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THE EUPHAUSIACEA OF EASTERN FLORIDA (CRUSTACEA: MALACOSTRACA)

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Abstract.—Twenty-eight species of euphausiacean crustaceans are recorded from off the eastern Florida coast, from collections by the University of Miami and Harbor Branch Foundation, Fort Pierce. *Thysanopoda cristata, T. pectinata, Nematobrachion sexspinosus,* and *Stylocheiron robustum* are newly recorded for the area. Species bibliographies and a key to adult specimens are presented, along with taxonomic and ecological notes.

Twenty-seven species of euphausiacean crustaceans have been previously recorded from off the eastern Florida coast (Table 1). Of the five previous reports, three (Hansen 1915; Tattersall 1926; James 1970, 1971) were large geographical surveys which included parts of the eastern Florida area. The remaining two reports (Lewis 1954, Stepien 1980) were non-taxonomic works within the study area. Three of the 27 species (*Thysanopoda subaequalis, Stylocheiron affine, S. longicorne*) have since been synonymized with other species (Brinton 1975, Mikkelsen 1981), reducing the number of species to 24.

A comprehensive faunal survey of the Indian River coastal zone on the central eastern Florida coast was conducted during 1973–1974 by Harbor Branch Foundation and Smithsonian Institution's Fort Pierce Bureau. Eight stations from this survey, plus one subsequent Harbor Branch collection, yielded a total of 11,080 euphausiids. An additional 12,259 specimens from 84 stations by University of Miami's R/V *Gerda* were subsequently located in the Invertebrate Museum at the Rosenstiel School of Marine and Atmospheric Science. Together these two collections provided a total of 23,339 specimens in 28 species, including four species (*Thysanopoda cristata, T. pectinata, Nematobrachion sexspinosus, Stylocheiron robustum*) newly recorded for the area. This report documents the eastern Florida euphausiacean fauna found in this material, and comments on taxonomic and ecologic findings.

Materials and Methods

The study area is defined as the region off eastern Florida which is south of the Georgian-Floridan geopolitical boundary, west of the Bahama Bank, north of 24°N latitude, and east of Key West (see Fig. 1).

Station positions for the 93 stations are shown in Fig. 1. University of Miami's 84 R/V *Gerda* stations were taken during 1962–1965 and ranged in depth from surface to 820 m ($\bar{x}$ = 274.3 m). The remaining nine stations by Harbor Branch Foundation (eight by R/V *Gosnold* in 1974; one by R/V *Johnson* in 1981) ranged in depth from 50–750 m ($\bar{x}$ = 208.3 m). Bottom depths ranged from 73–1222 m. Twenty-three stations were classified as daytime samples, defined as including any portion of the hours between 0600 and 1800; 70 stations were night samples. Detailed station data may be obtained from the author or from the Rosenstiel School of Marine and Atmospheric Science, University of Miami.

The history of the samples (e.g., sorting, sub-sampling, etc.) was unknown; 50 of the 93 samples contained less than 100 total

Table 1.—Summary of records of eastern Florida Euphausiacea: Hansen 1915 [one station off St. Augustine (481.3 m)]; Tattersall 1926 [three stations off Miami (150, 700, 800 m), three stations off Fort Pierce/Jupiter (250, 500, 700 m)]; Lewis 1954 (11 stations off Miami, all at 732–823.5 m); James 1970, 1971 [one station off the Florida Keys (400 m)]; Stepien 1980 [one station off Miami (600–750 m)]. * = new records by the present study.

Species	Hansen	Tattersall	Lewis	James	Stepien	Present study
Bentheuphausia amblyops	–	–	–	–	X	X
Thysanopoda aequalis	–	X	X	X	–	X
**T. cristata*	–	–	–	–	–	X
T. monacantha	X	X	X	X	–	X
T. obtusifrons	–	–	–	–	X	X
T. orientalis	X	–	–	X	–	X
**T. pectinata*	–	–	–	–	–	X
T. tricuspida	–	X	X	–	–	X
Euphausia americana	–	X	X	X	X	X
E. brevis	–	X	X	X	–	X
E. gibboides	–	X	X	–	–	X
E. hemigibba	–	X	X	X	X	X
E. mutica	–	X	X	–	X	X
E. pseudogibba	–	–	–	X	X	X
E. tenera	–	X	X	X	X	X
Nematobrachion boopis	–	–	X	X	X	X
Nb. flexipes	–	X	–	–	X	X
**Nb. sexspinosus*	–	–	–	–	–	X
Nematoscelis atlantica	–	–	X	–	X	X
Ns. megalops	–	–	X	–	–	–
Ns. microps	–	X	X	X	X	X
Ns. tenella	–	X	X	X	X	X
Stylocheiron abbreviatum	–	X	X	X	X	X
S. carinatum	–	X	X	X	X	X
S. elongatum	–	X	X	X	X	X
S. maximum	–	X	X	–	–	X
**S. robustum*	–	–	–	–	–	X
S. suhmii	–	X	X	X	–	X

specimens (including 13 with less than 10), and were suspected of being unrepresentative of the original collection. For this reason, samples with 100 or more total individuals (hereafter referred to as "100+" stations) were treated separately for analyses of species frequency and relative abundance. No further attempts were made to treat these collections quantitatively.

To confirm adult identifications, specimens were compared to type or other identified material obtained from several museums. All such material is listed in the "Material examined" sections of the species accounts. Cited repositories are as follows:

IRCZM—Indian River Coastal Zone Museum, Harbor Branch Foundation, Inc., Fort Pierce, Florida.

UMML—Invertebrate Museum, Rosenstiel School of Marine and Atmospheric Science, University of Miami, Florida.

USNM—Division of Crustacea, National Museum of Natural History, Smithsonian Institution, Washington, D.C.

The structure of the male copulatory structure, the petasma, is of taxonomic value in euphauseacean, and was used in final

verification of species determinations. Following clearing of the isolated appendage, using the method of Mikkelsen (1981), the species-specific arrangement of processes on the petasma could be observed without obstruction or further manipulation. The female copulatory structure, the thelycum, is believed equal to the petasma in diagnostic value (Einarsson 1942, Costanzo and Guglielmo 1976a). However, because thelyca are more difficult to prepare and observe, they were examined only when somatic characters of females were inconclusive.

Larvae were encountered but are not considered in this study (all are deposited in the IRCZM).

Synonymies are restricted to the original description, previous names, petasma and thelycum descriptions, and one or two useful recent descriptions. All body lengths are total lengths in millimeters, measured along the dorsal midline from the tip of the rostrum (or frontal plate) to the tip of the telson.

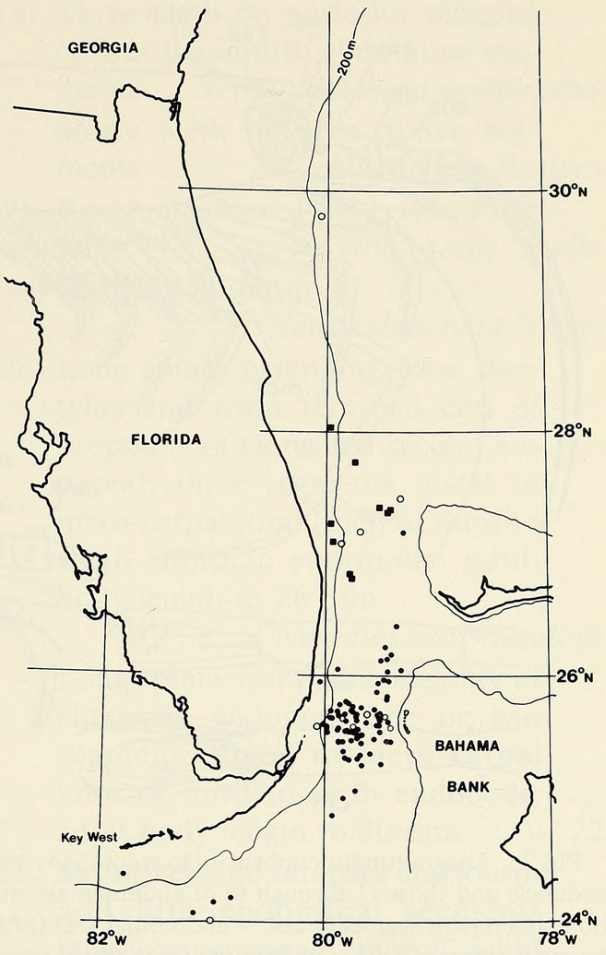

Fig. 1. Map of eastern Florida, showing stations utilized in this study. Open circles = previous records; solid circles = R/V *Gerda* stations; solid squares = R/V *Gosnold* and R/V *Johnson* stations (both HBF).

Taxonomic Section

The following artificial key is designed for identifying adult specimens, and relies heavily on structures most easily recognized in the often imperfect specimens commonly found in plankton tows. Previous keys (e.g., Boden et al. 1955, Lomakina 1978) depend on fragile structures, such as the thoracic appendages, which frequently suffer damage or loss during collection. Acronyms in brackets refer to those used in Fig. 2.

