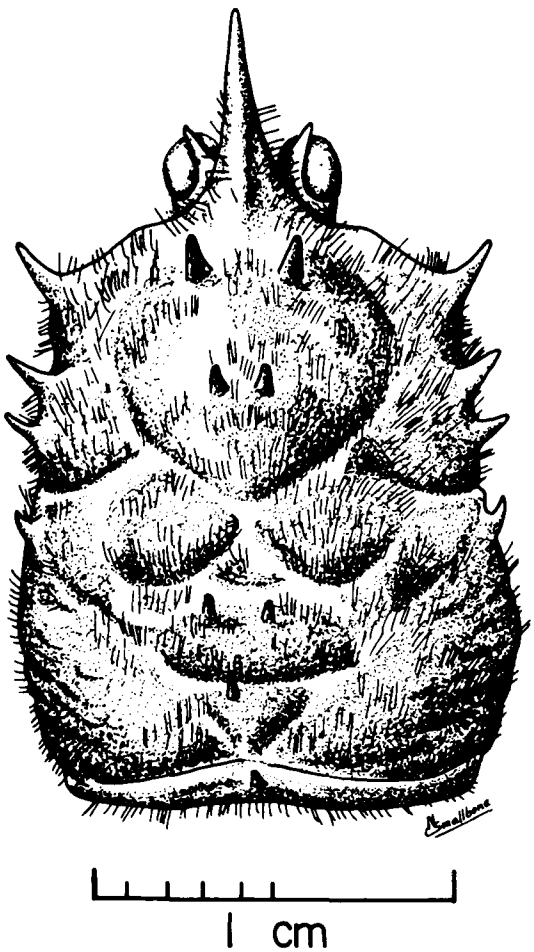

FIGURE 3.—*Munidopsis* sp. (similar to *Munidopsis bairdii*) USNM 171345, dorsal view of carapace.

Distribution.—*Munidopsis* sp. has only been collected from the lower continental slope at 1,829 m, which does not overlap with the depth range of *M. bairdii* (2,377-2,940 m).

Munidopsis ciliata Wood-Mason 1891

Munidopsis brevimana Henderson 1885:414 (original description); Henderson 1888:154 (redescription), pl. 17, fig. 1, 2.

Munidopsis ciliata Wood-Mason 1891:200 (original description); Faxon 1895:84 (synonymy with *M. brevimana*, comparison with *M. nitida*); Faxon 1895:81-82 (*M. ciliata* because genus synonomy caused prior usage of *M. brevimana*), pl. 18, fig. 3.

Material.—MCZ 4540, female, 27 mm CL, *Albatross* stn 3392, 7°5.5′ N, 79°40.0′ W, 2,324 m; MCZ 4541, male, 19 mm CL, *Albatross* stn 3393, 7°15.0′ N, 79°37.0′ W, 1,867 m; USNM 171342, female, 13 mm CL, stn CP-1-A, 45°55.3′ N, 125°36.1′ W, BMT 194, 2,030 m; USNM 171343, 13 specimens, stn CP-2-A, 45°52.5′ N, 126°40.8′ W, BMT 154, 2,666 m; OSUBI 00188, male, 15 mm CL, stn CP-1-E, 44°39.8′ N, 125°36.4′ W, BMT 184, 2,875 m; OSUBI 00189, 33 specimens, stn CP-2-D, 44°53.7′ N, 126°33.4′ W, BMT 162, 2,774 m; OSUBI 01581, females, 16 mm CL, stn CP-2-A, 45°48.3′ N, 126°28.2′ W, BMT 158, 2,651 m; OSUBI 01578, female, 12 mm CL, stn CP-2-C, 45°18.6′ N, 126°31.5′ W, BMT 265, 2,750 m.

Comparative material.—*Munidopsis nitida*: USNM 21287, female, 21 mm CL, *Albatross* stn 2140, 17°36.2′ N, 76°46.1′ W, 1,768 m. *Munidopsis verrilli*: Holotype, USNM 20556, female, 22 mm CL, *Albatross* stn 2923, 32°40.5′ N, 117°31.5′ W, 1,504 m.

Remarks.—The Oregon specimens differ from the *Albatross* specimens by the shorter, stouter spines on the carapace and legs; shorter setae covering the carapace and legs; rostrum with a narrower base; and no extra spine between the anterolateral and antennal spines, as sometimes occurs in the *Albatross* specimens (Figure 4). A small ventral spine occurs behind the large inner eye-spine on the Oregon specimens. Carapace sculpturing is similar in all specimens. I conclude that the observed differences are racial or varietal rather than specific. All specimens are from the Indian and Pacific Oceans.

Munidopsis ciliata is closely related to *M. nitida* Milne-Edwards, but has a more sculptured carapace. Faxon (1895) suggested the differences may be racial or varietal rather than specific. *Munidopsis nitida* has only been found in the Atlantic Ocean (Milne-Edwards 1880; Pequegnat and Pequegnat 1970). Because of the distinct differences in carapace sculpture, I consider *M. ciliata* and *M. nitida* to be separate species.

Both *M. ciliata* and *M. nitida* are closely related to *M. verrilli* Benedict, but differ in that *M. verrilli* has no epipods on the chelipeds or walking legs, whereas *M. ciliata* and *M. nitida* have epipods on only the chelipeds; *M. verrilli* has two spines on the crest of the chela and two spines on the inner edge of the merus of the cheliped, whereas *M. ciliata* and *M. nitida* do not; *M. verrilli* does not

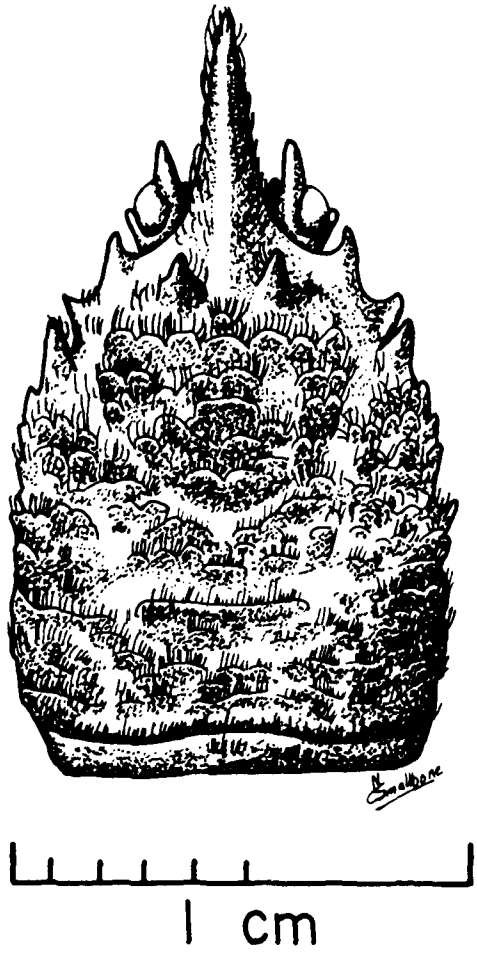

FIGURE 4.—*Munidopsis ciliata*, dorsal view of carapace.

have an inner spine on the third segment of the antennae, which is present in *M. ciliata* and *M. nitida*; and the cheliped is 1.5 times as long as the carapace length in *M. verrilli*, but about the same length in *M. ciliata* and *M. nitida*.

Distribution.—*Munidopsis ciliata* occurs in the eastern part of Cascadia Basin from 2,030 to 2,875 m, off Panama (Faxon 1895) and off the Arrou Islands, Indonesia, (Henderson 1888) in the Pacific Ocean, and the Bay of Bengal, Indian Ocean (Wood-Mason 1891; Alcock 1901). It occurs deeper than *M. verrilli*, which has only been reported off California from San Diego to the Pioneer Seamount at depths of 805-1,618 m (Goodwin 1952). No *M. verrilli* have been found at these depths off Oregon. Goodwin (1952) found *M. verrilli* on rock samples. In one beam trawl (BMT 162) off the Oregon coast, a log was collected at 2,724 m on which there were 33 *M. ciliata*, 67% of the total *M. ciliata* caught.

