Myodocopid Ostracoda of Pillar Point Harbor, Half Moon Bay, California

LOUIS S. KORNICKER
and
ELIZABETH HARRISON-NELSON

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY • NUMBER 593

SERIES PUBLICATIONS OF THE SMITHSONIAN INSTITUTION

Emphasis upon publication as a means of "diffusing knowledge" was expressed by the first Secretary of the Smithsonian. In his formal plan for the Institution, Joseph Henry outlined a program that included the following statement: "It is proposed to publish a series of reports, giving an account of the new discoveries in science, and of the changes made from year to year in all branches of knowledge." This theme of basic research has been adhered to through the years by thousands of titles issued in series publications under the Smithsonian imprint, commencing with *Smithsonian Contributions to Knowledge* in 1848 and continuing with the following active series:

Smithsonian Contributions to Anthropology
Smithsonian Contributions to Astrophysics
Smithsonian Contributions to Botany
Smithsonian Contributions to the Earth Sciences
Smithsonian Contributions to the Marine Sciences
Smithsonian Contributions to Paleobiology
Smithsonian Contributions to Zoology
Smithsonian Folklife Studies
Smithsonian Studies in Air and Space
Smithsonian Studies in History and Technology

In these series, the Institution publishes small papers and full-scale monographs that report the research and collections of its various museums and bureaux or of professional colleagues in the world of science and scholarship. The publications are distributed by mailing lists to libraries, universities, and similar institutions throughout the world.

Papers or monographs submitted for series publication are received by the Smithsonian Institution Press, subject to its own review for format and style, only through departments of the various Smithsonian museums or bureaux, where the manuscripts are given substantive review. Press requirements for manuscript and art preparation are outlined on the inside back cover.

I. Michael Heyman
Secretary
Smithsonian Institution

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY • NUMBER 593

Myodocopid Ostracoda of Pillar Point Harbor, Half Moon Bay, California

Louis S. Kornicker
and Elizabeth Harrison-Nelson

SMITHSONIAN INSTITUTION PRESS
Washington, D.C.
1997

ABSTRACT

Kornicker, Louis S., and Elizabeth Harrison-Nelson. Myodocopid Ostracoda of Pillar Point Harbor, Half Moon Bay, California. *Smithsonian Contributions to Zoology,* number 593, 53 pages, 28 figures, 6 tables, 1997.—Pillar Point Harbor, a small harbor formed in 1961 by construction of a breakwater in Half Moon Bay, California, in 1975 contained five species of benthic myodocopid Ostracoda. Analysis of the environment suggests that the distribution of individual species may, in part, have been affected by the substrate. Two new species, *Rutiderma apex* and *Euphilomedes morini,* are described and illustrated, and supplementary descriptions are provided for *Euphilomedes carcharodonta* (Smith, 1952) and *Postasterope barnesi* (Baker, 1978). The ontogenies of both species of *Euphilomedes* are described, and it is shown that juveniles of *E. morini* are capable of swimming, whereas those of *E. carcharodonta* are not. The abundance of the ostracodes in Pillar Point Harbor was greater than in many other continental bays for which abundances are known. Commensal protistans colonized carapaces of both species of *Euphilomedes* but not other species in the harbor.

OFFICIAL PUBLICATION DATE is handstamped in a limited number of initial copies and is recorded in the Institution's annual report, *Annals of the Smithsonian Institution.* SERIES COVER DESIGN: The coral *Montastrea cavernosa* (Linnaeus).

Library of Congress Cataloging-in-Publication Data
Kornicker, Louis S., 1919–
Myodocopid Ostracoda of Pillar Point Harbor, Half Moon Bay, California / Louis S. Kornicker and Elizabeth Harrison-Nelson.
p. cm. — (Smithsonian contributions to zoology ; no. 593)
Includes bibliographical references (p. 51).
1. Myodocopida—California—Half Moon Bay. I. Harrison-Nelson, Elizabeth. II. Title. III. Series.
QL1.S54 no. 593 [QL444.O85] 590 s–dc21 [595.3'3] 97-27398

∞ The paper used in this publication meets the minimum requirements of the American National Standard for Permanence of Paper for Printed Library Materials Z39.48—1984.

Contents

Myodocopid Ostracoda of Pillar Point Harbor, Half Moon Bay, California

Louis S. Kornicker
and Elizabeth Harrison-Nelson

Introduction

In 1961 Pillar Point Harbor was formed 32 km south of San Francisco by the construction of a breakwater that enclosed 245 acres (0.991 km^2) of Half Moon Bay, San Mateo County (Figure 1). A biological study of the harbor was made by personnel of the Marine Ecological Institute, Redwood City, California, during 1975 (Tuel et al., 1976). A few of the samples of myodocopid ostracodes that were collected at nine study stations (Figure 1) were submitted for identification or verification. In the report of 1976, five species were identified either only to genus or to both genus and species. One of the species, *Postasterope barnesi* (Baker, 1978), was later described by Baker (1978:139) from samples collected off southern California, and a supplementary description of that species is presented herein. Another of the species, *Asteropella slatteryi* Kornicker, 1981, was later described by Kornicker (1981:260) from the Pillar Point Harbor collection. A third new species, *Rutiderma apex*, is described herein. Two species, *Euphilomedes charcarodonta* (Smith, 1952) and *E. longiseta* (Juday, 1907) were not separated during the specimen counts made by the Marine Ecological Institute, and the total was presented as *Euphilomedes* spp. in Tuel et al. (1976:140). Because the original collection could not be found, in the ecological analysis herein, these counts are presented as *Euphilomedes* spp. According to Tuel et al. (1976:140), *E. charcarodonta* appeared to be more common than *E. longiseta*. A supplemental description of *E. charcarodonta* is presented herein. A closer study of the specimens that had been identified as *E. longiseta* revealed them to be a new species, *E. morini*, and it is described herein.

In addition to listing species counts at stations, Tuel et al. (1976:140, 141) briefly described the distribution of ostracodes in the harbor. They reported *Euphilomedes* spp. to be the most abundant of the benthic crustaceans and *Asteropella* sp. to be the sixth most common crustacean. In the present study the distribution of the ostracodes is considered in greater detail.

In addition to the collection from Pillar Point Harbor, some specimens collected north of San Francisco Bay, in Dark Gulch, Mendocino County, and in Tamales Bay, Marin County, are included in this study.

DISPOSITION OF SPECIMENS.—Specimens have been deposited in the collections of the former United States National Museum (USNM), now the National Museum of Natural History, Smithsonian Institution; these have been assigned USNM numbers.

ABBREVIATIONS.—In the figures, Arabic numerals indicate individual joints of each limb, and Roman numerals I–IV indicate the endites. The lettering of bristles of the 1st antenna are based on Skogsberg (1920:188). Arrows on illustrations indicate anterior of valve or specimen. The following abbreviations are used in illustrations and legends.

am	central adductor muscle attachments
ant	antenna
ap	anterior process
av	anterior view

Louis S. Kornicker, Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560. Elizabeth Harrison-Nelson, Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560.

Review Chairman: Austin B. Williams, National Marine Fisheries Service, Systematics Laboratory, Smithsonian Institution.
Reviewers: Brad L. Myers, Santa Ana, California; I.G. Sohn, Scientist Emeritus, U.S. Geological Survey, Reston, Virginia.

bas	basale
Bo	Bellonci organ
cx	coxale
dv	dorsal view
end	endopodite
epip	epipodite
esop	esophagus
ex	exopodite
fu	furca
gen	genital organ
gird	girdle
gl	gland
hrt	heart
im	inner margin of infold
iv	inside view
le	lateral eye
lft	left
ll	lower lip
lp	lamellar prolongation of selvage
lv	lateral view
me	medial eye
mls	medial longitudinal sclerite
mnd	mandible
mv	medial view
mx	maxilla
nabs	not all bristles shown
ov	outside view
precx	precoxale
prot	prodopodite
pv	posterior view
rt	right
s	shield
sens	sensory bristle of 5th joint of 1st antenna
ul	upper lip
vv	ventral view
Y-scl	Y-sclerite

ACKNOWLEDGMENTS.—We thank James R. Chess, Southwest Fisheries Center, Tiburon Laboratory, for supplying the specimens from Dark Gulch, Michael P. Wilderman, Marine Ecological Institute, for the specimens from Pillar Point Harbor, and Meredith L. Jones, Smithsonian Institution (retired), for specimens from Tomales Bay.

We are grateful to several people who assisted in the preparation of this paper: Carolyn Gast rendered shaded drawings of the carapaces; Jack Schroeder inked the penciled drawings of appendages. We appreciate the helpful comments of two reviewers; namely, Brad L. Myers and I.G. Sohn. We also thank Craig Warren, Smithsonian Institution Press, for editing and preparing the manuscript.

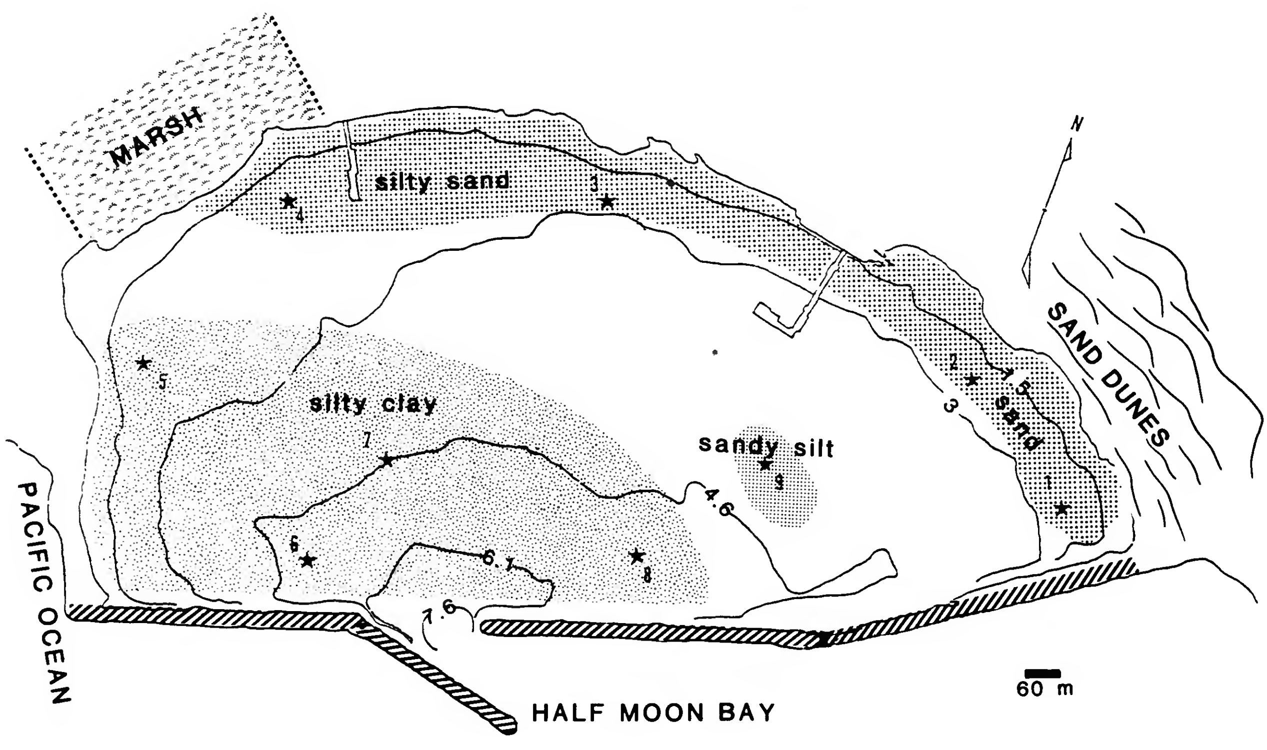

FIGURE 1.—Locations of stations 1–9 (black stars) and the distribution of bottom sediments in Pillar Point Harbor, California. Depth contours in meters; breakwater striated; map derived from Tuel et al. (1976, fig. 1).

Material and Methods

Material and methods are described in detail by Tuel et al. (1976:132) and are briefly summarized here. Sediment samples were collected March 13, 14, June 23, 25, September 10, 11, and December 1, 2, 1975. Unfortunately, the ostracode samples of March were lost. In the benthic survey three replicate samples were made with a Ponar grab (surface area 0.0596 m^2; jaws 15 cm in height). The grab sample was washed through a U.S. No. 30 sieve (mesh aperture 0.5 mm) and preserved in buffered 10% formalin. Organisms were later transferred to 70% ethyl alcohol, sorted to species, and counted. According to Tuel et al. (1976:133), "Differences in the number of organisms taken in the 3 grabs during each sampling period were assumed to represent real changes in the infauna populations and not variations in sampling success or patchiness of the populations." Plankton samples were collected with a #25 plankton net. All water depths were measured below mean low or low water.

Substrate and Environment

The following summary of the substrate and environment of Pillar Point Harbor is based mainly on Tuel et al. (1976). The crescent-shaped shore of the harbor enclosed sandy beaches except for a small marsh in the northwest corner (Figure 1). At the near-shore stations (sta 1–5), at depths of 1.8–2.4 m, the coarseness of the sediment decreased from east to west, from 82% sand at station 1 to 15% sand at station 5 (Figure 1; Table 1). Station 2 was in a kelp bed (Tuel et al., 1976:7). Cobbles were present at stations 3 and 5. The off-shore stations (sta 6–9) had a depth range of 4.3–5.2 m and a substrate of finer sediments than at most near-shore stations (sta 1–4) (Figure 1; Table 1).

Stations 2 and 3 were established near the mouths of Deer Creek and Dennison Creek, respectively. Station 4 was established in the vicinity of marsh outflow. The outflow of fresh water did not reduce the salinity below about 31 ppt at the 3 stations. The remaining stations (sta 6–9) were distant from fresh water inflows. During 1975 the salinity in the harbor ranged from 30.7 ppt to 36.4 ppt. The highest salinities (about 36 ppt) were encountered at stations 1 and 2 in July. Salinities were below 35 ppt at other stations, as well as at stations 1 and 2 during the months other than July.

The range of temperatures in the harbor during 1975 was 8.8°C to 16.0°C. Temperature fluctuations were greatest during the summer months mainly as the result of upwelling in the eastern Pacific Ocean bringing in colder water (Tuel et al., 1976:12). In the eastern Pacific Ocean adjacent to Pillar Point Harbor the southward flowing California Current continues from about February to November, then the strong northward Davidson Current replaces the California Current along shore. Thus, the June and September samples were collected during the southward flowing current, and the December samples were collected during the northward flowing current. According to Tuel et al. (1976:10), "The characteristics of the water in Pillar Point Harbor are greatly affected by the variations in the hydrographic conditions of the eastern Pacific Ocean."

The plankton samples that were collected in the summer months, which was during times of lowest water transparency, contained mostly diatoms, dinoflagellates, tintinnids, rotifers, and a large amount of organic detritus (Tuel et al., 1976:10). Winter samples had much less plankton, and the greater turbidity that occurred in the winter was probably the result of suspended sediments from seiche and storm action (Tuel et al., 1976:30). The entire composition of the plankton samples was not listed in Tuel et al. (1976), and ostracodes, if present, were not reported.

The bottom was studied by divers along two northerly-southerly transects: transect 1 began west of station 2, and transect 2 began east of station 5 and west of the marsh outflow; both transects terminated at the breakwater. Transect 1 passed through a kelp bed at 20 m from the sandy shore. The sandy bottom at the kelp bed changed to silty sand and then clayey silt covered by a red-brown film. The water at 100 m from shore became extremely turbid. On transect 2, at 100 m from shore,

TABLE 1.—Station parameters and average number of specimens of each species per square meter at each station in June, September, and December, 1975.

Sta	Depth	Sediment %*			*Rutiderma apex*†			*Asteropella slatteryi*†			*Euphilomedes* spp.†			*Postasterope barnesi*†		
	(m)	Sand	Silt	Clay	Jun	Sep	Dec	Jun	Sep	Dec	Jun	Sep	Dec	Jun	Sep	Dec
1	1.8	82	15	4	0	0	0	125	553	402	362	1462	1047	0	0	0
2	1.8	76	20	5	0	0	0	0	92	0	26	79	26	0	0	0
3	2.4	48	40	12	0	0	0	13	0	0	0	0	7	0	0	0
4	1.8	45	45	10	0	0	0	7	0	13	962	87	152	0	0	0
5	1.8	15	61	24	7	0	13	60	0	46	942	336	1054	92	40	178
6	5.2	3	68	29	20	33	20	40	0	53	613	303	1245	73	0	40
7	4.3	10	59	31	0	7	7	7	0	7	474	263	125	79	0	408
8	5.2	19	60	21	33	0	0	0	0	0	790	231	441	7	0	0
9	4.3	31	52	17	7	0	13	0	0	0	86	40	138	0	0	0

*From Tuel et al. (1976:165, table IV-2) rounded to nearest whole number.
†From Tuel et al. (1976:168–235, Appendix IV-A) rounded to nearest whole number.

the sandy beach changed to silty sand and then clayey silt with scattered cobbles and red-brown films. The central area of transect 2 contained much more algae than was present in the central area of transect 1, probably because of the availability of attachment sites on the rocks (Tuel et al., 1976:238). In deeper water the bottom had fewer rocks and appeared barren, and in October contained a large bed of "decaying drift algae." According to Tuel et al. (1976:238), "A conspicuous increase in the algal biomass and decrease in species was noted as the collections progresses further into the year."

Ostracode Distribution in Half Moon Bay

NEAR-SHORE STATIONS 1–5.—*Rutiderma apex* and *Postasterope barnesi* were present only in the clayey silt of station 5 (Figures 2, 3; Tables 1–3). *Euphilomedes* spp., except for being absent in June and September and sparse in December at station 2, were numerous at all near-shore stations (Figure 4; Tables 1, 2). The species were especially abundant in the sand at station 1 and clayey silt at station 5. *Asteropella slatteryi* was collected at all near-shore stations but was not present in all months, except at station 1 where it was abundant (Figure 5; Tables 1, 2).

OFF-SHORE STATIONS 6–9.—*Rutiderma apex* was collected at all off-shore stations, but except for station 6, the species was not collected in all months (Figure 2; Tables 1, 2). *Postasterope barnesi* was absent from station 9, and present at stations 6–8, but not in all months (Figure 3; Tables 1, 2). *Euphilomedes* spp. were abundant at all off-shore stations (Figure 4; Tables 1, 2). *Astropella slatteryi* was collected only at off-shore stations 6 and 7, but was absent from both stations in September (Figure 5; Tables 1, 2).

TOTAL HARBOR.—The average number of specimens of *R. apex* per square meter in the harbor for the months of June, September, and December remained about the same; more *A. slatteryi* were collected in September than in either June or December; fewer *Euphilomedes* spp. and *P. barnesi* were collected in September than in June or December; and more *P. barnesi* were collected in December than in either June or September (Table 1).

TABLE 2.—Average number of specimens of each species per square meter at each station during June, September, and December combined.*

Sta	*Rutiderma apex*	*Asteropella slatteryi*	*Euphilomedes* spp.	*Postasterope barnesi*
1	0	360	957	0
2	0	31	44	0
3	0	4	2	0
4	0	7	400	0
5	7	35	777	103
6	24	31	720	38
7	5	7	287	162
8	11	0	487	2
9	7	0	88	0

*From Table 1.

DISCUSSION OF DISTRIBUTION

Euphilomedes spp. are ubiquitous in the harbor (Figure 4); possibly the lower numbers at stations 2 and 3 are related to the presence of the mouths of fresh water streams near those stations; however, the salinities at both stations do not seem to differ enough from those at other stations to support that hypothesis. The relative abundances of *E. carcharodonta* and *E. morini* at each station is unknown. Because juveniles of *E. carcharodonta,* unlike those of *E. morini,* do not swim, they may prefer different environments. *Postasterope barnesi* and *R. apex* are more-or-less restricted to the southwestern quarter of the harbor in the general vicinity of the entrance (Figures 2, 3); possibly the influx of oceanic water into the harbor through the entrance exerts some control over the distribution of those species. *Asteropella slatteryi* occurs in the deeper water in the western part of the harbor as well as along its shoreline (Figure 5). After the specimens enter the harbor it is possible they are carried in a clockwise direction by currents and accumulate in the eastern corner (Sta 1), where they are abundant. *Euphilomedes* spp. also are present in large numbers at station 1 (Figure 4). The eastern corner of the harbor may represent a "dead spot" where specimens accumulate.

The histogram in Figure 6 shows the number of samples of

TABLE 3.—Number of samples with species at each station. (From Tuel et al., 1976, Appendix IV-A.)

Sta	*Rutiderma apex*			*Asteropella slatteryi*			*Euphilomedes* spp.			*Postasterope barnesi*			Total
	Jun	Sep	Dec	Jun	Sep	Dec	Jun	Sep	Dec	Jun	Sep	Dec	
1	0	0	0	3	3	3	3	3	3	0	0	0	18
2	0	0	0	1	3	0	0	3	1	0	0	0	8
3	0	0	0	1	0	0	0	0	1	0	0	0	2
4	0	0	0	1	0	2	3	1	3	0	0	0	10
5	1	0	2	3	0	3	3	3	3	3	1	3	25
6	2	2	2	3	0	3	3	3	3	1	0	2	24
7	0	1	1	1	0	1	3	3	3	3	0	3	19
8	2	0	0	0	0	0	3	2	3	1	0	0	11
9	1	0	1	0	0	0	2	2	3	0	0	0	9
Total	6	3	6	13	6	12	20	20	23	8	1	8	126

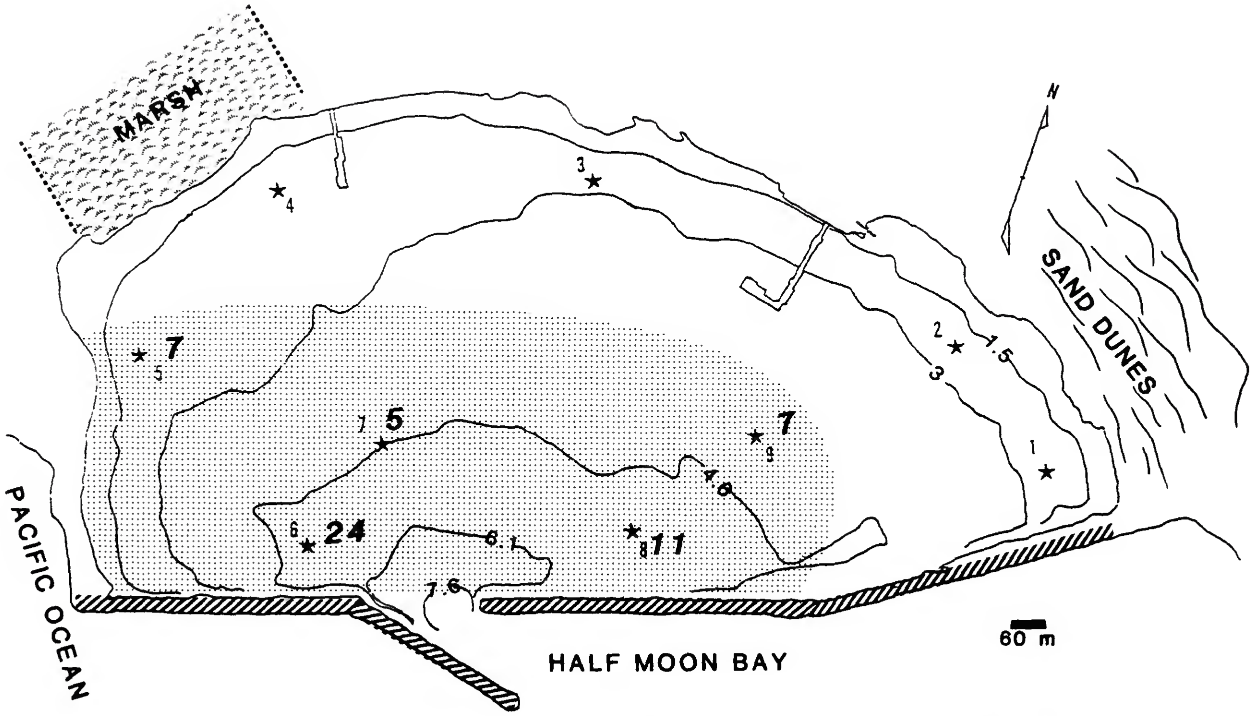

FIGURE 2.—Distribution of *Rutiderma apex*, new species, in Pillar Point Harbor, California. Depth contours in meters; station numbers indicated by small arabic numbers adjacent to stars; large italic numbers adjacent to stars indicate the number of specimens per square meter at each station based on combined samples collected in June, September, and December, 1975.

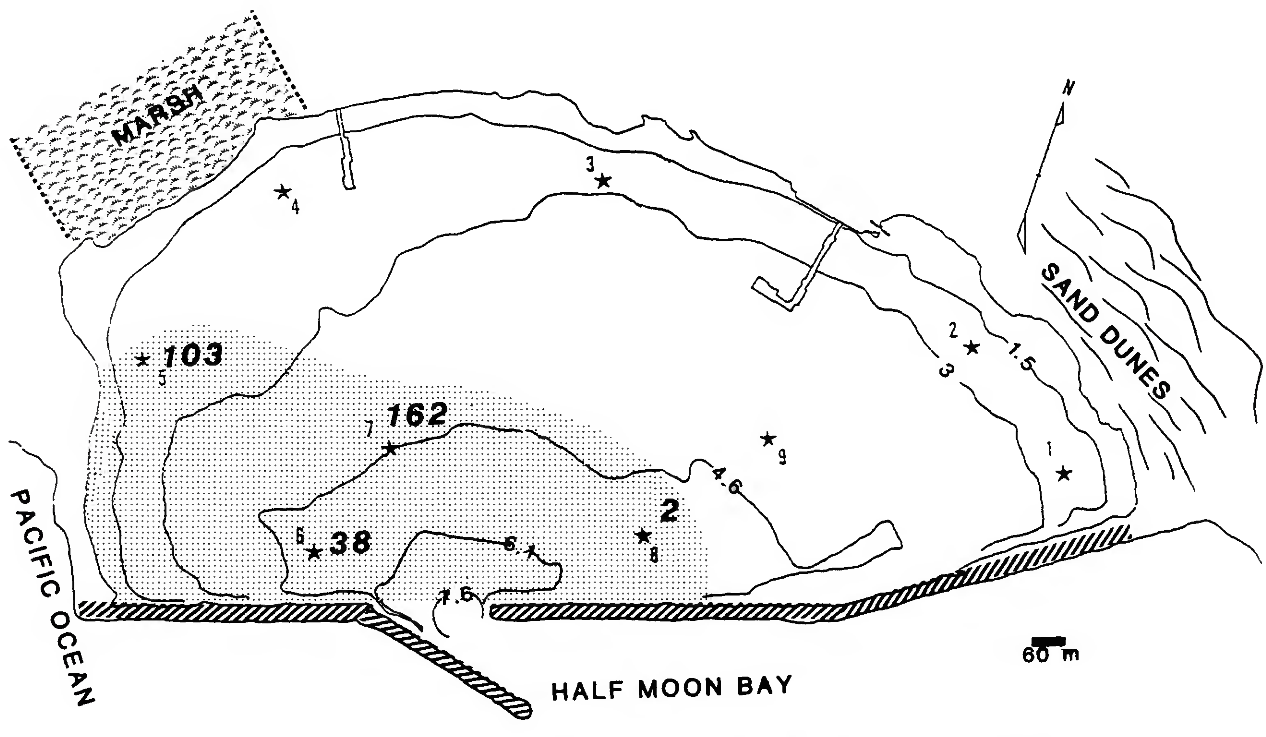

FIGURE 3.—Distribution of *Parasterope barnesi* in Pillar Point Harbor, California. The meaning of numbers is the same as in Figure 2.

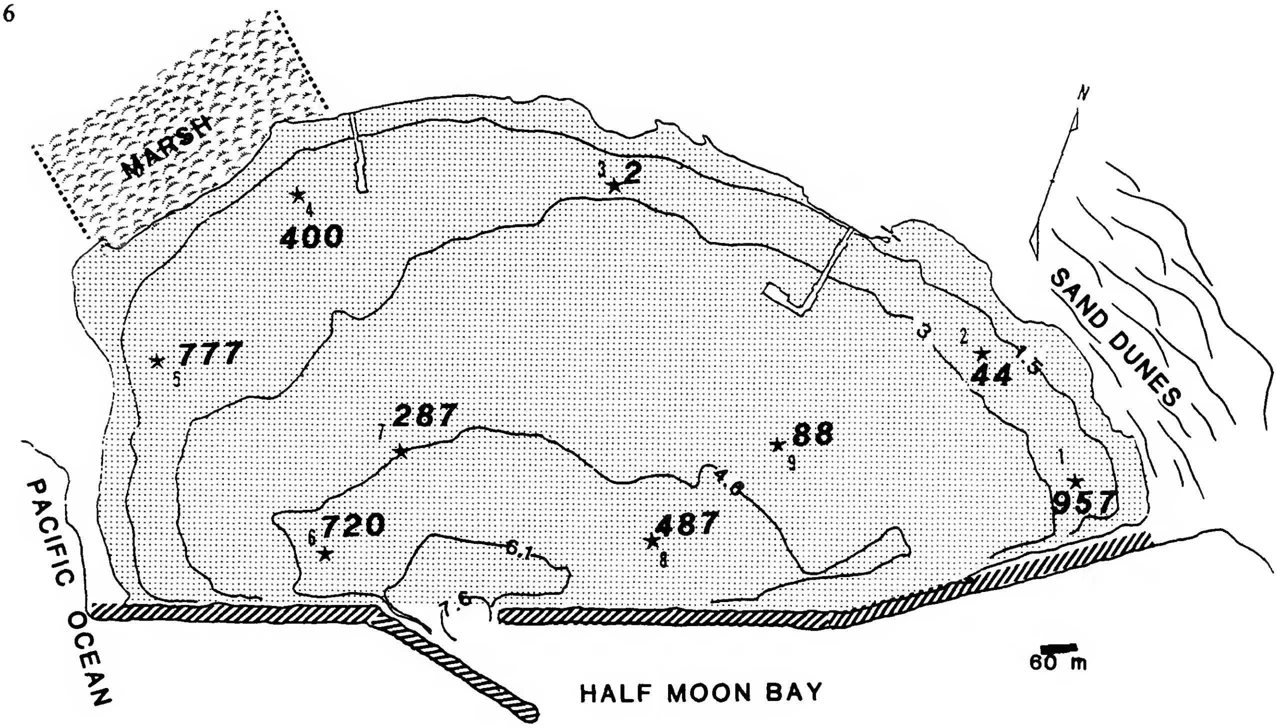

FIGURE 4.—Distribution of *Euphilomedes* spp. (total of *E. carcharodonta* and *E. morini*, new species) in Pillar Point Harbor, California. The meaning of numbers is the same as in Figure 2.

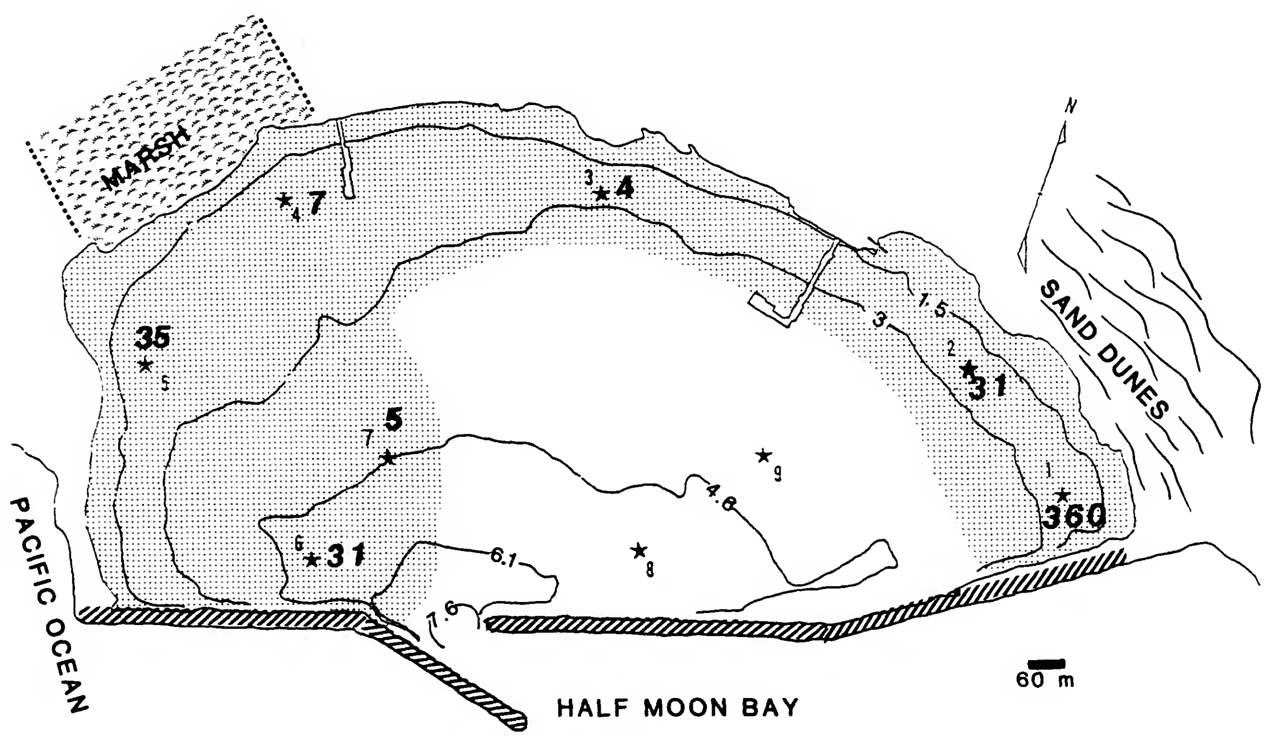

FIGURE 5.—Distribution of *Asteropella slatteryi* in Pillar Point Harbor, California. The meaning of numbers is the same as in Figure 2.