1. Eyes with few ommatidia, surrounded by homogeneous organic matrix ..... Family BENTHEUPHAUSIIDAE, ... *Bentheuphausia amblyops*
– Eyes with numerous, densely-packed ommatidia .... Family EUPHAUSIIDAE ... 2
2. Eyes round, or nearly so [eyr], without division into two lobes; no thoracic endopods greatly elongated .. (*Euphausia, Thysanopoda*) .. 3
– Eyes oblong and divided into two lobes [eyb]; second or third pair of thoracic endopods greatly elongated [ene] ..... (*Nematobrachion, Nematoscelis, Stylocheiron*) 16
3. Rostrum with secondary dorsal spine [rss] of varying length 4
– Rostrum simple, with no secondary spine 5
4. Dorsal process of first segment of antennular peduncle expanded as a "hood" ..... *Thysanopoda cristata*
– Dorsal process spine-like .... *Thysanopoda tricuspida*

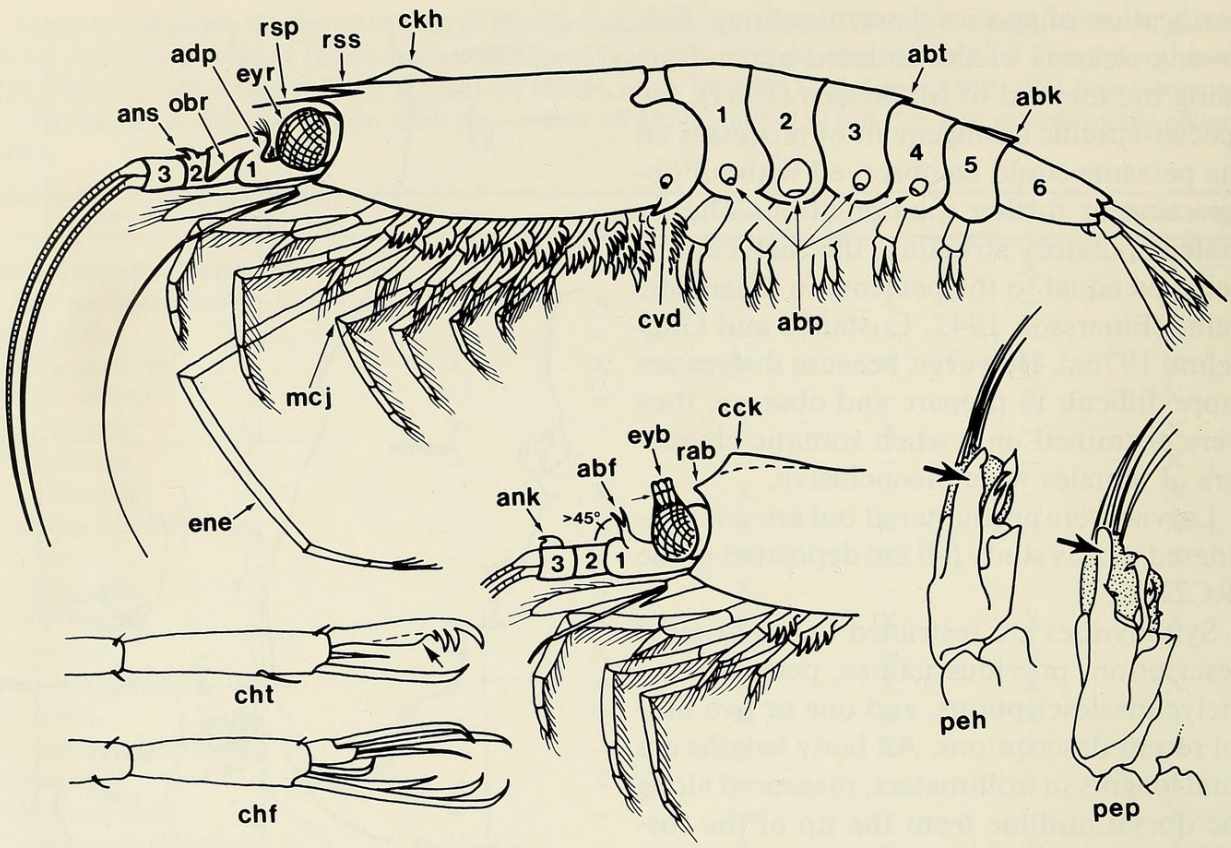

Fig. 2. Diagrammatic euphausiid to accompany artificial key. Segments (1, 2, 3) of antennular (=first antennal) peduncle and those (1 through 6) of abdomen are numbered for use with text. abf = antennular bifid process (first antennular segment); abk = abdominal keel (fifth segment); abp = abdominal photophores (that of second segment enlarged); abt = abdominal tooth (third segment); adp = antennular dorsal prominence (first segment); ank = antennular keel (tooth, third segment); ans = antennular spine (second segment); cck = crested carapace keel; ckh = carapace with humped keel; chf = false chela; cht = true chela; cvd = carapace with ventral denticle; ene = elongated thoracic endopod (third); eyb = bilobed eye (arrow indicates crystalline cones); eyr = round eye; mcj = mero-carpal joint (fourth thoracic endopod); obr = oblique ridge (process of first antennular segment); peh = petasma of *Euphausia hemigibba* (arrow indicates median lobe); pep = petasma of *Euphausia pseudogibba* (arrow indicates median lobe); rab = absent rostrum; rsp = spiniform rostrum; rss = rostral secondary spine.

5. Dorsal prominence ("hump") [adp] on first segment of antennular peduncle, directly anterior to eye .. .. (*Thysanopoda,* in part) 6
– Prominence absent .... (*Euphausia*) .. 10
6. Middorsal tooth [abt] on third abdominal segment ....*Thysanopoda monacantha*
– Tooth absent 7
7. Dorsal process of first segment of antennular peduncle pectinate .. ..*Thysanopoda pectinata*
– Process not pectinate 8
8. Dorsal process of first segment of antennular peduncle expanded distally, forming a conspicuous oblique lateral ridge [obr] ....*Thysanopoda aequalis*
– Dorsal process tapered distally in lateral view; ridge absent 9
9. Dorsal process of first segment of antennular peduncle truncate in dorsal view; small denticle [cvd] on postero-lateral margin of carapace ..... *Thysanopoda obtusifrons*
– Dorsal process acute in dorsal view; lateral denticle absent ....*Thysanopoda orientalis*
10. Dorsal process of first segment of

antennular peduncle pectinate .. .. *Euphausia americana*
– Process not pectinate 11
11. Middorsal tooth [abt] on third abdominal segment 12
– Tooth absent 14
12. Middorsal keel on third segment of antennular peduncle [ank] prominent and distally toothed . ..... *Euphausia gibboides*
– Keel low and untoothed 13
13. Median lobe of male petasma [pep, arrow] ending in a blunt, finger-shaped process; coxal lobes of female thelycum meeting at midventral line . *Euphausia pseudogibba*
– Median lobe of male petasma [peh, arrow] with a tapered end; coxal lobes of thelycum not meeting at midventral line .... *Euphausia hemigibba*
14. Dorsal process of first segment of antennular peduncle bifid [abf] .. 15
– Dorsal process very small and triangular (female), or absent (male) ..... *Euphausia tenera*
15. Bifid process pointing dorsally at angle greater than 45° [abf]; dorsal spine [ans] on second segment of antennular peduncle .... *Euphausia brevis*
– Bifid process pointing anteriorly at angle less than 45°; dorsal spine absent ..... *Euphausia mutica*
16. Ventral photophores [abp] present on more than one abdominal segment .....(*Nematobrachion, Nematoscelis*) 17
– Ventral abdominal photophores on first segment only ....(*Stylocheiron*) .. 23
17. Upper lobe of eye conspicuously wider than lower lobe 18
– Upper lobe nearly equal in width or narrower than lower lobe 21
18. Middorsal tooth [abt] on at least two abdominal segments 19
– Middorsal teeth absent 20
19. Three teeth on posterior margins of fourth and fifth abdominal segments .. *Nematobrachion sexspinosus*
– Single teeth only on above segments ..... *Nematobrachion flexipes*
20. Rostrum present and spiniform [rsp] ..... *Nematoscelis tenella*
– Rostrum absent [rab] .... *Nematobrachion boopis*
21. Long spines extending from dactylus and from terminal end of propodus of elongated second endopod; three segments distal to mero-carpal joint [mcj] of third to sixth thoracic endopods; adult body length to 26 mm .... *Nematoscelis megalops*
– Long spines from dactylus only of elongated endopod; one or two segments distal to mero-carpal joint of third to sixth endopods; adult body length to 20 mm 22
22. Strong keels on carapace and fourth and fifth abdominal segments [abk]; conspicuous "hump" [ckh] on carapace keel; upper eye lobe equal or slightly less in width to lower lobe .... *Nematoscelis microps*
– Above keels and "hump" weak or absent; upper eye lobe conspicuously narrower than lower .... *Nematoscelis atlantica*
23. Length of sixth abdominal segment greater than sum of lengths of fourth and fifth abdominal segments ..... *Stylocheiron elongatum*
– Length not greater than sum 24
24. Toothed middorsal keels [abk] on fourth and fifth abdominal segments .....*Stylocheiron abbreviatum*
– Keels absent 25
25. Middorsal "crested" keel [cck] on carapace .....*Stylocheiron carinatum*
– Keel not "crested" or absent 26
26. False chela [chf] at end of elongated third thoracic endopod; upper lobe of eye with conspicuous crys-

Table 2.—Species abundance and relative frequencies in all stations and 100+ stations. "Av. % of sp." is the mean relative abundance of the species in the 100+ stations in which it was found.

Species	All Stations (n = 93)		100+ Stations (n = 43)		
	Total no. (%)	No. (%) of sta. containing sp.	Total no. (%)	Av. % of sp.	No. (%) of sta. containing sp.
S. carinatum	4116 (17.6)	56 (60.2)	4032 (18.6)	12.6	37 (86.0)
Ns. microps	3303 (14.2)	64 (68.8)	2973 (13.7)	19.5	37 (86.0)
S. abbreviatum	2971 (12.7)	71 (76.3)	2704 (12.5)	16.7	37 (86.0)
E. tenera	2498 (10.7)	32 (37.6)	2477 (11.5)	10.2	24 (55.8)
E. americana	2245 (9.6)	46 (49.4)	2208 (10.2)	5.4	38 (88.4)
T. aequalis	1778 (7.6)	55 (59.1)	1647 (7.6)	11.4	36 (83.7)
T. tricuspida	943 (4.0)	60 (64.5)	854 (3.9)	9.0	39 (90.7)
E. hemigibba	864 (3.7)	51 (54.8)	812 (3.7)	6.8	36 (83.7)
T. monacantha	761 (3.3)	63 (67.7)	702 (3.2)	5.3	41 (95.3)
S. suhmii	534 (2.3)	49 (52.7)	493 (2.3)	2.0	32 (74.4)
E. gibboides	435 (1.9)	59 (63.4)	287 (1.3)	2.2	35 (81.4)
Ns. atlantica	433 (1.8)	44 (47.3)	374 (1.7)	3.7	29 (67.4)
Ns. tenella	350 (1.5)	52 (55.9)	301 (1.4)	2.2	34 (79.1)
Nb. flexipes	335 (1.4)	45 (48.4)	271 (1.2)	2.4	31 (72.1)
E. pseudogibba	322 (1.4)	47 (50.5)	288 (1.3)	2.5	33 (76.7)
E. brevis	303 (1.3)	24 (25.8)	292 (1.3)	3.6	20 (46.5)
S. elongatum	273 (1.2)	33 (35.5)	202 (0.9)	3.0	21 (48.8)
E. mutica	239 (1.0)	42 (45.2)	208 (1.0)	1.7	28 (65.1)
Nb. boopis	179 (0.8)	20 (21.5)	129 (0.6)	4.1	9 (20.9)
T. obtusifrons	166 (0.7)	20 (21.5)	165 (0.8)	2.4	19 (44.2)
T. orientalis	92 (0.4)	16 (17.2)	70 (0.3)	2.1	11 (25.6)
Nb. sexspinosus	72 (0.3)	25 (26.9)	49 (0.2)	1.0	16 (37.2)
S. robustum	56 (0.2)	19 (20.4)	42 (0.2)	1.2	13 (30.2)
S. maximum	41 (0.2)	14 (15.0)	29 (0.1)	1.3	9 (20.9)
T. pectinata	3 (<0.1)	3 (3.2)	2 (<0.1)	0.2	2 (4.6)
B. amblyops	3 (<0.1)	2 (2.1)	0 (0.0)	0.0	0 (0.0)
T. cristata	1 (<0.1)	1 (1.1)	1 (<0.1)	0.1	1 (2.3)
	23,316 (99.8)		21,612 (99.5)		

talline cones [eyb, arrow] of varying number ..... *Stylocheiron suhmii*

– True chela [cht] at end of elongated third thoracic endopod; eye bilobed but without conspicuous crystalline cones in upper lobe .. 27