Munidopsis yaquinensis n. sp. (Figure 5)

Material.—Holotype, USNM 171340, female, 17.4 mm CL, stn CP-3-A, 45°57.1′ N, 127°32.9′ W, BMT 321, 2,763 m; Paratypes: OSUBI 01583, 6 males, 12-13 mm CL, stn CP-1-A, 45°56.5′ N, 125°52.5′ W, BMT 251, 2,377 m.

Diagnosis.—A small species, 12-17 mm CL; large spatulate rostrum with strong carina, small stout eyespines hidden by rostrum; carapace with no spines but covered with small transverse ridges; antennal and anterolateral points of front carapace margin separated by semicircular margin; ambulatory legs with strong anterodorsal carinae.

Description.—Rostrum wide, spatulate, with crenulated edges, base of rostrum with notch around cornea; dorsal surface of rostrum sparsely covered with setae, strong dorsal median carina from anterior part of rostrum to center of gastric area, median carina not extending to tip of rostrum; ventral surface of rostrum covered with small setae and with central ridge; length, 4.9 mm.

Carapace length (17.4 mm) greater than anterior carapace width (8.3 mm), posterior carapace width (11.5 mm), or largest width of carapace (12.2 mm); frontal margin with antennal and anterolateral points separated by semicircular border; lateral margins without spines, forming raised rounded margin; single ridge at posterior border, unarmed; carapace surface covered by small ridges with setae on anterior side, ridges strongly transverse except for those on anterior branchial regions, two larger ridges with crenulated edges on anterior gastric area.

Sternum covered by very small ridges with long setae.

Abdomen unarmed, covered with setae, very slight ridges on somites two and three.

Ocular peduncle movable, with a small, stout, inner eyespine covered by rostrum, eyespine a little longer than length of unpigmented cornea.

Basal segment of antennular peduncle with small anterodorsal spine and anteroventral, jagged, stout tooth.

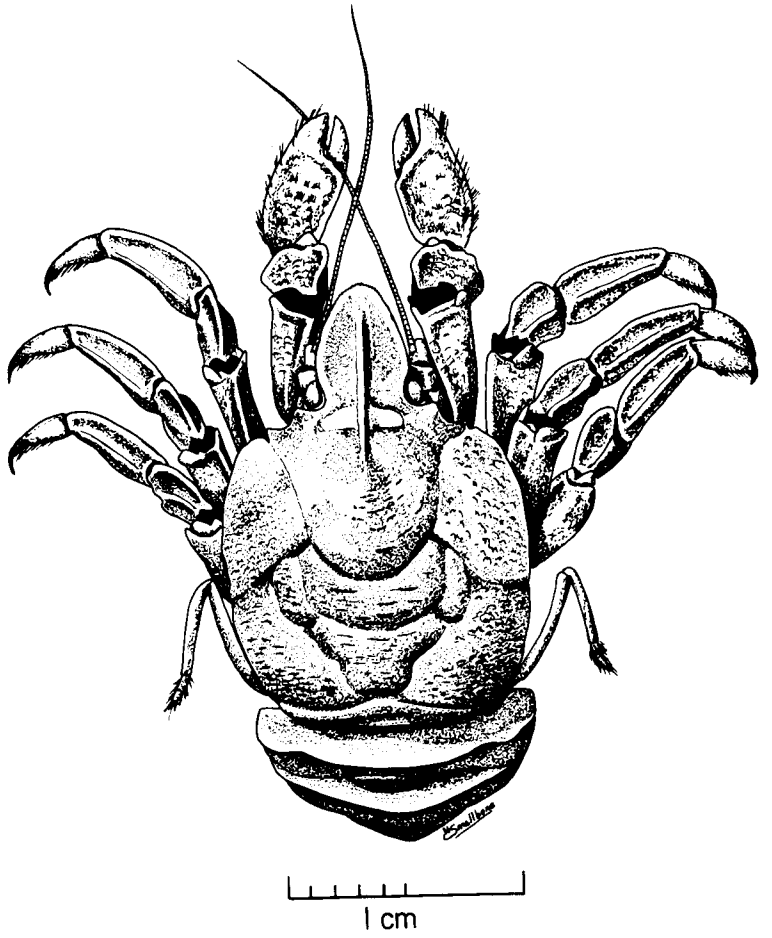

FIGURE 5.—*Munidopsis yaquinensis*, new species, female holotype, dorsal view.

Basal segment of antennal peduncle with two stout teeth; second, third, and fourth segments without teeth or spines; anterior fourth segment with outer rounded extension.

Inner margin of third maxilliped smooth.

Chelipeds with epipodites, chelipeds covered with very small ridges with setae, carpus with strong inner ridge, merus triangular with strong dorsal ridge, right finger length 47% of chela length (6.4 mm), right cheliped length 19.0 mm. Pereiopods without epipodites, covered sparsely with only short setae; propodus, carpus, and merus triangular in cross section, with prominent ridges on anterodorsal side.

Remarks.—The seven Oregon specimens are similar in all important characteristics, with the exception of an OSUBI 01583 specimen, which has an extra long, apparently deformed, rostrum with notched sides.

Munidopsis yaquinensis differs distinctly from all other known species. It most closely resembles *M. platirostris* (Milne-Edwards and Bouvier 1897) and *M. livida* (Pequegnat and Pequegnat 1971).

Etymology.—*Munidopsis yaquinensis* is named for the Oregon State University oceanographic ship RV *Yaquina*.

Distribution.—Occurs at 2,763 and 2,377 m in Cascadia Basin.

Munidopsis cascadia n. sp. (Figure 6)

Material.—Holotype, USNM 171338, female, 54 mm CL, stn CP-1-E, 44°35.5′ N, 125°35.4′ W, OTB 112, 2,810 m; Paratypes: USNM 134658, male, 45 mm CL, stn CP-1-E, 44°46.2′ N, 125°01.8′ W, OTB 49, 2,800 m; USNM 171339, female, 38 mm CL, stn CP-2-A, 45°59.1′ N, 126°40.1′ W, BMT 256, 2,743