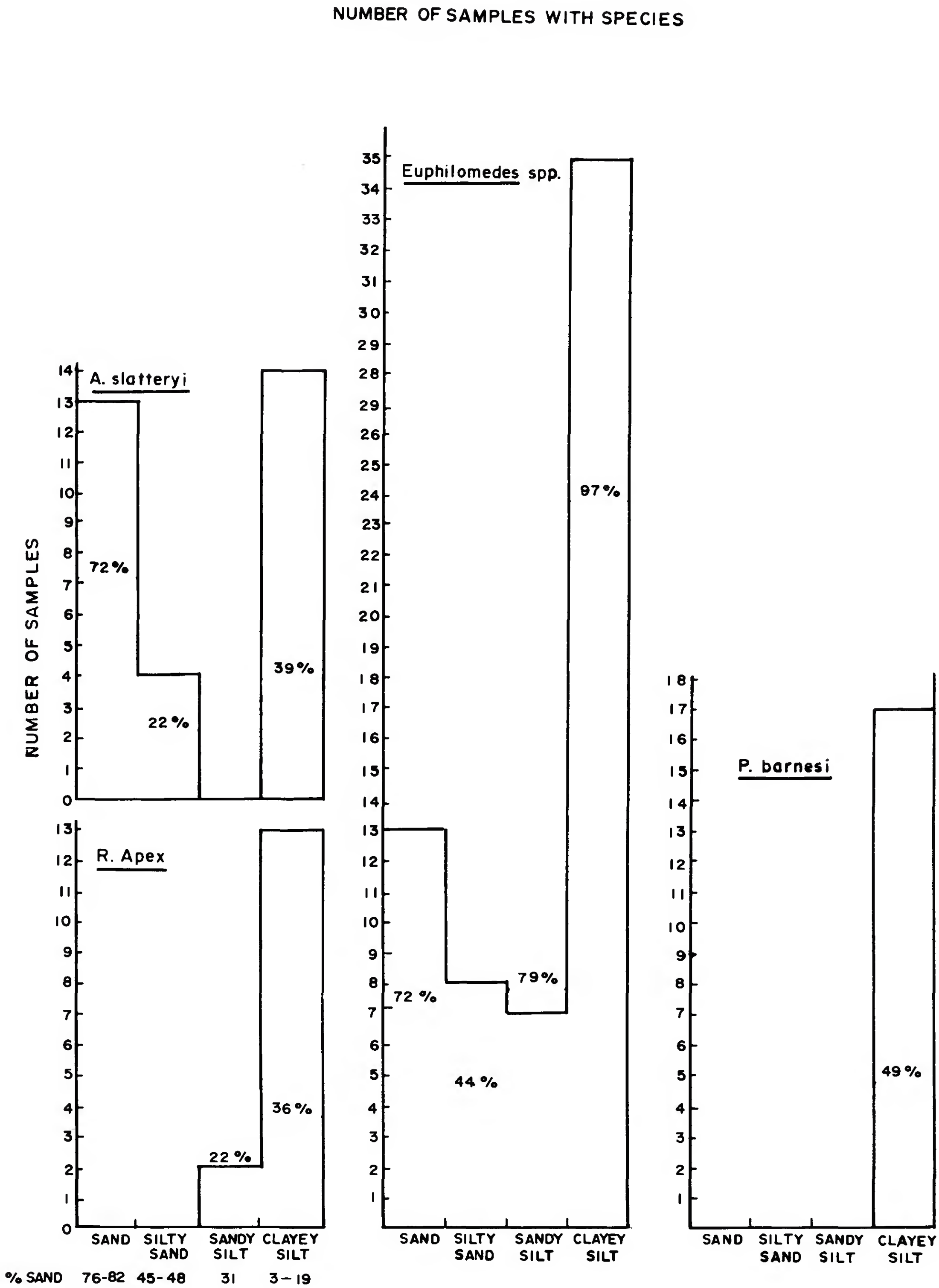

FIGURE 6.—Histogram showing the number of samples with *Asteropella slatteryi*, *Rutiderma apex*, *Euphilomedes* spp., and *Postasterope barnesi* (percent of samples with each species indicated within bars).

each sediment type containing a particular species (percent of samples containing the species shown in each bar), and Figure 7 shows the percent of samples of each sediment type containing a particular species. Clearly *R. apex* and *P. barnesi* are restricted to finer sediments. *Euphilomedes* spp. live on sediments of all types, and *A. slatteryi* has a bimodal distribution, being more numerous on sand and clayey silt substrates than on sediments of intermediate size.

Five species of ostracodes were collected in the harbor. The diversity at each station when samples for each month are combined (Table 2) differed depending on the substrate. Assuming (possibly incorrectly) that both species of *Euphilomedes* were present in samples containing the genus, three substrates, namely sand (sta 1, 2), silty sand (sta 3, 4), and sandy silt (sta 9), contained three species, whereas one substrate, clayey silt (sta 5–8), contained either four or five species.

The species distribution may be affected by the method of food gathering: *R. apex* is a carnivore, *Euphilomedes* spp. are detritus feeders, and *P. barnesi* and *A. slatteryi* are "filter feeders" (Cannon, 1933:756; Kornicker, 1975a:38). The histogram in Figure 8 shows the percentage distribution of the average number of specimens per square meter of each feeding type at each station. The detritus feeding *Euphilomedes* spp. were abundant at all stations and were dominant at all stations except stations 2 and 3, where the filter feeding *A. slatteryi* dominated. Filter feeders were present at all stations except station 9. The carnivore *R. apex* was present at stations 5–9, and was more abundant than filter feeders at station 8 as well as at station 9, where filter feeders were absent. Whereas *P. barnesi* was restricted to deeper water and fine sediments, *A. slatteryi* lived both in the deeper water in fine sediments as well as in shallow near-shore sands; because both species are filter feeders, it does not seem likely that their distribution was controlled by feeding type. Tuel et al. (1976:134, 135) gave the total number of organisms per square meter at each station: stations 1–4 had 1,869–11,490/m^2, and stations 5–9 had 13,223–21,850/m^2. Possibly, the larger number of organisms at stations 5–9 was a contributing factor to the presence of the carnivore *R. apex* at those stations.

The decrease in specimens of *A. slatteryi* and *Euphilomedes* spp. at some stations in September, and a concurrent increase at other stations, suggests that specimens may have migrated during that month. Specimens of *P. barnesi* were generally fewer in September, and as the species lived in the general vicinity of the entrance to the harbor, some may have left the harbor during that month. *Rutiderma apex* was absent from some stations during one month and from different stations during other months; the reason for this is not clear. The fact that the southward flowing California Current occurred during the June and September sampling, and the northward flowing Davidson Current during the October sampling, does not appear to have had an affect on the distribution of myodocopids in the harbor. The jutting breakwater at the opening to the harbor might divert organisms being carried by a southward current into the harbor, but this would probably have a greater affect on planktonics than on the primarily benthonic myodocopids.

Changes in abundance are often the result of the life cycle, with numbers increasing during the breeding season. The writers studied only a few samples and no attempt was made to determine variations in age classes during the months sampled. Because only three samples were collected at each station, no attempt was made to estimate sampling error. Also, because the samples were washed through a sieve with a mesh aperture of 0.5 mm, some early instars may have been lost. Clearly, more work is needed to understand the factors influencing the distribution of ostracode species in Pillar Point Harbor.

Myodocopa in Other Western North American Bay Areas

Juday (1907:143, 145, 149) reported *Cylindroleberis mariae* (Baird, 1850b), *Euphilomedes oblonga* (Juday, 1907) (= *Zeugophilomedes oblongus* (Juday, 1907)), and *Rutiderma rostratum* Juday, 1907, from San Diego Bay, California, but additional ostracode species also may live there.

In comprehensive studies, Lie (1968:271, tables 6–20, 1974:210), Lie and Kelley (1970:626), Lie and Kisker (1970:2279), and Lie and Evans (1973:125) found *E. carcharodonta* and *E. producta* Poulsen, 1962, to be dominant and *Rutiderma rostratum* Juday, 1907, and *Cylindroleberis mariae* (Baird, 1850b) common at certain stations in Puget Sound and vicinity, Washington.

Jones (1958:48) reported *Sarsiella tricostata* Jones, 1958 (= *Eusarsiella zostericola* (Cushman, 1906)), in San Francisco Bay, California. Kornicker (1975b:130) hypothesized that the San Francisco Bay population had been introduced with oysters transported from the east coast of the United States.

McKenzie (1965:57) reported six species from Scammon Lagoon, Baja California: *Asteropella scammonensis* McKenzie, 1965, *Rutiderma rostratum* Juday, 1907 (= *Rutiderma sp. indet.* Kornicker and Myers, 1981:4), *Rutiderma judayi* McKenzie, 1965, *Rutiderma californica* McKenzie, 1965 (= *Rutiderma rotundum* Poulsen, 1965), *Chelicopia kornickeri* McKenzie, 1965, and *Sarsiella* sp. McKenzie, 1965.

Kornicker (1977:165) gave the number of species found in bays along the Pacific coast including those in Half Moon Bay discussed herein, and noted that the number of species is greater in southern bays. The numbers of species were as follows: Departure Bay and Ganges Harbor, Vancouver Island, Canada, 2 spp.; Puget Sound, Washington, 4 spp. (Kornicker (1977:165) incorrectly omitted one species); Tomales Bay, California, 4 spp.; San Francisco Bay (probably an introduced population), 1 spp.; Pillar Point Harbor, Half Moon Bay, 5 spp.; Monterey Bay, 6 spp.; Bahia de San Quintin, Baja California, 6 spp.; Scammon Lagoon, Baja California, 6 spp. The specific composition is unknown at present for many of the above localities.

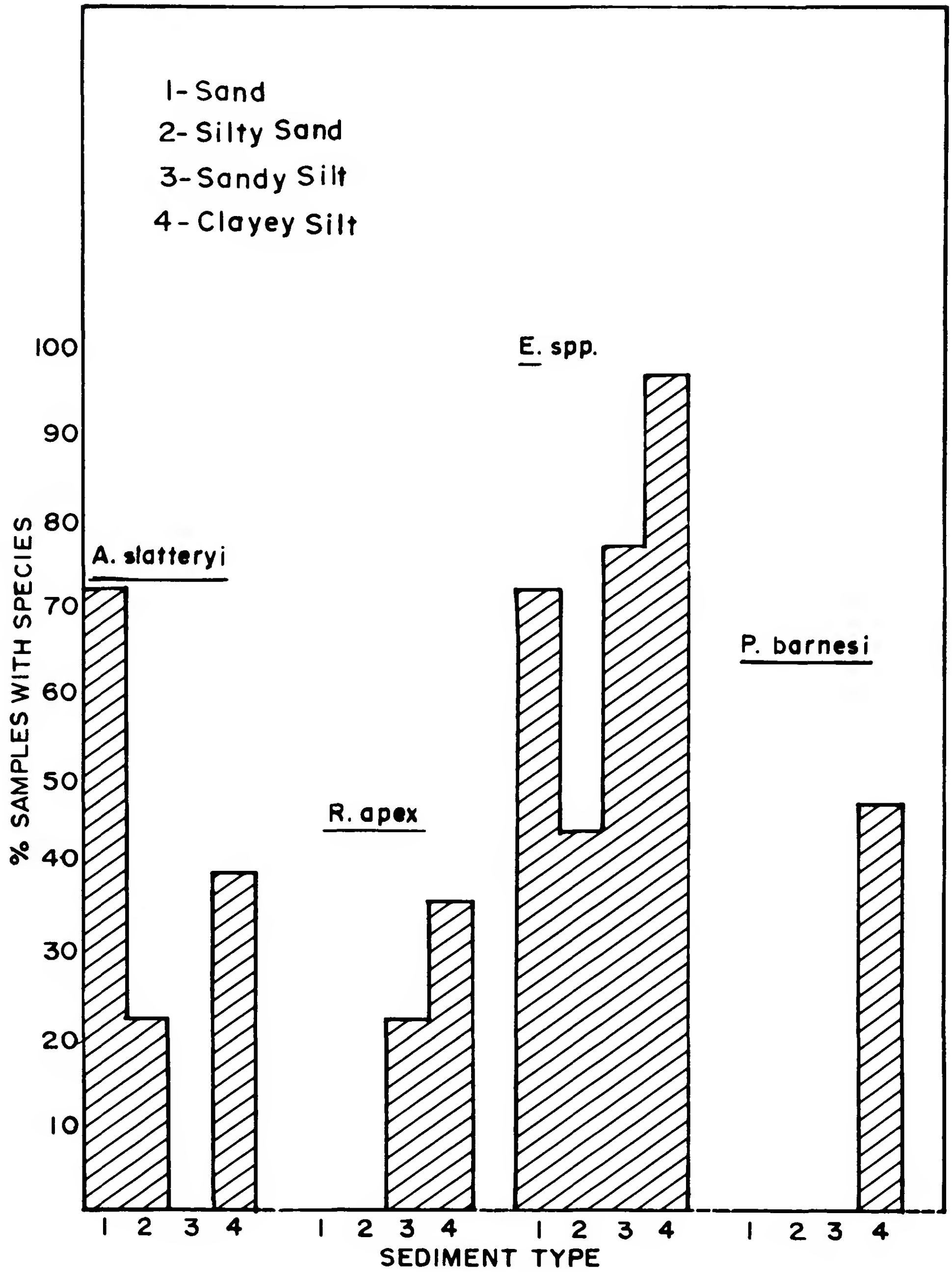

FIGURE 7.—Histogram showing the percent of samples of each sediment type containing *Asteropella slatteryi*, *Rutiderma apex*, *Euphilomedes* spp., and *Postasterope barnesi*.

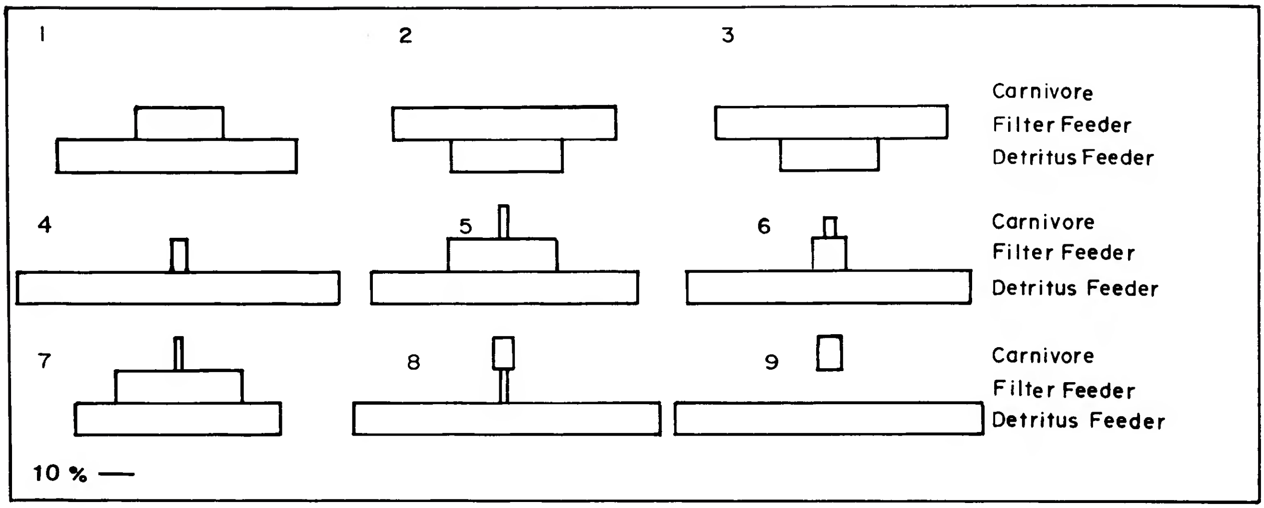

FIGURE 8.—Histogram showing the percentage distribution of the average number of specimens per square meter of each feeding type at each station. Length of bar in lower left is scale for horizontal bars.

Oliver et al. (1980) studied the relationship between wave disturbance and the zonation of benthic invertebrates along a subtidal high-energy beach in Monterey Bay, California. Three species of *Euphilomedes* (*E. longiseta, E. oblonga, E. charcarodonta*) were among the most common crustaceans in their southern transect. *Euphilomedes longiseta* was the most abundant species at the shallowest station (6 m); all three species were among the 10 most abundant species at a depth of 9 m; *E. oblonga* was among the 10 most abundant species at a depth of 14 m; and all three were less common at depths of 18 m and 24 m, where polychaetes rather than crustaceans were dominant. In the northern transect, where depths ranged from 9 m to 40 m the distribution of species was fairly similar to that of the southern transect. They concluded that wave-induced bottom disturbance plays a major role in the zonation of animals. No additional species of ostracodes were reported in their study.

Spies and Davis (1979:230) reported *Euphilomedes* sp. to be the second most abundant animal species at two stations (one near a natural oil seep) at about 16 m depth in the Santa Barbara Channel near Santa Barbara, California.

Stepien and Brusca (1985:95) collected the cypridinid *Vargula tsujii* Kornicker and Baker, 1977, in traps baited with live fish in a kelp-bed area at Lunada Bay, Palos Verdes, and off Redonda Beach, both in Southern California near Los Angelos.

The absence of species of the Sarsiellidae in Pillar Point Harbor appears to be shared with many other Californian bays.

Comparisons with Quantitative Studies Elsewhere

Eighty-one quantitative samples were collected in Pillar Point Harbor (Tuel et al., 1976, Appendix IV-A). Eighty percent of these contained myodocopid ostracodes. This compares with 65% from English Strait and Discovery Bay, Greenwich Island, one of the South Shetland Islands, Antarctica, 8% from Cape Cod Bay, Massachusetts, about 50% from the Beaufort Sea (Kornicker, 1988:2), and 30.4% from the southern California mainland shelf (Baker, 1975:22). A high percentage of samples (78%–93%) collected at depths of 6–14 m in Monterey Bay, California, contained individual species of *Euphilomedes* (Oliver et al., 1980:444); the numbers for the bay would be smaller if deeper bay samples were included.

In those samples containing myodocopids (65 of 81 samples), the average number of myodocopids per 0.1 m^2 in Pillar Point Harbor was 66 (maximum 265), much higher than Cape Cod Bay (average 4, maximum 19), Discovery Bay (average 4, maximum 10), and English Strait (average 10, maximum 52) (Kornicker, 1974:9), and 47% higher than in the Beaufort Sea (average 44, maximum 312) (Kornicker, 1988:3). The frequencies of the number of myodocopids per sample in the Beaufort Sea, Cape Cod Bay, and Pillar Point Harbor are compared in Figure 9. In Monterey Bay at depths of 6–14 m, the number of myodocopids is probably higher per 0.1 m^2 than in Pillar Point Harbor (0liver, 1980:444), but the data do not permit direct comparisons.

The ostracodes in the Antarctic localities were collected with 0.1 m^2 and 0.2 m^2 Petersen Grabs (Kornicker, 1974:8); the Cape Cod Bay and Beaufort Sea ostracodes were collected with a 0.1 m^2 Smith-McIntyre Grab (Kornicker, 1974:1, 1988:1); the southern California shelf ostracodes were collected with a modified Hayward Standard Orange-peel Bucket in water deeper than 10 m, and a modified 0.10 m^2 Van Veen Grab in water shallower than 10 m (Baker, 1975:15); the Monterey Bay ostracodes were collected with diver-held can corers (length 17 cm, area 0.018 m^2) (Oliver et al., 1980:438), and the Pillar

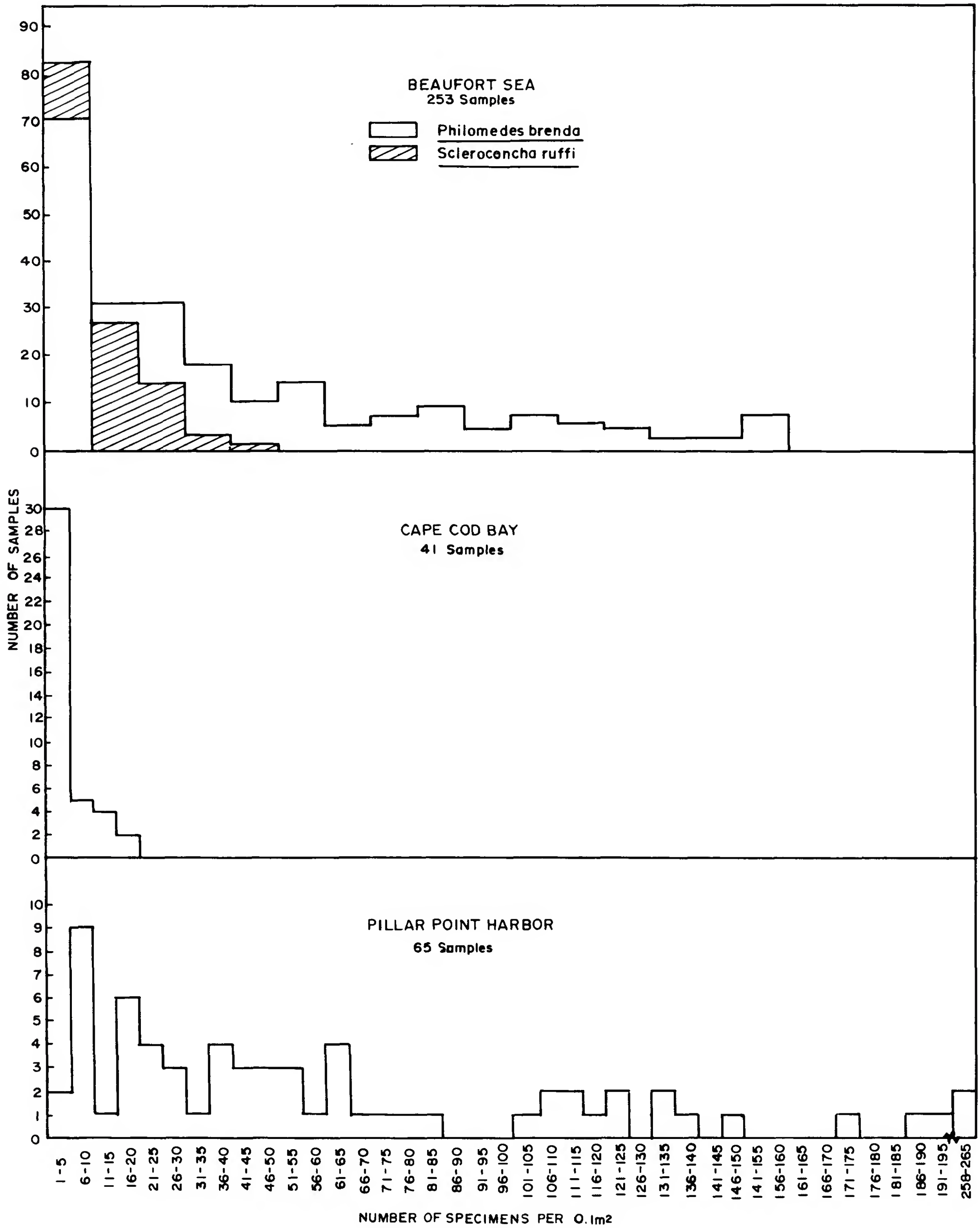

FIGURE 9.—Histograms showing the relative abundance of myodocopids in the Beaufort Sea, Cape Cod Bay, and Pillar Point Harbor.

Point Harbor ostracodes were collected with a 0.0506 m^2 Ponar Grab. In both the Antarctic and Cape Cod Bay studies, ostracodes were removed from the fraction retained on a 1.0 mm sieve (Kornicker, 1974:8); in the Southern California shelf study the finest screen had a mesh size of 0.71 m (Baker, 1975:15); in the Beaufort Sea study, ostracodes were removed from the fraction retained on a 0.42 mm sieve (Kornicker, 1988:3); whereas in the Pillar Point Harbor study as well as in the Monterey Bay study (Oliver et al., 1980:438), ostracodes were removed from the fraction retained on a 0.5 mm sieve. The effect of using the different types of collecting gear on the number of ostracodes obtained in the samples is unknown, but more smaller specimens would be retained on sieves with smaller mesh sizes.

Including samples at each station with and without myodocopids, the average number of specimens per square meter at the nine stations in Pillar Point Harbor during June, September, and December was 526 per square meter. If the numbers at the nine stations are considered representative of the harbor, which has an area of 0.991 km^2, the harbor during this period contained an average of about 520 million myodocopid ostracodes.

Podocopid ostracodes in Pillar Point Harbor were not mentioned by Tuel et al. (1976), and their abundance in the harbor cannot be compared with that of myodocopids. Elsewhere, in the innermost part of Niva Bay, Denmark, a population of primarily Podocopa varied between 33,000 and 380,000 per square meter, for the period April 1957 to January 1960 (Theisen, 1967:224). Reyment (1982:40) concluded that deme-sizes of marine ostracodes are mostly in the order of "a few tens of thousands" per square meter. If any of these estimates should hold for Podocopa of Pillar Point Harbor, the ratio of Podocopa to Myodocopa would be 20–600 to 1.

Commensal Protistans

Many specimens of *Euphilomedes carcharodonta* and *E. morini* in the harbor have attached to their shells stalked cup-like or ovoid protistans, and some specimens have them attached to appendages. None were observed on *Rutiderma apex* or *Postasterope barnesi*, nor were they reported by Kornicker (1981:260) on the fifth species in the harbor, *Asteropella slatteryi*.

Baker (1975:79) reported similar stalked peritrichous ciliate protozoa on five species collected on the continental shelf off southern California (Table 4). Four of those species are members of the Philomedidae and the other is in the family Cylindroleberididae (subfamily Cycloasteropinae).

Kornicker (1975a:60) reported that stalked cup-like protistans were very common on members of the Philomedidae, and sparse on members of other families in collections from Antarctica and Subantarctica.

In order to determine whether stalked cup-like protistans are really more common on the carapaces of certain families, a cursory survey of the literature was undertaken (Table 4). No doubt, many describers of ostracodes do not bother to mention attached protistans, so the list in Table 4 is incomplete and probably merely gives an indication of the actual distribution of protistans. Stalked ovoid protistans also are attached to shells and appendages, but because they could also be egg cases or various unknown other taxa, they have not been included in Table 4. In general, the ovoid forms are more abundant on those ostracode taxa also having cup-like forms.

The stalked cup-like protistans have been reported attached to the carapaces of eight species of Philomedidae, six species of Cylindroleberididae (only species of Cyclasteropinae and Asteropteroninae), only one species of Rutidermatidae, and no species of Cypridinidae, Sarsiellidae, or Cylindroleberidinae (Table 4). Also, they have been reported attached to the appendages of five additional species of Philomedidae, one additional species of Cyclasteropinae, and one species of Cylindroleberidinae (Table 4). It should be noted that an unstalked protistan has been reported on the cypridinid *Cypridina americana* (Müller, 1890) by Kornicker (1987:180, fig. 2a,d), and unknown egg-like protistans were attached to the posterior end of the carapace of the cylindroleberid *Heptonema homelix* Kornicker, 1991a (Kornicker, 1991a:124, fig. 67a,b). Also, foraminiferans, diatoms, bryozoans, and hydrozoans are present on some myodocopid carapaces (Baker, 1975:76; Kornicker, 1975a:52; 1988, fig. 2a; 1994:139; Kornicker and Calder, 1995:125), but they are not considered here, nor were they observed on the examined ostracodes in Pillar Point Harbor.

It is interesting to speculate as to why the stalked cup-like protistans appear to mainly colonize carapaces of members of the Philomedidae and Cyclasteropinae. Baker (1975:80) stated that the usual position of the stalked protistans along the ostracode rostrum may indicate that the ostracode does not burrow, and he also noted that in that location the protistans have a readily available supply of food from the ostracode.

According to Elofson, species of *Philomedes* are agile burrowers (Elofson, 1969:14), and it seems likely that *E. carcharodonta* and *E. morini* are also burrowers. Possibly, after burrowing they reside in the burrow with their anterior ends projecting from the sediment, thus permitting the protistans on the rostral area to be free in the water. However, according to Fenwick (1984:262), *Leuroleberis zealandica* (Baird, 1850b) lives in the sediment and is not visible from above, so there is no evidence that the anterior end of burrowing ostracodes projects into the water. It seems likely that other Cyclasteropinae also burrow, and unlikely, therefore, that the presence of protistans indicates that the host ostracode does not burrow.

It might be surmised that the host ostracode uses the protistans as bait for prey, but that seems unlikely because the Philomedidae are detritivores, not carnivores; also, that would not explain the protistans attached to appendages. The apparent absence of stalked cup-like protistans on sarsiellids and their sparsity on rutidermatids might be due, in some unknown way,

TABLE 4.—Distribution of stalked cup-like protistans on the carapaces and appendages of myodocopid ostracodes (A = attached to appendage; C = attached to carapace).

Taxon (Place of attachment)	Source
CYLINDROLEBERIDIDAE	
CYLINDROLEBERIDINAE	
Parasterope muelleri Skogsberg, 1920 (A)	Kornicker and Caraion, 1975:11, fig. 5n–p
CYCLASTEROPINAE	
Amboleberis americana (Müller, 1890) (C)	Baker, 1975:79, fig. 17h
Cycloleberis squamiger (Scott, 1894) (A)	Kornicker, 1975c:10, fig. 6i
Leuroleberis mackenziei (Kornicker, 1981) (C)	Kornicker, 1981:119, pl. 21b
Leuroleberis sharpei Kornicker, 1981 (C)	Kornicker, 1981:100, fig. 27f,g, pls. 7b, 19b
ASTEROPTERONINAE	
Asteropterygion oculitristis (Darby, 1965) (C)	Kornicker, 1981:295, 299
Asteropterygion setiferum Kornicker and Caraion, 1975 (C)	Kornicker, 1975c:32, fig. 16d,e
Asteropterygion thomassini Kornicker, 1981 (C)	Kornicker, 1981:312, pl. 145a–c,e,f
PHILOMEDIDAE	
PHILOMEDINAE	
Anarthron dithrix Kornicker, 1975a (C)	Kornicker, 1975a:359
Euphilomedes agilis (Thomson, 1879) (C)	Kornicker, 1975a:300, 306, fig. 184e
Euphilomedes carcharodonta (Smith, 1952) (C)	Baker, 1975:79, fig. 17e; Herein
Euphilomedes climax Kornicker, 1991b (A)	Kornicker, 1991b:16, 17, 19
Euphilomedes longiseta (Juday, 1907) (C)	Baker, 1975:79
Euphilomedes producta (Poulsen, 1962) (C)	Baker, 1975:79
Philomedes cubitum Kornicker, 1975a (A)	Kornicker, 1975a:290
Philomedes lofthousae Kornicker, 1975a (A*)	Kornicker, 1975a:285
Philomedes minys Kornicker, 1975a (A)	Kornicker, 1975a, fig. 165s
Philomedes ramus Kornicker, 1975a (A)	Kornicker, 1975a:280
Philomedes rotunda Skogsberg, 1920 (C)	Kornicker, 1975a:246, 248, fig. 145g
Philomedes subantarctica Kornicker, 1975a (C)	Kornicker, 1975a:267, fig. 161a–d
Philomedes tetrathrix Kornicker, 1975a (A)	Kornicker, 1975a:262
Zeugophilomedes fonsecensis (Hartmann, 1959) (C)	Baker, 1975:79, fig. 17f
PSEUDOPHILOMEDINAE	
Harbansus mayeri Kornicker, 1978 (C)	Kornicker, 1978:32, pl. 7a,e
RUTIDERMATIDAE	
RUTIDERMATINAE	
Rutiderma rotundum Poulsen, 1965 (C)	Kornicker and Myers, 1981:22, fig. 12q

*Protistan also attached to a larva inside marsupium of ovigerous female.

to members of the two families being carnivores; however, this feeding habit would not explain the absence of the protistans in the Cylindroleberidinae and their presence in the Cyclasteropinae, because both taxa are filter feeders.