27. Upper lobe of eye approximately equal in width to lower lobe; dactylus of true chela expanded [cht, arrow] proximal to secondary spines ..... *Stylocheiron maximum*

– Upper lobe of eye narrower than lower lobe; dactylus of equal width proximal and distal to secondary spines ..... *Stylocheiron robustum*

Order Euphausiacea Boas, 1883
Family Bentheuphausiidae Colosi, 1917
Genus *Bentheuphausia* G. O. Sars, 1885

Bentheuphausia amblyops (G.O. Sars, 1883)

Thysanopoda (?) *amblyops* G. O. Sars, 1883: 23.

Bentheuphausia amblyops.—G. O. Sars, 1885:109–114, fig. 4, pl. XIX.—Einarsson, 1942:278–284, figs. 13–16 [modified first male pleopod].—Lomakina, 1978: 75–77, fig. 40.—Guglielmo and Costanzo, 1983:278–279, fig. 1(a–b) [thelycum].

Material examined.—ATLANTIC: Ber-

muda-Bahamas line: 1 spm, *Bache* Sta 10182, USNM 62247.—Gulf of Mexico: 3 ♀, *Oregon* Sta 841, USNM 95999; 2 ♂, *Alaminos* Sta 65-A-14-7, USNM 135308.—PACIFIC: Galapagos Islands: 1 ♂, 1 ♀, *Albatross* Sta 4707, USNM 45353.

Vouchers: 1 ♂, GER-091, IRCZM 089: 05873; 2 juv., GER-358, UMML 32:5761.

Family Euphausiidae Dana, 1850
Genus *Thysanopoda* Latreille, 1831
Thysanopoda aequalis Hansen, 1905

Thysanopoda aequalis Hansen, 1905:18–20.—Boden et al., 1955:303–305, fig. 9(a–d) [petasma].—Brinton, 1975:165–167, figs. 89(a–c), 119(l–m).—Costanzo and Guglielmo, 1976a:46–47, text-fig. 1, pl. 1, fig. 1 [thelycum].
Thysanopoda subaequalis Boden, 1954:190–192, fig. 5.

Material examined.—ATLANTIC: Bahama Bank: 20+ spms, *Bache* Sta 10208, USNM 62258.—Gulf of Mexico: 22 ♂, 27 ♀, *Alaminos* Sta 65-A-9-6, USNM 135323.—Caribbean Sea: 1 ♂, 1 ♀, *Gerda* Sta CARIB-15, UMML 32:1482; 1 ♂, 2 ♀, *Gerda* Sta CARIB-18, UMML 32:1487.—Western Atlantic: 1 ♂, *Bache* Sta 62252 (in part).

Vouchers: 87 ♂, 124 ♀, GER-356, IRCZM 089:05874; 11 ♂, 22 ♀, GOS-173, IRCZM 089:05959; 37 ♂, 43 ♀, 1 spm, GER-200, UMML 32:5754; 10 ♂, 10 ♀, GOS-144, UMML 32:5753; 23 ♂, 19 ♀, 4 juv., 1 spm, GER-352, USNM 228239; 10 ♂, 10 ♀, GOS-144, USNM 228238.

Thysanopoda cristata G. O. Sars, 1883

Thysanopoda cristata G. O. Sars, 1883:22.—Boden et al., 1955:300–301, fig. 7(a–b) [petasma].—Guglielmo and Costanzo, 1977:275, text-fig. 2, pl. 1c [thelycum].—Lomakina, 1978:82–83, fig. 42.

Material examined.—ATLANTIC: Gulf of Mexico: 1 ♂, *Alaminos* Sta 65-A-14-5, USNM 135318; 1 ♀, *Alaminos* Sta 69-A-13-13, USNM 135317.

Vouchers: 1 ♂, GER-072, UMML 32: 5752.

Remarks.—This species has not been previously reported from the study area. A single male was collected off Miami at 458 m. The nearest previous record was in the Gulf of Mexico, west southwest of Key West (James 1970, 1971).

Thysanopoda monacantha Ortmann, 1893

Thysanopoda monacantha Ortmann, 1893: 9, pl. 1, fig. 2.—Boden et al., 1955:298–300, fig. 6(a–b) [petasma].—Guglielmo and Costanzo, 1977:275, text-fig. 1, pl. 1(a–b) [thelycum].—Lomakina, 1978:80–82, fig. 41.

Material examined.—ATLANTIC: eastern Florida: 1 ♂, *Albatross* Sta 2665, USNM 47510; 1 juv., *Gerda* Sta, UMML 32:1503.—north of Bahama Bank: 1 ♂, *Bache* Sta 10211, USNM 62254.—Gulf of Mexico: 1 ♂, 1 ♀, *Alaminos* Sta 69-A-11-91, USNM 135319.—Caribbean Sea: 1 juv., *Gerda* Sta CARIB-18, UMML 32:1486 (in part); 1 ♂, 1 ♀, *Gerda* Sta CARIB-18, UMML 32:1488; 2 ♂, 13 ♀, 25 juv., *Gerda* Sta CARIB-21, UMML 32:1491 (in part); 1 ♂, 3 ♀, *Gerda* Sta CARIB-21, UMML 32:1493 (in part); 1 ♂, *Gerda* Sta CARIB-9, UMML 32:1497 (in part).—Western Atlantic: 10 spms, *Bache* Sta, USNM 62252 (in part).

Vouchers: 14 ♂, 18 ♀, 1 juv., GER-326, IRCZM 089:05872; 3 ♂, 19 ♀, 10 juv., GOS-144, IRCZM 089:05958; 10 ♂, 35 ♀, 54 juv., GER-099, UMML 32:5750; 1 ♂, 4 ♀, GOS-173, UMML 32:5751; 17 ♂, 16 ♀, 2 juv., GER-327, USNM 228241; 1 ♂, 12 ♀, 23 juv., GOS-160, USNM 228240.

Thysanopoda obtusifrons G. O. Sars, 1883

Thysanopoda obtusifrons G. O. Sars, 1883: 21.—Boden et al., 1955:305–307, fig. 10(a–c) [petasma].—Guglielmo and Cos-

tanzo, 1977:278, text-fig. 4, pl. 1e [thelycum].—Lomakina, 1978:88–89, fig. 45.

Material examined.—ATLANTIC: Bermuda-Bahamas line: 3 ♀, *Bache* Sta 10182, USNM 62285.—Gulf of Mexico: 1 ♂, 3 ♀, *Alaminos* Sta 69-A-13-7, USNM 135320.—Western Atlantic: 1 juv. ♂, 2 ♀, 4 juv. ♀, *Bache* Sta, USNM 181671.—PACIFIC: Callao, Peru, to Easter Island: 12 spms, *Albatross* Sta 4685, USNM 45218.

Vouchers: 1 ♂, 8 ♀, GER-072, IRCZM 089:05870; 1 ♂, GER-107, IRCZM 089:05869; 3 ♂, 1 ♀, GOS-144, IRCZM 089:05960; 3 ♂, 4 ♀, GER-058, UMML 32:5756; 3 juv., GOS-159, UMML 32:5755; 1 ♂, 7 ♀, 3 juv., GER-346, USNM 228243; 1 ♂, GOS-172, USNM 228242.

Thysanopoda orientalis Hansen, 1910

Thysanopoda orientalis Hansen, 1910:85–87, pl. 13, fig. 2(a–i).—Boden et al., 1955:309–311, fig. 12(a–b) [petasma].—Guglielmo and Costanzo, 1977:278, text-fig. 6, pl. 2(a–b) [thelycum].—Lomakina, 1978:93–94, fig. 48.

Material examined.—ATLANTIC: eastern Florida: 1 spm, *Albatross* Sta 2665, USNM 47519.—Gulf of Mexico: 1 ♂, 1 ♀, *Oregon* Sta 841, USNM 96002; 1 spm, *Albatross* Sta 2382, USNM 47518.—PACIFIC: Easter Island to Galapagos Islands: 1 ♂, 1 ♀, *Albatross* Sta 4709, USNM 45213.

Vouchers: 1 ♀, GER-130, IRCZM 089:05883; 8 ♂, 6 ♀, 10 juv., GER-285, IRCZM 089:05871; 1 ♀, GOS-144, IRCZM 089:05961; 4 ♂, 6 ♀, 1 juv., GER-341, UMML 32:5757; 4 ♂, 2 ♀, 1 juv., GER-356, USNM 228244.

Thysanopoda pectinata Ortmann, 1893

Thysanopoda pectinata Ortmann, 1893:10, pl. 1, fig. 4.—Boden et al., 1955:307–309, fig. 11(a–c) [petasma].—Guglielmo and Costanzo, 1977:278, text-fig. 5, pl. 1f [thelycum].—Lomakina, 1978:91–93, fig. 47.

Material examined.—ATLANTIC: Gulf of Mexico: 2 ♀, *Alaminos* Sta 66-A-9-15, USNM 135322; 1 ♂, *Albatross* Sta 2393, USNM 47505.

Vouchers: 1 juv. ♂, GER-332, IRCZM 089:05868; 1 juv. ♂, GER-072, UMML 32:5758; 1 ♀, GER-196, USNM 228245.