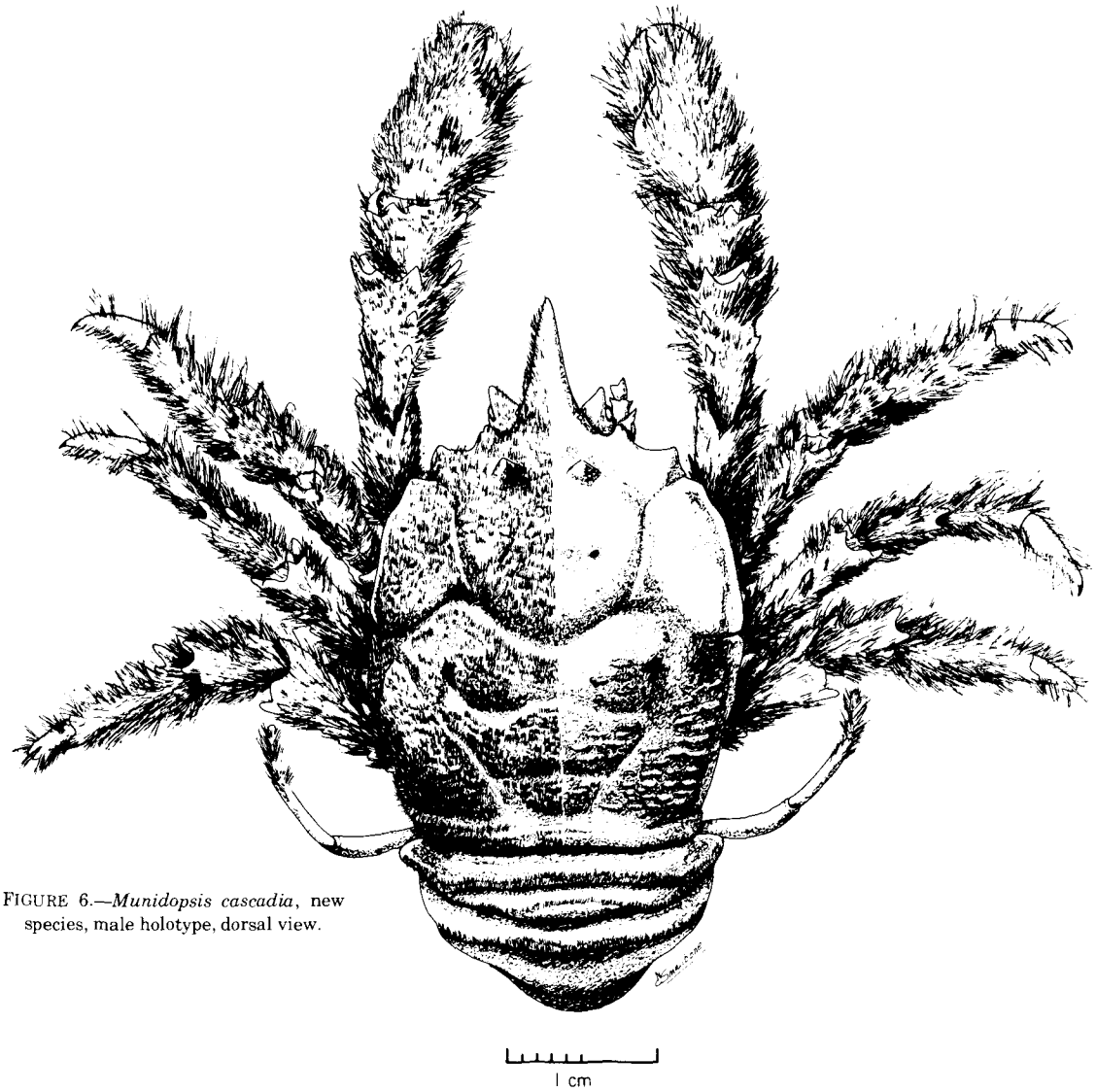

FIGURE 6.—*Munidopsis cascadia*, new species, male holotype, dorsal view.

m; OSUBI 00177, male, 51 mm CL, stn CP-1-E, 44°32.3′ N, 125°41.6′ W, OTB 77, 2,975 m; OSUBI 00178, gravid female, 37 mm CL, stn CP-1-E, 44°48.8′ N, 125°36.4′ W, BMT 287, 2,743 m; OSUBI 00179, male, 27 mm CL, stn CP-2-D, 44°53.7′ N, 126°33.4′ W, BMT 162, 2,884 m; OSUBI 00180, gravid female, 47 mm CL, stn CP-1-D, 44°55.4′ N, 125°40.6′ W, BMT 187, 2,760 m.

Comparative material.—Munidopsis bermudezi holotype, MCZ 10231, female, 38 mm CL, stn 2967, 19°43.5′ N, 74°57.5′ W, 2,434-3,020 m.

Diagnosis.—Moderate size (27-54 mm CL); carapace and legs densely covered with setae; stout eyespine on immovable eye stalk; two stout gastric spines; lateral margins of carapace smooth and slightly convex; resembles *Munidopsis bermudezi*.

Description.—Carapace length longer than wide, posterior width slightly greater than anterior width; strong antennal and anterolateral teeth separated by semicircular margin, a blunt tooth distal to anterolateral tooth, another blunt tooth at end of cervical groove; lateral margins raised

and slightly convex; pair of large, blunt, gastric spines, one pit behind each gastric spine, each pit surrounded by a small bare area; dorsal carapace surface densely covered with setae except for bare spots posterior to pits on gastric area, on cervical groove, and on anterior boundary of cardiac region; with setae removed dorsal surface fairly smooth except for rounded tubercles of posterior branchial area; one blunt ridge at unarmed posterior margin.

Rostrum 22% of carapace length, triangular in dorsal view, horizontal in lateral view, covered with setae, bluntly carinate dorsally.

Abdomen densely pubsecent, unarmed; second, third, and fourth somites with two blunt transverse ridges.

Sternum with few setae and small tubercles; with transverse setose ridge opposite legs.

Eyestalks immovable; long, stout, pubescent internal eye spine much longer than diameter of the cornea.

Basal segment of antennular peduncle with one long spine midventrally, one long spine middorsally, and an inner toothed process.

Basal segment of antennal peduncle covered with setae, bearing outer ventral tooth and stout, inner, ventral spine. Second segment with large, outer, ventral spine and small, inner, ventral tooth.

Inner margin or merus of third maxilliped has three main spines, the posterior two have two points.

Cheliped shorter than carapace length; densely pubescent; epipods on chelipeds only; ischium with dorsal and ventral spine at meral articulation and a ventral row of six to seven small spines (including spine at meral articulation); merus with five spines at carpal articulation, dorsal row of six spines (including spine at carpal articulation), and two spines on the inner margin; carpus with four spines at chela articulation and one spine on inner dorsal surface; chela without spines.

Remarks.—Paratypes differ only slightly from holotype (Table 3). The chelipeds of four paratypes (USNM 134658, USNM 171339, OSUBI 00177, and OSUBI 00178) are relatively longer than those of the holotype and two other paratypes (OSUBI 00179 and OSUBI 00180), as shown by the ratio of carapace length to cheliped length in Table 3. In two specimens (OSUBI 00180 and USNM 134658), the lateral carapace margins posterior to the cervical groove have jagged edges instead of being smooth. The number of spines on the inner edge of the merus of the third maxilliped is constant except for one maxilliped of USNM 134658.

The number of spines on the cheliped segments is usually constant. Only the holotype has five spines at the carpal-meral articulation—the paratypes have four. There are four to five spines of the dorsal row on the merus; usually there are four on the paratypes. The number of spines on the ventral row of the ischium is variable, ranging from three to six. The dorsal inner spine on the carpus is always present, but is greatly reduced on paratype OSUBI 00179, and on OSUBI 00177 there are two spines.

A rhizocephalan parasite is present under the abdomen of USNM 171339.

Munidopsis cascadia was compared with the type of *M. bermudezi*. *Munidopsis cascadia* has stouter, blunter gastric spines, no spines on the lateral margin of the carapace, convex rather than a straight lateral margin of the carapace, and more pubescence.

Etymology.—*Munidopsis cascadia* is named from Cascadia Basin since all the specimens were found there.

Distribution.—Only seven specimens of *M. cascadia* are known, all from Cascadia Basin at 2,743-2,926 m. *Munidopsis bermudezi* has only been found in the Atlantic Ocean (Chace 1942;

TABLE 3.—Morphometry of *Munidopsis cascadia*.

Measurement (mm)	USNM [1]171338	USNM 134658	USNM 171339	OSUBI 00177	OSUBI 00178	OSUBI 00179	OSUBI 00180
Carapace length	54	45	38	51	37	27	47
Rostrum length	14	13	10	15	9	8	13
Anterior carapace width	36	21	18	23	17	12	23
Posterior carapace width	38	27	25	32	24	16	36
Cheliped length	43	41	33	49	35	22	37
Chela length	21	19	14	24	12	10	17
Carapace length/cheliped length	1.26	1.10	1.15	1.04	1.06	1.23	1.27

[1]Type-specimen.

Sivertson and Holthuis 1956; Pequegnat and Pequegnat 1970; Laird et al. 1976).

Munidopsis beringana Benedict 1902

Munidopsis beringana Benedict 1902:279 (original description), fig. 23.

Material.—USNM 134659, male 32 mm CL, male, 29 mm CL, female, 29 mm CL, stn Coos Bay #A, 43°17.3′ N, 125°49.3′ W, OTB 76, 3,000 m; OSUBI 00175, female, 31 mm CL, stn CP-2-E, 44°40.8′ N, 126°26.5′ W, OTB 48, 2,800 m; OSUBI 00176, male, 23 mm CL, stn CP-3-D, 44°53.5′ N, 127°27.5′ W, BMT 332, 2,826 m; 20 uncataloged specimens, no ovigerous females.