Possibly, the Cylindroleberidinae, Cypridinidae, Sarsiellidae, and Rutidermatidae are able to chemically inhibit the attachment of the stalked cup-like protistans, or perhaps, they are mechanically capable of removing the protistans from the shell margins by manipulation of their appendages. The latter possibility could be explored by observing living specimens. The general sparsity of protistans along the ventral margins of the carapace could be the result of the ability of the ostracode to remove them more readily by appendage movement when they are in that location; however, it would not explain the absence of protistans along the hinged dorsal margins.

The density of protistans along the anterior edge of the carapace could be affected by the current of water created by the flapping vibratory plate (epipodite) of the myodocopid 5th limb. Water enters the anterior end of the carapace and leaves at the posterior end (Cannon, 1931:438), where protistans are often present, but usually in lower densities. The current may bring food to the protistans. Probably, the posterior protistans would benefit more from remnants of food escaping from the ostracode. This, of course, does not explain the lack of protistans on some taxa, because the current flow is probably similar in all.

Superorder MYODOCOPA Sars, 1866

Order MYODOCOPIDA Sars, 1866

Suborder MYODOCOPINA Sars, 1866

PHILOMEDIDAE Müller, 1906

This family contains two subfamilies, Philomedinae Müller, 1906, and Pseudophilomedinae Kornicker, 1967. Only the former has representatives in Pillar Point Harbor, but both have been reported in the eastern Pacific.

PHILOMEDINAE Müller, 1906

This subfamily includes seven genera of which only *Euphilomedes* is in the collection. Three additional genera have been reported from the eastern Pacific off North America, *Philomedes, Scleroconcha,* and *Zeugophilomedes.*

Euphilomedes Kornicker, 1967

Two species are in the collection from the harbor, *E. carcharodonta* (Smith, 1952) and *E. morini,* new species. Three additional species have been reported from the eastern Pacific off North America, *E. climax* Kornicker, 1991b, *E. longiseta* (Juday, 1907), and *E. producta* Poulsen, 1962; and *E. smithi* Poulsen, 1962, has been reported from San José, Pearl Islands (Kornicker, 1991b:3).

DISTRIBUTION.—Cosmopolitan except in Arctic and Antarctic waters. Known depth range shallow water to 2250 m, but mostly from the continental shelf and upper slope (Kornicker, 1991b:3, 4).

Euphilomedes carcharodonta (Smith, 1952)

FIGURES 10–13, 17*m*

Philomedes carcharodonta Smith, 1952:16, pl. I: figs. 1–8, pl. II: figs. 1–6.
Euphilomedes carcharodonta (Smith, 1952).—Poulsen, 1962:340, 359 (map), 360, 361, 362 (table), 376–382, 378, 380, 381, 411.—Tuel et al., 1976:140, 155.
Philomedes sp. McHardy, 1964:557, figs. 3–7.

HOLOTYPE.—None selected.

SYNTYPES.—Adult male and ovigerous female (Smith, 1952:16, 18).

MATERIAL.—Pillar Point Harbor: Sta 8B (Jun): USNM 194353, adult male on slide and in alcohol; USNM 194354, partly dissected ovigerous female in alcohol; USNM 194359, 4 undissected adult males in alcohol; USNM 194360, 4 undissected adult females in alcohol; USNM 194361, instar III female on slide and in alcohol; USNM 194367, instar III female in alcohol; 194368, instar III female in alcohol; USNM 194369, instar III male on slide and in alcohol; USNM 194365, instar IV female in alcohol; USNM 194362, instar IV female on slide and in alcohol; USNM 194366, instar IV male on slide and in alcohol; USNM 194363, instar V female on slide and in alcohol; USNM 194364, instar V male on slide and in alcohol; USNM 194355, 44 adult females and juveniles of both sexes in alcohol (some juveniles could be *E. longiseta*); unnumbered specimen, adult male in alcohol deposited in the Australian Museum, Sydney, NSW. Sta 1A (Dec): USNM 194356, adult female on slide and in alcohol; USNM 194381, partly dissected adult female in alcohol; USNM 194382, partly dissected ovigerous female in alcohol.

SYNTYPE LOCALITY.—Ganges Harbor, British Columbia, depth 5.5–7.3 m.

DISTRIBUTION.—Ganges Harbor, British Columbia (Smith, 1952:18). Near mouth of Indian Arm, a coastal inlet of British Columbia (single male collected with Clarke-Bumpus plankton sampler at a depth of 50–55 m in water approximately 60 m deep) (McHardy, 1964:557). Gabriele Island, Nanaimo, Pacific Coast of Canada, shallow water (Poulsen, 1962:376 (supplementary description)). Puget Sound, Washington, depth 23 m (Lie and Evans, 1973:123, 125). San Diego to Point Conception, Southern California, depth preference 5.5–60.0 m (range 5.2–1280.2 m) (Baker, 1975:90, 91). Baker (1975:90) also lists Monterey Bay, Red Sand Hill, Morro Bay, Bodega Bay, Halfmoon Bay, and Oceanside, California. Swain (1969:429, 473, text fig. 9, pl. VIII: fig. 5a,b) illustrated the outside views of a specimen of *Pseudophilomedes* sp. from La Jolla, California, from a depth of 45 m (Baker (1975:90) examined that material and placed it in the synonymy of *E. carcharodonta*. Pillar Point Harbor, herein.

REMARKS.—We have not examined either Baker's (1975) or Swain's (1969) specimens from California and, therefore, have left them out of the synonymy, but we have no reason to question the identifications of Baker. We have also not placed in the synonymy specimens from Puget Sound identified by Lie (1968:397) as *E. carcharodonta* because they are not extant and cannot be verified, but the species is likely to occur there. Because Pillar Point Harbor is a considerable distance from where the specimens described by Smith and Poulsen were collected, specimens from the present collection were studied in detail, and the supplementary description that follows points out some morphological differences between them and the Canadian specimens, and describes some characters not previously known. Differences observed in the Pillar Point Harbor specimens do not warrant proposal of a new species.

SUPPLEMENTARY DESCRIPTION OF ADULT MALE (Figure 10; Table 5).—Carapace shape similar to those illustrated by Smith (1952, pl. 1: fig. 2) and Poulsen (1962, fig. 165a) (Figure 10*a*).

Ornamentation: Poulsen (1962:377) stated that the shell pits are larger on the male than those of the female, and that the edges of the pits are fringed by numerous minute hairs. Smith (1952:19) described the outer surface of the male shell as being finely granular and with irregular depressions with short hairs. The pits or depressions (fossae) are present but indistinct on specimen USNM 194353 from Pillar Point Harbor, and the area between pits are covered by minute papillae (without hairs or spines), which may also be within fossae (typical papillae shown on tip of rostrum in Figure 10*b*). Long hairs on outer surface of shell similar to those described by Poulsen (1962:377).

Infold: Infold of rostrum with 10 or 11 bristles (Figure 10*b*). Anteroventral and anterior 1/3 of ventral margin with 11 long bristles oriented inward on specimens examined. Posterior infold with row of about 33 bristles (posterior 24 shown in Figure 10*c*).

Selvage: Similar to that described by Poulsen (1962:377). In vicinity of incisur, lamellar prolongation of rostrum overlaps laterally the lamellar prolongation ventral to incisur.

FIGURE 10.—*Euphilomedes carcharodonta* (Smith, 1952), adult male, USNM 194353: *a*, complete specimen from left side, length 2.11 mm; *b*, anterior right valve with stemmed ectozoan, iv; *c*, posterior right valve with row of oval ectozoa, iv; *d*, portion of right 2nd antenna, mv; *e*, endopodite, left 2nd antenna (detail of 1st joint showing stemmed ectozoan), mv; *f*, endites I and II of left maxilla; *g*, endite III of right maxilla; *h*, right maxilla (endites not shown), lv; *i*, endites of 5th limb, anterior to right; *j*, 1st and 2nd exopodial joints, 5th limb; *k*, inner lobe of 3rd exopodial joint and exopodial joints 4 and 5 of 5th limb; *l*, left lamella of furca, lv; *m,n*, anterior of body from left and right sides, respectively; *o*, upper lip from left side; *p*, left Y-sclerite; *q*, detail of ectozoan shown in *b*; *r*, detail of ectozoan shown in *c*; *s*, tip of 7th limb; *t*, comb teeth of limb opposite that shown in *s*.

Central Adductor Muscle Attachments (Figure 10*a*): Many attachments.

Carapace Size (length, height in mm): USNM 194353, 2.11, 1.21, height 57% of length. USNM 194359, 4 specimens: 2.10, 1.22, height 58% of length; 2.12, 1.22, height 58% of length; 2.10, 1.18, height 56% of length; 2.16, 1.20, height 56% of length. Range of length (5 specimens) 2.10–2.16 mm; range of height as percent of length 56–58. (Smith (1952:18) recorded the male length as 2.09 mm, whereas Poulsen (1962: 376) recorded the length range of males as 2.29–2.4 mm and the height as 61% of length. Poulsen's specimens are slightly longer than Smith's, as well as those from Pillar Point Harbor.)

First Antenna: Tip of sensory bristle of 5th joint with 5 short filaments (Poulsen's specimen had only 3 (1962:377)). Bristle of 6th joint and a-bristle of 7th joint without long hairs present on Poulsen's specimen.

Second Antenna: Protopodite with e-sclerite (Figure 10*d*, not all endopodial bristles shown). Endopodite (Figure 10*e*): proximal filament differs from that illustrated by Poulsen (1962: fig. 165d) in not being as broad relative to the narrowest part of the 3rd joint, and the 3rd joint appears longer relative to the 2nd joint. Exopodite: bristle of 3rd joint with natatory hairs; 9th joint with 6 bristles, branch otherwise similar to that described by Poulsen (1962:377).

Mandible: Coxale endite: 2 small proximal teeth described by Poulsen (1962:377) not observed. Basale: 7 long bristles with wreaths of long spines on or near ventral margin; dorsal margin with 1 long bare bristle at midlength and 2 subterminal with wreaths of long hairs. Numerous rows of medial spines present on basale and 1st and 2nd endopodial joints. Long medial claw of 3rd joint pectinate proximally, not bare as in Poulsen's specimen. Medial bristles of basale and balance of limb similar to Poulsen's specimen (1962:377).

Maxilla: Endite I with about 8 hirsute bristles (Figure 10*f*); endite II with about 7 hirsute bristles (Figure 10*f*); endite III with about 11 hirsute bristles (Figure 10g). Coxale with fairly short plumose dorsal bristle (Figure 10*h*). Basale with 3 long spinous bristles (1 ventral, 1 dorsal, 1 medial). Exopodite well developed, with 2 long terminal bristles and 1 shorter bristle slightly proximal to tip, all 3 bristles with long spines (Figure 10*h*). 1st endopodial joint with 1 alpha-bristle (with long proximal and short distal spines) and 5 hirsute beta-bristles (Figure 10*h*). 2nd endopodial joint with 3 a-bristles with few long proximal hairs, and 8 bristles with long hairs (detail to Figure 10*h*).

Fifth Limb: Epipodial bristles not counted. Bristles of 3 endites difficult to resolve but endite I has 4 bristles (2 short triangular bristles described by Poulsen (1962:379) not observed) (Figure 10*i*); endites II and III similar to those of Poulsen's specimen (Figure 10*i*). 1st exopodial joint with stout triangular spinous terminal process, a smaller indistinct spinous process, and a fairly long proximal bristle (Figure 10*j*). 2nd exopodial joint with stout spinous terminal process, a smaller proximal spinous process (not on Poulsen's specimen), and 3 bristles (Figure 10*j*). 3rd exopodial joint: inner lobe with 2 terminal bristles with marginal hairs (Figure 10*k*) (not bare as in Poulsen's specimen); outer lobe with 2 long stout spinous bristles (not shown). Remainder of limb similar to Poulsen's specimen except fused 4th and 5th joints with total of 7 bristles (Figure 10*k*).

Sixth Limb: USNM 194353 with 3 epipodial bristles on each limb (none seem to be missing). Remainder of limb similar to Poulsen's specimen.

Seventh Limb (Figure 10*s,t*): Proximal and terminal groups each with 4 bristles; bristles with 5–7 bells and weak marginal spines. Terminal comb with 7 teeth: middle tooth longest, bare; 3 teeth on each side with long marginal spines (spines of shortest tooth stouter than on other teeth and could be termed alate processes). Both pegs opposite comb with marginal spines (only proximal peg bears spines on male described by Poulsen (1962:381)).

Furca (Figure 10*l*): Similar to that described by Poulsen (1962:381).

Bellonci Organ (Figure 10*m*): According to Poulsen (1962:382), "The distal part tapers into a finely pointed tip," and the pointed tip is also shown in an illustration of the female organ (Poulsen, 1962: fig. 165c'). The tip of the organ of USNM 194353 is narrowly rounded and closer in shape to the organ illustrated by Smith (1952, pl. II: fig. 4).

Eyes: Lateral eye well developed with 33 ommatidia and black pigment (outline shown in Figure 10*a*). Medial eye smaller than lateral eye, with brown pigment (Figure 10*m*).

Upper Lip (Figure 10*n,o*): Lip projecting slightly anteriorly and with 4 lateral glandular openings (Figure 10*o*). A flat process on each side of lip with rows of slender spines and 3 indistinct glandular openings near ventral edge (Figure 10*o*); anterodorsal corner of process with indistinct lateral spine (could be wrinkle) (Figure 10*o*).

Genitalia: Not examined in detail but, in general, similar to those described and illustrated by Poulsen (1962:381, fig. 167a).

Anterior of Body (Figure 10*m,n*): Triangular process with sclerotized finger-like tip present just ventral to attachment of 1st antenna. (Process closer to 1st antenna than anterior process of female.)

Posterior of Body: Bare.

Y-*Sclerite* (Figure 10*p*): With ventral branch.

Epizoa: USNM 194353 and 194359 with stemmed protistans, some ovoid on posterior edge of shell (Figure 10*c,r*) and on protopodite and endopodite of 2nd antenna, some vase-shaped on rostrum and anteroventral edge of shell (Figure 10*b,q*).

Gut Content: USNM 194353 appearing to have fine particulate matter in gut.

SUPPLEMENTAL DESCRIPTION OF ADULT FEMALE (Figure 11; Table 5).—Carapace similar in shape to those illustrated by Smith (1952, pl. I: fig. 1) and Poulsen (1962, fig. 165b) (Figure 11*a*).

Ornamentation: Similar to that of male except for fewer long bristles on posterior end.

Infold: Rostral infold with 10 or 11 bristles. Anterior part of anteroventral infold with about 8 closely spaced striations parallel to valve margin (inner ridge thicker and interpreted to be list); posterior part of anteroventral infold with 4 striations between list and inner margin of infold and no striations on outer side of list; list extends along ventral and posterior infolds. Part of list of right valve near midlength and posterior to striated area with indistinct "crenulations." Anteroventral infold to about midlength of ventral infold with row of 10 widely spaced bristles. Posteroventral and posterior infolds with about 50 closely spaced bristles of varying lengths (most short), some forming clusters of 2–4 bristles.

Selvage: Similar to that of adult male.

Central Adductor Muscle Attachments (Figure 11*a*): Many attachments.

Carapace Size (length, height in mm): Sta 8B (Jun): USNM 194354, 2.16, 1.64, height 76% of length. USNM 194360, 4 specimens: 2.02, 1.54, height 76% of length; 1.98, 1.50, height 76% of length; 2.12, 1.61, height 76% of length; 2.01, 1.51, height 75% of length. Sta 1A (Dec): USNM 194356, separated right valve, 1.99, 1.49, height 75% of length; separated left valve, 2.03, 1.55, height 76% of length. USNM 194381, 2.07, 1.55, height 75% of length; USNM 194382, 2.07, 1.57, height 76% of length. Range of length (8 specimens) 1.98–2.16 mm; range of height as percent of length 75–76. (Smith (1952:18) recorded the female length as 2.29 mm. Poulsen (1962:376) recorded the length of an ovigerous female as 2.37 mm and the height as 74% of length. The females from Pillar Point harbor are smaller than those of both Smith and Poulsen from off Canada.)

First Antenna: Poulsen's specimen with many ventral spines on 1st joint (Poulsen, 1962, fig. 165c'); these absent on USNM 194356. Ventral bristle of 2nd joint long, slender, similar to that illustrated by Smith (1952, fig. 3), not short and stout as on specimen illustrated by Poulsen (1962, fig. 165c'). Small disto-medial tooth on 4th joint described and illustrated by Poulsen (1962:377, fig. 165c') absent on USNM 194356. (Tooth also absent on adult male USNM 194353.)

Second Antenna: Protopodite without e-sclerite (Figure 11*c*). Endopodite similar to that described and illustrated as "exopodite" by Smith (1952:18, pl. II: fig. 2), 1st joint with 6 short bristles (5 proximal, 1 distal) (Figure 11*c,e*). Exopodite similar to that described by Poulsen (1962:377), 9th joint with 7 bristles.

Mandible: Basale with 7 or 8 long spinous bristles on or near ventral margin; medial surface with 5 short proximal bristles (3 unringed, 2 ringed); dorsal margin with long spinous bristle at midlength and 2 long spinous bristles subterminal; medial, lateral, ventral, and dorsal margins spinous. Limb similar to that described by Poulsen (1962:377).

Maxilla (Figure 11*f*): Endite I with 11 spinous and pectinate bristles (1 terminal medial bristle (with small spines) quite short, about 1/4 width of endite at midlength); endite II with about 7 spinous and pectinate bristles; endite III with about 8 spinous and pectinate bristles plus 1 short spinous proximal lateral bristle. Dorsal margins of precoxale and coxale with fringe of long hairs. Coxale with plumose dorsal bristle about 1/2 length of dorsal bristle of basale. Basale with 3 long spinous terminal bristles (1 ventral, 1 dorsal, 1 medial). Exopodite: short bristle only slightly subterminal, bare; long middle bristle with long stout spines; other long bristle with short hairs. Endopodite: 1st joint spinous, with 1 alpha-bristle with long proximal and short distal spines, and 5 beta-bristles, either bare or with short spines; 2nd endopodial joint obscured on USNM 194356, but with 3 stout unringed pectinate claws in addition to ringed bristles.

Fifth Limb: Epipodial appendage with 55 bristles. Main tooth (Figure 11*g*): small peg described by Poulsen (1962:379, fig. 166b) not observed; bristle proximal to 3 slender teeth minutely pectinate, not bare as on bristle of Poulsen's specimen. Limb otherwise similar to that described by Poulsen (1962:379, fig. 166b,b') but endite bristles not counted.

Sixth Limb: USNM 194356 with 4 epipodial bristles (Poulsen (1962:380) stated that the limb is similar in both sexes, and that it has 5 epipodial bristles; however, only 4 are shown on his illustrated male limb (1962, fig. 166c)). All 3 terminal bristles of endite II with long spines. Limb otherwise similar to that described by Poulsen (1962:380).

Seventh Limb (Figure 11*h*): Limb almost twice width of adult male; with 4 proximal bristles (2 on each side) and 6 terminal bristles (3 on each side); bristles with 3–7 bells and stout marginal spines. Terminal comb with 9 teeth (middle tooth longest, middle and 1 slightly shorter bristle at each side with slightly rounded curved tips, 3 shorter bristles at each side pointed and with small spine on each side of base. Both curved pegs opposite comb with fairly long spines. (Poulsen (1962:381, fig. 186d) described a 7th limb with only 7 comb teeth.)

Furca: Number and distribution of claws similar to that of adult male. Claws 1 and 2 less curved than those of male. Claw 1 with medial and lateral row of teeth (proximal 4 lateral teeth larger than others); main claws 2, 3, and 5 differ from those of adult male in having only lateral row of teeth. (Poulsen (1962:382) stated that all main claws of his specimens have medial and lateral teeth.)

Bellonci Organ (Figure 11*b,i*): Short part at midlength bare, proximal and distal parts coated with minute flat discs (possibly foreign growth, not shown).

Eyes: Medial eye with area of black pigment (stippled in Figure 11*b,i*). Lateral eye absent.

Upper Lip (Figure 11*i,j*): In general, similar to that of adult male, but examined only at low magnification (×15 ocular, ×20 objective). Glandular openings indistinct (Figure 11*j*) and flat lateral process, which is so distinct on sides of lip of male, blends into anterior projection of lip of female.

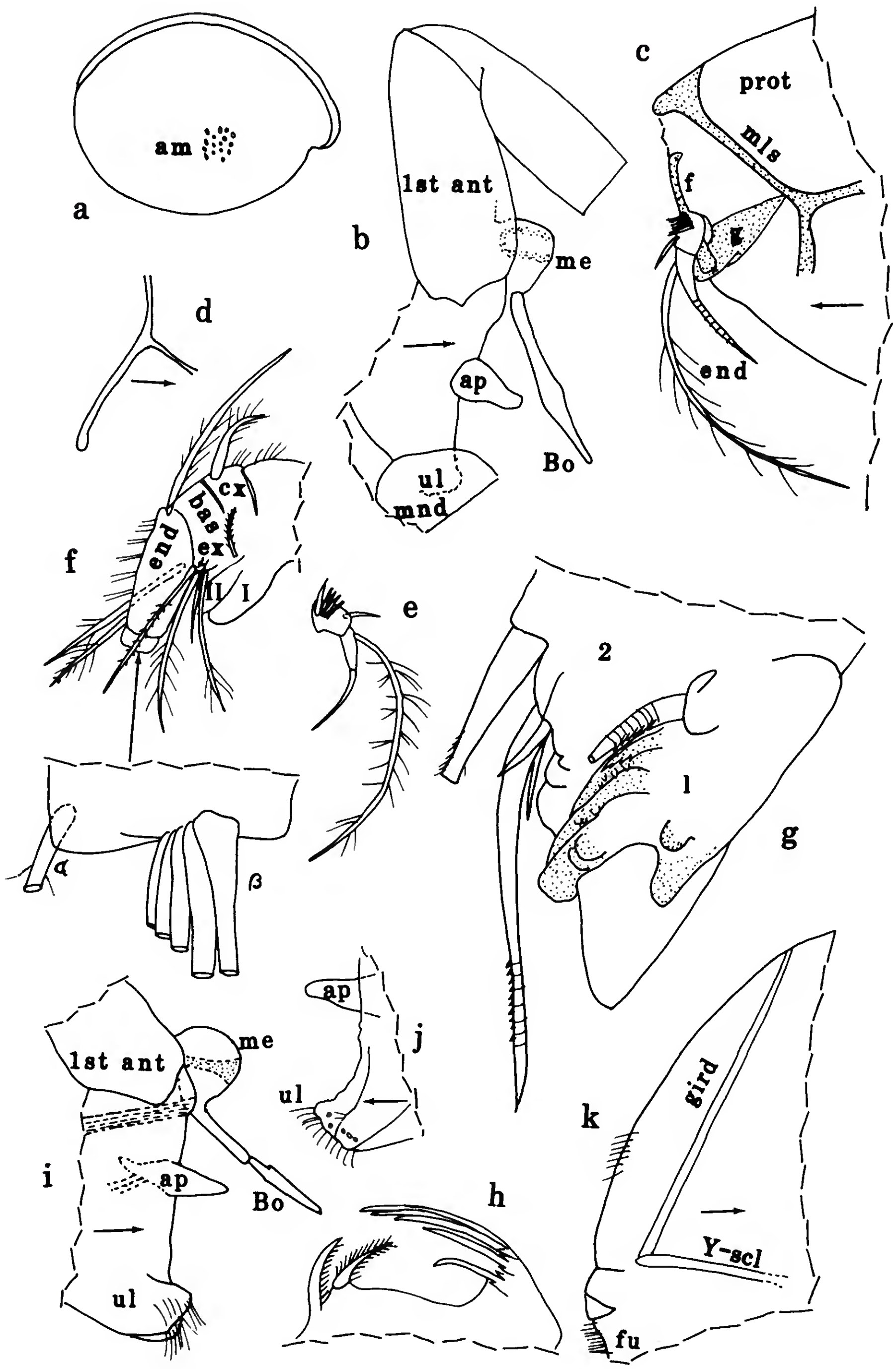

FIGURE 11.—*Euphilomedes carcharodonta* (Smith, 1952), adult female, USNM 194354: *a*, complete specimen from right side, length 2.16 mm; *b*, anterior of body from right side; *c*, portion of right 2nd antenna, mv; *d*, right Y-sclerite. Adult female, USNM 194356: *e*, endopodite, left 2nd antenna, mv; *f*, left maxilla (nabs), lv; *g*, 1st and 2nd exopodial joints, right 5th limb, pv; *h*, tip of 7th limb; *i,j*, anterior of body from right and left sides, respectively; *k*, posterior of body from right side (only posterior end of Y-sclerite shown).

Anterior of Body (Figure 11*b,i,j*): Anterior process larger than that of male and farther from 1st antenna (process on Poulsen's female appears closer to base of 1st antenna (Poulsen, 1962, fig. 165c′) than process on present specimens).

Posterior of Body (Figure 11*k*): With spines near midheight.

Genitalia: None observed.

Y-*Sclerite* (Figure 11*d*): With ventral branch.

Number of Eggs: USNM 194354 with 30 eggs in marsupium and no unextruded eggs; lengths of 3 eggs: 0.22 mm, 0.23 mm, 0.24 mm. USNM 194356 with unextruded eggs. USNM 194382 with 22 eggs in marsupium.

Epizoa: USNM 194354 and 194360 with stemmed vase-shaped protistans on rostrum and ventral to incisur (not shown).

Gut Content: USNM 194354 and USNM 194356 with amber-colored unrecognizable particles in gut.

DESCRIPTION OF INSTAR III FEMALE (Figure 12*a–i*; Table 5).—Carapace similar in shape to that of adult female (Figure 12*a*).

Carapace Size (length, height in mm): USNM 194361, 1.07, 0.73, height 68% of length. USNM 194367, 1.03, 0.77, height 75% of length. USNM 194368, 1.07, 0.75, height 70% of length.

First Antenna: Number of bristles on joints 1–4 listed in Table 5. Joints 5–8 with same number of bristles as on adult, but filaments not counted.

Second Antenna: Protopodite without e-sclerite. Endopodite similar to that of adult female except with only 3 bristles on 1st joint (Figure 12*b*; Table 5). Exopodite: bristles of joints 2–8 and 9 short and bare; 9th joint with 4 bristles.

Mandible: Coxale endite, exopodite, and dorsal bristles of basale similar to those of adult female. Bristles and claws noted in Table 5.

Maxilla: Not examined in detail, but 1st endopodial joint with 1 alpha- and 2 beta-bristles.

Fifth Limb: Main tooth of 1st exopodial joint with 1 stout and 2 slender teeth (Figure 12*c,d*). Combined 4th and 5th exopodial joints with 5 or 6 bristles (Figure 2*c*; Table 5). Remaining bristles of 1st, 2nd, and 3rd exopodial joints similar to those of adult female. Epipodial and endite bristles not counted.

Sixth Limb: Number of bristles listed in Table 5.

Seventh Limb (Figure 12*e*): Elongate, bare.

Furca (Figure 12*f*): With 6 claws: claws 1–4 primary, claws 5 and 6 secondary but shape fairly similar to primary claws. Claws with marginal teeth and right lamella anterior to left by width of base of claw 1.

Bellonci Organ (Figure 12*g*): Distal part not tapered as in adult female.

Eyes: Medial eye pigmented (stippled in Figure 12*g*). Lateral eye absent.

Upper Lip: Spinous projection.

Genitalia: None observed.

Anterior of Body (Figure 12*g*): With projecting rounded anterior process at midheight.

Posterior of Body: With hairs at midheight.

Y-*Sclerite* (Figure 12*h*): Similar to that of adult female.

Epizoa: Protopodite of 2nd antenna USNM 194361 with protistan with long stem attached to elongate oval (Figure 12*i*). Rostrum of USNM 194367 with stemmed vase-shaped protistans.

Gut Content: Guts of USNM 194361, 194367, and 194368 containing amber-colored unrecognizable particulate matter.

DESCRIPTION OF INSTAR III MALE (Figure 12*j–p*; Table 5).—Carapace similar to that of instar III female.

Carapace Size (length, height in mm): USNM 194369, 1.08, 0.67, height 64% of length.

First Antenna: Similar to that of instar III female (Table 5).

Second Antenna: Protopodite without e-sclerite; medial row of minute spines near posterodorsal curvature (Figure 12*j*). Endopodite 2-jointed (Figure 12*k,l*): 1st joint with 3 bristles; 2nd joint with 2 bristles and with broadly rounded tip (2nd joint broader than that of instar III female). Exopodite similar to that of instar III female.

Mandible: Distribution of bristles noted in Table 5.

Maxilla: Not examined in detail, but 1st endopodial joint with 1 alpha- and 2 beta-bristles.

Fifth Limb: Except for main tooth having 2 or 3 slender and 1 stout tooth, limb similar to that of instar III female, which has 2 slender and 1 stout tooth on both limbs of specimen examined.

Sixth Limb: Similar to that of instar III female (Table 5).

Seventh Limb (Figure 12*m*) and *Furca:* Similar to those of instar III female.

Eyes: Lateral eye small unpigmented, with several indistinct ommatidia (Figure 12*n,o*). Medial eye similar to that of instar III female (Figure 12*n*).

Upper Lip (Figure 12*p*), *Bellonci Organ* (Figure 12*n*), *Anterior of Body* (Figure 12*p*), and *Posterior of Body:* Similar to those of instar III female.

Genitalia: None observed.

Y-*Sclerite:* Elongate, with ventral branch observed on USNM 194384.

Epizoa: USNM 194369 with stemmed vase-shaped protistan near incisur, and several round protistans on short stems attached to protopodite of 2nd antenna.

Gut Content: USNM 194369 with amber-colored particulate matter and large rotaloid foram in gut.

DESCRIPTION OF INSTAR IV FEMALE (Figure 13*a–f*; Table 5).—Carapace similar in shape to that of adult female (Figure 13*a*).

Carapace Size (length, height in mm): USNM 194362, 1.22, 0.92, height 75% of length. USNM 194365, 1.26, 0.93, height 74% of length.

First Antenna: Distribution of bristles on joints 1–4 shown

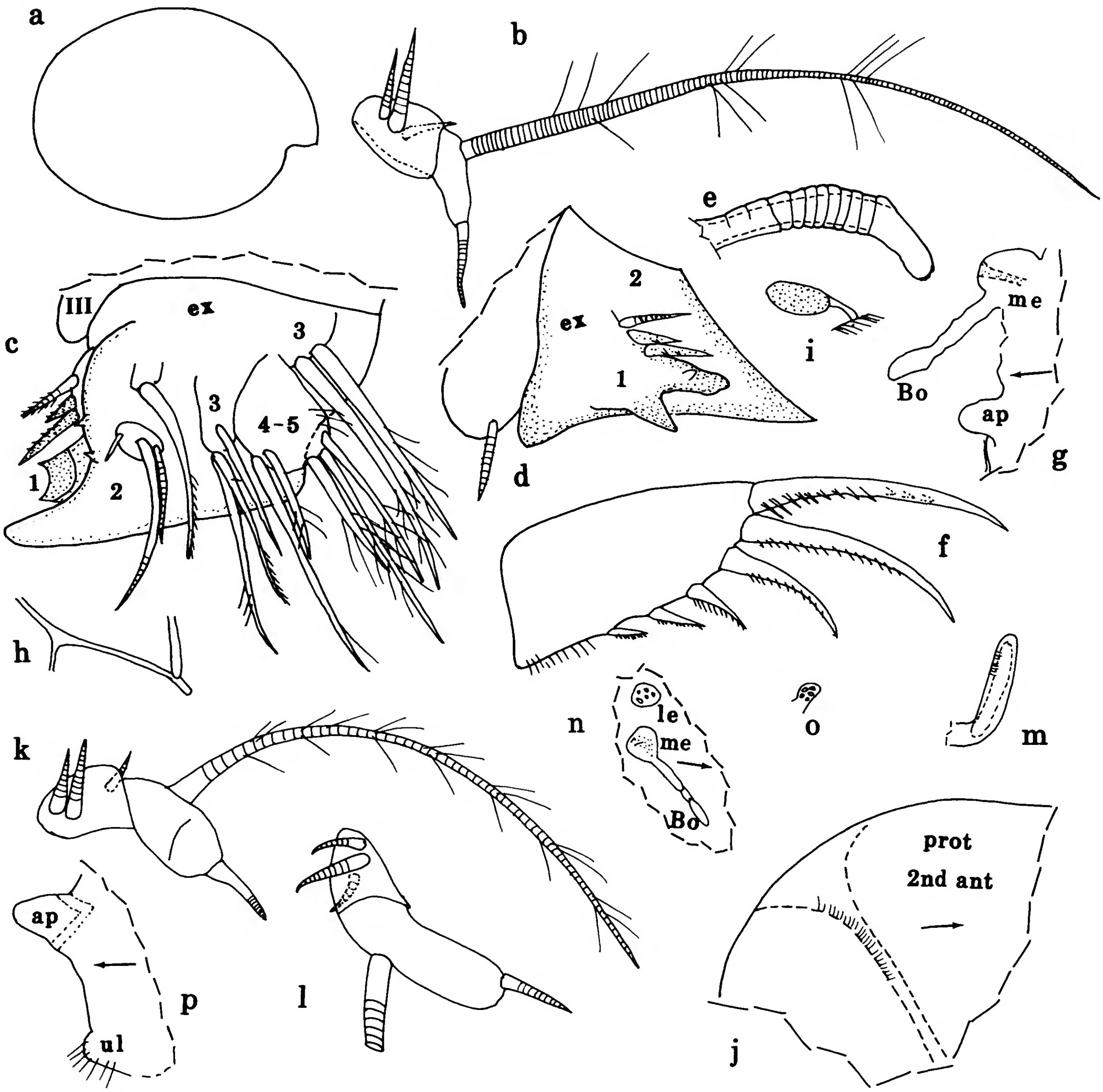

FIGURE 12.—*Euphilomedes carcharodonta* (Smith, 1952), female instar III, USNM 194361: *a*, outline of complete specimen from right side, length 1.07 mm; *b*, endopodite, left 2nd antenna, mv; *c*, tip of right 5th limb, pv; *d*, 1st exopodial joint, left 5th limb as seen through 2nd joint, pv; *e*, 7th limb; *f*, right lamella of furca, lv; *g*, anterior of body from left side; *h*, left Y-sclerite; *i*, ectozoa attached to prodopodite of 2nd antenna. Male instar III, USNM 194369: *j*, portion of protopodite of 2nd antenna, lv; *k*,*l*, endopodites of left and right 2nd antennae, respectively, mv; *m*, 7th limb; *n*, portion of anterior of body from right side (not under cover slip); *o*, right lateral eye; *p*, portion of anterior of body from left side.

in Table 5. Bristles of joints 5–8 not examined in detail but same number as on adult female.

