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Distribution and Taxonomy of Zooplankton in the Alboran Sea and Adjacent Western Mediterranean

A Literature Survey and Field Guide.

by

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Technical Report

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Abstract.

This is a survey of literature records for occurrence and taxonomy of zooplankton in the Western Mediterranean, with particular emphasis on the Alboran Sea. It is intended to give a general background on the fauna, and facilitate identification of specimens collected or observed. A description of the hydrography of the Alboran Sea is followed by a general account of zooplankton biomass distribution, and more detailed lists of the occurrence of 361 species of medusae, siphonophores, ctenophores, worms, tunicates and crustaceans in 7 regions of the Western Mediterranean. Bioluminescent properties of the organisms are indicated where known. An illustrated taxonomic guide provides capsule descriptions and illustrations of 254 of the listed species.

Key Words. zooplankton, Alboran Sea, bioluminescence

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Introduction.

This document is a literature-based survey of the occurrence and taxonomy of zooplankton in the Alboran Sea and adjacent regions of the western Mediterranean. It's purpose is to provide background on the kinds of plankton that one would expect to encounter in this area, and a convenient reference for shipboard identification of collected or photographed specimens. Because it is intended to support *in-situ* investigations, by submersible and SCUBA diving, of luminescent organisms, the taxonomic guide focusses on the gelatinous macrozooplankton and the more common crustaceans. It emphasizes characteristics of intact, live animals, and indicates whether they are known or suspected to be luminescent.

The western Mediterranean Basin is divided into several regional seas, as illustrated in Figure 1. The present survey includes distributional records for zooplankton in the:

a. Alboran Sea - extending from Gibraltar eastward to approximately 0° longitude;

b. Strait of Gibraltar;

c. Catalan (Balearic) Sea - between the southeast coast of Spain and the Balearic Islands;

d. Gulf of Lyon - extending southeast into the central basin west of Corsica and Sardinia;

e. Ligurian Sea - between the French Riviera and Corsica;

f. Tyrrhenian Sea - bounded by Corsica and Sardinia on the west, Italy on the east and Sicily at the south;

g. Adriatic Sea - between Italy and the Dalmatian coast.

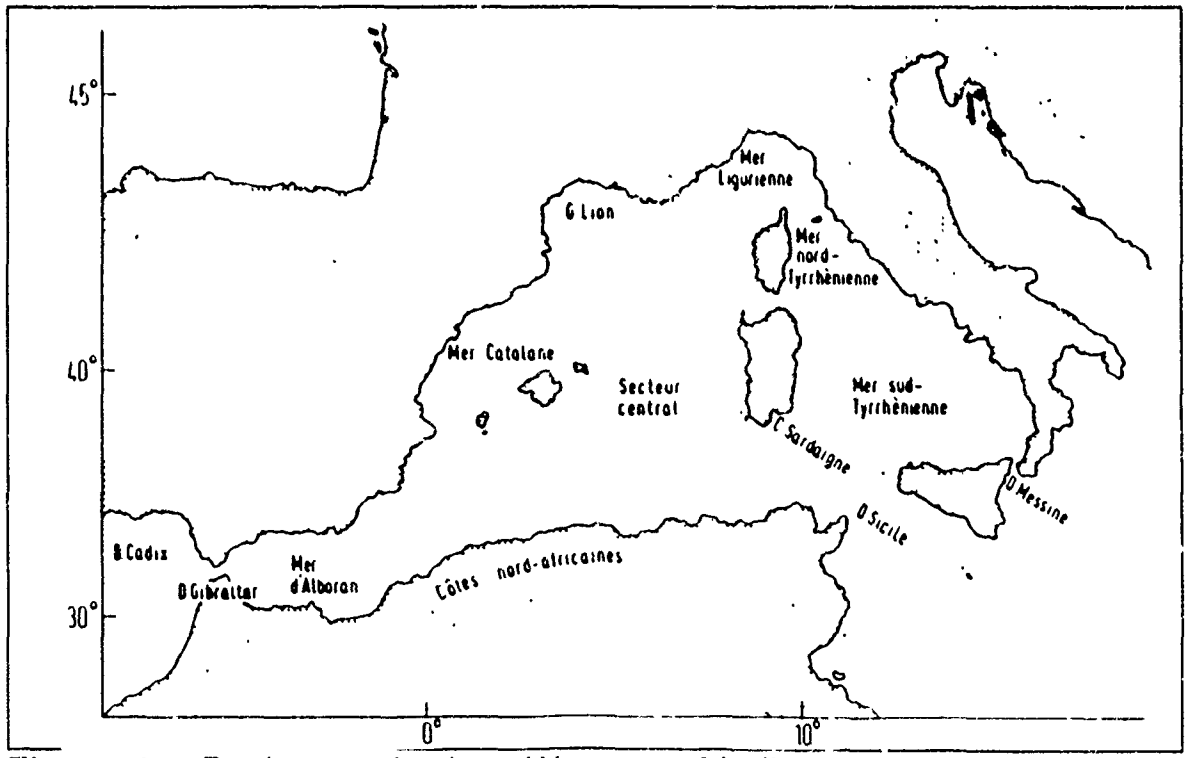


Figure 1. Regions of the Western Mediterranean Basin (from Furnestin, 1968)

The extent to which the planktonic fauna of these regions has been studied depends partly on the geographic distribution of marine laboratories on the coasts of these seas. Upwelling regions near Messina, Naples and Nice in the Tyrrhenian and Ligurian Seas have been known since antiquity. Laboratories have been established in these regions for over a hundred years, and the fauna is quite well known. Other laboratories in France and Italy have supported surveys in the Gulf of Lyon, the Catalan Sea and the North African coast. In addition, several oceanographic cruises have been undertaken in the western Mediterranean, adding coverage of the regions further offshore.

There is a fairly considerable classical literature on the planktonic fauna of the Mediterranean, based on work done in the mid to late 19th century at Messina, Naples, Villefranche, Trieste and a few other locations by pioneers like Brandt, Chun, Haeckel, Lohmann and others. A valuable and comprehensive systematic treatment of phytoplankton and zooplankton in the Mediterranean, the "Manuel du Planctonologie Mediterraneenne" was published by Gregoire Tregouboff and Maurice Rose in 1957. It is a quite inclusive work, summarizing the basic biology of each group and providing keys and illustrations for identification. It is somewhat cumbersome to use in the field however, because of the complex structure of the keys and the separation of the illustrations from accompanying text (including captions) in a separate volume. This work, and some of the old literature, has been used here as a source.

For the most part, however, the present survey is based on more recent investigations that used modern techniques for sampling zooplankton from larger areas and depth ranges. These studies also have the advantage of using a taxonomic nomenclature fairly well settled by major revisions published in the last several decades. Another relevant source of information for this survey are the reports of observations made from other submersibles and bathyscaphes. French scientists made numerous dives in the Gulf of Lyon and Ligurian Sea during the 1950's and 1960's (Bernard, 1955, 1958; Tregouboff, 1956, 1957) and more recently (Laval and Carré, 1988; Laval et al. 1989, Mills and Goy, 1988; Biggs et al., 1987). Although these reports provide mainly qualitative visual observations, the sightings have been included in the distributional lists and discussions where possible.

This survey is organized into three main sections. The first considers general patterns of zooplankton distribution. This is intended as an overview of hydrography, zooplankton biomass distribution, seasonal abundances and vertical zonation in the Alboran sea specifically, and in the adjoining regions.

The second section considers the occurrence and abundance in the western Mediterranean of the major groups of zooplankton with emphasis on gelatinous forms and bioluminescent species: colonial radiolaria, hydromedusae, scyphomedusae, siphonophores, ctenophores, some polychaetes, some molluscs, pelagic tunicates and some crustaceans. Groups with no known bioluminescent species, notably the pteropods, heteropods, and chaetognaths, are not included in

this survey; neither are adult or larval fishes. Cephalopods, although luminescent have not been included for lack of time and space, and because they are thought unlikely to contribute significantly to luminescence observed from the submersible (E. Widder, pers. comm.). Occurrence in the western Mediterranean of a total of 361 species is summarized in 7 tables. Species are listed alphabetically within Class, Order or Suborder, as appropriate. Abundance and vertical distribution of the most common species are discussed in more detail.

The tables also indicate whether the species is bioluminescent. The letter "a" in the "Lum" column means the genus is considered "definite" in the list of Herring (1987). The letter "b" indicates a genus is considered "uncertain" and the letter "c" indicates that the particular genus is not known to be luminescent, but one or more other genera in the same family is. A blank in the "Lum" column indicates no mention in Herring (1987).

The third section is a taxonomic guide designed to facilitate rapid field identification of animals collected by divers or a submersible, or photographed or videotaped *in situ*. Instead of keys, brief descriptions accompanied by line drawings are arranged in the same order as they appear in the tables of distribution. The illustrated guide includes 254 (70%) of the species listed in the tables. For each species, two higher taxa (Family, Suborder, Order, Subclass or Class) are listed to place species in context of their classification. It is hoped that acccurate identifications can be made fairly quickly by flipping through the pictures. Because the majority of Mediterranean species also occur in the Atlantic and elsewhere, this part of the survey should prove useful in other oceans as well.

General distribution patterns

1. General hydrography

The Alboran basin is relatively shallow, exceeding 1000 m only at the east and northeast. On the south it is bounded by a plateau stretching between Oran (Algeria) and Cabo Tres Forcas (Morocco). On the north, banks exist southeast of Malaga and southwest of Almeria (Spain). As the entry point for Atlantic waters into the Mediterranean, the Alboran Sea is strongly influenced by incurrent water masses. Circulation in the Alboran and western Mediterranean is discussed by Furnestin (1960) and Allain (1960); this brief outline is taken largely from the latter source.

The principal Atlantic surface current entering through the strait of Gibraltar bears east-northeast, but soon curves to the right, taking a more easterly direction (see Fig. 2). Water in the lower edge of this current comes completely around, forming an anticyclonic eddy to the west of Cabo Tres Forcas. Currents in this gyre attain about 1.2 knots on the westerly side. The main current accelerates in passing over the ridge beneath the Isla Alboran, cnanges direction toward the north. A second anticyclonal eddy is spun off in the bight east of Cabo Tres Forcas; it circulates more slowly, at about 0.2 knots. Turning southerly again, the main

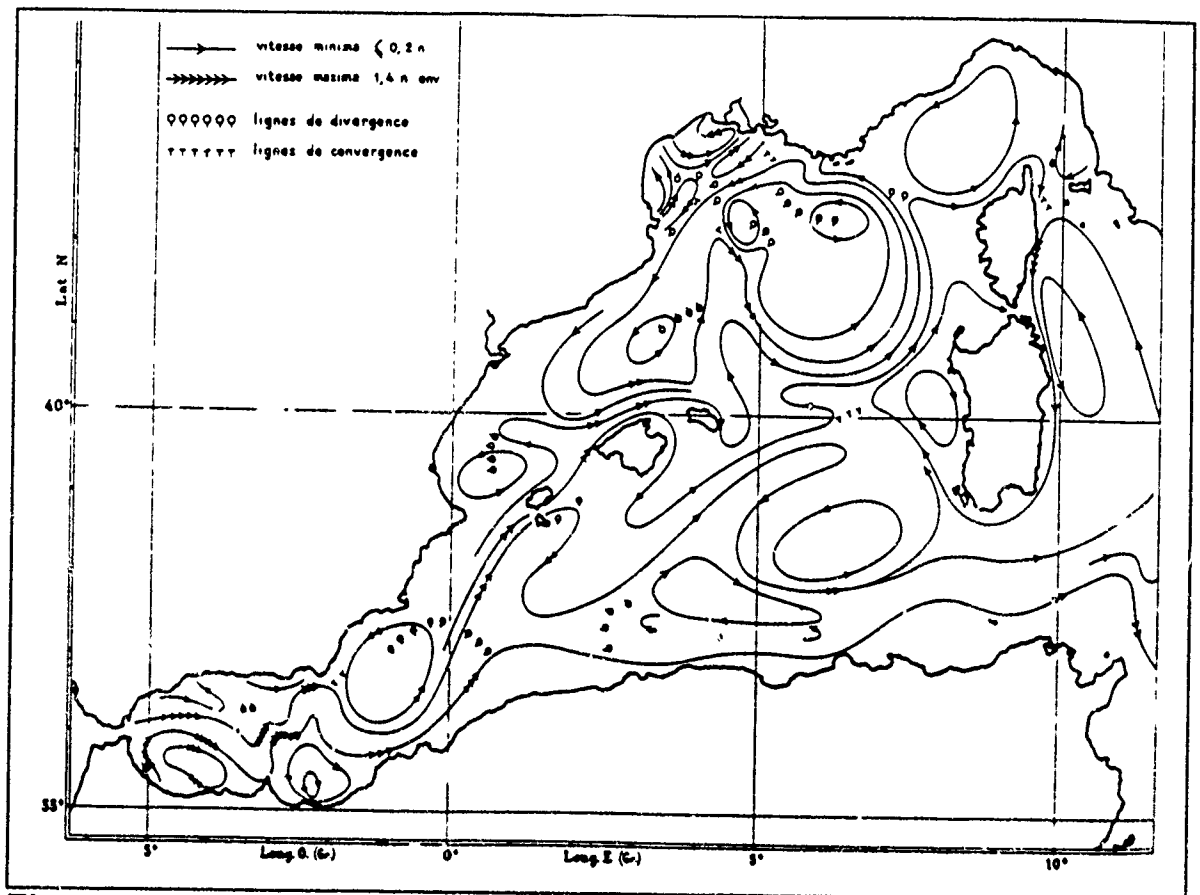


Figure 2. Surface currents in the Alboran Sea and Western Mediterranean (from Allain, 1960).

current passes close to the coast at Oran, then bears northeast, over deeper water, toward the Balearic Islands. A branch of the current continues to follow the north African coastpast Tunisia, and a large cyclonic eddy is produced on the north side of the main stream, within the bight bounded by Cabo de Gata and Cabo Palos in Spain.

The general pattern of surface circulation remains the same to a depth of about 200 m, though velocities are lower. Below 200 m, the water is mainly of Mediterranean origin, and a westerly current carrying Mediterranean water towards the strait of Gibraltar becomes established in the northeast part of the Alboran Sea. Below about 400 m, the circulation is reduced to almost nothing, with only the large cyclonic gyre east of Cabo de Gata and Cabo Palos still moving slowly.

2. Distribution of zooplankton biomass

Biomass and diversity of zooplankton are generally higher than in the eastern parts, due largely to the influence of Atlantic waters. The surface waters (to about

200 m) of the Alboran Sea therefore have the greatest abundances and the most similarity in species composition to the Atlantic. Species composition is in most respects identical to that found outside the strait of Gibraltar. Both abundance and Atlantic character of the fauna are diluted as the surface currents move east and northeast, so that the Ligurian and northern Tyrrhenian seas are poorer, and of a more Mediterranean character (Furnestin, 1968).

Within the Alboran Sea, a divergence zone south of the Spanish coast was found by Rodriguez et al. (1982) to have a zooplankton community distinct from that of neritic waters to the north of it. They did not provide any data, however, on biomass distribution within these communities. Bracconot et al. (1983) provide some rather sketchy data from October and November, 1981, on total zooplankton biomass in the 0-200 m layer from stations both within the Sea and in the strait of Gibraltar. Lowest values, around 150 mg d.w. per m^2, were found in the axis of the strait. Values of 500 mg/m^2 for the 200 m water column were found in the northwest part of the Alboran. In the divergence zone south of the Spanish coast and in the southeast part of the basin biomass ranged from 200 to 500 mg/m^2. Much of the zooplankton biomass in the east and southeast parts of the Sea was due to numerous *Salpa maxima*.

Sampling by Greze et al. (1983) on the Alboran (270 m deep) and Tofinio (90 m deep) banks in the southern part of the Alboran Sea indicated that zooplankton abundance (mainly copepods) was similar to that found in adjacent areas of open water. Numbers of individuals ranged from about 500 to 4600 per m^3, and biomass from 22 to 100 mg (d.w.) m^3 over the two banks.

Zooplankton distribution along the Catalan coast near Barcelona was investigated by Sabates et al. (1989) between April and July, and September through October, 1983. They found greatest abundances in April and May, when biomass values were as high as 60 mg/m^3 in the top 200 m that were sampled. Biomass decreased to about 12 mg/m^3 by June and July, and reached a seasonal minimum of 4.5 mg/m^3 in September, increasing slightly in October. Values were higher further from shore. Gelatinous forms were a major part of this biomass in the spring. Salps peaked in April and May, and doliolids in July. Medusae and siphonophores were present throughout the sampling period at about the same abundance. Euphausiids were most abundant in April and June, but copepods dominated the abundances in April, June and July.

Occurrence and distribution of zooplankton groups in the Alboran Sea and adjacent areas.

1. Colonial Radiolaria and Acantharia

Radiolaria, both solitary and colonial forms, are widely distributed in all the world oceans. Colonial forms consist of hundreds of cells in a gelatinous matrix and can attain sizes of several cm. The *Collozoum, Thalassicolla, Raphidozoum, Sphaerozoum, Acrosphaera, Collosphaera, Siphonosphaera* and *Cytocladus* are bioluminescent (Herring, 1987). These organisms are readily recognized as radiolarians by their gelatinous or "fluffy" appearance, and some species have quite consistent appearances.

The species listed in Table 1 are those reported from submersible observations. Bernard (1958) ranked the radiolarians, mainly colonial forms, third in abundance after copepods and other crustaceans in his visual census of the water column. They were found throughout the water column, to 900 m.

TABLE 1. RADIOLARIANS AND ACANTHARIANS. Geographic Occurrence

Species	Figure	Lum	Alboran	Gibralter	Catalan	Lyon	Ligurian	Tyrrhenian	Adriatic
acantharians							X		
Acanthometra sp.						X			
Arachnosphaera sp.							X		
Aulacantha scolymantha						X	X		
Aulosphaera spp.		a					X		
Collozoum spp.		a				X	X		
Myxosphaera coerulea		ɔ					X		
Sphaerozoum spp.		a					X		
Spongosphaera streptacantha							X		

References

Lyon: Bernard '58, Franqueville '70
Ligurian: Tregouboff '56, '58

2. Hydromedusae and Scyphomedusae.

There appears to be relatively little data on the distribution of hydromedusae or scyphomedusae within the Alboran Sea itself (Goy, 1983; Rodriguez, 1983), but there are several studies that consider seasonal and sometimes vertical occurrence of medusae from the Catalan Sea (Gili et al., 1987, 1988), Gulf of Lyon (Casanova, 1970) Ligurian Sea (Goy, 1972; Goy et al., 1989), Gulf of Naples (Vannucci, 1966; Brinckmann, 1970, 1987) and the Adriatic (Benovic, 1973a, 1973b, 1976, 1977; Vucetic, 1982). Probably many of these species are widely distributed throughout the Mediterranean, but simply haven't been as well sampled in the Alboran Sea as they have at Naples, Messina or Villefranche. Although Goy (1983) refers to the strait of Gibraltar as a "planktonic desert" and considers it a zoogeographic barrier for hydromedusae, most species known from the Mediterranean also occur in the Atlantic and elsewhere.

Table 2 lists 104 species of hydromedusae and 9 species of scyphomedusae reported from the Western Mediterranean; of these 92 are described and illustrated in Section D. The species are listed alphabetically within orders. The medusan species which appear to be most abundant in the Alboran Sea and adjacent regions are discussed here, with seasonal and vertical distributions, where known.

Some hydromedusae noted as common in the Alboran area include *Lizzia blondina*, and *Obelia* spp., both abundant in March and April (Rodriguez, 1983). Goy (1983) reported 11 species in the Alboran Sea in autumn, of which *Eucheilota paradoxica* was most abundant, especially in the southwest part of the Sea. Numerous specimens of *Pandea conica* were collected in 1986 by divers in the Alboran (Harbison, pers. comm.). *Persa incolorata* was the only species found in any abundance in the strait of Gibraltar by Goy (1983). Along the Catalan coast, the commonest species collected in the upper 200 m during May and June were *Podocoryne carnea, P. minuta, Lizzia blondina, Obelia spp. Eirene viridula, Aglaura hemistoma* and *Persa incolorata* (Gili et al., 1988). Spring and early summer appeared to be the times of peak abundance for the medusae in this area, with *Lizzia* and *Aglaura* occurring at densities of 10's m^{-3}.

Deeper collections were reported by Casanova (1970), who found a few species of trachymedusae and narcomedusae in tows as deep as 2000 m. Commonest was *Solmissus albescens*, a large, widely distributed and luminescent narcomedusa. This species occurs throughout the Mediterranean, and is a vertical migrator. In the Adriatic, populations of *S. albescens* migrate between about 600 m and the surface (Benovic, 1973). Mills and Goy (1988) characterize *S. albescens* as "the most numerous medusa in the mesopelagic western Mediterranean", and describe its vertical migration and swimming behavior as observed from a submersible diving near Villefranche. There the medusa moved from daytime depths between 400-700 m to the upper 100 m at night, swimming at about 100 m h^{-1}. *Solmissus* has also been reported by other observers in submersibles as one of the commonest medusae seen (Tregouboff, 1956, 1957; Bernard, 1958). Laval et al. (1989) estimated densities of 15 to 208 *Solmissus* per 1000 m^3. The abundance,

fairly large size (to 5 cm) and bright luminescence of this species make it likely to be an important source of midwater bioluminescence. Sketches of its appearance *in-situ*, as reported by Mills and Goy (1989) are reproduced in Fig. 3.

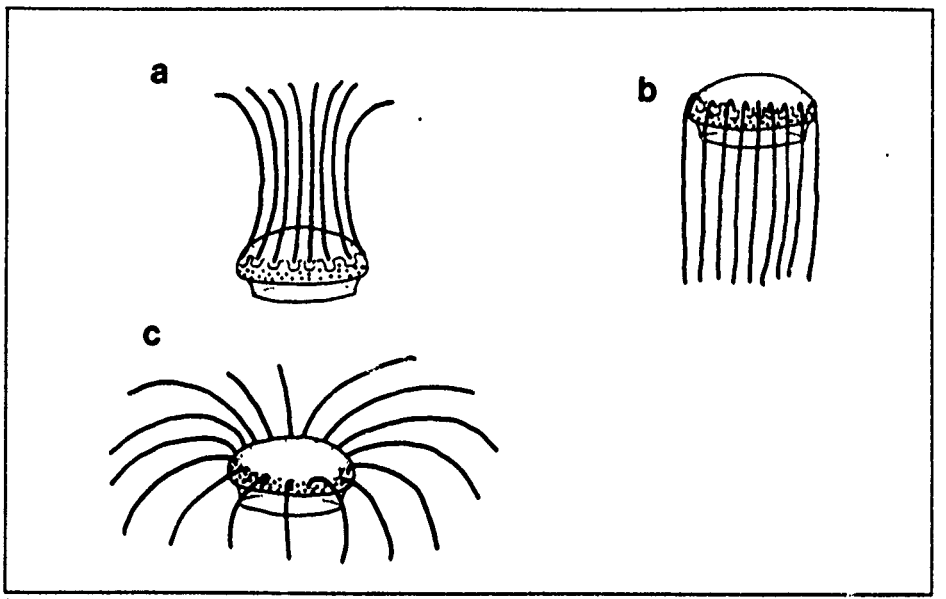


Figure 3. In-situ appearance of *Solmissus albescens* (from Mills and Goy, 1989).

The most abundant scyphomedusa from this area appears to be the ubiquitous and troublesome *Pelagia noctiluca*, a medium-size but strongly bioluminescent semaeostome. In recent years, populations of *Pelagia* have reached nuisance proportions in several parts of the Mediterranean. Gili et al. (1987) report maximium densities in the Catalan area of 30 m^{-3} in June. In the Gulf of Lyon and waters off Toulon, Franqueville (1971) found *Pelagia* migrated vertically between about 500 m and the surface. Individuals collected in April had bell diameters between 10 and 50 mm. Evidently, populations of *Pelagia* fluctuate on a cycle of approximately 12 years, going from almost none to very high densities (Goy et al., 1989). Other scyphomedusae that appear fairly common in the western Mediterranean are *Atolla wyvillei*, and *Periphylla periphylla*, which do not migrate (Franqueville, 1971), but are found below about 500 m.

TABLE 1. HYDRO- AND SCYPHOMEDUSAE. Geographic Occurrence

Species	Fig	Lum	Alboran	Gibralter	Catalan	Lyon	Ligurian	Tyrrhenian	Adriatic
HYDROMEDUSAE									
Anthomedusae									
Amphinema dinema	M-1	c			X			X	X
Amphinema rubrum	M-2	c					X		
Amphinema rugosum	M-3	c						X	
Amphinema turrida	M-4	c					X		
Bougainvillia ramosa	M-5	c				X	X	X	X
Bythotiara murrayi	M-6					X			X
Calycopsis simplex	M-7						X		
Calycopsis sp.								X	
Cirrholovenia tetranema							X	X	
Cladonema radiatum	M-8						X	X	
Cytaeis tetrastyla	M-9		X					X	
Dipurena halterata	M-10						X	X	
Dipurena ophiogaster	M-11						X	X	
Ectopleura dumortieri	M-12						X	X	X
Ectopleura larynx								X	
Ectopleura sacculifera								X	
Eleutheria dichotoma							X	X	
Eucodonium brownei	M-13				X			X	
Euphysa aurata	M-14	a			X	X		X	X
Halitiara formosa	M-15						X	X	
Hybocodon prolifer	M-16				X				
Koellikerina fasciculata	M-17				X			X	
Leuckartiara nobilis	M-18	a					X	X	
Leuckartiara octona	M-19	a			X	X		X	X
Lizzia blondina	M-20	b	X		X	X	X		
Lizzia fulgurans	M-21	b						X	
Merga tergestina	M-22	c						X	
Merga tregoubovii		c					X		

Species	Fig	Lum	Alboran	Gibralter	Catalan	Lyon	Ligurian	Tyrrhenian	Adriatic
Merga violacea	M-23	c					X		
Neoturris pileata	M-24	c			X	X			X
Niobia dendrotentaculata	M-25							X	
Oceania armata	M-26							X	X
Octotiara violacea							X		
Pandea conica	M-27	c	X			X	X	X	
Paragotoea bathybia	M-28						X	X	
Podocoryne areolata							X		X
Podocoryne carnea	M-29				X	X		X	
Podocoryne hartlaubi	M-30					X		X	
Podocoryne minima	M-31				X			X	X
Podocoryne minuta	M-32				X				X
Rathkea octopunctata	M-33	b				X	X		
Sarsia eximia	M-34						X		
Sarsia gemmifera	M-35		X			X		X	X
Sarsia prolifera	M-36						X		
Sarsia tubulosa	M-37				X				
Staurocladia portmanni								X	
Steenstrupia nutans	M-38				X		X	X	X
Thamnostoma sp.							X		
Tiaranna rotunda	M-39					X			
Tregoubovia atentaculata							X		
Turritopsis nutricula	M-40							X	
Zanclea costata	M-41		X		X		X	X	X
Leptomedusae									
Aequorea aequorea	M-42	a				X	X	X	
Eirene viridula	M-43					X	X		X
Eucheilota paradoxica	M-44		X						

Species	Fig	Lum	Alboran	Gibralter	Catalan	Lyon	Ligurian	Tyrrhenian	Adriatic
Eugymnanthea inquilina					X			X	
Eutima gegenbauri	M-45				X	X			X
Eutima gracilis	M-46								X
Eutima sp.								X	
Eutonina scintillans							X		
Helgicirrha schulzei	M-47				X	X		X	X
Krampella dubia	M-48						X		X
Laodicea neptuna	M-49	b						X	
Laodicea ocellata	M-50	b				X			X
Laodicea undulata	M-51	b			X	X		X	X
Lovenella cirrata	M-52	a						X	
Mitrocoma annae	M-53	c						X	
Mitrocomella brownei	M-54	c			X				
Obelia spp.	M-55	a	X		X	X	X	X	X
Octophialucium funerarium	M-56	a			X	X	X		X
Orchistomella graeffei							X		X
Phialidium hemisphaericum	M-57	a			X	X	X		X
Phialidium mccradyi	M-58	a						X	
Phialidium sp.		a					X		
Tima lucullana	M-59	a			X			X	
Limnomedusae									
Gonionemus vertens	M-60						X		
Odessia maeotica	M-61					X	X	X	
Olindias phosphorica	M-62						X	X	
Proboscidactyla ornata	M-63						X	X	
Scolionema suvaensis	M-64						X	X	

Species	Fig	Lum	Alboran	Gibralter	Catalan	Lyon	Ligurian	Tyrrhenian	Adriatic
Trachymedusae									
Aglantha digitale	M-65				X				
Aglaura hemistoma	M-66		X		X	X	X	X	X
Amphogona pusilla							X		
Arctapodema amplum	M-67	c					X		
Arctapodema australe		c							X
Geryonia proboscidalis	M-68	b				X	X	X	
Haliscera bigelowi	M-69				X	X			
Haliscera conica	M-70						X		
Liriope tetraphylla	M-71	b	X			X	X	X	X
Persa incolorata	M-72		X	X	X	X			X
Ptychogastria asteroides								X	
Ransonia krampi	M-73				X	X			
Rhopalonema funerarium	M-74	c			X				
Rhopalonema velatum	M-75	c	X		X	X	X	X	X
Sminthea eurygaster	M-76	c			X				X
Narcomedusae									
Cunina globosa	M-77	a			X				
Cunina sp.		a					X	X	
Pegantha rubiginosa	M-78						X		
Solmaris flavescens	M-79				X			X	
Solmaris leucostyla	M-80					X	X		X
Solmaris solmaris	M-81				X				
Solmissus albescens	M-82	a	X	X	X	X	X		X
Solmundella bitentaculata	M-83	c	X	X	X	X		X	X

Species	Fig	Lum	Alboran	Gibralter	Catalan	Lyon	Ligurian	Tyrrhenian	Adriatic
SCYPHOMEDUSAE									
Coronatae									
Atolla wyvillei	M-84	a			X				
Nausithoe punctata	M-85				X	X			
Nausithoe spp.							X		X
Paraphyllina intermedia	M-86				X				
Periphylla periphylla	M-87	a			X	X			
Semaeostomae									
Chrysaora hysoscella	M-88	c					X		
Discomedusa lobata	M-89				X		X		
Pelagia noctiluca	M-90	a			X	X	X		X
Rhizostomae									
Rhizostoma pulmo	M-91						X		

References

General: Kramp, '59
Alboran: Goy '83, Rodriguez '83, Harbison pers. comm.
Gibralter: Goy '83
Catalan: Gili et al, '87; '88
Lyon: Razouls & Thiriot '68, Casanova '70, Franqueville '70
Ligurian: Goy '72, Goy et al '89, Tregouboff '56, '58
Tyrrhenian: Brinckmann-Voss '87
Adriatic: Benovic & Bender '87

3. Siphonophores.

Siphonophores are diverse and widely distributed predators. Most Mediterranean species are also found in warm parts of the Atlantic or other oceans. Because of the complex life cycle and morphology of siphonophores, and their fragility, many species are known only from parts of the whole organism. Distribution of siphonophores in the Alboran Sea and adjacent areas has been reported by Alvarino (1957), Casanova (1970), Gili et al. (1987, 1988), and Patriti (1969). General distribution in the Mediterranean is discussed by Bigelow and Sears (1937), and worldwide distribution of most described species is summarized by Alvarino (1971). Table 3 lists 56 species of siphonophores reported from the Western Mediterranean. They are arranged alphabetically within suborders, and 49 of them are described and illustrated in Section D. The most abundant species in the western Mediterranean are discussed here.

The small calycophorans are the most common siphonophores in surface waters. Of these, *Abylopsis tetragona, Chelophyes appendiculata, Diphyes dispar, Muggiaea atlantica, Eudoxoides spiralis* and *Lensia conoidea* are listed as common in the western Mediterranean. In the Catalan Sea, *M. atlantica* occurred in densities up to hundreds m^{-3} in May and June, and *M. kochi* was found in maximum densities of more than 4 m^{-3} in the Gulf of Gabes near Tripoli (Patriti, 1969). Franqueville (1971) found peak abundances of *A. tetragona* and *Chelophyes appendiculata* in the spring near Toulon, and no evidence for vertical migration.

C. appendiculata was also the most abundant siphonophore seen during submersible dives near Villefranche by Laval et al. (1989). They found this species in the 100-250 m depth range, with evidence of a migration toward the surface at night. Densities of total diphyids (mostly *C. appendiculata*) ranged to over 200 per 1000 m^3. They also noted that *C. appendiculata* could be distinguished *in-situ* from the similar *Lensia conoidea* because in the former both nectophores and stem hang vertically, while in the latter the nectophore is horizontal and the stem hangs perpendicular to it. Other siphonophores reported by Laval et al. and earlier papers (Tregouboff 1956, 1957; Bernard, 1958) included *Lensia subtilis, Muggiaea sp., Abylopsis tetragona, Hippopodius hippopus, Lilyopsis rosea, Agalma elegans, Nanomia bijuga, Halistemma rubrum* and *Forskalia edwardsi.*

Physonects are less commonly reported from plankton tows; they are harder to quantify because the colonies break apart in nets. *Agalma elegans* was quite abundant in May in the Catalan Sea (Gili et al. 1988) Submersible observations and collections elsewhere (Pugh and Harbison, 1986, 1987) indicate that large physonects and calycophorans are probably much more common in deep water than net tows suggest.

TABLE 3. SIPHONOPHORES. Geographic Occurrence

Species	Figure	Lum	Alboran	Gibralter	Catalan	Lyon	Ligurian	Tyrrhenian	Adriatic
Cystonectae									
Rhizophysa filiformis	S-1	a	X			X	X	X	
Physonectae									
Agalma elegans	S-2	a			X	X	X	X	
Agalma okeni	S-3	a			X		X	X	
Agalma sp.		a				X			
Apolemia uvaria	S-4	a					X	X	
Athorybia rosacea	S-5						X	X	
Cordagalma cordiformis	S-6	c			X				
Forskalia edwardsi	S-7	a			X	X	X	X	
Forskalia spp.		a				X	X		
Halistemma rubrum	S-8	a	X		X		X	X	
Halistemma spp.		a					X		
Lychnagalma utricularia	S-9	c						X	
Marrus orthocanna	S-10	c			X				
Nanomia bijuga	S-11	a	X		X		X	X	
Nanomia cara	S-12	a						X	
Physophora hydrostatiça	S-13		X		X	X	X	X	X
Calycophorae									
Abyla haeckeli	S-14	a			X				
Abylopsis eschscholtzi	S-15	a	X		X	X	X		
Abylopsis tetragona	S-16	a	X	X	X	X	X	X	X
Amphicaryon acaule	S-17	a						X	
Bassia bassensis	S-18	a	X	X	X	X	X	X	X
Ceratocymba sagittata	S-19	a	X	X					
Chelophyes appendiculata	S-20	a	X	X	X	X	X	X	X

Species	Figure	Lum	Alboran	Gibraltar	Catalan	Lyon	Ligurian	Tyrrhenian	Adriatic
Chelophyes contorta	S-21	a	X						
Chuniphyes multidentata	S-22					X			
Clausophyes ovata	S-23						X		
Diphyes dispar	S-24	a			X	X	X		
Enneagonum hyalinum	S-25	c	X	X	X	X		X	
Eudoxoides spiralis	S-26	c	X	X	X	X	X	X	X
Hippopodius hippopus	S-27	a	X	X	X	X	X	X	X
Lensia campanella	S-28	c							X
Lensia conoidea	S-29	c	X	X	X	X	X	X	
Lensia fowleri	S-30	c	X		X	X	X	X	X
Lensia meteori	S-31	c			X	X	X		X
Lensia multicristata	S-32	c	X	X	X	X	X	X	
Lensia subtilis	S-33	c			X	X	X	X	X
Lensia subtiloides	S-34	c		X	X				
Lilyopsis rosea	S-35	c					X		
Muggiaea atlantica	S-36	c	X		X	X	X		
Muggiaea kochi	S-37	c	X		X	X	X	X	X
Muggiaea sp.		c					X		
Rosacea cymbiformis	S-38	a				X	X	X	
Rosacea plicata	S-39	a					X	X	
Sphaeronectes bougisi					X				
Sphaeronectes gracilis	S-40						X	X	
Sphaeronectes irregularis	S-41								X
Sphaeronectes kollikeri						X	X		X
Sphaeronectes sp.							X	X	
Sulculeolaria biloba	S-42	a	X		X	X	X	X	X
Sulculeolaria chuni	S-43	a				X			
Sulculeolaria quadrivalvis	S-44	a			X	X	X	X	

Species	Figure	Lum	Alboran	Gibralter	Catalan	Lyon	Ligurian	Tyrrhenian	Adriatic
Sulculeolaria turgida	S-45	a				X			
Vogtia glabra	S-46	a			X	X	X	X	
Vogtia pentacantha	S-47	a			X	X	X	X	
Vogtia spinosa	S-48	a	X		X	X		X	

References

General: Alvarino '71, Bigelow and Sears '37, Totton '65
Alboran: Harbison pers. comm.
Catalan: Gili et al '87, '88, Rodriguez '83
Lyon: Razouls & Thiriot '68, Casanova '70, Franqueville '70, Bernard '55,58
Ligurian: Biggs et al '86, Laval et al '89, Tregouboff '56, '58
Adriatic: Hure '55

4. Ctenophores

Ctenophores are not easily collected in nets, and are rarely found in conventional zooplankton surveys. The only recent reports of ctenophoran fauna in the Alboran Sea found were unpublished dive logs (Harbison, pers. comm.) indicating the presence of *Pleurobrachia* sp., and unidentified cydippid ("red-tentacle"), *Bolinopsis vitrea, Leucothea multicornis* and *Beroe* spp. A diving survey made near Villefranche in 1986 also found *Leucothea multicornis, Pleurobrachia pileus, Callianira bialata, Cestum veneris* and *Beroe* sp. in densities of <1 per $1000m^3$ in the top 20 m (Biggs et al. 1987). Many ctenophore species were originally studied and described in the Meditteranean by Chun (1878, 1880, 1898), Fedele (1940) and others working in areas like Naples or Messina, where ctenophores were common at the surface and could be collected by dipping from a rowboat. Species found anywhere in the Mediterranean are likely to occur in the Alboran Sea. Most of the Mediterranean species also occur in the Atlantic, with the apparent exception of the genus *Ocyropsis*. Since this is known from the Canary Islands, it seems remarkable that it has never entered the Mediterranean, and it is possible that it has simply been overlooked. Table 4 lists 25 species of ctenophores from the Mediterranean, of which 20 are described and illustrated.

Some ctenophores occur elsewhere in periodically dense populations. These include species of *Pleurobrachia, Mnemiopsis, Leucothea* and *Beroe*. Large populations are more likely near the surface and near shore, where they may be partly caused by hydrographic aggregation. Most of the species listed here are known from surface waters, but a very rich mesopelagic ctenophore fauna has been discovered in recent years through the use of submersibles. *Bathocyroe fosteri* and *Thalassocalyce inconstans* (Madin and Harbison, 1978a,b), originally described from the Atlantic, have been reported in the Mediterranean (Laval et al. 1989, Carré, pers. comm.). A great many other new species have been reported from submersible dives in the western Atlantic (Larson et al., 1988) and are in the process of being described (Harbison and Botkin, in prep.; Madin, unpubl.).

Virtually all ctenophores studied to date are brightly luminescent, producing light in the meridional canals, or in *Eurhamphaea vexilligera*, releasing luminous secretions when disturbed. They are likely to be important luminous sources in midwater, but may also be difficult to collect and identify.

Ctenophores have been reported from submersible dives by several authors. Laval et al. (1989) reported that *Bathocyroe* sp. was one of the most abundant species seen, occuring mostly between 200 and 750 m. Other species reported were *Pleurobrachia rhodopis, Cestum veneris, Beroe ovata* and *Thalassocalyce inconstans*. Tregouboff (1956, 1957) saw *Pleurobrachia, Cestum, Bolinopsis* and another lobate in bathyscaphe dives near Villefranche, and Bernard (1958) reported small cydippids between 50 and 1000 m off the coast of Toulon.

TABLE 4. CTENOPHORES. Geographic Occurrence

Species	Figure	Lum	Alboran	Gibralter	Catalan	Lyon	Ligurian	Tyrrhenian	Adriatic
Cydippida									
Callianira bialata	C-1	a					X	X	
Euplokamis stationis	C-2							X	
Haeckelia bimaculata	C-3	a					X		
Haeckelia rubra	C-4	a						X	
Hormiphora hormiphora		a						X	
Hormiphora plumosa	C-5	a						X	
Hormiphora spatulata	C-6	a		X					
Hormiphora spp.		a					X		
Lampea pancerina	C-7	a						X	X
Pleurobrachia pileus	C-8	a	X			X	X	X	
Pleurobrachia rhodopis		a					X	X	
"red-tentacle cydippid"			X						
Lobata									
Bathocyroe fosteri	C-9						X		
Bolinopsis spp.		a					X		
Bolinopsis vitrea	C-10	a	X					X	
Deiopea kaloktenota	C-11	a						X	X
Eurhamphaea vexilligera	C-12	a						X	
Leucothea multicornis	C-13	a	X				X	X	
Thalassocalycida									
Thalassocalyce inconstans	C-14						X		
Cestida									
Cestum veneris	C-15	a					X	X	
Velamen parallelum	C-16	a						X	

Species	Figure	Lum	Alboran	Gibralter	Catalan	Lyon	Ligurian	Tyrrhenian	Adriatic
Beroida									
Beroe forskalii	C-17	a	X					X	
Beroe mitrata	C-18	a					X		
Beroe ovata	C-19	a				X	X	X	

References

General: Chun '80, Fedele '40
Alboran: Harbison pers. comm.
Lyon: Razouls & Thiriot '68
Ligurian: Tregouboff '56,'58, Laval et al '89, Biggs et al '86
Tyrrhenian: Chun '80, Fedele '40
Adriatic: Fedele '40

5. Polychaetes and Nudibranchs

Records of pelagic polychaetes and nudibranchs are rather scattered; only Hure (1955) devotes much attention to the species found in the Adriatic. Most species however, have a fairly wide distribution and probably can be expected in the Alboran Sea as much as anywhere. The tomopterids are known to be bioluminescent (Herring, 1987), and the alciopids secrete a greenish-yellow ink when disturbed, which may be luminescent. The nudibranch *Phyllirhoe* is also luminescent. These zooplankters rarely seem abundant enough that their vertical or seasonal distributions have been analyzed. Bernard (1955) saw *Tomopteris* at 660 and 1085 m; Tregouboff (1956, 1957) noted that genus and other pelagic polychaetes at 200, 650 and 990 m. In the Caribbean, large (25 cm) tomopterids have been collected at about 900 m (Madin, unpubl.). Table 5 lists 14 species; 6 are illustrated.

TABLE 5. POLYCHAETES and NUDIBRANCHS. Geographic Occurrence

Species	Figure	Lum	Alboran	Gibralter	Catalan	Lyon	Ligurian	Tyrrhenian	Adriatic
Polychaetes									
Alciopa contrainii									X
Asterope candida									X
Calizonella lepidota	P-1								X
Lopadorhynchus brevis									X
Lopadorhynchus uncinatus	P-2					X			X
Sagitella kowalevskii									X
Tomopteris cavalii		a				X	X		X
Tomopteris elegans		a							X
Tomopteris helgolandica	P-3								X
Tomopteris planktonis									X
Tomopteris sp.		a	X						
Vanadis crystallina	P-4								X
Vanadis formosa	P-5								
Nudibranchs									
Phyllirhoe sp.	P-6								

References

Lyon: Bernard '55, Franqueville '71
Ligurian: Tregouboff '56, '58
Adriatic: Hure '55

6. Pelagic Tunicates

There don't seem to be any recent reports of pelagic tunicates from the Alboran, but Jansa (1985) collected 13 species of larvaceans and 1 salp in the region west and south of Mallorca in the Catalan Sea. Most abundant were *Oikopleura longicauda, O. dioica* and *Fritillaria borealis*. The only salp collected was *Thalia democratica*. Most species known from the Mediterranean are widely distributed there (and in other oceans), and probably occur in the Alboran. Table 6 lists 54 species of Thaliaceans and Larvaceans, and 38 of these are described and illustrated. The larvaceans are better represented in net collections because they are smaller and more numerous. Except in periodic swarms, salps are likely to be sparsely distributed. Doliolids can also form dense populations, but are more likely to be scattered in midwater. Pyrosomes are intensely luminescent, but luminescence of salps and doliolids is doubtful.

A few species, *Pyrosoma atlantica, Salpa fusiformis, Iasis zonaria* and possibly *Thetys vagina* are vertical migrators. Off Toulon, Franqueville (1971) found *P. atlantica* and *S. fusiformis* between 300 -900 m during the day and in the top 200 m at night. Other species reported (*S. maxima, P. bicaudata, T. democratica, I. punctata*) were generally at shallower depths. Maximum abundance of the salps was generally in the spring, but most pyrosomes were collected in autumn.

Salps have been rather infrequently seen from submersibles in the Mediterranean. Bernard (1958) reported a few *Thalia* at 310 m; Tregouboff (1956, 1957) saw these, as well as *S. maxima* and *P. bicaudata*. Laval et al. (1989) found only a few *S. fusiformis* and 7 pyrosome colonies. On the other hand, small pyrosomes (to 10 cm), were quite common on dives made by Tregouboff (1956, 1957).

Larvaceans and their houses are much more commonly reported from submersibles. Tregouboff and Bernard saw species of *Fritillaria, Megalocercus* and *Stegosoma*, some to depths of 300 m. Laval et al. (1989) observed very high densities of houses of *Oikopleura albicans* and other oikopleurids in the upper layers. They estimated that abundances ranged from 200 to 1 million houses per 1000 m^3, and that over 50% of them were abandoned. Similar densities were reported in surface waters by Scuba divers (Biggs et al., 1987). Much larger houses, attributed to *Megalocercus abyssorum* or *Stegosoma magnum* were seen from 300-450 m. These houses were up to 4 cm in diameter, and were seen in densities up to 59 per 1000 m^3. Both the larvaceans themselves and the houses (in some species at least) are luminescent (Galt, 1989).