Remarks.—*Thysanopoda pectinata* has not been previously reported from the study area. Three specimens were collected in this study, all from off Miami, in depths ranging from 256–458 m. The species was also previously collected in the northern and western Gulf of Mexico (Hansen 1915; Springer and Bullis 1956; James 1970, 1971).

Thysanopoda tricuspida
H. Milne Edwards, 1837

"Thysanopode tricuspide" H. Milne Edwards, 1830:454, pl. 19, figs. 1–9 [Note: Milne Edwards' "fig. 5" is applied to two different illustrated appendages, and should read as numbers 5 and 6; those labelled figs. 6–9 should therefore be figs. 7–10, as reflected in the figure captions, p. 410.].

Thysanopoda tricuspida H. Milne Edwards, 1837:466, pl. 26, figs. 1–6.—Lucas, 1840:205.—Desmarest, 1852:43.

Thysanopodus tricuspidatus Guérin Méneville, 1829–1844: pl. 23, figs. 4, 4(a–l).—Lucas, 1840: pl. 17, fig. 2.

Thysanopoda tricuspidata.—G. O. Sars, 1883:20–21; 1885:98–102, pl. 17, figs. 1–25, larvae 165–169, pl. 31, figs. 1–22.—Hansen, 1910:82–84, pl. 12, fig. 3(a–b) [petasma].—Guglielmo and Costanzo, 1977:275, 278, text-fig. 3, pl. 1d [thelycum].—Lomakina, 1978:83–85, fig. 43.

Cyrtopia rostrata Dana, 1852:648; 1855: pl. 43, fig. 2(a–b) [fide G. O. Sars, 1885:165; larvae].

Material examined.—ATLANTIC: Gulf of Mexico: 1 ♂, 1 ♀, *Alaminos* Sta 69-A-11-91, USNM 135324.—Caribbean Sea: 1 ♀, *Gerda* Sta CARIB-10, UMML 32:1476; 2 ♀, *Gerda* Sta CARIB-23, UMML 32:1478;

7 ♂, 21 ♀, 16 juv., *Gerda* Sta CARIB-15, UMML 32:1483 (in part); 2 ♂, 3 ♀, *Gerda* Sta CARIB-18, UMML 32:1485; 2 ♂, 2 ♀, *Gerda* Sta CARIB-21, UMML 32:1491 (in part); 2 ♂, 2 ♀, *Gerda* Sta CARIB-21, UMML 32:1492 (in part); 50 ♂, 126 ♀, 5 juv., 3 spms, *Gerda* Sta CARIB-21, UMML 32:1493 (in part); 1 ♂, *Gerda* Sta CARIB-22, UMML 32:1495; 1 ♂, *Gerda* Sta CARIB-9, UMML 32.1497 (in part); 1 ♂, 1 ♀, *Gerda* Sta CARIB-9, UMML 32:1499.—Western Atlantic: 22 spms, *Bache* Sta, USNM 62248.

Vouchers: 71 ♂, 62 ♀, 48 juv., GER-286, IRCZM 089:05867; 10 ♂, 15 ♀, 2 juv., GOS-173, IRCZM 089:05962; 27 ♂, 53 ♀, 18 juv., GER-351, UMML 32:5759; 5 ♂, 12 ♀, 5 juv., GOS-172, UMML 32:5760; 26 ♂, 18 ♀, 17 juv., GER-098, USNM 228247; 5 ♂, 7 ♀, 1 juv., GOS-160, USNM 228246.

Remarks.—A correction is made here to the spelling of this species name. The first description and illustration of this species, under the French vernacular "Thysanopode triscupide," was read before the Académie des Sciences by H. Milne Edwards in 1830. Latreille (1831) was first to latinize Milne Edwards' genus "Thysanopode" to *Thysanopoda,* without reference to the specific epithet "tricuspide." The latter was latinized to *tricuspida* by H. Milne Edwards (1837). Because vernacular names have no status in zoological nomenclature, they cannot be emended. These latinizations are therefore first appearances and thus take authorship from those first appearances, i.e., *Thysanopoda* Latreille, 1831, and *T. tricuspida* H. Milne Edwards, 1837.

Dr. L. B. Holthuis (in litt. 1980) noted that Milne Edwards may not have been first to latinize the specific epithet "tricuspide." Plate 23 of Guérin Méneville's (1829–1844) "Iconographie du Règne Animal de Cuvier" illustrates Milne Edwards' species under the name "*Thysanopodus tricuspidatus* Edw." The exact publication date of this plate, and thus of *Thysanopodus tricuspidatus,* is unknown, except that it fell between 1829 and December 1837, when the last plate was published (Cowan 1971). According to Cowan (in litt. to L. B. Holthuis 1976), plate 23 most likely appeared with one of the livraisons between livr. 23 (September 1832) and livr. 41 (December 1835). If this should prove to be true, Guérin Méneville's specific name would precede that of Milne Edwards (1837). However, without further evidence, Cowan's suggested dates cannot be proven at this time. Therefore, the earliest date which can be accepted for plate 23 must be December 1837, the date by which all of the plates had been published. Because Milne Edwards' name appeared in July 1837, *Thysanopoda tricuspida* has priority.

Desmarest (1852) was the last to apply the valid name to this species, but without citation of any of the earlier authors. In summary, then, the name *Thysanopoda tricuspida* has been a nomen oblitum for over 130 years. G. O. Sars' (1883, 1885) form of the species name, *T. tricuspidata,* has been used by virtually every author since 1883, being attributed variously to Milne Edwards, 1830, or 1837. Such usage might provide sufficient reason to petition the International Commission on Zoological Nomenclature to suppress the unused senior synonym. However, I concur with Dr. L. B. Holthuis (in litt. 1980), who considered *T. tricuspida* "not a common species and . . . only known to taxonomists," in that nomenclatural stability of the Euphausiacea will not be seriously disturbed by reinstating the original spelling.

G. O. Sars (1883, 1885) was first to note the prominent dorsal spine on the carapace, just posterior to the rostrum. Although this character was neither noted nor illustrated in any work prior to 1883, other anatomical characters of this euphausiid illustrated by Milne Edwards (1830, 1837) and Sars (1885) compare favorably and leave little doubt that both authors were dealing with the same species. However, because Milne Edwards had overlooked or neglected to mention the very prominent post-rostral spine, exami-

nation of type material was desirable. Regrettably, the collections of the Muséum National d'Histoire Naturelle (Paris), believed to contain the existing specimens of H. Milne Edwards, yielded only one lot (MNHN Eu 29) under the name *Thysanopoda tricuspida*. Completely lacking locality data, the lot included the label "A. Milne Edwards, 4-99," indicating only that it was in the collection which A. Milne Edwards had in his cabinet in 1899 (J. Forest in litt. 1980). That this was part of a syntypic series of the elder Milne Edwards seems doubtful. Moreover, the single intact and seven fragmented specimens in the lot proved to be representatives of *Meganyctiphanes norvegica* (M. Sars, 1857), a species bearing little or no resemblance to *T. tricuspida*. Beyond these, no other specimens apparently exist which could be construed as type material for *T. tricuspida*. However, the identity of this species is well understood, principally through the work of G. O. Sars (1885), so no neotype need be designated.

Genus *Euphausia* Dana, 1850

Euphausia americana Hansen, 1911

Euphausia americana Hansen, 1911:23–24, fig. 6 [petasma].—Guglielmo and Costanzo, 1978:145, pl. 1(a–b) [thelycum].—Lomakina, 1978:128–129, fig. 69.

Material examined.—ATLANTIC: Caribbean Sea: 11 spms, *Albatross* Sta 138, USNM 9122; 1 ♂, *Gerda* Sta CARIB-23, UMML 32:1480; 1 ♀, *Gerda* Sta CARIB-15, UMML 32:1483 (in part); 2 ♂, 3 ♀, *Gerda* Sta CARIB-15, UMML 32:1484 (in part); 1 ♂, 1 ♀, *Gerda* Sta CARIB-18, UMML 32:1486 (in part).

Vouchers: 17 ♂, 25 ♀, 1 spm, GER-286, IRCZM 089:05863; 20 ♂, 20 ♀, GOS-130, IRCZM 089:05951; 5 ♂, 5 ♀, 12 juv., GER-740, UMML 32:5763; 20 ♂, 20 ♀, GOS-130, UMML 32:5762; 8 ♂, 9 ♀, GER-195, USNM 228201; 20 ♂, 20 ♀, GOS-130, USNM 228200.

Euphausia brevis Hansen, 1905

Euphausia brevis Hansen, 1905:15–16.—Boden et al., 1955:328–330, fig. 21(a–d) [petasma].—Costanzo and Guglielmo, 1976a:50, text-fig. 4, pl. 2, fig. 2 [thelycum].—Lomakina, 1978:124–125, fig. 66.

Material examined.—ATLANTIC: Bermuda-Bahamas line: "many," *Bache* Sta 10186, USNM 62271.

Vouchers: 1 ♂, 2 ♀, GER-286, IRCZM 089:05864; 1 ♂, GER-314, IRCZM 089:05866; 2 ♀, GER-345, IRCZM 089:05865; 7 ♂, 8 ♀, GOS-173, IRCZM 089:05952; 3 ♂, 1 ♀, GER-338, UMML 32:5765; 6 ♂, 8 ♀, GOS-173, UMML 32:5764; 2 ♂, 5 ♀, 1 juv., GER-717, USNM 228203; 6 ♂, 9 ♀, GOS-173, USNM 228202.

Euphausia gibboides Ortmann, 1893

Euphausia gibboides Ortmann, 1893:12, pl. 1, fig. 5.—Boden et al., 1955:347–349, fig. 32(a–b) [petasma].—James, 1970:209 [key], fig. 7-4.—Guglielmo and Costanzo, 1978:150, pl. 23(a–b) [thelycum].

Material examined.—ATLANTIC: Caribbean Sea: 2 ♀, *Gerda* Sta CARIB-10, UMML 32.1477; 25 ♂, 22 ♀, *Gerda* Sta CARIB-23, UMML 32.1479; 53 ♂, 49 ♀, 2 spms, *Gerda* Sta CARIB-18, UMML 32:1486 (in part); 1 ♀, *Gerda* Sta CARIB-21, UMML 32:1491 (in part); 22 ♂, 29 ♀, *Gerda* Sta CARIB-21, UMML 32:1492 (in part); 4 ♂, 2 ♀, *Gerda* Sta CARIB-14, UMML 32:1494; 1 ♂, 3 ♀, 1 juv., *Gerda* Sta CARIB-9, UMML 32:1500; 2 ♀, *Gerda* Sta CARIB-13, UMML 32:1505.—Western Atlantic: 10+ spms, *Bache* Sta, USNM 62278.