Second Antenna: Protopodite without e-sclerite. Endopodite similar to that of adult female except 1st joint with only 4 bristles (Figure 13*b*). Exopodite with short bare bristles; 9th joint with 5 bristles.

Mandible: Coxale endite, exopodite, and dorsal bristles of basale similar to those of adult female. Distribution of claws and bristles noted in Table 5.

Maxilla: Not examined in detail, but 1st endopodial joint with 1 alpha- and 3 beta-bristles.

Fifth Limb: Main tooth with 1 stout and 3 slender pectinate teeth. Combined 4th and 5th exopodial joints with 6 bristles. Limb otherwise similar to that of adult female. Epipodial and endite bristles not counted.

Sixth Limb: Number of bristles noted in Table 5.

Seventh Limb: With 4 proximal bristles (2 on each side) and 4 terminal bristles (2 on each side); all bristles short and tapered; each bristle with 1 bell and large terminal clapper that could be interpreted to be 2nd bell, and marginal spines. Comb with 1 curved tooth at midwidth and on each side 2 teeth with 3 long prongs and 2 small basal spines (Figure 13*c*). Side opposite comb with blunt inner peg with long spines and pointed outer peg with short spines.

Furca (Figure 13*d*): Each lamella with 8 claws: claws 1, 2, 3, and 5 primary and with medial and lateral teeth, claws 4, 6–8 secondary and with single row of posterior teeth (teeth not shown). Right lamella anterior to left by width of base of claw 1.

Bellonci Organ (Figure 13*e*): Distal part not tapered as in adult.

Eyes: Similar to those of adult female (Figure 13*e*).

Upper Lip (Figure 13*f*): Spinous projection.

Genitalia: Not observed.

Anterior of Body (Figure 13*e,f*): With rounded anterior process.

Posterior of Body: With hairs at midheight.

Y-*Sclerite:* Similar to that of adult female.

Epizoa: USNM 194362 and 194365 with stemmed vase-shaped protistans on rostrum or both on rostrum and ventral to rostrum.

Gut Content: USNM 194362 and 194365 with amber-colored unrecognizable particulate matter in guts. Gut of USNM 194362 also with large rotaloid foram near posterior end.

DESCRIPTION OF INSTAR IV MALE (Figure 13*g–i*; Table 5).—Shape similar to that of instar IV female.

Carapace Size (length, height in mm): USNM 194366, 1.35, 0.96, height 71% of length.

First Antenna: Similar to that of instar IV female (Table 5).

Second Antenna: Protopodite and exopodite similar to that of instar IV female (Table 5). Endopodite 3-jointed (Figure 13*g*): 1st joint with 4 short bristles; 2nd joint with 2 ventral bristles (1 long proximal and 1 short distal); 3rd joint with 2 bristles (1 distal dorsal and 1 shorter terminal).

Mandible: Except for some variability in number of bristles, limb similar to that of instar IV female (Table 5).

Maxilla: Not examined in detail, but 1st endopodial joint with 1 alpha- and 3 beta-bristles.

Fifth Limb, Sixth Limb, Seventh Limb, and *Furca:* Similar to those of instar IV female.

Bellonci Organ (Figure 13*h*): Tip broken off on USNM 194366.

Eyes: Medial eye similar to that of instar IV female (Figure 13*h*). Lateral eye small with light brown pigment and several small cells (Figure 13*h*).

Upper Lip (Figure 13*h*), *Anterior of Body* (Figure 13*h*), and *Posterior of Body:* Similar to those of instar IV female.

Genitalia: Not observed.

Y-*Sclerite:* Fragmented on USNM 194366.

Epizoa: USNM 194366 with stemmed oval protistan on protopodite of 2nd antenna.

Gut Content: USNM 194366 with large rotaloid foram (stippled in Figure 13*i*) in addition to brown unrecognizable particulate matter (short lines in Figure 13*i*).

DESCRIPTION OF INSTAR V FEMALE (Figure 13*j,k*; Table 5).—Shape similar to that of adult female (Figure 13*j*).

Carapace Size (length, height in mm): USNM 194363 (appendages of adult female visible within), 1.72, 1.27, height 74% of length.

First Antenna: Distribution of bristles on joints 1–4 noted in Table 5. Bristles of joints 5–7 not examined in detail but same number as on adult female.

Second Antenna: Protopodite without e-sclerite. Endopodite similar to that of adult female but 1st joint with only 5 bristles (Figure 13*k*). Exopodite with short bare bristles; 9th joint with 6 bristles.

Mandible: Coxale endite, exopodite, and dorsal margin of basale similar to those of adult female; distribution of remaining bristles noted in Table 5.

Maxilla: Not examined in detail, but 1st endopodial joint with 1 alpha- and 4 beta-bristles.

Fifth Limb: Exopodite similar to that of adult female (Table 5). Epipodial and endite bristles not counted.

Sixth Limb: Distribution of bristles shown in Table 5.

Seventh Limb: Same number of bristles as on adult female (Table 5); bristles tapered and with 1–4 bells and marginal spines. Comb with 1 curved claw (with proximal spines) at midwidth and on each side 3 teeth each with 3 long prongs and a basal spine on each side. Pegs opposite comb similar to those of adult female.

Furca: Similar to that of adult female.

Bellonci Organ: Distal part broken off on USNM 194363.

Eyes: Similar to those of adult female.

Upper Lip: Spinous anterior projection with indistinct lateral glandular openings along ventral edge (3 in anterior row; 4 in posterior row).

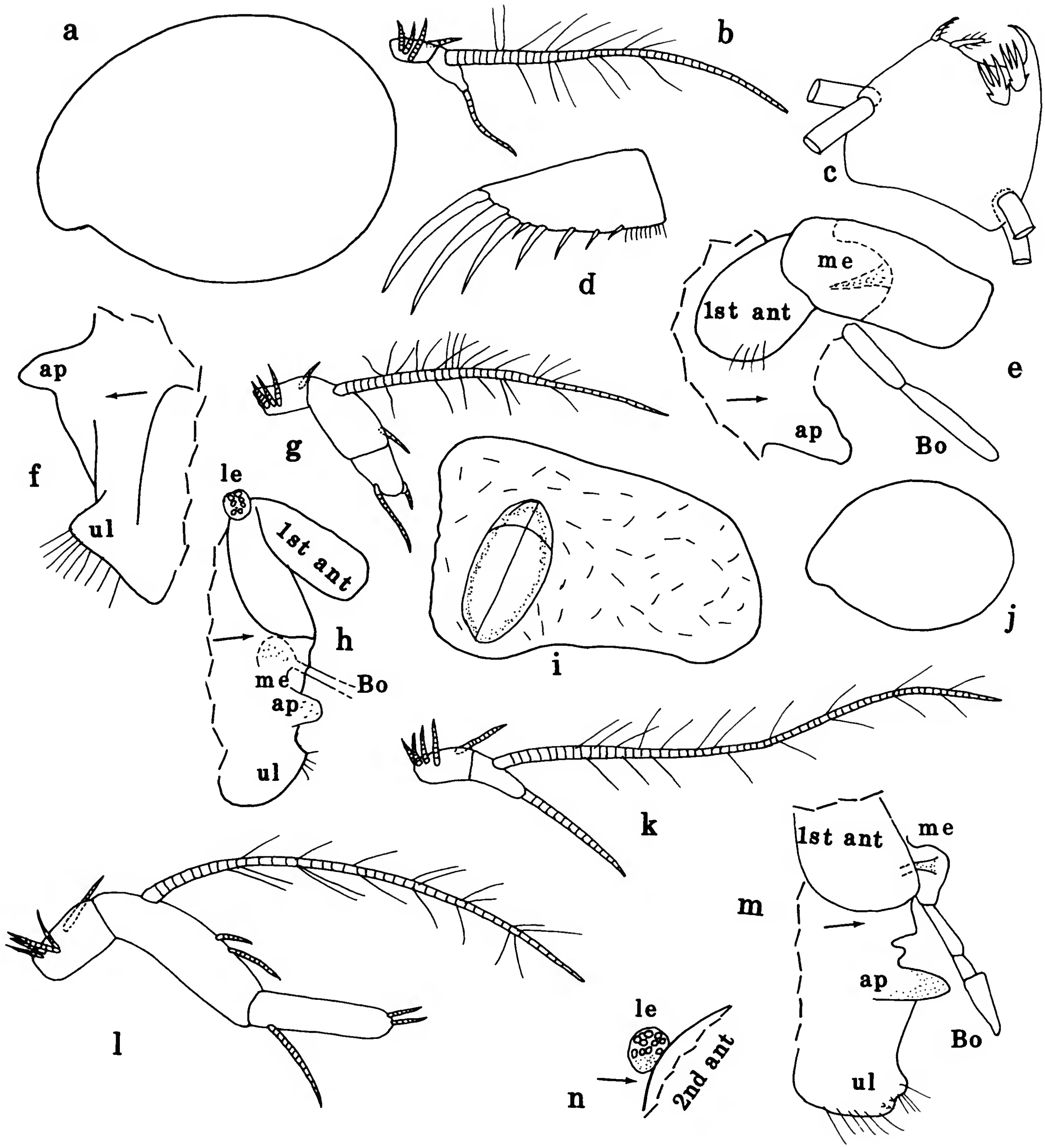

FIGURE 13.—*Euphilomedes carcharodonta* (Smith, 1952), female instar IV, USNM 194362: *a,* outline of complete specimen from left side, length 1.22 mm; *b,* endopodite, left 2nd antenna, mv; *c,* tip of 7th limb; *d,* left lamella of furca, lv; *e,f,* portions of anterior of body from right and left sides, respectively. Male instar IV, USNM 194366: *g,* endopodite, left 2nd antenna, mv; *h,* anterior of body from right side; *i,* portion of of gut containing a foraminiferan. Female instar V, USNM 194363: *j,* outline of complete specimen from left side, length 1.72 mm; *k,* endopodite, left 2nd antenna, mv. Male instar V, USNM 194364: *l,* endopodite, left 2nd antenna, mv; *m,* anterior of body from right side; *n,* right lateral eye.

Genitalia: Not observed.

Anterior of Body: Similar to that of adult female.

Posterior of Body: With hairs at midheight.

Y-*Sclerite:* Similar to that of adult female.

Epizoa: USNM 194363 with stemmed vase-like protistan on rostrum.

Gut Content: USNM 194363 with unrecognizable amber-colored particulate matter in gut.

DESCRIPTION OF INSTAR V MALE (Figure 13*l*–*n*; Table 5).—Carapace similar to that of adult female.

Carapace Size (length, height in mm): USNM 194364, 1.75, 1.26, height 72% of length.

First Antenna: Similar to that of instar V female (Table 5).

Second Antenna: Protopodite and exopodite similar to that of instar V female. Endopodite 3-jointed (Figure 13*l*): 1st joint with 5 short bristles; 2nd joint with 1 long and 2 short ventral bristles; 3rd joint with 1 proximal and 2 terminal bristles.

Mandible: Similar to that of instar V female (Table 5).

Maxilla: Not examined in detail, but 1st endopodial joint with 1 alpha- and 4 beta-bristles.

Fifth Limb: Similar to that of instar V female, but fused 4th and 5th joints fragmented on USNM 194364 and number of bristles could not be counted.

Sixth Limb: Except for number of bristles differing slightly, limb similar to that of instar V female (Table 5).

Seventh Limb: Differs from that of instar V female mainly in having only 4 terminal bristles (Table 5).

Furca: Distribution and number of claws similar to those of instar V female. Spines observed along anterior and posterior edges of secondary claws. Claw 1 with teeth forming medial and lateral rows; claws 2, 3, and 5 with row of lateral teeth.

Bellonci Organ (Figure 13*m*): Distal part tapering to narrowly rounded tip.

Eyes: Medial eye similar to that of instar V female (Figure 13*m*). Lateral eye small with light brown pigment and many small indistinct cells (ommatidia?) (Figure 13*n*).

Upper Lip (Figure 13*m*): Projecting anteriorly, spinous.

Genitalia: Tapered lobes.

Anterior of Body (Figure 13*m*): With rounded projecting anterior process.

Posterior of Body: With few rows of spines at midheight.

Y-*Sclerite:* Fragmented.

Epizoa: USNM 194364 with numerous stemmed vase-shaped protistans on and ventral to rostrum.

Gut Content: Gut of USNM 194364 with 4 rotaloid forams in addition to unrecognizable particulate matter.

REMARKS.—The main difference between the male from Pillar Point Harbor and those described by Smith (1952:16) and Poulsen (1962:376) is the papillate shell surface. It is assumed herein that papillae on the shells of the Canadian specimens were overlooked. Of possible significance is that both terminal pegs of the 7th limb of the adult male of the Pillar Point Harbor specimens are spinous, whereas only the proximal peg is spinous on the male described by Poulsen (1962:381).

ONTOGENY (Table 5).—Hiruta (1980:145) described the ontogeny of *Euphilomedes nipponica* Hiruta, 1976, collected in shallow water off Japan, and Kornicker (1991b:19–21) described the ontogeny of *Euphilomedes climax* Kornicker, 1991b, from hydrothermal vents in the eastern Pacific Ocean. Instars I–V as well as adults were available for those studies. In the present study of *E. carcharodonta* only instars III–V were available in addition to adults (Table 5). The ontogeny of instars III–V and adults of all three species are quite similar (taking into account specific differences). Both *E. nipponica* and *E. climax* have a secondary claw between primary claws 2 and 4, whereas *E. carcharodonta* has a secondary claw between primary claws 3 and 5. In the first two species the secondary claw is added in instar III, whereas in *E. carcharodonta* it is added in instar IV. The addition of 1 bristle in each developmental stage on the 9th exopodial joint of the 2nd antenna conforms with the tabular key of Kornicker (1991b:21).

Poulsen (1962:382) described a single young "female" of the species. Unlike the adult female the juvenile has lateral eyes, and the endopodite of the 2nd antenna differs considerably from that of the adult female. It was mainly because of those unusual characters that the present study of juveniles was undertaken. Based on the present study, it is concluded that Poulsen's young "female" is an instar IV male. The carapace is larger than the 4th instars encountered in Pillar Point Harbor, but the endopodite of the 2nd antenna is almost identical to that of the instar IV male and is unlike that of juvenile females. In addition, juvenile females lack lateral eyes. Poulsen (1962:382) based his sex determination on the lack of any trace of copulatory limbs on the specimen. The copulatory limbs are not visible on the male 4th instar in the present collection and are either absent or difficult to identify. Poulsen (1962:382) also stated that the exopodite of the 5th limb of the following instar, which is visible inside the 5th limb of his specimen, is of the female type. That does not help establish the sex of instar IV, because the 5th limb of the instar V male is also of the female type. Poulsen was aware of this and may not have given much weight to that observation in determining sex, unless he thought that the specimen may have been a 5th instar (A–1 stage), which is possible.

EPIZOA.—Many specimens have long stalked cup-like protistans along the anterior end of the rostrum or on the anteroventral margin ventral to the rostrum. Fewer specimens have round protistans with or without short stems along the posterior edge of the carapace. A few specimens have a few short stemmed ball-like protistans along the edge of the protopodite of the 2nd antenna. Baker (1975:76–79, fig. 17e,j) has previously described stalked cup-like protistans along the anterior edge of *E. carcharodonta.* He also described a hydroid occurring in the same place. The latter was not observed on the few specimens studied herein, but hydroids have been observed on *Philomedes brenda* (Baird, 1850a) collected on the Alaskan continental shelf (Kornicker (1988, fig. 2a,b)).

TABLE 5.—Morphometrics and meristics for selected characters of instars and adults of *Euphilomedes carcharodonta* (b = bristles, c = claws, d = dorsal, l = lateral, m = medial, na = not applicable, nd = no data, p = proximal, t = terminal, v = ventral, – = absent, + = present).

Character	Stage			
	III	IV	V	Adult
	FEMALE			
Carapace length (avg. mm)	1.06	1.24	1.72	2.06
First Antenna				
1st joint bristles	0	0	0	0
2nd joint bristles (v/d/l)	1/1/1	1/1/1	1/1/1	1/1/1
3rd joint bristles (v/d)	1/2	1/2	1/2	1/2
4th joint bristles (v/d)	1/1	2/2	3/2	4/2
Second Antenna				
Endopodite				
1st joint bristles	3	4	5	6
2nd joint bristles	2	2	2	2
3rd joint bristles	na	na	na	na
Exopodite				
9th joint bristles	4	5	6	7
Mandible				
Basale bristle (m/v)	6/2–3	6/4	6/6	6/7–8
Endopodial bristles				
1st joint (v)	3	4	4–5	5
2nd joint (v/d)	4–5/7	5/7	6/10	6/8
3rd joint (c/b)	3/3	3/3	3/4	3/4
Maxilla				
Endopodite				
alpha-bristles	1	1	1	1
beta-bristles	2	3	4	5
Fifth Limb				
1st joint, pectinate teeth	3	4	4	4
4th + 5th joint bristles	5–6	6	7	7
Sixth Limb				
Epipodial bristles	1	2	3	4
Endite bristles	17	21	23–24	25
End joint bristles	7	15	20–21	28
Seventh Limb bristles	0	8	10	10
Bristles (p/t)	0	4/4	4/6	4/6
Bells on bristles	na	1	1–4	3–7
Comb teeth	0	5	7	7
Number of pegs	0	2	2	2
Pegs with spines	na	2	2	2
Furca, claws	6	8	10	10
Lateral eye (–/+)	–	–	–	–
	MALE			
Carapace length (avg. mm)	1.08	1.35	1.75	2.12
First Antenna				
1st joint bristles	0	0	0	0
2nd joint bristles (v/d/l)	1/1/1	1/1/1	1/1/1	1/1/1
3rd joint bristles (v/d)	1/2	1/2	1/2	1/2
4th joint bristles (v/d)	1/1	2/2	3/2	4/2
Second Antenna				
Endopodite				
1st joint bristles	3	4	5	6
2nd joint bristles	2	2	3	2
3rd joint bristles	na	2	3	3
Exopodite				
9th joint bristles	4	5	6	6
Mandible				
Basale bristle (m/v)	6/3	6/5	6/6	6/7
Endopodial bristles				
1st joint (v)	4	3	5	4–6
2nd joint (v/d)	5/8	5/8	5–6/8–9	5–6/7–9
3rd joint (c/b)	3/3	3/3	3/4	3/3–4

TABLE 5.—Continued.

Character	Stage III	IV	V	Adult
Maxilla				
Endopodite				
alpha-bristles	1	1	1	1
beta-bristles	2	3	4	5
Fifth Limb				
1st joint, pectinate teeth	3–4	4	4	na
4th + 5th joint bristles	5–6	6	nd	7
Sixth Limb				
Epipodial bristles	1	2	3	3
Endite bristles	18	20	~25	25
End joint bristles	7	15	~24	27
Seventh Limb bristles	0	6	8	8
Bristles (p/t)	0	4/4	4/4	4/4
Bells on bristles	na	1–2	2–4	5–7
Comb teeth	0	5	6	7
Number of pegs	0	2	2	2
Pegs with spines	na	2	2	2
Furca, claws	6	8	10	10
Lateral eye	+	+	+	+

FEEDING.—According to Cannon (1933:755, 756), in the Philomedidae the mandible kicks up particles of detritus from the sediment, and these particles are sucked into the shell by a current created by the flapping of the epipodial appendage of the 5th limb. The particles are then pushed into the esophagous by appendages around the mouth. Elofsen (1941:465; 1969:215) observed that specimens apparently consume silt without filtering out coarse particles. This type of feeding has been termed "detritus feeder" or "collector" (Turpaeva, 1957:137; Walker, 1972:83; Kornicker, 1975a:40). One or more whole rotaloid forams were observed in the guts of three *E. carcharodonta* studied herein, and they were previously noted in specimens examined by Baker (1975:82). The guts contain mainly unrecognizable amber-colored particulate matter.

SEX RATIO.—In order to study the ontogeny of the species, juveniles were removed from the sample from sta 8B (Jun), which contained 60 specimens, until a male and female of each represented stage were obtained. The nine specimens selected consisted of the following: Instar III—1 male, 3 females; Instar IV—1 male, 2 females; Instar V—1 male, 1 female. The sample contained six adult males; the remaining balance were ovigerous and non-ovigerous females and instars III–V of both sexes.

Euphilomedes morini, new species

FIGURES 14–16, 17*a–l,n,o*, 18

Euphilomedes longiseta.—Tuel et al., 1976:140, 155 [not *E. longiseta* (Juday, 1907)].

ETYMOLOGY.—Named in honor of James G. Morin, University of California.

HOLOTYPE.—USNM 194372, undissected ovigerous female in alcohol.

TYPE LOCALITY.—Sta 1A (Dec), Pillar Point Harbor, Half Moon Bay, California.

PARATYPES.—Pillar Point Harbor: Sta 1A (Dec): USNM 194357, ovigerous female on slide and in alcohol; USNM 194358, adult male on slide and in alcohol; USNM 194370, partly dissected adult male in alcohol; USNM 194371, partly dissected ovigerous female in alcohol; USNM 194373, 6 undissected adult males in alcohol; USNM 194377, instar IV male on slide and in alcohol; USNM 194375, instar IV female on slide and in alcohol; USNM 194374, instar IV female in alcohol; 194376, instar IV female in alcohol; USNM 194378, 8 undissected instar IV's, sex unknown, in alcohol; USNM 194379, partly dissected instar V female in alcohol; USNM 194380, instar V male on slide and in alcohol.

ADDITIONAL MATERIAL.—USNM 194383, 68 undissected adult females and juveniles (some of these could be juvenile *E. carcharodonta)* in alcohol.

DISTRIBUTION.—Pillar Point Harbor, Half Moon Bay, California, depth 1.8 m.

DESCRIPTION OF ADULT MALE (Figures 14, 15; Table 6).—Carapace elongate with shallow incisur (Figure 14*a*).

Ornamentation: Carapace with indistinct small widely separated pits. Long bristles more common along anterior, anteroventral, and posterior margins. (Surface either without minute tubercles that cover surface of shell of *E. carcharodonta*, or with smaller tubercles.)

Infold: Rostral infold with row of 12 spinous bristles (Figure 14*b*); 1 bristle at inner curvature of incisur, then space and row of 5 spinous bristles. Posterior end of ventral infold and posterior infold with row of about 50 small bristles along midwidth, and 2 bristles posterior to row (not all bristles shown in Figure 14*c*).

Selvage: Lamellar prolongation of selvage weakly divided at inner end of incisur. Prolongation with very long marginal hairs except along posterior margin where hairs are short on left valve and absent on right valve.

Carapace Size (length, height in mm): USNM 194358, 1.73, 1.00, height 58% of length. USNM 194370, 1.65, 0.99, height 60% of length. USNM 194373, 4 specimens: 1.79, 1.02, height 57% of length; 1.63, 0.97, height 60% of length; 1.71, 0.99, height 58% of length; 1.68, 0.97, height 58% of length. Range of length (6 specimens) 1.63–1.79; range of height as percent of length 57–60.

First Antenna: 1st joint with short dorsal spines, a few rows of short medial spines, and long lateral hairs in distal dorsal corner. 2nd joint with dorsal, ventral, lateral, and medial spines, and 3 bristles (1 dorsal, 1 ventral, 1 lateral (missing on left limb of USNM 194358)), all with long spines. 3rd joint short with medial and lateral spines and 3 bristles (2 dorsal, 1 ventral), all with short spines. 4th joint with ventral, medial, and lateral spines, and 6 bristles: 2 dorsal with long proximal and short distal spines, and 4 ventral, some with long proximal and short distal spines. 5th joint wedged ventrally between joints 4 and 6, with sensory filament with stout proximal part with numerous long slender filaments, followed by 1 short proximal filament, 3 short subterminal filaments, and 2 short terminal filaments. 6th joint with medial bristle near dorsal margin, with long proximal and short distal spines. 7th joint (Figure 14*d,e*): a-bristle with long proximal and short distal spines; b-bristle same length as a-bristle, with 3 proximal filaments (2 long and 1 short), 2 short subterminal filaments, and 2 short terminal filaments; c-bristle extremely long (about 3 times length of combined lengths of joints 2–8) with 13 short marginal filaments. 8th joint lateral to 7th joint (Figure 14*d*): d-and e-bristles about 1/3 longer than b-bristle, bare with blunt tips; f-bristle slightly shorter than c-bristle, with 12 short marginal filaments; g-bristle about same length as d-bristle, with 5 marginal filaments. A flat medial shield covers basal part of 7th and 8th joints (shield indicated by letter s in Figure 14*d,e*). Under cover slip, joints of left limb of USNM 194358 (Figure 14*d*) narrower than those of right limb (Figure 14*e*) (possibly an artifact of mounting).

Second Antenna: Protopodite with e-sclerite, and without hairs or spines (Figure 14*f*). Endopodite 3-jointed (Figure 14*g,h*): 1st joint with 5 short proximal bristles and 1 long distal bristle with wreath of long spines; 2nd joint with 2 short distal ventral bristles; 3rd joint reflexed on 2nd, with long ringed proximal bristle, 2 small subterminal bristles, and ridges at tip. Exopodite: 1st joint with small straight terminal medial bristle; 2nd joint short, with ventral bristle (with short slender ventral spines near tip) reaching joints 7 or 8; 3rd joint twice length of 2nd joint; bristles of joints 3–8 long and with natatory hairs; 9th joint with 6 bristles (4 long, 2 short) with natatory hairs; joints 3–8 with minute spines on distal dorsal corner.

Mandible: Coxale endite consisting of 3 weakly developed bristles (Figure 14*i*). Basale: medial side with 5 small proximal bristles near ventral margin and 1 short ringed bristle at 1/3 length (Figure 14*i*); 7 long bristles (with wreaths of long spines) on or near ventral margin; dorsal margin with 3 bristles (1 at midlength, 2 subterminal) with wreaths of long spines. Numerous medial rows of long spines on basale and 1st and 2nd endopodial joints. Exopodite about 1/2 length dorsal margin of 1st endopodial joint, with 2 terminal bristles (1 long with long spines, 1 about 1/3 or 1/2 length of long bristle and bare). 1st endopodial joint with 5 ventral bristles (2 long with long spines, 1 long with short spines, 2 short with short spines). 2nd endopodial joint: dorsal margin with 2 long bristles in proximal group and 6 or 7 (5 or 6 long, 1 small) in distal group; ventral margin with spines and 2 distal groups of bristles, each group with 3 long bristles. 3rd endopodial joint with 3 pectinate claws (dorsal claw about 1/3 length of remaining 2 subequal claws) and 4 ringed bristles.

Maxilla: Limb reduced. Precoxale and coxale with hirsute dorsal fringe (Figure 15*b*). Coxale with plumose dorsal bristle (Figure 15*b*). Basale with 2 long distal bristles (1 ventral, 1 dorsal). Exopodite with 3 bristles (2 long, 1 short). 1st endopodial joint narrow with 1 bare alpha-bristle and about 4 beta-bristles (Figure 15*b*). 2nd endopodial joint with about 8 indistinct bristles. Endites with indistinct bristles (Endite I with about 8 bristles, endite II with about 6 bristles, endite III with about 9 bristles) (Figure 15*a*).

Fifth Limb: Endite I with 4 ringed bristles (Figure 15*d*); endite II with about 9 ringed bristles (Figure 15*c*); endite III with about 8 ringed bristles (Figure 15*c*). 1st exopodial joint with broad terminal process and about 5 bristles (2 unringed) (detail in Figure 15*d*). 2nd exopodial joint with broad terminal process and 2 long bristles (detail in Figure 15*d*). 3rd exopodial joint: inner lobe with 1 short and 2 long bare bristles; outer lobe with 2 long plumose bristles (Figure 15*d*). 4th and 5th joints fused, hirsute, with 1 long bristle with widely separated short spines and 5 shorter bare bristles (Figure 15*d*).

Sixth Limb (Figure 15*e*): With 3 short plumose epipodial bristles. Endite I with 1 bare terminal bristle and 2 shorter plumose medial bristles; endite II with 4 bristles (1 long and 2 short terminal, 1 short plumose medial); endites III and IV each with 8 or 9 terminal bristles (endite bristles not shown in Figure 15*e*). End joint with 18 or 19 plumose and spinous bristles. Limb hirsute (hairs not shown).

Seventh Limb: Proximal and terminal groups each with 4 bristles, 2 on each side; bristles with indistinct spines and 3–5 bells, but tips of some bristles (with possible additional bells) broken off. Terminal comb with 5 teeth with long spines, middle tooth longest (Figure 15*f*). Side opposite comb with 2 curved spinous pegs.

Furca (Figure 15*g*): Each lamella with 11 claws; claws 1, 2, 4, and 6 primary; claws 3, 5, 7–11 secondary. Claw 1 with long teeth along posterior edge (proximal 6 or 7 teeth longer); other primary claws and secondary claws with smaller teeth (teeth not shown); long slender medial spines along lamellae at bases of claws (spines not shown). Right lamella anterior to left by width of base of claw 1.