TABLE 6 PELAGIC TUNICATES. Geographic Occurrence

Species	Figure	Lum	Alboran	Gibralter	Catalan	Lyon	Ligurian	Tyrrhenian	Adriatic
Pyrosomas									
Pyrosoma atlanticum	T-1	a				X	X		
pyrosomes		a	X				X		X
Doliolids									
Dolioletta gegenbauri	T-2	c					X		X
Doliolum denticulatum	T-3	b			X		X		X
Doliolum mulleri	T-4	b	X		X		X		X
Doliolum nationalis		b	X		X	X			X
Salps									
Cyclosalpa affinis	T-5	b			X				
Cyclosalpa pinnata	T-6	b				X			
Cyclosalpa polae	T-7	b							
Helicosalpa virgula	T-8				X		X	X	
Iasis zonaria	T-9								
Ihlea punctata	T-10					X	X		
Pegea bicaudata	T-11					X	X		
Pegea confoederata	T-12						X		
Pegea socia	T-13		X						
Salpa fusiformis	T-14				X	X	X		X
Salpa maxima	T-15		X		X	X	X		X
Thalia democratica	T-16		X		X	X	X		X
Thalia orientalis	T-17				X				
Thetys vagina	T-18				X				

Species	Figure	Lum	Alboran	Gibralter	Catalan	Lyon	Ligurian	Tyrrhenian	Adriatic
Appendicularians									
Appendicularia sicula	T-19				X		X	X	X
Appendicularia tregouboffi							X		
Folia gracilis	T-20	b					X	X	
Fritillaria aequatorialis	T-21				X		X	X	
Fritillaria borealis	T-22				X		X		X
Fritillaria charybdae							X	X	
Fritillaria fagei							X		
Fritillaria formica							X		
Fritillaria fraudax					X		X		
Fritillaria gracilis	T-23				X		X	X	
Fritillaria haplostoma	T-24				X	X	X	X	X
Fritillaria megachile	T-25				X	X	X	X	
Fritillaria messanensis							X	X	
Fritillaria pellucida	T-26		X	X	X	X	X	X	X
Fritillaria spp.			X				X		
Fritillaria tenella							X	X	
Fritillaria urticans							X	X	
Fritillaria venusta	T-27				X		X	X	
Kowalevskia tenuis	T-28					X	X	X	X
Kowalevskia oceanica							X		
Megalocercus abyssorum	T-29	c			X	X	X	X	X
Oikopleura albicans	T-30	a			X	X	X	X	X
Oikopleura cophocerca	T-31	a			X	X	X		X
Oikopleura dioica	T-32	a			X	X	X	X	X
Oikopleura fusiformis	T-33	a			X	X	X	X	X
Oikopleura graciloides		a					X	X	
Oikopleura intermedia	T-34	a			X		X	X	X

Species	Figure	Lum	Alboran	Gibralter	Catalan	Lyon	Ligurian	Tyrrhenian	Adriatic
Oikopleura mediterranea		a						X	X
Oikopleura parva	T-36	a			X	X	X	X	
Oikopleura rufescens	T-37	a			X		X	X	
Oikopleura sp.		a	X						
Pelagopleura haranti		c					X		
Stegosoma magnum	T-38	a			X	X	X	X	X
Tectillaria fertilis							X		

References

General: Fenaux '67
Alboran: Rodriguez '83, Rodriguez et al '82, Harbison, pers. comm.
Catalan: Jansa '85, Trepat '83, Godeaux '85
Lyon: Bernard '58, Franqueville '70,'71, Razouls & Thiriot '68, Casanova '70
Ligurian: Tregouboff '56,'58, Laval et al '89, Bracconot '70,'73, Fenaux '59
Adriatic: Hure '55, Godeaux '87

7. Crustaceans

As elsewhere, the crustaceans, particularly copepods, make up most of the numbers, biomass and diversity of the zooplankton. Although there is a much larger historical literature concerning copepods and other crustaceans in the Mediterranean, only recent studies concerned with the Alboran Sea and adjacent areas are considered here. The papers by Rodriguez (1983) and Rodriguez et al. (1982) are mainly concerned with copepods in the Alboran. Table 7 lists 90 species of hyperiid amphipods, euphausiids, mysids, copepods, ostracods and decapod shrimp; 45 of these are described and illustrated. Cladocerans have no known luminescent genera and are not included. One hyperiid amphipod genus is reportedly luminescent, as are a few copepods. All the listed genera of euphausiids, ostracods and almost all the decapods are also bioluminescent.

The most abundant copepods reported in the Alboran Sea in March, April and May from tows taken in the top 20 m were *Paracalanus parvus, Clausocalanus spp., Centropages chierchiae, Acartia clausi, Temora stylifera, Oncaea* spp. and *Oithona* spp. (Rodriguez, 1983). Furnestin (1968) cites *P. parvus, Clausocalanus arcuicornis* and *T. stylifera* as the species constituting most of the copepod biomass in the Alboran in early summer. The only ostracod reported by Rodriguez (1983) was *Conchoecia* sp., which had maximal abundance in March and April. Another genus, *Cypridina*, is distributed throughout the Mediterranean but in deeper water than sampled by Rodriguez.

Euphausiids were collected with midwater trawls by Wiebe and D'Abramo (1972) in several parts of the Mediterranean. The dominant species occuring in the Alboran Sea were *Euphausia krohni, Nematoscelis megalops, Stylocheiron abbreviatum* and *S. suhmii*. Vertical distribution of larger crustaceans near Toulon is reported by Franqueville (1971). With the exception of *Stylocheiron maximum*, which was always found between 200 - 500 m, euphausiids collected by Franqueville were diel migrators, moving from 400 - 2400 m by day to near surface waters at night. Most abundant species were *Meganyctiphanes norvegica*, with maximum abundances in summer of 100 per 5000 m^3, *Euphausia krohnii* and *Nematoscelis megalops*. The hyperiid amphipods *Phronima sedentaria* and *Scina crassicornis* exhibited diel migration between 400 - 1400 m by day and 0 - 200 m at night. Maximum seasonal abundances of *P. sedentaria* and *Phrosina semilunata* were in spring and fall. Decapod shrimp in Franqueville's samples were dominated by *Sergestes arcticus*, with maximum abundance in summer, and *Gennadas elegans*, most common in winter and spring. Both migrate from daytime depths as great as 1400 m to the top 100 m at night.

Submersible observations (Bernard, 1955, 1958; Tregouboff, 1956, 1957) have included reports of "large copepods", mainly calanoids 3 - 5 mm long and mainly below 900 m, *Sapphirina* sp. at 300 and 1900 m, euphausiids common between 600 and 2000 m, the peneid *Gennadas elegans* between 500 - 600 m, and sergestids below about 600 m. Laval et al. (1989) saw *Phronima* in barrels from their submersible.

TABLE 7. CRUSTACEANS. Geographic Occurrence

Species	Figure	Lum	Alboran	Gibralter	Catalan	Lyon	Ligurian	Tyrrhenian	Adriatic
Amphipods									
Amphithyrus bispinosus									X
Amphithyrus similis						X			
Brachyscelus crusculum	CR-1		X	X	X	X	X	X	X
Calamorhynchus rigidus									X
Euprimno macropus						X			X
Eupronoe minuta		c				X			X
Glossocephalus milne-edwardsi						X			
Hyperia schizogeneios						X			X
Hyperia hydrocephala									X
Hyperioides longipes						X			X
Lycaeopsis themistoides						X			
Paralycaea gracilis						X			
Paraphronima gracilis									X
Phronima atlantica	CR-2					X			X
Phronima sedentaria	CR-3					X	X		
Phronimella elongata	CR-4					X			
Phronimopsis spinifera									X
Phrosina semilunata	CR-5					X			X
Platyscelus ovoides	CR-6		X	X	X	X	X	X	X
Platyscelus serratulus						X			X
Pseudolycea pachypoda	CR-7					X	X	X	
Rhabdosoma brevicaudatum									X
Scina borealis		a				X			
Scina crassicornis	CR-8	a				X			X
Streetsia challengeri	CR-9		X	X	X	X	X	X	

Species	Figure	Lum	Alboran	Gibralter	Catalan	Lyon	Ligurian	Tyrrhenian	Adriatic
Tetrathyrus forcipatus									X
Vibilia armata						X			X
Vibilia jeangerardi									X
Vibilia viatrix						X			X
Euphausiids									
Euphausia brevis		a	X					X	
Euphausia hemigibba		a			X	X		X	
Euphausia krohnii	CR-10	a				X			
euphausiids		a				X	X		
Meganyctiphanes norvegica	CR-11	a				X			
Nematoscelis atlantica		a				X			
Nematoscelis megalops	CR-12	a				X			
Stylocheiro abbreviatu		a				X			
Stylocheiron longicorne		a	X		X	X		X	
Stylocheiron maximum	CR-13	a				X			
Stylocheiron suhmii		a	X					X	
Thysanopoda aequalis	CR-14	a	X		X	X		X	
Mysids									
Boreomysis semicaeca						X			
Euchaetomeropsis merolepis						X			
Eucopia hanseni						X			
Lophogaster typicus		c				X			

Species	Figure	Lum	Alboran	Gibralter	Catalan	Lyon	Ligurian	Tyrrhenian	Adriatic
Copepods									
Acartia clausi	CR-15		X						X
Acartia grani			X						
Aetidius armatus			X						X
Calanus brevicornis		c	X	X					
Calanus helgolandicus	CR-16	c	X						X
Calanus minor		c	X						
Calocalanus sp.			X						X
Centropages chierchiae	CR-17		X	X	X		X		
Centropages kroyeri	CR-18		X						
Centropages typicus	CR-19		X						X
Clausocalanus arcuicornis	CR-20		X						X
Clausocalanus sp.			X						
Coryceus sp.	CR-21	b	X						X
Ctenocalanus vanus			X		X	X	X		X
Eucalanus elongatus	CR-22		X	X	X		X		X
Eucalanus hyalinus			X						
Eucalanus monachus			X	X	X		X		
Euterpina acutifrons			X						
Haloptilis acutifrons	CR-23	a	X						X
Lucicutia flavicornis	CR-24	a	X						X
Oithona sp.	CR-25	b	X						X
Oncaea sp.	CR-26	a	X						X
Onchocalanus spp.							X		
Paracalanus parvus	CR-27		X						X
Pleuromamma borealis	CR-28	a	X						
Pleuromamma gracilis	CR-29	a	X						X
Pseudocalanus elongatus			X						
Rhincalanus nasutus	CR-30		X						
Sapphirina sp.	CR-31		X						X

Species	Figure	Lum	Alboran	Gibraltar	Catalan	Lyon	Ligurian	Tyrrhenian	Adriatic
Scolecithrix bradyi	CR-32	c	X						X
Temora longicornis	CR-33		X						
Temora stylifera	CR-34		X						X
Ostracods									
Conchoecia sp.	CR-35	a	X						X
Cypridina castanea	CR-36	a							
Decapods									
Acanthephyra pelagica	CR-37	a				X			
Funchalia sp.							X		
Gennadus elegans	CR-38	b				X			
Lucifer typus						X			X
Pasiphaea multidentata	CR-39	c				X			
Pasiphaea sivado	CR-40	c				X			
Sergestes arcticus	CR-41	a				X			X
Sergestes corniculum		a				X			
Sergestes mollis		a				X			
Sergestes robustus	CR-42	a				X			
Sergestes sargassi	CR-43	a				X			
Sergestes spp.		a				X	X		
Sergestes vigilax	CR-44	a				X			

References

General: Stephensen '25, Rose '33, Crosnier & Forest '73, Wiebe & D'Abramo '72
Alboran: Rodriguez '83, Rodriguez et al '82, Furnestin '68
Lyon: Bernard '55, Franqueville '70,'71, Casanova, Razouls & Thiriot '68
Ligurian: Tregouboff '56, '58
Adriatic: Hure '55

Illustrated systematic guide to zooplankton of the Alboran Sea and adjacent areas.

The following guide is intended for use in the field, with live animals or images of them. An effort was made to keep the descriptions concise, specific and free of specialized terminology or abbreviations. Some terms specific to major groups are defined in the beginning of each taxonomic section. For some groups like copepods and larvaceans, specialists differentiate species on the basis of rather obscure or morphometric characters. These have been avoided here wherever possible. The illustrations are compiled from a variety of sources, indicated for each section. Wherever possible, a picture of the whole animal was used, but in the case of some siphonophores, larvaceans and crustaceans, only illustrations of parts were available. Original captions (not always in English) have been left on the illustrations in some instances.

Hydromedusae and Scyphomedusae

What are commonly called jellyfish are medusae belonging to two Classes of the Cnidaria -- the Hydrozoa and the Scyphozoa. Hydromedusae possess a velum around the umbrella opening that scyphomedusae lack. Since the morphology and life history is broadly similar, it is most practical to treat them as one group here. There are perhaps 1000 species of hydro- and scyphomedusae, with undoubtedly more to be discovered, especially in deep or polar waters (e.g. Larson et al. 1988; Larson and Harbison, 1990). Some meso- or bathypelagic species known from other regions may occur in the Mediterranean, but have not yet been reported, and are not included here. Many species are luminescent, some very conspicuously.

Many of these medusae are part of a life history that alternates between a sessile, benthic, asexually reproducing polyp and a sexually reproducing and dispersing planktonic medusa. However, many oceanic medusae have lost the polyp stage and have evolved a variety of sexual and asexual reproductive mechanisms that do not require a benthic habitat. In many cases polyp and medusa stages were described separately, with different names, and there are still many instances in which the two stages have not been recognized as belonging to the same species. There are two classifications for Hydromedusae, based either on the polyp (hydroid) or medusoid forms. In this description, the classification follows that of Kramp (1961) based on medusoid stages.

HYDROMEDUSAE

1. Anthomedusae. This order includes relatively small forms ranging in size from less than 1 mm to several cm. The umbrella is usually a tall bell shape, and gonads are almost always found on the sides of the central stomach. There are 4 radial canals connecting the stomach to a marginal ring canal. Tentacles occur in varying numbers around the umbrella margin and sometimes around the mouth. Anthomedusae alternate with polyp forms, but some also bud medusae directly.

2. Leptomedusae. These medusae are generally flatter than a hemisphere. They usually have 4 radial canals, but sometimes 8 or more, or canals that are branched. Gonads are located on the radial canals, and there may be various sense organs on the margin. The stomach is sometimes flat, and sometimes mounted on a peduncle which can be quite long. There are tentacles around the margin but not the mouth. Leptomedusae also alternate with hydroids, but again there are instances of direct production of new medusae by budding or fission.

3. Limnomedusae. Both high and low umbrella shapes are found in this group. There are usually 4 radial canals, sometimes branched. Centripetal canals occur in some species. Gonads are either on the stomach or the radial canals. There is alternation of generations. Many limnomedusae live in brackish or even fresh water, but there are marine genera.

4. Trachymedusae. These medusae do not alternate generations, but develop young medusae directly from planula larvae. The umbrella is often high, with stiff mesoglea and well developed muscle fibers. Most have 8 unbranched radial canals and gonads located on them. Many trachymedusae live in deep water and are heavily pigmented.

5. Narcomedusae. Narcomedusae also have direct development of medusae from planulae, and larvae are often parasitic on other medusae. There are no radial canals, but the flat central stomach is very wide and, in some genera, extends into radial stomach pouches. The umbrella margin is divided into lobes by grooves. Tentacles are solid and stiff, and often extend aborally. Narcomedusae are common in epipelagic and mesopelagic environments; some are strong vertical migrators.

SCYPHOMEDUSAE

6. Coronatae. This order of scyphomedusae includes mainly deepwater forms. The umbrella is divided into a high central part and a thinner marginal part by a coronal groove. The margin of the bell is divided into lappets; sense organs and solid tentacles arise from the cleft between lappets. The mouth has simple lips and the gastrovascular cavity is often deeply pigmented.

7. Semaeostomae. The familiar large jellyfish are mainly in this order of the Scyphozoa. The umbrella margin is divided into lappets, and bears sense organs and hollow tentacles. There is no coronal groove around the umbrella. The mouth opening is surrounded by four long oral arms, often frilled. Gonads are in folds of the subumbrella.

The classification and nomenclature used here follows Kramp (1961). Descriptions, illustrations and distributions are mainly from Kramp (1959, 1961), Goy (1983), Russell (1953, 1970) and Tregouboff and Rose (1957).

Terminology:

abaxial - outer surface of tentacle or bulb, away from umbrella

aboral - the side of the umbrella opposite the mouth

bell or umbrella - the main gelatinous body of a medusa

centripetal canals - radial canals that begin at the bell margin and run partway to the apex

cirri - small tentacle-like structures between true tentacles on the margin

cordyli - club-shaped marginal structures located between tentacles

coronal groove - a groove separating the central part of the bell from the peripheral in coronate scyphomedusae

exumbrellar - the upper or aboral surface of the umbrella

interradial - aligned between the 4 primary radii

lappets - separated sections of the umbrella margin

manubrium - central part of the medusa containing stomach and mouth

margin - the edge of the umbrella

marginal clubs - short clublike structures around the margin, between tentacles

marginal vesicles - spherical sensory structures arranged around the margin

nematocyst knobs - clump of nematocysts at the end of the tentacles

nematocyst rings - thickened rings of nematocysts around the shaft of the tentacles

nematocyst tracks - rows of nematocysts, usually on the umbrella surface

ocelli - light sensitive structures around the margin or at the bases of the tentacles

oral arms - extended lips hanging down from the mouths of semaeostome scyphomedusae

oral tentacles - tentacles arranged around the mouth in anthomedusae

otoporpae - linear structures, possibly sensory, on the marginal lappets of some narcomedusae

perradial - aligned with the 4 principal radial canals

pyriform - pear-shaped

radial canals - the gastrovascular canals in the umbrella, extending from the stomach to the margin

rhopalia - complex sensory structures on the margin of scyphomedusae

statocysts - gravity-sensing vesicles on the margin

stomach pouches - radial extensions of the central gastrovascular cavity

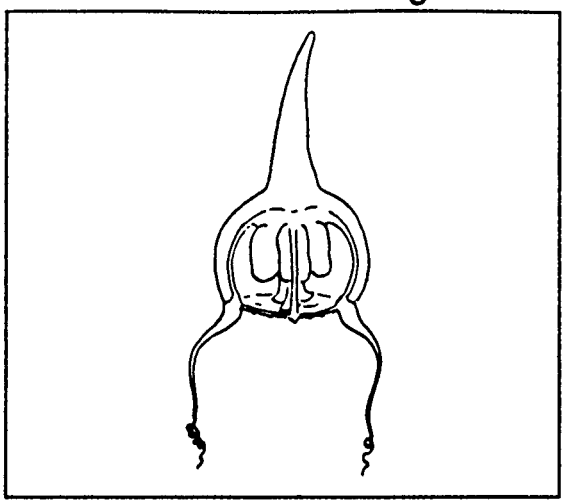
subumbrella - the under or oral side of the umbrella

tentacle bulbs - the swellings on the margin from which the tentacles arise

tentacle rudiments - undeveloped tentacle bulbs

tentaculae - small tentacles

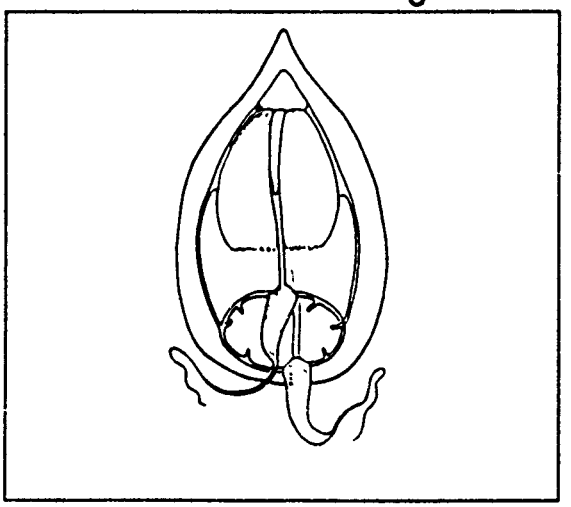
Fig. M-1



SPECIES: ***Amphinema dinema***

FAMILY: Pandeidae
ORDER: Anthomedusae
SIZE: to 6 mm high, 4 mm wide
DESCRIPTION: globular bell with long, conical apical projection, 2 long tentacles with long conical bulbs, flask-shaped stomach with 4 recurved lips, simple adradial gonads
LUMINESCENCE: Herring (1987) lists 2 other pandeids as definitely luminescent
DISTRIBUTION: N. Atlantic, Indian, Med.

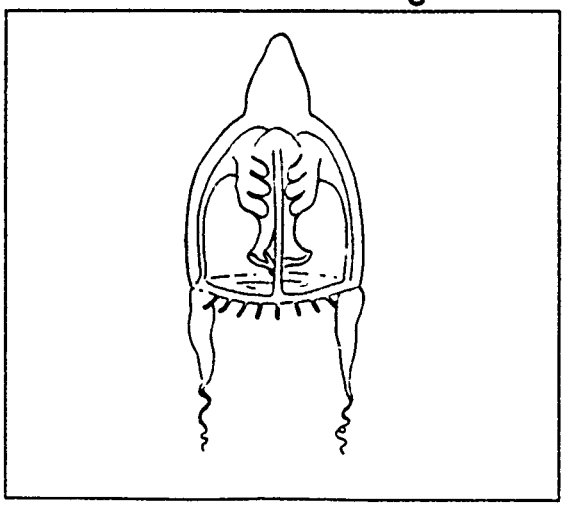
Fig. M-2



SPECIES: ***Amphinema rubra***

FAMILY: Pandeidae
ORDER: Anthomedusae
SIZE: 7 mm high, 4.5 mm wide
DESCRIPTION: ovoid bell coming to apical point, thick jelly, 2 tentacles with large conical bulbs, 6 small tentaculae, stomach barrel shaped, dark reddish-brown.
LUMINESCENCE: Herring (1987) lists 2 other pandeids as definitely luminescent
DISTRIBUTION: Antarctic, in deep water.

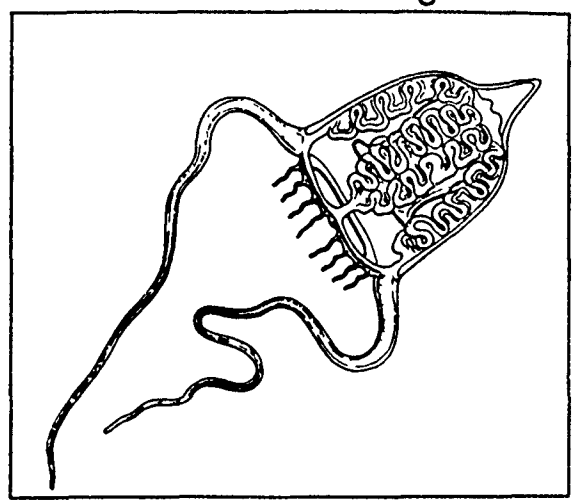
Fig. M-3



SPECIES: ***Amphinema rugosum***

FAMILY: Pandeidae
ORDER: Anthomedusae
SIZE: 5 mm high, 3 mm wide
DESCRIPTION: domed bell with conical apical projection, 2 long tentacle with long bulbs, 16-24 solid tentaculae, stomach flask-shaped, gonads with 3-4 folds.
LUMINESCENCE: Herring (1987) lists 2 other pandeids as definitely luminescent
DISTRIBUTION: N. Atlantic, W. Pacific, Med.

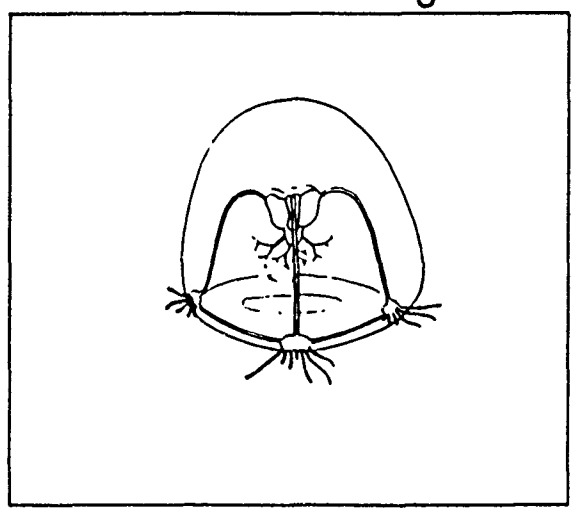
Fig. M-4



SPECIES: ***Amphinema turrida***

FAMILY: Pandeidae
ORDER: Anthomedusae
SIZE: 4-7 mm high, slightly less wide
DESCRIPTION: domed bell, conical projection, 2 long tentacles, 14 small tentaculae, pyriform stomach with large lips, gonads folded, extending along radial canals
LUMINESCENCE: Herring (1987) lists 2 other pandeids as definitely luminescent
DISTRIBUTION: tropical Atlantic, Pacific, Med.

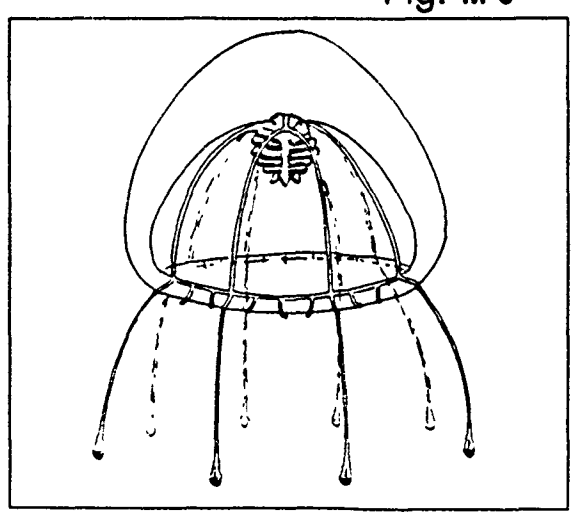
Fig. M-5



SPECIES: ***Bougainvillia ramosa***

FAMILY: Bougainvilliidae
ORDER: Anthomedusae
SIZE: 2 - 3.5 mm high and wide
DESCRIPTION: globular bell, thick jelly, 3-4 long tentacles from each bulb, stomach short, oral tentacles short, divided 1-2 times, gonads globular in female, elongate in male
LUMINESCENCE: Herring (1987) lists *Lizzia* in this family as uncertain.
DISTRIBUTION: N. Atlantic, Med.

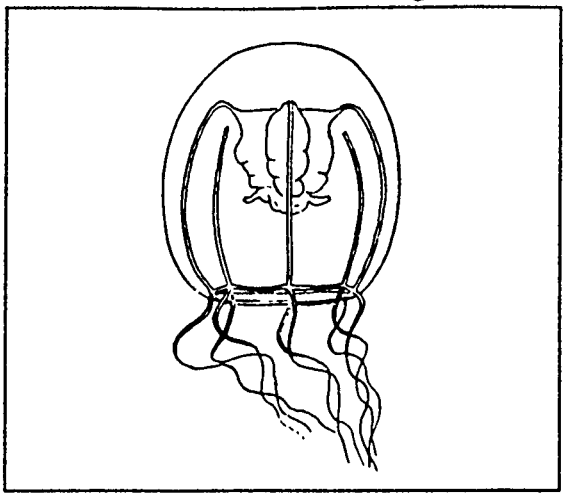
Fig. M-6



SPECIES: ***Bythotiara murrayi***

FAMILY: Calycopsidae
ORDER: Anthomedusae
SIZE: to 20 mm high and wide
DESCRIPTION: globular bell, thick walls, 4 bifurcate radial canals, 8 or more long tentacles with end knobs, small tentaculae, small stomach, gonads with transverse furrows.
LUMINESCENCE: unknown
DISTRIBUTION: E. Atlantic, Med. in deep water

Fig. M-7



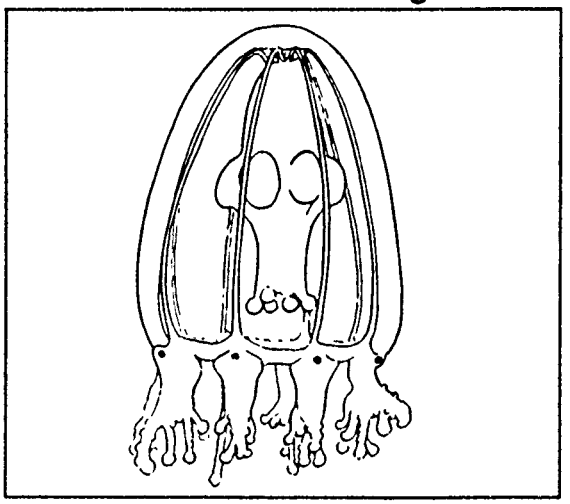
SPECIES: ***Calycopsis simplex***

FAMILY: Calycopsidae
ORDER: Anthomedusae
SIZE: 8 mm high and wide
DESCRIPTION: globular bell, 4 centripetal canals, 8 tentacles, stomach short, gonads with few transverse folds.

LUMINESCENCE: unknown

DISTRIBUTION: Norway, in deep water

Fig. M-8

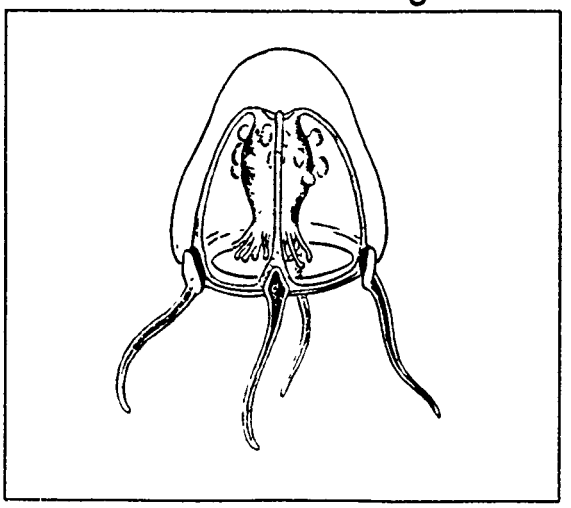


SPECIES: ***Cladonema radiatum***

FAMILY: Cladonematidae
ORDER: Anthomedusae
SIZE: 4 mm high, 3 mm wide
DESCRIPTION: thin walled bell, 4-5 bifurcate or 8-10 simple radial canals, 8-10 tentacles with 4-6 branches, nematocyst knobs, 4-5 oral tentacles, gonad with 4-5 sacs.
LUMINESCENCE: unknown

DISTRIBUTION: N. Atlantic, Med., Black Sea, creeps and swims

Fig. M-9

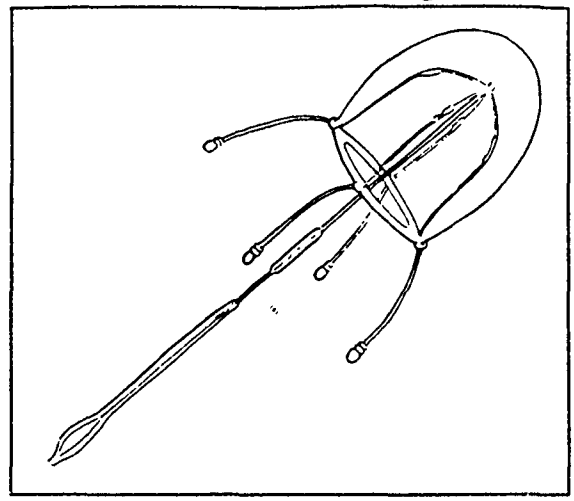


SPECIES: ***Cytaeis tetrastyla***

FAMILY: Cytaeidae
ORDER: Anthomedusae
SIZE: 6 mm high, 5 mm wide
DESCRIPTION: domed bell, 4 tentacles with large, black bulbs, to 32 oral tentacles with nematocyst knobs, large stomach with medusa buds on upper part.
LUMINESCENCE: unknown

DISTRIBUTION: tropical and subtropical Atlantic, Pacific, Indian, Med.

Fig. M-10

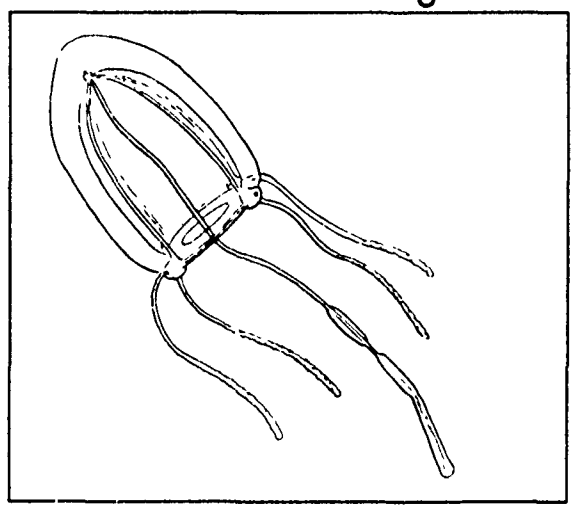


SPECIES: ***Dipurena halterata***

FAMILY: Corynidae
ORDER: Anthomedusae
SIZE: 8 mm high, 6 mm wide
DESCRIPTION: bell-shaped, thick jelly, 4 tentacles with 3-6 nematocyst rings and terminal knob, stomach on very long manubrium, gonads halfway down manubrium
LUMINESCENCE: unknown

DISTRIBUTION: N. Atlantic, Med.

Fig. M-11

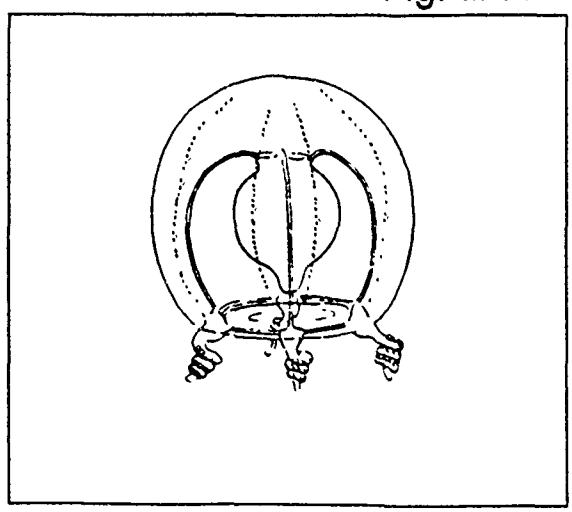


SPECIES: ***Dipurena ophiogaster***

FAMILY: Corynidae
ORDER: Anthomedusae
SIZE: 5 mm high, slightly less wide
DESCRIPTION: bell-shaped, 4 tentacles with small, irregular nematocyst clusters, stomach on long manubrium, gonad with 2-6 segments on manubrium.
LUMINESCENCE: unknown

DISTRIBUTION: N. Atlantic, Pacific, Med.

Fig. M-12

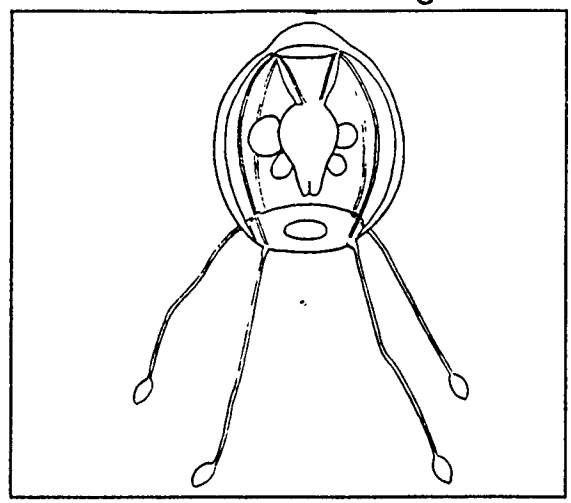


SPECIES: ***Ectopleura dumortieri***

FAMILY: Tubulariidae
ORDER: Anthomedusae
SIZE: 2-3 mm high and wide
DESCRIPTION: spherical bell, thick jelly, 4 tentacles with large bulbs, nematocyst clusters along length, 8 nematocyst tracks on exumbrella, stomach short.
LUMINESCENCE: Herring (1987) lists *Euphysa* in this family as definite.

DISTRIBUTION: Atlantic, Indian, Pacific, Med.

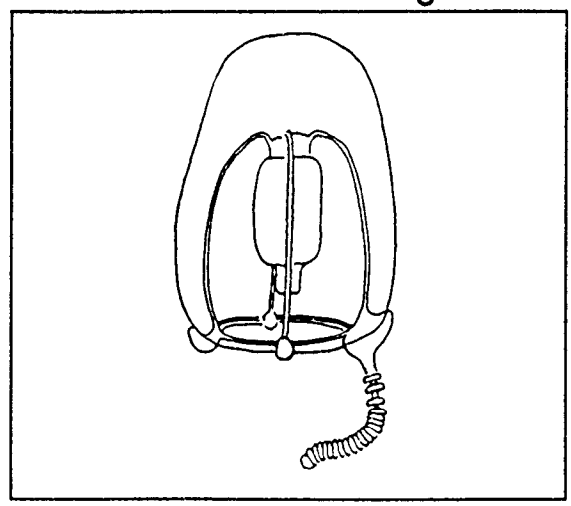
Fig. M-13



SPECIES: ***Eucodonium brownei***

FAMILY: Tubulariidae
ORDER: Anthomedusae
SIZE: 1 mm high and wide
DESCRIPTION: globular bell, thin walls, 4 thin tentacles with terminal nematocyst knobs, stomach on short peduncle, with medusa buds on upper part, simple mouth.
LUMINESCENCE: Herring (1987) lists *Euphysa* in this family as definite.
DISTRIBUTION: N. Atlantic, Med.

Fig. M-14



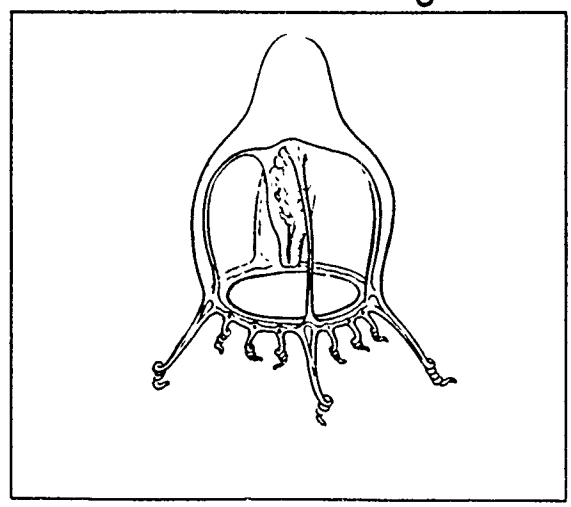
SPECIES: ***Euphysa aurata***

FAMILY: Tubulariidae
ORDER: Anthomedusae
SIZE: 4 mm high, slightly less wide
DESCRIPTION: tall bell, thick jelly, 1 tentacle with rings of nematocysts, stomach tubular, encircled by gonad.

LUMINESCENCE: Herring (1987) lists as definite.

DISTRIBUTION: Atlantic, Pacific, Med.

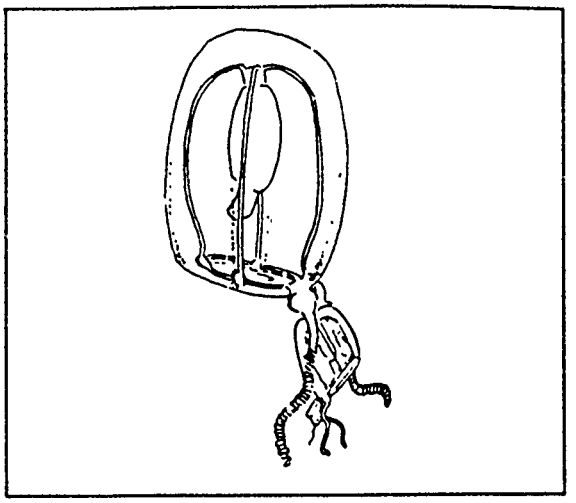
Fig. M-15



SPECIES: ***Halitiara formosa***

FAMILY: Pandeidae
ORDER: Anthomedusae
SIZE: 3 mm high
DESCRIPTION: pear-shaped bell, solid apical projection, 4 hollow main tentacles, 24-35 short, solid, tightly-coiled tentacles, stomach half as long as bell, mouth simple.
LUMINESCENCE: Herring (1987) lists 2 other pandeids as definitely luminescent
DISTRIBUTION: tropical Atlantic, Pacific, Indian, Med.

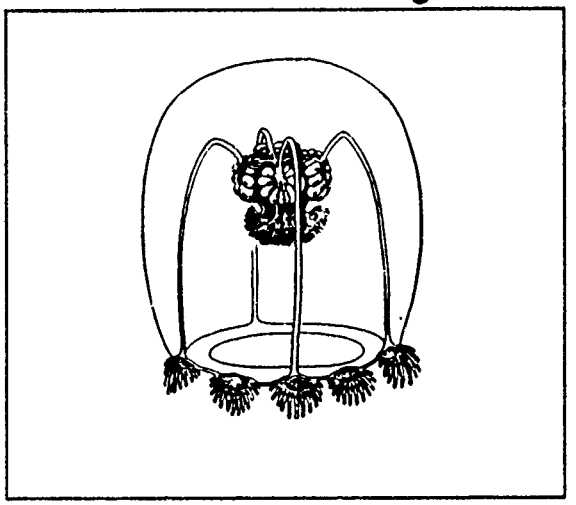
Fig. M-16



SPECIES: ***Hybocodon prolifer***

FAMILY: Tubulariidae
ORDER: Anthomedusae
SIZE: 4 mm high, 3 mm wide
DESCRIPTION: bell-shaped, margin oblique, 1 bulb with 1-3 tentacles, 5 exumbrellar nematocyst tracks, cylindrical stomach and gonad, medusa buds on tentacle bulb.
LUMINESCENCE: Herring (1987) lists *Euphysa* in this family as definite.
DISTRIBUTION: temperate and subarctic Atlantic, Pacific

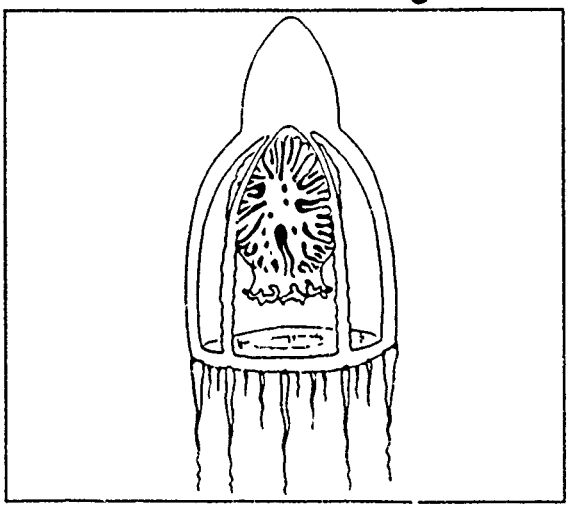
Fig. M-17



SPECIES: ***Koellikerina fasciculata***

FAMILY: Bougainvilliidae
ORDER: Anthomedusae
SIZE: 8 mm high, 9 mm wide
DESCRIPTION: barrel-shaped, thick walls, 8 tentacle bulbs, each with 10-13 tentacles, stomach on short peduncle, with oral tentacles divided 7 times, 4 horseshoe shaped gonads.
LUMINESCENCE: Herring (1987) lists *Lizzia* in this family as uncertain.
DISTRIBUTION: Med., Atlantic, Black Sea.

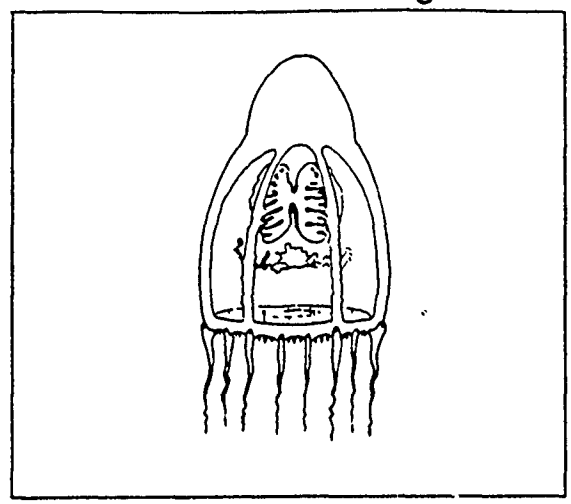
Fig. M-18



SPECIES: ***Leuckartiara nobilis***

FAMILY: Pandeidae
ORDER: Anthomedusae
SIZE: to 27 mm high and 20 mm wide
DESCRIPTION: bell-shaped with conical apical projection, about 40 tentacles of various sizes, dark red ocelli, large manubrium, folded lips, folded gonads cover stomach.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: N. Atlantic, Pacific, Med.

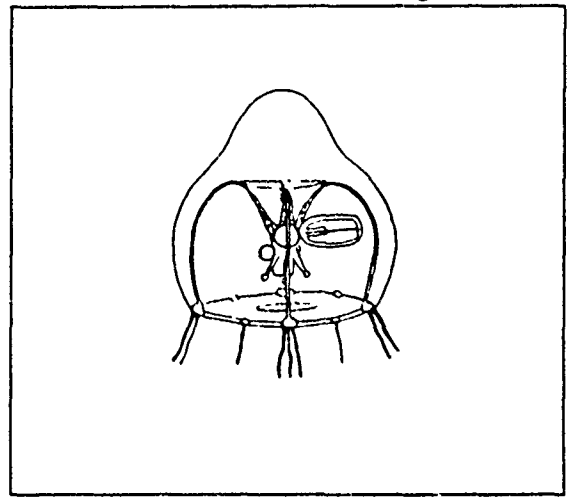
Fig. M-19



SPECIES: ***Leuckartiara octona***

FAMILY: Pandeidae
ORDER: Anthomedusae
SIZE: to 20 mm high
DESCRIPTION: bell-shaped, with conical or spherical apical projection, 12-24 (usu.16) tentacles, 16+ tentacle rudiments, red ocelli, furrowed gonads cover broad stomach.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

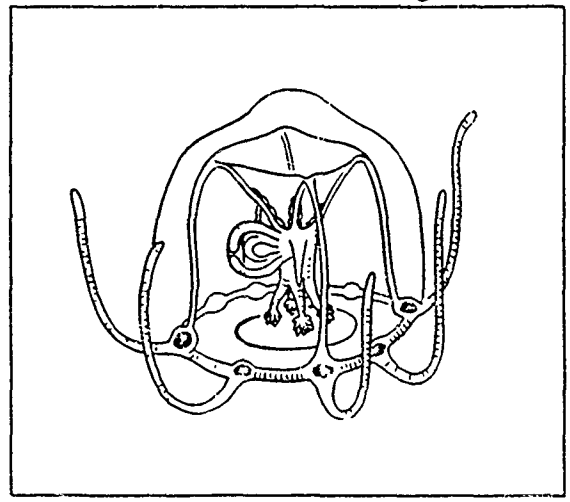
Fig. M-20



SPECIES: ***Lizzia blondina***

FAMILY: Bougainvilliidae
ORDER: Anthomedusae
SIZE: 1-2 mm high and wide
DESCRIPTION: globular bell, thick apex, 8 tentacle bulbs, perradial with 1-3 tentacles, interradial with 1, stomach on short peduncle with oral tentacles, medusa buds.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: NE Atlantic, Med.

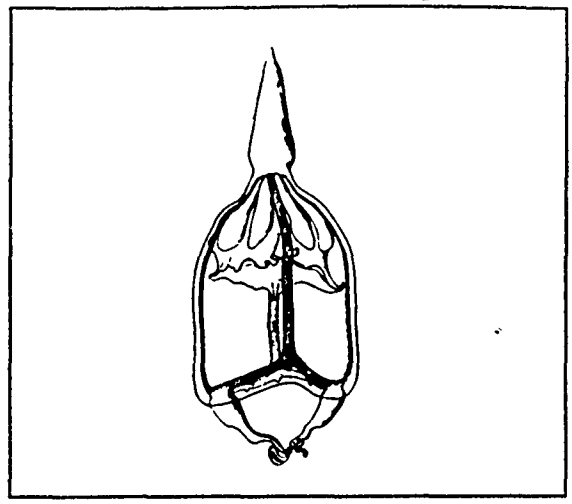
Fig. M-21



SPECIES: ***Lizzia fulgurans***

FAMILY: Bougainvilliidae
ORDER: Anthomedusae
SIZE: 1 mm high
DESCRIPTION: soft, globular bell, 8, sometimes 16, stiff recurved tentacles, small stomach on pyramidal peduncle, 4 oral tentacles, medusa buds on stomach.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: NW Atlantic.

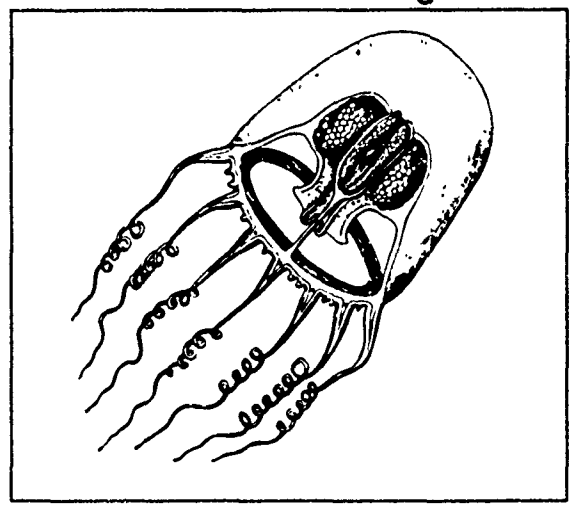
Fig. M-22



SPECIES: ***Merga tergestina***

FAMILY: Pandeidae
ORDER: Anthomedusae
SIZE: 7 mm high, 4 mm wide
DESCRIPTION: bell with thin walls and high, pointed apical projection, 4-8 tentacles with large bulbs, also some rudimentary bulbs, stomach short, gonads smooth.
LUMINESCENCE: Herring (1987) lists 2 other pandeids as definitely luminescent
DISTRIBUTION: E. tropical Atlantic, Med.