Vouchers: 30 ♂, 21 ♀, 1 juv., GER-011, IRCZM 089:05862; 6 ♂, 15 ♀, 19 juv., GOS-160, IRCZM 089:05953; 14 ♂, 14 ♀, 2 juv., GER-321, UMML 32:5767; 4 ♂, 3 ♀, 6 juv., GOS-159, UMML 32:5766; 8 ♂, 11 ♀, GER-084, USNM 228205; 4 ♂, 4 ♀, 6 juv., GOS-159, USNM 228204.

Euphausia hemigibba Hansen, 1910

Euphausia hemigibba Hansen, 1910:100, pl. 14, fig. 5(a–f).—Boden et al., 1955:342–344, fig. 29(a–e) [petasma].—James, 1977: 1039–1040, fig. 1 [thelycum].—Lomakina, 1978:149–150, fig. 86.

Material examined.—ATLANTIC: Caribbean Sea: 1 ♀, *Gerda* Sta CARIB-18, UMML 32:1486 (in part); 1 ♂, *Gerda* Sta CARIB-21, UMML 32:1492 (in part).—Western Atlantic: 200+ spms, *Bache* Sta, USNM 62277.

Vouchers: 17 ♂, 29 ♀, GER-011, IRCZM 089:05858; 10 ♂, 17 ♀, GOS-144, IRCZM 089:05954; 6 ♂, 10 ♀, GER-327, UMML 32: 5769; 10 ♂, 16 ♀, GOS-144, UMML 32:5768; 6 ♂, 6 ♀, GER-107, USNM 228207; 10 ♂, 17 ♀, GOS-144, USNM 228206.

Remarks.—Separation of this species from *Euphausia pseudogibba* was not possible using somatic characters alone. The dorsal spine on the third abdominal segment was variable in length and was thus unreliable as a diagnostic feature in these collections. Therefore, petasmal and thelycal structures were used, unfortunately excluding subadult specimens from identification to the species level. In mature individuals, the shape of the median lobe of the petasma (Fig. 2, pep, peh) or that of the sixth coxal lobes of the thelycum (see James 1977) were readily observable without dissection, allowing fairly rapid separation of the two species.

Euphausia mutica Hansen, 1905

Euphausia mutica Hansen, 1905:14–15; 1910:93–94, pl. 14, fig. 1(a–d) [petasma].—Guglielmo and Costanzo, 1978: 145, pl. 3(a–b) [thelycum].—Lomakina, 1978:123–124, fig. 65.

Material examined.—ATLANTIC: Caribbean Sea: 8 spms, *Albatross* Sta surf. 138, USNM 47615; 1 ♂, 1 ♀, *Gerda* Sta CARIB-22, UMML 32:1496.—West Indies: 1 spm, *Albatross* Sta, USNM 47618.—Western Atlantic: 30+ spms, *Bache* Sta, USNM 62272.

Vouchers: 10 ♂, 9 ♀, GER-286, IRCZM 089:05859; 16 ♂, 20 ♀, GOS-160, IRCZM 089:05955; 4 ♂, 9 ♀, 2 juv., GER-338, UMML 32:5771; 10 ♂, 6 ♀, GOS-144, UMML 32:5770; 7 ♂, 4 ♀, GER-351, USNM 228209; 9 ♂, 5 ♀, 3 juv., GOS-144, USNM 228208.

Euphausia pseudogibba Ortmann, 1893

Euphausia pseudogibba Ortmann, 1893:12–13, pl. 1, fig. 6.—Boden et al., 1955:340–342, fig. 28(a–d) [petasma].—James, 1977: 1040, fig. 2 [thelycum].—Lomakina, 1978: 151–153, fig. 88.

Material examined.—ATLANTIC: Caribbean Sea: 1 ♂, *Gerda* Sta CARIB-18, UMML 32:1486 (in part); 1 ♂, *Gerda* Sta CARIB-21, UMML 32:1491 (in part); 2 ♂, *Gerda* Sta CARIB-21, UMML 32:1492 (in part).—PACIFIC: Philippine Islands: 50+ spms, *Albatross* Sta 5649, USNM 49451.

Vouchers: 11 ♂, 16 ♀, GER-072, IRCZM 089:05860; 21 ♂, 7 ♀, GOS-160, IRCZM 089:05956; 13 ♂, 14♀, GER-351, UMML 32:5773; 3 ♂, 5 ♀, GOS-144, UMML 32: 5772; 7 ♂, 9 ♀, GER-326, USNM 228211; 3 ♂, 4 ♀, GOS-144, USNM 228210.

Remarks.—See remarks under *Euphausia hemigibba.*

Euphausia tenera Hansen, 1905

Euphausia tenera Hansen, 1905:9.—Boden et al., 1955:335–337, fig. 25(a–c) [petasma].—Guglielmo and Costanzo, 1978: 148, pl. 15(a–b) [thelycum].—Lomakina, 1978:162–164, fig. 98.

Material examined.—ATLANTIC: Caribbean Sea: 1 ♀, *Gerda* Sta CARIB-15, UMML 32:1484 (in part).—Western Atlantic: 30 + spms, *Bache* Sta, USNM 62273.

Vouchers: 29 ♂, 29 ♀, 7 juv., GER-740, IRCZM 089:05861; 20 ♂, 20 ♀, GOS-130, IRCZM 089:05957; 3 ♂, 4 ♀, GER-717,

UMML 32:5775; 20 ♂, 20 ♀, GOS-130, UMML 32:5774; 10 ♂, 12 ♀, GER-286, USNM 228213; 20 ♂, 20 ♀, GOS-130, USNM 228212.

Genus *Nematobrachion* Calman, 1905

Nematobrachion boopis (Calman, 1896)

Nematodactylus boopis Calman, 1896:16–19, pl. 2, figs. 19–28.

Nematobrachion boopis.—Calman, 1905: 153–154, pl. 26.—Boden et al., 1955:377–379, fig. 47(a–b) [petasma].—Lomakina, 1978:104–105, fig. 55.—Guglielmo and Costanzo, 1983:290, fig. 11(a–b) [thelycum].

Material examined.—ATLANTIC: Gulf of Mexico: 4 spms, *Alaminos* Sta 69-A-13-19, USNM 135309.

Vouchers: 19 ♂, 22 ♀, GER-072, IRCZM 089:05856; 2 ♂, 2 ♀, GOS-159, IRCZM 089: 05964; 4 ♂, 5 ♀, 2 juv., GER-352, UMML 32:5777; 3 ♀, GOS-172, UMML 32:5776; 10 ♂, 9 ♀, 1 juv., GER-285, USNM 228215; 1 ♂, 1 ♀, GOS-172, USNM 228214.

Remarks.—No pattern of abdominal photophore reduction was noted for *Nematobrachion boopis*; males and females of all sizes possessed the full complement of photophores. In view of the patterns of reduction noted in the other species of this genus (see below), this "non-reduction" is in fact a species-specific characteristic.

Nematobrachion flexipes (Ortmann, 1893)

Stylocheiron flexipes Ortmann, 1893:18–19, pl. 1, fig. 7.

Nematodactylus flexipes.—Calman, 1896: 16.

Nematobrachion flexipes.—Calman, 1905: 153.—Boden et al., 1955:373–376, fig. 45(a–c) [petasma].—Lomakina, 1978: 101–102, fig. 53.—Guglielmo and Costanzo, 1983:287, fig. 9(a–b) [thelycum].

Material examined.—ATLANTIC: Gulf of Mexico: 3 ♀, *Alaminos* Sta 65-A-9-6, USNM 135310.—Western Atlantic: 51 ♂, 45 ♀, 37 juv., USNM 62288 (in part).

Vouchers: 37 ♂, 42 ♀, 2 juv., GER-286, IRCZM 089:05857; 4 ♂, 2 ♀, 6 juv., GOS-144, IRCZM 089:05940; 2 ♂, 5 ♀, 3 juv., GER-100, UMML 32:5779; 3 ♂, 2 ♀, 4 juv., GOS-144, UMML 32:5778; 5 ♂, 4 ♀, GER-327, USNM 228217; 3 ♂, 2 ♀, 4 juv., GOS-144, USNM 228216.

Remarks.—P. T. James (quoted by Herring and Locket 1978) noted sexual dimorphism in the abdominal photophores of this species in the eastern Atlantic; males lacked the third photophore, and females lacked both the second and third photophores. This same pattern of photophore reduction was noted in all specimens examined in this study. However, a further observation was made: Whereas large males (ca. 15 mm in length) lacked only the third photophore, small males (ca. 11 mm in length) with underdeveloped, but recognizable, petasmata, lacked both the second and third. Males of an intermediate length (ca. 13 mm) possessed the second photophore, although it was smaller in diameter than the first and fourth. All subadults (<10 mm in length, with underdeveloped reproductive structures) lacked both the second and third photophores. Thus while females of any size lacked both the second and third photophores, males appeared to acquire the second with maturity.

Nematobrachion sexspinosus Hansen, 1911

Nematobrachion sexspinosus Hansen, 1911: 50–51.—Boden et al., 1955:376–377, fig. 46(a–d) [petasma].—Lomakina, 1978: 102–103, fig. 54.

Nematobrachion sexspinosum Mauchline and Fisher, 1969:92, fig. 31 [unjustified emendation].—Guglielmo and Costanzo, 1983:288, 290, fig. 10(a–b) [thelycum].

Material examined.—ATLANTIC: Gulf of Mexico: 1 ♂, 1 ♀, *Alaminos* Sta 66-A-5-3, USNM 135311.—Western Atlantic: 1 ♂,

1 ♀, *Bache* Sta, USNM 62289.—PACIFIC: Easter Island to Galapagos Islands: 1 ♂ (HOLOTYPE), *Albatross* Sta 4699, USNM 45374.

Vouchers: 4 ♂, GER-286, IRCZM 089:05852; 1 ♀, GER-353, IRCZM 089:05854; 1 ♀, GER-358, IRCZM 089:05853; 1 ♂, 3 ♀, GOS-144, IRCZM 089:05963; 2 ♂, 3 ♀, GER-339, UMML 32:5780; 2 ♂, 7 ♀, GER-341, USNM 228218; 1 ♀ with parasitic isopods, GER-346, USNM 228219.