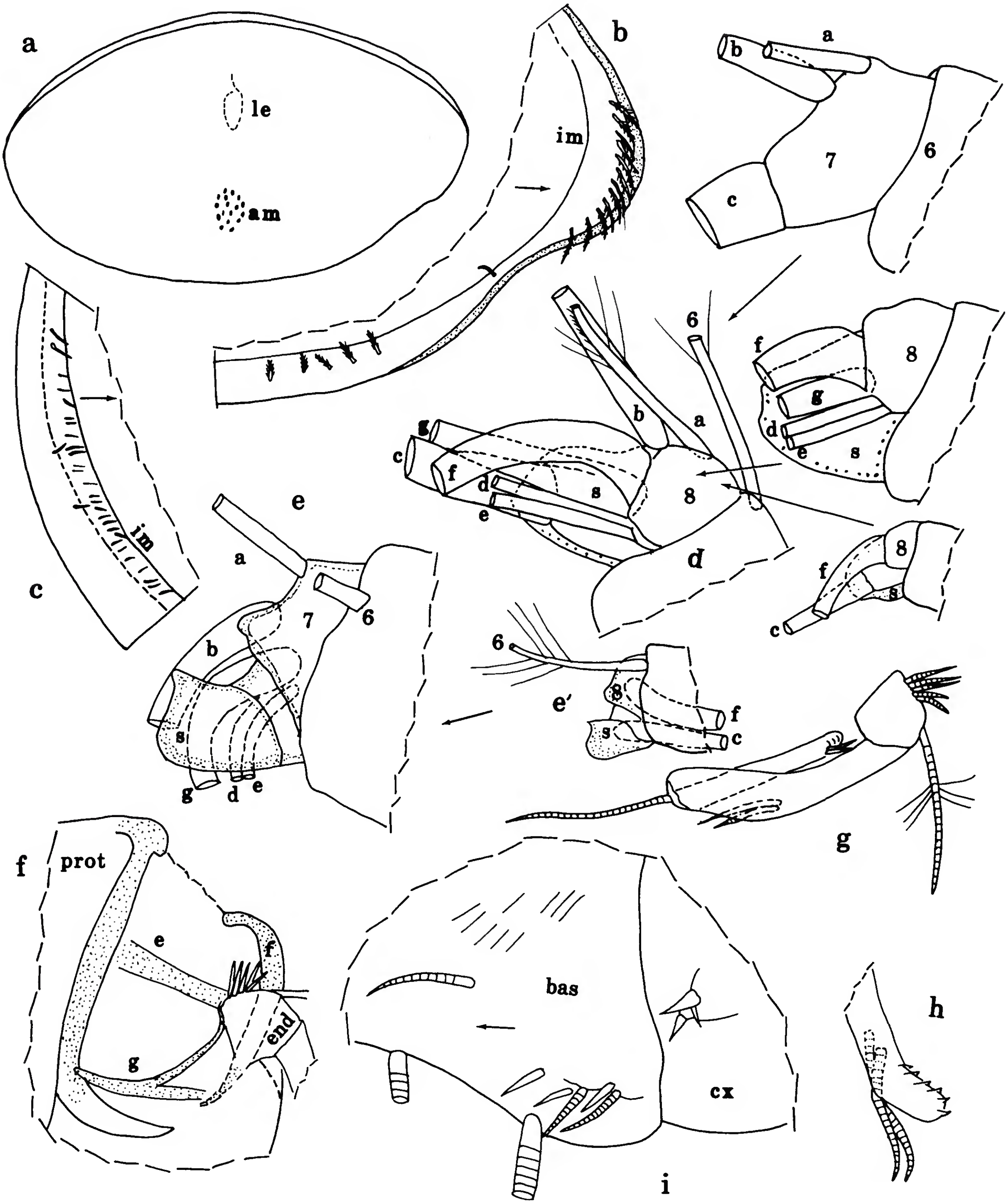

FIGURE 14.—*Euphilomedes morini*, new species, adult male, paratype, USNM 194358: *a*, outline of complete specimen from right side, length 1.73 mm; *b*, anterior left valve, iv; *c*, posteroventral corner left valve, iv; *d*, tip of left 1st antenna with 3 detailed illustrations, lv; *e*, *e'*, tip of right 1st antenna, mv; *f*, portion of left 2nd antenna, mv; *g*, endopodite, left 2nd antenna, mv; *h*, tip of 3rd joint of endopodite, right 2nd antenna, lv; *i*, portion of right mandible, mv.

FIGURE 15.—*Euphilomedes morini*, new species, adult male, paratype, USNM 194358: *a*, endites I–III, right maxilla, lv; *b*, right maxilla with 2 detailed illustrations (nabs), lv; *c*, endites II and III of 5th limb; *d*, 5th limb with two detailed illustrations (nabs); *e*, left 6th limb (endite bristles not shown), lv; *f*, tip of 7th limb (bristles not shown); *g*, left lamella of furca, lv; *h*, portion of anterior of body from left side; *i*, lateral eye (black pigment stippled); *j*, portion of anterior of body from right side; *k*, copulatory organs from right side (furca, which lies between left and right organs, not shown); *l*, posterior of body from left side.

Bellonci Organ (Figure 15*h*): Elongate with short triangular terminal part with narrowly rounded tip.

Eyes: Medial eye with brown pigment (Figure 15*h*). Lateral eye well developed with 33 ommatidia with black pigment (stippled in Figure 5*i*) between them (outline of eye shown in Figure 15*h*).

Upper Lip (Figure 15*j*): Projecting slightly anteriorly.

Genitalia (Figure 15*k*): Elongate with a copulatory limb dangling on each side of furca, with small terminal bristles.

Anterior of Body (Figure 15*h,j*): With sclerotized irregular protuberance at tip of triangular process just ventral to base of 1st antennae.

Posterior of Body (Figure 15*l*): With long spines ventral to midheight.

Y-*Sclerite* (Figure 15*l*): With axe-shaped tip (structure less evident on right sclerite of USNM 194358).

Epizoa: USNM 194373: rostrum of 6 specimens with vase-shaped stemmed protistans. USNM 194370 with similar protistans along rostrum and incisur.

Gut Content: USNM 194370 and 194358 with unrecognizable amber-colored particles in gut.

DESCRIPTION OF ADULT FEMALE (Figures 16, 17*a–l*; Table 6).—Carapace with shallow incisur (Figure 16*a*).

Ornamentation: Carapace with indistinct small widely separated pits. Long bristles along anterior and ventral margins, sparse elsewhere. Outer surface with minute closely spaced papillae (Figure 17*l*), smaller than those of *E. carcharodonta* (Figure 17*m*), and not visible on most specimens.

Infold: Rostral infold with row of 12 or 13 spinous bristles (Figure 16*b*); 1 short spinous bristle at inner curvature of incisur, then space and row of 7 short spinous bristles (4 shown in Figure 16*b*) along outer edge of 5 or 6 ridges paralleling valve edge (Figure 16*b*). 2nd or 3rd ridge from outer edge continues along ventral infold (at midwidth) as narrow list; list indistinct or absent along posterior infold; posterior end of ventral infold along outer edge of list and posterior infold with row of about 70 short bristles on right valve and 35 on left valve, and 7 widely spaced bristles outside of row of short bristles on right valve, and 4 on left valve (not all bristles shown in Figure 16*c*). Part of ventral list of right valve not crenate as on *E. smithi* (Poulsen, 1962:373, fig. 163b).

Selvage (Figure 16*b*): Lamellar prolongation broader on rostrum becoming narrower at small indentation at ventral end of rostrum (Figure 16*b*). Selvage not clearly divided at inner end of incisur but it may be. Prolongation with very long marginal hairs except along posteroventral and posterior margins of right valve.

Carapace Size (length, height in mm): USNM 194357, 1.62, 1.10, height 68% of length. USNM 194372, 1.64, 1.11, height 68% of length. USNM 194371, 1.74, 1.25, height 72% of length. Range of length (3 specimens) 1.62–1.74; range of height as percent of length 68–72.

First Antenna: 1st joint with long and short medial spines, distal lateral row of short spines, and few rows of short dorsal spines. 2nd joint with dorsal and distal lateral spines and 3 bristles (1 ventral, 1 dorsal, 1 lateral) with long spines (Figure 16*d*). 3rd joint short with medial row of minute indistinct spines, row of terminal lateral spines, and 3 bristles (1 ventral with short spines, 2 dorsal bare or with short spines) (bristles not shown). 4th joint with medial and ventral spines and 6 bristles (4 ventral, 2 dorsal) with long spines (bristles not shown). Sensory bristle of long 5th joint with 7 short marginal filaments, 3 short subterminal filaments, and bifurcate tip (bristle not shown). Long medial bristle of minute 6th joint with base near dorsal margin and with long proximal and short distal spines (Figure 16*e*). 7th joint (Figure 16*e*): a-bristle similar to bristle of 6th joint; b-bristle long with 2 short filaments near midlength, 2 subterminal filaments, and bifurcate tip; c-bristle with 5 short marginal filaments, 3 subterminal filaments, and bifurcate tip. 8th joint (Figure 16*e*): d- and e-bristles bare with blunt tips; 2 minute lateral papillae just proximal to d-bristle on short lateral shield (Figure 16*e*); f-bristle with 4 marginal filaments, 3 subterminal filaments, and bifurcate tip; g-bristle with 5 marginal filaments, 3 subterminal filaments, and bifurcate tip; b- to g-bristles about same length as sensory bristle of 5th joint, a-bristle shorter.

Second Antenna: Protopodite without e-sclerite; with long hairs near anterodorsal corner and at midlength of dorsal margin, few minute medial spines in posterodorsal corner, and short spines along distal ventral margin. Endopodite 2-jointed (Figure 16*f,g*): 1st joint with row of 5 short bare proximal bristles and 1 long spinous distal bristle; 2nd joint with very long spinous proximal bristle and short bare terminal bristle. Exopodite: 1st joint with minute medial straight terminal bristle; bristle of 2nd joint reaching well past 9th joint, with abundant slender ventral spines; bristles of joints 3–8 with natatory hairs, no spines; 9th joint with 7 bristles (4 long with natatory hairs, 3 shorter with abundant slender spines); joints 2–8 with row of terminal spines.

Mandible: Coxale endite bifurcate, spinous, with small ringed bristle near base. Basale: medial surface and dorsal and ventral margins with rows of spines, and 5 bristles in proximal ventral corner (3 pectinate unringed, 2 ringed and with long spines), and 1 short ringed bristle (with either short spines only, or both long and short spines) closer to midlength; dorsal margin with 3 long bristles (1 at midlength, 2 subterminal) with long spines; 6 or 7 bristles (with long spines) on or near ventral margin. Exopodite slightly more than 1/2 length of dorsal margin of 1st endopodial joint (Figure 17*h*), with few terminal spines and 2 bristles (proximal very long with long spines at midlength and short spines distally, terminal bristle about 1/4 length of proximal bristle and with short spines; bristles not shown in Figure 17*h*). 1st endopodial joint with medial spines and 4 ventral bristles (3 long with long spines, 1 small with short spines). 2nd endopodial joint: dorsal margin with 2 long bristles (with few long spines) in proximal group and 7 bare

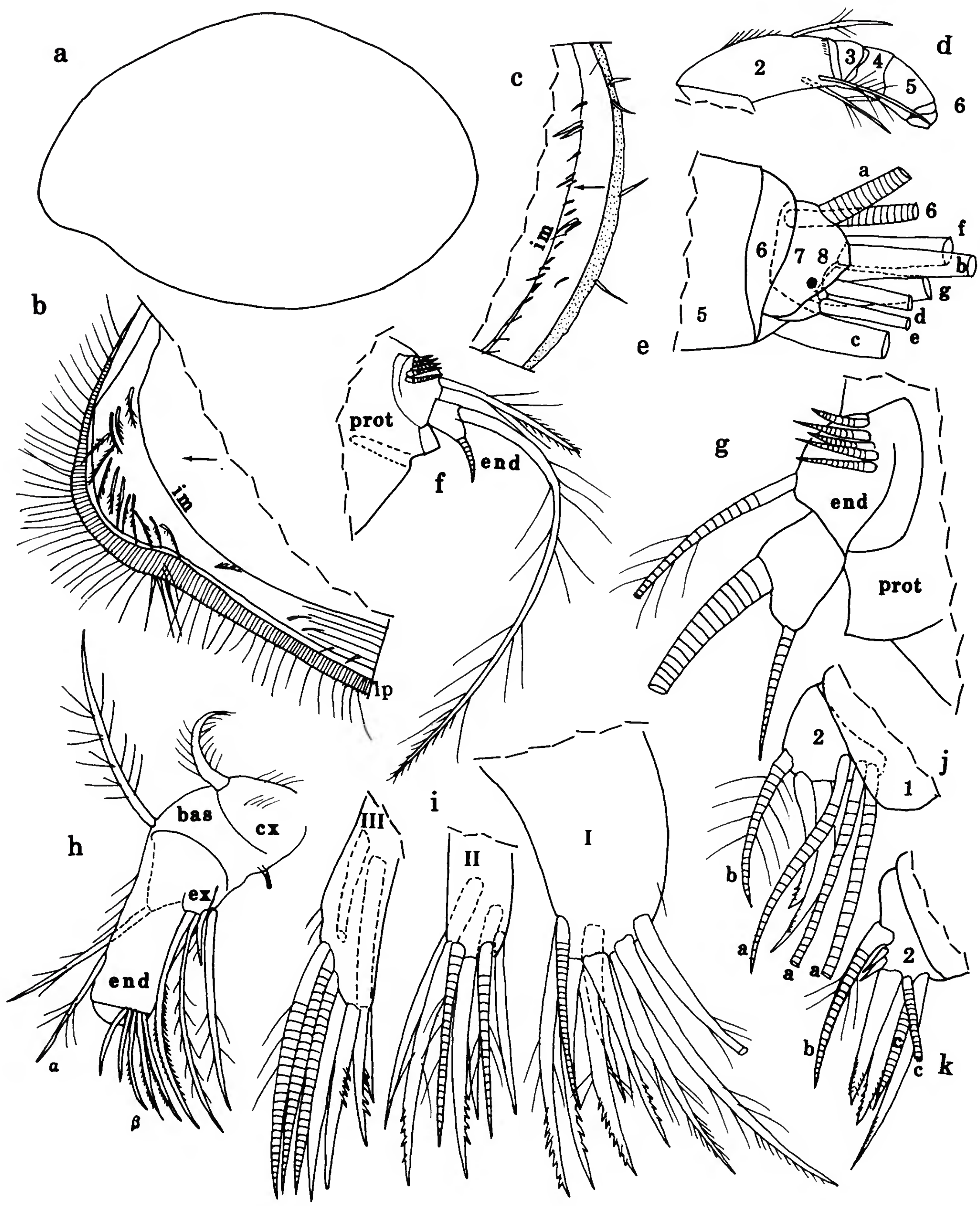

FIGURE 16.—*Euphilomedes morini*, new species, ovigerous female, paratype, USNM 194357: *a*, outline of complete specimen from left side, length 1.62 mm; *b*, anterior right valve, iv; *c*, posterior right valve, iv; *d*, right 2nd antenna (only bristles of 2nd joint shown), lv; *e*, tip of right 1st antenna, lv; *f*, endopodite, left 2nd antenna, mv; *g*, endopodite, right 2nd antenna, mv; *h*, left maxilla (endites and bristles of 2nd endopodial joint not shown), lv; *i*, endites I-III, left maxilla, mv; *j*, 2nd endopodial joint, left maxilla (nabs), lv; *k*, 2nd endopodial joint, right maxilla (nabs), mv.

bristles in distal group (1 short, others long); ventral margin with bristles in 2 distal groups, each with 3 bristles (some with short spines); joint without medial and ventral spines present on adult male. 3rd endopodial joint with 3 pectinate claws (dorsal claw short, about $^{1}/_{4}$ length of longest claw; lateral long claw about $^{3}/_{5}$ length of longest claw), and 4 ringed bristles.

Maxilla: Precoxale and coxale with hirsute dorsal fringe. Coxale with plumose dorsal bristle (Figure 16*h*). Basale with 3 terminal bristles (1 ventral, 1 dorsal, 1 medial) with long spines (Figure 16*h*). Exopodite with 3 bristles (short proximal bristle with few long spines, long middle bristle with long spines, other long bristle with short spines (Figure 16*h*). 1st endopodial joint with dorsal spines, 1 alpha-bristle with long spines, and 5 beta-bristles, bare or with short spines (Figure 16*h*). 2nd endopodial joint with 3 a-bristles (Figure 16*j*), 3 pectinate claw-like bristles, 1 anterior ringed b-bristle with long spines, and 2 ringed c-bristles (Figure 16*k*); right limb only with 2 small spines near base of b-bristle (Figure 16*k*). Endites with stout spinous and pectinate bristles (endite I with 9 bristles, endite II with 7 bristles, endite III with 8 bristles) (Figure 16*i*).

Fifth Limb: Epipodite with 41 bristles. Endites I, II, and III with about 6, 8, and 9 bristles, respectively (Figure 17*a*). 1st exopodial joint: anterior side with 2 bristles (with long spines) on distal edge (Figure 17*b*); outer corner with 2 small bristles (Figure 17*b*); main tooth with 3 slender pointed teeth at midlength, 1 large distal squarish tooth with five prongs, minute peg proximal to pointed teeth, and 1 spinous proximal bristle (Figure 17*d*). 2nd exopodial joint (Figure 17*b,c*): posterior side with 1 proximal and paired (usual 3rd bristle not observed, possibly obscured) distal bristles (longer unringed pectinate, shorter ringed and with few spines) near inner edge (Figure 17*c*), and minute spinous bristle in outer distal corner (Figure 17*b*).

Sixth Limb: Epipodial bristles fragmented. Endite I with 3 bristles; endite II with 4 bristles; endites III and IV each with 8 bristles. End joint with 21 or 22 bristles (6 or 7 posterior bristles plumose, most remaining bristles with long proximal hairs or spines and short distal spines). Limb hirsute.

Seventh Limb: Proximal group with 4 bristles (2 on each side with 4 bells) and 6 terminal bristles (3 on each side with 3–5 bells); all bristles with well defined marginal spines. Terminal comb with 7 slender teeth; 2 slender curved spinous pegs opposite comb (Figure 17*e*).

Furca (Figure 17*f*), *Bellonci Organ* (Figure 17*g,h*), and *Upper Lip* (Figure 17*g,k*): Similar to those of adult male.

Eyes: Lateral eyes absent. Medial eye similar to that of adult male (Figure 17*g,h*).

Genitalia: Not observed.

Anterior of Body (Figure 17*g,h,k*): Anterior process horn-like.

Posterior of Body (Figure 17*i*): Similar to that of adult male.

Y-*Sclerite* (Figure 17*j*): Similar to that of adult male.

Epizoa: USNM 194371 with ovoid stemmed protistans along rostrum.

Gut Content: USNM 194357 with unidentified minute brown particles in gut.

Eggs: USNM 194357 with 19 eggs in marsupium, length of typical egg 0.20 mm. USNM 194371 with 15 well developed eggs, each with visible black medial eye, length excluding transparent sack, 0.32 mm.

DESCRIPTION OF INSTAR IV MALE (Figure 17*n–p*; Table 6).—Carapace similar in shape to that of adult female (Figure 17*n*). (USNM 194377 with appendages of instar V indistinctly visible within appendages of instar IV.)

Carapace Size (length, height in mm): USNM 194377, 1.14, 0.78, height 68% of length.

Second Antenna: Protopodite without e-sclerite; with long medial hairs in distal dorsal corner, and few rows of minute medial spines in proximal dorsal corner. Endopodite 2-jointed (Figure 17*o*): 1st joint with 3 short proximal bristles and 1 long distal bristle; 2nd joint elongate with 1 long spinous proximal bristle, 1 small ventral bristle at midlength, and 2 short terminal bristles, all bristles ringed. Exopodite: 1st joint with minute straight medial terminal bristle; bristle of 2nd joint reaching well past 9th joint, with abundant slender ventral spines; bristle of 3rd joint slightly longer than bristle of 2nd joint, with few slender spines at midlength; bristles of joints 4–8 longer, with natatory hairs; 9th joint with 5 bristles (2 long with natatory hairs, 3 shorter with slender spines); joints 3–8 with small spines along distal edges.

Seventh Limb: Proximal and terminal groups each with 4 short tapered bristles with marginal spines and 1 bell. Terminal comb with about 5 teeth; 2 curved pegs opposite comb.

Furca: With 9 claws on each lamella; claws 1, 2, 4, and 6 primary; claws 3, 5, and 7–9 secondary.

Bellonci Organ (Figure 17*p*): Elongate with rounded tip.

Eyes: Medial eye pigmented (Figure 17*p*). Lateral eye consisting of clear sac containing pigmented eye (with several ommatidia) belonging to next instar (Figure 17*p*).

Upper Lip (Figure 17*p*): Projecting anteriorly.

Genitalia: None observed.

Anterior of Body (Figure 17*p*): With large projecting anterior process.

Posterior of Body: With long hairs ventral to midheight.

Epizoa: None on USNM 194377.

Gut Content: USNM 194377 with unidentified amber-colored particles within gut.

Remarks: The carapace of USNM 194377 contains large anastomosing calcareous nodules, but none are in the shell of the next instar, which lies inside the old shell. This suggests that the new shell may not contain calcium.

DESCRIPTION OF INSTAR IV FEMALE (Figure 18*a–d*; Table 6).—Carapace shape similar to that of adult female (Figure 18*a*).

Carapace Size (length, height in mm): USNM 194374, 1.14, 0.79, height 69% of length. USNM 194375, 1.12, 0.75,

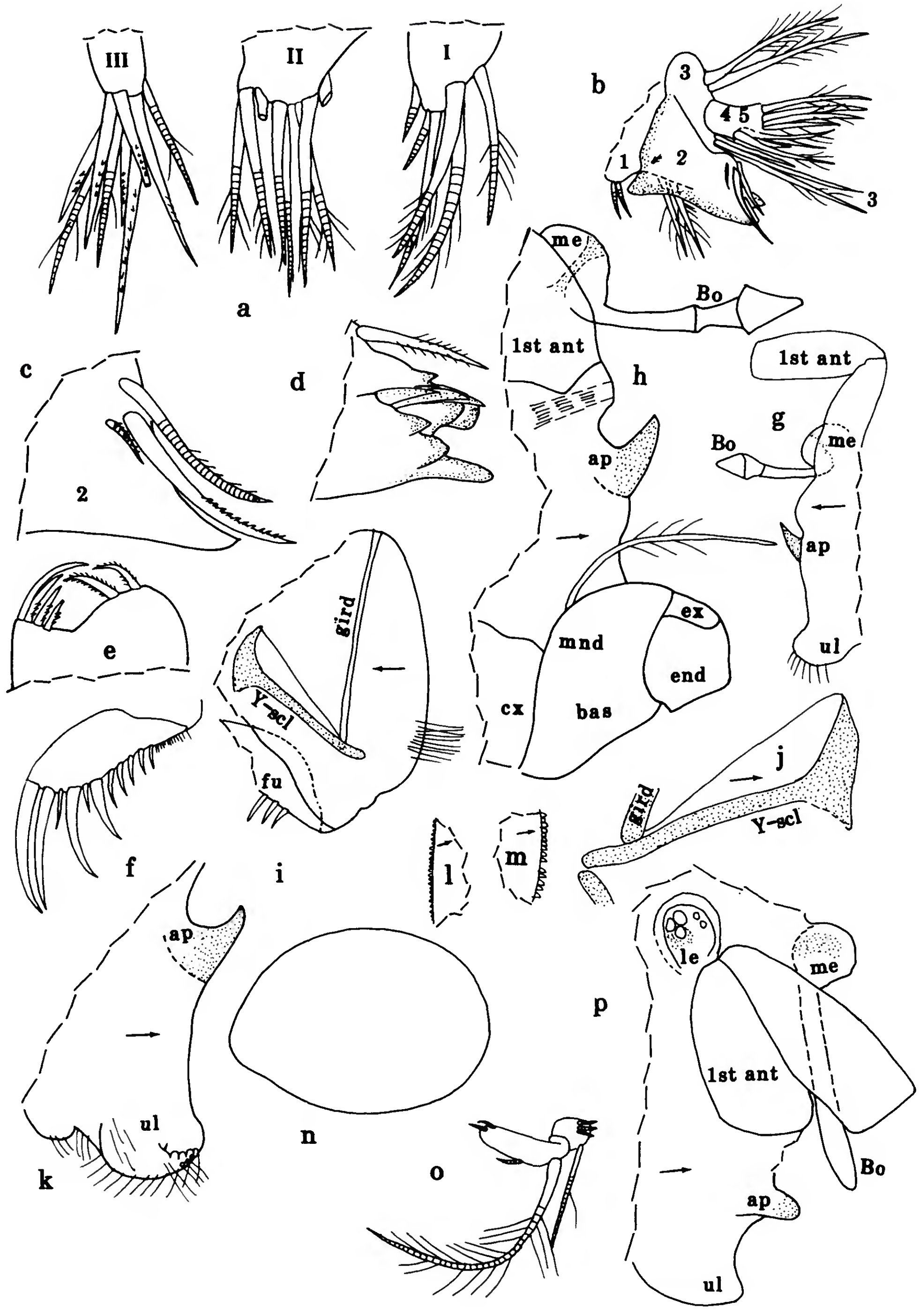

FIGURE 17.—*Euphilomedes morini*, new species, ovigerous female, paratype, USNM 194357: *a*, endites I-III, left 5th limb; *b*, tip of left 5th limb, pv; *c*, detail from *b*; *d*, main tooth of 1st exopodial joint, right 5th limb, av; *e*, tip of 7th limb (not all comb teeth shown); *f*, left lamella of furca, lv; *g,h*, anterior of body from left and right sides, respectively; *i*, posterior of body from left side (Y-sclerite stippled); *j*, Y-sclerite from right side; *k*, anterior process and upper lip from right side; *l*, posteroventral edge of left valve, iv. *Euphilomedes carcharodonta* (Smith, 1952), adult female, USNM 194356: *m*, edge of rostrum of left valve (drawn at same magnification as *l*), iv. *Euphilomedes morini*, new species, male, instar IV, paratype, USNM 194377: *n*, outline of complete specimen from left side, length 1.14 mm; *o*, endopodite, left 2nd antenna, mv; *p*, anterior of body from right side.

height 67% of length. USNM 194376, 1.17, 0.79, height 68% of length.

Second Antenna: Protopodite and exopodite similar to those of instar IV male. Endopodite 2-jointed (Figure 18*b*): 1st joint with 3 small bare proximal bristles and 1 long spinous distal bristle; 2nd joint with long spinous proximal bristle and short bare terminal bristle; all bristles ringed.

Seventh Limb: Bristles similar to those of instar IV male; terminal comb with a tooth consisting of 3 long prongs on each side of longer unpronged tooth (Figure 18*c*); 2 curved bare pegs opposite comb.

Furca: USNM 194375 with 8 or 9 claws on each lamella; claws 1, 2, 4, 6, primary; claws 3, 5, and 7 to 8 or 9 secondary. USNM 194374 and 194376 with 9 claws on each lamella and claws 3, 5, and 7–9 secondary.

Bellonci Organ (Figure 18*d*): Similar to that of instar IV male.

Eyes: Medial eye similar to that of instar IV male (Figure 18*d*). Lateral eye absent.

Genitalia: None observed.

Anterior of Body (Figure 18*d*) and *Posterior of Body:* Similar to those of instar IV male.

Y-*Sclerite:* Anterior end axe-shaped, similar to that of adult.

Epizoa: None on USNM 194374 and 194375. USNM 194376 with vase-shaped stemmed protistans along incisur and anteroventral edge of valves.

Gut Content: USNM 194374, 194375, 194376 with unidentified brown and amber-colored particulate matter in gut.

DESCRIPTION OF INSTAR V MALE (Figure 18*e–g*; Table 6).—Carapace similar to that of adult female (Figure 18*e*).

Carapace Size (length, height in mm): USNM 194380, 1.47, 1.02, height 69% of length.

Second Antenna: Protopodite without e-sclerite; with few long medial hairs in anterodorsal corner and long dorsal hairs near midlength. Endopodite 3-jointed (Figure 18*f*): 1st joint with 4 short bare proximal bristles and 1 long spinous distal bristle; 2nd joint elongate, with 1 long spinous proximal ventral bristle and 2 short bare ventral bristles at midlength; 3rd joint elongate with 1 proximal dorsal bristle and 2 short terminal bristles. Exopodite: bristle of 2nd joint with abundant slender ventral spines; bristles of joints 3–8 long and with natatory hairs; 9th joint with 6 bristles (3 long with natatory hairs, 3 shorter with short slender spines).

Seventh Limb: Proximal group with 4 short tapered bristles, each with 2 bells; terminal group with 4 longer slightly tapered bristles, each with 3 bells; all bristles with marginal spines. Terminal comb with few teeth opposite 2 curved pegs.

Furca: Each lamella with 10 claws; claws 1, 2, 4, and 6 primary; claws 3, 5, 7–10 secondary.

Bellonci Organ (Figure 18*g*): Similar in outline to that of adult female.

Eyes (Figure 18*g*): Medial eye with black pigment (stippled) similar to that of adult female. Lateral eye small with black pigment (stippled) and few indistinct ommatidia.

Genitalia: None observed.

Anterior of Body (Figure 18*g*): With prominent anterior process.

Posterior of Body: With long hairs ventral to midheight.

Y-*Sclerite:* With axe-shaped anterior end.

Epizoa: None on USNM 194380.

Gut Content: USNM 194380 with brown unidentified particles in gut.

DESCRIPTION OF INSTAR V FEMALE (Figure 18*h–k*; Table 6).—Carapace similar in shape to that of adult female (Figure 18*h*).

Infold: Rostrum with 13 bristles on left valve and 16 on right valve. Remaining infold similar to that of adult female, but bristles not counted.

Selvage: Similar to that of adult female.

Carapace Size (length, height in mm): USNM 194379, 1.44, 1.01, height 70% of length.

Second Antenna: Protopodite without e-sclerite; with long medial hairs in anterodorsal corner and at midlength of dorsal margin, and few short medial rows of minute spines in posterodorsal corner. Endopodite with 4 instead of 5 short proximal bristles on 1st joint, otherwise similar to that of adult female (Figure 18*i*). Exopodite: bristle of 2nd joint with abundant ventral spines; bristles of joints 3–8 long and with natatory hairs; 9th joint with 6 bristles (3 long with natatory hairs, 3 shorter with slender spines).

Seventh Limb: Proximal group with 4 tapered bristles (2 on each side, each with 2 bells and marginal spines); terminal group with 6 tapered bristles (3 on each side, each with 1–3 bells and marginal spines). Terminus with comb of about 5 teeth opposite 2 curved pegs.

Furca: Each lamella with 10 claws; claws 1, 2, 4, and 6 primary, claws 3, 5, and 7–10 secondary.

Bellonci Organ (Figure 18*j*): Similar in outline to that of adult female.

Eyes: Medial eye similar to that of adult female (Figure 18*j*). Lateral eye absent.

Genitalia: None observed.

Anterior of Body (Figure 18*j*) and *Posterior of Body:* Similar to those of adult female.

Y-*Sclerite* (Figure 18*k*): With axe-shaped anterior end.

Epizoa: None on USNM 194379.

Gut Content: USNM 194379 with unrecognizable brown particulate matter in gut.

ONTOGENY (Table 6).—In general, similar to that of *E. carcharodonta.* Differences observed are that in *E. morini* furcal claws are added more gradually, and the 3rd joint of the endopodite of the 2nd antenna of the instar IV male has not separated from the 2nd joint.

EPIZOA.—Many specimens with stalked cup-like protistans along anterior of rostrum similar to those of *E. carcharodonta.*

FEEDING.—The gut of all closely examined specimens contained amber-colored or brown particulate matter similar to that of *E. carcharodonta,* but none contained forams.

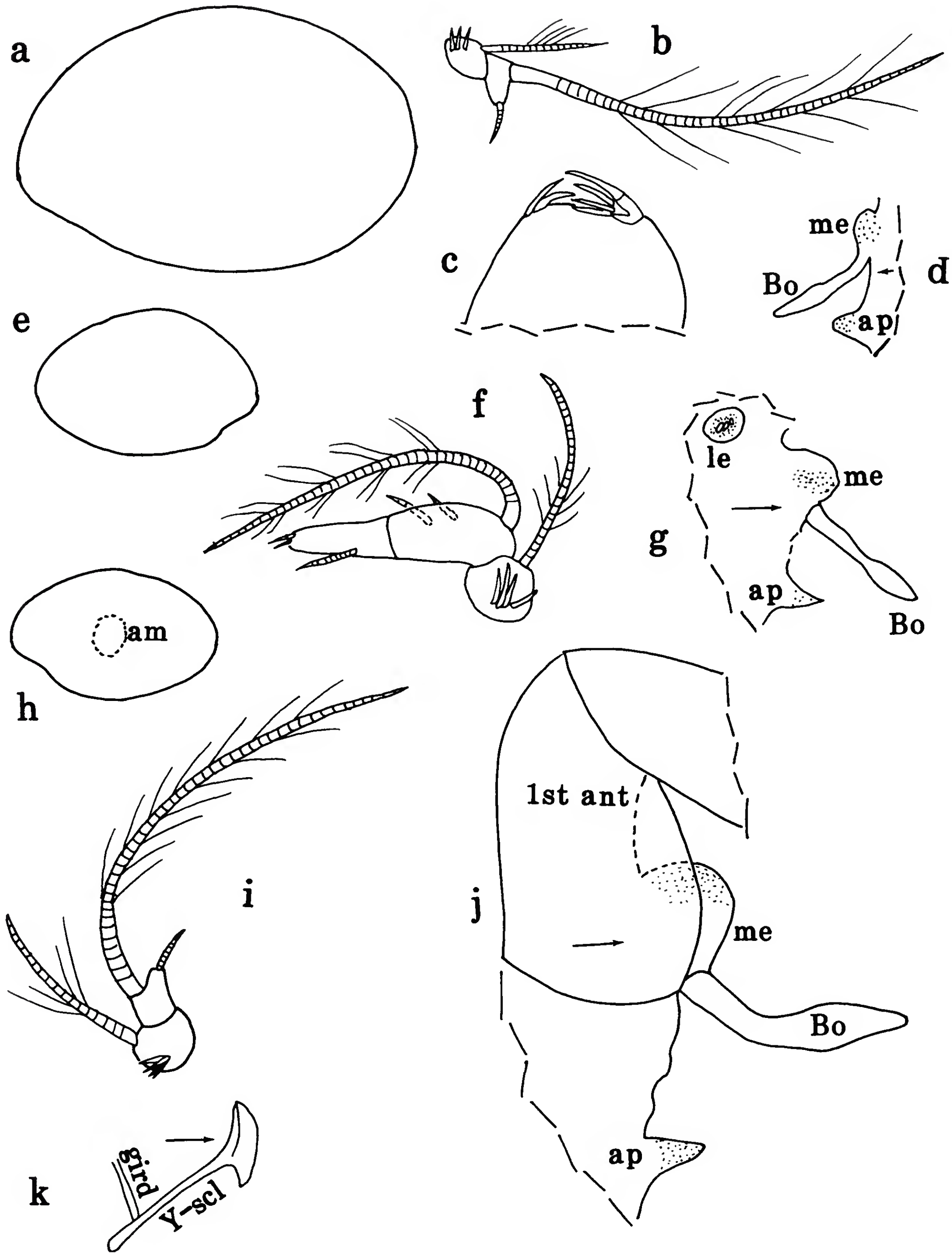

FIGURE 18.—*Euphilomedes morini*, new species, female, instar IV, paratype, USNM 194375: *a*, outline of complete specimen from left side, length 1.12 mm; *b*, endopodite, left 2nd antenna, mv; *c*, tip of 7th limb; *d*, portion of anterior of body from left side. Male, instar V, paratype, USNM 194380: *e*, outline of complete specimen from right side, length 1.47 mm; *f*, endopodite, right 2nd antenna, mv; *g*, portion of anterior of body from right side. Female, instar V, paratype, USNM 194379: *h*, outline of complete specimen from left side, length 1.44 mm; *i*, endopodite, left 2nd antenna, mv; *j*, portion of anterior of body from right side; *k*, right Y-sclerite.