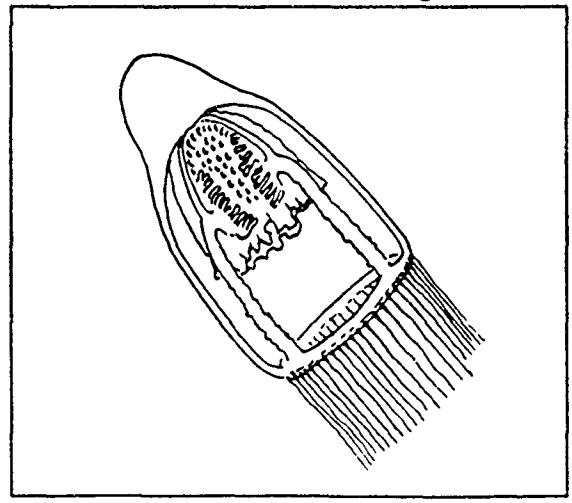
Fig. M-23



SPECIES: ***Merga violacea***

FAMILY: Pandeidae
ORDER: Anthomedusae
SIZE: to 11 mm high, 7 mm wide
DESCRIPTION: bell with domed apex, 8-12 long and 24-36 rudimentary tentacles, stomach half length of bell, cross-shaped in section, smooth adradial gonads.
LUMINESCENCE: Herring (1987) lists 2 other pandeids as definitely luminescent
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

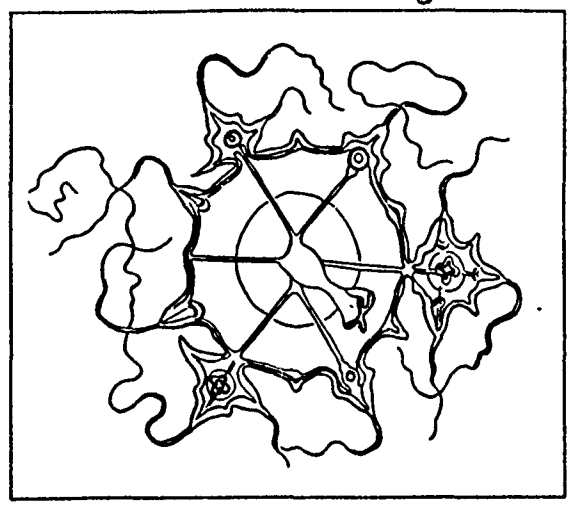
Fig. M-24



SPECIES: ***Neoturris pileata***

FAMILY: Pandeidae
ORDER: Anthomedusae
SIZE: to 40 mm high, 25 mm wide
DESCRIPTION: bell with variable apical projection, 60-80 tentacles with elongated bulbs, radial canals with short branches, stomach broad, complex lips, gonads pitted.
LUMINESCENCE: Herring (1987) lists 2 other pandeids as definitely luminescent
DISTRIBUTION: Atlantic, Med.

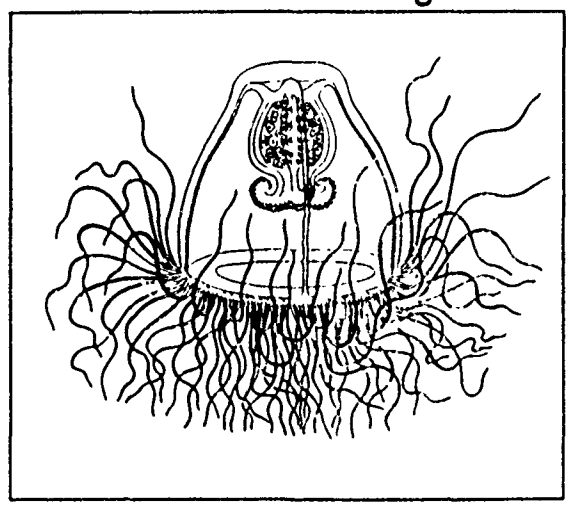
Fig. M-25



SPECIES: ***Niobia dendrotentaculata***

FAMILY: Pandeidae
ORDER: Anthomedusae
SIZE: 4 mm wide
DESCRIPTION: very flat bell, 2 of 4 radial canals bifurcate, so 6 reach margin, 12 tentacles, medusa buds develop from tentacle bulbs, stomach elongate, gonads interradial.
LUMINESCENCE: Herring (1987) lists 2 other pandeids as definitely luminescent
DISTRIBUTION: W. Atlantic, Indian

Fig. M-26

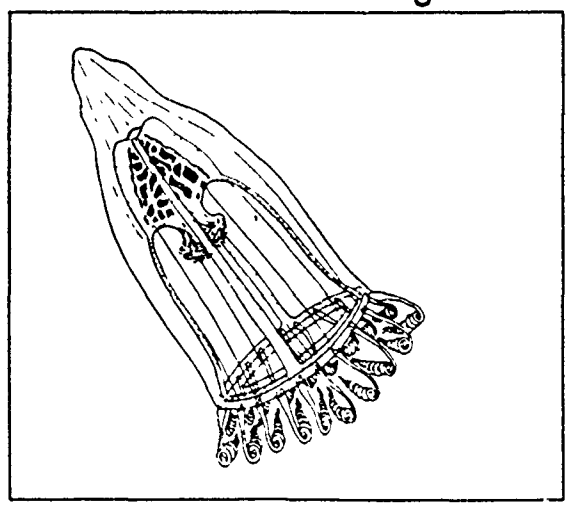


SPECIES: ***Oceania armata***

FAMILY: Clavidae
ORDER: Anthomedusae
SIZE: to 10 nmm high
DESCRIPTION: bell with thin walls, flat top, 60-100 crowded tentacles, stomach flask-shaped, on short peduncle, lips with nematocyst knobs.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Med.

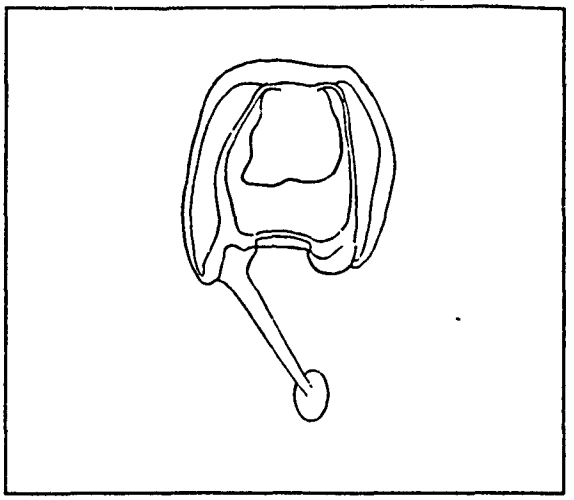
Fig. M-27



SPECIES: ***Pandea conica***

FAMILY: Pandeidae
ORDER: Anthomedusae
SIZE: to 21 mm high, 10 mm wide
DESCRIPTION: conical bell with apical projection, ridges on exumbrella, 16-24 tentacles with abaxial ocelli, stomach in upper bell, with folded lips, reticulate gonads around stomach.
LUMINESCENCE: Herring (1987) lists 2 other pandeids as definitely luminescent
DISTRIBUTION: Atlantic, Pacific, Med.

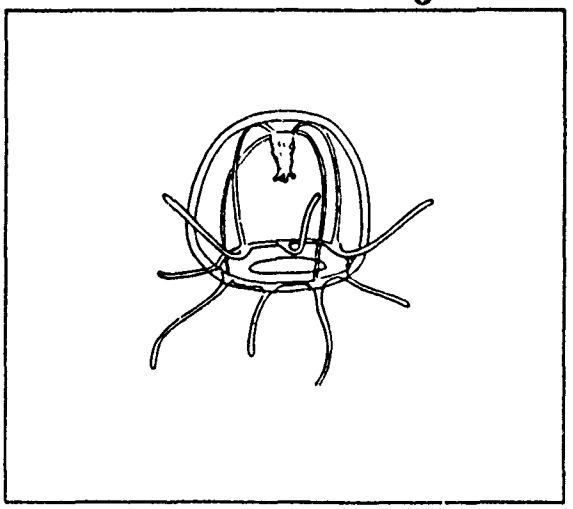
Fig. M-28



SPECIES: ***Paragotoea bathybia***

FAMILY: Tubulariidae
ORDER: Anthomedusae
SIZE: 2 mm high, 3 mm wide
DESCRIPTION: bell with thin walls, nematocyst clusters on exumbrella, 1 solid tentacle with nematocyst knob, stomach short with simple mouth, gonads surround stomach.
LUMINESCENCE: Herring (1987) lists *Euphysa* in this family as definite.
DISTRIBUTION: boreal Atlantic in deep water

Fig. M-29



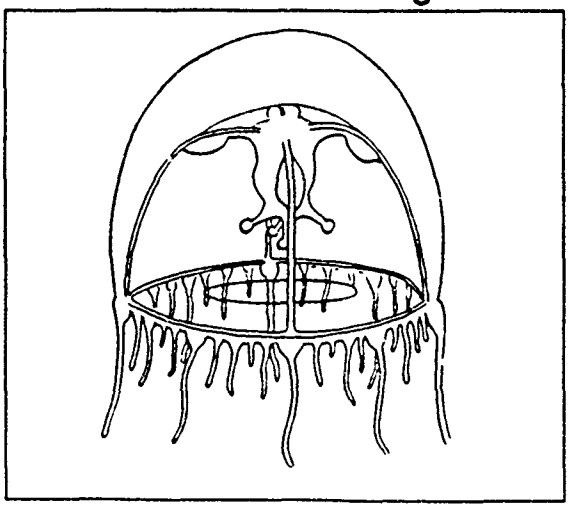
SPECIES: ***Podocoryne carnea***

FAMILY: Hydractiniidae
ORDER: Anthomedusae
SIZE: 1 mm high and wide
DESCRIPTION: bell with thin walls, 4-16 tentacles, stomach cylindrical with simple mouth arms, gonads interradial.

LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Med.

Fig. M-30

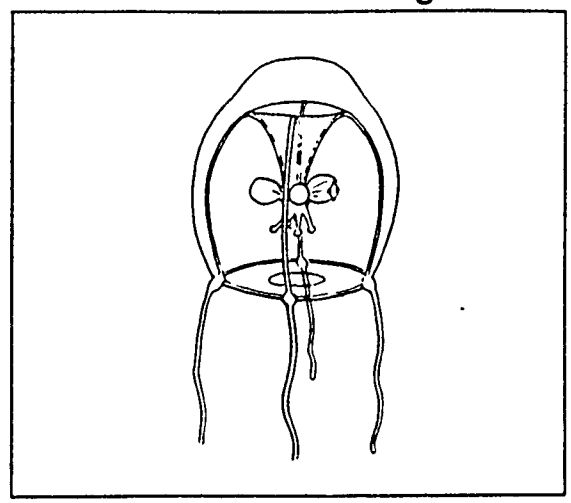


SPECIES: ***Podocoryne hartlaubi***

FAMILY: Hydractiniidae
ORDER: Anthomedusae
SIZE: 3.5 mm high and wide
DESCRIPTION: domed bell, thick at top, 8 large tentacles, up to 50 smaller ones, mouth with 4 simple arms, gonads on stomach, extend partway along radial canals.
LUMINESCENCE: unknown

DISTRIBUTION: NE Atlantic, Med.

Fig. M-31

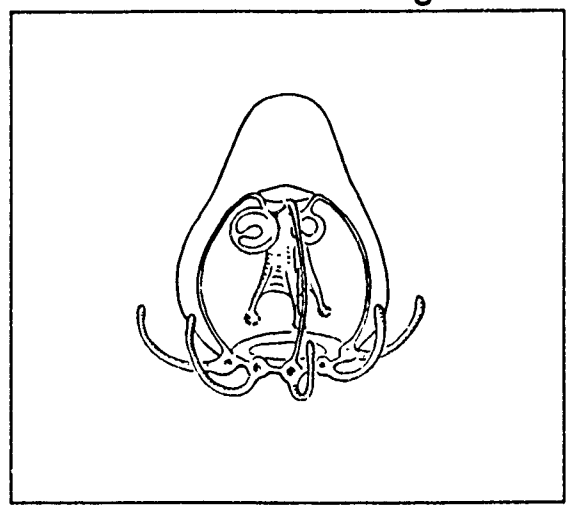


SPECIES: ***Podocoryne minima***

FAMILY: Hydractiniidae
ORDER: Anthomedusae
SIZE: to 1 mm high and wide
DESCRIPTION: bell with slightly thicker apex, 4 tentacles, stomach on peduncle, 4 mouth arms, medusa buds on interradial sides of stomach.
LUMINESCENCE: unknown

DISTRIBUTION: North Sea, Med.

Fig. M-32

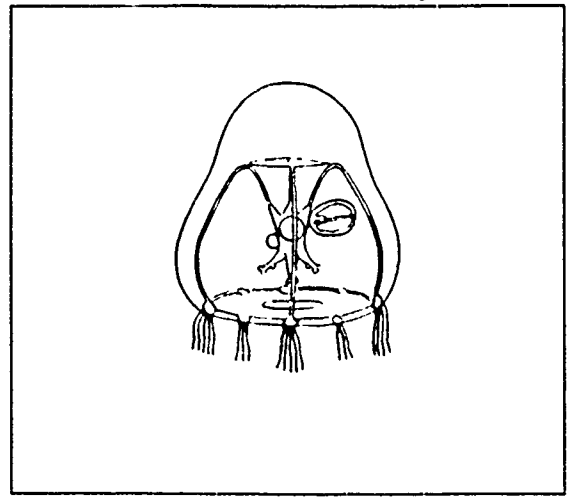


SPECIES: ***Podocoryne minuta***

FAMILY: Hydractiniidae
ORDER: Anthomedusae
SIZE: 0.3 mm high
DESCRIPTION: bell pear-shaped, with solid apex, 8 equal tentacles, stomach on short peduncle, mouth with 4 arms, medusa buds on sides of stomach.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Med.

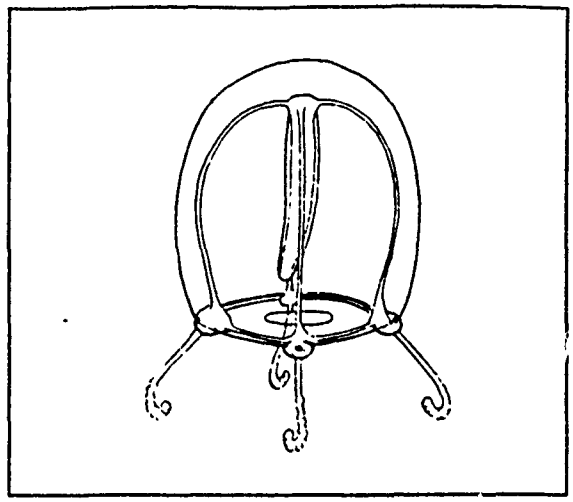
Fig. M-33



SPECIES: ***Rathkea octopunctata***

FAMILY: Rathkeidae
ORDER: Anthomedusae
SIZE: 3-4 mm high
DESCRIPTION: bell pear-shaped with solid apex, 8 groups of dark pigmented tentacles, with 3 in interradial and 3-5 in perradial groups, mouth with 4 lips, medusa buds on stomach.
LUMINESCENCE: Herring (1987) lists this genus as uncertain.
DISTRIBUTION: Atlantic, Pacific, Black Sea, Med.

Fig. M-34

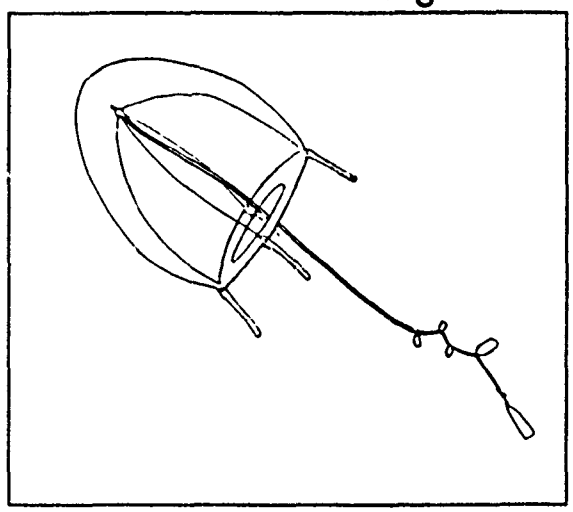


SPECIES: ***Sarsia eximia***

FAMILY: Corynidae
ORDER: Anthomedusae
SIZE: 3-4 mm high
DESCRIPTION: bell-shaped, 4 tentacles with large oval bulbs, ocelli, nematocyst warts and terminal knob, stomach cylindrical, surrounded by gonad.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Med.

Fig. M-35

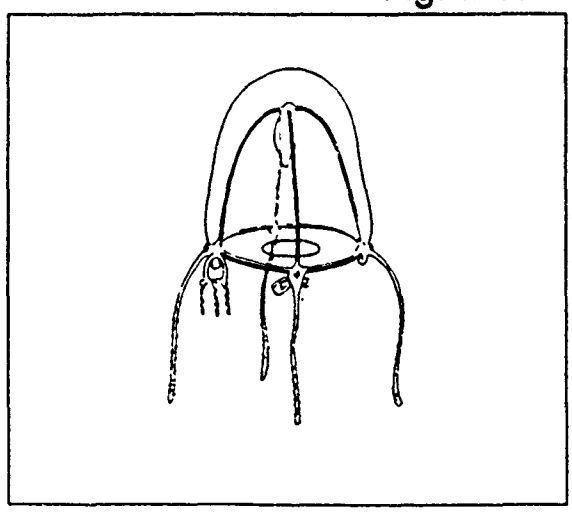


SPECIES: ***Sarsia gemmifera***

FAMILY: Corynidae
ORDER: Anthomedusae
SIZE: to 5 mm high
DESCRIPTION: thick walls, 4 tentacles with nematocyst warts and terminal knob, very long manubrium with medusa buds along it, gonads around manubrium above stomach.
LUMINESCENCE: unknown

DISTRIBUTION: N. Atlantic, Med.

Fig. M-36

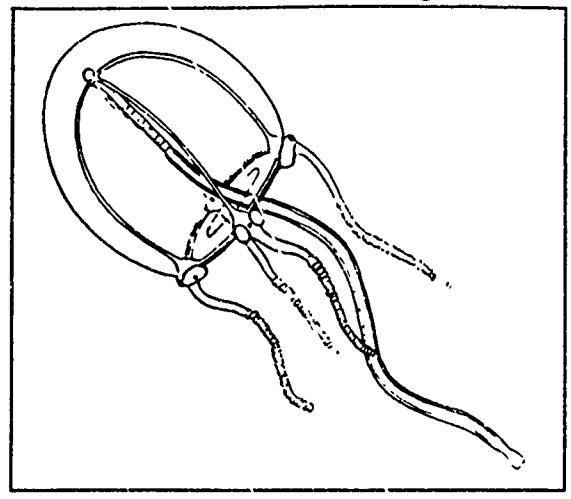


SPECIES: ***Sarsia prolifera***

FAMILY: Corynidae
ORDER: Anthomedusae
SIZE: to 4 mm high and wide
DESCRIPTION: bell-shaped, thin walls, 4 tentacles with nematocyst warts, medusa buds from tentacle bulbs, manubrium short, gonads surround it.
LUMINESCENCE: unknown

DISTRIBUTION: N. Atlantic, Black Sea

Fig. M-37

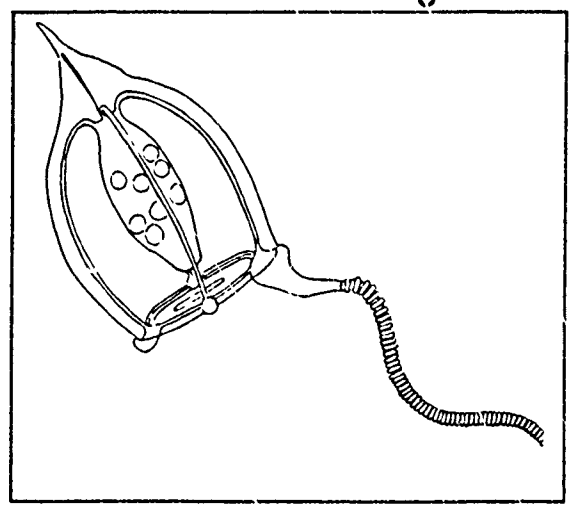


SPECIES: ***Sarsia tubulosa***

FAMILY: Corynidae
ORDER: Anthomedusae
SIZE: to 18 mm high
DESCRIPTION: bell-shaped, fairly thick walls, 4 long tentacles with nematocyst warts, no terminal knob, manubrium very long, gonads surround it, no medusa buds.
LUMINESCENCE: unknown

DISTRIBUTION: N. Atlantic, Pacific

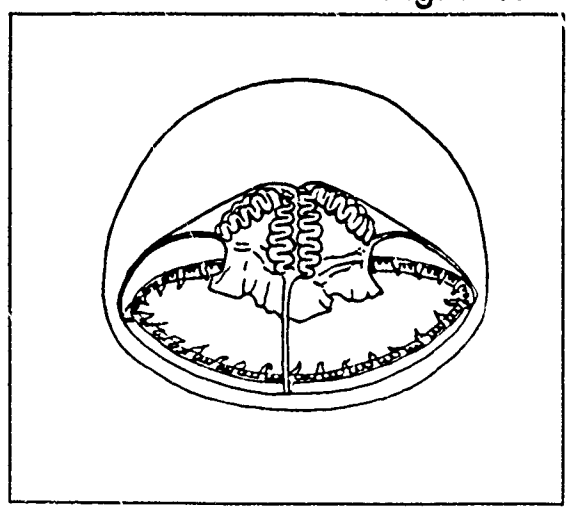
Fig. M-38



SPECIES: ***Steenstrupia nutans***

FAMILY: Tubulariidae
ORDER: Anthomedusae
SIZE: 5-6 mm high, 3-4 mm wide
DESCRIPTION: bell with conical apical projection, 1 long tentacle with nematocyst rings, 3 undeveloped bulbs, stomach on short peduncle, surrounded by gonad.
LUMINESCENCE: Herring (1987) lists *Euphysa* in this family as definite.
DISTRIBUTION: N. Atlantic, Black Sea, Med.

Fig. M-39

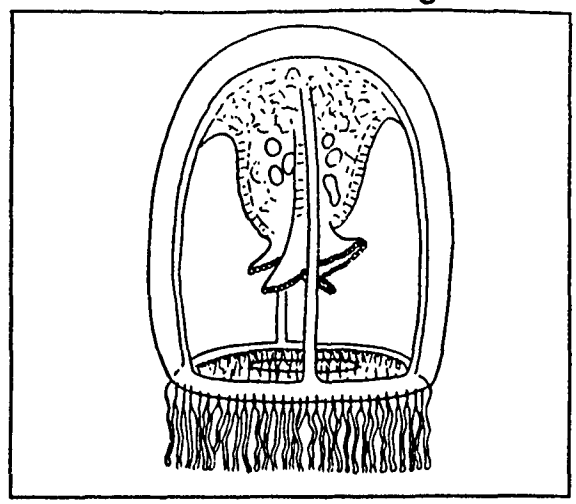


SPECIES: ***Tiaranna rotunda***

FAMILY: Tiarannidae
ORDER: Anthomedusae
SIZE: to 20 mm wide
DESCRIPTION: hemispherical bell, thick jelly, 16-28 tentacles, 2-3 cordyli between each, broad cruciform stomach with large lips, gonads in folds, extend under bell.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Antarctic, Med. in deep water

Fig. M-40



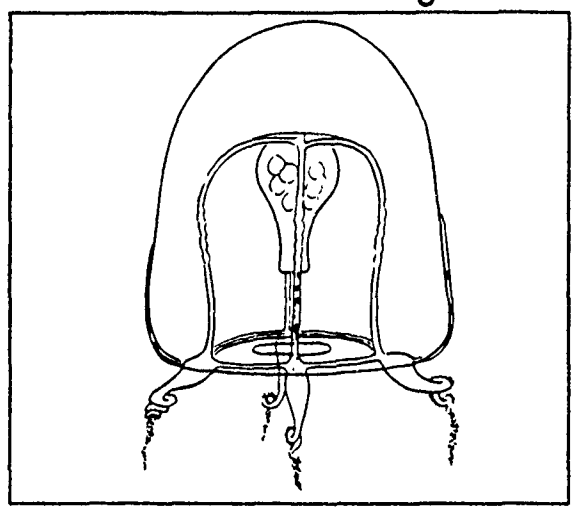
SPECIES: ***Turritopsis nutricula***

FAMILY: Clavidae
ORDER: Anthomedusae
SIZE: 4-5 mm high and wide
DESCRIPTION: bell-shaped, thin walls, 80-90 tentacles, large cruciform stomach, 4 lips with nematocyst knobs.

LUMINESCENCE: unknown

DISTRIBUTION: N. Atlantic, Pacific, Indian, Med.

Fig. M-41

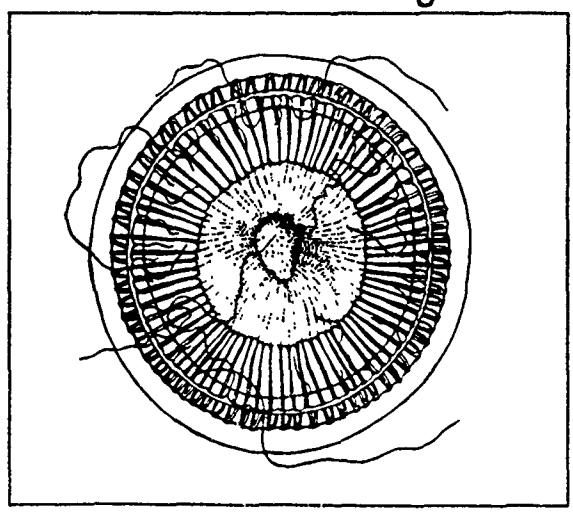


SPECIES: ***Zanclea costata***

FAMILY: Zancleidae
ORDER: Anthomedusae
SIZE: to 3 mm high and wide
DESCRIPTION: bell-shaped, thick jelly, 2 or 4 tentacles with stalked nematocyst capsules along length, patches or tracks of nematocysts on exumbrella, stomach cylindrical.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med.

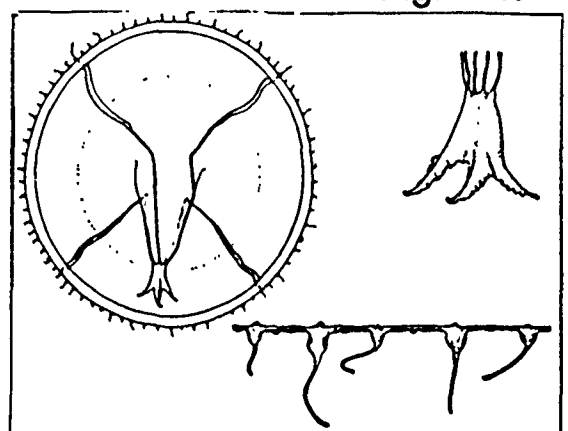
Fig. M-42



SPECIES: ***Aequorea aequorea***

FAMILY: Aequoreidae
ORDER: Leptomedusae
SIZE: up to 175 mm wide
DESCRIPTION: disk shape, thicker in center, usually 60-80 radial canals, tentacles usually fewer than canals, with elongated bulbs, stomach half width of umbrella.
LUMINESCENCE: Herring (1987) lists this genus as definite. Source of aequorin.
DISTRIBUTION: Atlantic, Med.

Fig. M-43



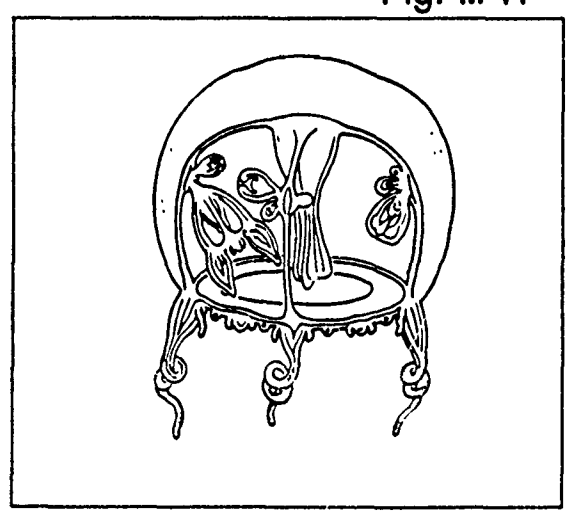
Eirene viridula, with stomach and bell margin (after KÜNNE).

SPECIES: ***Eirene viridula***

FAMILY: Eirenidae
ORDER: Leptomedusae
SIZE: 20-30 mm wide
DESCRIPTION: bell hemispherical, thick at center, 60+ tentacles of various sizes, 40+ marginal vesicles, stomach on gelatinous peduncle, gonads along radial canals.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Indian, Med.

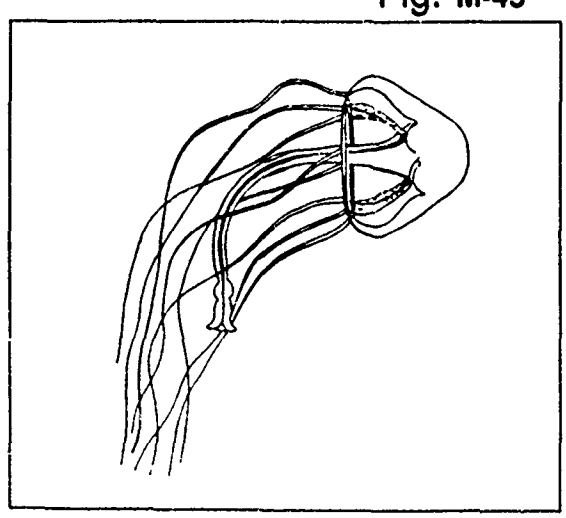
Fig. M-44



SPECIES: ***Euchellota paradoxica***

FAMILY: Lovenellidae
ORDER: Leptomedusae
SIZE: 4 mm wide
DESCRIPTION: globular bell, 4 tentacles with lateral cirri, 4 rudimentary bulbs with cirri, stomach small, gonads in middle of radial canals, medusa buds from gonads.
LUMINESCENCE: Herring (1987) lists *Lovenella* in this family as definite.
DISTRIBUTION: Atlantic, Pacific

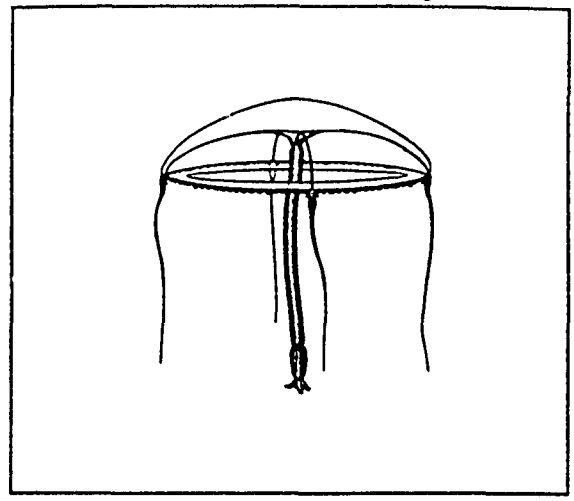
Fig. M-45



SPECIES: ***Eutima gegenbauri***

FAMILY: Eutimidae
ORDER: Leptomedusae
SIZE: 20 mm wide
DESCRIPTION: bell hemispherical, thick jelly at apex, 8-16 tentacles and 60-80 marginal warts, both with 1-2 cirri, stomach on long gelatinous peduncle, gonads on radial canals.
LUMINESCENCE: Herring (1987) lists *Tima* in this family as definite.
DISTRIBUTION: N. Atlantic, Med.

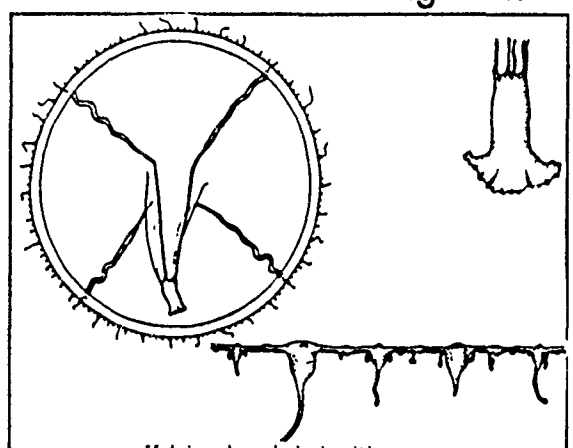
Fig. M-46



SPECIES: ***Eutima gracilis***

FAMILY: Eutimidae
ORDER: Leptomedusae
SIZE: to 13 mm wide
DESCRIPTION: bell flatter than hemisphere, jelly thick, 2-4 long tentacles, 40-80 marginal warts, both with cirri, stomach on long narrow peduncle, gonads along peduncle.
LUMINESCENCE: Herring (1987) lists *Tima* in this family as definite.
DISTRIBUTION: N. Atlantic, Med.

Fig. M-47



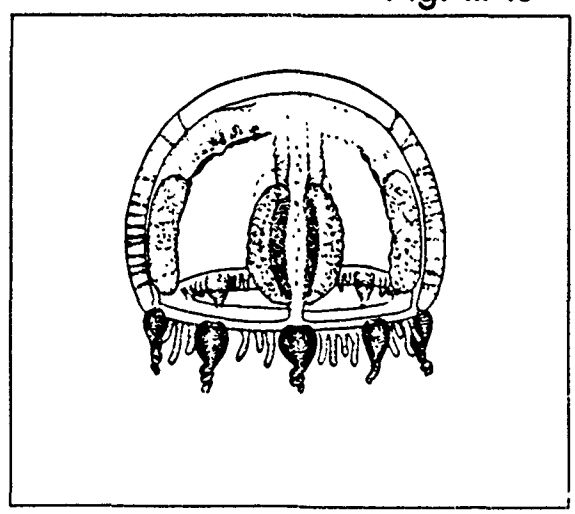
Helgicirrha schulzei, with stomach and bell margin (after KUNNE).

SPECIES: ***Helgicirrha schulzei***

FAMILY: Eirenidae
ORDER: Leptomedusae
SIZE: 30-40 mm wide
DESCRIPTION: bell flatter than hemisphere, jelly thin, 30-40 large tentacles, 100+ small tentacles or bulbs with lateral cirri, stomach small, gonads linear along radial canals.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Med.

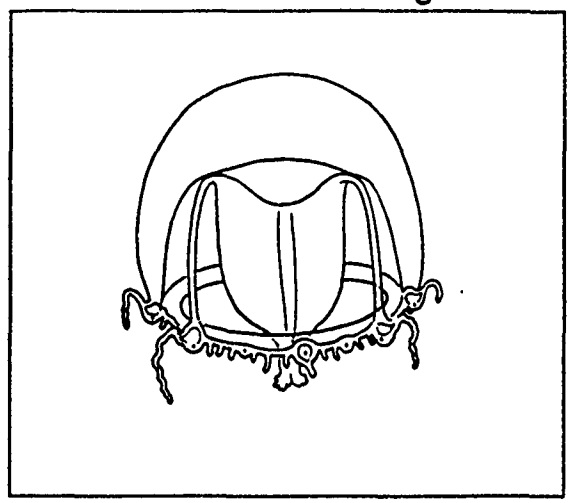
Fig. M-48



SPECIES: ***Krampella dubia***

FAMILY: Laodiceidae (?)
ORDER: Leptomedusae
SIZE: 3 mm wide
DESCRIPTION: bell hemispherical, 8 tentacles with swollen bases, 3-4 cirri between tentacles, gonads along length of broad radial canals, systematic position uncertain.
LUMINESCENCE: Herring (1987) lists two genera in this family as uncertain.
DISTRIBUTION: Atlantic

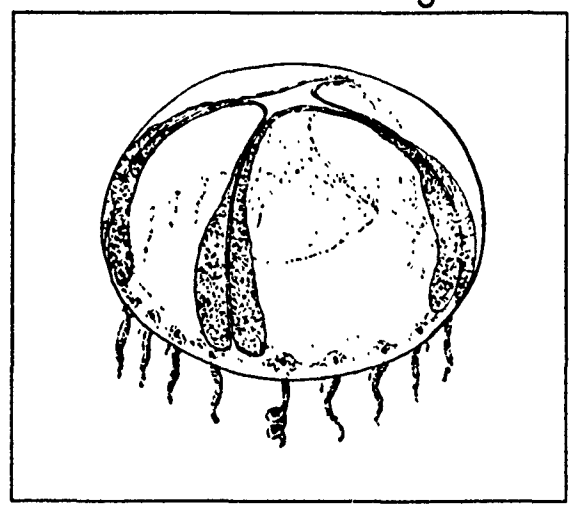
Fig. M-49



SPECIES: ***Laodicea neptuna***

FAMILY: Laodiceidae
ORDER: Leptomedusae
SIZE: 2.5 mm wide
DESCRIPTION: bell nearly hemispherical, 8 short tentacles, 8 rudimentary bulbs, numerous cirri, stomach large, lips with 4 nematocyst clusters, gonads on upper parts of radial canals.
LUMINESCENCE: Herring (1987) lists this genus as uncertain.
DISTRIBUTION: Atlantic

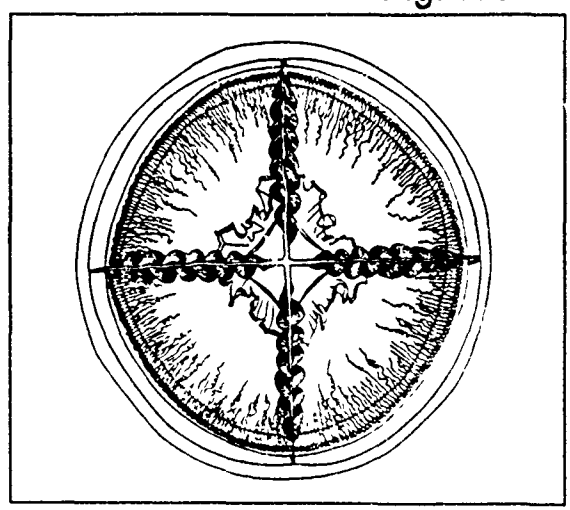
Fig. M-50



SPECIES: ***Laodicea ocellata***

FAMILY: Laodiceidae
ORDER: Leptomedusae
SIZE: 3.5 mm wide
DESCRIPTION: bell globular, thin jelly, 7-14 tentacles, 10-18 rudimentary bulbs, large black ocelli on bulbs, lips short, thick club-shaped gonads along radial canals.
LUMINESCENCE: Herring (1987) lists this genus as uncertain.
DISTRIBUTION: Med.

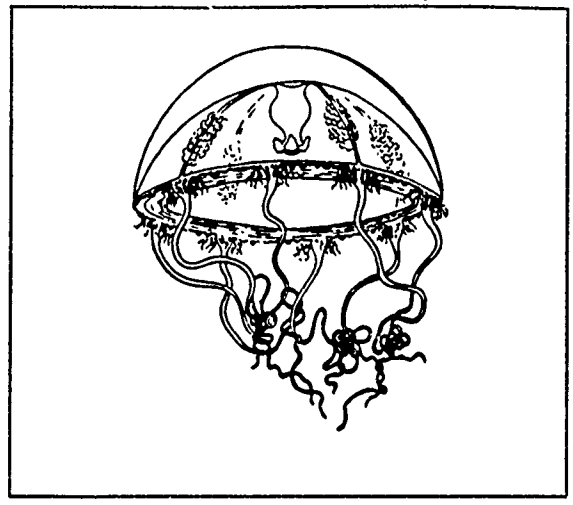
Fig. M-51



SPECIES: ***Laodicea undulata***

FAMILY: Laodiceidae
ORDER: Leptomedusae
SIZE: to 37 mm wide
DESCRIPTION: bell flatter than hemisphere, 400-600 tentacles, spiral cirri and cordyli between tentacles, stomach short, long sinuous gonads along radial canals, reaching stomach.
LUMINESCENCE: Herring (1987) lists this genus as uncertain.
DISTRIBUTION: Atlantic, Med.

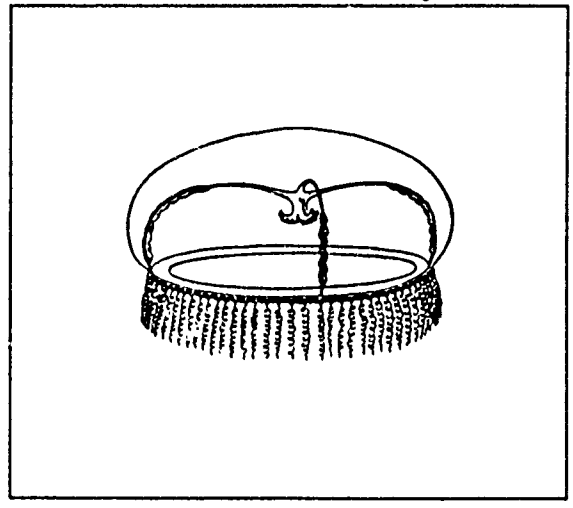
Fig. M-52



SPECIES: ***Lovenella cirrata***

FAMILY: Lovenellidae
ORDER: Leptomedusae
SIZE: to 16 mm wide
DESCRIPTION: bell hemispherical, 8-16 tentacles with 3-4 pairs spiral cirri and 3 rudimentary bulbs, stomach urn-shaped, gonads spindle-shaped, on distal radial canals.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Med.

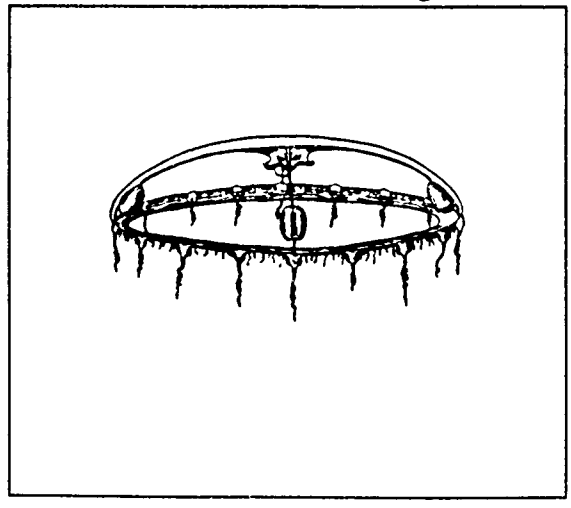
Fig. M-53



SPECIES: ***Mitrocoma annae***

FAMILY: Mitrocomidae
ORDER: Leptomedusae
SIZE: 30-40 mm wide
DESCRIPTION: bell flatter than hemisphere, 60-100 tentacles with 3-8 cirri between them, 60-100 marginal vesicles, stomach small, gonads sinuous along distal radial canals.
LUMINESCENCE: Herring (1987) lists *Halistaura* in this family as definite.
DISTRIBUTION: Med.

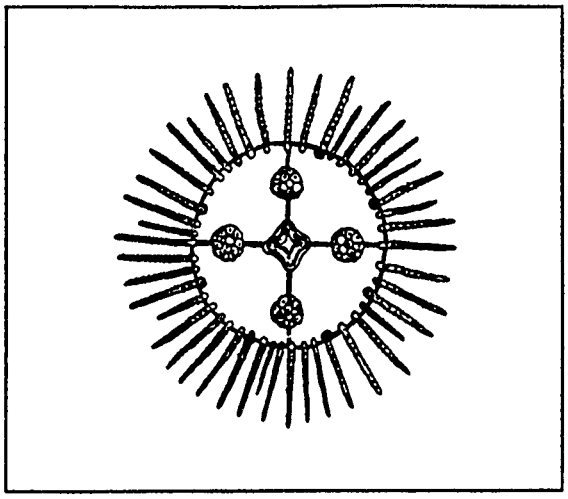
Fig. M-54



SPECIES: ***Mitrocomella brownei***

FAMILY: Mitrocomidae
ORDER: Leptomedusae
SIZE: 4-7 mm wide
DESCRIPTION: bell flatter than hemisphere, 16-24 tentacles with 6-8 cirri between them, 8 marginal vesicles, stomach small, gonads oval, near distal ends of radial canals.
LUMINESCENCE: Herring (1987) lists *Halistaura* in this family as definite.
DISTRIBUTION: Atlantic, Med.

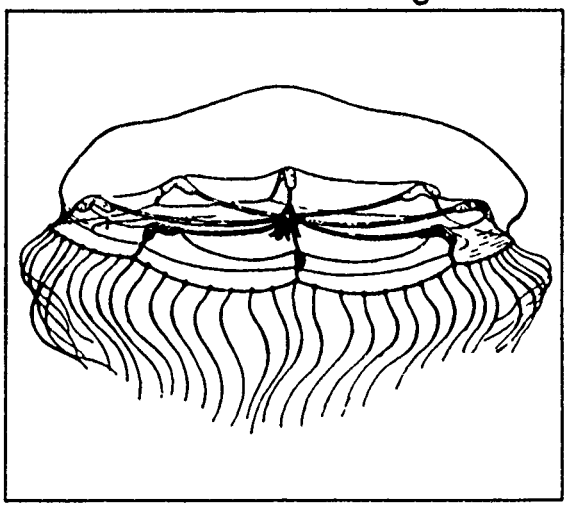
Fig. M-55



SPECIES: ***Obelia spp.***

FAMILY: Campanulariidae
ORDER: Leptomedusae
SIZE: to 6 mm wide
DESCRIPTION: bell flat, jelly thin, numerous stiff, solid tentacles, 8 marginal vesicles, stomach short with square base, gonads spherical, on middles of radial canals.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: world-wide except polar

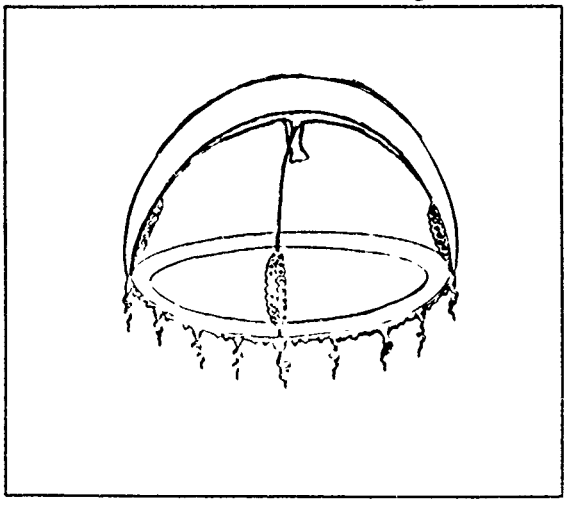
Fig. M-56



SPECIES: ***Octophialucium funerarium***

FAMILY: Phialuciidae
ORDER: Leptomedusae
SIZE: 30-40 mm wide
DESCRIPTION: bell lens-shaped, jelly thick, 8 radial canals, 64-128 tentacles, 2 marginal vesicles between tentacles, stomach small, gonads on distal part of radial canals.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: N. Atlantic, Med. in deep water

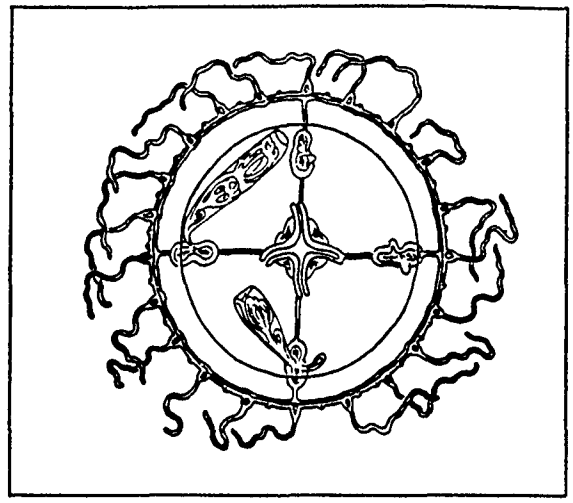
Fig. M-57



SPECIES: ***Phialidium hemisphaericum***

FAMILY: Campanulariidae
ORDER: Leptomedusae
SIZE: to 20 mm wide
DESCRIPTION: bell hemispherical, jelly thin, 16-58 tentacles with 2 marginal vesicles between them, stomach small with simple lips, gonads oval or linear, along distal radial canals.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Indian, Med.