Remarks.—Three Oregon specimens (USNM 134659) were compared with Benedict's syntypes at the USNM by Henry B. Roberts.[2] He found considerable variation between the Oregon specimens and the syntypes regarding number of spines on the gastric area, length and spacing of the rugae on the carapace, and number of spines on the lateral edges of the carapace and on the meri of the chelipeds. The rugae of the Oregon specimens are, in general, shorter, more prominent, and more widely separated than the rugae of Benedict's specimens from the Bering Sea. The number of spines on the gastric area of the Oregon specimens varied from 4 to 17, on the lateral edge of the carapace from 2 to 4, and on the meri of the chelipeds from 7 to 12.

Distribution.—*Munidopsis beringana* was obtained in the deeper portions of Cascadia Basin from 2,800 to 3,041 m, on Tufts Plain from 3,354 to 3,990 m, and in the Bering Sea at *Albatross* stn 3603, 3,276 m (Benedict 1902).

Munidopsis tuftsi n. sp. (Figure 7)

Material.—Holotype, USNM 171336, male, 70 mm CL, stn TP-3, 44°40.8′ N, 133°26.3′ W, BMT 233, 3,717 m; Paratypes: USNM 171337, male, 36 mm CL, stn TP-4, 44°31.1′ N, 134°43.8′ W, OTB 334, 3,858 m; OSUBI 00181, male, 62 mm CL, stn TP-3, 44°39.8′ N, 133°37.2′ W, BMT 232, 3,724 m; OSUBI 00183, gravid female, 67 mm CL, stn TP-7, 44°58.0′ N, 133°14.5′ W, BMT 302, 3,500 m; OSUBI 01582, male, 15 mm CL, stn TP-6, 44°59.8′ N, 132°12.1′ W, BMT 302, 3,585 m.

Comparative material.—*Munidopsis crassa*: USNM 8563, female 45+ mm CL, *Albatross* stn 2224, 36°16.5′ N, 68°21′ W, 4,710 m; USNM 10803, female, 43 mm CL, *Albatross* stn 2573, 40°34.3′ N, 66°09′ W, 3,188 m; USNM 19289, male 44 mm CL, *Albatross* stn 2566, 37°23′ N, 68°08′ W, 4,795 m. *Munidopsis aculeata*: USNM 21277, male 39 mm CL, *Albatross* stn 3382, 6°21.0′ N, 80°41.0′ W, 3,281 m. *Munidopsis subsquamosa*: See *M. subsquamosa*.

Diagnosis.—Medium-sized species, 36-70 mm CL; triangular rostrum with small lateral spines; long eyespines; carapace wider posteriorly than anteriorly, covered with tubercles, first lateral spine not much larger than anterolateral spine; similar to *Munidopsis crassa*.

Description.—Rostrum triangular, bearing six (two right, four left) small spines laterally on distal half, upturned distally, dorsal median carina; dorsal surface with small tubercles; ventral surface smooth; length 26% of carapace length.

Carapace longer than wide, anterior width and length measured between first lateral spines less than posterior width; frontal margin bearing antennal spines, anterolateral spine on hepatic region with three spinules. First lateral spine on anterior lobe of branchial region with spinules on anterolateral spine. Several (five or six) small spines on lateral edge behind first lateral spine. Gastric area covered by crenulated tubercles bearing setae; six main spines—four at the base of the rostrum, two posterior to these—and numerous slightly smaller spines, smooth spaces between spines and tubercles. Cardiac and posterior branchial areas with crenulated transverse ridges bearing setae, smooth between ridges. Posterior margin unarmed, double ridge of small tubercles.

Sternum smooth, except for scattered setae on bumps and lateral ridges with many setae on top.

Abdomen spineless, covered with tubercles; ridges on somites two to four.

Ocular peduncle slightly moveable, extends beyond unpigmented cornea as stout inner spine, about twice the length of diameter of cornea, spinule on inner side of cornea.

Basal segment of antennular peduncle with one long slender spine midventrally; one long slender

[2]Henry B. Roberts, Senior Museum Specialist, U.S. National Museum, Washington, DC 20560, pers. commun. July 1970.

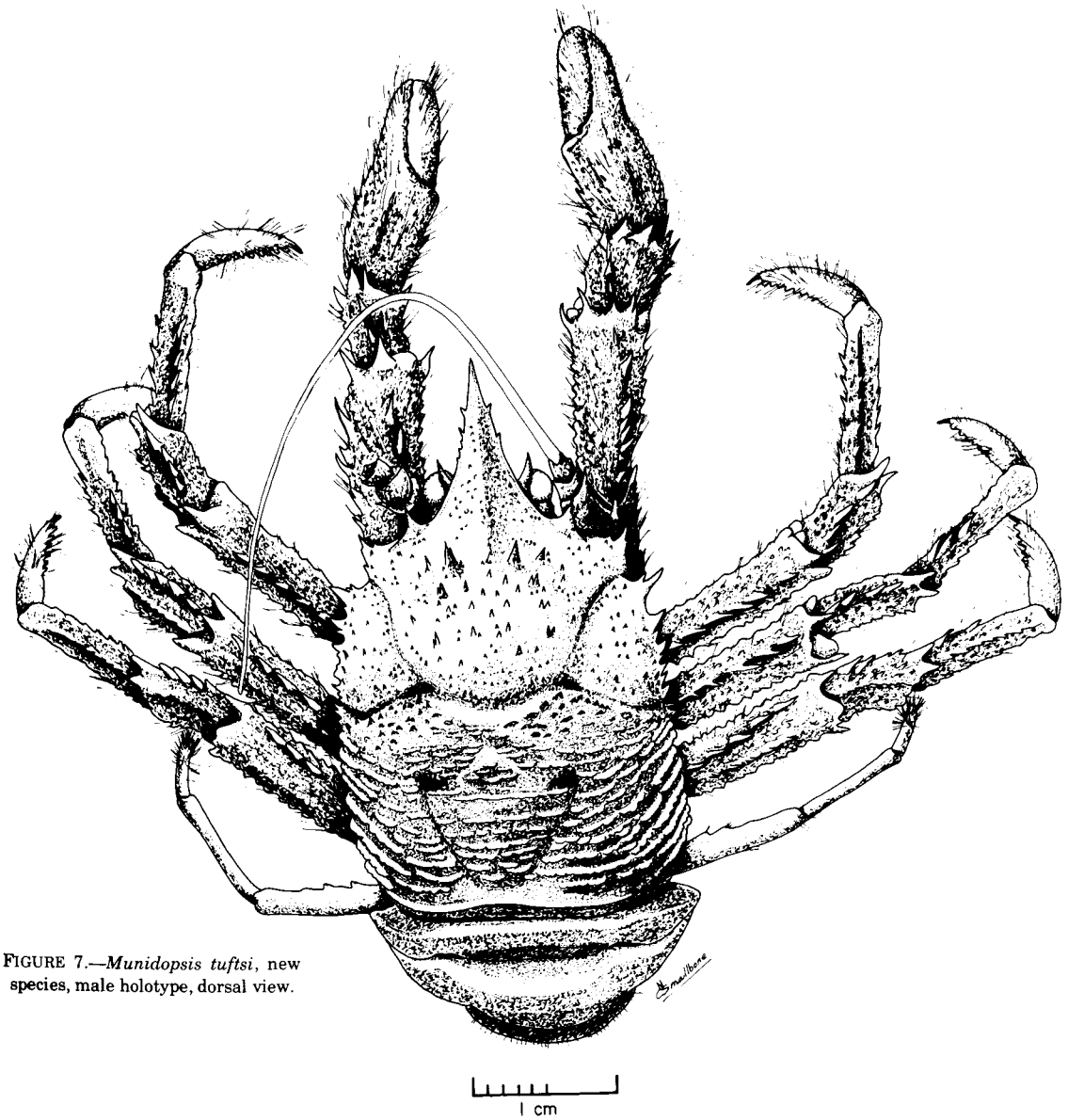

FIGURE 7.—*Munidopsis tuftsi*, new species, male holotype, dorsal view.

spine middorsally; a rounded, toothed process on inner side; and spinule on outer side.