Remarks.—Mauchline and Fisher (1969) and some subsequent authors have used the specific epithet *sexspinosum* for this species. Although Mauchline and Fisher (1969) did not comment on the change in spelling, it is most logically interpreted as a change in ending from masculine to neuter, to agree in gender with the genus name. The Greek stem, "brachion," of the genus, however, is masculine, rendering the emendation unjustified. It is unlikely that *sexspinosum* was an unintentional subsequent spelling because the original spelling was cited and the change was used consistently throughout Mauchline and Fisher's 1969 review and Mauchline's 1980 revision.

A previously unknown pattern of abdominal photophore reduction was noted in this species; all males examined possessed the full complement of four photophores, however, all females lacked the third.

Parasitic isopods were found attached to one specimen (1 ♀, GER-346, USNM 228219).

This is the first record of *Nematobrachion sexspinosus* from eastern Florida. James (1970, 1971) collected a single specimen from 24°00'N, 83°11'W, west of the area presently under consideration, plus 24 other specimens from various locations throughout the Gulf of Mexico.

Genus *Nematoscelis* G. O. Sars, 1883

Nematoscelis atlantica Hansen, 1910

Nematoscelis atlantica Hansen, 1910:106–107.—Gopalakrishnan, 1975:799–808, figs. 1a, 4Ab, 4Bb, 5d, 6b, 8d [petasma].—Costanzo and Guglielmo, 1976a:51–52, text-fig. 7, pl. 4 [thelycum].

Material examined.—ATLANTIC: Martha's Vineyard, Mass.: 2 ♀, *Albatross* Sta 2210, USNM 8404; 3 spms, *Albatross* Sta 2565, USNM 35239.

Vouchers: 4 ♂, 27 ♀, 1 ovig. ♀, GER-072, IRCZM 089:05855; 2 ♂, 6 ♀, GOS-144, IRCZM 089:05941; 1 ♂, 6 ♀, 1 ovig. ♀, GER-285, UMML 32:5782; 3 ♂, 4 ♀, GOS-144, UMML 32:5781; 5 ♂, 15 ♀, GER-352, USNM 228221; 2 ♂, 4 ♀, GOS-144, USNM 228220.

Remarks.—*Nematoscelis atlantica* is extremely difficult to distinguish from *N. microps*. Gopalakrishnan's (1975) study, although thorough, cited diagnostic characters subsequently found to be ambiguous in eastern Florida material. Specimens of *N. atlantica* differed from *N. microps* in having generally narrower upper eye lobes, a weaker carapace keel with a lower "hump," and weaker or absent keels on the fourth and fifth abdominal segments. Adult females usually retained the juvenile lateral denticles on the edge of the carapace, although the largest had lost them as in *N. microps* (see remarks under *N. microps*). Males were present in two forms as described by Gopalakrishnan (1975), viz., either unmodified or with enlarged abdominal photophores on the second and third segments plus dorsal prominences on the first and second segments. Immature males of the latter category showed some photophore enlargement, with further enlargement and development of the dorsal prominences occurring with increasing body length.

Two females with external ova were collected, one each in September and April.

Of the 30 stations containing males of *Nematoscelis atlantica,* 16 (53%) stations had males with enlarged photophores on the second and third abdominal segments as described by Gopalakrishnan (1975). Of a to-

tal of 143 male specimens, 35 (24.5%) were males with enlarged photophores (=MEP's). Numbers of males per station were too low to provide a meaningful indication of percent of the population possessing this feature. All of the MEP's occurred in stations containing other *Nematoscelis* species.

Nematoscelis megalops G. O. Sars, 1883

Nematoscelis megalops G. O. Sars, 1883: 27.—Gopalakrishnan, 1975:802–807, figs. 4Af, 4Bf, 5g, 6f, 7a [petasma].—Costanzo and Guglielmo, 1976a:50, text-fig. 6, pl. 3, fig. 2 [thelycum].

Material examined.—ATLANTIC: off Chesapeake Bay: 300+ spms, *Bache* Sta 10158, USNM 62281.—off Nantucket Shoals, Mass.: 1 ♀, *Albatross* Sta 2044, USNM 35451.

Remarks.—*Nematoscelis megalops* was not represented in the collections analyzed here. The only previous record for the species in Floridan waters is a single specimen from the Florida Straits off Miami (Lewis 1954). Unfortunately, the specimen could not be located either at the Rosenstiel Invertebrate Museum nor through communication with Mr. Lewis (in litt. 1980), therefore the record remains unverified.

Nematoscelis microps G. O. Sars, 1883

Nematoscelis microps G. O. Sars, 1883:28.—Gopalakrishnan, 1975:799–808, figs. 1b, 4Ac, 4Bc, 5c, 6a, 8b [petasma].—Costanzo and Guglielmo, 1980:315, figs. 7–9 [thelycum].

Material examined.—ATLANTIC: Caribbean Sea: 1 ♂, *Albatross* Sta 2151, USNM 47387; 1 ♂, *Gerda* Sta CARIB-23, UMML 32:1481 (in part).—Western Atlantic: 25+ spms, *Bache* Sta, USNM 62283; 1 juv., *Bache* Sta, USNM 62288 (in part).

Vouchers: 41 ♂, 282 ♀, 33 ovig. ♀, GER-072, IRCZM 089:05876; 13 ♂, 10 ♀, 3 ovig. ♀, GOS-159, IRCZM 089:05942; 65 ♂, 16 ♀, 4 ovig. ♀, 15 juv., GER-326, UMML 32:5784; 13 ♂, 10 ♀, 3 ovig. ♀, GOS-159, UMML 32:5783; 45 ♂, 119 ♀, 1 ovig. ♀, GER-327, USNM 228223; 13 ♂, 10 ♀, 3 ovig. ♀, GOS-159, USNM 228222.

Remarks.—See remarks under *Nematoscelis atlantica.* Subadult females possessed a lateral denticle on the rear edge of the carapace, a feature which gradually decreased in size with increasing body length. Adult females lacked the denticle completely, in agreement with Gopalakrishnan (1975). Parasitic isopods were encountered on three specimens (1 ♂, GER-286; 1 ♀, GER-338; 1 ♀, GOS-144); these specimens, with their euphausiid hosts, are now housed at the USNM. Males corresponding to Gopalakrishnan's (1975) two forms were encountered: those with an enlarged photophore on the second abdominal segment plus a dorsal prominence on the first segment, and those without these features. As with *N. atlantica,* enlarged photophores and prominences were more fully developed in larger males.

Females carrying external ova were collected in January, March, April, June, July, August, September, and December.

Of the 53 stations containing males of *Nematoscelis microps,* 32 (60%) contained males with enlarged photophores on the first abdominal segment as described by Gopalakrishnan (1975). A total of 909 males yielded 330 (36%) MEP's. Percentage of MEP's per station [calculated using only those stations (n = 22) with 10 or more total males] ranged from 0–100% ($\bar{x}$ = 41.6%); 93% of the MEP's occurred in stations containing other *Nematoscelis* species.

Nematoscelis microps was the second most abundant species in the present study (Table 2).

Nematoscelis tenella G. O. Sars, 1883

Nematoscelis tenella G. O. Sars, 1883:28.—Gopalakrishnan, 1975:802–808, figs. 4Ad, 4Bd, 5e, 6d, 8a [petasma].—Costanzo and Guglielmo, 1980:312–313, figs. 3A, 4A [thelycum].

Material examined.—ATLANTIC: Gulf of Mexico: 6 spms, *Alaminos* Sta 66-A-5-3, USNM 135312.—Caribbean Sea: 2 ♂, *Gerda* Sta CARIB-23, UMML 32:1481 (in part); 1 ♀, *Gerda* Sta CARIB-18, UMML 32:1490.—Western Atlantic: 15+ spms, *Bache* Sta, USNM 62286; 1 juv., *Bache* Sta, USNM 62288 (in part).

Vouchers: 5 ♂, 18 ♀, 1 ovig. ♀, GER-072, IRCZM 089:05875; 5 ♂, 15 ♀, 12 juv., GOS-144, IRCZM 089:05949; 2 ♂, 10 ♀, 7 ovig. ♀, GER-285, UMML 32:5786; 5 ♂, 7 ♀, 1 ovig. ♀, 5 juv., GOS-159, UMML 32:5785; 4 ♂, 12 ♀, GER-346, USNM 228227; 4 ♂, 8 ♀, 6 juv., GOS-159, USNM 228226.

Remarks.—Females carrying external ova were collected in April, September, and January.

Of the 34 stations containing males of *Nematoscelis tenella,* only 2 stations (6%) contained males with enlarged photophores on the second and third abdominal segments as described by Gopalakrishnan (1975); only 2 (2%) of the 87 males encountered possessed this feature. As with *N. atlantica,* numbers per station were too low to calculate a meaningful figure for percent of the population exhibiting this feature. Both MEP's were found in samples containing other species of *Nematoscelis.*

Genus *Stylocheiron* G. O. Sars, 1883

A previous paper (Mikkelsen 1981) reported on *Stylocheiron elongatum* and *S. suhmii* [=*S. affine, S. longicorne, S. microphthalma*] from this study. Outside material examined and R/V *Gosnold* vouchers have already been given for these species and are not repeated here.

Stylocheiron abbreviatum G. O. Sars, 1883

Stylocheiron abbreviatum G. O. Sars, 1883: 33.—Boden et al., 1955:390–391, fig. 54(a–c) [petasma].—Costanzo and Guglielmo, 1976b:180, text-fig. 5, pl. 3, fig. 1 [thelycum].—Lomakina, 1978:215–216, fig. 131.

Material examined.—ATLANTIC: Miami: 2 ♀, *Gerda* Sta, UMML 32:1498; 6 ♂, 9 ♀, *Gerda* Sta, UMML 32.1502; 2 ♀, *Gerda* Sta, UMML 32:1504.—Caribbean Sea: 1 ♂, 1 ♀, *Gerda* Sta CARIB-7, UMML 32:1506; 2 ♂, 1 ♀, *Gerda* Sta CARIB-22, UMML 32.1507; 1 ♂, *Gerda* Sta CARIB-19, UMML 32:1508.—Western Atlantic: 30+ spms, *Bache* Sta, USNM 62296.

Vouchers: 158 ♂, 338 ♀, 1 ovig. ♀, GER-333, IRCZM 089:05877; 18 ♂, 29 ♀, 4 ovig. ♀, 56 juv., GOS-144, IRCZM 089:06021; 35 ♂, 92 ♀, 1 juv., GER-338, UMML 32:5788; 5 ♂, 12 ♀, 7 juv., GOS-173, UMML 32:5787; 26 ♂, 37 ♀, 6 juv., GER-326, USNM 228229; 4 ♂, 12 ♀, 7 juv., GOS-173, USNM 228228.