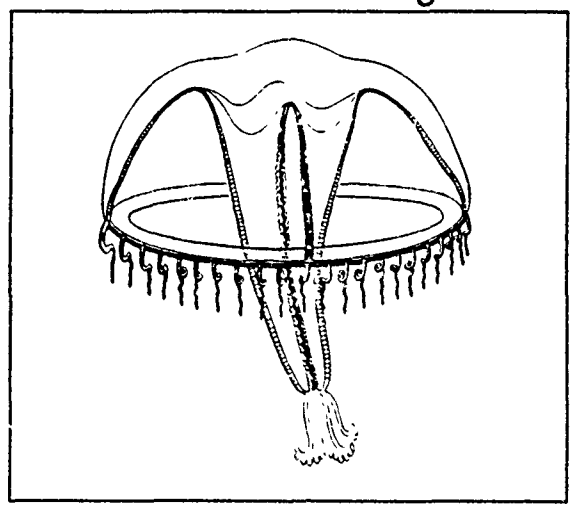
Fig. M-58



SPECIES: ***Phialidium mccradyi***

FAMILY: Campanulariidae
ORDER: Leptomedusae
SIZE: 15 mm wide
DESCRIPTION: bell lens-shaped, 16-24 tentacles, 1-2 marginal vesicles between them, stomach short with 4 lips, small gonads on radial canals, with hydroid buds.
LUMINESCENCE: Herring (1967) lists this genus as definite.
DISTRIBUTION: N. Atlantic

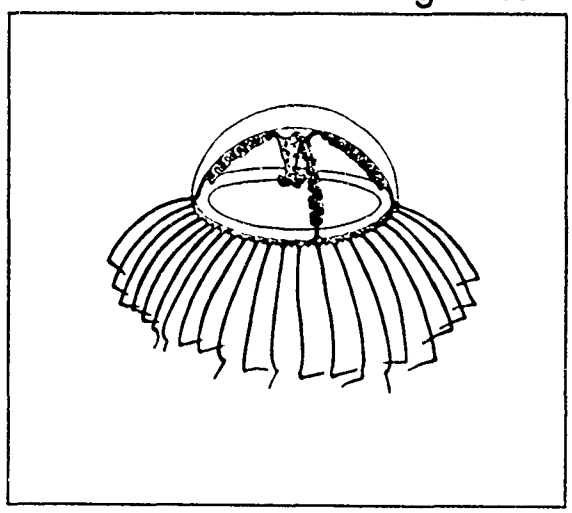
Fig. M-59



SPECIES: ***Tima lucullana***

FAMILY: Eutimidae
ORDER: Leptomedusae
SIZE: to 74 mm wide
DESCRIPTION: bell flatter than hemisphere, jelly thin, radial canals extend onto peduncle, 60-70 short tentacles with 7 marginal warts between them, gonads along radial canals.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Med.

Fig. M-60

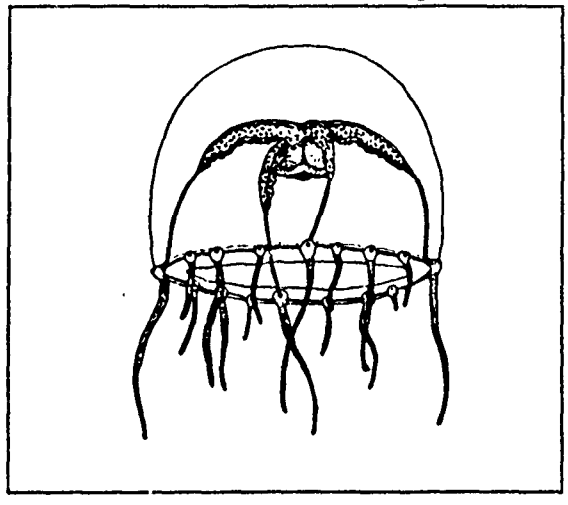


SPECIES: ***Gonionemus vertens***

FAMILY: Olindiadidae
ORDER: Limnomedusae
SIZE: 15-20 mm wide
DESCRIPTION: bell flatter than hemisphere, 60-80 long, stiff tentacles with adhesive pads on bent ends, stomach with 4 ruffled lips, folded gonads along most of radial canals.
LUMINESCENCE: unknown

DISTRIBUTION: world-wide temperate

Fig. M-61

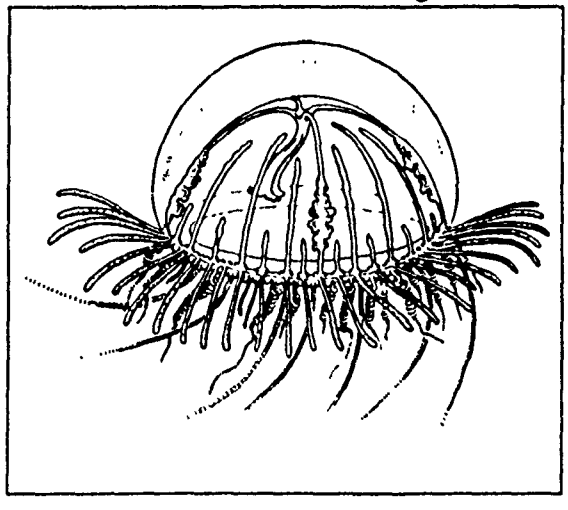


SPECIES: ***Odessia maeotica***

FAMILY: Moerisiidae
ORDER: Limnomedusae
SIZE: to 18 mm wide
DESCRIPTION: bell almost hemispherical, jelly thick, 16-32 tentacles, lobes of stomach extend along radial canals, gonads on radial canals and stomach walls.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Black Sea, Med. in brackish water

Fig. M-62

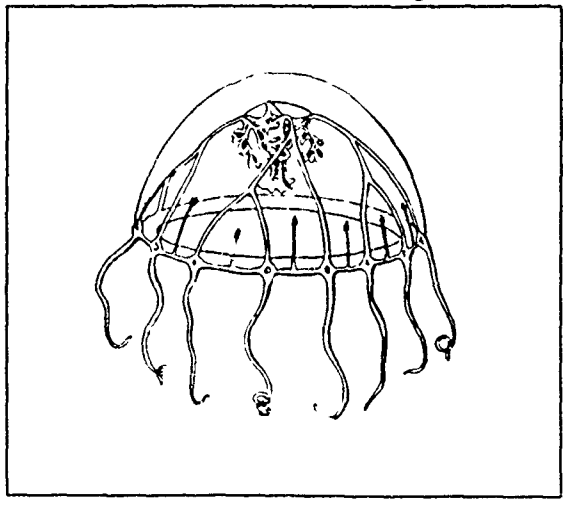


SPECIES: ***Olindias phosphorica***

FAMILY: Olindiadidae
ORDER: Limnomedusae
SIZE: 40-60 mm wide
DESCRIPTION: bell hemispherical, 40-80 centripetal canals, 50-60 primary tentacles project aborally, 100-120 secondary tentacles, 100-170 marginal clubs.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic and Med.

Fig. M-63

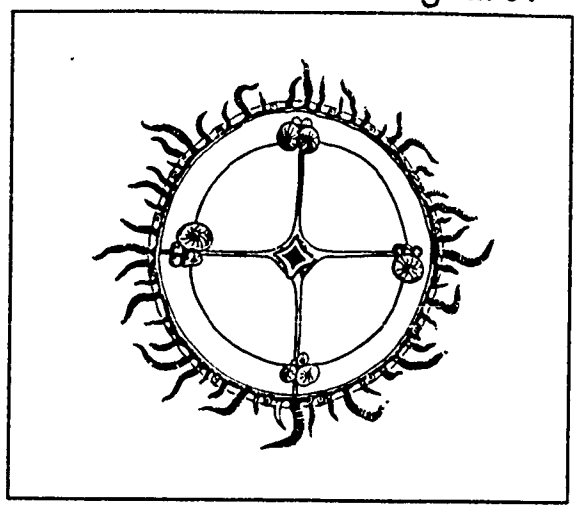


SPECIES: ***Proboscidactyla ornata***

FAMILY: Proboscidactylidae
ORDER: Limnomedusae
SIZE: 5 mm wide
DESCRIPTION: jelly thick, 4 radial canals branch to 16-20, 16-20 tentacles, nematocyst tracks on umbrella, stomach with 4 radial lobes, medusa buds on stomach or canals.
LUMINESCENCE: unknown

DISTRIBUTION: world-wide in coastal waters

Fig. M-64

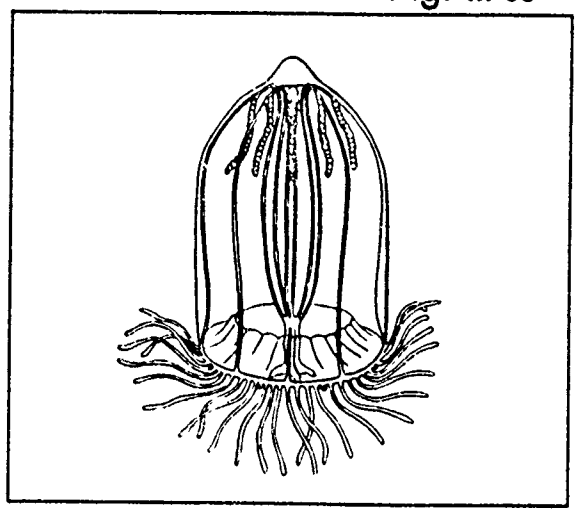


SPECIES: ***Scolionema suvaensis***

FAMILY: Olindiidae
ORDER: Limnomedusae
SIZE: 6 mm high, 9 mm wide
DESCRIPTION: jelly thick, 40-70 tentacles of various lengths, with nematocyst rings and bent tips, cruciform stomach with small lips, gonads along distal radial canals.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med.

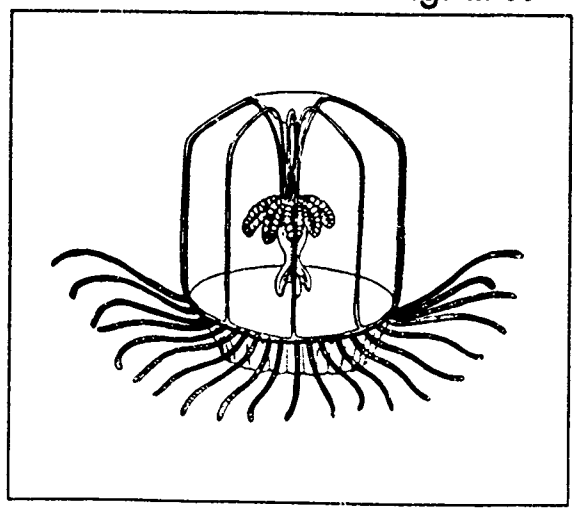
Fig. M-65



SPECIES: ***Aglantha digitale***

FAMILY: Rhopalonematidae
ORDER: Trachymedusae
SIZE: 10-40 mm high, 5-20 mm wide
DESCRIPTION: thimble-shaped bell, clear, pink or red, 8 radial canals, 80+ tentacles, stomach on long peduncle, sausage-like gonads hang inside bell.
LUMINESCENCE: Herring (1987) lists two genera in this family as definite.
DISTRIBUTION: Atlantic, Pacific, surface to deep water

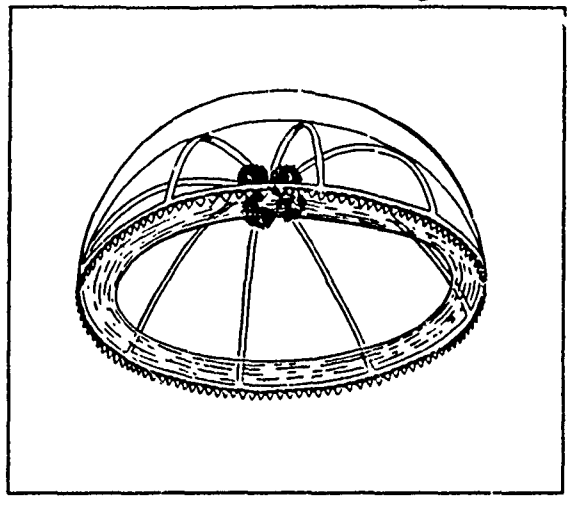
Fig. M-66



SPECIES: ***Aglaura hemistoma***

FAMILY: Rhopalonematidae
ORDER: Trachymedusae
SIZE: 4-6 mm high, 3-4 mm wide
DESCRIPTION: bell with flat top, jelly thin, 8 radial canals, 48-85 tentacles, peduncle shorter than bell, stomach with 4 simple lips, sausage-like gonads attached above stomach.
LUMINESCENCE: Herring (1987) lists two genera in this family as definite.
DISTRIBUTION: world-wide in surface layers

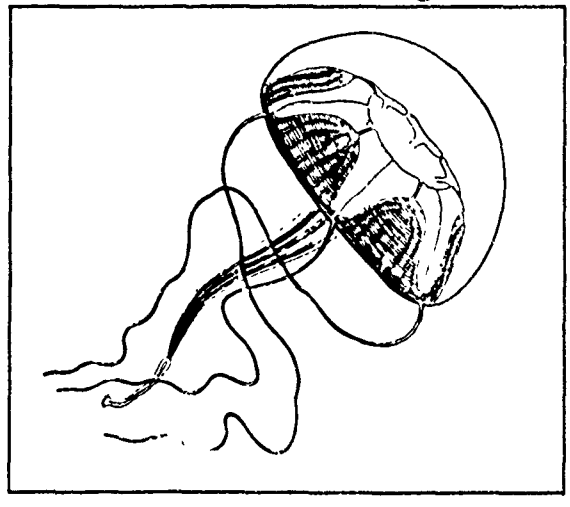
Fig. M-67



SPECIES: ***Arctapodema ampla***

FAMILY: Rhopalonematidae
ORDER: Trachymedusae
SIZE: to 15 mm wide
DESCRIPTION: bell flatter than hemisphere, thin walls, 8 radial canals, 100 tentacles, stomach with radial lobes, 8 gonads adjacent to stomach.
LUMINESCENCE: Herring (1987) lists two genera in this family as definite.
DISTRIBUTION: Atlantic, Antarctic, Med. in deep water

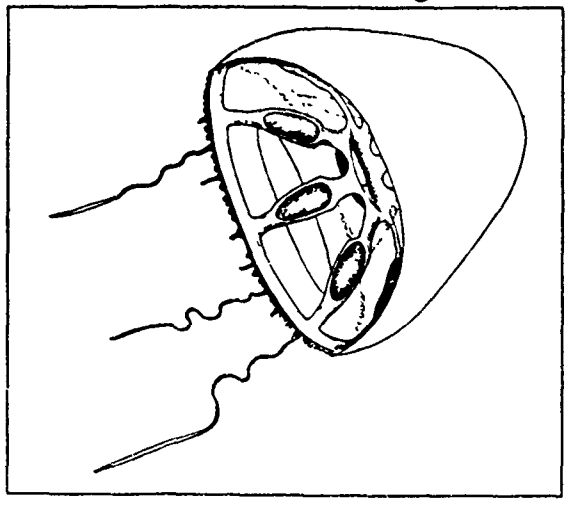
Fig. M-68



SPECIES: ***Geryonia proboscidalis***

FAMILY: Geryonidae
ORDER: Trachymedusae
SIZE: 35-80 mm wide
DESCRIPTION: bell hemispherical, jelly thick, 6 radial canals with up to 7 centripetal between, 6 long and 6 small tentacles, stomach on long peduncle, gonads heart-shaped on canals.
LUMINESCENCE: Herring (1987) lists this genus as uncertain.
DISTRIBUTION: world-wide, tropical and subtropical

Fig. M-69

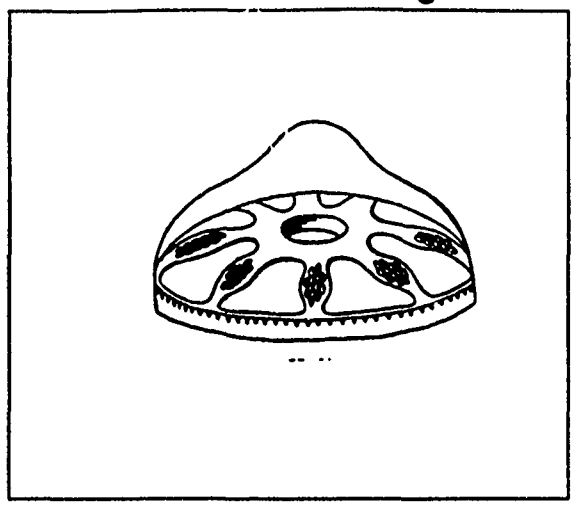


SPECIES: ***Haliscera bigelowi***

FAMILY: Halicreatidae
ORDER: Trachymedusae
SIZE: 10 mm high, 17 mm wide
DESCRIPTION: high bell with thick apex, 8 broad radial canals, 96 tentacles, 24 statocysts, broad circular stomach, long oval gonads on canals.
LUMINESCENCE: unknown

DISTRIBUTION: N. Atlantic, Pacific in deep water

Fig. M-70

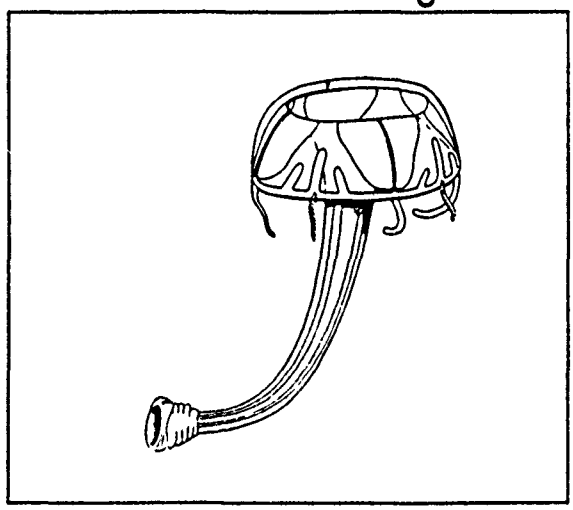


SPECIES: ***Haliscera conica***

FAMILY: Halicreatidae
ORDER: Trachymedusae
SIZE: to 18 mm wide
DESCRIPTION: low bell with blunt conical apex, stiff jelly, 8 broad radial canals, 64-72 tentacles, 16 statocysts, broad circular stomach, oval gonads in middle of canals.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Indian, Pacific, Med. in deep water

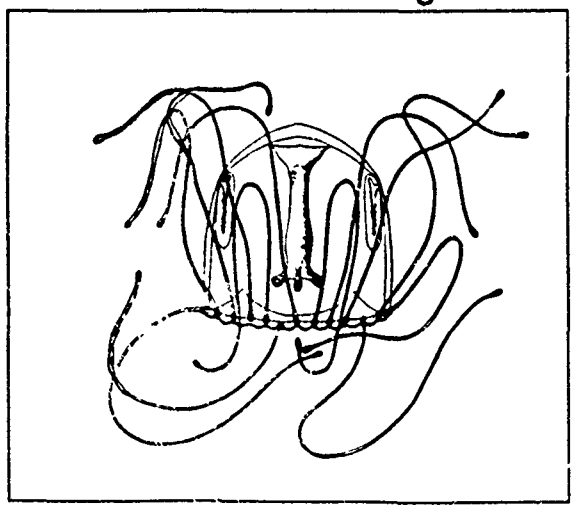
Fig. M-71



SPECIES: ***Liriope tetraphylla***

FAMILY: Geryonidae
ORDER: Trachymedusae
SIZE: 10-30 mm wide
DESCRIPTION: hemispherical bell, thick jelly, 4 radial canals, 4 long and 4 short tentacles, small stomach on long peduncle, gonads of variable leaf-like shape, on radial canals.
LUMINESCENCE: Herring (1987) lists this genus as uncertain
DISTRIBUTION: world-wide in warm water

Fig. M-72



SPECIES: ***Persa incolorata***

FAMILY: Rhopalonematidae
ORDER: Trachymedusae
SIZE: 3 mm high, 2 mm wide
DESCRIPTION: high bell with thin walls, 8 radial canals, to 48 long tentacles with nematocyst knobs, tubular stomach on short peduncle, 2 oval pendent gonads on radial canals.
LUMINESCENCE: Herring (1987) lists two genera in this family as definite.
DISTRIBUTION: Atlantic, Indian, Med.

Fig. M-73

SPECIES: ***Ransonia krampi***

FAMILY: Rhopalonematidae
ORDER: Trachymedusae
SIZE: 15 mm high, 8 mm wide
DESCRIPTION: high conical bell, thin walls, solid apical projection, 8 radial canals, 88 tentacles, small stomach on long peduncle, gonads along radial canals on peduncle
LUMINESCENCE: Herring (1987) lists two genera in this family as definite.
DISTRIBUTION: Atlantic, Med. in deep water

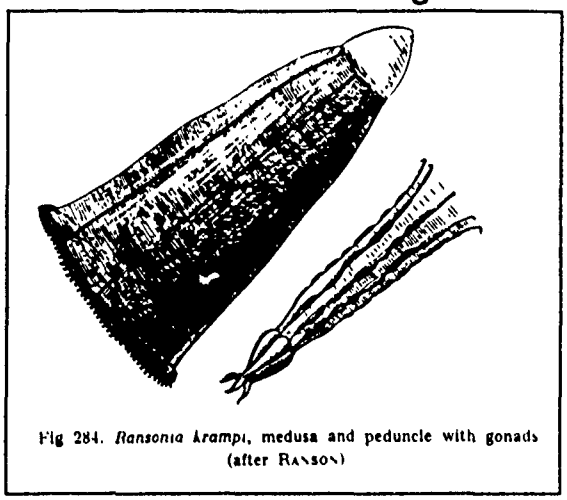


Fig 284. *Ransonia krampi*, medusa and peduncle with gonads (after RANSON)

Fig. M-74

SPECIES: ***Rhopalonema funerarium***

FAMILY: Rhopalonematidae
ORDER: Trachymedusae
SIZE: to 17 mm wide, 14 mm high
DESCRIPTION: bell domed, 8 radial canals, 8 main tentacles, 24 smaller cirri with terminal knobs, stomach narrow, linear gonads along distal radial canals.
LUMINESCENCE: Herring (1987) lists two genera in this family as definite.
DISTRIBUTION: Atlantic, Indian, Pacific, Med.? in deep water

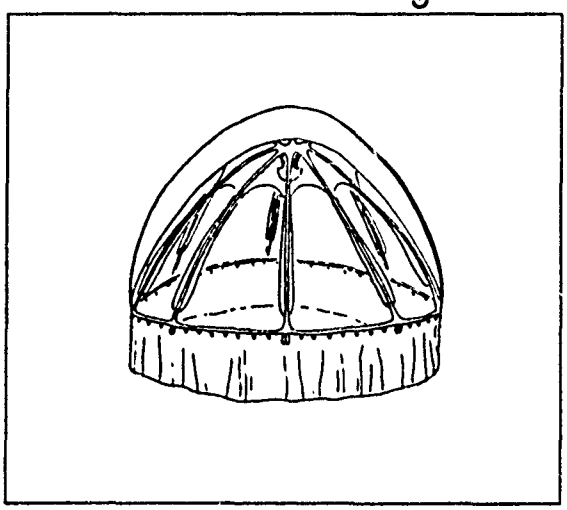


Fig. M-75

SPECIES: ***Rhopalonema velatum***

FAMILY: Rhopalonematidae
ORDER: Trachymedusae
SIZE: 8-10 mm wide
DESCRIPTION: bell flatter than hemisphere, with apical knob, 8 radial canals, 8 club-shaped tentacles and 8-16 cirri, stomach long and narrow, gonads on radial canals.
LUMINESCENCE: Herring (1987) lists two genera in this family as definite.
DISTRIBUTION: N. Atlantic, Med., surface to deep

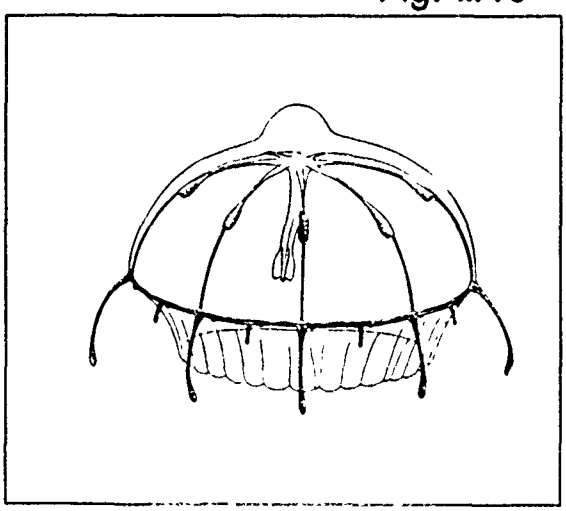
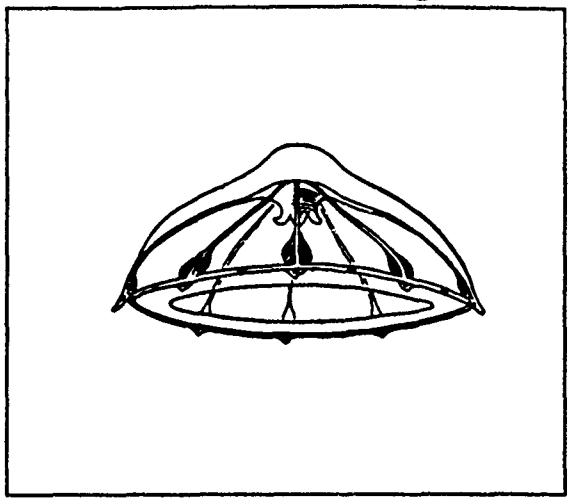


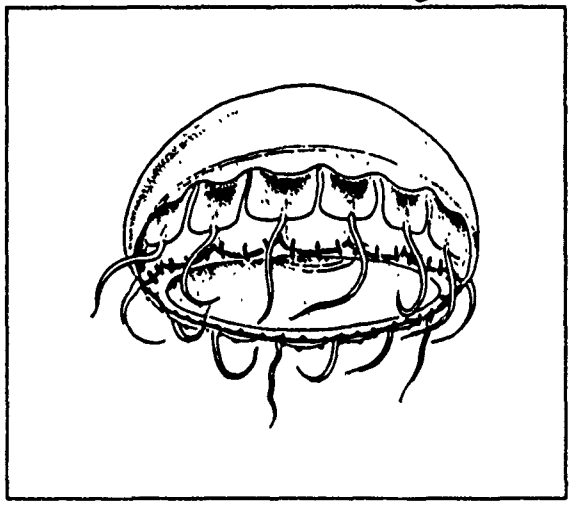
Fig. M-76



SPECIES: ***Sminthea eurygaster***

FAMILY: Rhopalonematidae
ORDER: Trachymedusae
SIZE: to 6 mm wide, 3 mm high
DESCRIPTION: bell with small apical knob, 8 radial canals, 8 tentacles and statocysts, short stomach with 4 short lips, globular gonads on distal radial canals.
LUMINESCENCE: Herring (1987) lists two genera in this family as definite.
DISTRIBUTION: Atlantic, Indian, Med. in deep water

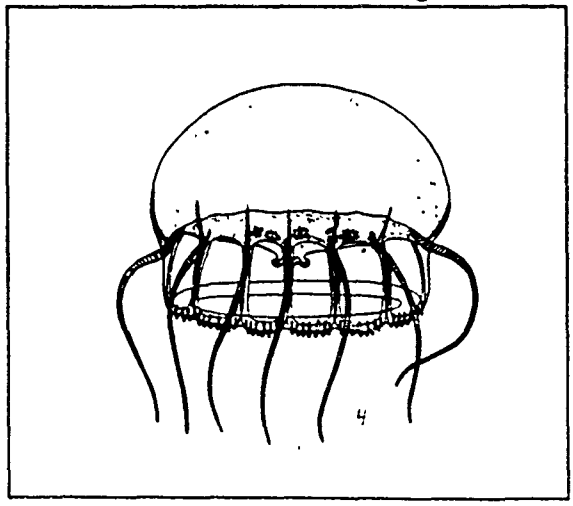
Fig. M-77



SPECIES: ***Cunina globosa***

FAMILY: Cuninidae
ORDER: Narcomedusae
SIZE: to 18 mm wide
DESCRIPTION: globular bell, thick jelly, no radial canals, 16 tentacles, stomach on broad gelatinous peduncle, 10-14 stomach pouches with square outline.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: tropical Atlantic, Pacific, Med.

Fig. M-78

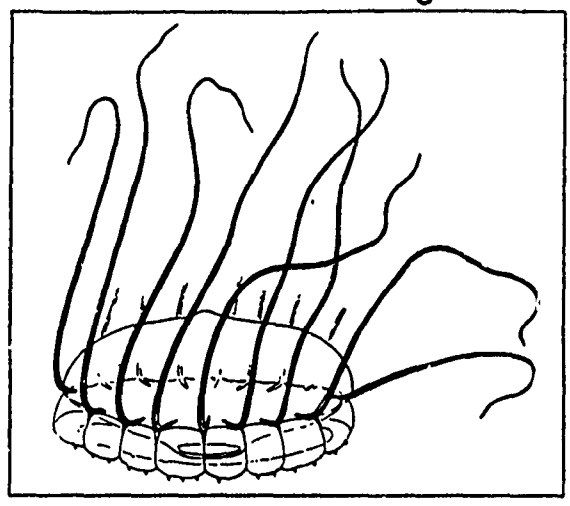


SPECIES: ***Pegantha rubiginosa***

FAMILY: Solmarisidae
ORDER: Narcomedusae
SIZE: to 16 mm wide
DESCRIPTION: domed bell, jelly thick, no radial canals, 12-16 rectangular marginal lappets and tentacles, 2 long & 2 short otoporpae on each lappet, stomach without pouches.
LUMINESCENCE: unknown

DISTRIBUTION: tropical Atlantic, Med.

Fig. M-79

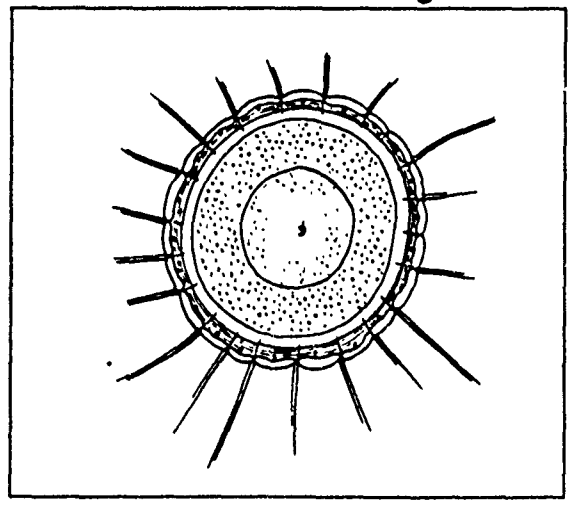


SPECIES: ***Solmaris flavescens***

FAMILY: Solmarisidae
ORDER: Narcomedusae
SIZE: 15-23 mm wide
DESCRIPTION: flat, lens-shaped bell, thick jelly, 12-17 tentacles, no radial canals, marginal lappets thin, with 2 statocysts, stomach without pouches.
LUMINESCENCE: unknown

DISTRIBUTION: Med. and adjacent Atlantic

Fig. M-80

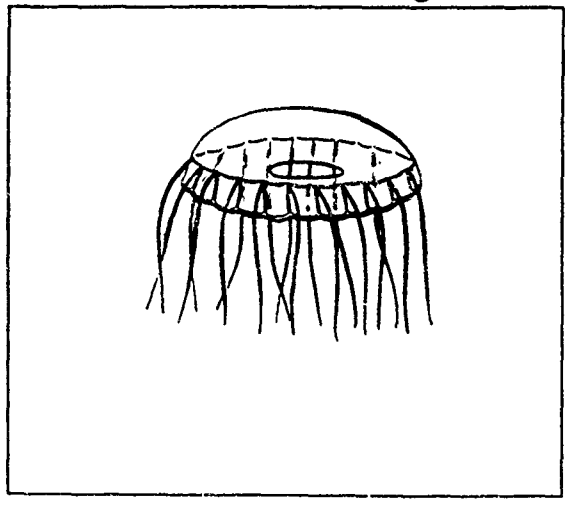


SPECIES: ***Solmaris leucostyla***

FAMILY: Solmarisidae
ORDER: Narcomedusae
SIZE: 3 mm wide
DESCRIPTION: flat to hemispherical bell, no radial canals, 12-26 tentacles, 12-26 marginal lappets with 1 statocyst, stomach without pouches, annular gonad.
LUMINESCENCE: unknown

DISTRIBUTION: Med.

Fig. M-81

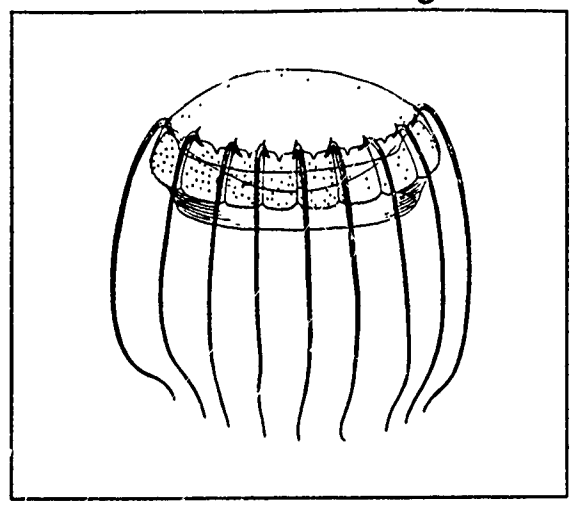


SPECIES: ***Solmaris solmaris***

FAMILY: Solmarisidae
ORDER: Narcomedusae
SIZE: to 35 mm wide
DESCRIPTION: flat, lens-shaped bell, no radial canals, 18-20 tentacles, marginal lappets with 6-8 statocysts, stomach without pouches, annular gonad.
LUMINESCENCE: unknown

DISTRIBUTION: Med.

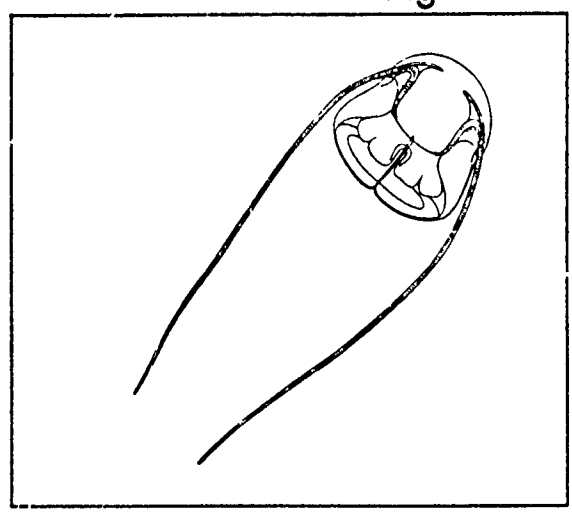
Fig. M-82



SPECIES: ***Solmissus albescens***

FAMILY: Cuninidae
ORDER: Narcomedusae
SIZE: 25-30 mm wide
DESCRIPTION: lens-shaped bell, with warts on exumbrella, no radial canals, 14-16 stomach pouches and tentacles, marginal lappets rectangular with 5-8 statocysts.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Med. common in deep water

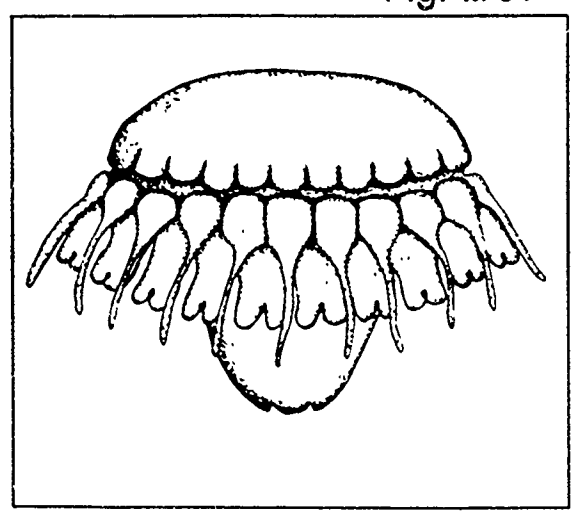
Fig. M-83



SPECIES: ***Solmundella bitentaculata***

FAMILY: Aeginidae
ORDER: Narcomedusae
SIZE: to 12 mm wide
DESCRIPTION: high bell with thick apex, no radial canals, 2 tentacles attached near apex and held aborally, 8-16 statocysts, 8 stomach pouches.
LUMINESCENCE: Herring (1987) lists two genera in this family as definite.
DISTRIBUTION: world-wide tropical-temperate, surface to deep water

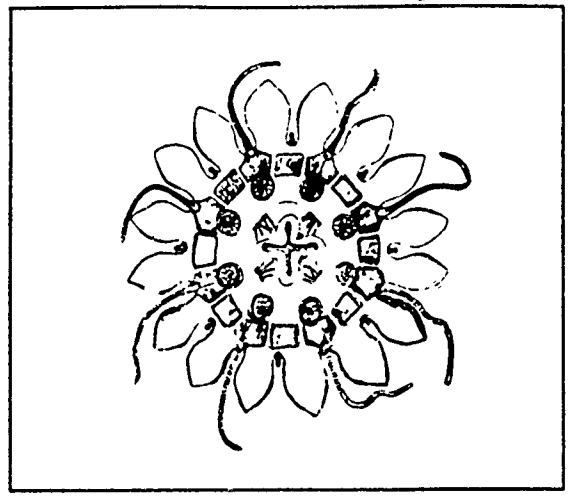
Fig. M-84



SPECIES: ***Atolla wyvillei***

FAMILY: Atollidae
ORDER: Coronatae
SIZE: to 150 mm wide
DESCRIPTION: disc-shaped bell, deep coronal groove between center and margin, 22 tentacles and sense organs, stomach pigmented deep red, remainder brownish red.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: world-wide in deep water

Fig. M-85



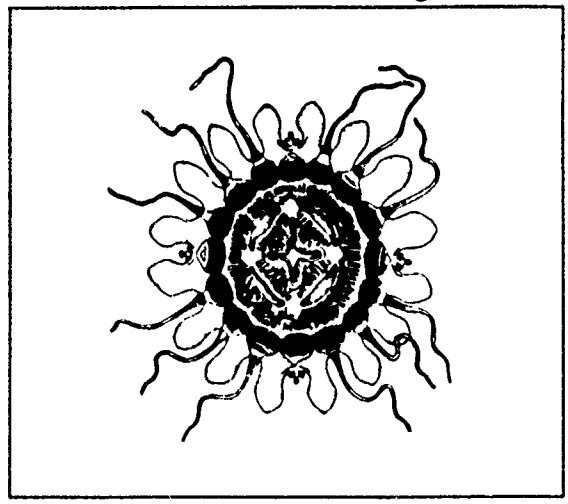
SPECIES: ***Nausithoe punctata***

FAMILY: Nausithoidae
ORDER: Coronatae
SIZE: 9-15 mm wide
DESCRIPTION: disk-shaped with thick center, 8 tentacles and 16 marginal lappets, 16 stomach pouches, large round yellow gonads.

LUMINESCENCE: unknown

DISTRIBUTION: world-wide

Fig. M-86



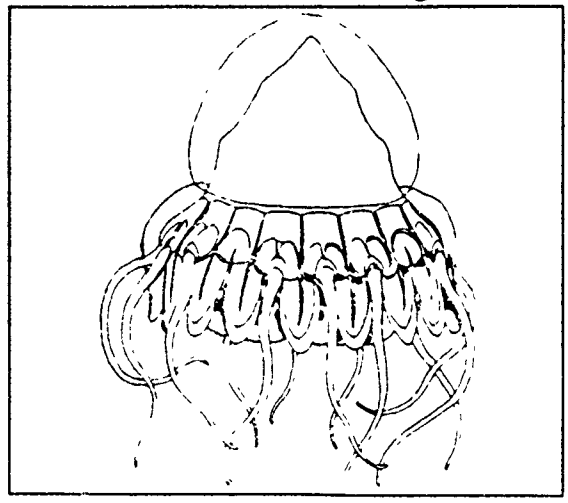
SPECIES: ***Paraphyllina intermedia***

FAMILY: Paraphyllinidae
ORDER: Coronatae
SIZE: 15 mm wide, 8 m[illegible]h
DESCRIPTION: domed bell, deep coronal groove, 12 tentacles and 16 marginal lappets, stomach reddish brown, 4 pairs of ovoid gonads.

LUMINESCENCE: unknown

DISTRIBUTION: Pacific, Indian, Med. in deep water

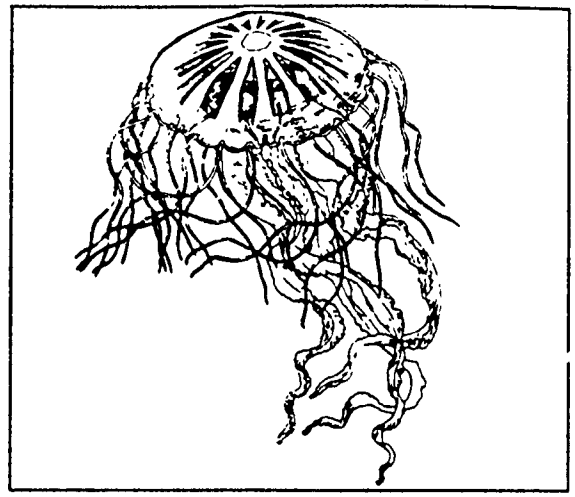
Fig. M-87



SPECIES: ***Periphylla periphylla***

FAMILY: Periphyllidae
ORDER: Coronatae
SIZE: to 200 mm high
DESCRIPTION: high domed or conical bell, 12 stiff tentacles often held aborally, 16 marginal lappets, stomach and subumbrella dark red or purple, 8 U-shaped gonads.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: world-wide in deep water

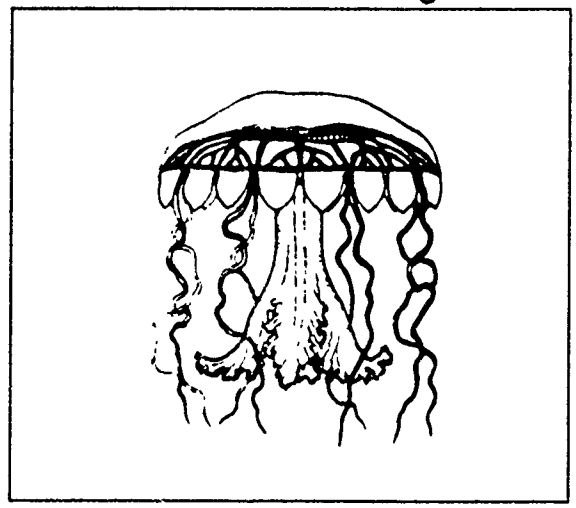
Fig. M-88



SPECIES: ***Chrysaora hysoscella***

FAMILY: Peiagiidae
ORDER: Semaeostomeae
SIZE: to 200 mm wide
DESCRIPTION: saucer-shaped bell, smooth surface, 16 broad radial brown bands on exumbrella, 24 tentacles in 8 groups of 3, 32 marginal lappets, long frilled oral arms.
LUMINESCENCE: Herring (1987) lists *Pelagia* in this family as definite.
DISTRIBUTION: Atlantic, Med.

Fig. M-89

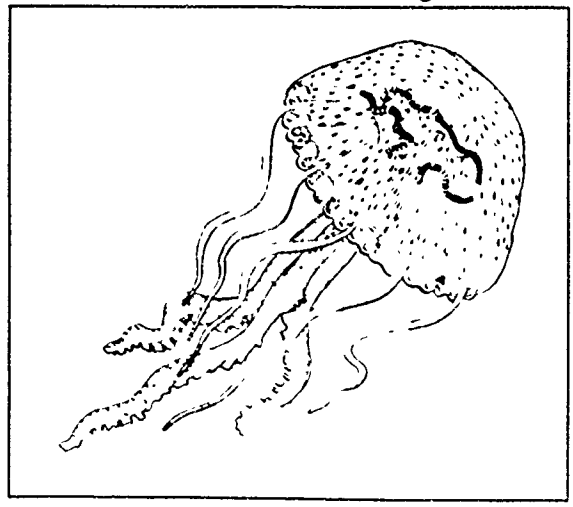


SPECIES: ***Discomedusa lobata***

FAMILY: Ulmaridae
ORDER: Semaeostomeae
SIZE: 150 mm wide
DESCRIPTION: disk-shaped bell, 24 tentacles, 32 marginal lappets, 8 rhopalia

LUMINESCENCE: Herring (1987) lists *Poralia* in this family as definite.
DISTRIBUTION: Atlantic, Med.

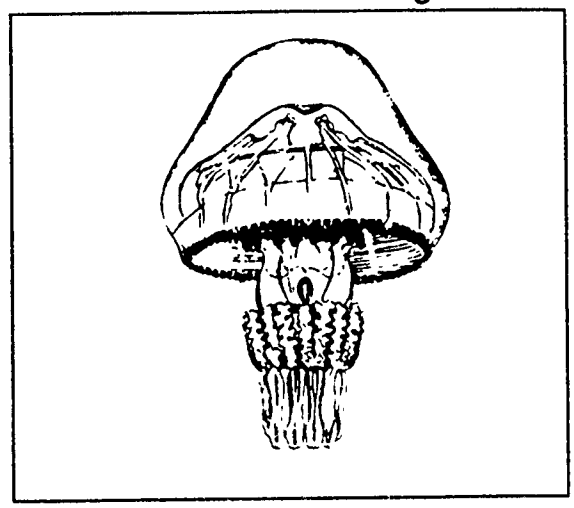
Fig. M-90



SPECIES: ***Pelagia noctiluca***

FAMILY: Pelagiidae
ORDER: Semaeostomeae
SIZE: to 65 mm wide
DESCRIPTION: bell flatter than hemisphere, yellow, brown or pink, nematocyst warts on outer surface, 8 tentacles and sense organs, 16 marginal lappets, 4 long oral arms.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: world-wide

Fig. M-91



SPECIES: ***Rhizostoma pulmo***

FAMILY: Rhizostomatidae
ORDER: Rhizostomeae
SIZE: to 600 mm wide
DESCRIPTION: domed bell, very thick jelly, nematocyst warts on surface, no tentacles, 64-72 marginal lappets, oral arms divided into multiple mouths.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Med.

Siphonophores

The siphonophores compose an order of the class Hydrozoa, and are thus most closely related to hydromedusae. Their complex life cycle and colonial morphology are very different from the relatively simple hydromedusae and for most practical purposes it is easier to consider the siphonophores as a separate group.