Basal segment of antennal peduncle with two stout ventral spines. Second segment with outer spines and a small dorsal tooth. Third segment with four spines: inner, outer, and smaller dorsal and ventral spines. Fourth segment with two small, blunt, dorsal processes.

Inner margin of merus of third maxilliped with four main spines, plus several spinules.

Chelipeds with epipods. Chelipeds covered with setae and small tubercles, chela bears no major spines; carpus with five small spines at distal edge, and two rows of dorsal spines; merus with three to five small spines at distal edge, row of six to nine spines on dorsal surface, and two inner spines on left merus. Ambulatory legs without epipods, covered with setae and tubercles, and with spines on carina of propodus, carpus, and merus.

Remarks.—The three paratypes vary from the holotype in the number and presence of spinules

and spines. Both the holotype and OSUBI 00181 have spinules on the inner side of the ocular peduncle; OSUBI 00183 has no inner spinule but has an outer spinule; USNM 171337 has no spinules on the ocular peduncle. The number of small spines on the rostrum varies from two to seven with the smallest specimen having only two spines. Paratypes USNM 171337 and OSUBI 00183 have very few spinules on the anterolateral and first lateral spines compared with the other two specimens. The number of spines on the inner margin of the third maxilliped varies from two to four. The specimens are similar in the ornamentation of the carapace and in their proportions (Table 4).

Munidopsis tuftsi belongs to a species complex including *M. crassa, M. aculeata*, and *M. subsquamosa*. These species can be separated by observing several characteristics (Table 5). In this complex, *M. tuftsi* most closely resembles *M. crassa*, but differs in having a narrower anterior carapace and narrower width between first lateral spines compared with the posterior carapace width; anterolateral and first lateral spines of the same size; and small spines on the lateral edges of the rostrum. Although *M. tuftsi* has some characteristics in common with *M. aculeata* and *M. subsquamosa*, it has a distinctly more spinous ornamentation on the carapace. A very small specimen of *M. tuftsi*, OSUBI 01582, differs from the larger specimens only in the smoother carapace ornamentation and a larger ratio for anterior carapace width/posterior carapace width (Table 5). The ratio of cornea diameter divided by eyespine length is quite variable for *M. subsquqmosa*, but is usually between 0.46 and 0.55 for *M. crassa* and *M. tuftsi*.

Etymology.—*Munidopsis tuftsi* is named for Tufts Plain where all specimens were collected.

Distribution.—The four specimens of *M. tuftsi* were collected from Tufts Plain at depths of 3,500-3,858 m. *Munidopsis crassa*, the most similar species, has only been found from the Atlantic Ocean (Laird et al. 1976).

TABLE 4.—Morphometry of *Munidopsis tuftsi*.

Measurement (mm)	USNM 171336[1]	OSUBI 00181	USNM 171337	OSUBI 00183	OSUBI 01582
Carapace length	70	62	36	[2]67	14.8
Rostrum length	18	17	9	[2]16	4.2
Rostrum length/carapace length	0.26	0.27	0.25	0.24	0.27
Anterior carapace width	30	29	18	32	7.6
Posterior carapace width	41	37	22	42	8.2
Width between first lateral spines	38	36	21	42	8.2
Right cheliped	84	69	43	76	14.1

[1]Holotype.
[2]Rostrum broken at tip.

Munidopsis subsquamosa Henderson 1885

Munidopsis subsquamosa Henderson 1885:414 (original description); Henderson 1888:152 (redescription), pl. 16, fig. 4.

Munidopsis subsquamosa Henderson var. *pallida* Alcock 1894:331 (original description); Alcock 1901:268 (redescription).

Munidopsis geyeri Pequegnat and Pequegnat 1970:149 (original description).

TABLE 5.—Morphometric ratios and spination that distinguishes *Munidopsis tuftsi, M. crassa, M. aculeata*, and *M. subsquamosa*.

Characteristics	*M. tuftsi*[1]	*M. crassa*[2]	*M. aculeata*[3]	*M. subsquamosa*[4]
1. Chela length/carapace length	0.41-0.44	0.42-0.45	0.65	0.37-0.46
2. Anterior carapace width/posterior carapace width	0.73-0.93	[5]0.90	0.92	0.80-0.98
3. Width between first lateral spines/posterior carapace width	0.93-1.00	1.03-1.13	1.05	1.07-1.25
4. Cornea length/eyespine length	0.48-0.55	0.36-0.49	0.89	0.52-0.82
5. First lateral spine compared with anterolateral spine	Same size	Larger	Same size	Larger
6. Armature on lateral edges of rostrum	Small spines	Minute teeth, none	None	Minute teeth and small spines
7. Rostrum turned up sharply	No	No	Yes	No
8. Number of spines on gastric area	2-6	2-4	6	2-12
9. Ornamentation on gastric area	Tubercles with blunt teeth	Tubercles with blunt teeth	Sparsely covered with small scalelike tubercles	Densely covered with large scalelike tubercles
10. Geographic distribution	Tufts Plain	Off North Carolina, SE of Martha's Vineyard, SE of Georges Bank	Gulf of Panama	Gulf of Panama, Cascadia Basin, Gulf of Mexico, Carribbean

[1]USNM 171336 (holotype), USNM 171337, OSUBI 00181, OSUBI 00183, OSUBI 01582.
[2]USNM 9563 (holotype; measurements from Smith (1885) because holotype is in poor condition), USNM 19289, USNM 10803.
[3]USNM 21277.
[4]USNM 21314 (holotype), USNM 171348, OSUBI 00185, OSUBI 00186, OSUBI 00187, *M. geyeri*—USNM 299042, TAMU 2-0574, TAMU 2-0575.
[5]Unknown for holotype.

Material.—Munidopsis subsquamosa: Holotype, USNM 21314, female 20 mm CL, *Albatross* stn 3361, 6°10.0′ N, 83°6.0′ W, 2,692 m; USNM 171348, male, 57 mm CL, stn Coos Bay #A, 43°17.3′ N, 125°49.3′ W, OTB 76, 3,000 m; OSUBI 00185, male, 70 mm CL, stn CP-3-C, 45°12.0′ N, 127°32.5′ W, BMT 324, 2,809 m; OSUBI 00186, female with parasite, 41 mm CL, stn NAD 20A, 44°30.1′ N, 125°24.3′ W, OTB 64, 2,772 m; OSUBI 00187, male, 23 mm CL, stn CP-1-E, 44°31.3′ N, 125°35.5′ W, OTB H-1, 2,736 m; OSUBI 00184, male with isopod parasite, stn CP-1-E, 44°40.5′ N, 125°40.0′ W, OTB 18, 2,850 m; 46 uncataloged specimens from off Oregon, smallest ovigerous female 54 mm CL.

Comparative material.—Munidopsis geyeri: Holotype, USNM 128812, male, 25 mm CL, *Alaminos* stn 69-A-11-92, 23°30′ N, 95° W, 2,928-3,001 m; TAMU 2-0574, female, 38 mm CL, male, 47 mm CL, *Alaminos* stn 70-A-10-48, 14°29.5′ N, 74°28.8′ W, 4,154 m; TAMU 2-0575, male, 46 mm CL, male, 18 mm CL, *Alaminos* stn 70-A-10-50, 15°50′ N, 77°24.5′ W, 2,654-2,791 m.

Remarks.—Munidopsis geyeri found in the Caribbean and Gulf of Mexico is here synonymized with *M. subsquamosa* from the Pacific and with *M. subsquamosa* var. *pallida* from the Indian Ocean. When compared with closely related species (*M. tuftsi, M. aculeata,* and *M. crassa*), *M. geyeri* and *M. subsquamosa* are identical (Table 5). *Munidopsis subsquamosa* and *M. aculeata* have similar carapace ornamentation, but with *M. subsquamosa* the scalelike tubercles are larger and closer together. The two species are also distinguished by characteristics 1, 3, 5, and 7 of Table 5. *Munidopsis crassa* and *M. tuftsi* have smaller, more spiny tubercles on the carapace and usually have longer, stouter eyespines than *M. subsquamosa*.