TABLE 6.—Morphometrics and meristics for selected characters of instars and adults of *Euphilomedes morini*, new species (na = not applicable, p = proximal, t = terminal, – = absent, + = present).

Character	Stage		
	IV	V	Adult
		FEMALE	
Carapace length (avg. mm)	1.14	1.44	1.67
Second Antenna			
Endopodite			
1st joint bristles	4	5	6
2nd joint bristles	2	2	2
3rd joint bristles	na	na	na
Exopodite			
9th joint bristles	5	6	7
Seventh Limb bristles			
Bristles (p/t)	4/4	4/6	4/6
Bells on bristles	1	1–3	3–5
Number of pegs	2	2	2
Furca, claws	9	10	11
Lateral eyes	–	–	–
		MALE	
Carapace length (avg. mm)	1.14	1.47	1.69
Second Antenna			
Endopodite			
1st joint bristles	4	5	6
2nd joint bristles	4	2	2
3rd joint bristles	na	3	3
Exopodite			
9th joint bristles	5	6	6
Seventh Limb			
Bristles (p/t)	4/4	4/4	4/4
Bells on bristles	1	2–3	3–5
Number of pegs	2	2	2
Furca, claws	9	10	11
Lateral eye	+	+	+

SEX RATIO.—In order to study the ontogeny of the species, juveniles were picked (until a male and female of each stage present were obtained) from the sample from sta 1A (Dec), which contained about 100 specimens. The six specimens selected consisted of the following: Instar IV—1 male, 3 females; Instar V—1 male, 1 female. The sample also contained eight adult males and three ovigerous females; the balance were nonovigerous females and instars IV and V of both sexes.

COMPARISONS.—Juday (1907:140) described only the adult male of *Euphilomedes longiseta* from San Diego, California. He illustrated the endopodite of the 2nd antenna (pl. XVIII: fig. 14) and described it (p. 141), in part, as follows: "The basal portion of the third joint bears a very long, peculiar seta; the proximal half of this seta is large and has thin walls similar to those of the joints; this tapers down to a small annulated portion." That bristle on the adult male of *E. morini* is a normal slender annulated bristle. The length of the carapace of the male *E. longiseta* given by Juday (1907:141) is 1.9 mm; that of the male *E. morini* is slightly smaller, 1.63–1.79 mm. Lucas (1931:399) and Smith (1952:18) described the adult female *E. longiseta* from the Vancouver Island region, Canada. The terminal seta on the illustrated 3rd endopodial joint of the 2nd antenna (Smith, 1952, pl. II: fig. 11) is twice the length of the 3rd joint, compared to less than 1 1/2 times on *E. morini*, the 3rd endopodial joint is narrower on *E. longiseta*, and the length of the carapace of *E. longiseta* is 1.8 mm compared to 1.62–1.74 mm for *E. morini*. According to Lucas (1931:399) the adult male specimens in her collection were similar to those of Juday (1907) so, presumably, the proximal bristles of the 3rd endopodial joints of the 2nd antennae are similar. The specimens of Juday, Lucas, and Smith are not extant and cannot be reexamined. *Euphilomedes smithi* Poulsen, 1962:373, was described from a female collected in the Pacific off Panama. It differs from the female of *E. morini* in having 13 compared to 11 furcal claws on each lamella, and in the carapace being smaller: length 1.3 mm, compared to 1.62–1.74 mm.

The furca of *E. morini* differs from that of *E. carcharodonta* in having a secondary bristle between the 2nd and 4th primary claws, rather than between the 3rd and 5th primary claws (distribution of claws of the furca are often visible through the carapace), and the carapace is smaller. The outer surface of the valves of *E. carcharodonta* bear abundant minute papillae larger and more evident than those of *E. morini*; papillae are seen best along the edges of disarticulated valves, and they are not always clearly visible on unopened specimens. The lamellar prolongation at the inner end of the incisur is more clearly divided into two parts on *E. carcharodonta*. Juveniles of *E. morini* have natatory hairs on many exopodial bristles of the 2nd antenna, whereas similarly placed bristles of *E. carcharodonta* are bare. Adult *E. carcharodonta* in the collection are a darker amber color than adult and juvenile *E. morini*. Instars IV and V of *E. morini* have a long distal bristle on the 1st endopodial joint of the 2nd antenna; this bristle is short on instars IV and V of *E. carcharodonta*. The Y-sclerite has a normal ventral branch on *E. carcharodonta* and an unusual axe-shaped anterior end on *E. morini*.

The carapace of *E. morini* differs from that of *E. producta* Poulsen, 1962, in lacking a sclerotized triangular process in the posterodorsal corner. (*Euphilomedes producta* has been reported along the Pacific coast from Canada to southern California (Baker, 1977:245).)

DISCUSSION.—The juveniles of *E. morini* (only instars IV and V are known) are unusual in that they have natatory hairs on exopodial bristles of joints 3–9 of the 2nd antenna, which indicates that they are capable of swimming. Other members of the Philomedidae known to have natatory hairs in juveniles are in the Pseudophilomedinae: *Pseudophilomedes darbyi* Kornicker (in Kornicker and Iliffe, 1989:9), and *P. kylix* Kornicker and Iliffe (in Kornicker and Iliffe, 1989:11, 28). These hairs indicate that the juveniles of *E. morini* are capable of swimming, whereas those of *E. carcharodonta* are unable to swim.

The Y-sclerite of *E. morini* is unusual in having an axe-shaped anterior tip, which probably developed by the fusing of the usual ventral and dorsal branches present on other Philomedidae. The axe-shaped Y-sclerite may warrant proposal of a new genus.

RUTIDERMATIDAE Brady and Norman, 1896

This family contains two subfamilies: Rutidermatinae Brady and Norman, 1896, and Metaschismatinae Kornicker, 1994. Only the former has been reported in the vicinity of North and South America.

RUTIDERMATINAE Brady and Norman, 1896

This subfamily contains three genera of which only *Rutiderma* Brady and Norman, 1896, has been reported off the Californian coast.

Rutiderma Brady and Norman, 1896

Including the new species described herein, six species of this genus have been reported from off the coast of California: *R. apex,* new species, *R. chessi* Kornicker and Myers, 1981, *R. juday* McKenzie, 1965, *R. lomae* (Juday, 1907), *R. rostratum* Juday, 1907, and *R. rotundum* Poulsen, 1965. For distributional data of the genus from the Southern California continental shelf see Baker (1975) and Kornicker and Myers (1981).

DISTRIBUTION.—This genus is cosmopolitan between latitudes 45°N and 53°S and intertidal to 317 m (questionably collected at 1834 m) (Cohen and Kornicker, 1987:3).

Rutiderma apex, new species

FIGURES 19–25

Rutiderma sp. Tuel et al., 1976:155.

ETYMOLOGY.—From the Latin *apex* (tip, top).

HOLOTYPE.—USNM 158263, undissected ovigerous female in alcohol.

TYPE LOCALITY.—Pillar Point Harbor, Half Moon Bay, California, Sta 9A (Dec).

PARATYPES.—Pillar Point Harbor: Sta 5A (Jun): USNM 194349, undissected adult male in alcohol. Sta 5C (Jun): USNM 194335, undissected adult male in alcohol. Sta 6A (Dec): USNM 194333, undissected specimen in alcohol (length 1.16 mm, height 0.80 mm); USNM 194334, adult male in alcohol with body removed and some appendages missing. Sta 6B (Jun): USNM 194332, 2 undissected adult females in alcohol. Sta 6C (Sep): USNM 194337, undissected ovigerous female in alcohol (length 1.18 mm, height 0.86 mm); USNM 194338, 3 undissected specimens (includes A-1 male) in alcohol. Sta 8B (Jun): USNM 194331, undissected adult female in alcohol; USNM 158264, adult male on slide and in alcohol; USNM 194336, 2 undissected ovigerous females in alcohol. Sta 9A (Dec): USNM 158262, ovigerous female on slide and in alcohol. Dark Gulch, Mendocino County, 29 Jan 1986: USNM 194339, ovigerous female with body removed from carapace, in alcohol; USNM 194340, 2 undissected juveniles in alcohol. Dark Gulch, Mendocino County, 12 May 1992: USNM 194341, 7 undissected specimens in alcohol (1 adult male, 1 ovigerous female, 3 adult females, 2 juveniles); USNM 194342, partly dissected adult male in alcohol. Tamales Bay: USNM 158269, 1 undissected ovigerous female in alcohol; USNM 194343, 78 undissected specimens in alcohol.

DISTRIBUTION.—California coast: Stations 5–9, Pillar Point Harbor, Half Moon Bay, depth range 1.8–5.2 m; Dark Gulch, Mendocino County, 39°14.5′N, 123°45.8′W, depth 9.1–11 m; Tomales Bay (detailed station data unavailable).

DESCRIPTION OF ADULT FEMALE (Figures 19–22).—Carapace oval in lateral view with convex ventral and dorsal margins, moderately well-developed incisur, small rostrum with slight overhang when viewed laterally, and small projecting caudal process with slightly rounded tip (Figures 19, 20) (projection of caudal process negligible in some specimens).

Ornamentation (Figures 19, 20): Each valve with 2 well-developed ribs (Figure 19): 1 above (rib 1) and 1 below (rib 2) central adductor muscle attachments; anterior ends of both ribs terminates at about $^{1}/_{3}$ valve length, upper rib slightly longer; posterior end of rib 1 terminates in small process just reaching (or just reaching past) posterior edge of valve, and a small projecting process present between posterior end of rib and valve edge; posterior end of rib 2 broadly rounded and joins a vertical rib that connects with posterior end of upper rib 1; vertical rib distinctly concave posteriorly and shape constant for species (Figure 20*d,g,i-k*). Many large irregular shallow fossae (much better developed in some specimens than in others) on surface between anterior ends of both ribs and the

FIGURE 19.—*Rutiderma apex,* new species, ovigerous female, paratype, USNM 158262: complete specimen from left side, length 1.18 mm.

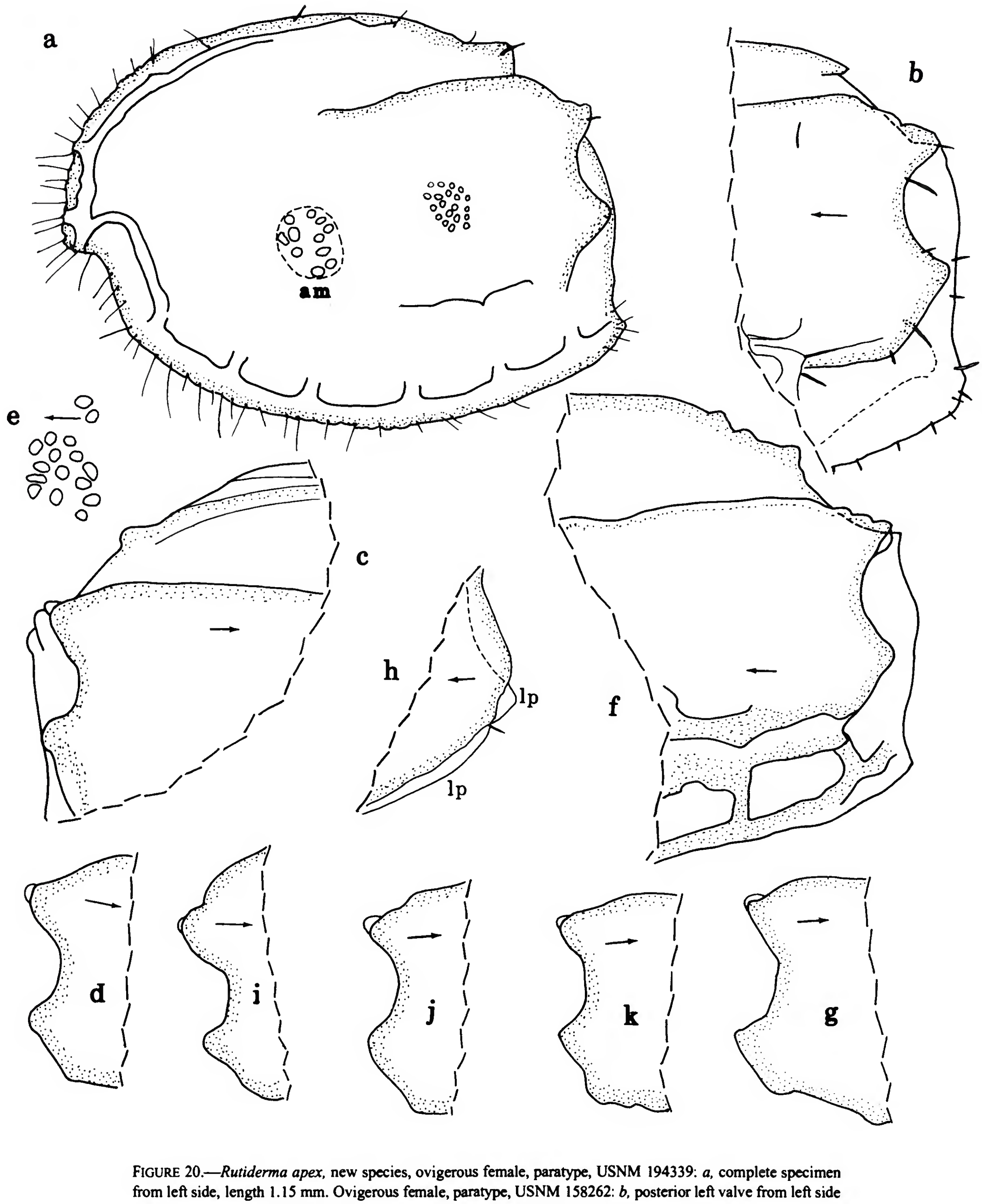

FIGURE 20.—*Rutiderma apex*, new species, ovigerous female, paratype, USNM 194339: *a*, complete specimen from left side, length 1.15 mm. Ovigerous female, paratype, USNM 158262: *b*, posterior left valve from left side (valve length 1.2 mm), ov; *c*, portion of posterior right valve from right side (valve length 1.15 mm), ov; *d*, posterior end of ribs of right valve shown in *c*; *e*, central adductor muscle attachments of left valve, ov. Ovigerous female, paratype, USNM 158269: *f*, posterior end of left valve from left side (length of specimen 1.21 mm), ov; *g*, posterior end of ribs of right valve, ov. Adult female, paratype, USNM 194331: *h*, tip of caudal process of complete specimen from left side showing lamellar prolongation (lp) of selvage of left valve (length of specimen 1.18 mm), ov. *i–k*, Posterior ends of ribs of right valves, ov: *i*, ovigerous female, holotype, USNM 158263 (length of specimen 1.25 mm); *j*, ovigerous female, paratype, USNM 194341 (length of specimen 1.15 mm); *k*, ovigerous female, paratype, USNM 194337 (length of specimen 1.18 mm).

short vertical rib just posterior to incisur; valve surface ventral to rib 2 with large irregular shallow fossae (better developed in some specimens than in others); some specimens with few large irregular fossae between ribs 1 and 2. Dorsal end of the short vertical rib posterior to incisur bends anteriorly and intersects a 3rd rib lying just within anterodorsal and dorsal valve margins. Oblique posterodorsal margin of valve posterior to midlength fairly straight and with projecting triangular process near midlength (Figure 20*a*); this process appears as posterior end of 3rd rib on some specimens (Figures 19, 20*b,c*), but on most specimens 3rd rib appears to terminate anterior to triangular process (Figure 20*a*); this process better developed in some specimens than in others but observed on all specimens; process rarely with 2 or 3 adjacent nodes (Figure 20*f*). A 4th rib lies along ventral edge of valve (Figures 19, 20*a*); 6 or 7 short radial riblets (better developed in some specimens than in others) extend dorsally from 4th rib. Anterior end of 4th rib terminates anteriorly at anteroventral valve curvature (Figure 19); rib 4 near anterior end intersects the short vertical rib posterior to incisur (Figures 19, 20*a*). Posterior edge at midheight of each valve without small projecting process present on valves of *Rutiderma judayi* McKenzie, 1965 (Kornicker and Myers, 1981, fig. 17). Surface of valves including ribs and bottoms of large fossae with abundant minute round fossae. Undivided bristles very sparsely distributed on valve surface but more abundant (some with broad bases) along anterodorsal, anteroventral, and ventral margins. Anterodorsal and anteroventral margins, and anterior $^3/_4$ of ventral margin scalloped (Figure 19).

Infold: Rostral infold with 10 long bristles forming row parallel to anterior margin of rostrum (Figure 21*a*); 2 small bristles present at inner corner of incisur; anteroventral infold with row of 10 or 11 bristles (only 7 bristles and 2 sockets shown in Figure 21*a*). Anterior ridge of infold of caudal process more distinct at posterior end but visible to about $^1/_3$ valve length measured from dorsal end of valve, with 16 small bristles along edge (not all shown in Figure 21*b*); 1 small bristle in pocket posterior to posterior end of ridge, and row of 3 small bristles on infold dorsal to posterior end of ridge (Figure 21*b*).

Selvage: Wide lamellar prolongation present along anterior, posterior, and ventral margins; with hirsute fringe along anterior and ventral margins; prolongation divided at inner corner of incisur, and with indentation at bristle at tip of caudal process (detail in Figure 21*b*).

Central Adductor Muscle Attachments (Figure 20*e*): With 16 ovoid attachments.

Carapace Size (length, height in mm): Pillar Point Harbor: USNM 158262, 1.20, 0.87. USNM 158263, 1.25; 0.91. USNM 194331, 1.18, 0.90. USNM 194332, 2 specimens, 1.23, 0.89; 1.20, 0.89. USNM 194336, 1.25, 0.91. USNM 194337, 1.18, 0.86. Dark Gulch: USNM 194339, 1.15, 0.90. USNM 194341 (ovigerous female), 1.20, 0.94. Tamales Bay: USNM 158269, 1.21, 0.91.

First Antenna (Figure 21*c*): 1st joint with rows of minute medial spines. 2nd joint with 2 spinous bristles (1 lateral, 1 dorsal) and spines forming row along distal lateral margin and dorsal margin. 3rd and 4th joints fused; 3rd joint short with 3 spinous bristles (2 dorsal, 1 ventral); 4th joint long with 3 spinous bristles (1 dorsal, 2 ventral). 5th and 6th joints fused. Sensory bristle of long 5th joint with minute proximal filament. Medial bristle of minute 6th joint short spinous. 7th joint: a-bristle spinous, about same length as bristle of 6th joint; b-bristle almost twice length of a-bristle, bare; c-bristle about same length as sensory bristle of 5th joint, bare. 8th joint: d-and e-bristles about same length as c-bristle, bare with blunt tips; f-bristle about twice length of b-bristle, with short proximal filament; g-bristle about same length as c-bristle, with short proximal filament. Some bristles of 7th and 8th joints with spine at tip.

Second Antenna (Figure 21*d*): Protopodite bare: Endopodite single jointed with 4 short proximal anterior bristles. Exopodite: 1st joint with minute straight medial terminal bristle; bristle of 2nd joint reaching to about 9th joint, with row of minute blunt ventral spines and minute hook-like spine at tip; bristles of joints 3–5 longer but with similar ventral spines; bristles of joints 6–8 longer, with natatory hairs, but no spines; 9th joint with 6 bristles (3 long and 1 short with natatory hairs, 2 (dorsal) minute bare).

Mandible (Figure 21*e*): Coxale endite well developed, bifurcate, pectinate, with long hairs at base. Basale: dorsal margin with 3 bristles (1 at midlength, 2 just distal to midlength); medial surface near ventral margin with 4 proximal bristles (1 (proximal) long spinous, 2 short pectinate, 1 short bare), 1 near midlength minute, and 1 distal long. 1st endopodial joint with medial spines and 2 small ventral bristles. 2nd endopodial joint: medial surface spinous; dorsal margin with 3 short slender proximal bristles; ventral terminal margin with 2 short a-bristles, 1 small b-bristle with broad base, 1 stout claw-like c-bristle with proximal dorsal peg-like process, serrate dorsal margin, and curved tip, and 2 short lateral d-bristles. 3rd endopodial joint with 3 slender medial a-bristles, broad unringed b-bristle with perpendicular spines along edges, and stout claw-like terminal c-bristle with minute medial process near dorsal edge of curved tip.

Maxilla (Figure 22*a,b*): Endite I with 2 stout pectinate claws and 2 ringed spinous bristles (Figure 22*a*); endite II with 2 pectinate claws and 3 ringed bristles; endite III with 3 pectinate claws, 3 distal bristles, and 1 proximal ringed bristle. Precoxale and coxale with dorsal fringe of long hairs; coxale with ringed spinous dorsal bristle. Basale with 3 short distal ringed bristles (1 dorsal spinous, 1 medial with few spines, 1 ventral (ventral bristle shown in Figure 22*b*)). Exopodite with 2 bristles (1 short, 1 long) (Figure 22*b*). 1st endopodial joint with medial and dorsal spines, 1 spinous alpha-bristle and 1 spinous beta-bristle. 2nd endopodial joint with 2 terminal pectinate claws (inner of these stouter), and 5 short ringed spinous bristles (2 lateral a-bristles, 1 medial b-bristle proximal

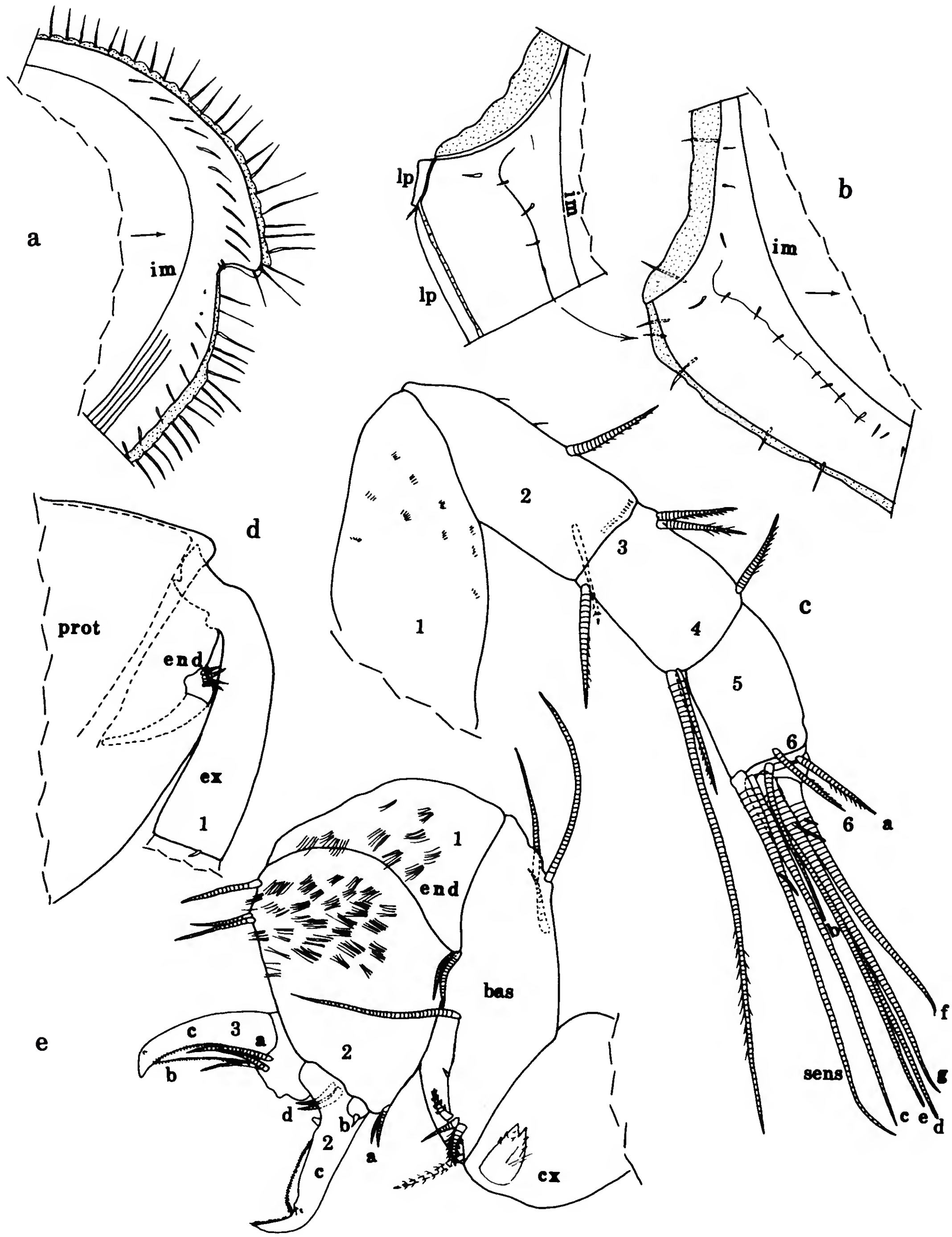

FIGURE 21.—*Rutiderma apex*, new species, ovigerous female, paratype, USNM 158262: *a*, anterior left valve, iv; *b*, caudal process, left valve, iv; *c*, left 1st antenna, mv; *d*, portion of left 2nd antenna, mv; *e*, right mandible, mv.

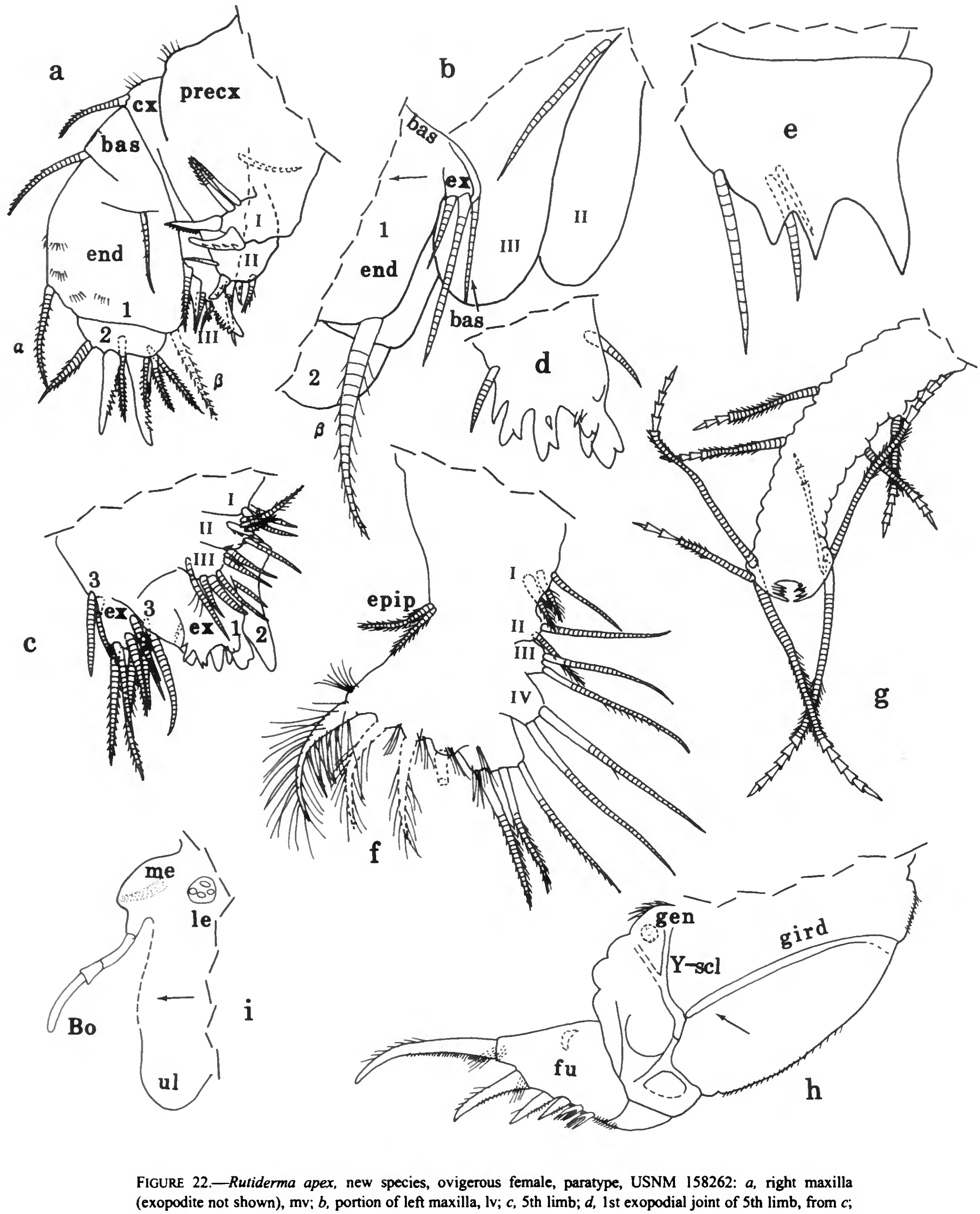

FIGURE 22.—*Rutiderma apex*, new species, ovigerous female, paratype, USNM 158262: *a*, right maxilla (exopodite not shown), mv; *b*, portion of left maxilla, lv; *c*, 5th limb; *d*, 1st exopodial joint of 5th limb, from *c*; *e*, 2nd exopodial joint of 5th limb, from *c*; *f*, 6th limb; *g*, 7th limb; *h*, posterior of body from left side; *i*, anterior of body from left side.

to inner terminal claw, 1 bristle on outer edge dorsal to outer terminal claw, and 1 slightly lateral bristle near base of inner terminal claw).

Fifth Limb: Epipodite with 37 bristles; proximal and distal bristles shorter than others. Endite I with 2 short ringed bristles; endite II with 6 bristles; endite III with 6 or 7 bristles (not all endite bristles shown in Figure 22*c*). Main tooth with 4 constituent teeth (Figure 22*d*): proximal tooth small smooth; 2nd to 4th teeth larger and with marginal teeth; 1 ringed bristle proximal to smooth tooth, and 1 ringed bristle on margin proximal to 4th tooth. 2nd exopodial joint consisting of large flat sclerotized tooth having 3 smooth lobes forming inner margin, 1 proximal ringed bristle on inner margin, and 2 smaller posterior ringed bristles near proximal lobe of inner margin of flat tooth (Figure 22*e*). Inner and outer lobes of 3rd endopodial joint each with 2 ringed bristles (Figure 22*c*). 4th and 5th exopodial joints fused, with total of 5 ringed bristles.

Sixth Limb (Figure 22*f*): With 2 epipodial bristles. Endite I with 3 bristles; endites II—IV each with 2 bristles. End joint with projecting anterior part broader than endite IV, with 3 terminal bristles; posterior part of distal margin of end joint with 4 bristles (posterior 3 plumose).

Seventh Limb (Figure 22*g*): With 4 proximal bristles, 2 on each side, each with 3 or 4 rings and marginal spines. Terminus with 6 bristles, 3 on each side, each with 2-5 bells and marginal spines; distal end of terminus with opposing combs, each with about 6 alate teeth.

Furca (Figure 22*h*): Each lamella with 4 primary claws followed by 2 secondary claws; claw 1 with lateral and medial rows of teeth along posterior edge, some teeth longer than others, and lateral teeth longer than medial teeth; claw 2 with lateral and medial rows of teeth smaller than those of claw 1; claws 3 and 4 with slender spines along posterior margin; secondary claws 5 and 6 with long slender spines along posterior edge (proximal spine stouter than others); claws 1 and 2 with long medial hairs near base; long hairs on lamellae between and following secondary claws; claw 1 with slender spines along anterior margin; claws 2 and 3 with few anterior spines; right lamella with spines along anterior margin (distal spines longer). Right lamella anterior to left by more than width of base of claw 1.