The colonial, or polygastric, phase of the life cycle is the largest and most familiar, and the part which is described here. Siphonophores consist of a collection of medusoid and polypoid zooids (see terminology) which are budded asexually from a founding larval polyp. The colony may include a gas float, nectophores or swimming bells, and a series of stem groups that include the feeding polyps and tentacles. In some siphonophores the stem groups break off as secondary dispersal and sexually reproductive stages called eudoxids. The colony can be thought of as an overgrown, polymorphic juvenile stage which eventually bears the sexually reproductive adults. These are medusoid zooids called gonophores which produce gametes. In different groups, the gonophores may remain attached to the colony, detach as part of a eudoxid or detach as individual medusae. Siphonophores range in size from a few mm to over 30 m in length, and occur throughout the water column. All are predators on other small zooplankton, and many genera are known to be luminescent.

The colonies are fragile, and usually break up into their various units when collected in plankton nets. For this reason, much of the taxonomy is based on the morphology of the pieces, principally nectophores, and some species are known only from a few such pieces. As a result, the appearance of the intact colonial stage is not always known. Where possible, illustrations of intact siphonophres are provided here, but in some cases only pictures of pieces are available. In recent years many new deepwater species collected with submersibles have been described (Pugh and Harbison, 1987; Pugh and Youngbluth, 1988). Although not yet reported from the Mediterranean (or included here), these, or other new species, may well be encountered at depth. The Order Siphonophora is divided into 3 suborders and 15 families.

1. Cystonectae. This suborder includes siphonophores which possess a float but no swimming bells. The Portuguese man-o-war is the most familiar example. The float is so large that the animal floats on the surface. It is not generally taken in plankton collections and is not included here.

2. Physonectae. These siphonophores have more complex colonies, comprising a small apical float, numerous swimming bells that form a nectosome, and a stem containing several groups of gastrozooids, tentacles, bracts etc. The stem typically contracts when the animal is swimming, and then relaxes so that the stem and tentacles extend to maximum length for fishing. Many physonects are strong swimmers and vertical migrators.

3. Calycophorae. In this group, the float is absent, and the nectophores are reduced to a small number, most frequently two. The stem can be retracted completely into a cavity in the nectophores. A sequence of stem groups are budded, and break free as eudoxids. Calycophorans are the most diverse, widely distributed and abundant siphonophores.

The classification used here is based on Totton (1965). Descriptions and illustrations are compiled from Bigelow and Sears (1937), Biggs (1977), Carré (1979), Pugh and Harbison (1986), Totton (1965) and Tregouboff and Rose (1957). Distributional data came mainly from Alvariño (1971), Bigelow and Sears (1937, Pugh (1974) and Totton (1965).

Terminology:

basal tooth - a tooth or projection from the ostial surface of a nectophore

bract - a flattened, leaf-like zooid with little internal structure, for protection of stem groups and buoyancy

cnidoband - folded or coiled band of nematocysts that is part of a tentillum

cormidia - stem groups on the siphosome, usually consisting of gastrozooids, palpons, bracts and gonophores

eudoxid - a stem group released from calycophorans as a free-swimming dispersal stage

gastrozooid - polypoid feeding zooid with a single tentacle that catches and ingests prey

hydroecium - cavity in the nectophore of calycophorans that houses the retracted stem

nectophore - an asexual medusoid zooid that provides locomotion by jet propulsion

nectosac - the cavity in the nectophore from which water is expelled for propulsion

ostium - the opening of the nectophore

palpon - a reduced gastrozooid with a simple tentacle and no ingestive capability

pneumatophore - the gas float of a cystonect or physonect

siphosome - the part of the stem with the gastrozooids, tentacles, bracts etc (cormidia)

somatocyst - a part of the gastric cavity which occurs in the nectophores of calycophorans

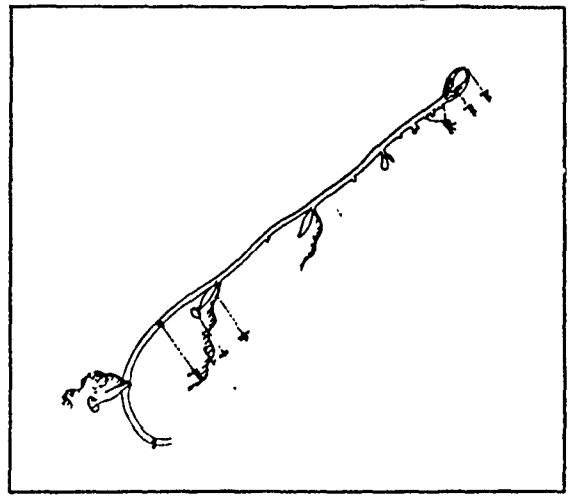
tentilla - a side branch of the tentacle which may be simple or consist of a cnidoband and other terminal appendages

terminal filaments - filaments attached to the sac containing the cnidoband on a tentillum

tricornuate - tentillum having three appendages off the cnidoband

unicornuate - tentillum having one appendage off the cnidoband

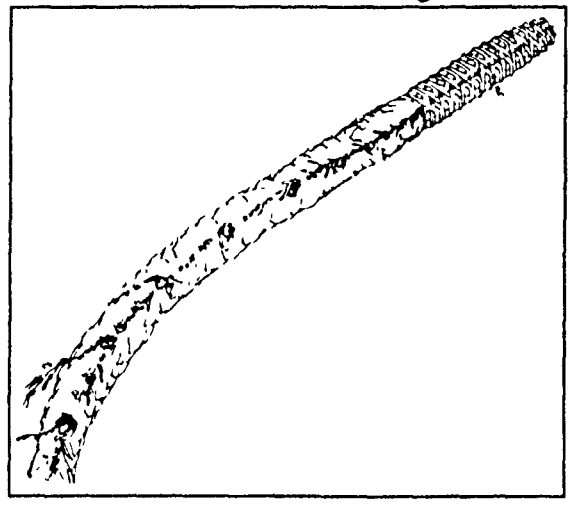
Fig. S-1



SPECIES: ***Rhizophysa filiformis***

FAMILY: Rhizophysidae
SUBORDER: Cystonectae
SIZE: 2-50 cm long
DESCRIPTION: apical pneumatophore 12 mm high, no nectophores, gastrozooids 25 mm apart on highly contractile stem, 1 tentacle per gastrozooid, with 3 types of tentilla.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Med.

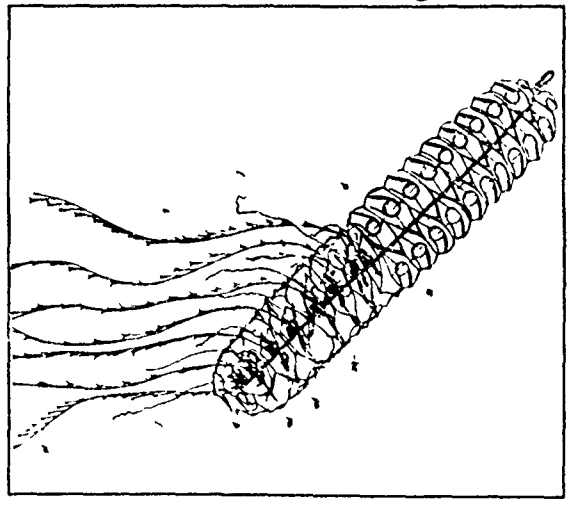
Fig. S-2



SPECIES: ***Agalma elegans***

FAMILY: Agalmidae
SUBORDER: Physonectae
SIZE: to 1 m long
DESCRIPTION: nectophores arranged in 2 rows, slightly rounded with triangular nectosac, 2 rows of triangular bracts with 3 ridges, brick-red tricornuate tentilla.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Med.

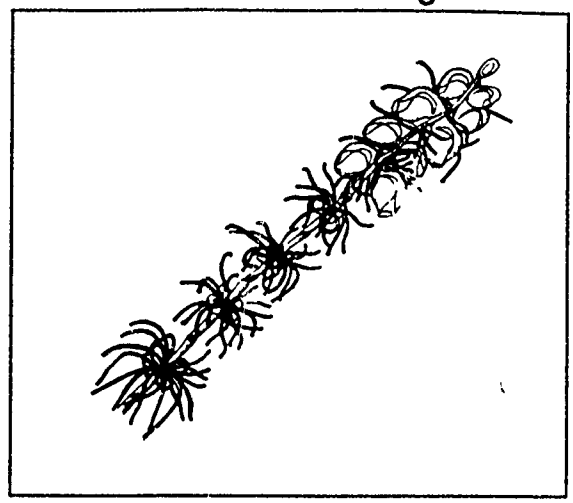
Fig. S-3



SPECIES: ***Agalma okeni***

FAMILY: Agalmidae
SUBORDER: Physonectae
SIZE: to 30 cm long
DESCRIPTION: prismatic nectophores form dodecagonal nectosome, Y-shaped nectosac, thick, faceted bracts, brick-red bicornuate or tricornuate tentilla.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: world-wide in warm regions

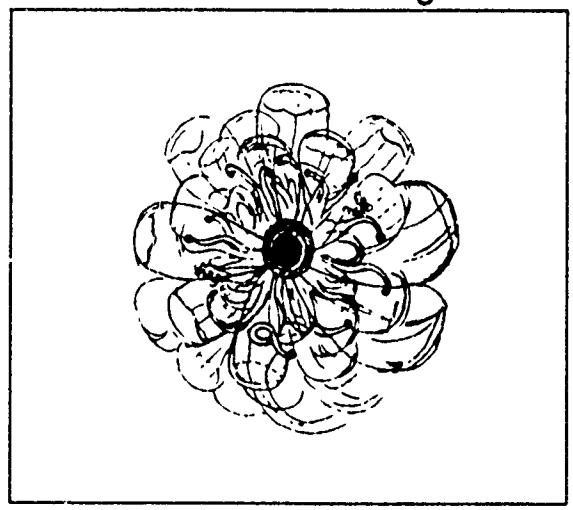
Fig. S-4



SPECIES: ***Apolemia uvaria***

FAMILY: Apolemiidae
SUBORDER: Physonectae
SIZE: to 30 m long
DESCRIPTION: about 12 nectophores with tentacles, white cormidia including 3-4 gastrozooids, 2-40 bracts and 20-40 red palpons are widely spaced on siphosome.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. S-5



SPECIES: ***Athorybia rosacea***

FAMILY: Athorybiidae
SUBORDER: Physonectae
SIZE: to 3 cm wide
DESCRIPTION: large central pink-red pneumatophore, no nectophores, no siphosome, elongate bracts like overlapping petals, bi- or tricornuate tentilla.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Med.

Fig. S-6

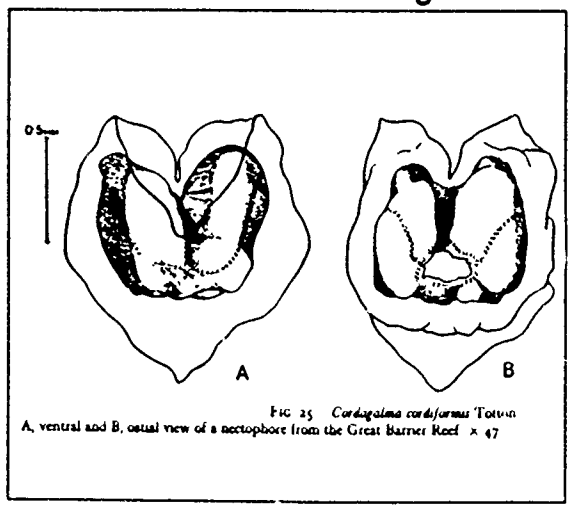


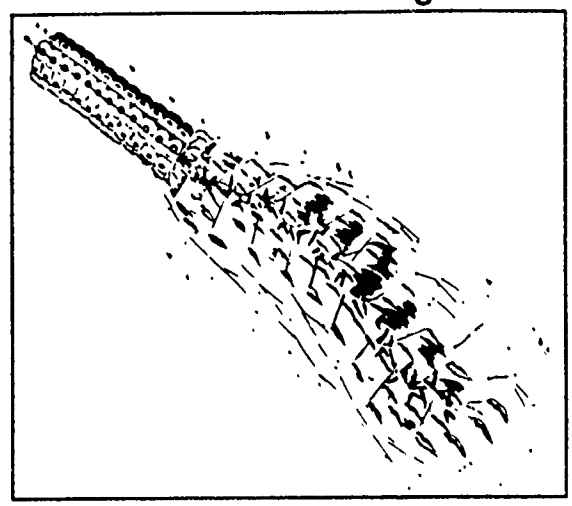
FIG 25 *Cordagalma cordiformis* Totton
A, ventral and B, ostial view of a nectophore from the Great Barrier Reef × 47

SPECIES: ***Cordagalma cordiformis***

FAMILY: Agalmidae
SUBORDER: Physonectae
SIZE:
DESCRIPTION: very small, heart-shaped nectophores

LUMINESCENCE: Herring (1987) lists three other genera in this family as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Red Sea, Med.

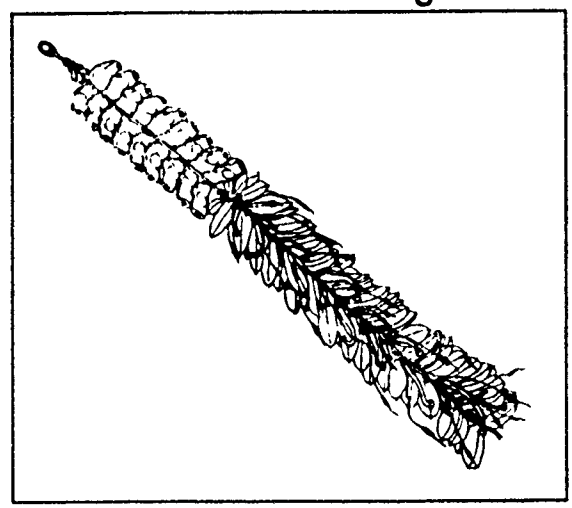
Fig. S-7



SPECIES: ***Forskalia edwardsi***

FAMILY: Forskaliidae
SUBORDER: Physonectae
SIZE: to 3 m long when extended
DESCRIPTION: cylindrical or conical nectosome of numerous small nectophores with yellow spots on the orifices, long gastrozooids, palpons release red liquid.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, common in Med.

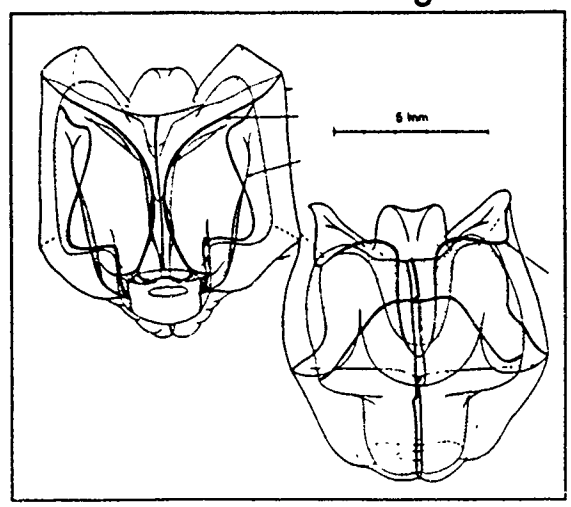
Fig. S-8



SPECIES: ***Halistemma rubrum***

FAMILY: Agalmidae
SUBORDER: Physonectae
SIZE: to 2 m long
DESCRIPTION: nectosome of up to 60 nectophores, colony often rose colored, tentacles with vermilion, unicornuate tentilla, palpons long and extensile.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Med.

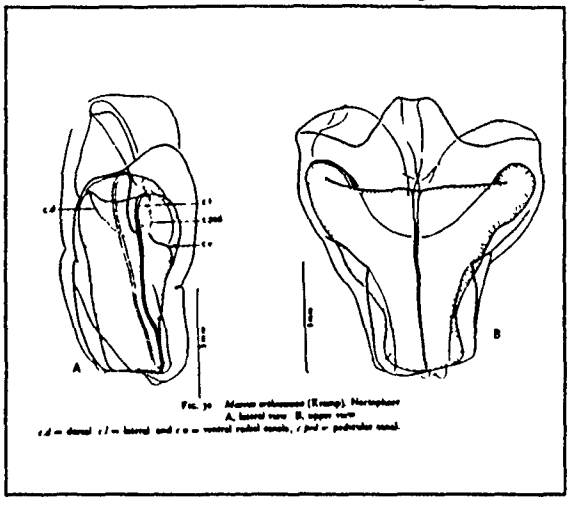
Fig. S-9



SPECIES: ***Lychnagalma utricularia***

FAMILY: Agalmidae
SUBORDER: Physonectae
SIZE: to 20 cm long
DESCRIPTION: 11-25 nectophores in 2 rows, bracts flimsy, with 2 distal points, tentilla unique, with red cnidoband and 8 terminal filaments, gastrozooids on stalks.
LUMINESCENCE: Not, but three other genera in this family are definite (Herring, 1987).
DISTRIBUTION: Atlantic, Indian, Med. in deep water

Fig. S-10

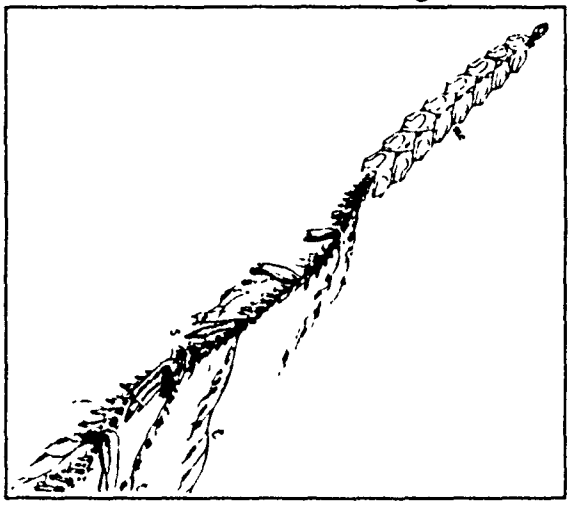


SPECIES: ***Marrus orthocanna***

FAMILY: Agalmidae
SUBORDER: Physonectae
SIZE: large
DESCRIPTION: large nectophores, long spindle or club-shaped gastrozooids, scarlet colored stem.

LUMINESCENCE: Herring (1987) lists three other genera in this family as definite.
DISTRIBUTION: arctic Atlantic in deep water

Fig. S-11

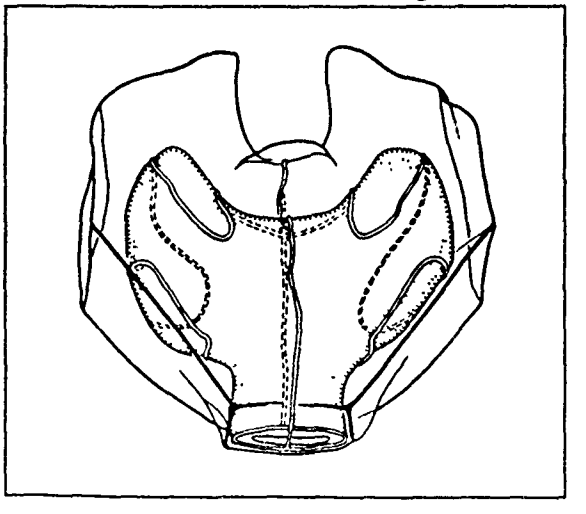


SPECIES: ***Nanomia bijuga***

FAMILY: Agalmidae
SUBORDER: Physonectae
SIZE: 10-45 cm long
DESCRIPTION: nectosome 1/5 of total length, square nectophores in 2 rows, unicornuate tentilla, dark red splotches on stem.

LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Med.

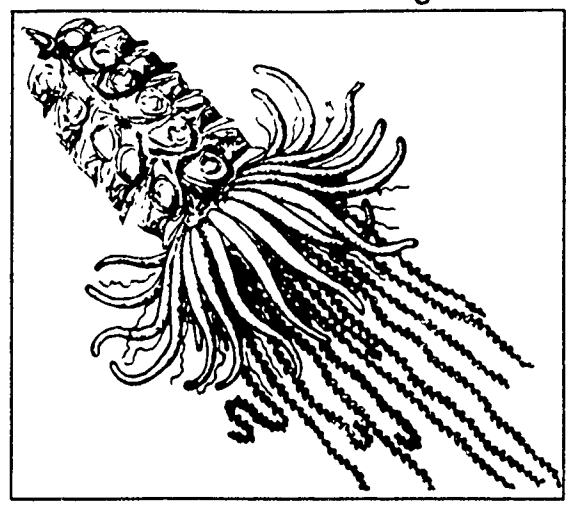
Fig. S-12



SPECIES: ***Nanomia cara***

FAMILY: Agalmidae
SUBORDER: Physonectae
SIZE: to 50 cm long
DESCRIPTION: to 30 nectophores in 2 rows, horizontally flattened, nectosome about 1/5 total length, unicornuate tentilla with pigmented cnidoband.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Med.

Fig. S-13

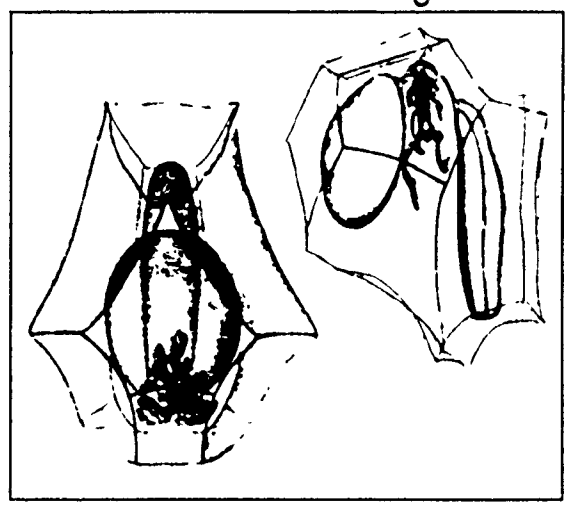


SPECIES: ***Physophora hydrostatica***

FAMILY: Physophoridae
SUBORDER: Physonectae
SIZE: to 12 cm high
DESCRIPTION: conspicuous plum-color apical pneumatophore, 8-12 nectophores in 2 rows, large green-pink palpons around base of nectosome, tentacles below it.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. S-14

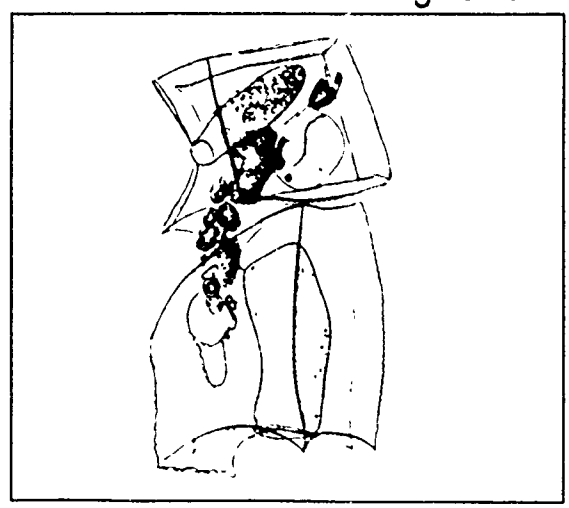


SPECIES: ***Abyla haeckeli***

FAMILY: Abylidae
SUBORDER: Calycophorae
SIZE: ant. nectophore 5 mm high
DESCRIPTION: 11-faceted anterior nectophore, tubular nectosacs, stem withdraws into hydroecium.

LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian. Med.

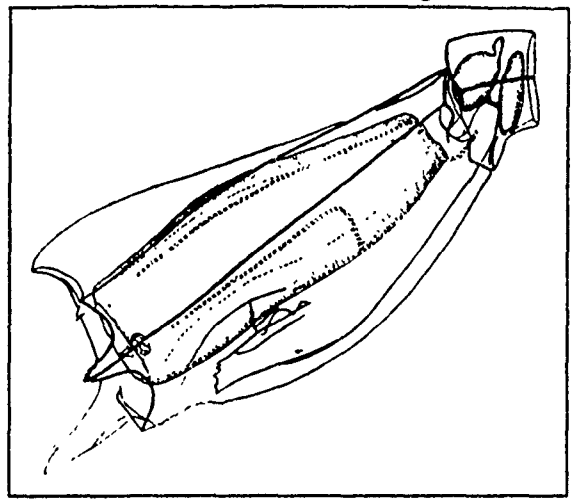
Fig. S-15



SPECIES: ***Abylopsis eschscholtzi***

FAMILY: Abylidae
SUBORDER: Calycophorae
SIZE: 6 mm high
DESCRIPTION: cubic anterior nectophore, nectosac directed laterally, larger faceted posterior nectophore with finely toothed edges.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Red Sea, Med. in shallow water

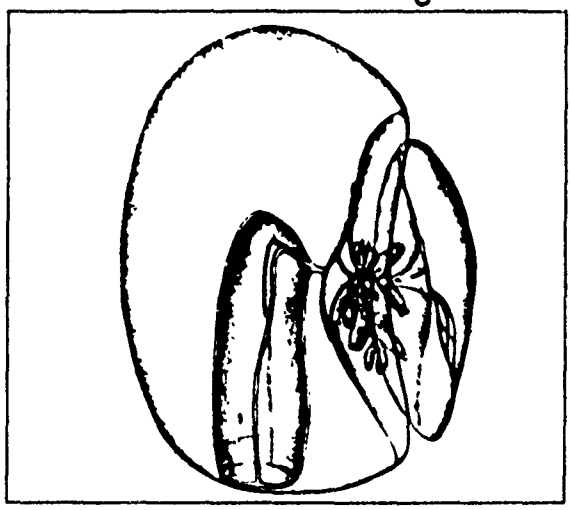
Fig. S-16



SPECIES: ***Abylopsis tetragona***

FAMILY: Abylidae
SUBORDER: Calycophorae
SIZE: to 35 mm high
DESCRIPTION: small cuboidal anterior nectophore, larger posterior nectophore 3x long as broad, with 5 terminal teeth of various lengths.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: common in Atlantic, Med.

Fig. S-17



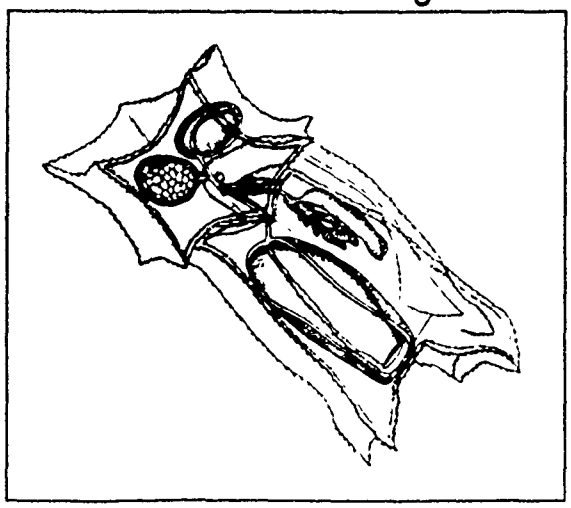
SPECIES: ***Amphicaryon acaule***

FAMILY: Prayidae
SUBORDER: Calycophorae
SIZE: about 5 mm diameter
DESCRIPTION: 1 large rounded nectophore and 2 small, flattened vestigial nectophore with nectosac not open to exterior.

LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Red Sea, Med.

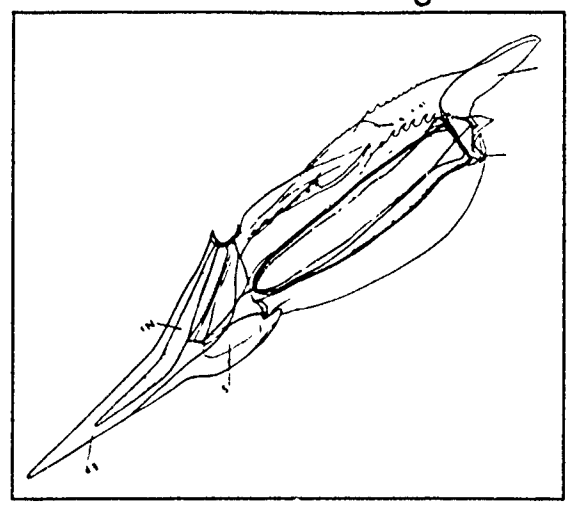
Fig. S-18



SPECIES: ***Bassia bassensis***

FAMILY: Abylidae
SUBORDER: Calycophorae
SIZE: to 15 mm high
DESCRIPTION: small, cuboidal anterior nectophore, faceted posterior nectophore, 2x long as broad, fairly short terminal teeth.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: world-wide, usually near surface

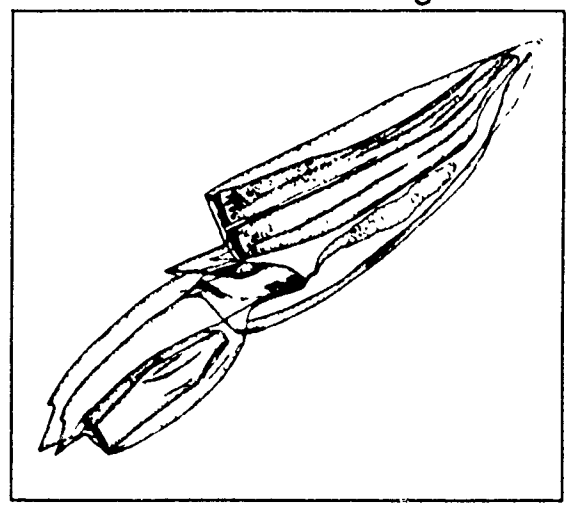
Fig. S-19



SPECIES: ***Ceratocymba sagittata***

FAMILY: Abylidae
SUBORDER: Calycophorae
SIZE: to 60 mm high
DESCRIPTION: anterior nectophore with long, pyramidal apical projection, long tubular nectosac, posterior nectophore with large ventral terminal tooth and toothed margins.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Med.

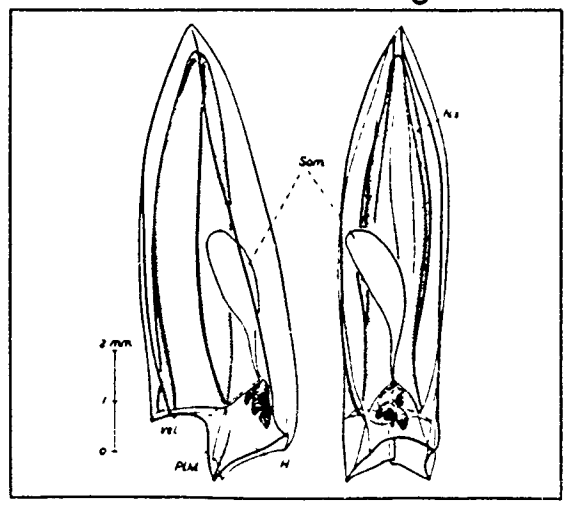
Fig. S-20



SPECIES: ***Chelophyes appendiculata***

FAMILY: Diphyidae
SUBORDER: Calycophorae
SIZE: 30 mm high
DESCRIPTION: large anterior nectophore with 3 ridges and large nectosac, smaller posterior nectophore has ventral ridges that end in terminal teeth.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: world-wide, "the commonest of all siphonophores"

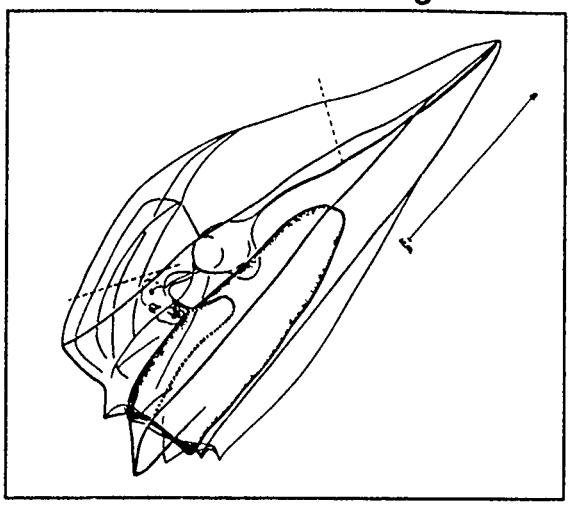
Fig. S-21



SPECIES: ***Chelophyes contorta***

FAMILY: Diphyidae
SUBORDER: Calycophorae
SIZE: 10 mm high
DESCRIPTION: large anterior nectophore with 3 ridges, ventral facet slightly twisted, smaller posterior nectophore with 2 terminal teeth.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. S-22

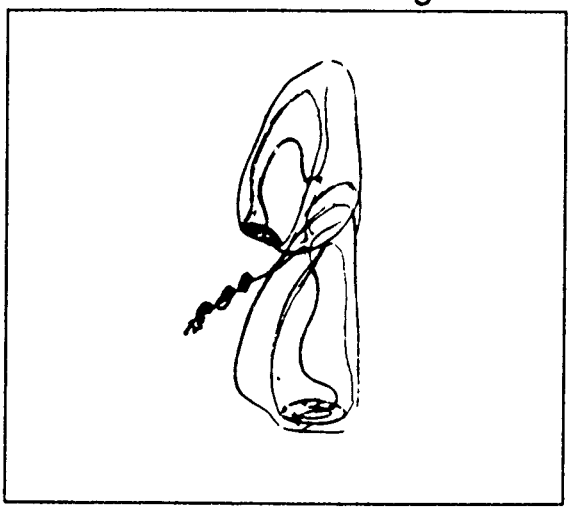


SPECIES: ***Chuniphyes multidentata***

FAMILY: Clausophyidae
SUBORDER: Calycophorae
SIZE: to 60 mm high
DESCRIPTION: anterior nectophore with pointed apex, 4 ridges branching to 6, posterior nectophore with 3 ridges branching to 6, ending in 6 terminal teeth.
LUMINESCENCE: unknown

DISTRIBUTION: world-wide in deep water

Fig. S-23



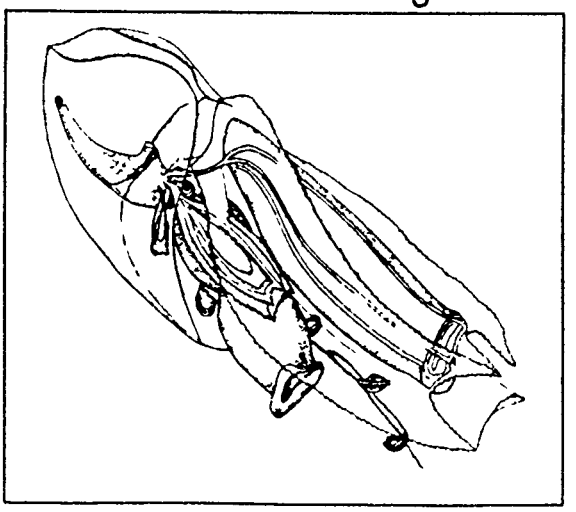
SPECIES: ***Clausophyes ovata***

FAMILY: Clausophyidae
SUBORDER: Calycophorae
SIZE: to 40 mm high
DESCRIPTION: soft, pear-shaped anterior nectophore, larger posterior nectophore with tapered apex.

LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med. in deep water

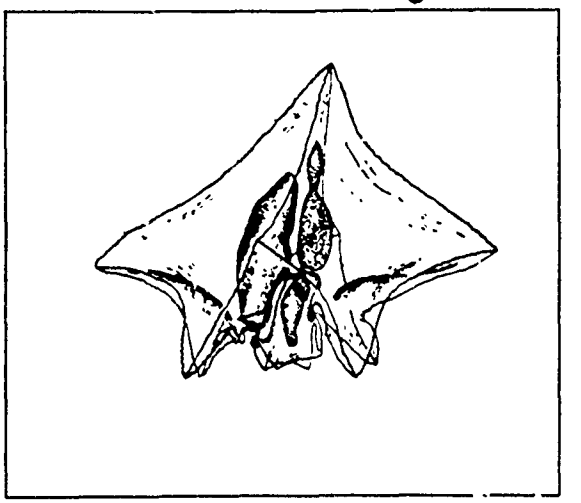
Fig. S-24



SPECIES: ***Diphyes dispar***

FAMILY: Diphyidae
SUBORDER: Calycophorae
SIZE: to 50 mm high
DESCRIPTION: anterior nectophore laterally compressed with 5 ridges, dorsal ridge serrated with terminal tooth, posterior nectophore with smooth edges and teeth.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. S-25



SPECIES: ***Enneagonum hyalinum***

FAMILY: Abylidae
SUBORDER: Calycophorae
SIZE: 15 mm high
DESCRIPTION: consists of cuboidal anterior nectophore only, with strong dorsal ridge and serrated basal edges and teeth.

LUMINESCENCE: Herring (1987) lists 4 genera in this family as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Red Sea, Med.

Fig. S-26

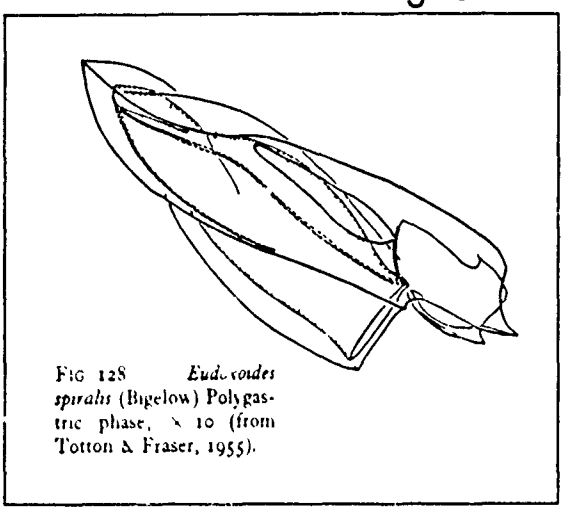


FIG 128 *Eudoxoides spiralis* (Bigelow) Polygastric phase, × 10 (from Totton & Fraser, 1955).

SPECIES: ***Eudoxoides spiralis***

FAMILY: Diphyidae
SUBORDER: Calycophorae
SIZE: to 11 mm high
DESCRIPTION: anterior nectophore with 5 twisted longitudinal ridges, 4 of which reach apex, no posterior nectophore.

LUMINESCENCE: Herring (1987) lists 3 genera in this family as definite.
DISTRIBUTION: world-wide and common

Fig. S-27

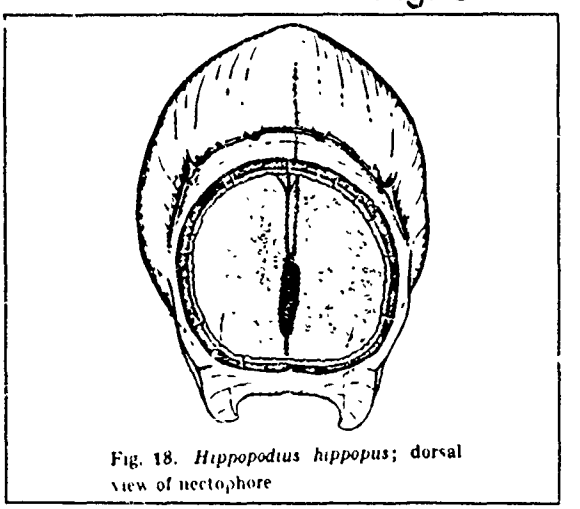


Fig. 18. *Hippopodius hippopus*; dorsal view of nectophore

SPECIES: ***Hippopodius hippopus***

FAMILY: Hippopodiidae
SUBORDER: Calycophorae
SIZE: to 30 mm high
DESCRIPTION: up to 12 horseshoe-shaped nectophores stacked above each other, without teeth or serration, no bracts, mesogiea turns opaque white on contact.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: world-wide

Fig. S-28

SPECIES: ***Lensia campanella***

FAMILY: Diphyidae
SUBORDER: Calycophorae
SIZE: to 6 mm high
DESCRIPTION: anterior nectophore twisted at apex (or possibly not in live specimens), ridges indistinct, orange-red spots on nectophores.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med.

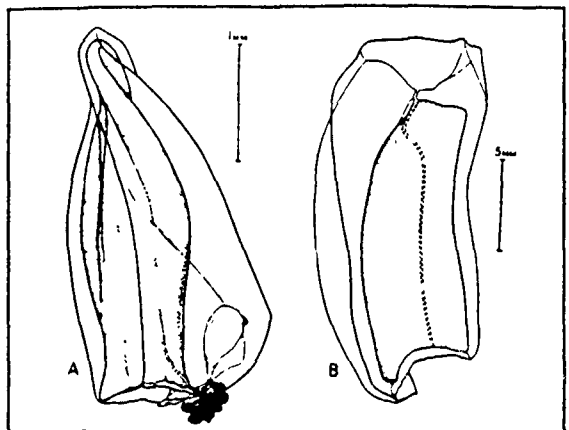


FIG. 100 *Lensia campanella* (Moser). Polygastric phase, GL Barrier Reef. A, left lateral view of the anterior nectophore, × 30. B, right lateral view of the posterior nectophore × 46 (from Totton, 1932, fig 33)

Fig. S-29

SPECIES: ***Lensia conoidea***

FAMILY: Diphyidae
SUBORDER: Calycophorae
SIZE: to 45 mm high
DESCRIPTION: pyramidal anterior nectophore with 5 ridges and smooth facets, large nectosac, posterior nectophore with 5 ridges and facets.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med.

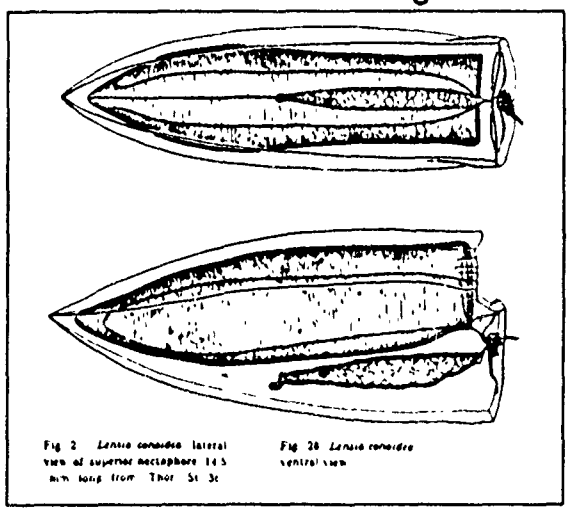


Fig 2 *Lensia conoidea* lateral view of superior nectophore 14.5 mm long from Thor St 3c

Fig 28 *Lensia conoidea* ventral view

Fig. S-30

SPECIES: ***Lensia fowleri***

FAMILY: Diphyidae
SUBORDER: Calycophorae
SIZE: to 12 mm high
DESCRIPTION: anterior nectophore with 5 ridges, smooth facets, no basal teeth, posterior nectophore 3/4 length of anterior.

LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Red Sea, Med.

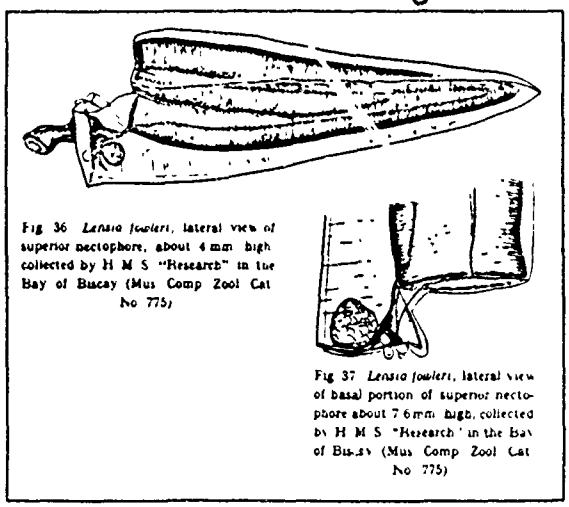
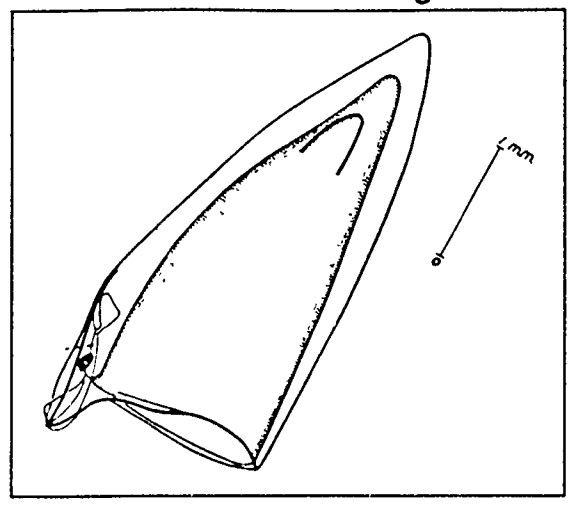


Fig 36 *Lensia fowleri*, lateral view of superior nectophore, about 4 mm high collected by H M S "Research" in the Bay of Biscay (Mus Comp Zool Cat No 775)

Fig 37 *Lensia fowleri*, lateral view of basal portion of superior nectophore about 7.6 mm high, collected by H M S "Research" in the Bay of Biscay (Mus Comp Zool Cat No 775)

Fig. S-31



SPECIES: ***Lensia meteori***

FAMILY: Diphyidae
SUBORDER: Calycophorae
SIZE: to 5 mm high
DESCRIPTION: anterior nectophore with indistinct ridges and smooth conical surface, posterior nectophore non-existent or unknown.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Red Sea, Med.

Fig. S-32

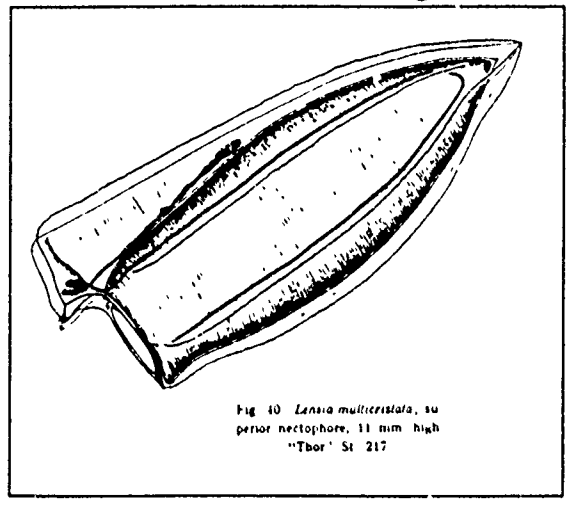


Fig. 40 *Lensia multicristata*, superior nectophore, 11 mm high "Thor" St 217

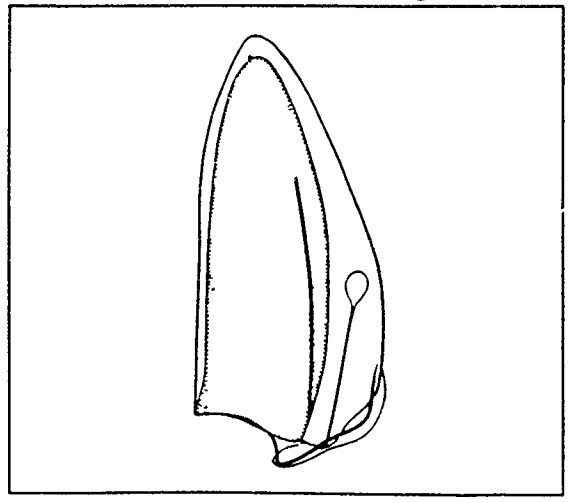
SPECIES: ***Lensia multicristata***

FAMILY: Diphyidae
SUBORDER: Calycophorae
SIZE: to 20 mm high
DESCRIPTION: anterior nectophore with 7 ridges, 5 reaching the apex and basal margin, posterior nectophore with 5 ridges.

LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. S-33



SPECIES: ***Lensia subtilis***

FAMILY: Diphyidae
SUBORDER: Calycophorae
SIZE: to 20 mm high
DESCRIPTION: anterior nectophore with 5 indistinct ridges, smooth surface and rounded apex, posterior nectophore with 5 ridges, yellow pigmentation.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Red Sea, Med. near surface

Fig. S-34

SPECIES: ***Lensia subtiloides***

FAMILY: Diphyidae
SUBORDER: Calycophorae
SIZE: to 7 mm high
DESCRIPTION: anterior nectophore with 5 ridges, less distinct at apex, no basal tooth on dorsal ridge, posterior nectophore with 5 ridges.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Red Sea, Med. near surface

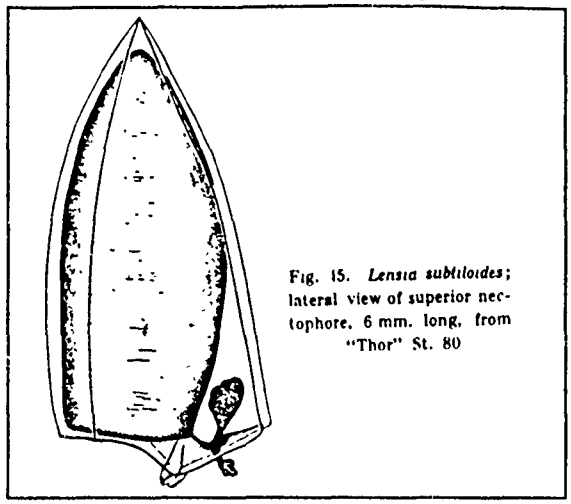


Fig. 15. *Lensia subtiloides*; lateral view of superior nectophore, 6 mm. long, from "Thor" St. 80

Fig. S-35

SPECIES: ***Lilyopsis rosea***

FAMILY: Prayidae
SUBORDER: Calycophorae
SIZE: to 20 cm (?)
DESCRIPTION: 2 large, equal, opposed nectophores of roughly conical shape, with large nectosacs, stem with large bracts, red pigment spots on stem eudoxids.
LUMINESCENCE: Herring (1987) lists 5 genera in this family as definite.
DISTRIBUTION: Med., rare

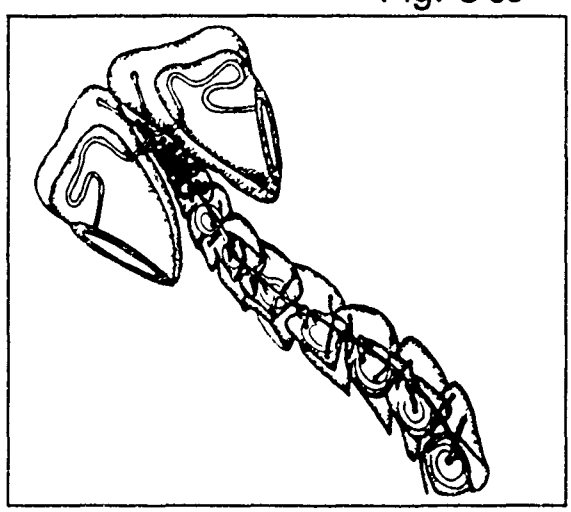


Fig. S-36

SPECIES: ***Muggiaea atlantica***

FAMILY: Diphyidae
SUBORDER: Calycophorae
SIZE: to 7 mm high
DESCRIPTION: anterior nectophore with 5 serrate ridges, somatocyst reaches top of nectosac, no posterior nectophore.

LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med. common

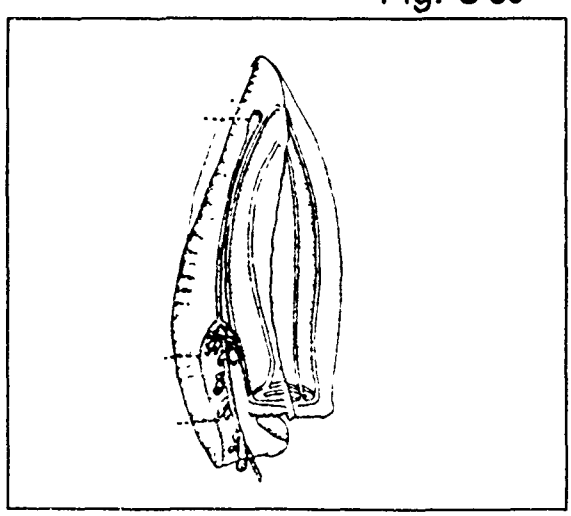
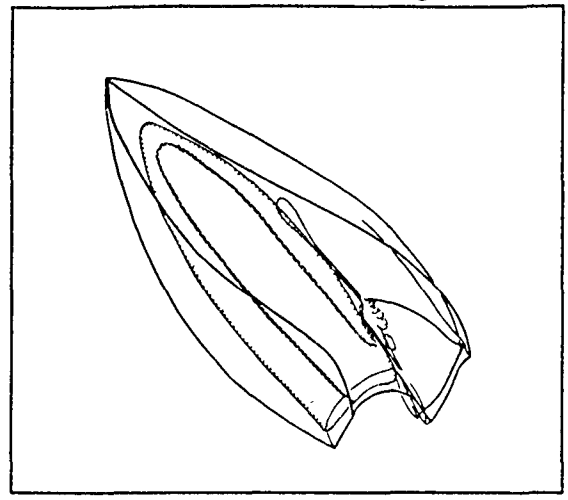


Fig. S-37



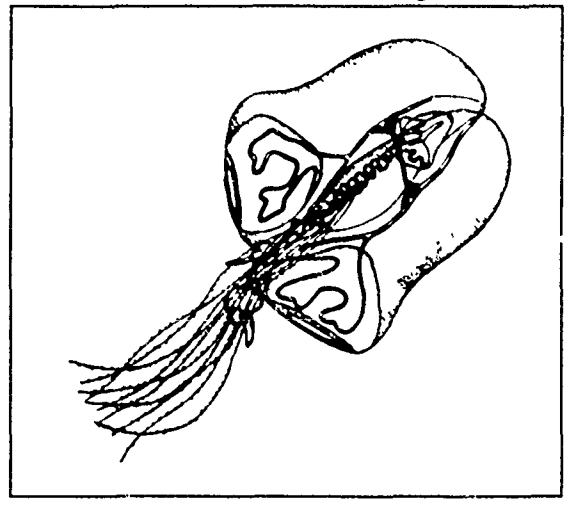
SPECIES: ***Muggiaea kochi***

FAMILY: Diphyidae
SUBORDER: Calycophorae
SIZE: to 5 mm high
DESCRIPTION: anterior nectophore with 5 ridges, somatocyst reaches halfway up nectosac, no posterior nectophore.

LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med. common

Fig. S-38



SPECIES: ***Rosacea cymbiformis***

FAMILY: Prayidae
SUBORDER: Calycophorae
SIZE: to 2 m long extended
DESCRIPTION: 2 large, unequal, oblong nectophores with small nectosacs, soft jelly, somatocyst extends below nectosac, numerous stem groups with large bracts.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Med.

Fig. S-39

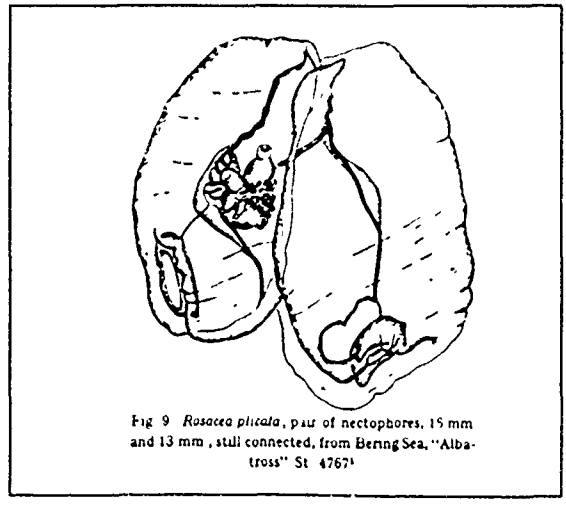
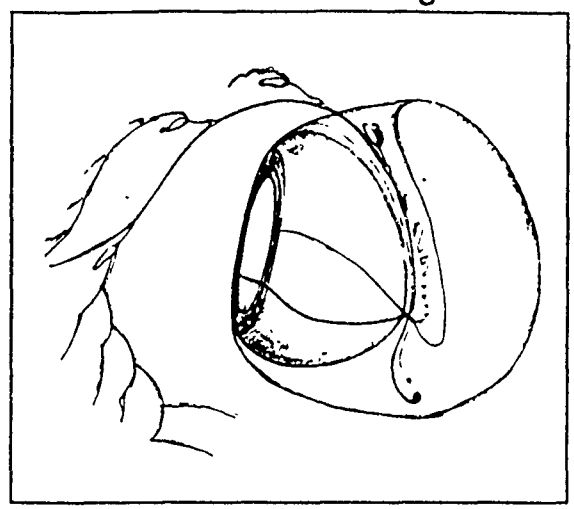


Fig 9 *Rosacea plicata*, pair of nectophores, 15 mm and 13 mm, still connected, from Bering Sea, "Albatross" St 4767[1]

SPECIES: ***Rosacea plicata***

FAMILY: Prayidae
SUBORDER: Calycophorae
SIZE: 1-2 m extended (?)
DESCRIPTION: 2 large, unequal oblong nectophores, small nectosacs, somatocyst stops above nectosac, numerous stem groups with large bracts.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Antarctic, Med.

Fig. S-40



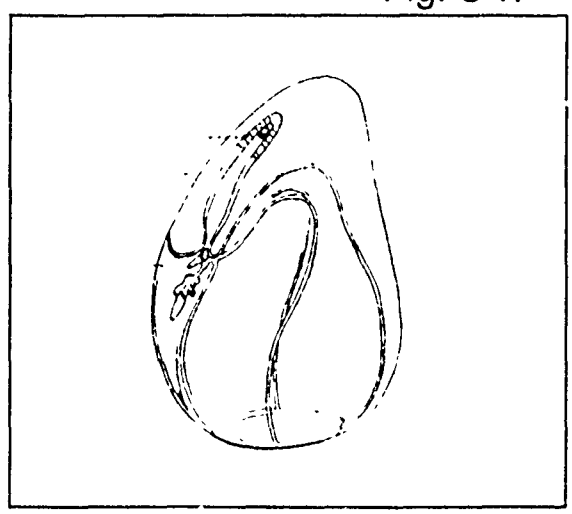
SPECIES: ***Sphaeronectes gracilis***

FAMILY: Sphaeronectidae
SUBORDER: Calycophorae
SIZE: 8 mm diameter
DESCRIPTION: single, spherical nectophore with hemispherical nectosac and curved, elongate somatocyst.

LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Med.

Fig. S-41



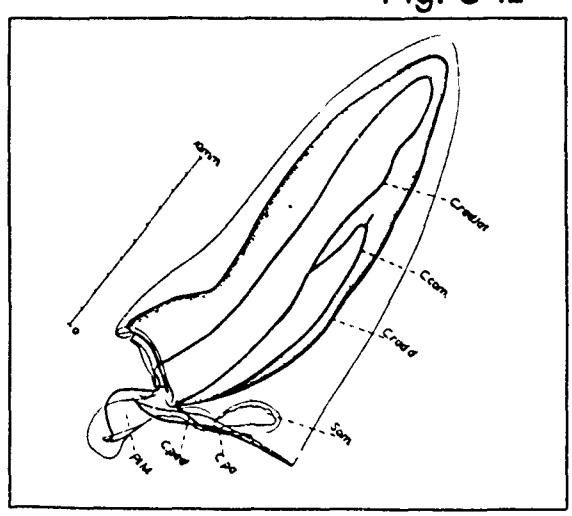
SPECIES: ***Sphaeronectes irregularis***

FAMILY: Sphaeronectidae
SUBORDER: Calycophorae
SIZE: 7 mm diameter
DESCRIPTION: single, pear-shaped nectophore and nectosac, short, straight somatocyst.

LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Med.

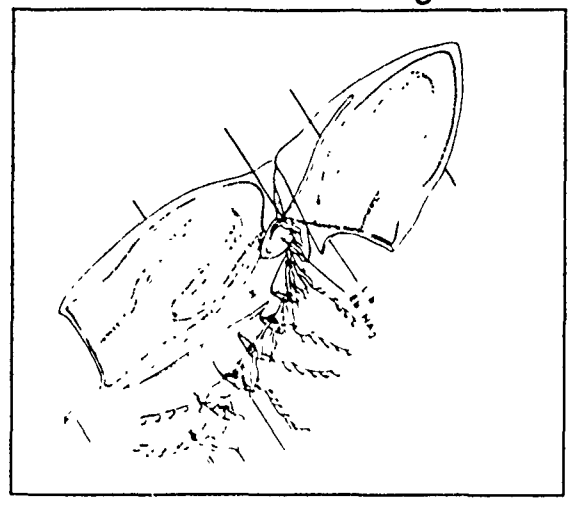
Fig. S-42



SPECIES: ***Sulculeolaria biloba***

FAMILY: Diphyidae
SUBORDER: Calycophorae
SIZE: to 1+ m long, extended
DESCRIPTION: conical anterior nectophore, nectosac opens obliquely, short somatocyst, 2 large basal lobes, posterior nectophore without basal lobes or teeth.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

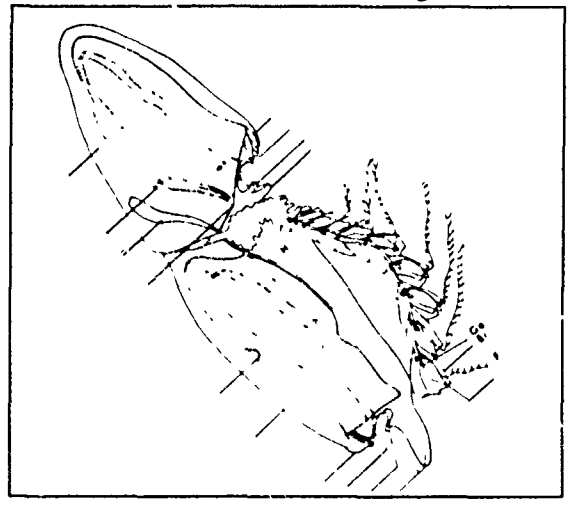
Fig. S-43



SPECIES: ***Sulculeolaria chuni***

FAMILY: Diphyidae
SUBORDER: Calycophorae
SIZE: 10+ cm long
DESCRIPTION: conical anterior nectophore, long, thin somatocyst, 2 short basal lobes, posterior nectophore without basal lobes or teeth.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Red Sea, Med.

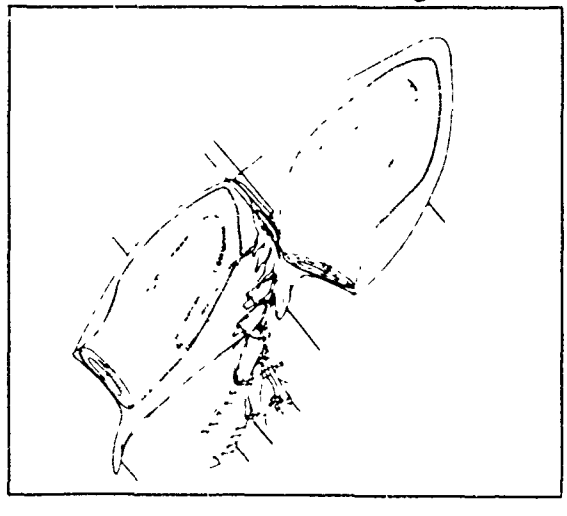
Fig. S-44



SPECIES: ***Sulculeolaria quadrivalvis***

FAMILY: Diphyidae
SUBORDER: Calycophorae
SIZE: 1+ m long, extended
DESCRIPTION: conical anterior nectophore, medium length somatocyst, 2 large basal lobes, posterior nectophore with 2 lateral and 2 dorsal teeth at opening.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Red Sea, Med.

Fig. S-45



SPECIES: ***Sulculeolaria turgida***

FAMILY: Diphyidae
SUBORDER: Calycophorae
SIZE: 20 cm long
DESCRIPTION: conical anterior nectophore, small somatocyst, 2 basal lobes, no teeth, posterior nectophore with single large basal lobe.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. S-46

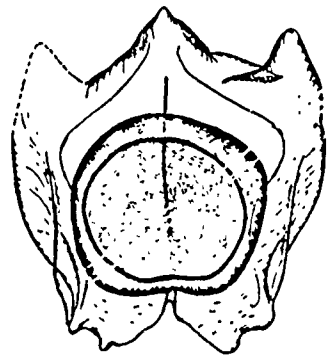
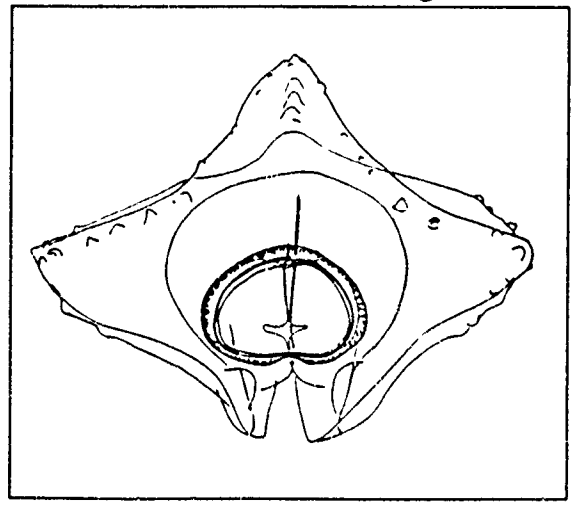


Fig. 20. *Vogtia glabra*; dorsal view of nectophore, 11 mm. in length from "Thor" St. 91.

SPECIES: ***Vogtia glabra***

FAMILY: Hippopodiidae
SUBORDER: Calycophorae
SIZE: 10 cm long (?)
DESCRIPTION: up to 12 similar nectophores, partly overlapping in 2 rows, with smooth, rounded exterior, 3 lateral ridges and 2 dorsal humps.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

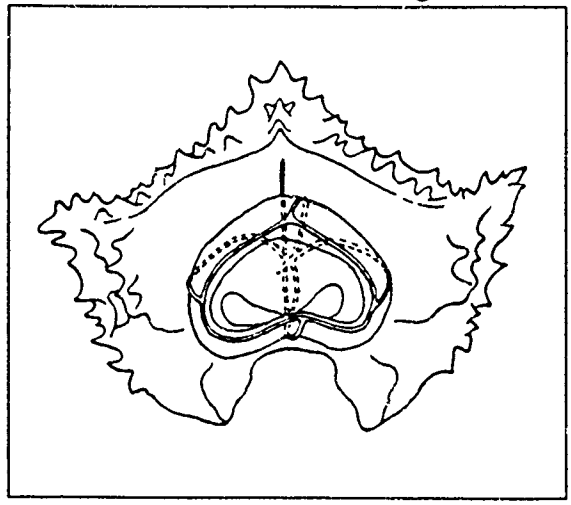
Fig. S-47



SPECIES: ***Vogtia pentacantha***

FAMILY: Hippopodiidae
SUBORDER: Calycophorae
SIZE: 10 cm long (?)
DESCRIPTION: up to 12 similar nectophores, partly overlapping in 2 rows, pentagonal in section, with teeth on edges but not surfaces of facets.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Med. in deep water

Fig. S-48



SPECIES: ***Vogtia spinosa***

FAMILY: Hippopodiidae
SUBORDER: Calycophorae
SIZE: 10 cm long (?)
DESCRIPTION: up to 12 similar nectophores, partly overlapping in 2 rows, pentagonal in section, with teeth on edges and surfaces of facets.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Med. in deep water

Ctenophores

The phylum Ctenophora comprises perhaps a hundred or more gelatinous animals, almost all of which are planktonic. With few exceptions, ctenophores are strongly bioluminescent, emitting light from the gastrovascular canals, and sometimes from luminous secretions. They occur from shallow to deep water in all oceans, and are predators on other zooplankton. Ctenophores are fragile and difficult to collect or preserve. Many new species have only recently been described using *in-situ* methods, and undoubtedly many more species remain to be discovered, especially in deep water (Harbison and Botkin, in prep; Madin and Harbison, 1978a,b).

The classification of the phylum remains somewhat unsettled due to the recent influx of new species and higher taxa. At least five orders are represented in the Mediterranean plankton and are included here.

1. Cydippida. The cydippids generally have oval or cylindrical bodies with a mouth at one end and a statocyst at the other. They range in size from a few mm to nearly 30 cm. Cydippids have two long tentacles which are extended outside the body for fishing, but can be withdrawn into it. Division into families is based on the structure of the tentacles , their position (emerging near the oral or the aboral end of the body), body shape, and connections of the internal gastrovascular canals.

2. Lobata. In these ctenophores the oral end of the body is enlarged into two oral lobes, which are spread out as food-catching surfaces. The external tentacles are reduced to a veil of fine side-branches or tentilla which cover the surfaces of the lobes and parts of the body. Lobates have elongate, flattened bodies, and range from about 10 mm to a meter or more across. Families are distinguished on the basis of body shape, arrangement of canals or the presence of particular structures.

3. Thalassocalycida. This order contains a single genus which occurs mainly in midwater. It is most similar to the lobates, but the oral lobes are connected to form a continuous, medusa-like bell.

4. Cestida. The two genera in this order have similar morphologies, but differ in size. The body is extremely flattened and elongate, looking like a transparent belt. The tentacles are within grooves on one edge of the body, and tentilla cover the flat surfaces of the body.

5. Beroida. These ctenophores lack tentacles altogether. The body is quite flattened, and oval or conical in outline; size ranges from a few mm to 20 cm or more. Beroids have a large, expansive mouth and stomodeum with which they engulf other ctenophores as prey.

The classification used here is based on Harbison and Madin (1982), Harbison (1985) and Mills (1987). Descriptions, illustrations and distributional data are compiled from Carré and Carré (1989), Chun (1878, 1880, 1898), Fedele (1940), Harbison (pers. comm.), Komai (1918), Madin (unpubl. data), Madin and Harbison (1978a,b), Mayer (1912), Mills (1987), Moser (1910), Tregouboff and Rose (1957).

Terminology:

auricles - 4 flattened or elongate structures on lobate ctenophores that attach near the base of the lobes

colloblasts - glue-cells on tentacles and tentilla which stick to prey

comb rows - 8 meridional rows of ctenes which provide propulsion

ctenes - plates of fused cilia that beat like paddles, arranged in comb rows

diverticula - side branches off gastrovascular canals that sometimes anastomose

meridional canals - 8 main gastrovascular canals running longitudinally through body or into lobes

paragastric canals - canals running along each side of the stomodeum

stomodeal canals - 4 meridional canals in the stomodeal plane of the body

stomodeal plane - the plane of symmetry in which the flattened stomodeum lies

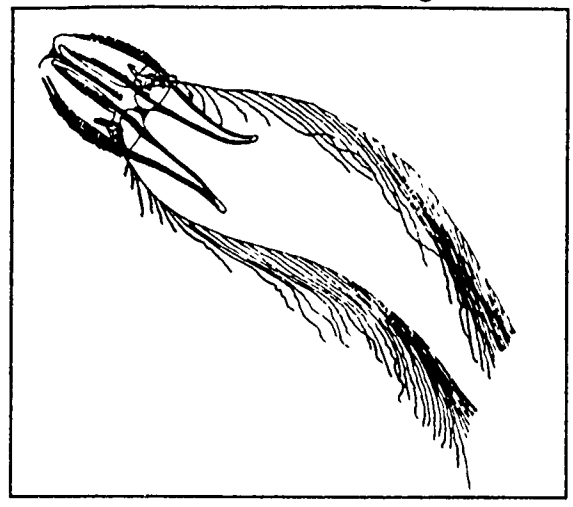
stomodeum - the large first part of the gut into which prey is taken

tentacle sheaths - cavities in the body of cydippids into which the tentacles can be withdrawn

tentacular plane - the plane of symmetry, orthogonal to the stomodeal, in which the tentacle bulbs and sheaths lie

tentilla - side branches off the tentacles, may be simple, complex or coiled

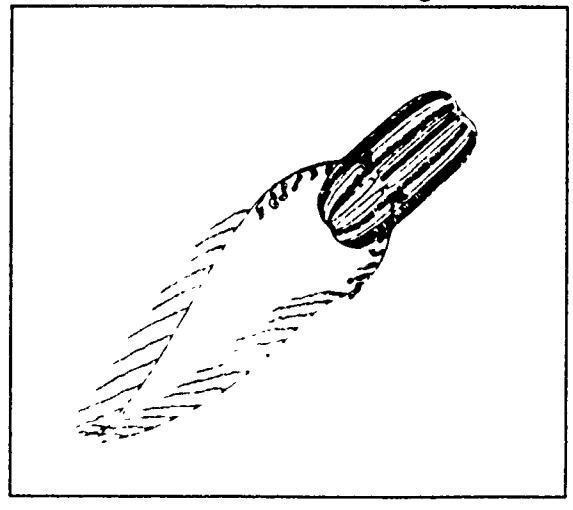
Fig. C-1



SPECIES: ***Callianira bialata***

FAMILY: Mertensiidae
ORDER: Cydippida
SIZE: to 30 mm high
DESCRIPTION: body flattened in stomodeal plane, with 2 long aboral projections, tentacles emerge near aboral end, and have many fine tentilla.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Med. in deep water

Fig. C-2

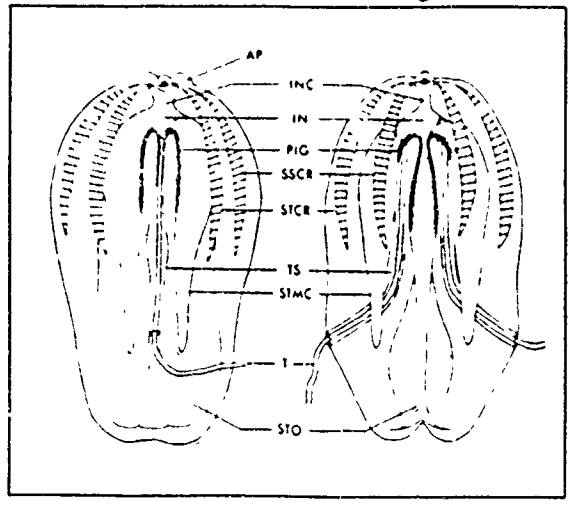


SPECIES: ***Euplokamis stationis***

FAMILY: Euplokamidae
ORDER: Cydippida
SIZE: to 25 mm high
DESCRIPTION: cylindrical or ovoid body, comb rows extend 2/3 body height, tentacles emerge near aboral end, with fine, helically coiled tentilla.
LUMINESCENCE: probable but not published

DISTRIBUTION: Med.

Fig. C-3

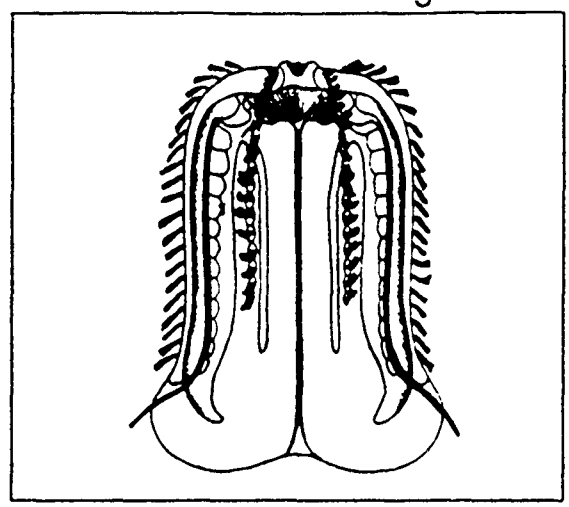


SPECIES: ***Haeckelia bimaculata***

FAMILY: Haeckeliidae
ORDER: Cydippida
SIZE: 3 mm
DESCRIPTION: ellipsoidal body, tentacles lack tentilla, emerge near mouth, large orange spots on stomodeum, small red spots along comb rows, no green pigmentation.
LUMINESCENCE: probable, but not published

DISTRIBUTION: Med.

Fig. C-4

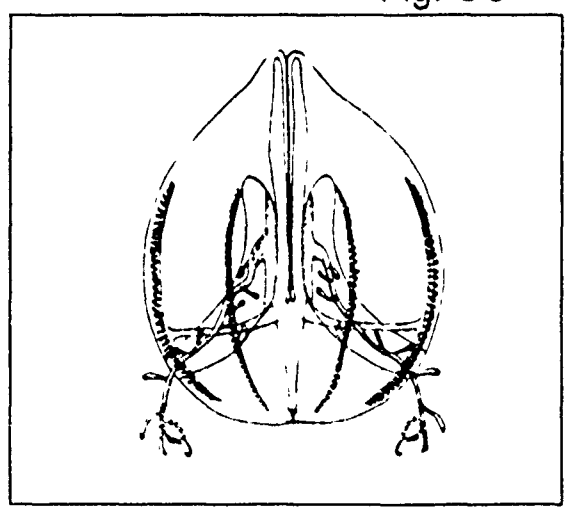


SPECIES: ***Haeckelia rubra***

FAMILY: Haeckeliidae
ORDER: Cydippida
SIZE: to 10 mm high
DESCRIPTION: body short and squareish, large mouth, orange tentacle sheaths, tentacles emerge near mouth, lack tentilla and colloblasts, but have nematocysts.
LUMINESCENCE: probable, but not published

DISTRIBUTION: Atlantic, Pacific, Med. in shallow water

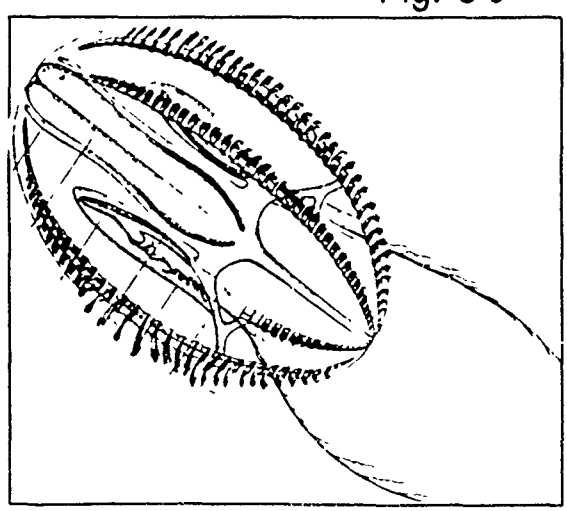
Fig. C-5



SPECIES: ***Hormiphora plumosa***

FAMILY: Pleurobrachiidae
ORDER: Cydippida
SIZE: to 20 mm
DESCRIPTION: ovoid body with elongate oral end, comb rows about 1/2 body height, tentacles emerge aborally, with simple and hand-shaped tentilla.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Med. in shallow water

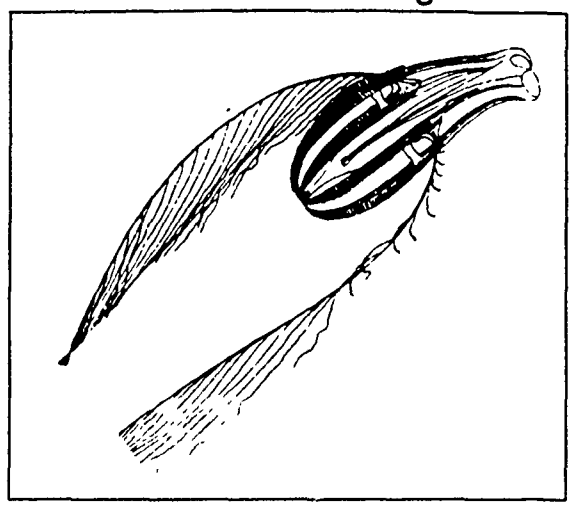
Fig. C-6



SPECIES: ***Hormiphora spatulata***

FAMILY: Pleurobrachiidae
ORDER: Cydippida
SIZE: to 21 mm high
DESCRIPTION: ovoid body, not compressed, tentacles sheaths diverge orally from stomodeum, comb rows almost as long as body, tentacles with 2 sizes of tentilla.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Med.

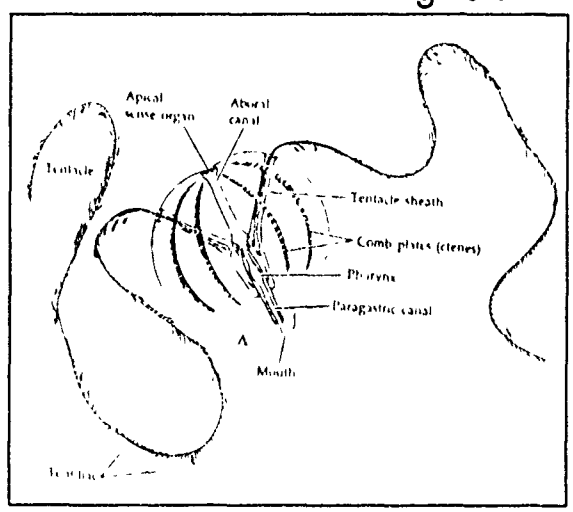
Fig. C-7



SPECIES: ***Lampea pancerina***

FAMILY: Lampeidae
ORDER: Cydippida
SIZE: to 75 mm high
DESCRIPTION: cylindrical body with large, extensile mouth, comb rows 2/3 body height, tentacles emerge orally, with simple tentilla that coil up.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Med. in shallow water

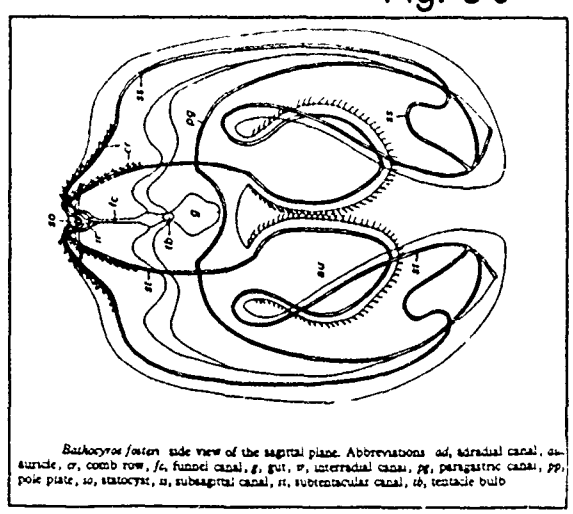
Fig. C-8



SPECIES: ***Pleurobrachia pileus***

FAMILY: Pleurobrachiidae
ORDER: Cydippida
SIZE: to 20 mm high
DESCRIPTION: ovoid body, not compressed, comb rows 3/4 body height, tentacle sheaths distant from stomodeum, tentacles emerge aborally, with fine tentilla.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Med. in shallow water

Fig. C-9



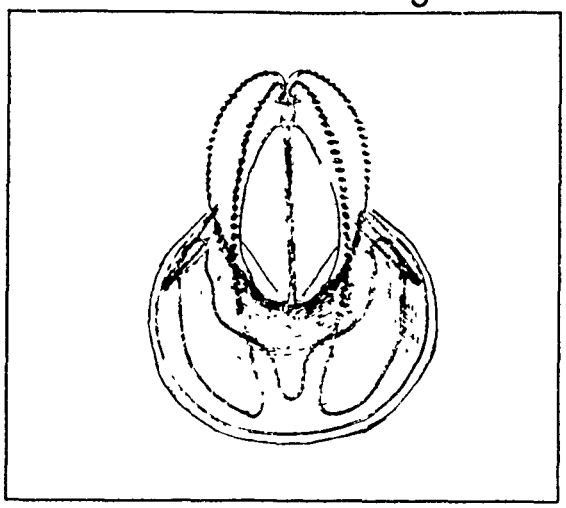
Bathocyroe fosteri, side view of the sagittal plane. Abbreviations: *ad*, adradial canal; *au*, auricle; *cr*, comb row; *fc*, funnel canal; *g*, gut; *ir*, interradial canal; *pg*, paragastric canal; *pp*, pole plate; *so*, statocyst; *ss*, subsagittal canal; *st*, subtentacular canal; *tb*, tentacle bulb

SPECIES: ***Bathocyroe fosteri***

FAMILY: Bathocyroidae
ORDER: Lobata
SIZE: to 40 mm high
DESCRIPTION: short body with broad oral lobes that flap to swim, auricles flat and broad, stomach red, paragastric canals extend onto inner lobe surfaces.
LUMINESCENCE: yes, along comb rows

DISTRIBUTION: Atlantic, Pacific, Med. in deep water

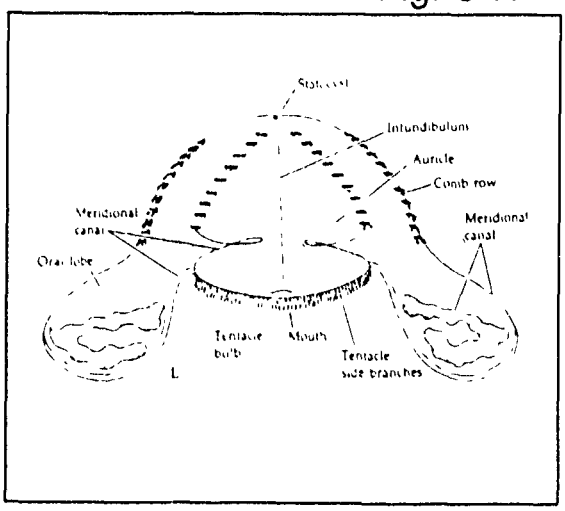
Fig. C-10



SPECIES: ***Bolinopsis vitrea***

FAMILY: Bolinopsidae
ORDER: Lobata
SIZE: to 80 mm high
DESCRIPTION: oval body, compressed in stomodeal plane, oral lobes 1/2 body height, auricles slender, stomodeal canals make simple loops in oral lobes.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Med.

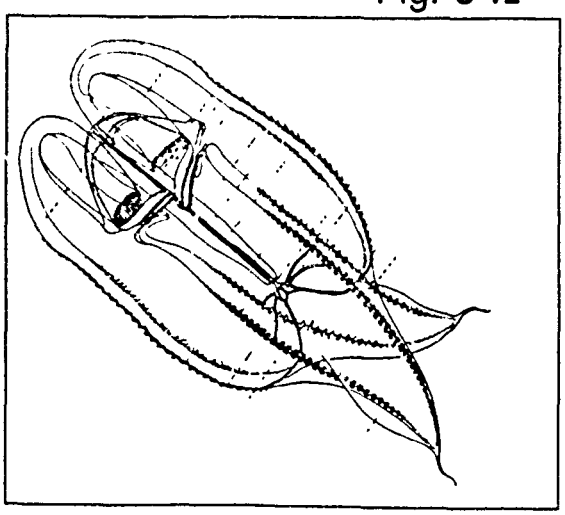
Fig. C-11



SPECIES: ***Deiopea kaloktenota***

FAMILY: Bolinopsidae
ORDER: Lobata
SIZE: to 50 mm high
DESCRIPTION: wide body, strongly compressed in stomodeal plane, short comb rows with few large, widely spaced ctenes, lobes 1/2 body height.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Med. in deep water

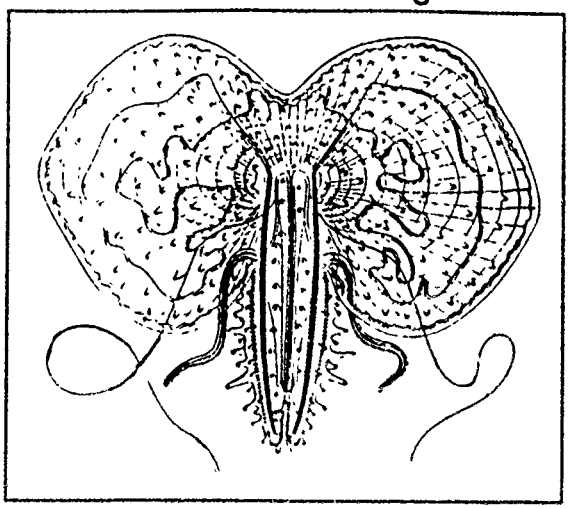
Fig. C-12



SPECIES: ***Eurhamphaea vexilligera***

FAMILY: Eurhamphaeidae
ORDER: Lobata
SIZE: to 150 mm high
DESCRIPTION: long, narrow body with 2 aboral processes, compressed in stomodeal plane, rows of conspicuous red vesicles under comb rows that release ink.
LUMINESCENCE: Herring (1987) lists this genus as definite. Ink is luminescent.
DISTRIBUTION: Atlantic, Pacific, Med.

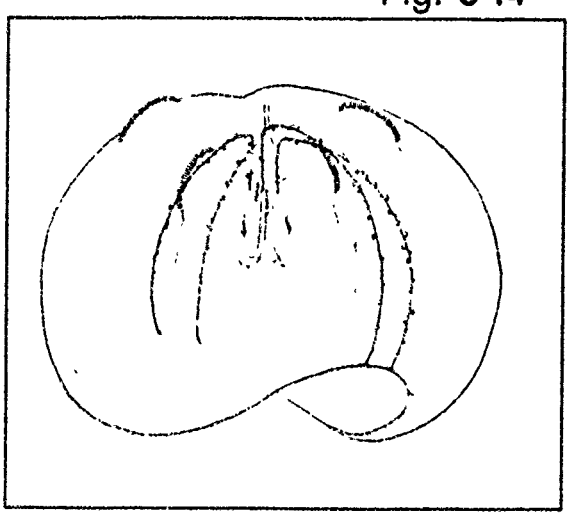
Fig. C-13



SPECIES: ***Leucothea multicornis***

FAMILY: Leucotheidae
ORDER: Lobata
SIZE: to 250 mm high
DESCRIPTION: long body, flattened in stomodeal plane, voluminous oral lobes, extensile papillae on body and lobes, long, sinuous auricles, 2 aboral trailing tentacles.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Med.

Fig. C-14

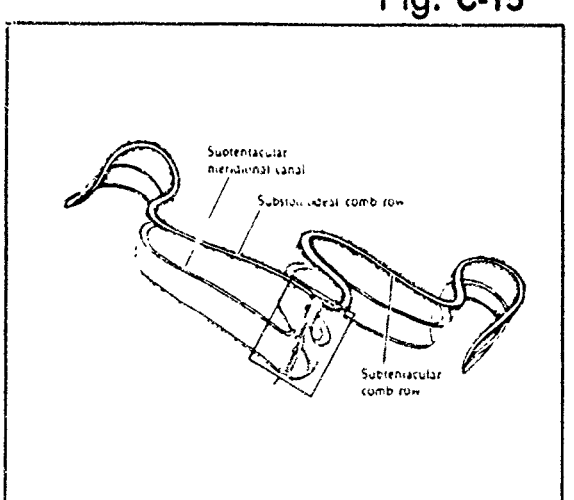


SPECIES: ***Thalassocalyce inconstans***

FAMILY: Thalassocalycidae
ORDER: Thalassocalycida
SIZE: to 150 mm diameter
DESCRIPTION: body umbrella-shaped when expanded, contracts to spherical or bi-lobed form, stomodeum on peduncle, short comb rows, delicate tentacles with tentilla.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Med.

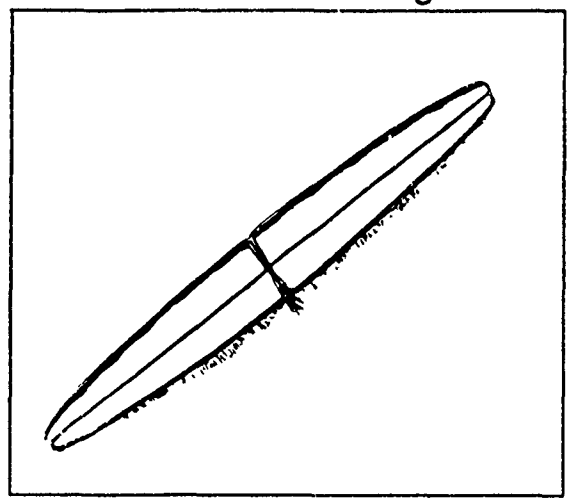
Fig. C-15



SPECIES: ***Cestum veneris***

FAMILY: Cestidae
ORDER: Cestida
SIZE: to 1 m long (wide)
DESCRIPTION: flat, belt-shaped body with central stomodeum, comb rows extend along entire aboral edge, tentacles along oral edge with tentilla covering body sides.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: world-wide

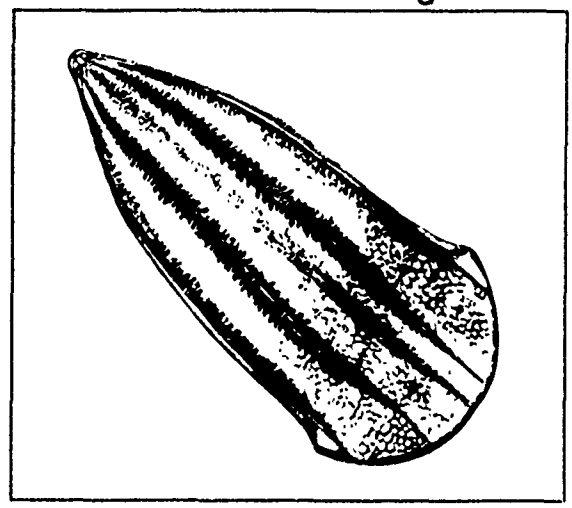
Fig. C-16



SPECIES: ***Velamen parallelum***

FAMILY: Cestidae
ORDER: Cestida
SIZE: to 150 mm long (wide)
DESCRIPTION: body shape like *Cestum* but smaller, gonads form dark dashes along aboral edge, stomodeum short, meridional canals converge in center of body.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Med.

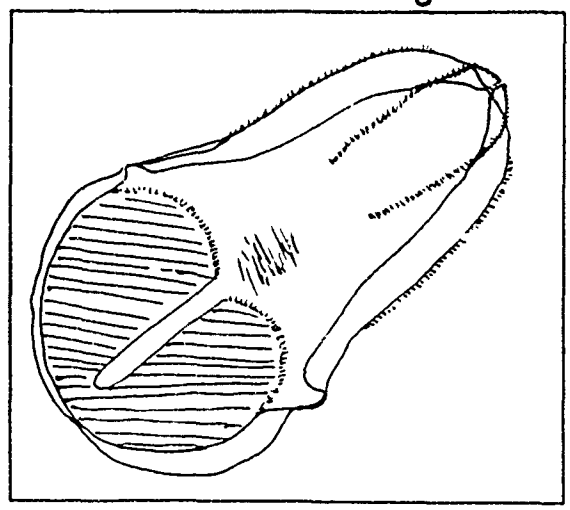
Fig. C-17



SPECIES: ***Beroe forskalii***

FAMILY: Beroidae
ORDER: Beroida
SIZE: to 20 cm high
DESCRIPTION: conical body with wide, flaring mouth, anastomosing diverticula from meridional and paragastric canals, dark pink color overall.
LUMINESCENCE: Herring (1987) lists this genus as definite. Details in Panceri (1872).
DISTRIBUTION: Atlantic, Pacific, Med.

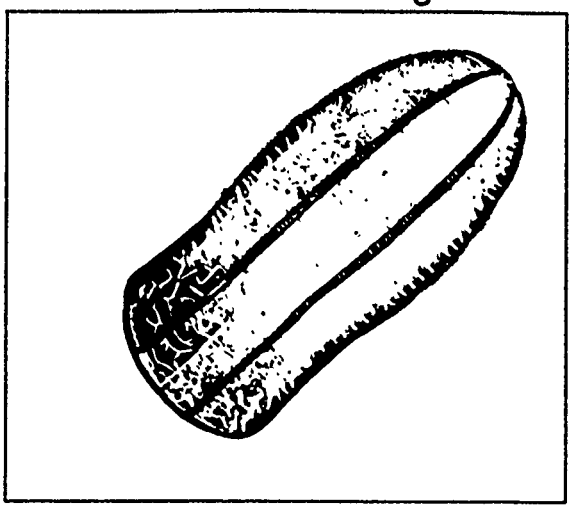
Fig. C-18



SPECIES: ***Beroe mitrata***

FAMILY: Beroidae
ORDER: Beroida
SIZE: to 30 mm high
DESCRIPTION: compressed, mitre-shaped body, large mouth, the few meridional diverticula don't anastomose, but some join paragastrics, orange spot in mid body.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Med.