The distinctions given by Pequegnat and Pequegnat (1970) to distinguish *M. geyeri* from *M. subsquamosa*, and other taxonomic charcteristics were examined on the Oregon specimens of *M. subsquamosa*, the holotype of *M. subsquamosa*, and five specimens of *M. geyeri*, including the holotype. The range of variations of these characteristics for the Oregon specimens included those found for *M. geyeri*, except for the number of teeth on the lateral edges of the rostrum (Table 6). With the addition of the Oregon specimens, the maximum size and range of variation of *M. subsquamosa* is extended. Mayo (1974), who collected three specimens of *M. geyeri*, proposed that *M. geyeri* might become a synonym of *M. subsquamosa* when more material was available.

Alcock (1894, 1901) stated that *M. subsquamosa* var. *pallida* differs from *M. subsquamosa* by the former having only two spines on the gastric area of the carapace. Henderson (1885) did not state how many gastric spines the holotype has; I found only two.

Five of the Oregon female specimens have rhizocephalan parasites on the ventral side of the abdomen. Two other specimens had isopod parasites under the carapace on the posterior branchial area.

Distribution.—Munidopsis subsquamosa occurs mainly in the eastern part of Cascadia Basin from 1,829 to 3,000 m. This species is cosmopolitan, since it has also been collected at 3,431 m off Yokohama, Japan (Henderson 1888), 1,471 and 1,672 m off Panama (Faxon 1895), 3,299 m in the Bay of Bengal (Alcock 1894, 1901), 2,938-3,001 m in the southwest Gulf of Mexico (Pequegnat and Pequegnat 1970), 4,154 m in the Colombian Basin (Pequegnat and Pequegnat 1971), 2,790-2,650 m south of Jamaica (Pequegnat and Pequegnat 1971), and 3,111-3,496 m off Haiti (Mayo 1974).

Munidopsis verrucosus Khodkina 1973

Munidopsis verrucosus Khodkina 1973:1156-1159 (original description), fig. 1, 2.

Material.—Munidopsis verrucosus, USNM

TABLE 6.—Selected spine counts for *Munidopsis geyeri* and *M. subsquamosa*.

Characteristic	*M. geyeri*		*M. subsquamosa*		
	Type USNM 289042 (n = 1)	TAMU 2-0574 TAMU 2-0575 (n = 4)	Type USNM 21314 (n = 1)	Oregon specimens (n = 20) Mean	Range
Number of spines on 3d maxilliped (total, right + left)	9	8-10	6	7.8	6-11
Total number of teeth on lateral edges of rostrum	18	7-19	6	3.1	0-6
Number of spines on gastric area of carapace	2	[1]2	2	4.8	2-12
Number of spines behind anterolateral spine of carapace (total, right + left)	4	4-8	2	9.2	4-12

[1] Gastric area of carapace cracked on one specimen.

171347, gravid female, 25 mm CL, Gorda Ridge, 40°13.4′ N, 126°30.0′ W, OTB 104, 4,260 m; OSUBI 00172, female, 26 mm CL, stn TP-9, 45°01.1′ N, 135°12.6′ W, BMT 308, 3,932 m.

Remarks.—The Oregon specimens are indistinguishable from those described by Khodkina (1973). *Munidopsis verrucosus* is very similar to *M. granosa*, but differs in having an epipodite on the cheliped, setae on the tubercles of the carapace, plumose setae on portions of the chelipeds and pereiopods, no small antennal tooth, and no dorsal carina on the rostrum.

Distribution.—Khodkina (1973) collected three male specimens of *M. verrucosus* (33.8 mm, 34.8 mm, and 40.6 mm CL) from the Atakamsky Trench off Antofagasta, Chile, at two stations (lat. 23°47.1′ S, long. 71°03.2′ W, 4,300 m, and lat. 23°15.1′ S, long. 71°39.1′ W, 4,880 m). The two Oregon specimens were also found at great depths—3,932 m on Tufts Plain and 4,194 m on Gorda Ridge off northern California. Alcock (1901) collected one male specimen of *Munidopsis granosa* from 2,812 m in the Bay of Bengal.

Munidopsis latirostris (Henderson) Faxon 1895

Elasmonotus latifrons. Henderson 1885:416 (original description); Henderson 1888:160 (redescription), pl. 19, fig. 1.

Orophorhynchus latifrons. Milne-Edwards and Bouvier 1894:287 (in key to *Orophorhynchus*).

Munidopsis latirostris. Faxon 1895:81-82, 99 (changed name because genus synonomy caused prior usage of *M. latifrons*).

Material.—USNM 21285, female, 15 mm CL, *Albatross* stn 3381, 4°56.0′ N, 80°52.5′ W, 3,243 m; MCZ 4563, female, 16 mm CL, *Albatross* stn 3391, 7°15.0′ N, 79°36.0′ W, 280 m; USNM 171341, 14 specimens, stn CP-1-E, 44°28.2′ N, 125°32.3′ W, OTB 50, 2,800 m; OSUBI 00190, 28 specimens, stn CP-1-E, 44°35.7′ N, 125°34.3′ W, OTB 155, 2,830 m; OSUBI 00191, gravid female, 23 mm CL, male, 22 mm CL, male, 20 mm CL, stn C-P-3E Channel, 44°41.2′ N, 127°21.2′ W, BMT 407, 3,041 m; 541 uncataloged specimens from off Oregon, smallest ovigerous female 18 mm CL.

Remarks.—The characteristics of the Oregon specimens agree with those of the USNM and the MCZ specimens, but differ slightly from the type description (Henderson 1888). The "two slightly rounded elevations" at the base of the rostrum on the gastric area are blunt spines in the observed specimens. The "faint median carina" on the rostrum is a definite rounded ridge extending from the end of the rostrum to the blunt gastric spines (Figure 8).

The following observations are added to Henderson's description of *M. latirostris*. The basal segment of the antennular peduncle is swollen with two outer spines. The basal segment of the antennal peduncle has an outer tooth and an inner spine; the second segment has an outer stout tooth. The meri of the ambulatory legs have dorsal ridges with setae on the anterior side. Epipods are present on the chelipeds only.

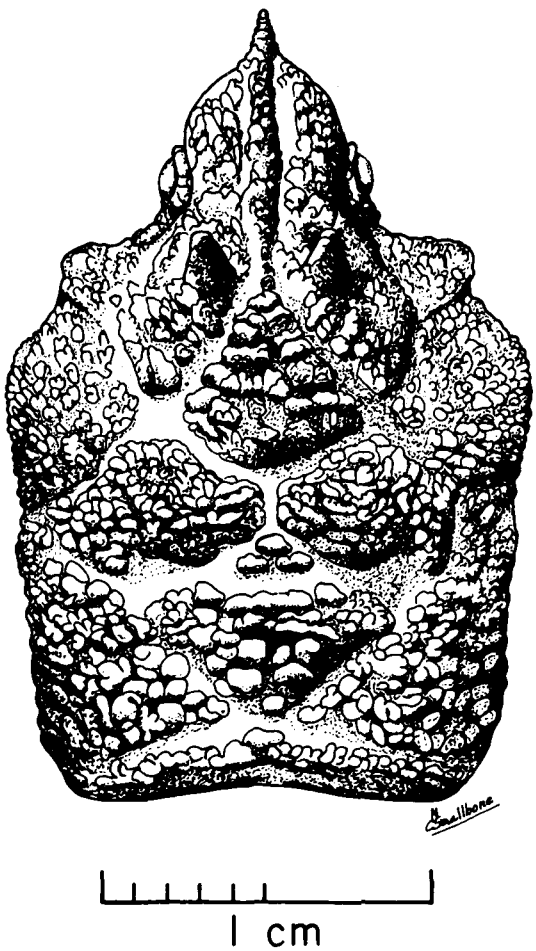

FIGURE 8.—*Munidopsis latirostris*, dorsal view of carapace.