Remarks.—Females carrying external ova were collected in January, May, June, and July.

Stylocheiron carinatum G. O. Sars, 1883

Stylocheiron carinatum G. O. Sars, 1883: 31.—Hansen, 1910:113–115, pl. 16, fig. 1(a–h) [petasma].—Lomakina, 1978:203–205, fig. 123.

Material examined.—ATLANTIC: Chesapeake Bay-Bermuda line: 50+ spms, *Bache* Sta 10169, USNM 62290.—Caribbean Sea: 1 ♀, *Gerda* Sta CARIB-18, UMML 32:1489.

Vouchers: 13 ♂, 9 ♀, 4 juv., GER-746, IRCZM 089:05878; 20 ♂, 21 ♀, 5 ovig. ♀, GOS-173, IRCZM 089:05950; 158 ♂, 366 ♀, 3 ovig. ♀, GER-740, UMML 32:5790; 20 ♂, 20 ♀, 5 ovig. ♀, GOS-173, UMML 32:5789; 2 ♂, 6 ♀, GER-104, USNM 228231; 20 ♂, 20 ♀, 5 ovig. ♀, GOS-173, USNM 228230.

Remarks.—The thelycum of *Stylocheiron carinatum* is undescribed, and is presently being studied by L. Guglielmo and G. Costanzo (pers. comm.). Females carrying external ova were collected in January, February, May, August, and September.

This was the most abundant species in the collections analyzed here (Table 2).

Stylocheiron elongatum G. O. Sars, 1883

Stylocheiron elongatum G. O. Sars, 1883: 32.—Lomakina, 1978:212–214, fig. 129.—Mikkelsen, 1981:1177, figs. 1a, 3a [thelycum and petasma].

Vouchers: 3 ♂, 22 ♀, 1 juv., GER-349, IRCZM 089:05880; 2 ♂, 7 ♀, GER-199, UMML 32:5792; 4 ♂, 4 ♀, GOS-144, UMML 32:5791; 1 ♂, 14 ♀, 2 juv., GER-058, USNM 228232.

Remarks.—R/V *Gosnold* material of this species was thoroughly examined in a previous study (Mikkelsen 1981) which included material examined and petasmal and thelycal structures.

Females with external ova were collected in January.

Stylocheiron maximum Hansen, 1908

Stylocheiron maximum Hansen, 1908:92.—Boden et al., 1955:391–393, fig. 55(a–d) [petasma].—Costanzo and Guglielmo, 1976b:180, text-fig. 6, pl. 3, fig. 2 [thelycum].—Lomakina, 1978:217–219, fig. 133.

Material examined.—ATLANTIC: Gulf of Mexico: 1 ♂, 1 ♀, *Alaminos* Sta 65-A-96, USNM 135314.—Western Atlantic: 1 ♂, 17 ♀, *Bache* Sta, USNM 62297.

Vouchers: 2 ♂, 3 ♀, 1 juv., GER-309, IRCZM 089:05882; 1 ♂, 3 ♀, GER-339, IRCZM 089:05881; 3 ♂, 1 ♀, GER-353, UMML 32:5793; 2 ♂, 3 ♀, GER-286, USNM 228233.

Remarks.—No females with external ova were collected.

Stylocheiron robustum Brinton, 1962

Stylocheiron robustum Brinton, 1962:174–178, figs. 4–5, table 3 [petasma].—Lomakina, 1978:217, fig. 132.

Material examined.—PACIFIC: south of Japan: 1 ♂ (HOLOTYPE), "Norpac" Sta 141, USNM 107830.—off eastern Australia: 1 ♀ (ALLOTYPE), "Monsoon" Exped. Sta 19, USNM 107831.

Vouchers: 2 ♂, 4 ♀, GER-071, IRCZM 089:05836; 2 ♀, GOS-144, IRCZM 089:05948; 2 ♂, 2 ♀, GER-339, UMML 32:5794; 2 ♂, 2 ♀, GER-326, USNM 228234.

Remarks.—This is the first record of this species from the study area, although James (1970, 1971) collected 26 specimens in the Gulf of Mexico, including a single specimen from just west of the study area, off western Cuba. *Stylocheiron robustum* is somatically very similar to *S. abbreviatum,* except that it lacks dorsal keels on the fourth and fifth abdominal segments, and the upper eye lobe is only slightly narrower than the lower lobe. It differs from *S. maximum* mainly in the relative sizes of the eye lobes, which in *S. maximum* are more nearly equal in width. In addition, the dactyl of the "true chela" in *S. robustum* (see Brinton 1962, fig. 4C) is narrower proximal to the secondary spines than that of *S. abbreviatum* (see James 1970, figs. 7–9) or *S. maximum* (see Hansen 1910, pl. 16, fig. 6b).

The thelycum of *Stylocheiron robustum* is undescribed, and is presently being studied by L. Guglielmo and G. Costanzo (pers. comm.). No females with external ova were collected.

Stylocheiron suhmii G. O. Sars, 1883

Stylocheiron suhmii G. O. Sars, 1883:31.—Mikkelsen, 1981:1196–1199, figs. 2, 3B, 5, 8 [petasma and thelycum].

Stylocheiron affine Hansen, 1910:118–120, pl. 16, fig. 4(a–d).

Stylocheiron longicorne G. O. Sars, 1883: 32.

Stylocheiron microphthalma Hansen, 1910: 117–118, pl. 16, fig. 3(a–d).

Vouchers: 1 ♂, 2 ♀, GER-339, IRCZM 089:05835; 7 ♂, 23 ♀, GER-740, IRCZM 089:05879; 1 ♂, 2 ♀, GER-195, UMML 32:5799; 3 ♂, 9 ♀, GER-338, UMML 32:5797; 1 ♂, 2 ♀, GER-339, UMML 32:5798; 1 ♂, 3

Table 3.—Recorded day/night occurrence for species in all stations. All cited depths are maximum limits of open net hauls. Daytime defined as any time period either partially or completely included in the period from 0600 to 1800 hrs. Frequency defined as percentage of the day or night hauls, respectively, which contained the species. ND = no data.

Species	Day (23 sta.; 35–805 m; $\bar{x}$ = 324.4 m) Depth range (m)	Day Frequency (%)	Night (70 sta.; 0–820 m; $\bar{x}$ = 249.4 m) Depth range (m)	Night Frequency (%)
B. amblyops	ND	0	520–648	3
T. aequalis	157–805	43	26–820	64
T. cristata	458	4	ND	0
T. monacantha	35–805	52	26–820	74
T. obtusifrons	250–596	22	130–750	21
T. orientalis	250–596	26	256–820	14
T. pectinata	458	4	256–342	3
T. tricuspida	78–805	52	0–820	68
E. americana	157–596	48	0–750	53
E. brevis	250–595	17	0–750	28
E. gibboides	157–596	52	45–750	67
E. hemigibba	91–596	39	26–750	60
E. mutica	250–596	30	0–750	50
E. pseudogibba	78–596	39	38–520	54
E. tenera	35–596	30	0–750	36
Ns. atlantica	174–596	35	38–750	48
Ns. microps	157–805	56	38–820	73
Ns. tenella	157–805	48	38–820	58
Nb. boopis	300–596	26	200–820	20
Nb. flexipes	157–596	48	26–750	48
Nb. sexspinosus	250–596	30	181–520	26
S. abbreviatum	91–805	78	38–750	76
S. carinatum	35–595	52	0–820	63
S. elongatum	250–596	43	181–820	33
S. maximum	300–805	30	256–520	10
S. robustum	250–805	30	181–500	17
S. suhmii	78–596	61	38–750	50

♀, 3 juv., GOS-159, UMML 32:5796; 6 ♂, 8 ♀, 2 juv., GOS-160, UMML 32:5795; 3 ♀, GER-324, USNM 228236; 2 ♂, 4 ♀, GER-331, USNM 228235; 3 ♀, GER-339, USNM 228237.

Remarks.—This species and its synonyms were thoroughly investigated in a previous paper (Mikkelsen 1981), which included a redescription, synonymy, material examined, and petasmal and thelycal structures. Specimens corresponding to the descriptions (Brinton 1975, and authors) of *Stylocheiron suhmii* s.s., *S. affine,* and *S. longicorne* were encountered.

Females with external ova were collected in January.

Discussion

The eastern Florida euphausiacean fauna may be characterized as predominantly warm-temperate to tropical, with 17 (71%) of the 24 species encountered categorized as such according to Western Atlantic distributional data from Lomakina (1978). Although four species (*Thysanopoda cristata, T. pectinata, Nematobrachion sexspinosus, Stylocheiron robustum*) are recorded for the

Table 4.—Comparison of day/night composition in hauls reaching various depth maxima. List indicates first appearance and is cumulative, that is, those species listed in the <50 m category are also components of the two succeeding categories, etc. Lines indicate night depth locations of each day group, and do not mean to imply migratory pathways. M = migrator; N = nonmigrator; ? = unknown or conflicting reports on migratory behavior (Mauchline and Fisher 1969; Mauchline 1980).

		DAY	NIGHT
Encountered in hauls reaching max. <50 m	M	*T. monacantha*	
	M	*E. tenera*	
	?	*S. carinatum*	
max. <200 m	M	*T. aequalis*	
	M	*T. tricuspida*	
	M	*E. americana*	
	M	*E. gibboides*	
	M	*E. hemigibba*	
	M	*E. pseudogibba*	
	M	*Ns. atlantica*	
	M	*Ns. microps*	
	M	*Ns. tenella*	
	M	*Nb. flexipes*	
	?	*S. abbreviatum*	
	N	*S. suhmii*	
max. >200 m	M	*E. brevis*	
	M	*E. mutica*	
	M	*T. obtusifrons*	
	M	*Nb. sexspinosus*	
	N	*S. elongatum*	
	?	*S. robustum*	
	M	*T. orientalis*	
	M	*T. pectinata*	
	N	*Nb. boopis*	
	?	*S. maximum*	

first time off eastern Florida in the present study, all have been previously collected in the Gulf of Mexico and so do not reflect dramatic range extensions for circumglobal, pelagic species such as these.