Fig. C-19



SPECIES: ***Beroe ovata***

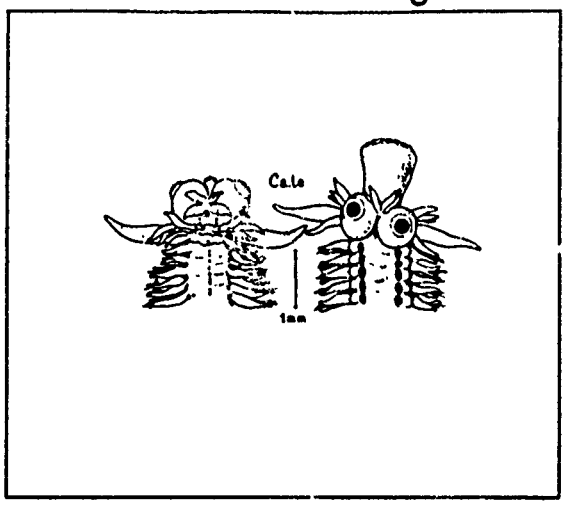
FAMILY: Beroidae
ORDER: Beroida
SIZE: to 115 mm high
DESCRIPTION: body mitre-shaped, moderately compressed, milky to pink, meridional diverticulae anastomose with paragastric branches, not each other.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Med.

Polychaetes and Nudibranchs

Planktonic polychaetes include both adult forms and numerous larval stages of benthic species. The holoplanktonic species typically have large paddle-like parapodia, swim in an undulating fashion and are predators on other zooplankton. At least one widespread genus, *Tomopteris* is reported to be luminescent. Tomopterids in deep water attain lengths of up to 20 cm. There are six families of polychaetes with pelagic genera that are reported to occur in the Mediterranean by Tregouboff and Rose (1957). However only 2 genera have been reported in more recent studies of the western Mediterranean plankton, and those are described here.

There are two genera of holoplanktonic nudibranchs, *Phyllirhoe* and *Cephalopyge*, of which the first is luminescent. Description of *Phyllirhoe* is taken from Lalli and Gilmer (1989) and Tregouboff and Rose (1957).

Fig. P-1

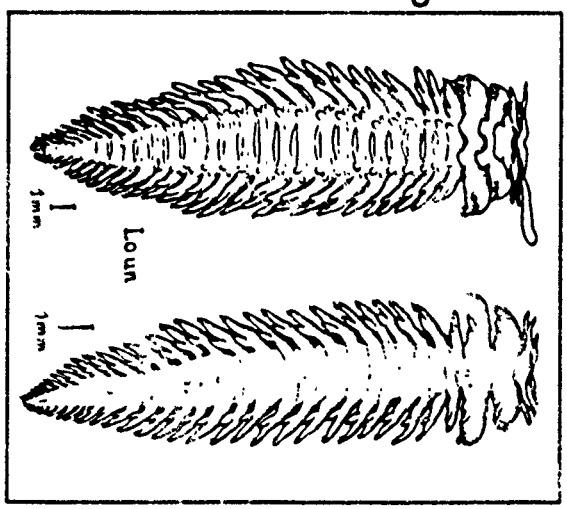


SPECIES: ***Callizonella lepidota***

FAMILY: Alciopidae
SUBCLASS: Errantia
SIZE:
DESCRIPTION: elongate body, large round red eyes, parapodia with 1 cirriform appendage.

LUMINESCENCE: Herring (1987) lists 3 genera in this family as uncertain.
DISTRIBUTION:

Fig. P-2



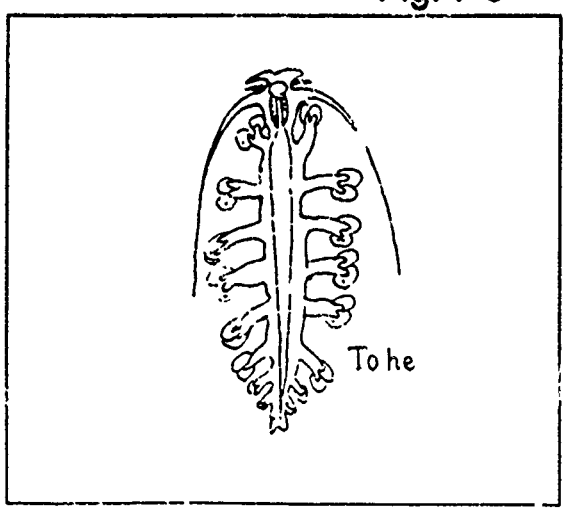
SPECIES: ***Lopadorhynchus uncinatus***

FAMILY: Phyllodocidae
SUBCLASS: Errantia
SIZE: to 20 mm long
DESCRIPTION: broad, tapered body, 4 antennae, no palps, may be dark colored.

LUMINESCENCE: unknown

DISTRIBUTION: Med., Atlantic.

Fig. P-3

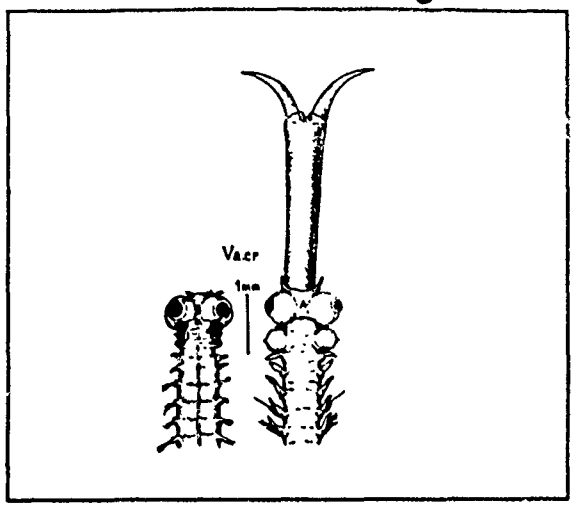


SPECIES: ***Tomopteris helgolandica***

FAMILY: Tomopteridae
SUBCLASS: Errantia
SIZE: to 200 mm
DESCRIPTION: Body usually transparent, with long trailing antennae, paired paddle-like parapodia with conical lobes.

LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: world-wide

Fig. P-4

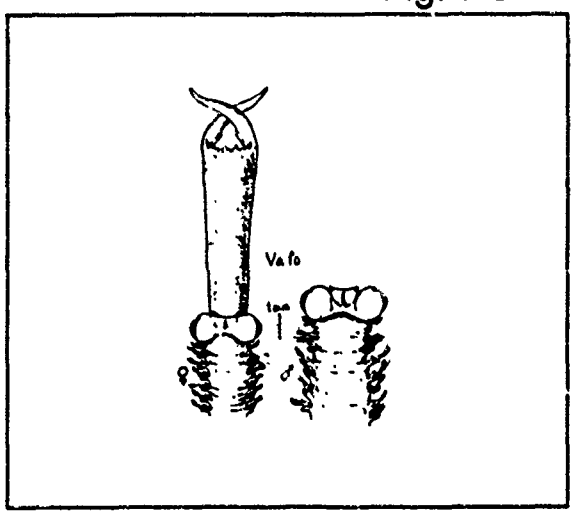


SPECIES: ***Vanadis crystallina***

FAMILY: Alciopidae
SUBCLASS: Errantia
SIZE:
DESCRIPTION: very elongate body, head with conspicuous round red eyes, parapodia with single cirriform appendages.

LUMINESCENCE: Herring (1987) lists 3 genera in this family as uncertain.
DISTRIBUTION: Atlantic, Med.

Fig. P-5

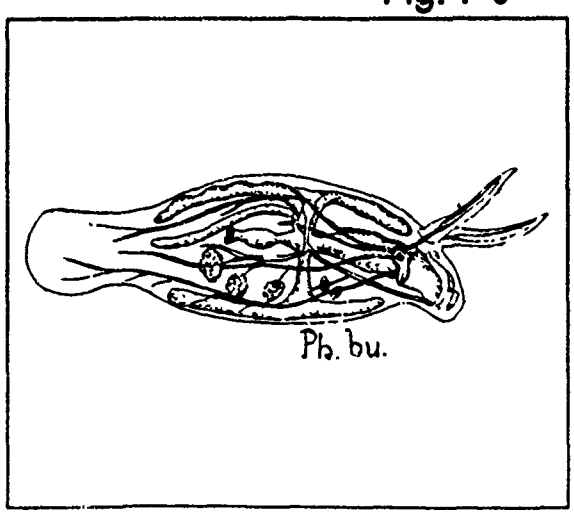


SPECIES: ***Vanadis formosa***

FAMILY: Alciopidae
SUBCLASS: Errantia
SIZE:
DESCRIPTION: very elongate body, head with conspicuous round red eyes, parapodia with single cirriform appendages.

LUMINESCENCE: Herring (1987) lists 3 genera in this family as uncertain.
DISTRIBUTION: Atlantic, Med.

Fig. P-6



SPECIES: ***Phyllirhoe bucephala***

FAMILY: Phylliroidae
ORDER: Nudibranchia
SIZE: to 40 mm
DESCRIPTION: flattened, transparent,leaf-like body with expanded tail, conspicuous internal organs, 2 long anterior tentacles, gills absent and foot reduced.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic Med.

Pelagic Tunicates: Thaliacea and Larvacea

The class Thaliacea includes three orders -- the colonial Pyrosomes, which may range in length up to a meter or more and are strongly bioluminescent, the doliolids, and the salps, which are filter-feeders with tubular bodies and alternating generations. The class Larvacea comprises a single order of small, tadpole-like organisms that produce an external mucous filtering structure called a house. In some genera both the animal and the house are luminescent. They are widely distributed and often abundant.

1. Pyrosomida. The colonies are made up of numerous small ascidian-like zooids embedded in a stiff matrix or tunic. The colony is tubular, with a single terminal opening. Water pumped through each zooid for filter-feeding passes into the lumen of the colony and out the opening for jet propulsion. External morphology of the colony is variable, and although pyrosomas are unmistakable, specific identification is difficult, and there are many uncertain species and synonyms.

2. Doliolida. This order of the Thaliacea comprises small, barrel shaped animals with circumferential muscle bands used to create jet propulsion. The life cycle involves 6 different stages, and at one point includes a large polymorphic colony of thousands of zooids, which may attain lengths over 1 m. These colonies are fragile and rarely collected intact. The taxonomy is usually based on the gonozooid (sexually reproducing) stage, which is single and free-swimming. The oozooid (asexually budding) stage develops into the "nurse" which pulls the polymorphic colony; since this form is fairly sturdy it is often collected intact. Included here are descriptions of the gonozooid (gz) and nurse stages. Doliolids are easily recognized, but not easily identified to species.

3. Salpida. This order is of larger filter feeding animals, also with circumferential muscle bands. The salps alternate between two forms, an asexually budding solitary stage and a sexually reproducing aggregate stage. The aggregate salps usually remain connected together in chains or whorls of various types. The individual animals range in size from 5 to over 100 mm, and chains can be several m long. Descriptions and illustrations of both solitary (s) and aggregate (a) forms are included here.

4. Larvacea. This class is divided into 3 families of small (1-10 mm) animals consisting of a trunk and long, flat tail. Much of the taxonomy is based on arrangement of internal organs, which are difficult to see without using microscopy on fixed specimens. Descriptions are included here only for the more common Mediterranean species, and those characteristics likely to be most apparent in living, whole animals are emphasized.

Descriptions, illustrations and distributional data for Thaliaceans are compiled from Bracconot (1970, 1971), Madin (1974), Madin and Harbison (1978), Madin et al. (1981), Sewell (1953), van Soest (1973, 1974a,b, 1975), Thompson (1948) and Tregouboff and Rose (1957). Information for Larvaceans is mainly from Fenaux (1967), with other material from Galt (1989), Thompson (1948) and Tregouboff and Rose (1957).

Terminology:

body muscles - circumferential muscle bands around the tubular body of salps and doliolids, continuous in the former and interrupted ventrally in the latter

caeca - blind extensions of the gut

cluster - loose radial group of many aggregate *Cyclosalpa polae*

endostyle - ventral organ in thaliaceans and larvaceans that secretes mucus

gonozooid - free-swimming sexually reproductive stage of doliolid

helical chain - chain of aggregate salps arranged in double helix

"light organs" - stripes of opaque tissue along sides of Cyclosalps, sometimes thought to be luminescent

linear chain - chain of aggregates all aligned with zooid axes nearly parallel to chain axis

longitudinal muscle - body muscle of salps that runs longitudinally on the dorsal surface

nurse - later growth stage of doliolid oozooid that loses digestive organs and serves only for locomotion of colony

oblique chain - chain of aggregate salps aligned with zooid axes at oblique angle to chain axis

peduncle - mid-ventral projection on aggregate cyclosalps that attaches them into whorl or cluster

radial whorl - chain of 10-15 cyclosalps arranged like segments of an orange

spiracles - ciliated openings into the pharynx of larvaceans that pump water through the pharyngeal filter net

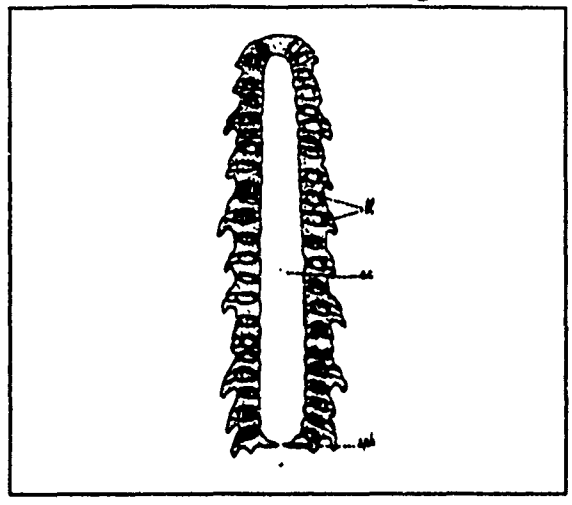
stolon - strand of tissue that buds asexually produced aggregate salps, may remain attached to parent solitary salp while developing

subchordal cells - large cells present in the tails of larvaceans, often in species-specific numbers

test or tunic - the stiff gelatinous part of the body of a salp or pyrosome

transverse chain - chain of aggregate salps aligned with zooid axes perpendicular to the chain axis

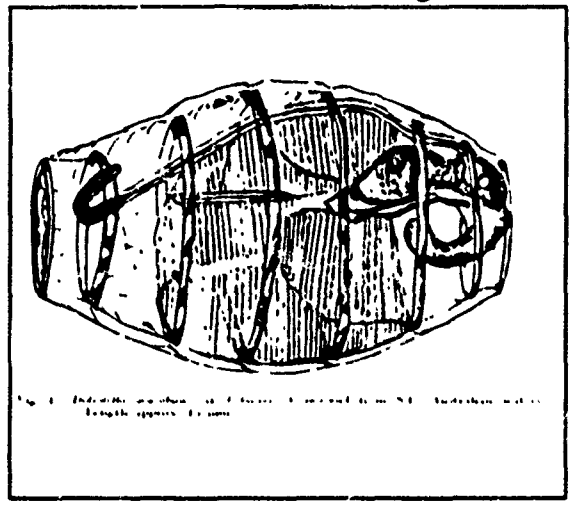
Fig. T-1



SPECIES: ***Pyrosoma atlanticum***

ORDER: Pyrosomida
CLASS: Thaliacea
SIZE: colony to 60 cm
DESCRIPTION: cylindrical colony, colorless to pink or brownish, test fairly rigid with dentate processes of varying length, zooids irregularly arranged in larger colonies.
LUMINESCENCE: Herring (1987) lists this genus as definite. One of the most brightly luminous organisms.
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

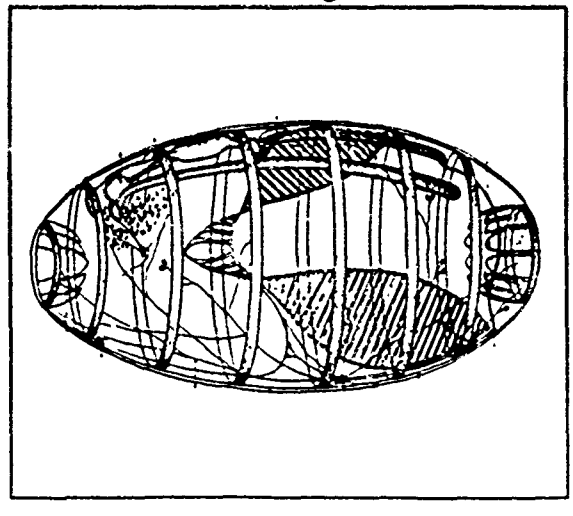
Fig. T-2



SPECIES: ***Doliolella gegenbauri***

ORDER: Doliolida
CLASS: Thaliacea
SIZE: gz 10 mm
DESCRIPTION: gz: barrel shaped, 8 circular body muscles, gut mid-ventral, in tight dextral coil. nurse: with muscles 3,4 wider than the others.
LUMINESCENCE: Herring (1987) lists the genus *Doliolum* in this order as uncertain.
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

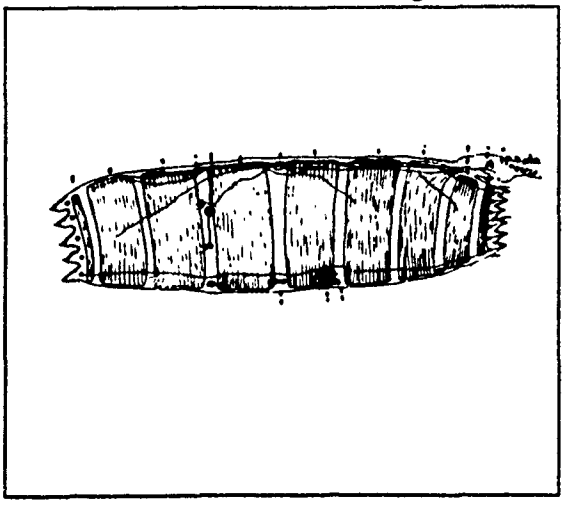
Fig. T-3



SPECIES: ***Doliolum denticulatum***

ORDER: Doliolida
CLASS: Thaliacea
SIZE: gz 10 mm, nurse 15 mm
DESCRIPTION: gz: barrel-shaped, with 8 body muscles, scalloped oral valve, gut in a broad curve on ventral floor. nurse: body muscles fused into continuous sheet.
LUMINESCENCE: Herring (1987) lists this genus as uncertain.
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

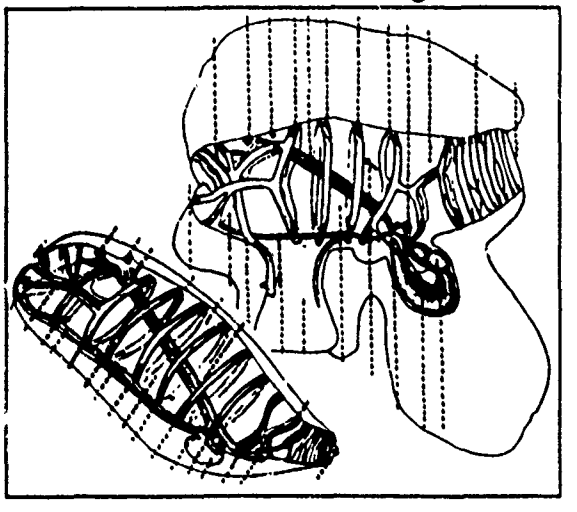
Fig. T-4



SPECIES: ***Doliolum mulleri***

ORDER: Doliolida
CLASS: Thaliacea
SIZE: gz 4 mm, nurse 8 mm
DESCRIPTION: gz: barrel-shaped body, 8 muscles, gut forms upright U or S-shaped loop. nurse: body muscles fused into continuous sheet.
LUMINESCENCE: Herring (1987) lists this genus as uncertain.
DISTRIBUTION: Atlantic, Med.

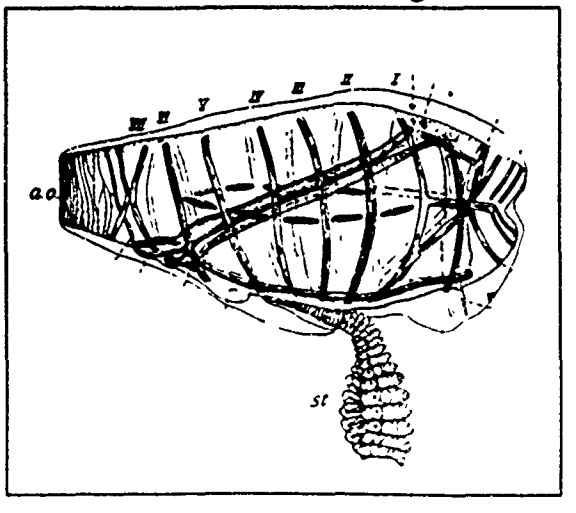
Fig. T-5



SPECIES: ***Cyclosalpa affinis***

ORDER: Salpida
CLASS: Thaliacea
SIZE: s to 80 mm, a to 60 mm
DESCRIPTION: s: cylindrical body, 7 body muscles, 1st 2 interrupted dorsally, no "light organs". a: 4 body muscles, short ventral peduncle, gut in open loop, radial whorls, connected in chains.
LUMINESCENCE: Herring (1987) lists this genus as uncertain
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

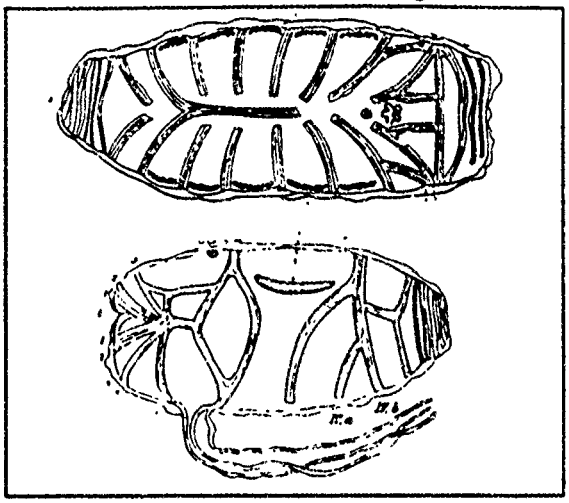
Fig. T-6



SPECIES: ***Cyclosalpa pinnata***

ORDER: Salpida
CLASS: Thaliacea
SIZE: s to 75 mm, a to 65 mm
DESCRIPTION: s: 7 body muscles, interrupted dorsally, linear gut with 2 caeca, 5 purple "light organs" on each side. a: 4 body muscles, short peduncle, 1 light organ on each side, in radial whorls of 10-15 salps.
LUMINESCENCE: Herring (1987) lists this genus as uncertain
DISTRIBUTION: Atlantic, Med.

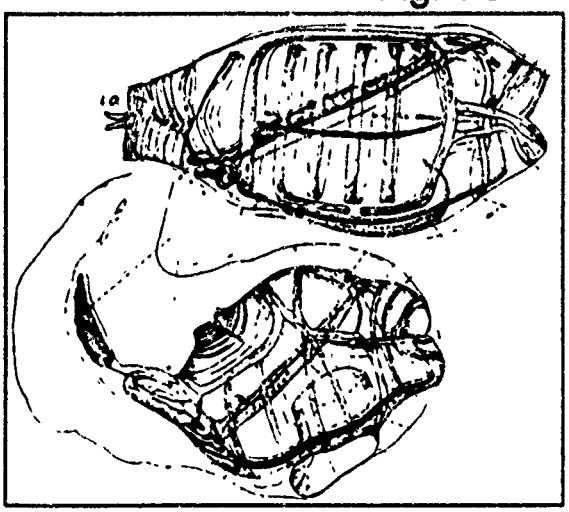
Fig. T-7



SPECIES: ***Cyclosalpa polae***

ORDER: Salpida
CLASS: Thaliacea
SIZE: s to 80 mm, a to 40 mm
DESCRIPTION: s: 7 body muscles, interrupted dorsally, 6th forms longitudinal muscle, 5 white "light organs" on each side. a: 4 body muscles, long peduncle, 1 light organ each side, in clusters of up to 200 salps.
LUMINESCENCE: Herring (1987) lists this genus as uncertain
DISTRIBUTION: Atlantic, Med.

Fig. T-9

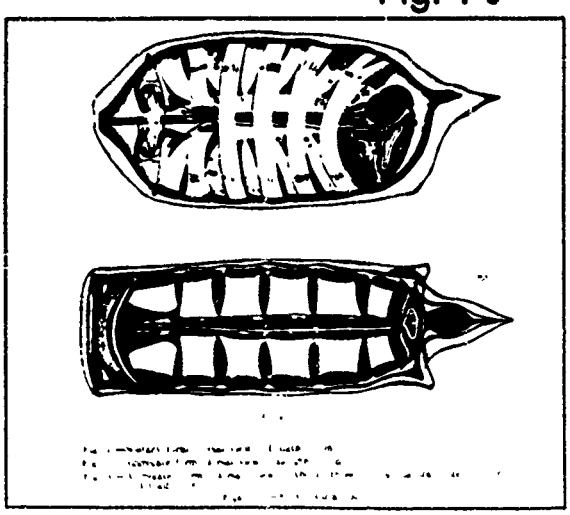


SPECIES: ***Helicosalpa virgula***

ORDER: Salpida
CLASS: Thaliacea
SIZE: s to 180 mm, a to 35 mm
DESCRIPTION: s: 7 body muscles interrupted by paired longitudinal muscles, 1 "light organ" on each side, linear gut with 2 caeca. a: asymmetric, 4 body muscles, testis in posterior projection, helical chain.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. T-9

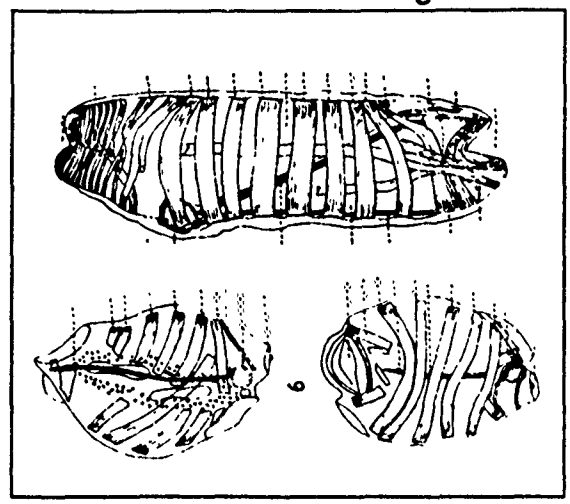


SPECIES: ***Iasis zonaria***

ORDER: Salpida
CLASS: Thaliacea
SIZE: s to 65 mm, a to 50 mm
DESCRIPTION: s: elongate, prismatic with stiff test, 5 broad body muscles, stolon coils around compact gut. a: stiff test, asymmetrical, 5 broad muscles, in tight linear chain.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med.

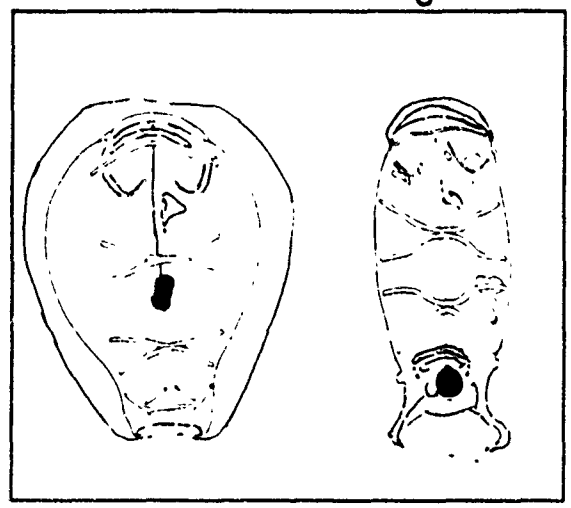
Fig. T-10



SPECIES: ***Ihlea punctata***

ORDER: Salpida
CLASS: Thaliacea
SIZE: s to 70 mm, a to 23 mm
DESCRIPTION: s: 9 wide body muscles, some fused dorsally, yellow pigment band around body, round gut. a: 6 asymmetric body muscles, orange-red spots on ventral side, linear chain.
LUMINESCENCE: unknown
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. T-11

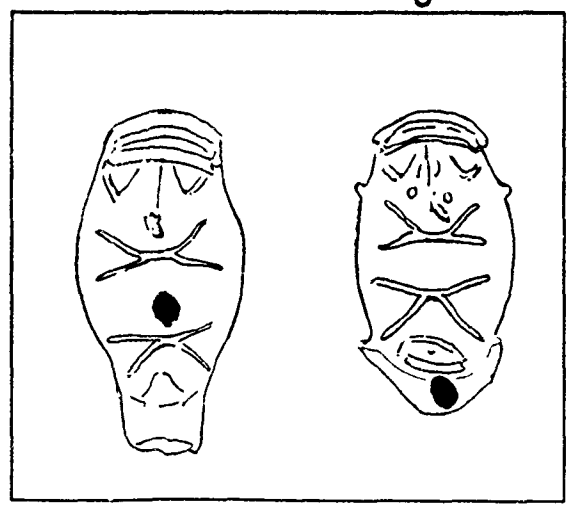


SPECIES: ***Pegea bicaudata***

ORDER: Salpida
CLASS: Thaliacea
SIZE: s to 72 mm, a to to 80 mm
DESCRIPTION: s: globular test with diffuse yellow or red pigment, 4 body muscles, stolon coils around gut. a: cylindrical test with yellow pigmentation posteriorly, 2 "tails", 4 body muscles, transverse chain.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med.

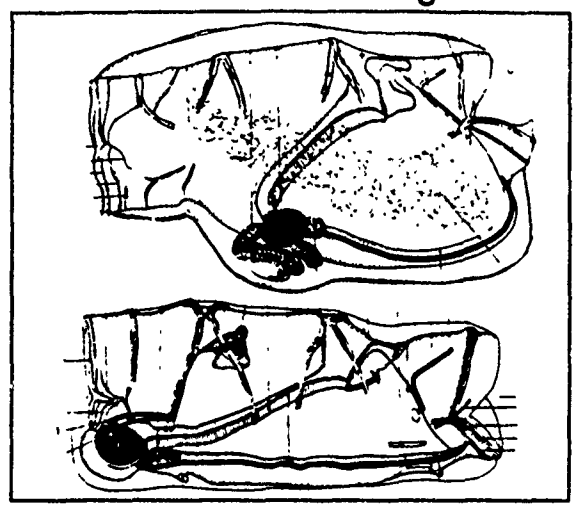
Fig. T-12



SPECIES: ***Pegea confoederata***

ORDER: Salpida
CLASS: Thaliacea
SIZE: s to 90 mm, a to 110 mm
DESCRIPTION: s: test more cylindrical, with reticulate brown pigmentation, reddish-brown spherical gut. a: short, plump body with thick test around gut, no processes, transverse chain.
LUMINESCENCE: unknown
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

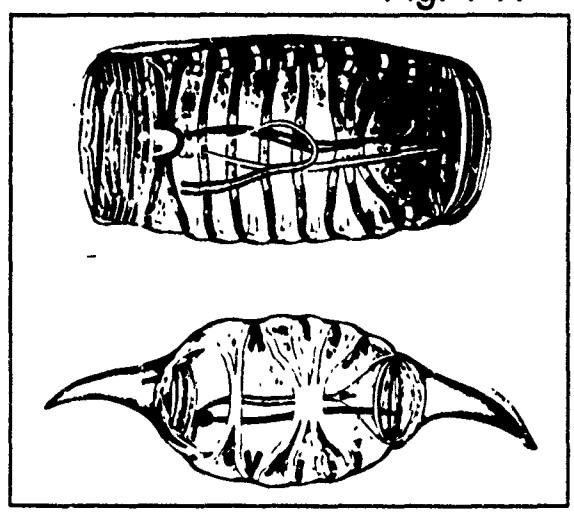
Fig. T-13



SPECIES: ***Pegea socia***

ORDER: Salpida
CLASS: Thaliacea
SIZE: s to 140 mm, a to 120 mm
DESCRIPTION: s: plump body with yellow band of pigment along each side, stolon coils twice around gut. a: body cylindrical, uniform gold pigmentation, no processes, transverse chain.
LUMINESCENCE: unknown
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. T-14

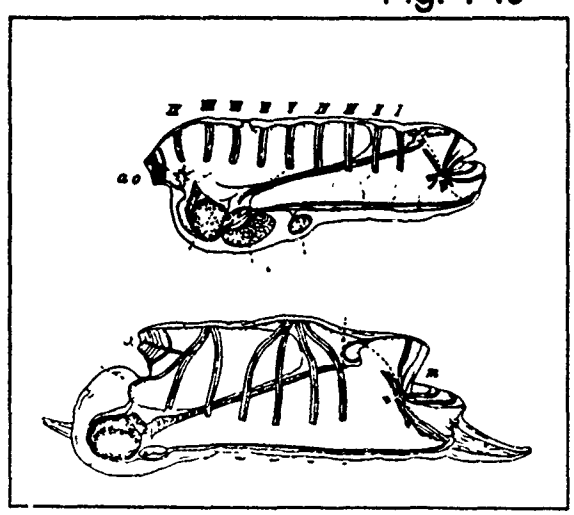


SPECIES: ***Salpa fusiformis***

ORDER: Salpida
CLASS: Thaliacea
SIZE: s to 55 mm, a to 52 mm
DESCRIPTION: s: smooth symmetric body, 9 body muscles, small, round, reddish gut. a: fusiform body with long anterior, posterior projections, 6 body muscles, linear chain.
LUMINESCENCE: unknown

DISTRIBUTION: world-wide and common

Fig. T-15

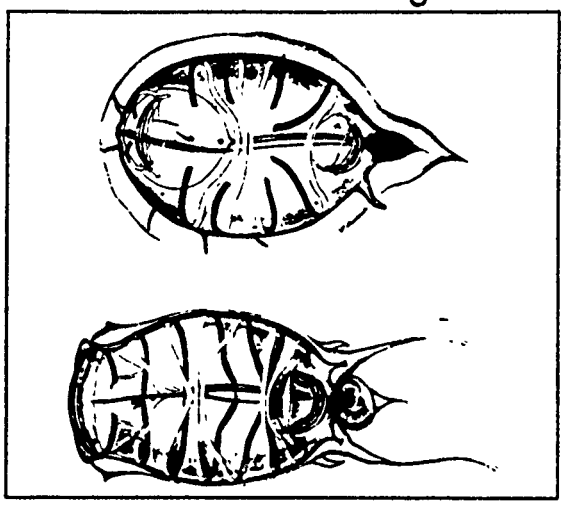


SPECIES: ***Salpa maxima***

ORDER: Salpida
CLASS: Thaliacea
SIZE: s to 180 mm, a to 100 mm
DESCRIPTION: s: smooth body, thick test, 9 body muscles parallel on dorsal side, large round, red gut. a: cylindrical with short anterior, posterior projections, 6 body muscles, round gut, linear chain
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. T-16

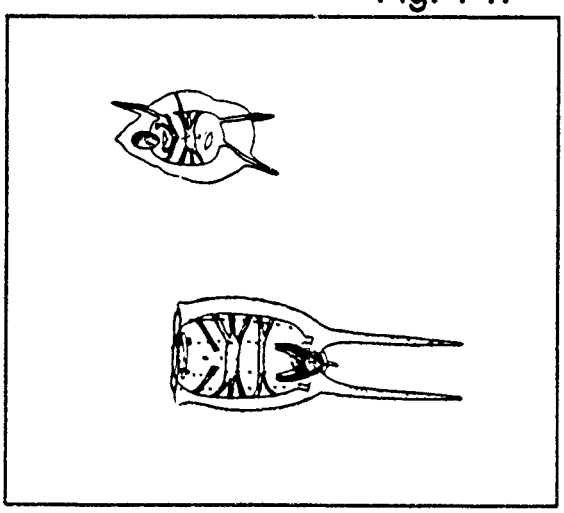


SPECIES: ***Thalia democratica***

ORDER: Salpida
CLASS: Thaliacea
SIZE: s to 15 mm, a to 18 mm
DESCRIPTION: s: 6 body muscles, 2 long posterior projections, shorter projections around gut, round, blue or brown gut. a: ovoid body, 5 body muscles, posterior projection of gut, oblique chain.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. T-17

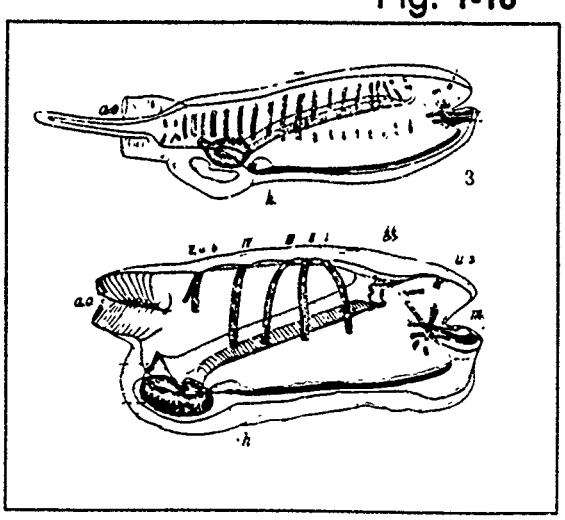


SPECIES: ***Thalia orientalis***

ORDER: Salpida
CLASS: Thaliacea
SIZE: s to 7 mm, a to 5 mm
DESCRIPTION: 6 body muscles, 2 very long posterior projections, 8 toothed ridges along test, no lateral projections. a: ovoid body, thick test, 5 body muscles, no gut projection, oblique chain.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. T-18

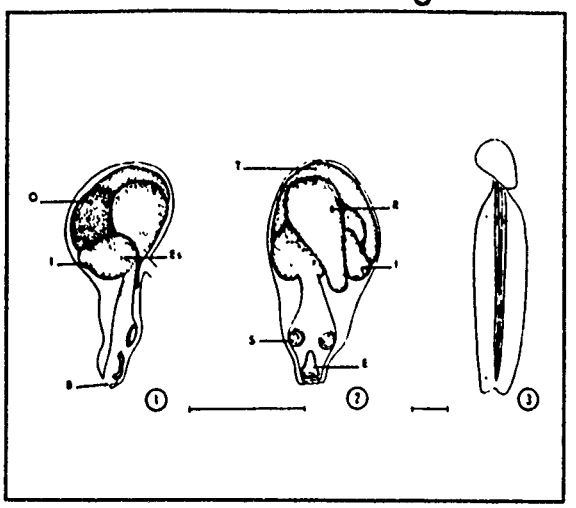


SPECIES: ***Thetys vagina***

ORDER: Salpida
CLASS: Thaliacea
SIZE: s to 300 mm, a to 120 mm
DESCRIPTION: s: 16-22 body muscles, body broad at mouth, tapered at posterior, with 2 lateral appendages. Test thick, greenish. a: cylindrical body, thick test of greenish hue. 5 body muscles, interrupted dorsally.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. T-19



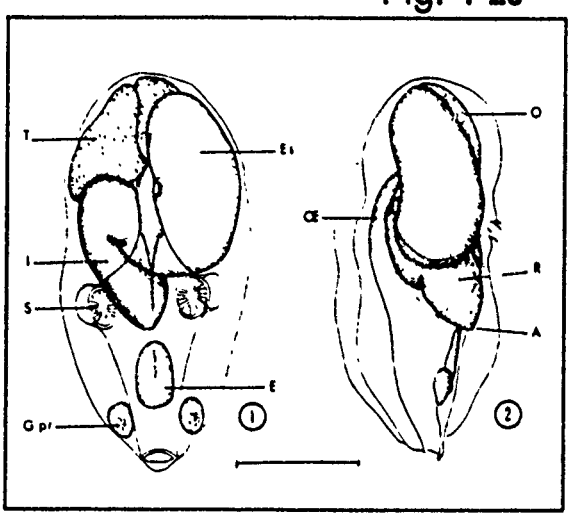
SPECIES: ***Appendicularia sicula***

FAMILY: Fritillaridae
CLASS: Larvacea
SIZE: trunk 0.5 mm, entire 1.5 mm
DESCRIPTION: short, pear-shaped trunk, round mouth without lips, tail is broad, narrows near attachment to trunk.

LUMINESCENCE: unknown

DISTRIBUTION: world-wide in warm or temperate water

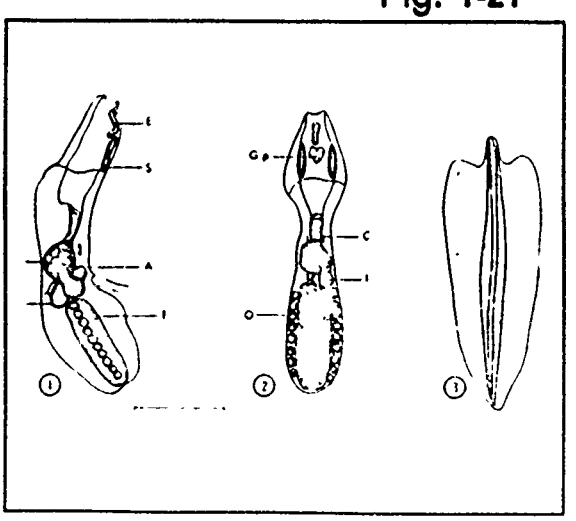
Fig. T-20



SPECIES: ***Folia gracilis***

FAMILY: Oikopleuridae
CLASS: Larvacea
SIZE: trunk 0.6 mm
DESCRIPTION: ovoid trunk, flattened dorso-ventrally, narrow mouth with small ventral lip, tail pointed distally, lacks subchordal cells.
LUMINESCENCE: Herring (1987) lists *Oikopleura* in this family as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. T-21



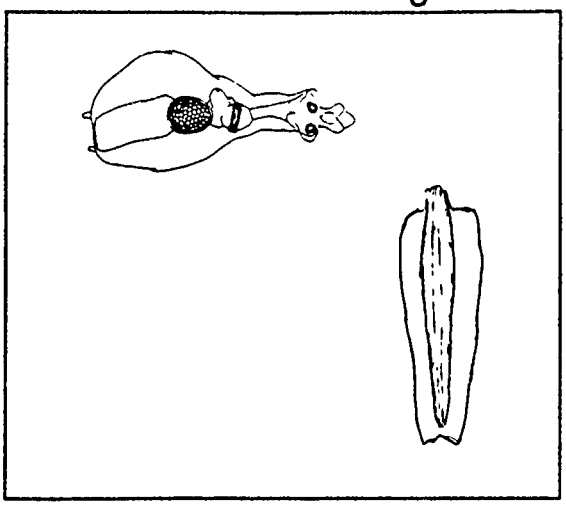
SPECIES: ***Fritillaria aequatorialis***

FAMILY: Fritillaridae
CLASS: Larvacea
SIZE: trunk 0.7 mm, entire 1.0 mm
DESCRIPTION: trunk long and narrow with enlarged pharynx, leaf-shaped tail with pointed end attaches at middle of trunk.

LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Med.

Fig. T-22



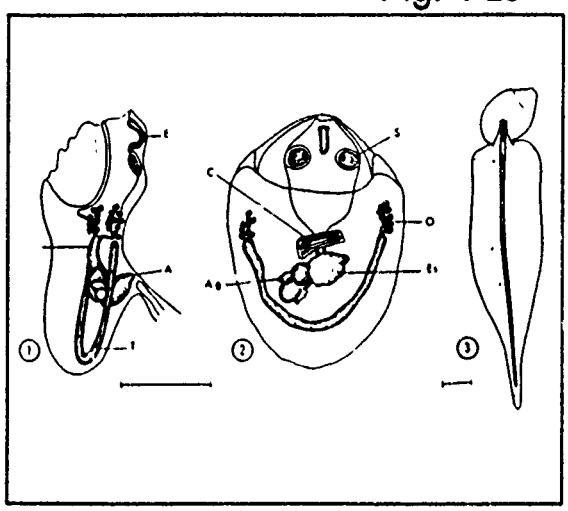
SPECIES: ***Fritillaria borealis***

FAMILY: Fritillaridae
CLASS: Larvacea
SIZE:
DESCRIPTION: pear-shaped trunk, mouth with rounded lip, tail rectangular, with central musculature and incised end.

LUMINESCENCE: unknown

DISTRIBUTION: world-wide

Fig. T-23



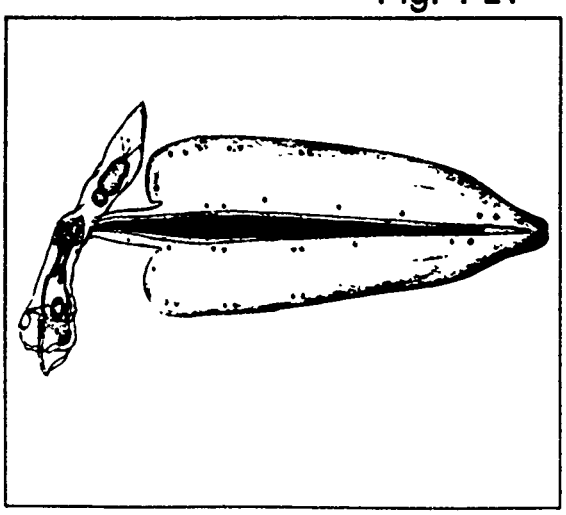
SPECIES: ***Fritillaria gracilis***

FAMILY: Fritillaridae
CLASS: Larvacea
SIZE: trunk 0.7 mm, entire 2.7 mm
DESCRIPTION: trunk oval, broader at anterior end, mouth without lips, tail sharply narrowed at distal end.

LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. T-24



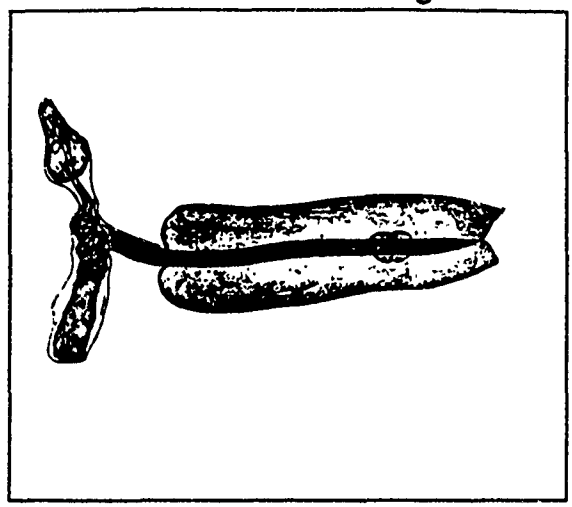
SPECIES: ***Fritillaria haplostoma***

FAMILY: Fritillaridae
CLASS: Larvacea
SIZE: trunk 1.0 mm, entire 2.3 mm
DESCRIPTION: long, narrow trunk, mouth with 1 large upper lip and 2 small lower lips, tail lanceolate, with scattered gland cells.