Bellonci Organ (Figure 22*i*): Elongate with broad, short, central part, and broadly rounded tip.

Eyes (Figure 22*i*): Lateral eye small with 4 amber-colored ommatidia. Medial eye bare with brown pigment (stippled).

Genitalia: Small amber-colored oval on each side of body anterior to Y-sclerite (Figure 22*h*). USNM 158262 with few spines in vicinity of genitalia (Figure 22*h*).

Upper Lip (Figure 22*i*): Simple lobe.

Posterior of Body (Figure 22*h*): With numerous spines.

Y-*Sclerite:* USNM 158262 with ventral branch weakly developed (Figure 22*h*).

Number of Eggs: USNM 158262 with 4 eggs in marsupium and several smaller unextruded eggs; length of 1 extruded egg 0.25 mm. USNM 158263, 194336, 194339, and 194340 each with 4 eggs in marsupium. USNM 194337 and 158269 with 3 eggs in marsupium. Ovigerous females were present in Pillar Point Harbor all 3 months that were sampled (Jun, Sep, Dec). An ovigerous female was also collected in May in Dark Gulch.

DESCRIPTION OF ADULT MALE (Figure 23–25*a–f*).—Carapace with posterior end of alar process similar to that of adult female (Figure 23); other ribs absent or subdued; surface with abundant minute round fossae similar to those of carapace of adult female (not shown).

Infold: Not examined.

Carapace Size (length, height in mm): Pillar Point Harbor: USNM 158264, 1.29, 0.79. USNM 194334, 1.28, 0.81. USNM 194349, 1.22, 0.75. Dark Gulch: USNM 194341, 1.30, 0.86. USNM 194342, 1.32, 0.85.

Central Adductor Muscle Attachments (Figure 24*a,b*): With 15–17 small ovoid attachments.

First Antenna (Figure 24*c*).—1st joint bare. 2nd joint with short spinous dorsal bristle distal to midlength, 1 distal lateral bristle, ventral spines, medial spines in ventral half, and distal lateral spines. 3rd joint well defined, shorter on medial side than on lateral side, with 3 bristles (1 ventral, 2 dorsal). 4th joint with 4 bristles (3 ventral, 1 dorsal). 5th joint small, wedged ventrally between 4th and 6th joints; sensory bristle with stout proximal part having obtuse distal end bearing numerous thin filaments, 1 small filament just distal to stout proximal part, 1 or more minute spines near midlength, and minute terminal spine. 6th joint with short spinous medial bristle near dorsal margin. 7th joint: a-bristle spinous, about same length as bristle of 6th joint; b-bristle about 3 times length of a-bristle, with 2 small proximal filaments and minute spine at tip; c-bristle extremely long, with 11 short filaments, each with 2 spines at

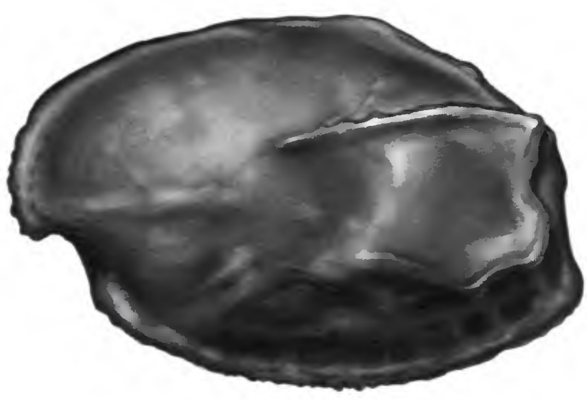

FIGURE 23.—*Rutiderma apex*, new species, adult male, paratype, USNM 158264: complete specimen from left side, length 1.29 mm.

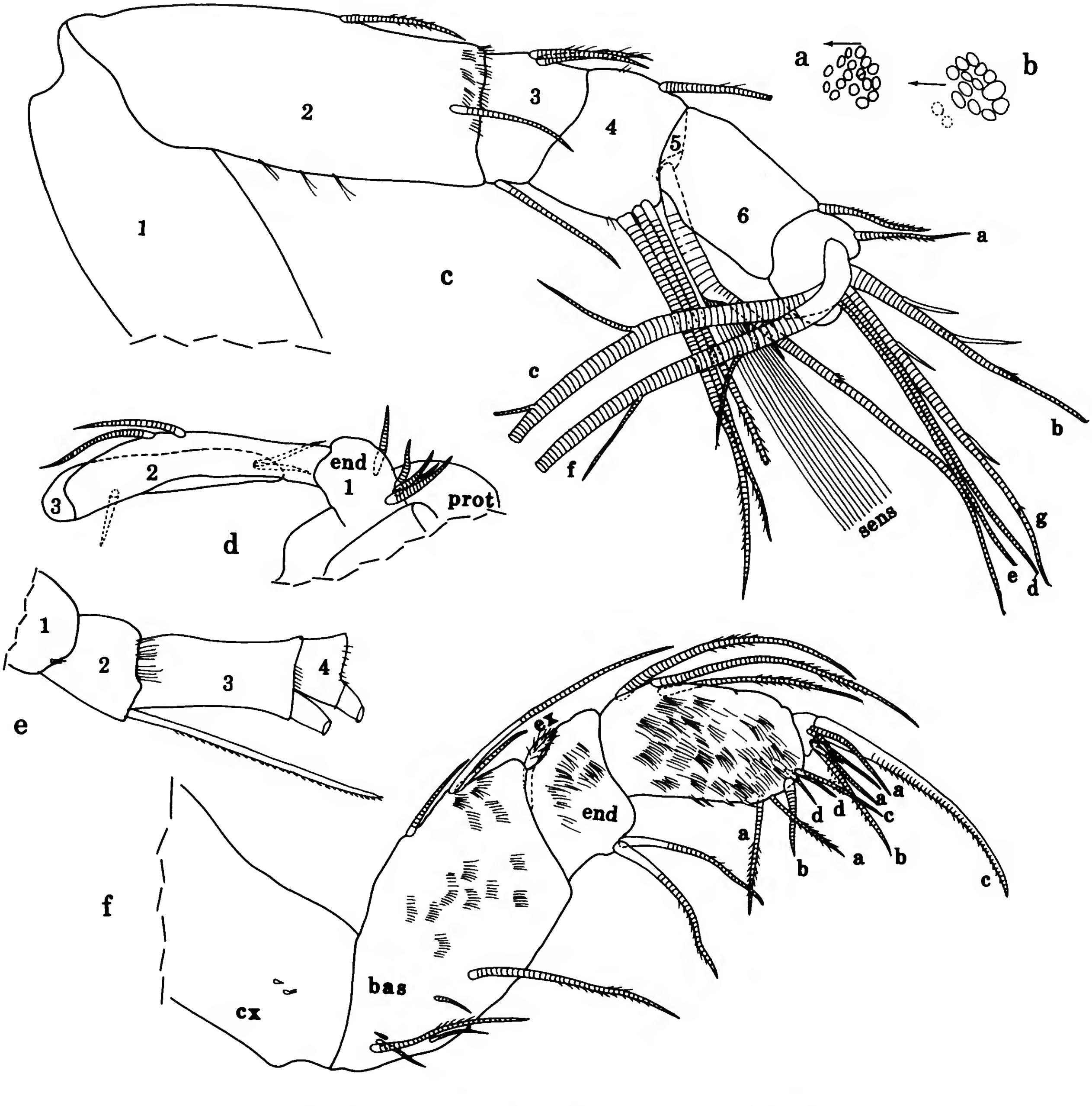

FIGURE 24.—*Rutiderma apex*, new species, adult male, paratype, USNM 158264: *a*, central adductor muscle attachments of left valve, ov; *b*, central adductor muscle protruding from left side of body removed from shell, ov; *c*, right 1st antenna, lv; *d*, endopodite, right 2nd antenna, mv; *e*, portion of exopodite, left 2nd antenna, lv; *f*, left mandible, mv.

tip. 8th joint: d- and e-bristles slightly longer than b-bristle, bare with blunt tips; f-bristle similar to c-bristle, g-bristle longer than b-bristle, with 1 or 2 short proximal filaments and minute spine at tip.

Second Antenna: Protopodite bare. Endopodite 3-jointed (Figure 24*d*): 1st joint small with 5 short anterior bristles; 2nd joint elongate with 2 small bristles near midlength; 3rd joint elongate, reflexed on 2nd joint, with short proximal bristle (bristle missing but socket visible on USNM 158264, and dashed bristle shown in Figure 24*d* drawn from right limb of USNM 194341) and 2 small subterminal bristles. Exopodite (Figure 24*e*): 1st joint elongate with minute straight medial spine on distal margin; 2nd joint short with 2 rows of long lateral spines along distal edge; ventral bristle of 2nd joint reaching 6th joint, with few proximal ventral spines followed by smaller spines in 6 linear sections (sections not well defined in Figure 24*e*); 3rd joint about twice length of 2nd joint, with spines along distal edge, and long ventral bristle with natatory hairs but no spines (Figure 24*e*); bristles of joints 4–8 with natatory hairs, no spines; joint 9 with 1 short bare medial bristle near dorsal edge and 4 long terminal bristles with natatory hairs.

Mandible (Figure 24*f*): Coxale endite represented by 2 minute distal medial spines near midwidth. Basale: dorsal margin with 3 bristles; medial surface with 6 bristles near ventral margin and rows of spines. Exopodite finger-like, hirsute. 1st endopodial joint: medial surface spinous; ventral margin with 2 bristles. 2nd endopodial joint: medial surface spinous; dorsal margin with 3 proximal bristles; distal ventral margin with 2 slender spinous a-bristles, 1 small bare b-bristle, 1 spinous c-bristle, and 2 small d-bristles. 3rd endopodial joint with 3 or 4 small a-bristles (some with spines), 1 spinous b-bristle, and a stout claw-like spinous c-bristle.

Maxilla (Figure 25*a*): Limb extremely small, details difficult to resolve. With 3 endites: I with 5 bristles; II with about 4 bristles; III with about 6 bristles. Precoxale and coxale with fringes of long hairs. Basale with 2 spinous distal bristles (1 ventral, 1 dorsal). Small exopodite with 2 bristles (1 long, 1 short, both with indistinct hairs). 1st endopodial joint with 1 alpha-bristle with few spines and 1 hirsute beta-bristle. 2nd endopodial joint with 1 long bristle with long proximal hairs and 6 shorter bristles.

Fifth Limb (Figure 25*b*): Epipodite with about 31 spinous bristles. With 3 endites: I with 3 or 4 ringed bristles; II with 5 ringed bristles; III with 6 or 7 ringed bristles. 1st exopodial joint with 2 ringed bristles and 3 weakly developed unringed bare finger-like bristles. 2nd exopodial joint with 3 ringed bristles (not shown) and 3 bare finger-like bristles. 3rd exopodial joint with 3 short bare ringed bristles on inner lobe, and 2 stout ringed hirsute bristles on outer lobe. Fused 4th + 5th joints with 4 bare ringed bristles.

Sixth Limb (Figure 25*c*): With 1 epipodial bristle. Endite I with 3 small bristles; endite II with 2 bristles (1 long, 1 short); endites III and IV each with 2 long bristles. End joint with projecting anterior part (broader than endite IV but with similar amount of projection) with 3 terminal bristles with short spines; posterior part of distal margin of end joint with 4 broad bristles with long hairs.

Seventh Limb (Figure 25*d*): With 3 proximal bristles, 1 on one side, 2 on other side, each with 3 bells and marginal spines. Terminus with 4 bristles, 2 on each side with 3–6 bells and marginal spines. Tip of terminus with opposing combs, each with 3 alate teeth. (Marginal spines of bristles not shown.)

Furca: Distribution of claws similar to those of adult female. Claws 1 and 2 more elongate than those of female.

Bellonci Organ (Figure 25*e*): Similar to that of adult female.

Eyes: Medial eye similar to that of adult female but with black pigment (stippled) (Figure 25*e*). Lateral eye large with 16 amber-colored ommatidia, with black pigment between ommatidia (stippled) (Figure 25*e,f*).

Genitalia: Indistinct lobes.

Upper Lip (Figure 25*e*): Simple lobe.

Anterior of Body (Figure 25*e*): With broad anterior process.

Posterior of Body: With few spines dorsal to dorsal end of girdle.

Y-*Sclerite:* Obscured on USNM 158264.

DESCRIPTION OF A–1 MALE (Figure 25*g*).—Carapace similar in shape to that of adult female.

Carapace Size (mm): USNM 194338, length 1.15, height 0.76.

EPIZOA.—Stemmed protistans, which were abundant on the carapaces of *Euphilomedes carcharodonta* and *E. morini,* were absent on the carapaces of 30 specimens (males, females, and juveniles) examined.

COMPARISONS.—The surface ornamentation of *R. apex* resembles that of *R. judayi* McKenzie, 1965, except the female is without a small process near the middle of posterior margin that projects past posterior end of valve. The length of the female carapace of *R. judayi* is 0.95–1.05 mm, compared to 1.18–1.25 mm for *R. apex.* The rostral infold of the female *R. judayi* bears a row of 7 bristles compared to 10–12 on *R. apex.* The vertical rib at the posterior end of the alar process on the carapace of the female *R. lomae* (Juday, 1907) has a space near middle (Figure 26*b*), whereas it is continuous on *R. apex* (Figure 26*a*), and *R. lomae* is larger (Figure 26). Adults males of *R. lomae* and *R. apex* are difficult to separate, except the middle part of the vertical rib of the carapace of *R. apex* does appear to be better developed (see Kornicker and Myers, 1981:15, for *R. lomae*). The caudal process of the carapace of the female *R. chessi* Kornicker and Myers, 1981, projects farther than that of *R. apex,* the c-bristles of the 2nd and 3rd endopodial joints of the mandible are more elongate, and the Bellonci organ has a pointed rather than a rounded tip. The ridges of the carapace of the female *R. rostratum* Juday, 1907, are less well-defined than those of *R. apex,* and the c-bristle of the 2nd endopodial joint of the female mandible of *R.*

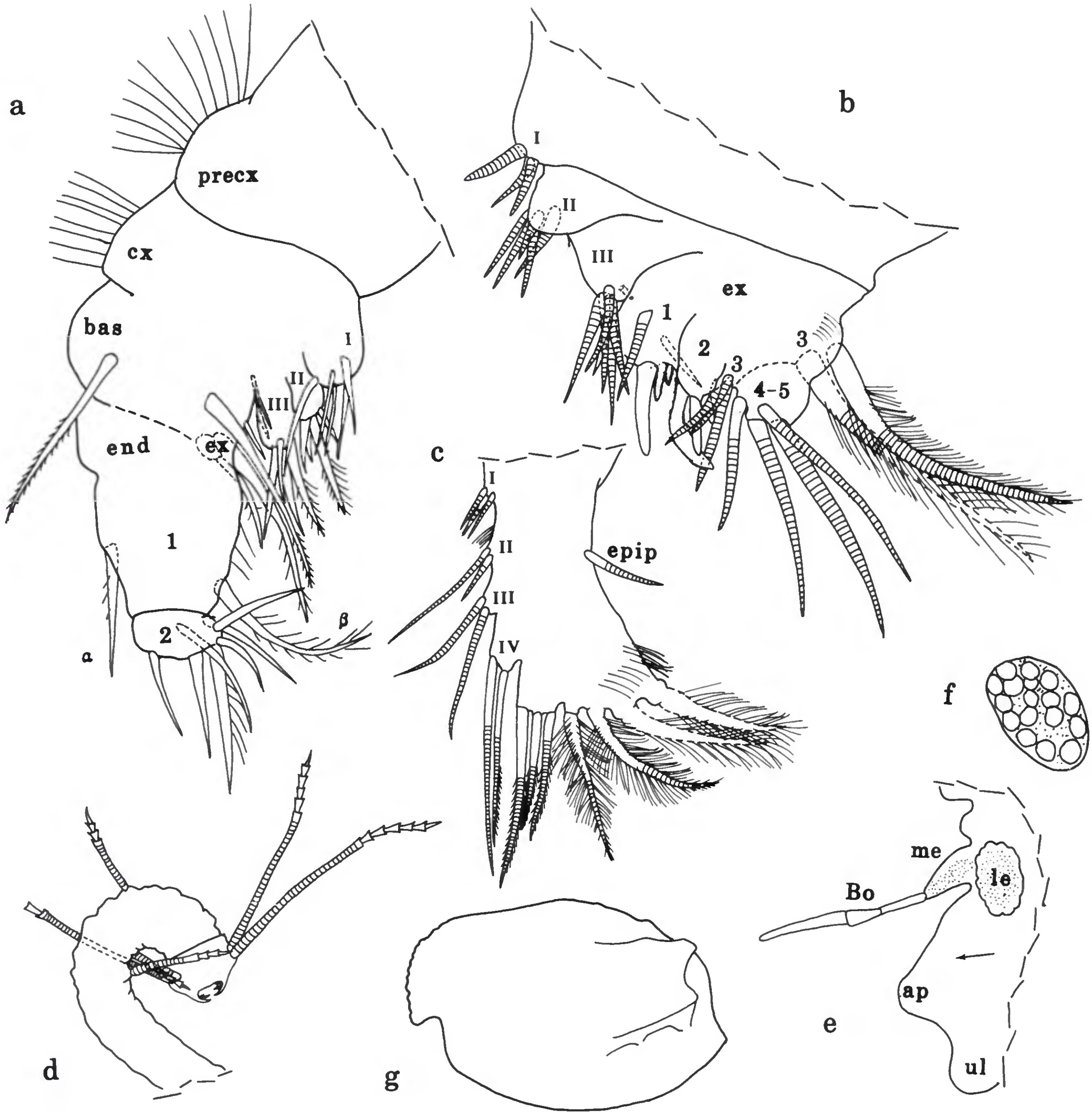

FIGURE 25.—*Rutiderma apex*, new species, adult male, paratype, USNM 158264: *a*, right maxilla, mv; *b*, 5th limb; *c*, 6th limb; *d*, 7th limb; *e*, anterior of body from left side; *f*, lateral eye. A-1 male, paratype, USNM 194338: *g*, outline of complete specimen from left side, length 1.15 mm.

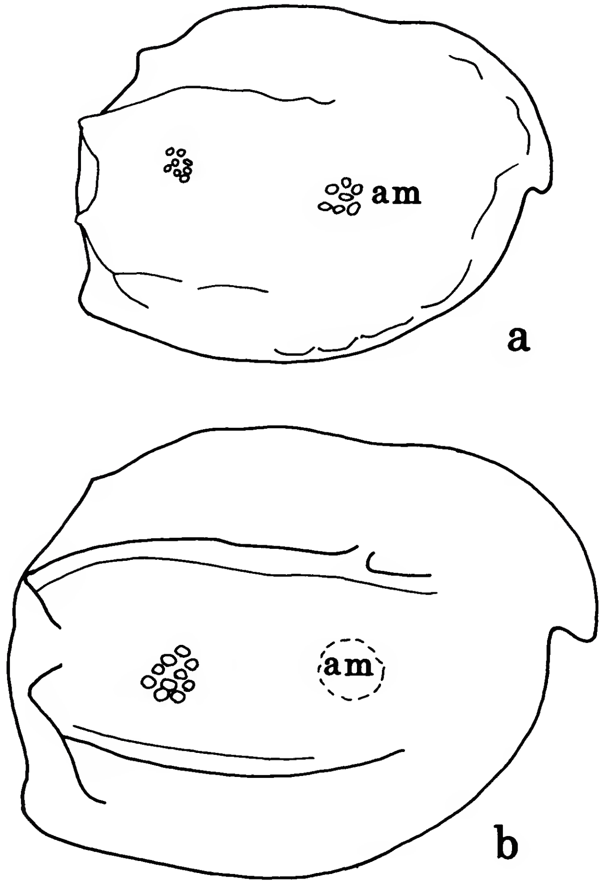

FIGURE 26.—Comparison of posterior ends of ribs of right valves: *a, Rutiderma apex*, ovigerous female, paratype, USNM 194339, length 1.15 mm. *b, Rutiderma lomae* (Juday, 1907), adult female, USNM 158259, from Santa Catalina Island, length 1.42 mm.

rostratum has a long produced tip that is absent on *R. apex*. The ribs of the carapace of *R. apex* resemble those of *R. hartmanni* Poulsen, 1965, from the Gulf of Panama, but the carapace of *R. apex* is slightly larger and the caudal process has less posterior projection; the anterior ridge of the infold of the caudal process is more concave posteriorly on *R. hartmanni*, and the c-bristle of the 2nd endopodial joint of the female mandible of *R. hartmanni* bears a small terminal extension that is absent on *R. apex*. The lateral ribs of *R. rotundum* Poulsen, 1965, are evenly rounded posteriorly, not indented like the vertical rib of *R. apex*, and each lamella of the furca of *R. rotundum* bears 3 primary claws compared to 4 on *R. apex*.

CYLINDROLEBERIDIDAE Müller, 1906

The family contains three subfamilies: Cylindroleberidinae Müller, 1906, Cyclasteropinae Poulsen, 1965, and Asteropteroninae Kornicker, 1981. All subfamilies have been reported from the Californian coast (Kornicker, 1981), but only the first and last were collected in Pillar Point Harbor. The last subfamily is represented by *Asteropella slatteryi* Kornicker, 1981. Specimens of this species collected in Pillar Point Harbor were part of the type series in the original description (Kornicker, 1981:260), and no supplementary description is present herein.

CORRECTION.—Kornicker (1981:97) stated that specimens of *Leuroleberis sharpei* Kornicker, 1981, USNM 13107, from San Diego Bay, California, which were reported by Sharpe (1908:425), could not be located. In the present study a slide (in poor condition) with that number and containing appendages of that species, as well as a vial with that number containing two specimens (bodies removed from shell) of that species in alcohol, were found in the collection of the National Museum of Natural History; both are incorrectly labeled "*Cylindroleberis oblonga* Grube, San Diego Bay, Calif. From H. Hemphill (4)."

CYLINDROLEBERIDINAE Müller, 1906

This subfamily has 16 genera of which three have been reported off the Californian coast: *Bathyleberis* Kornicker, 1975a, *Parasterope* Poulsen, 1965, and *Postasterope* Kornicker, 1986.

Postasterope Kornicker, 1986

This genus contains four species of which only *P. barnesi* (Baker, 1978) has been reported from the Californian coast.

DISTRIBUTION.—This genus has been reported from Florida, Bahamas, West Indies, and California at depths of 1–401.4 m (Kornicker, 1986:96).

Postasterope barnesi (Baker, 1978)

FIGURES 27, 28

Parasterope sp. Tuel et al., 1976:155.
Parasterope barnesi Baker, 1978:139, figs. 1, 2.
Postasterope barnesi (Baker, 1978).—Kornicker, 1986:96.

HOLOTYPE.—AHF 5743, adult female on slide and in alcohol.

TYPE LOCALITY.—Sta 4825, south of Santa Barbara, California, 34°24′28″N, 119°38′20″W, depth 12.8 m.

MATERIAL.—PARATYPES: USNM 151398, adult female on 2 slides; USNM 151399, adult male on 2 slides. NONTYPES: Pillar Point Harbor: Sta 5A (Jun): USNM 194348, 1 adult male, 1 ovigerous female, and 4 other specimens, all undissected and in alcohol. Sta 5A (Sep): USNM 194347, 2 ovigerous females and 4 other specimens, all undissected and in alcohol. Sta 5C (Dec): USNM 194351, 3 ovigerous females and 6 other specimens, all undissected and in alcohol. Sta 6B (Jun): USNM

194344, ovigerous female on slide and in alcohol; USNM 194345, adult male on slide and in alcohol; USNM 194346, 2 ovigerous females and 7 other specimens, all undissected and in alcohol. Sta 7A (Dec): USNM 194350, 3 ovigerous females and 6 other specimens, all undissected and in alcohol. Sta 7C (Dec): USNM 194352, 4 ovigerous females and 34 other specimens, all undissected and in alcohol.

DISTRIBUTION.—Sta 5-8, Pillar Point Harbor, Half Moon Bay, California, depth range 1.8-5.2 m; southern California mainland shelf from San Diego to Point Conception, except in area from Seal Beach to Long Point, depth range 6.1-401.4 m (Baker, 1978:140).

REMARKS.—Baker (1978:139) placed in the synonymy of *Parasterope barnesi* specimens referred to *Cylindroleberis mariae* (Baird, 1850a) by Juday (1907:143) from off Southern California, and Lie (1968:550) and Lie and Evans (1973:125) from Puget Sound, Washington, and also specimens referred to *Cylindroleberis oblonga* (Grube, 1859) by Sharpe (1908:423) from San Diego Harbor. Insufficient information is known about those specimens to be able to refer them with certainty to any species, and we therefore refer them to *Species Inquirenda*. Although Sharpe (1908:424) designated his only specimen as USNM 13108, it could not be located at this museum. The following organizations were contacted without success in a search for the Ostracoda reported by Juday (1907:135-156): Allan Hancock Foundation, University of Southern California; California Academy of Sciences, San Francisco; Los Angeles County Museum; San Diego Museum of Natural History; Paleontology Museum, University of California, Berkeley; University of California, San Diego; University of California, Berkeley; Wisconsin Geological and Natural History Survey; Scripps Institution of Oceanography, La Jolla; and the Zoological Museum, University of Wisconsin.

DISCUSSION.—The specimens from Pillar Point Harbor differ in a few characters from the description of the species by Baker (1978:139). Therefore, a male and female paratype of the species were studied and are described below. The descriptions mainly include characters that differ from the specimens described by Baker as well as containing additional information. The specimens from Pillar Point Harbor are larger than those from off the coast of Southern California, but a similar difference in the size of specimens from various localities was also found in *Parasterope pollex* Kornicker in Bowman and Kornicker, 1967, that had been collected along the Atlantic Coast of North America and in the Gulf of Mexico (Kornicker, 1986, fig. 14).

SUPPLEMENTARY DESCRIPTION OF FEMALE PARATYPE USNM 151398 (Figure 27*a,b*).—*First Antenna:* 1st and 2nd joints with medial spines. 6th joint with long medial bristle with short spines. 7th joint: a-claw bare; b-bristle with 4 spinous marginal filaments, and spines on stem distal to filaments; c-bristle with part of stem adjacent to 4th filament with short marginal spines. 8th joint: f-bristle bent dorsally, with 3 proximal filaments with spines and 1 shorter subterminal filament, and spines on part of stem distal to 3rd filament; g-bristle with 5 marginal filaments and spines on stem distal to 4th filament.

Second Antenna: Protopodite with small distal medial bristle (Figure 27*a*). Exopodite: joints 2 or 3 to 8 with basal spines increasing in length on distal joints; spine of 8th joint about half length of 9th joint; 9th joint with lateral spine about same length as basal spine of 8th joint; joints 3-8 with row of small spines along distal edges; bristle of 2nd joint reaching past 9th joint, with abundant slender ventral spines; bristles of joints 3-8 and 2 long bristles of 9th joint with stout ventral spines in addition to natatory hairs; short bristle of 9th joint with short hairs.

Mandible: Basale endite: medial side of left limb partly obscured but appearing to have only 1 dwarf bristle. Basale: 2 subterminal dorsal bristles with indistinct short spines. 2nd endopodial joint: a- to g-bristles spinous; short spinous medial cleaning bristle between b- and c-bristles, and row of 6 spinous medial cleaning bristles just proximal to c-bristle; ventral margin with 3 long spinous terminal bristles; medial surface with rows of minute spines. 3rd endopodial joint with bare claw and 5 spinous bristles (4 long, 1 short medial).

Maxilla (Figure 27*b*): Endite I with short indistinct bristle in addition to 3 long bristles. Epipodite with distal hairs. Basale with 1 proximal lateral bristle at midheight, 3 short medial bristles near dorsal margin (1 proximal, 1 at midlength, and 1 distal), and 3 ventral bristles (1 short proximal, 1 minute distal, and 1 long terminal). 1st endopodial joint with minute protuberance on dorsal margin proximal to alpha-bristle. Beta-bristle of 2nd endopodial joint slightly shorter than terminal bristle of 3rd endopodial joint.

Fifth Limb: Lateral side of comb with 2 slender anteriorly pointing ringed bristles just ventral to base of long stout spinous exopodial bristle, and 2 pairs of bristles closer to ventral edge of comb.

Sixth Limb: Medial side with minute spine-like bristle near anterior dorsal corner. Bristle of distal anterior endite about twice length of bristle of proximal endite. Anterior of paired bristles at anterior tip of skirt about twice as broad at base as posterior bristle and longer. Ventral edge of skirt with 4 slender bristles at midlength; posteroventral corner of skirt with 1 slender bristle; all 5 bristles with long marginal spines. Limb hirsute.

Seventh Limb: Terminus with opposing combs, each with about 15 spinous teeth.

Furca: Not in good condition but with at least 8 claws. (Baker (1978:142) described the female furca as having 8 claws on each lamella, and he also stated (p. 145) that the male furca is the same as that of the female; however, his illustration (fig. 2i) of the male furca has claws numbered 1-9.)

SUPPLEMENTAL DESCRIPTION OF ADULT MALE PARATYPE USNM 151399 (Figure 27*c-e*).—*First Antenna* (Figure 27*c,d*): 6th joint with spinous medial bristle. 7th joint: a-claw denticulate; b-bristle with spinous filaments and stem with

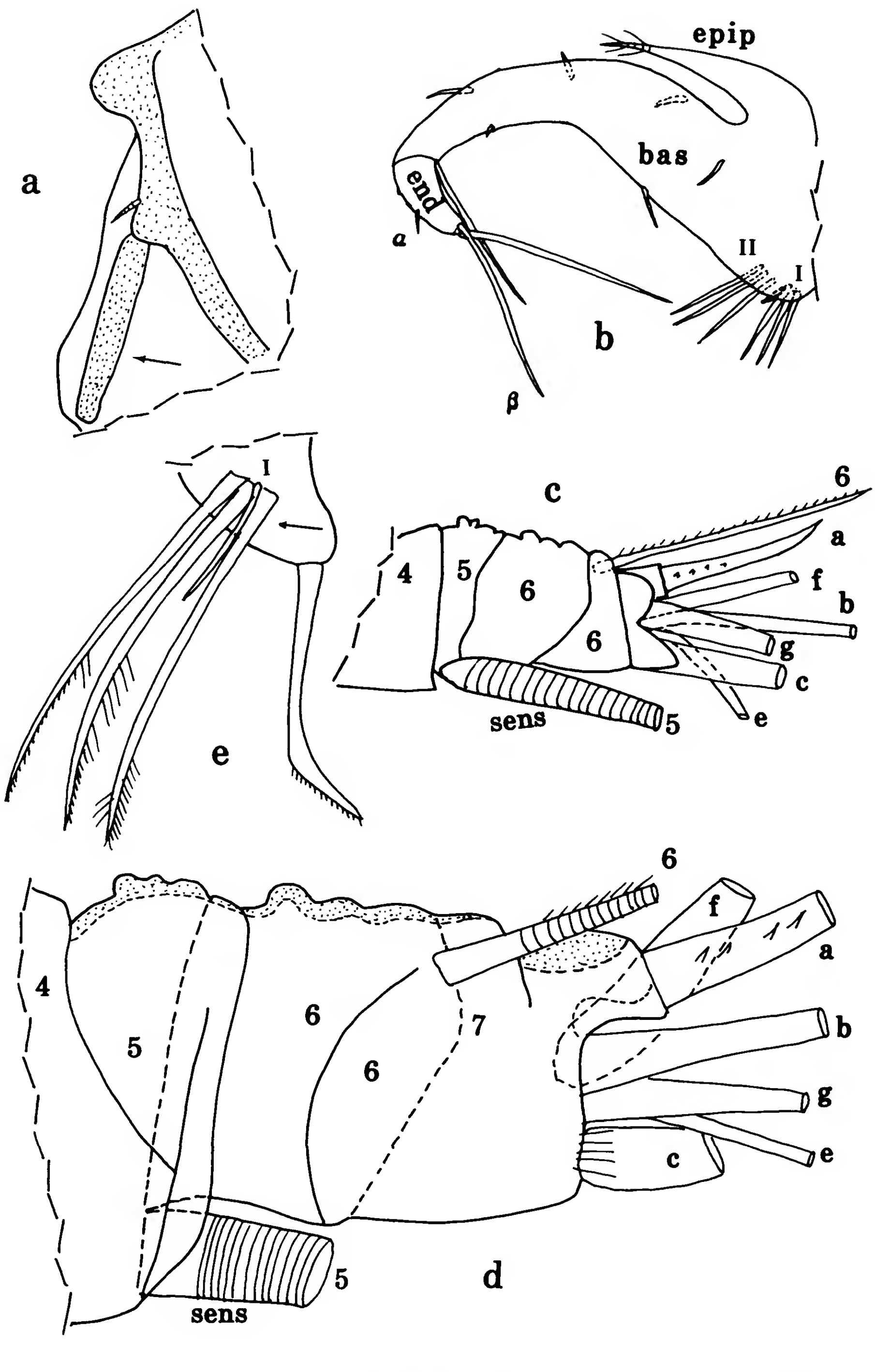

FIGURE 27.—*Postasterope barnesi* (Baker, 1978), adult female, paratype, USNM 151398: *a,* distal end of protopodite, right 2nd antenna, mv; *b,* left maxilla, lv. Adult male, paratype, USNM 151399: *c,d,* tips of right (lv) and left (mv) 1st antennae; *e,* endite I and axe-shaped bristle of right maxilla, mv.

distal spines; c-bristle with 21 filaments. 8th joint: f-bristle with 21 filaments.