In all specimens examined, the ocular peduncle extends beyond the eye as a blunt spine, although Benedict (1902) does not consider it an eyespine in his key. On the carina of the second, third, and fourth abdominal somites, there are slight median projections. Benedict (1902) considers these projections "armature on the abdomen confined to the median line."

The main variation of the Oregon and *Albatross* specimens is in the shape of the apex of the rostrum. Henderson (1888, plate XIX, figure 1) describes the rostrum as ending in an "acute apex," which is true for USNM 21285 and some of the Oregon specimens. In most of the Oregon specimens and MCZ 4563, the rostrum ends as a spine (Figure 9).

Rhizocephalan parasites occurred under the abdomen in 40 of 444 Oregon specimens; 23 hosts were females and 17 were males.

Distribution.—Munidopsis latirostris is the most abundant *Munidopsis* species found in Cascadia Basin, with a wide depth range, 1,900-3,021 m. This species has also been found in the tropical Pacific Ocean at 280 and 3,243 m off Panama (Faxon 1895) and at 1,958 m between Papua and Admiralty Islands (Henderson 1888).

VERTICAL AND GEOGRAPHIC DISTRIBUTION OF THE SPECIES

Twelve species of *Munidopsis* were captured in 51% or 146 of the total number of tows. Collections from both otter and beam trawls are included in the distributional analysis for more complete coverage. Although samples from otter trawls have been considered quantitative (number per hour trawled, Haedrich et al. 1975), beam trawls were designed to be more quantitative, giving number per square meter (Carey and Heyamoto 1972). Carney (1976) questioned the reliability of beam trawl data for area covered and expressed abundance as number per trawl for samples with similar wheel readings. In this paper, abundances are expressed as average number per trawl (number of specimens/number of trawls towed) because beam and otter trawls were towed for approximately the same time. Some specimens which can escape through 1.3 cm mesh liners are not sampled adequately. Adult densities of small species such as *M. ciliata, M. quadrata,* and *M. yaquinensis*, and immature individuals of the other species are probably underestimated. Immature specimens included *M. subsquamosa, M. latirostris, M. bairdii, M. tuftsi*, and *M. beringana*.

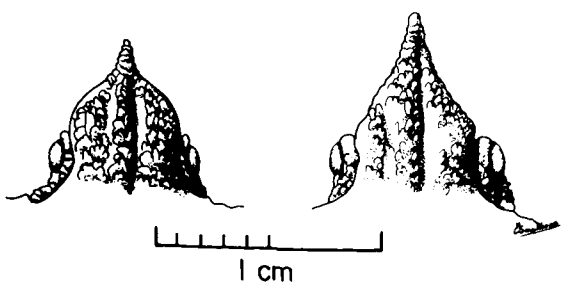

FIGURE 9.—*Munidopsis latirostris*, variation in rostrum, left rostrum ends as spine, right rostrum ends as acute apex.

Cascadia Basin off Oregon was probably the only area trawled adequately enough to sample all the species, since most species were collected at least several times there. The most abundant species, *M. latirostris*, contributed 73.0% of the total number of specimens. Three species together contributed 20.2% of the total: *M. bairdii* (7.5%), *M. ciliata* (6.2%), and *M. subsquamosa* (6.5%). These four species together represented 93.2% of all specimens, and were only found in Cascadia Basin. At the deepwater dumpsite stations in northern Cascadia Basin, all of the above except *M. ciliata* were collected. Five additional species (32 specimens) were also found on Cascadia Basin. Although 106 tows were taken on the continental slope off Oregon, only 5 tows yielded a total of three species (six specimens). Three species (17 specimens) were found on Tufts Plain (Table 7).

Abundances (number per trawl) for all *Munidopsis* species were about the same for the base of the continental slope (CP-1 line) and the CP-2 line (Table 7). However, the relative abundance of species changed from east to west. *Munidopsis latirostris* was the most abundant on both the CP-1 and CP-2 lines. On the CP-1 line, *M. subsquamosa* was second in rank, but on the CP-2 line, *M. subsquamosa* was fourth, *M. ciliata* was second, and *M. bairdii* was third (Table 7).

Eight of the 12 *Munidopsis* species were collected in Cascadia Basin, especially below 2,250 m (Figure 10). The single sample from Gorda Ridge, south of Cascadia Basin, contained one specimen of the rare, deepwater form, *M. verrucosus*. *Munidopsis quadrata* was the only species occurring over a wide depth range on the continental slope. A single tow on the lower part of the continental slope contained *Munidopsis* sp. and *M. subsquamosa*.

TABLE 7.—Occurrence of *Munidopsis* species on the continental slope, Cascadia Basin, and Tufts Plain (Figure 1).

Species	Total	Continental slope	Base of continental slope (CP-1, CP-x)	Cascadia Basin (CP-2)	Cascadia Basin (CP-3, CP-4)	Northern Cascadia (DWD)	Tufts Plain (TP-A, TP-B, TP-C)	Gorda Ridge
	number of specimens collected							
M. latirostris	586	0	362	132	77	15	0	0
M. bairdii	60	0	8	45	4	3	0	0
M. ciliata	50	0	2	48	0	0	0	0
M. subsquamosa	52	1	24	15	1	11	0	0
M. beringana	25	0	7	2	5	0	11	0
M. cascadia	7	0	4	3	0	0	0	0
M. yaquinensis	7	0	6	0	1	0	0	0
M. quadrata	6	4	0	0	0	2	0	0
M. tuftsi	5	0	0	0	0	0	5	0
M. aries	2	0	0	1	1	0	0	0
M. verrucosus	2	0	0	0	0	0	1	1
Munidopsis sp.	1	1	0	0	0	0	0	0
Total no. of *Munidopsis* spp.	803	6	413	246	89	31	17	1
Mean no./trawl	2.8	0.1	5.1	6.5	2.3	3.1	0.9	1.0
Total no. of trawls	289	106	81	38	38	10	18	1
Percent trawls with *Munidopsis* spp.	51	5	70	87	79	60	78	trace