In an analysis of species abundance and relative frequencies (Table 2), the six top-ranking species comprised over 70% of the entire collection. Species ranking in this category was not significantly altered when only "100+ stations" were analyzed, unlike ranking by relative frequency which showed noticeable change. The figures generated by analysis of "100+ stations" thus probably represent a more accurate description of the eastern Florida euphausiacean community than those from analysis of the entire collection.

Because all collections analyzed here were made with open nets, few positive statements may be made about the vertical distribution or migration of the various species. However, some information may be obtained by examining species lists from shallow (<50 m), medium (<200 m), and deep (>200 m) hauls. Table 4 shows that 14 (82%) of the 17 species in the top 50 m at night were not found in day hauls to the same depth, suggesting vertical migration on the part of those species. The list also shows three shallow-water species (*Thysanopoda monacantha, Euphausia tenera, Stylocheiron carinatum*) and four deep-water species (*T. orientalis, T. pectinata, Nematobrachion boopis, S. maximum*) which did not change depth category, suggesting the absence of marked vertical migration. Most of these observations are consistent with the current categorizations of these species as migratory or nonmigratory (Table 4).

Gopalakrishnan (1975) discussed the occurrence of patterns of enlarged abdominal photophores in the genus *Nematoscelis*. Sixty-nine stations analyzed here contained one or more *Nematoscelis* species, with 58 stations containing males. Of these 58, 35 stations contained at least one male with enlarged photophores (=MEP). Fifteen stations yielded only one species of *Nematoscelis*; of these, two stations contained MEP's. Seventeen stations yielded two species of *Nematoscelis,* with 10 stations containing one MEP species, and 1 station containing both species with MEP's. The remaining 37 stations contained all three species of *Nematoscelis*; 14 stations contained no MEP's, 11 contained one MEP species, 11 contained

two MEP species, and one station contained all three species with MEP's. These data indicate that MEP's are more frequently encountered in populations containing more than one species of *Nematoscelis,* lending support to Gopalakrishnan's (1975) suggestion that enlarged photophores may play a role in species recognition. The observation of more fully enlarged photophores in larger males of *N. atlantica* and *N. microps* further supports this hypothesis.

Species recognition may also apply as explanation for the species-, sex-, and size-dependent patterns of abdominal photophore reduction shown here for the three species of *Nematobrachion.*

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Literature Cited

Boden, B. P. 1954. The euphausiid crustaceans of southern African waters.—Transactions of the Royal Society of South Africa 34(1):181–243.

———, M. W. Johnson, and E. Brinton. 1955. The Euphausiacea (Crustacea) of the North Pacific.—Bulletin of the Scripps Institution of Oceanography 6:287–400.

Brinton, E. 1962. Two new species of Euphausiacea, *Euphausia nana* and *Stylocheiron robustum* from the Pacific.—Crustaceana 4(3):167–179.

———. 1975. The distribution of southeast Asian euphausiids.—Naga Report 4(5):1–287.

Calman, W. T. 1896. On deep-sea Crustacea from the south-west of Ireland.—Transactions of the Royal Irish Academy 31(1):1–21, 2 pls.

———. 1905. Note on a genus of euphausiid crustacean.—Scientific Investigations of the Fisheries Branch, Department of Agriculture, etc., for Ireland 1902–1903 4(2):153–155, 1 pl.

Costanzo, G., and L. Guglielmo. 1976a. Diagnostic value of the thelycum in euphausiids, I. Mediterranean species (first note).—Crustaceana 31(1):45–53.

———, and ———. 1976b. Diagnostic value of the thelycum in euphausiids, I. Mediterranean species (second note).—Crustaceana 31(2):178–180, pls. 1–3.

———, and ———. 1980. Diagnostic value of the thelycum in euphausiids. II. Oceanic species, genus *Nematoscelis.*—Marine Biology 56(4):311–317.

Cowan, C. F. 1971. On Guérin's *Iconographie*: Particularly the insects.—Journal of the Society for the Bibliography of Natural History 6(1):18–29.

Desmarest, E. 1852. In: Girard, E., and A. Boitte,

eds. Encyclopédie d'histoire naturelle ou traité complet de cette science . . . par le Dr. Chenu. Crustacés–Mollusques–Zoophytes. Édition Fermin-Didot et Cie, Paris, [6] + 312 pp., 40 pls., 320 text-figs.

Einarsson, H. 1942. Notes on Euphausiacea. I–III. On the systematic value of the spermatheca, on sexual dimorphism in *Nematoscelis* and on the male in *Bentheuphausia*. —Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening 106:263–286.

Gopalakrishnan, K. 1975. Biology and taxonomy of the genus *Nematoscelis* (Crustacea, Euphausiacea).—United States National Marine Fisheries Service, Fishery Bulletin 73(4):797–814.

Guérin Méneville, F. E. 1829–1844. Iconographie du Règne Animal de G. Cuvier, ou représentation d'après nature de l'une des espèces les plus remarquables et souvent non figurées de chaque genre d'animaux. Avec une texte descriptif mis au courant de la science. Ouvrage pouvant servir d'atlas à tous les traités de zoologie. Vol. 2. Crustacés. J. B. Baillière, Paris, 36 pls.

Guglielmo, L., and G. Costanzo. 1977. Diagnostic value of the thelycum in euphausiids, II. Oceanic species. Genus *Thysanopoda* Milne Edwards, 1830.—Crustaceana 33(3):275–283.

———, and ———. 1978. Diagnostic value of the thelycum in euphausiids. II. Oceanic species. Genus *Euphausia* Dana, 1852.—Archivio di Oceanografia e Limnologia 19:143–155.

———, and ———. 1983. Diagnostic value of the thelycum in euphausiids. II. Oceanic species. Genera *Bentheuphausia, Nyctiphanes, Pseudeuphausia, Tessarabrachion,* and *Nematobrachion.*—Journal of Crustacean Biology 3(2):278–292.

Hansen, H. J. 1905. Further notes on the Schizopoda.—Bulletin du Musée Océanographique de Monaco 42:1–32.

———. 1908. Crustacea Malacostraca.—Danish Ingolf-Expedition 3(2):1–120.

———. 1910. Schizopoda of the Siboga Expedition.—Siboga-Expeditie Monograph 37:1–123, 16 pls.

———. 1911. The genera and species of the order Euphausiacea, with account of remarkable variation.—Bulletin de l'Institut Océanographique de Monaco 210:1–54.

———. 1915. The Crustacea Euphausiacea of the United States National Museum.—Proceedings of the United States National Museum 48:59–114, 4 pls.

Herring, P. J., and N. A. Locket. 1978. The luminescence and photophores of euphausiid crustaceans.—Journal of Zoology, London 186:431–462.

James, B. M. 1970. Euphausiacean Crustacea. Pp. 205–229 *in* W. E. Pequegnat and F. A. Chace, Jr., eds., Contributions on the biology of the Gulf of Mexico. Texas A&M University Oceanographic Studies, vol. 1, 270 pp.

———. 1971. Gulf of Mexico deep sea fauna: Decapoda and Euphausiacea. Folio 20, *in* W.E. Pequegnat et al., Serial atlas of the marine environment, American Geographical Society, New York, 24 pp.

James, P. T. 1977. The comparative morphology of the thelycum in the *Euphausia gibba* species group.—Deep-Sea Research 24(11):1037–1048.

Latreille, M. 1931. Cours d'entomologie, ou de l'histoire naturelle des Crustacés, des Arachnides, des Myriapodes et des Insectes; a l'usage des élèves de l'école du Muséum d'Histoire Naturelle. Année I. Librairie Encyclopédique de Roret, Paris, 568 pp.

Lewis, J. B. 1954. The occurrence and vertical distribution of the Euphausiacea of the Florida Current.—Bulletin of Marine Science of the Gulf and Caribbean 4(4):265–301.

Lomakina, N. B. 1978. Eufauziidy Mirovogo okeana (Euphausiacea) [Euphausiids of the world ocean]. [In Russian.]—Opredeliteli Faune SSSR 118. 222 pp. Nauka, Leningrad.

Lucas, M. 1840. Histoire naturelle des Crustacés, des Arachnides et des Myriapodes. P. Duménil, Paris, 600 pp., 46 pls.

Mauchline, J. 1980. The biology of euphausiids.—Advances in Marine Biology 18:373–623.

———, and L. R. Fisher. 1969. The biology of euphausiids.—Advances in Marine Biology 7:1–454.

Mikkelsen, P. M. 1981. Studies on euphausiacean crustaceans from the Indian River region of Florida. I. Systematics of the *Stylocheiron longicorne* species-group, with emphasis on reproductive morphology.—Proceedings of the Biological Society of Washington 94(4):1174–1204.

Milne Edwards, H. 1830. Mémoire sur une disposition particulière de l'appareil branchial chez quelques Crustacés.—Annales des Sciences Naturelles 19:451–460, pl. 19.

———. 1837. Histoire naturelle des Crustacés, comprenant l'anatomie, la physiologie et la classification de ces animaux. Vol. 2. Librarie Encyclopédique de Roret, Paris, 531 pp., 10 pls.

Ortmann, A. E. 1893. Decapoden und Schizopoden.—Ergebnisse der Plankton-Expedition der Humbolt Stiftung 2, 120 pp., 7 pls., 3 maps.

Sars, G. O. 1883. Preliminary notices on the Schizopoda of H.M.S. "Challenger" Expedition.—Forhandlinger Videnskabs-Selskabets i Kristiania 7:1–43.

———. 1885. Report on the Schizopoda collected by

H.M.S. "Challenger" during the years 1873–1876.—Challenger Reports, Zoology 13(37):1–228, 38 pls.

Springer, S., and H. R. Bullis, Jr. 1956. Collections by the Oregon in the Gulf of Mexico. List of crustaceans, mollusks, and fishes identified from collections made by the exploratory fishing vessel Oregon in the Gulf of Mexico and adjacent seas 1950 through 1955.—U.S. Department of the Interior, Bureau of Commercial Fisheries, Special Scientific Report, Fisheries No. 196.

Stepien, J. C. 1980. The occurrence of chaetognaths, pteropods and euphausiids in relation to deep flow reversals in the Straits of Florida.—Deep-Sea Research 27A:987–1011.

Tattersall, W. M. 1926. Crustacea of the orders Euphausiacea and Mysidacea from the western Atlantic.—Proceedings of the United States National Museum 69(8):1–31.

Indian River Coastal Zone Museum, Harbor Branch Oceanographic Institution, 5600 Old Dixie Highway, Fort Pierce, Florida 33450-9719.