Second Antenna: Protopodite with small distal medial bristle similar to that of adult female, otherwise bare. Endopodite: 2nd joint: distal of 3 dorsal bristles about 1/3 length of others; 3rd joint: tip pointed and with 6 minute ridges. Exopodite: bristles of joints 2–8 and 3 long bristles of 9th joint with natatory hairs but no spines; short bristle of 9th joint with natatory hairs shorter than those of other bristles; joints 2–7 with 2 or 3 minute lateral spines in usual place of basale spine; joint 8 with small basal spine about 1/5 length of 9th joint; 9th joint with minute lateral spine about same size as basal spine of 8th joint; joints 1–8 with rows of distal hairs or spines.

Mandible: 2nd endopodial joint: dorsal margin with 2 slender bristles proximal to a-bristle, lateral of these reaching 3rd endopodial joint, other shorter, otherwise similar to that of adult female. 3rd endopodial joint similar to that of adult female. (Coxale and basale endites missing from single right limb on slide.)

Maxilla (Figure 27*e*): Only endites of right limb on slide. Endite I with 4 bristles (3 long, 1 short).

Fifth Limb: Comb bristles similar to those of adult female.

Sixth Limb, Seventh Limb, and *Furca:* Not on slide.

Genitalia: Consisting of several lobes either with few bristles or spinous.

REMARKS.—Whether the differences between the descriptions of the species by Baker and those above based on the paratypes are the result of intraspecific variability or inaccuracies in the original description are not known. The main differences are as follows: (1) protopodite of the 2nd antenna with one rather than no small distal medial bristle (probably an inaccuracy in the original description because bristle is minute); (2) 2nd endopodial joint of the male mandible with two bristles rather than one bristle proximal to the a-bristle (possibly an intraspecific variability); (3) basale endite of mandible possibly with one (obscured) rather than two dwarf bristles (possibly an intraspecific variability); (4) endite I of maxilla with four rather than three bristles (probably an inaccuracy in the original description because the 4th bristle is small and often indistinct); (5) medial surface near the dorsal margin of basale of the maxilla with three rather than two bristles (possibly an inaccuracy in the original description because the bristle at midlength is quite small, but it could also be an intraspecific variability); (6) comb of the 5th limb with two rather than no slender bristles just ventral to the main exopodial bristle (probably an inaccuracy in the original description); (7) ventral edge of the skirt of the female 6th limb with four rather than two spinous bristles at midlength (probably an intraspecific variability).

DESCRIPTION OF ADULT FEMALE FROM PILLAR POINT HARBOR (Figure 28*a–h*).—Carapace oval in lateral view (Figure 28*a*).

Carapace Size (length, height in mm): USNM 194344, 1.74, 0.97, height 56% of length (Figure 28*a*). USNM 194346, 2 specimens: 1.72, 0.94, height 55% of length; 1.68, 0.99, height 59% of length. USNM 194347, 2 specimens: 1.66, 0.97, height 58% of length; 1.72, 1.00, height 58% of length.

First Antenna (Figure 28*b*): Similar to paratype described above.

Second Antenna: Protopodite with long dorsal spines and rows of minute medial spines. Endopodite and exopodite similar to paratype described above.

Mandible: Coxale endite broken off USNM 194344; medial surface of coxale with rows of short spines. Basale endite with 1 dwarf bristle adjacent to short glandular peg. Basale: ventral margin with U-shaped depression near midlength but without bristles; medial surface without spines; dorsal margin with 2 long subterminal spinous bristles. Exopodite and endopodite similar to paratype described above.

Maxilla and *Fifth Limb:* Similar to paratype described above.

Sixth Limb: Both limbs of USNM 194344 with 4 ventral bristles at midlength of skirt; right limb lacking single bristle at posterior corner of skirt but present on left limb. Limb otherwise similar to paratype described above.

Seventh Limb (Figure 28*c*): Similar to paratype described above.

Furca (Figure 28*d*): Each lamella with 9 claws, none bent upwards. Small triangular segment posterior to lamellae with marginal spines, 2 longer than others.

Bellonci Organ (Figure 28*e*): Elongate, crinkled proximally, and with broadly rounded tip.

Eyes: Lateral eye with 17 ommatidia (only those along edge indicated in Figure 28*f*) and black pigment (general area indicated by stippling) between ommatidia (Figure 28*a,f*). Medial eye slightly larger than lateral eye, with long dorsal hairs and black pigment (stippled in Figure 28*e*).

Lips (Figure 28*g*): Each lobe with 2 stout anterior spines; saddle between lobes with 3 minute indistinct spines. Lower lip a hirsute flap on each side of mouth.

Posterior of Body (Figure 28*h*): With short spinous posterodorsal thumb-like process.

Genitalia: None visible.

Y-Sclerite: Typical for subfamily.

Number of Eggs: USNM 194344 with 9 eggs in marsupium and none unextruded (4 shown in Figure 28*a*); length of 1 egg 0.29 mm.

DESCRIPTION OF ADULT MALE FROM PILLAR POINT HARBOR (Figure 28*i–l*).—Carapace with ventral and dorsal edges more parallel than on female carapace (Figure 28*i*).

Carapace Size (length, height in mm): USNM 194345, 1.73, 0.88, height 51% of length. USNM 194348, 1.79, 0.85, height 47% of length.

First Antenna (Figure 28*i,j*): Similar to those of male paratype described above.

Second Antenna: Protopodite without dorsal or medial

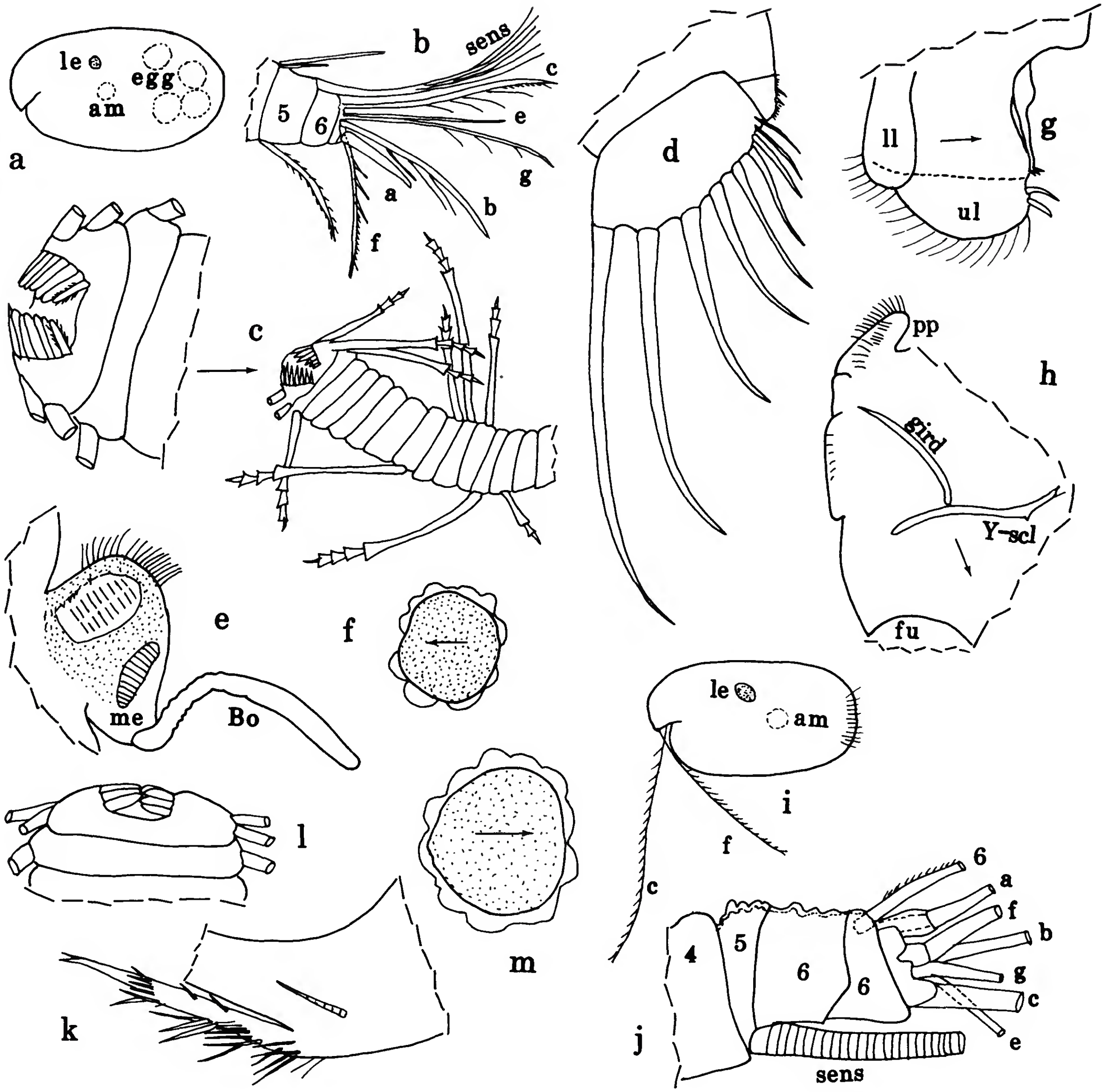

FIGURE 28.—*Postasterope barnesi* (Baker, 1978), ovigerous female, USNM 194344: *a*, complete specimen from left side, length 1.74 mm; *b*, tip of left 1st antenna (ventral edge at top of illustration); *c*, 7th limb; *d*, left lamella of furca, lv; *e*, medial eye and Bellonci organ; *f*, left lateral eye, lv; *g*, lips from right side; *h*, posterior of body from right side. Adult male, USNM 194345: *i*, complete specimen from left side, length 1.73 mm: *j*, tip of right 1st antenna, lv; *k*, ventral branch of coxale endite of left mandible, mv; *l*, tip of 7th limb; *m*, right lateral eye (same magnification as *f*), lv.

spines. Remainder of appendage similar to that of male paratype described above.

Mandible: Coxale endite: dorsal branch broken off both limbs of USNM 194345, but with slender medial bristle near base of ventral branch (Figure 28*k*); ventral branch with 4 oblique rows of spines and tip with 2 slender spines; proximal part of coxale with few rows of slender spines. Basale endite with 3 triaenid bristles with 6 or 7 pairs of spines in addition to terminal pair. Claw of 3rd endopodial joint with 4 minute medial subterminal teeth near dorsal edge. Remainder of appendage similar to that of male paratype described above.

Maxilla and *Fifth Limb:* Similar to those of male paratype described above.

Sixth Limb: Right limb of USNM 194345 with 4 midventral bristles on skirt; left limb with only 3. Each limb with 1 bristle on posteroventral corner of skirt. Limb otherwise similar to those of female paratype described above.

Seventh Limb: Comb teeth fewer and more poorly developed than those of female limb (Figure 28*l*). Remainder of limb similar to that of female described above (Figure 28*c*).

Furca: Similar to that of female described above (with 9 claws) (Figure 28*d*).

Bellonci Organ: Similar to that of female described above (Figure 28*e*).

Eyes: Medial eye similar to that of female (Figure 28*e*). Lateral eye about 1.4 times longer than that of female, with 17–19 ommmatidia (not shown except along edge) and black pigment between ommatidia (stippled in Figure 28*m*).

Lips and *Posterior of Body:* Similar to those of female (Figure 28*g*).

Genitalia: Similar to that of male paratype above.

EPIZOA.—Stemmed protistans, which are common on the carapaces of *Euphilomedes carcharodonta* and *E. morini,* are absent from the carapaces of 23 specimens (males, females, and juveniles) examined.

REMARKS.—The lengths of the carapaces of specimens described by Baker (1978:139–140) are 1.43–1.61 mm for two females, and 1.43 mm for one male. The lengths of specimens from Pillar Point Harbor are 1.66–1.74 mm for five females, and 1.73–1.79 for two males.

Literature Cited

Baird, W.

1850a. *The Natural History of the British Entomostraca.* 364 pages, 36 plates. London. [Printed for the Ray Society.]

1850b. Description of Several New Species of Entomostraca. *Proceedings of the Zoological Society of London,* 18:254–257, plates 17, 18.

Baker, James H.

1975. Distribution, Ecology, and Life Histories of Selected Cypridinacea (Myodocopida, Ostracoda) from the Southern California Mainland Shelf. 185 pages, 27 figures, 2 charts. Unpublished doctorial dissertation, University of Houston, Houston, Texas.

1977. Life History Patterns of the Myodocopid Ostracod *Euphilomedes producta* Poulsen, 1962. *In* Heinz Löffler and Dan Danielopol, editors, Aspects of Ecology and Zoogeography of Recent and Fossil Ostracoda, *Proceedings of the 6th International Symposium on Ostracods, Saalfelden (Salzburg), July 30–August 8, 1976,* pages 245–254, figures 1–3. The Hague, The Netherlands: Dr. W. Junk b.v. Publishers.

1978. Two New Species of *Parasterope* (Myodocopina, Ostracoda) from Southern California. *Crustaceana,* 35(2):139–141, 4 figures.

Bowman, T.E., and L.S. Kornicker

1967. Two New Crustaceans: The Parasitic Copepod *Sphaeronellopsis monothrix* (Choniostomatidae) and Its Myodocopid Ostracod Host *Parasterope pollex* (Cylindroleberidae) from the Southern New England Coast. *Proceedings of the United States National Museum,* 123(3613): 29 pages, figures 1–7, one unnumbered plate.

Brady, G.S., and A.M. Norman

1896. A Monograph of the Marine and Fresh Water Ostracoda of the North Atlantic and of Northwestern Europe. *Scientific Transactions of the Royal Dublin Society,* series 2, 5:621–784, plates 50–68.

Cannon, H. Graham

1931. On the Anatomy of a Marine Ostracod, *Cypridina* (*Doloria*) *levis* Skogsberg. *Discovery Reports,* 2:435–482, figures 1–12, plates 6, 7.

1933. On the Feeding Mechanism of Certain Marine Ostracods. *Transactions of the Royal Society of Edinburgh,* 57, part 3(30):739–764, figures 1–11, table 1.

Cohen, Anne C., and Louis S. Kornicker

1987. Catalog of the Rutidermatidae (Crustacea: Ostracoda). *Smithsonian Contributions to Zoology,* 449: 11 pages.

Cushman, J.A.

1906. Marine Ostracoda of Vineyard Sound and Adjacent Waters. *Proceedings of the Boston Society of Natural History,* 32(10):359–385, plates 27–38.

Darby, D.G.

1965. Ecology and Taxonomy of Ostracoda in the Vicinity of Sapelo Island, Georgia. *In* R.V. Kesling, editor, *Four Reports of Ostracod Investigations,* 2:1–77, 11 figures, 33 plates. Ann Arbor, Michigan: University of Michigan.

Elofson, O.

1941. Zur Kenntnis der marinen Ostracoden Schwedens mit besonderer berücksichtigung des Skageraks. *Zoologiska Bidrag Från Uppsala,* 19:215–534.

1969. Marine Ostracoda of Sweden with Special Consideration of the Skagerrak. 286 pages. [Translation of 1941 publication. Published for the Smithsonian Institution and the National Science Foundation, Washington, D.C. by the Israel Program for Scientific Translations, 1969.]

Fenwick, Graham D.

1984. Life History and Population Biology of the Giant Ostracod *Leuroleberis zealandica* (Baird, 1850) (Myodocopida). *Journal of Experimental Marine Biology and Ecology,* 77:255–289.

Grube, E.

1859. Bemerkungen über Cypridina unde eine neue Art dieser Gattung (*Cypridina oblonga*). *Archiv fur Naturgeschichte* (Berlin), 25(1):322–337, plate 12.

Hartmann, Gerd

1959. Zur Kenntnis der lotischen Lebensbereiche der pazifischen Küste von El Salvador unter besonderer Berücksichtigung seiner Ostracodenfauna. *Kieler Meeresforschungen,* 15(2):187–241, figures 27–48.

Hiruta, ShinIchi

1976. *Euphilomedes nipponica* n. sp. from Hokkaido, with a Redescription of *E. sordida* (G.W. Mueller) (Ostracoda: Myodocopina). *Journal of the Faculty of Science, Hokkaido University,* series VI (Zoology), 20(3):579–599, figures 1–12.

1980. Morphology of the Larval Stages of *Vargula hilgendorfi* (G.W. Müller) and *Euphilomedes nipponica* Hiruta from Japan (Ostracoda: Myodocopina). *Journal of Hokkaido University of Education,* (Section IIB), 30(2):145–167.

Jones, M.E.

1958. *Sarsiella tricostata,* A New Ostracod from San Francisco Bay (Myodocopa: Cypridinidae). *Journal of the Washington Academy of Sciences,* 48(2):48–52.

Juday, Chauncy

1907. Ostracoda of the San Diego Region, II: Littoral Forms. *University of California Publications in Zoology,* 3(9):135–156.

Kornicker, Louis S.

1967. The Myodocopid Ostracod Familes Philomedidae and Pseudophilomedidae (New Family). *Proceedings of the United States National Museum,* 120(3580): 35 pages, 12 figures, 1 plate, 2 tables.

1974. Ostracoda (Myodocopina) of Cape Cod Bay, Massachusetts. *Smithsonian Contributions to Zoology,* 173: 20 pages, 11 figures.

1975a. Antarctic Ostracoda (Myodocopina), Parts 1 and 2. *Smithsonian Contributions to Zoology,* 163: 720 pages, 432 figures, 9 plates, 21 tables.

1975b. Spread of Ostracodes to Exotic Environs on Transplanted Oysters. *Bulletin of American Paleontology,* 65(282):129–138, figures 1–3.

1975c. Ivory Coast Ostracoda (Suborder Myodocopina). *Smithsonian Contributions to Zoology,* 197: 46 pages, 32 figures, 3 tables.

1977. Diversity of Benthic Myodocopid Ostracodes. *In* Heinz Löffler and Dan Danielopol, editors, Aspects of Ecology and Zoogeography of Recent and Fossil Ostracoda, *Proceedings of the 6th International Symposium on Ostracods, Saalfelden (Salzburg), July 30–August 8, 1976,* pages 159–173. The Hague, The Netherlands: Dr. W. Junk b.v. Publishers.

1978. *Harbansus,* A New Genus of Marine Ostracoda, and A Revision of the Philomedidae (Myodocopina). *Smithsonian Contributions to Zoology,* 260: 75 pages, 37 figures, 16 plates, 2 tables.

1981. Revision, Distribution, Ecology, and Ontogeny of the Ostracode Subfamily Cyclasteropinae (Myodocopina: Cylindroleberididae). *Smithsonian Contributions to Zoology,* 319: 548 pages, 174 figures, 185 plates, 23 tables.

1986. Cylindroleberididae of the Western North Atlantic and the Northern Gulf of Mexico, and Zoogeography of the Myodocopina (Ostracoda). *Smithsonian Contributions to Zoology,* 425: 139 pages, 63 figures, 6 tables.

1987. Supplementary Description of *Cypridina americana* (Müller, 1890),

a Luminescent Myodocopid Ostracode from the East Pacific. *Proceedings of the Biological Society of Washington,* 100(1):173–181, figures 1–4.
1988. Mydocopid Ostracoda of the Beaufort Sea, Arctic Ocean. *Smithsonian Contributions to Zoology,* 456: 40 pages, 19 figures, 3 tables.
1991a. Myodocopid Ostracoda of Enewetak and Bikini Atolls. *Smithsonian Contributions to Zoology,* 505: 140 pages, 71 figures.
1991b. Myodocopid Ostracoda of Hydrothermal Vents in the Eastern Pacific Ocean. *Smithsonian Contributions to Zoology,* 516: 46 pages, 25 figures, 2 tables.
1994. Ostracoda (Myodocopina) of the SE Australian Continental Slope, Part 1. *Smithsonian Contributions to Zoology,* 553: 200 pages, 111 figures, 4 tables.

Kornicker, Louis S., and James H. Baker
1977. *Vargula tsujii,* A New Species of Luminescent Ostracoda from Lower and Southern California (Myodocopa: Cypridininae). *Proceedings of the Biological Society of Washington,* 90(2):218–231, figures 1–6.

Kornicker, Louis S., and Dale R. Calder
1995. Hydroids Colonizing the Carapaces of the Ostracode *Philomedes brenda* from the Beaufort Sea, Arctic Ocean. *Proceedings of the Biological Society of Washington,* 108(1):125–129, figures 1–3.

Kornicker, Louis S., and Francisca Elena Caraion
1974. West African Myodocopid Ostracoda (Cylindroleberididae). *Smithsonian Contributions to Zoology,* 179: 78 pages, 43 figures, 1 table.

Kornicker, Louis S., and Thomas M. Iliffe
1989. Ostracoda (Myodocopina, Cladocopina, Halocypridina) from Anchialine Caves in Bermuda. *Smithsonian Contributions to Zoology,* 475: 88 pages, 49 figures, 22 tables.

Kornicker, Louis S., and Brad Myers
1981. Rutidermatidae of Southern California (Ostracoda: Myodocopina). *Smithsonian Contributions to Zoology,* 334: 35 pages, 20 figures.

Lie, Ulf
1968. A Quantitative Study of Benthic Infauna in Puget Sound, Washington, USA, in 1963–1964. *Fiskeridirektoratets Skrifter*, serie Havundersøkelser, 14(5):229–556.
1974. Distribution and Structure of Benthic Assemblages in Puget Sound, Washington, U.S.A. *Marine Biology,* 26(3):203–223.

Lie, Ulf, and R.A. Evans
1973. Long-term Variability in the Structure of Subtidal Benthic Communities in Puget Sound, Washington, U.S.A. *Marine Biology,* 21(2):122–126.

Lie, Ulf, and J.C. Kelley
1970. Benthic Infauna Communities off the Coast of Washington and in Puget Sound: Identification and Distribution of the Communities. *Journal of the Fisheries Research Board of Canada,* 27(4):621–651.

Lie, Ulf, and D.S. Kisker
1970. Species Composition and Structure of Benthic Infauna Communities off the Coast of Washington, *Journal of the Fisheries Research Board of Canada*, 27(12):2273–2285.

Lucas, Verna Z.
1931. Some Ostracoda of the Vancouver Island Region. *Contributions to Canadian Biology and Fisheries, Studies from the Biological Stations of Canada*, new series, 6(17)(Series A, General, No. 2):399–416 [reprint pages 1–20].

McHardy, R.A.
1964. Marine Ostracods from the Plankton of Indian Arm, British Columbia, Including a Diminutive Subspecies Resembling *Conchoecia alata major* Rudjakov. *Journal of the Fisheries Research Board of Canada,* 21(3):555–576, figures 1–22.

McKenzie, K.G.
1965. Myodocopid Ostracoda (Cypridinacea) from Scammon Lagoon, Baja California, Mexico, and Their Ecologic Associations. *Crustaceana*, 9(1):57–70, 6 figures.

Müller, G.W.
1890. Neue Cypridiniden. *Zoologische Jahrbücher,* 5:211–252, plates 25–27.
1906. Ostracoda. In *Wissenschaftliche Ergnebnisse der Deutsche Tiefsee-Expedition...1898–1899,* 8(2): 154 pages, 31 plates.

Oliver, John S., Peter N. Slattery, Larry W. Hulberg, and James W. Nybakken
1980. Relationships between Wave Disturbance and Zonation of Benthic Invertebrate Communities along a Subtidal High-Energy Beach in Monterey Bay, California. *Fishery Bulletin,* 78(2):437–454, figures 1–15, tables 1–4.

Poulsen, Erik M.
1962. Ostracoda-Myodocopa, 1: Cypridiniformes-Cypridinidae. *Dana Report,* 57: 414 pages, 181 figures. Copenhagen: Carlsberg Foundation.
1965. Ostracoda-Myodocopa, 1: Cypridiniformes-Rutidermatidae, Sarsiellidae and Asteropidae. *Dana Report,* 65: 484 pages, 156 figures. Copenhagen: Carlsberg Foundation.

Reyment, R.A.
1982. Speciation in a Late Cretaceous Lineage of *Veenia* (Ostracoda). *Journal of Micropalaeontology,* 1:37–44, figure 1, plate 1, tables 1–3.

Sars, G.O.
1866 [1865]. Oversigt af Norges marine Ostracoder. *Forhandlinger i Videnskabs-Selskabet I Christiania,* 8:1–130. [Preprint, 1865.]

Scott, Thomas
1894. Report on Entomostraca from the Gulf of Guinea, Collected by John Rattray, B.Sc. *Transactions of the Linnean Society,* series 2, 6:1–161, 15 plates.

Sharpe, R.W.
1908. A Further Report on the Ostracoda of the United States National Museum. *Proceedings of the United States National Museum,* 35(1651):399–430, plates 50–65.

Skogsberg, T.
1920. Studies on Marine Ostracods, 1: Cyprdinids, Halocyprids, and Polycopids. *Zoologiska Bidrag Från Uppsala,* supplement 1: 784 pages.

Smith, Verna Z.
1952. Further Ostracoda of the Vancouver Island Region. *Journal of the Fisheries Research Board of Canada,* 9(1):16–41, plates I–XI.

Spies, R.B., and P.H. Davies
1979. The Infaunal Benthos of a Natural Oil Seep in the Santa Barbara Channel. *Marine Biology,* 50:227–237, figures 1–6, tables 1–5.

Stepien, Carol A., and Richard C. Brusca
1985. Nocturnal Attacks on Nearshore Fishes in Southern California by Crustacean Zooplankton. *Marine Ecology Progress Series,* 25:91–105, figures 1–9, tables 1–3.

Swain, Frederick M.
1969. Taxonomy and Ecology of Near-Shore Ostracoda from the Pacific Coast of North and Central America. *In* J.W. Neale, editor, *The Taxonomy, Morphology, and Ecology of Recent Ostracoda.* Pages 423–474, 26 figures, 11 plates, 2 tables. Edinburgh, Scotland: Oliver and Boyd.

Theisen, B.F.
1967. The Life History of Seven Species of Ostracods from a Danish Brackish-Water Locality. *Meddelelser fra Danmarks Fiskeri- og Havundersøgelser,* 4(8):215–270, tables 1–7.

Thomson, G.M.
1879. On the New Zealand Entomostraca. *Transactions of the New Zealand Institute,* 11:251–263, plate 11.

Tuel, M.D., M.P. Wilderman, J.E. Trapani, and P.E. Hayes
1976. *A Biological Survey of Pillar Point Harbor, El Granada, California.* 254 pages. Report prepared by Marine Ecological Institute, Redwood City, California, for San Mateo County Harbor District,

Pillar Point Harbor, El Granada, California. [Figures, tables, and appendices numbered separately in each section.]

Turpaeva, E.P.

1957. Food Interrelationships of Dominant Species in Marine Benthic Biocoenoses. *In* B.N. Nikitin, editor, Marine Biology. *Transactions of the Institute of Oceanology,* 2:137–148. [Published in the United States by the American Institute of Biological Sciences.]

Walker, K.R.

1972. Trophic Analysis: A Method for Studying the Function of Ancient Communities. *Journal of Paleontology,* 46(1):82–93.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1997 417-844/20029

REQUIREMENTS FOR SMITHSONIAN SERIES PUBLICATION

Manuscripts intended for series publication receive substantive review within their originating Smithsonian museums or offices and are submitted to the Smithsonian Institution Press with Form SI-36, which must show the approval of the appropriate authority designated by the sponsoring organizational unit. Requests for special treatment—use of color, foldouts, casebound covers, etc.—require, on the same form, the added approval of the sponsoring authority.

Review of manuscripts and art by the Press for requirements of series format and style, completeness and clarity of copy, and arrangement of all material, as outlined below, will govern, within the judgment of the Press, acceptance or rejection of manuscripts and art.

Copy must be prepared on typewriter or word processor, double-spaced, on one side of standard white bond paper (not erasable), with 1¼" margins, submitted as ribbon copy (not carbon or xerox), in loose sheets (not stapled or bound), and accompanied by original art. Minimum acceptable length is 30 pages.

Front matter (preceding the text) should include: **title page** with only title and author and no other information; **abstract** page with author, title, series, etc., following the established format; table of **contents** with indents reflecting the hierarchy of heads in the paper; also, **foreword** and/or **preface**, if appropriate.

First page of text should carry the title and author at the top of the page; **second page** should have only the author's name and professional mailing address, to be used as an unnumbered footnote on the first page of printed text.

Center heads of whatever level should be typed with initial caps of major words, with extra space above and below the head, but with no other preparation (such as all caps or underline, except for the underline necessary for generic and specific epithets). Run-in paragraph heads should use period/dashes or colons as necessary.

Tabulations within text (lists of data, often in parallel columns) can be typed on the text page where they occur, but they should not contain rules or numbered table captions.

Formal tables (numbered, with captions, boxheads, stubs, rules) should be submitted as carefully typed, double-spaced copy separate from the text; they will be typeset unless otherwise requested. If camera-copy use is anticipated, do not draw rules on manuscript copy.

Taxonomic keys in natural history papers should use the aligned-couplet form for zoology and may use the multi-level indent form for botany. If cross referencing is required between key and text, do not include page references within the key, but number the keyed-out taxa, using the same numbers with their corresponding heads in the text.

Synonymy in zoology must use the short form (taxon, author, year:page), with full reference at the end of the paper under "Literature Cited." For botany, the long form (taxon, author, abbreviated journal or book title, volume, page, year, with no reference in "Literature Cited") is optional.

Text-reference system (author, year:page used within the text, with full citation in "Literature Cited" at the end of the text) must be used in place of bibliographic footnotes in all Contributions Series and is strongly recommended in the Studies Series: "(Jones, 1910:122)" or ". . . Jones (1910:122)." If bibliographic footnotes are required, use the short form (author, brief title, page) with the full citation in the bibliography.

Footnotes, when few in number, whether annotative or bibliographic, should be typed on separate sheets and inserted immediately after the text pages on which the references occur. Extensive notes must be gathered together and placed at the end of the text in a notes section.

Bibliography, depending upon use, is termed "Literature Cited," "References," or "Bibliography." Spell out titles of books, articles, journals, and monographic series. For book and article titles use sentence-style capitalization according to the rules of the language employed (exception: capitalize all major words in English). For journal and series titles, capitalize the initial word and all subsequent words except articles, conjunctions, and prepositions. Transliterate languages that use a non-Roman alphabet according to the Library of Congress system. Underline (for italics) titles of journals and series and titles of books that are not part of a series. Use the parentheses/colon system for volume(number):pagination: "10(2):5–9." For alignment and arrangement of elements, follow the format of recent publications in the series for which the manuscript is intended. Guidelines for preparing bibliography may be secured from Series Section, SI Press.

Legends for illustrations must be submitted at the end of the manuscript, with as many legends typed, double-spaced, to a page as convenient.

Illustrations must be submitted as original art (not copies) accompanying, but separate from, the manuscript. Guidelines for preparing art may be secured from Series Section, SI Press. All types of illustrations (photographs, line drawings, maps, etc.) may be intermixed throughout the printed text. They should be termed **Figures** and should be numbered consecutively as they will appear in the monograph. If several illustrations are treated as components of a single composite figure, they should be designated by lowercase italic letters on the illustration; also, in the legend and in text references the italic letters (underlined in copy) should be used: "Figure 9b." Illustrations that are intended to follow the printed text may be termed **Plates**, and any components should be similarly lettered and referenced: "Plate 9b." Keys to any symbols within an illustration should appear on the art rather than in the legend.

Some points of style: Do not use periods after such abbreviations as "mm, ft, USNM, NNE." Spell out numbers "one" through "nine" in expository text, but use digits in all other cases if possible. Use of the metric system of measurement is preferable; where use of the English system is unavoidable, supply metric equivalents in parentheses. Use the decimal system for precise measurements and relationships, common fractions for approximations. Use day/month/year sequence for dates: "9 April 1976." For months in tabular listings or data sections, use three-letter abbreviations with no periods: "Jan, Mar, Jun," etc. Omit space between initials of a personal name: "J.B. Jones."

Arrange and paginate sequentially every sheet of manuscript in the following order: (1) title page, (2) abstract, (3) contents, (4) foreword and/or preface, (5) text, (6) appendixes, (7) notes section, (8) glossary, (9) bibliography, (10) legends, (11) tables. Index copy may be submitted at page proof stage, but plans for an index should be indicated when manuscript is submitted.