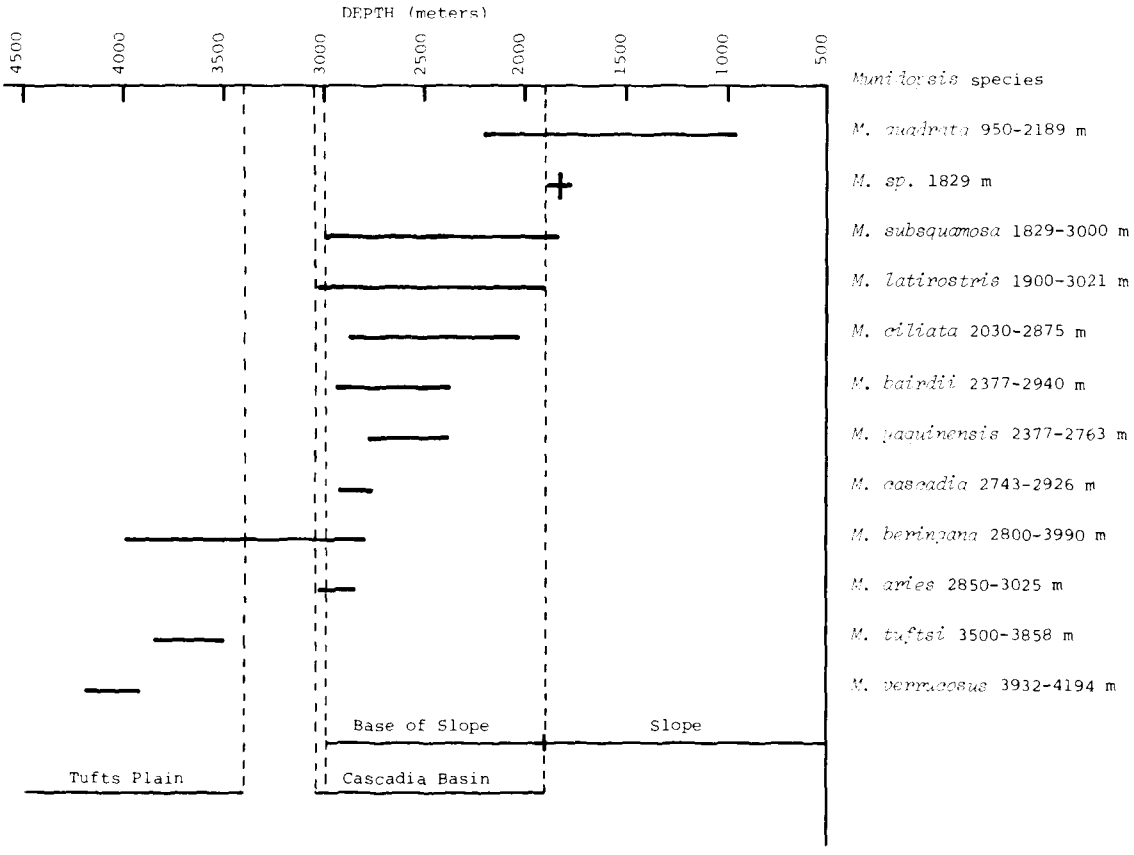

FIGURE 10.—Bathymetry of *Munidopsis* species from the continental slope, Cascadia Basin, and Tufts Plain off Oregon and Washington.

Four types of species distribution patterns emerge when all the stations on Cascadia Basin and Tufts Plain are considered (Figure 11). Two species, *M. latirostris* and *M. bairdii*, were found at most stations sampled in Cascadia Basin. The most abundant species, *M. latirostris*, was also the most widespread since it occurred at all but two of the Cascadia Basin stations. It occurred at

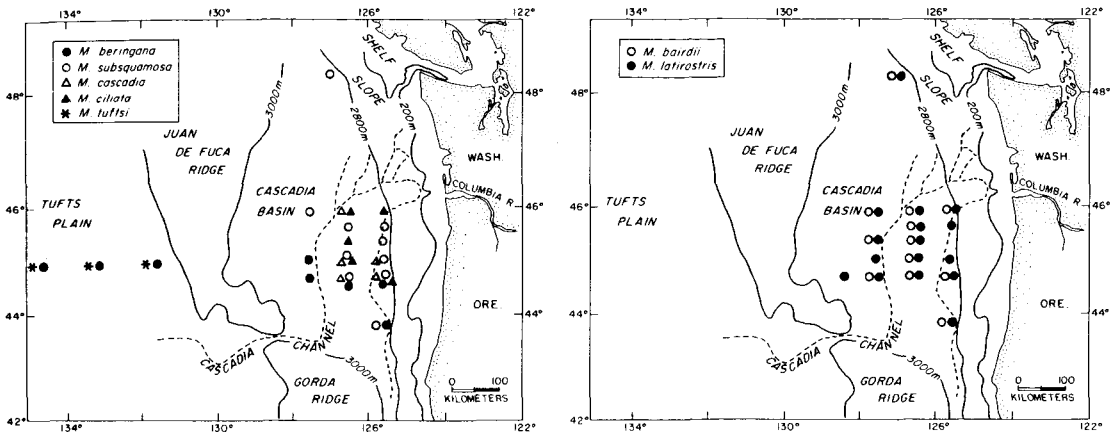

FIGURE 11.—Distribution of *Munidopsis* species off Oregon and Washington; upper—*M. cascadia, M. ciliata, M. tuftsi, M. subsquamosa,* and *M. beringana;* lower—*M. bairdii* and *M. latirostris.*

CP-4-E, the deepest and most western station on Cascadia Basin. Three species—*M. subsquamosa, M. cascadia*, and *M. ciliata*—occurred predominantly on the eastern side of Cascadia Basin. Only *M. beringana* was taken on both abyssal plains, notably occurring in Cascadia Basin only at the deeper, southern stations. Two species occurred only on Tufts Plain—*M. verrucosus* and *M. tuftsi.*

Carney (1976) found greater overlap in species distributions between Cascadia Basin and Tufts Plain for holothurians than for *Munidopsis* species. He described three basic distribution patterns: 1) present on Cascadia Basin but generally absent from the base of the continental slope, 2) present over all of Cascadia Basin extending to the eastern edge of Tufts Plain, and 3) present in the deepest and farthest offshore stations of Cascadia Basin and on Tufts Plain.

Two distributional studies of infauna on Cascadia Basin have shown great variation in species composition between different stations: Hancock's (1969) polychaete study along the CP-E line (Newport hydrographic line) and the gammarid amphipod study at stations CP-1-E and CP-3-E by Dickinson and Carey (1978). Carney (1976) showed that the species composition of polychaetes had greater variability between stations than that of the holothurians. Of the 20 most abundant gammarid amphipod species at the two Cascadia Basin stations, only 6 had similar abundances at both stations, and 10 species only occurred at one station (Dickinson and Carey 1978). Of the eight *Munidopsis* species I found on Cascadia Basin, only three occurred at both CP-1-E and CP-3-E. In all three groups (polychaetes, amphipods, galatheid crabs), there are differences in species composition between stations on either side of Cascadia Basin, which Dickinson and Carey (1978) suggested may be caused by decreasing sedimentation rates with increasing distance offshore, since other environmental conditions are constant across Cascadia Basin.

Of 65 known abyssal species of *Munidopsis*, Doflein and Balss (1913) found that a high percentage (71%) are endemic to specific oceanic regions. Since many abyssal species have been described from single or few specimens, the percentage of endemism declines with further collecting. My collections off Oregon extended the geographic range of seven species, three of which were previously known from only one location: *M. beringana* from the Bering Sea, *M. aries* from the Caribbean, and *M. verrucosus* from off Chile.

The number of cosmopolitan *Munidopsis* species, those found in all three major oceans, is small (Doflein and Balss 1913). Only one of the Oregon species, *M. subsquamosa*, can be considered cosmopolitan. Seven of the Oregon species are found only in the Pacific Ocean; one is also found in the Indian Ocean (Table 8). However, four of the Pacific and Indian-Pacific species have sibling species in the Atlantic Ocean, evidence that at one time the progenitors had broader distributions.

The four most abundant species from Cascadia Basin have tropical Pacific affinities (Table 8). Only one species, *M. beringana*, has arctic affinities and is found in the deepest parts of Cas-

TABLE 8.—Geographic occurrences of *Munidopsis* species from Cascadia Basin and Tufts Plain (Milne-Edwards 1880; Smith 1884, 1886; Henderson 1888; Faxon 1895; Alcock 1901; Benedict 1902; Rathbun 1904; Kensley 1968; Pequegnat and Pequegnat 1970, 1971; Khodkina 1973; Mayo 1974; Laird et al. 1976).

	Eastern Pacific Ocean					World ocean			Sibling species[1]	
Species	Endemic	North America	Arctic	Tropical	Bipolar	Pacific	Indian and Pacific	Atlantic	Species	Ocean
M. aries								+	—	—
M. bairdii				+				+	—	—
M. beringana			+			+			—	—
M. cascadia	+					+			*M. bermudezi*	Atlantic (Laird et al. 1976)
M. ciliata				+			+		*M. nitida*	Atlantic (Pequegnat and Pequegnat 1970)
M. latirostris				+		+			—	—
M. quadrata		+				+			—	—
M. subsquamosa				+			+	+	—	—
M. tuftsi	+					+			*M. crassa*	Atlantic (Laird et al. 1976)
M. verrucosus					+	+			*M. granosa*	Indian (Alcock 1901)
M. yaquinensis	+					+			—	—

[1]Most similar species, as described in this paper.

cadia Basin and on Tufts Plain. *Munidopsis verrucosus*, another deepwater species, may have a bipolar distribution since its only other known occurrence is in the Peru-Chile trench. The three new species may be endemic, but two of them have sibling species in the Atlantic Ocean. *Munidopsis quadrata* is only found off the west coast of North America from Washington to Mexico. Of the five species occurring off California and Mexico (Schmitt 1921; Haig 1956), *M. quadrata* is the only one whose range extends north to Oregon and Washington.

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