LUMINESCENCE: unknown

DISTRIBUTION: world-wide in warm water

Fig. T-25

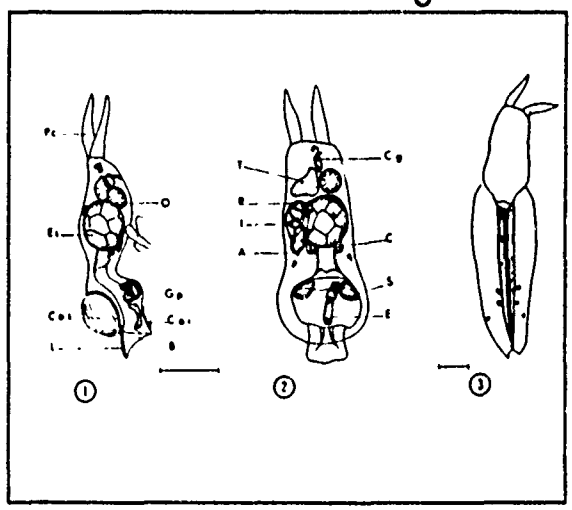


SPECIES: ***Fritillaria megachile***

FAMILY: Fritillaridae
CLASS: Larvacea
SIZE: trunk 2.0 mm, entire 4.0 mm
DESCRIPTION: trunk slim and elongate, not curved, mouth with large upper lip and 2 small lower lips, tail broadly rectangular with notched end, scattered gland cells.
LUMINESCENCE: unknown

DISTRIBUTION: world-wide in warm water

Fig. T-26



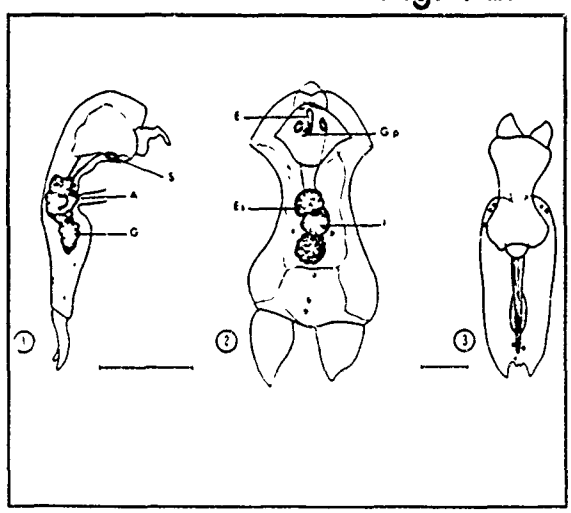
SPECIES: ***Fritillaria pellucida***

FAMILY: Fritillaridae
CLASS: Larvacea
SIZE: trunk 1.5 mm, entire 3.0 mm
DESCRIPTION: trunk elongate with enlarged anterior end, 2 conspicuous conical horns on posterior, tail broad with V notch in end.

LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med. very common

Fig. T-27

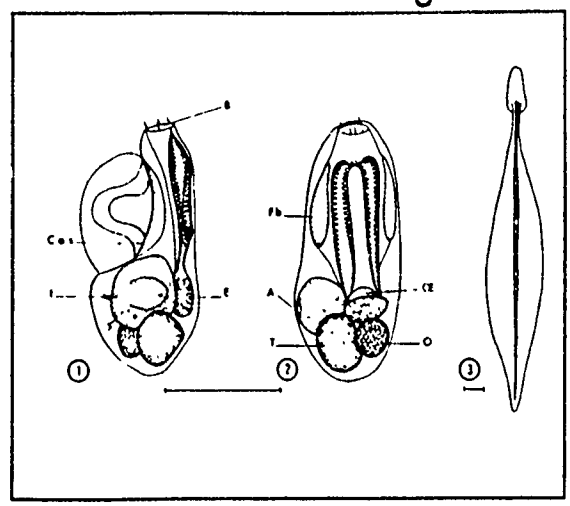


SPECIES: ***Fritillaria venusta***

FAMILY: Fritillaridae
CLASS: Larvacea
SIZE: trunk 1.5 mm, entire 2.5 mm
DESCRIPTION: trunk hourglass-shape from from above, flattened dorso-ventrally, with 2 large, flat horns posteriorly, mouth with large upper lip, tail lanceolate, notched.
LUMINESCENCE: unknown

DISTRIBUTION: world-wide

Fig. T-28

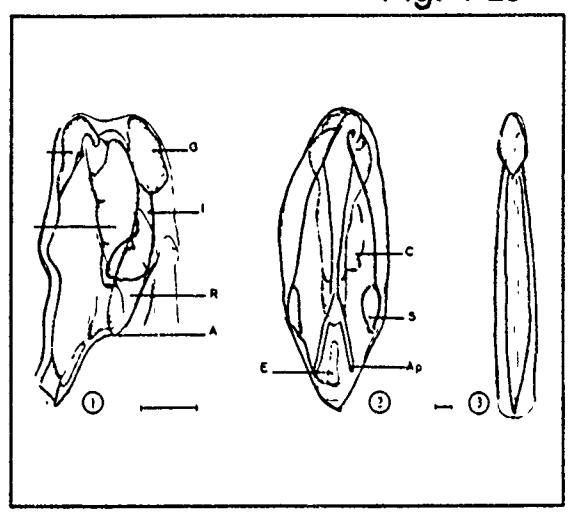


SPECIES: ***Kowalevskia tenuis***

FAMILY: Kowalevskiidae
CLASS: Larvacea
SIZE: trunk 1.0 mm, entire 8.0 mm
DESCRIPTION: trunk short, without endostyle, spiracles or heart, large rounded mouth, narrow, lanceolate tail, much longer than trunk.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Antarctic, Med.

Fig. T-29

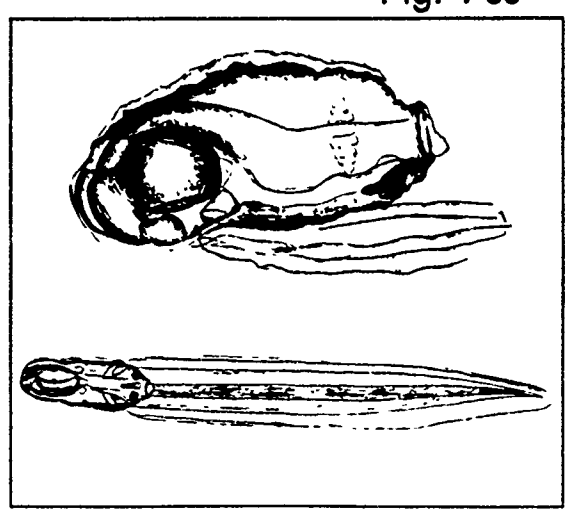


SPECIES: ***Megalocercus abyssorum***

FAMILY: Oikopleuridae
CLASS: Larvacea
SIZE: trunk 5 mm, entire 30 mm
DESCRIPTION: ovoid trunk, with red-orange pigmentation, fairly small mouth with lower lip, tail broad, muscular with blunt end.

LUMINESCENCE: Herring (1987) lists *Oikopleura* in this family as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Med. in deep water

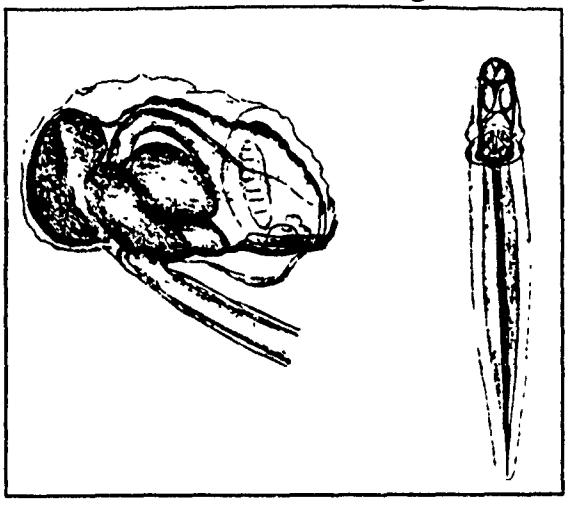
Fig. T-30



SPECIES: ***Oikopleura albicans***

FAMILY: Oikopleuridae
CLASS: Larvacea
SIZE: trunk 4 mm, entire 7 mm
DESCRIPTION: trunk slender and elongate, conspicuous large white gonads in mature animals, tail slender and pointed, well developed muscles.
LUMINESCENCE: Herring (1987) lists this genus as definite. House is also luminous (Galt, 1969).
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

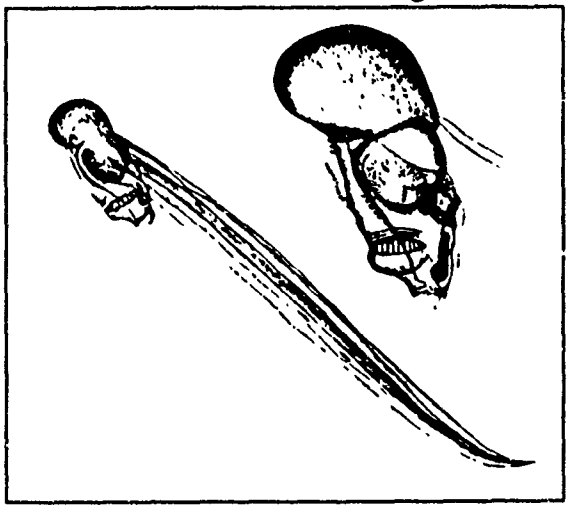
Fig. T-31



SPECIES: ***Oikopleura cophocerca***

FAMILY: Oikopleuridae
CLASS: Larvacea
SIZE: trunk 0.7 mm, entire 2.6 mm
DESCRIPTION: trunk nearly rectangular, but tapered at anterior, fairly large mouth with prominent lower lip, tail muscular, with tapered end.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

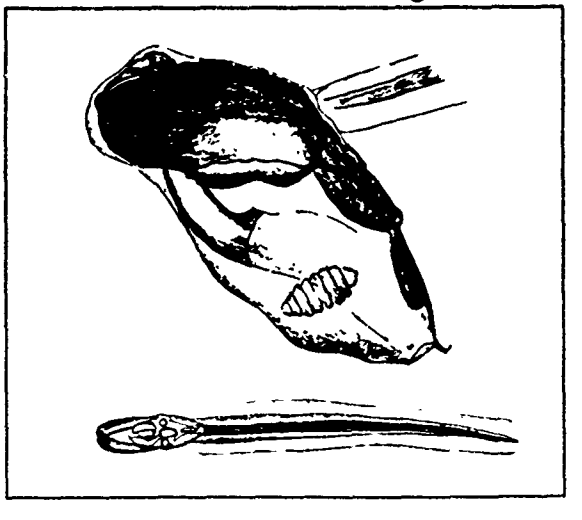
Fig. T-32



SPECIES: ***Oikopleura dioica***

FAMILY: Oikopleuridae
CLASS: Larvacea
SIZE: trunk 0.5 mm, entire 1.5 mm
DESCRIPTION: small, globular trunk, separate sexes, terminal mouth with small lower lip, tail with narrow musculature and pointed tip.
LUMINESCENCE: Herring (1987) lists this genus as definite. House is also luminous (Galt, 1969).
DISTRIBUTION: world-wide except Antarctic

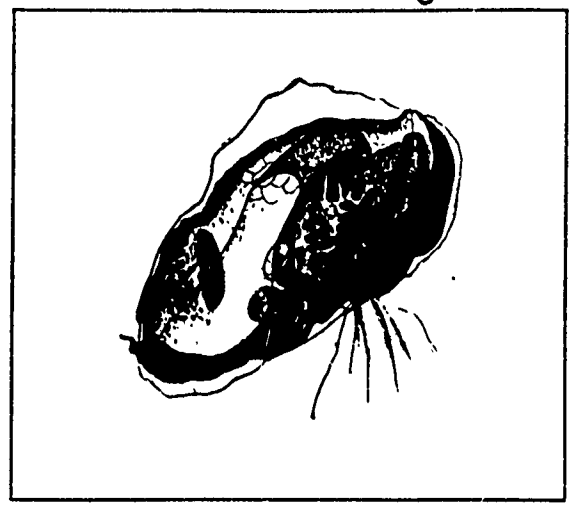
Fig. T-33



SPECIES: ***Oikopleura fusiformis***

FAMILY: Oikopleuridae
CLASS: Larvacea
SIZE: trunk 0.5 mm, entire 3.0 mm
DESCRIPTION: trunk elongate, ovoid, flat dorsal surface, mouth opens obliquely upwards, tail long and slim, without subchordal cells.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: world-wide except Antarctic

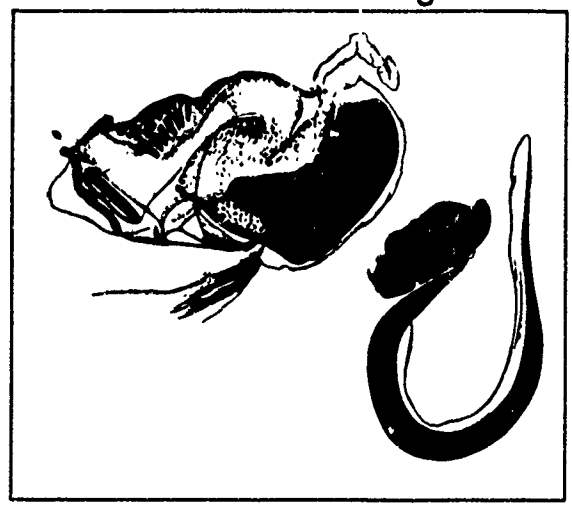
Fig. T-34



SPECIES: ***Oikopleura intermedia***

FAMILY: Oikopleuridae
CLASS: Larvacea
SIZE: trunk 1.5 mm, entire 5.0 mm
DESCRIPTION: ovoid trunk, tapered anteriorly, with convex dorsal surface, mouth opens obliquely upwards, tail with broad musculature, rounded tip.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

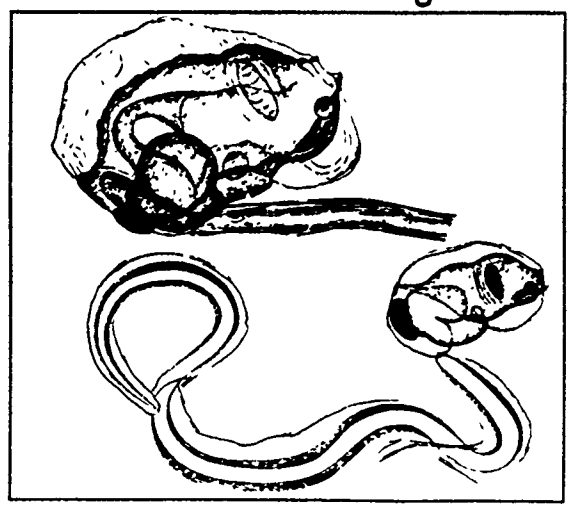
Fig. T-35



SPECIES: ***Oikopleura longicauda***

FAMILY: Oikopleuridae
CLASS: Larvacea
SIZE: trunk 0.7 mm, entire 3.5 mm
DESCRIPTION: short, ovoid trunk with characteristic membranous hood over posterior dorsal part, tail with broad musculature, rounded tip.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: world-wide, the commonest warm water species.

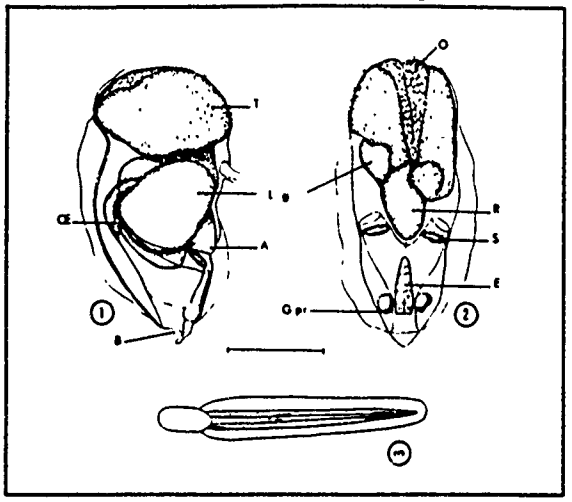
Fig. T-36



SPECIES: ***Oikopleura parva***

FAMILY: Oikopleuridae
CLASS: Larvacea
SIZE: trunk 0.5 mm, entire 3.0 mm
DESCRIPTION: trunk slender, ovoid, mouth opens anteriorly, with small lower lip, tail with narrow musculature, 4 subchordal cells near tip.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: world-wide in midwater

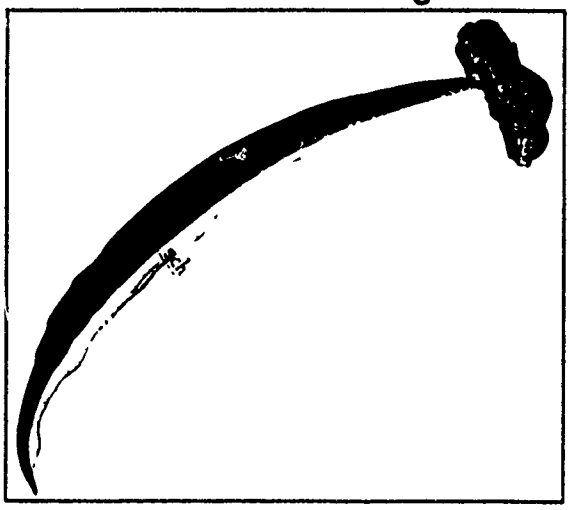
Fig. T-37



SPECIES: ***Oikopleura rufescens***

FAMILY: Oikopleuridae
CLASS: Larvacea
SIZE: trunk 1.5 mm, entire 5.0 mm
DESCRIPTION: trunk short and ovoid, with strongly convex dorsal side, terminal mouth with small lower lip, tail broad with narrow musculature and 1 large subchordal cell.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Med. common

Fig. T-38



SPECIES: ***Stegosoma magnum***

FAMILY: Oikopleuridae
CLASS: Larvacea
SIZE: trunk 3.0 mm, entire 10 mm
DESCRIPTION: trunk elongate and laterally compressed, with arched anterior dorsal surface, small terminal mouth, tail long with narrow musculature, 8 subchordal cells.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Crustaceans

Crustaceans, especially copepods, are almost invariably the most abundant and often the most diverse constituent of the zooplankton. Some of the copepods and ostracods, and most of the euphausiids and decapods are known to be luminescent. Some possess discrete photophores and others discharge luminous secretions. A complete systematic coverage of the crustacean zooplankton of the western Mediterranean is well beyond the scope of this summary. Therefore this is not a comprehensive listing of the Mediterranean fauna, but those species of amphipods, euphausiids, mysids, ostracods, copepods and decapods reported in recent zooplankton studies or from submersible observations in the western Mediterranean are summarized in Table 9. Of those 88 species, 45, including most that are thought to be luminescent, are described and illustrated here. Some reports cited in Table 9 do not identify copepods or ostracods to species; in cases where the genus is luminescent, a common species within it is given here as an example. "M" = male, "F" = female.

Because of the diversity and complexity of crustaceans, identification to species, especially of copepods, can be difficult, and require expert familiarity with morphology of the body and appendages, and the accompanying descriptive terminology. Descriptions here refer where possible to general body shape and other characters that can be seen in live animals under a dissecting microscope. Identification of some groups may require the assistance of a specialist.

Classification, descriptions and illustrations for amphipods are compiled from Bowman and Gruner (1973), Shoemaker (1945), Stephensen (1925), Pillai, (1966a,b) and Tregouboff and Rose (1957). Information on copepods is principally from Rose (1933) with additional material from Owre and Foyo (1967), Tanaka (1956a,b, 1957, 1961, 1963, 1964) and Tregouboff and Rose. Ostracod descriptions are from Tregouboff and Rose. Descriptions and illustration of euphausiids are from Brinton (1975), Boden et al. (1955), Mauchline (1971), Wiebe (1976) and Tregouboff and Rose. Data on decapods is compiled from Crosnier and Forest (1973), Stephensen (1923) and Rice (1967).

Terminology

basal plate - the first segment of a pereopod, enlarged into a flat plate

cephalothorax - the fused head and thorax of a copepod

chelate - having a claw in which the 6th segment closes over the 5th

furca - paired distal appendages on the urosome of copepods

geniculate - having a grasping articulation at the end of the antenna

pereopods - the thoracic legs

rostrum - anterior projection of the carapace, out in front of the head

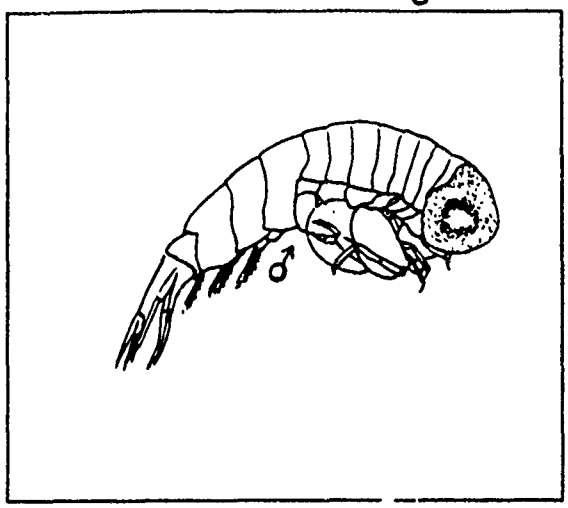
simple - legs without claws

subchelate - having a claw in which the 7th segment closes over the 6th

uropods - the paired appendages of the urosome or tail

urosome - the tail section consisting of last abdominal appendage, uropods and telson

Fig. CR-1

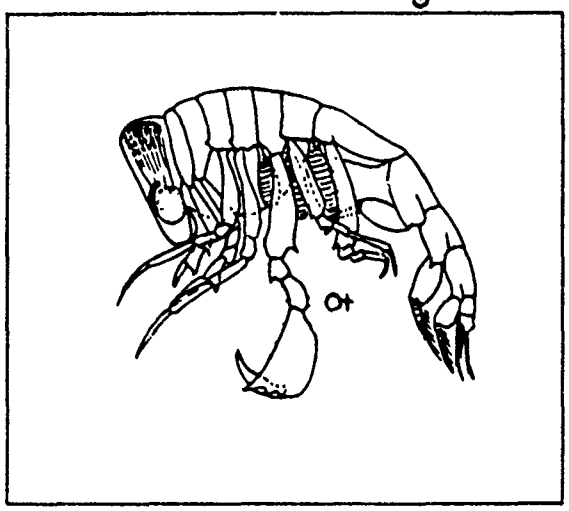


SPECIES: ***Brachyscelus crusculum***

FAMILY: Lycaeidae
SUBORDER: Hyperiidea
SIZE: to 17 mm
DESCRIPTION: slender body with rounded head, large eyes, antenna 1 short, antenna 2 absent in F, long in M, pereopods 1 & 2 subchelate with teeth on margin, usually associated with medusae.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. CR-2

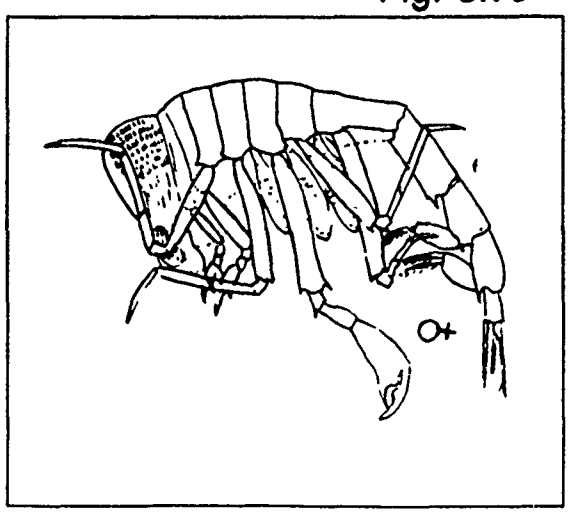


SPECIES: ***Phronima atlantica***

FAMILY: Phronimidae
SUBORDER: Hyperiidea
SIZE: to 40 mm
DESCRIPTION: slender body with subconical head, elongate and narrowed ventrally, eyes have dorsal and lateral sections, pereopod 5 long with large claw, others simple, F in barrels made from salps.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Indian, Med.

Fig. CR-3

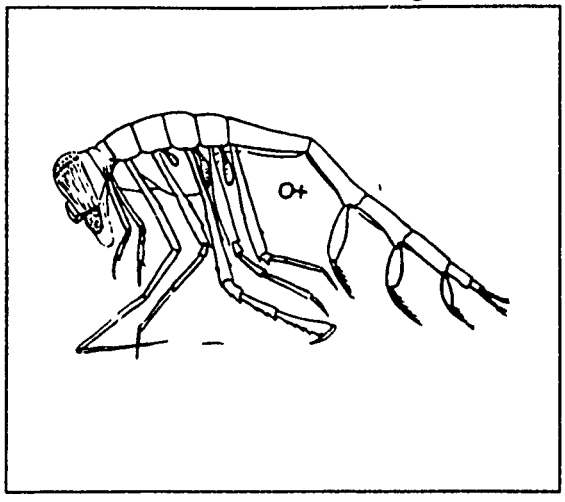


SPECIES: ***Phronima sedentaria***

FAMILY: Phronimidae
SUBORDER: Hyperiidea
SIZE: to 40 mm
DESCRIPTION: body and head similar to *P. atlantica*, pereopods 4,6,7 nearly as long as 5, narrow claw on 5, F in barrels made from salps.
LUMINESCENCE: unknown

DISTRIBUTION: world-wide

Fig. CR-4

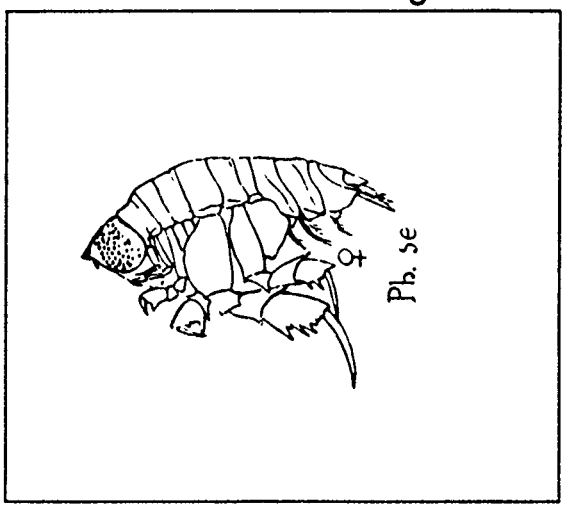


SPECIES: ***Phronimella elongata***

FAMILY: Phronimidae
SUBORDER: Hyperiidea
SIZE: to 15 mm
DESCRIPTION: very slender body with long abdomen, very long and thin pereopods, pereopod 5 with simple claw and toothed edge, F in short, round barrels.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. CR-5

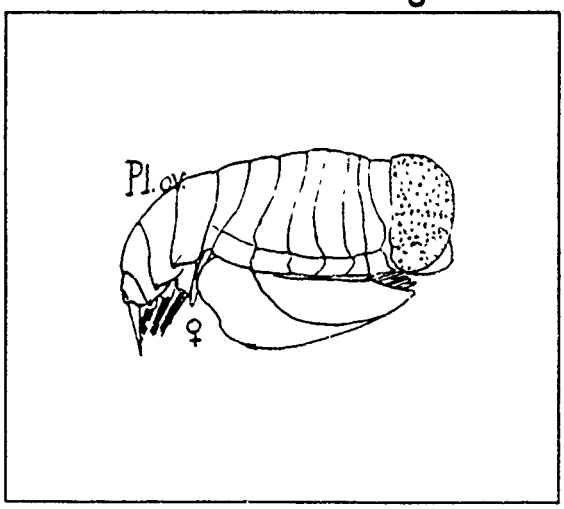


SPECIES: ***Phrosina semilunata***

FAMILY: Phrosinidae
SUBORDER: Hyperiidea
SIZE: to 20 mm
DESCRIPTION: compact body, large head with anterior "horns", pereopods 1 & 2 subchelate, 5 & 6 very large and subchelate, with toothed margins, pereopod 7 reduced to basal plate, free-swimming.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Indian, Med.

Fig. CR-6

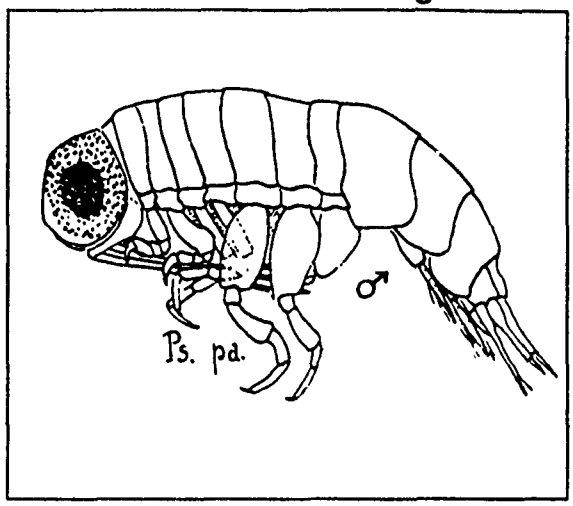


SPECIES: ***Platyscelus ovoides***

FAMILY: Platyscelidae
SUBORDER: Hyperiidea
SIZE: to 20 mm
DESCRIPTION: body almost globular, rolls into ball, plate-like pereopods 5 & 6 cover ventral side, pereopods 1 & 2 chelate, pereopod 7 reduced, associated with siphonophores.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Indian, Med.

Fig. CR-7

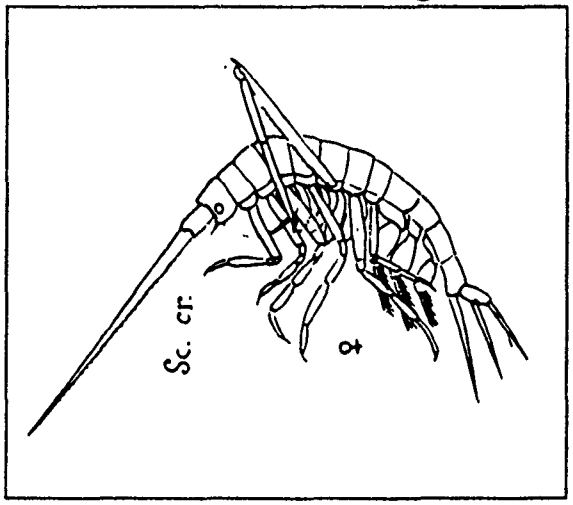


SPECIES: ***Pseudolycaea pachypoda***

FAMILY: Lycaeidae
SUBORDER: Hyperiidea
SIZE: to 7 mm
DESCRIPTION: body moderately plump, large round head, pereopods slender, without chelae, antenna 2 long and folded in M, absent in F, associated with medusae.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Indian, Med.

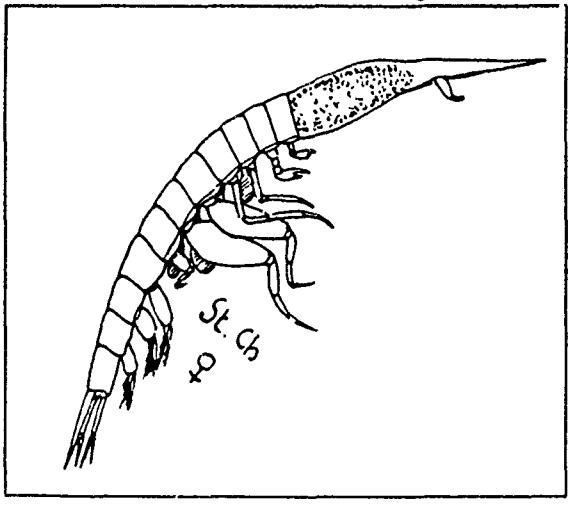
Fig. CR-8



SPECIES: ***Scina crassicornis***

FAMILY: Scinidae
SUBORDER: Hyperiidea
SIZE: to 21 mm
DESCRIPTION: elongate body, flattened dorso-ventrally, small head and eyes, long pointed antenna 1, long slender pereopods, long pointed uropods, body orange or red.
LUMINESCENCE: Herring (1987) lists this genus as definite
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. CR-9

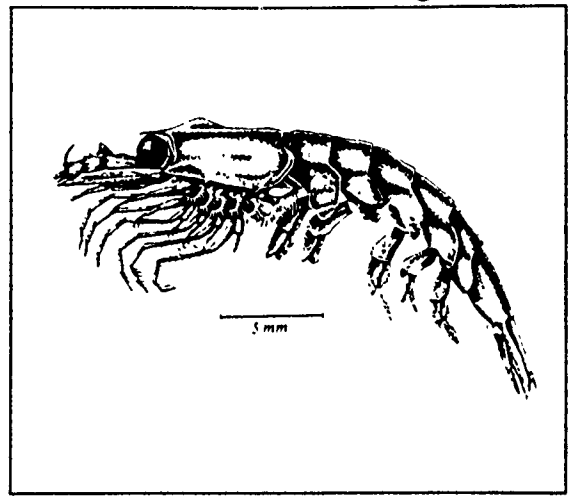


SPECIES: ***Streetsia challengeri***

FAMILY: Oycephalidae
SUBORDER: Hyperiidea
SIZE: to 40 mm
DESCRIPTION: slender body with long pointed head, covered by compound eye, pereopods 1 & 2 chelate and spiny, other pereopods slender and simple.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. CR-10

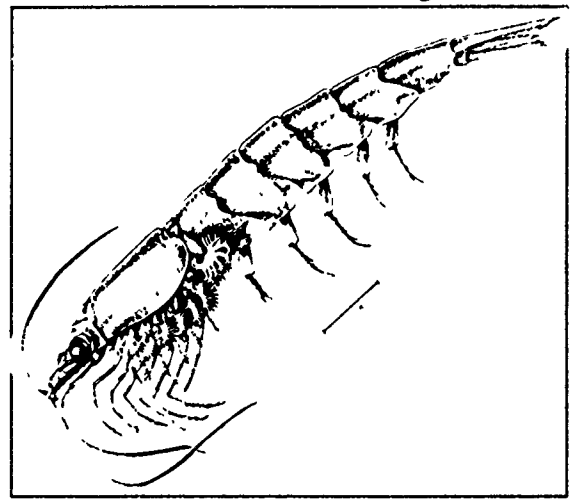


SPECIES: ***Euphausia krohnii***

FAMILY: Euphausiidae
ORDER: Euphausiacea
SIZE: to 25 mm
DESCRIPTION: medium size round eye, 2 pairs of lateral teeth on carapace, pereopods 1-6 similar, 7 & 8 reduced.

LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Med.

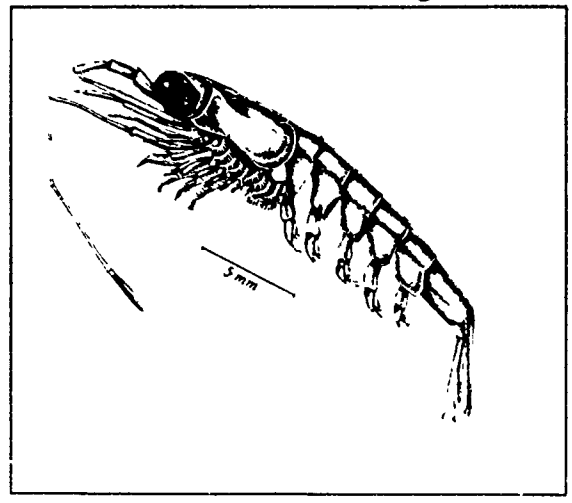
Fig. CR-11



SPECIES: ***Meganyctiphanes norvegica***

FAMILY: Euphausiidae
ORDER: Euphausiacea
SIZE: to 40 mm
DESCRIPTI elongate body, rostrum ends behind round eyes, pereopods 1-7 similar, 8 reduced, 1 pair of lateral teeth on carapace.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: N. Atlantic, Med.

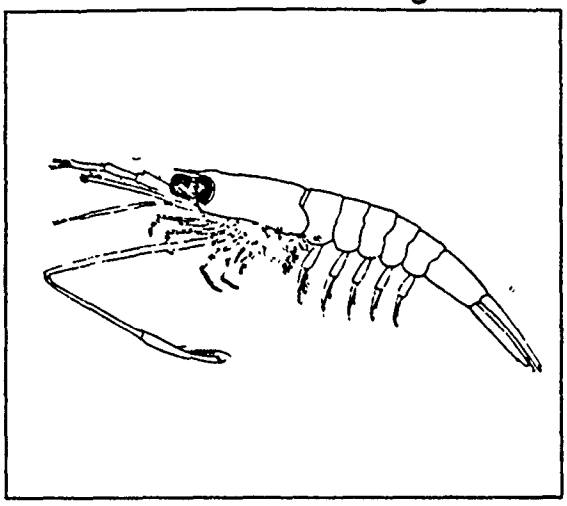
Fig. CR-12



SPECIES: ***Nematoscelis megalops***

FAMILY: Euphausiidae
ORDER: Euphausiacea
SIZE: to 20 mm
DESCRIPTION: eyes divided into upper and lower lobes, 2nd pereopod extremely elongate, slender with apical bristles, no teeth on carapace.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

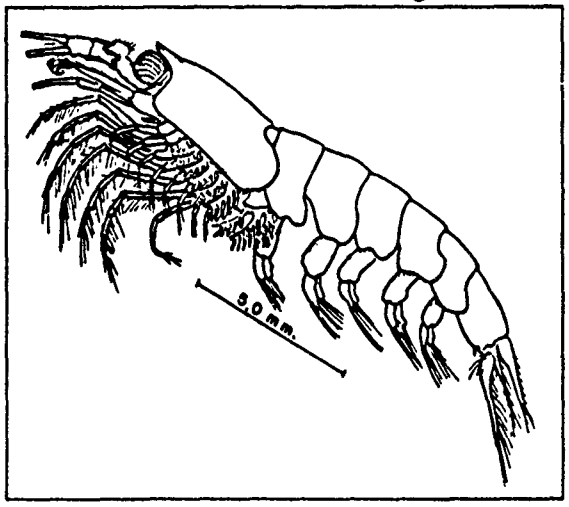
Fig. CR-13



SPECIES: ***Stylocheiron maximum***

FAMILY: Euphausiidae
ORDER: Euphausiacea
SIZE: to 30 mm
DESCRIPTION: carapace with sharp rostrum extending to end of large, elongate eyes, robust thorax, with reduced 1st, 2nd, but extremely long 3d pereopod with chela.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Med. mesopelagic

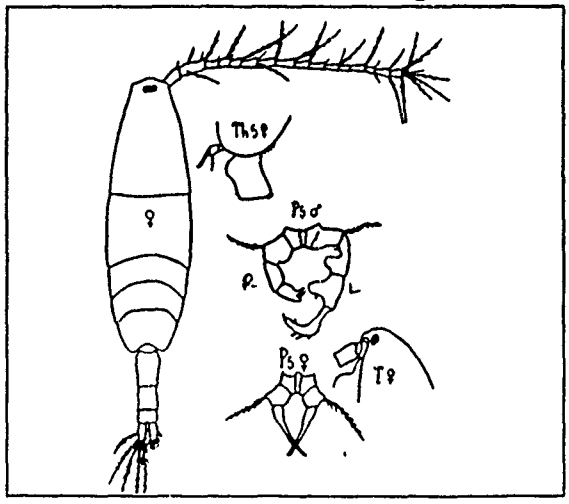
Fig. CR-14



SPECIES: ***Thysanopoda aequalis***

FAMILY: Euphausiidae
ORDER: Euphausiacea
SIZE: to 20 mm
DESCRIPTION: carapace with dorsal trough, rostrum does not reach end of small, round eyes, very long antennae, pereopods uniformly short.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. CR-15



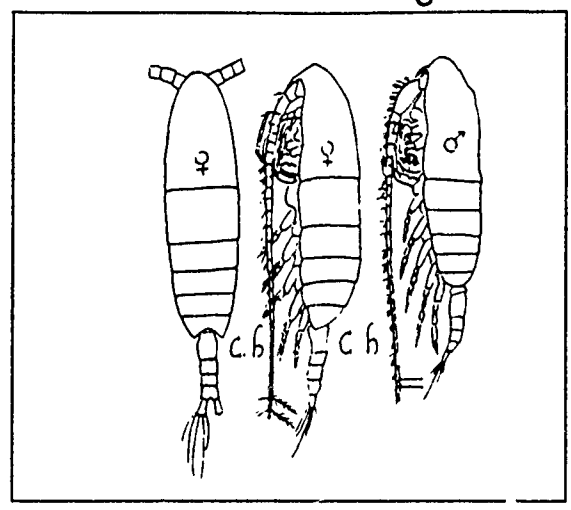
SPECIES: ***Acartia clausi***

FAMILY: Acartiidae
SUBCLASS: Copepoda
SIZE: to 1.2 mm
DESCRIPTION: no rostrum, abdomen about 1/3 length of cephalothorax, short hairs on edges of thoracic segments.

LUMINESCENCE: unknown

DISTRIBUTION: world-wide

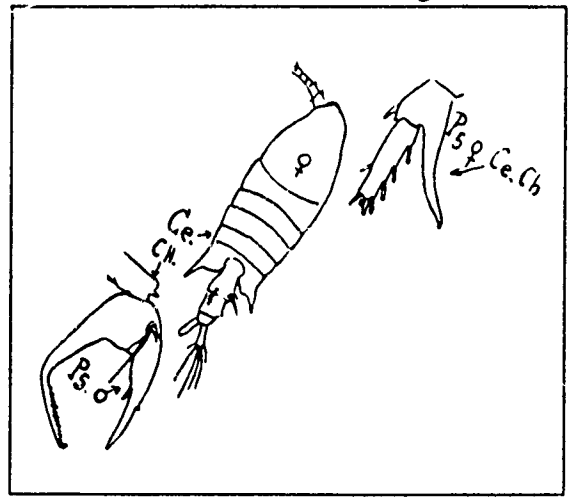
Fig. CR-16



SPECIES: ***Calanus helgolandicus***

FAMILY: Calanidae
SUBCLASS: Copepoda
SIZE: to 3 mm
DESCRIPTION: long, narrow body, antenna 1 longer than body and tail, 5 spines on each caudal furca, margin of basal segment of 5th pereopod toothed.
LUMINESCENCE: Herring (1987) lists two genera in this family as uncertain.
DISTRIBUTION: world-wide

Fig. CR-17

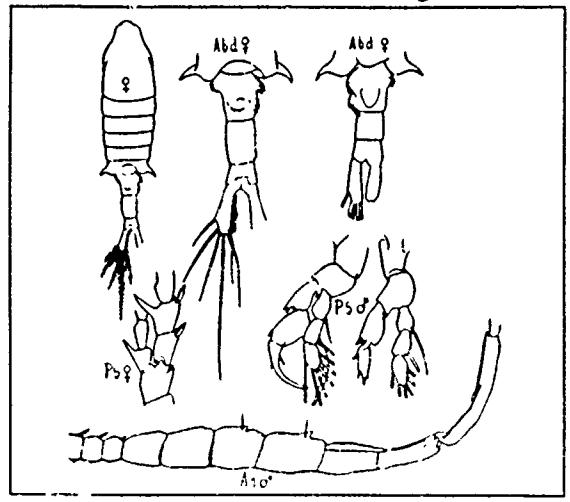


SPECIES: ***Centropages chierchiae***

FAMILY: Centropagidae
SUBCLASS: Copepoda
SIZE: 1.8 mm
DESCRIPTION: body with tapered anterior, projections on posterior corners of last thoracic segment, antenna 1 shorter than body, long spines on urosome.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Med.

Fig. CR-18

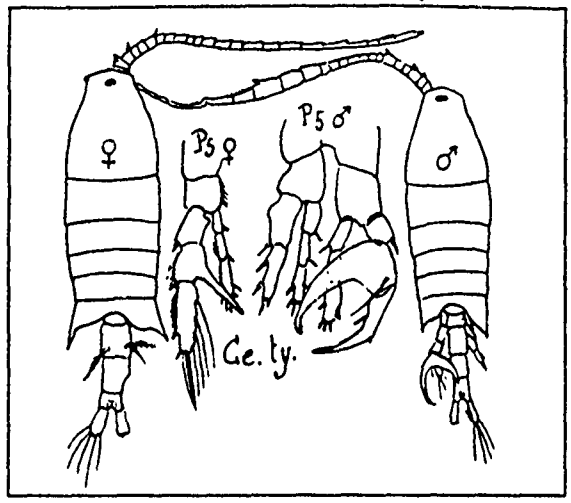


SPECIES: ***Centropages kroyeri***

FAMILY: Centropagidae
SUBCLASS: Copepoda
SIZE: 1.3 mm
DESCRIPTION: body tapered anteriorly, poterior projections on last thoracic segment, pereopod 5 chelate, with strong spines.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Indian, Med.

Fig. CR-19



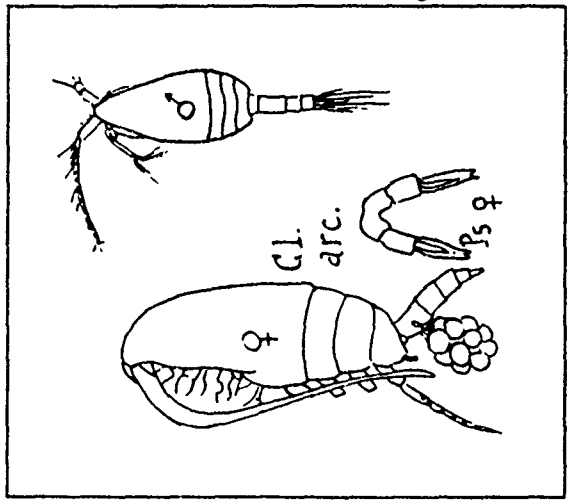
SPECIES: ***Centropages typicus***

FAMILY: Centropagidae
SUBCLASS: Copepoda
SIZE: to 2.0 mm
DESCRIPTION: symmetrical posterior points on last thoracic segment in M, asymmetric in F, antenna 1 longer than cephalothorax.

LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Med.

Fig. CR-20

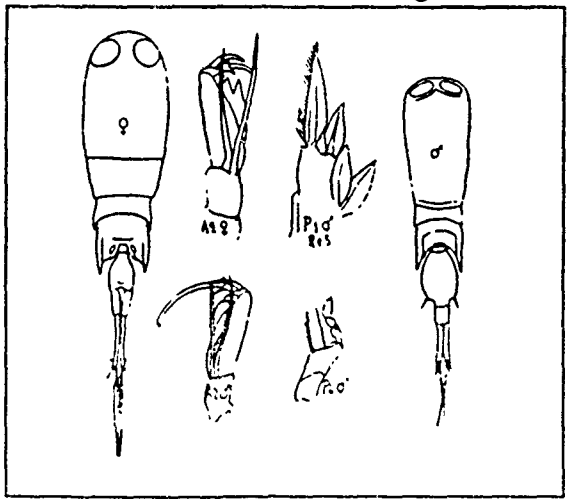


SPECIES: ***Clausocalanus arcuicornis***

FAMILY: Pseudocalanidae
SUBCLASS: Copepoda
SIZE: to 1.2 mm
DESCRIPTION: short body, tapered anteriorly, abdomen with 4 segments in , 5 in , pereopod 5 long and straight in M, short and curved in F.
LUMINESCENCE: Unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Red Sea, Med.

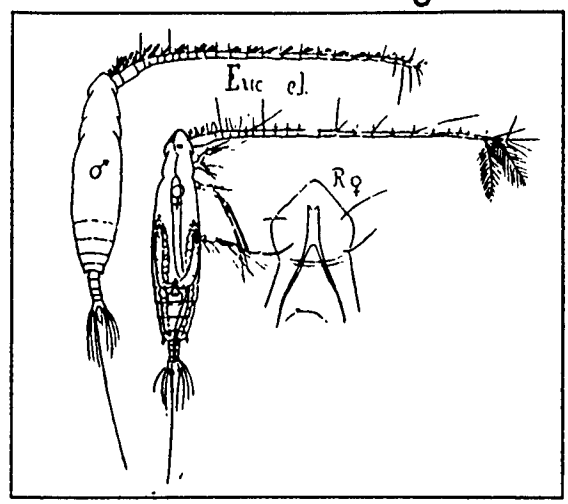
Fig. CR-21



SPECIES: ***Corycaeus typicus***

FAMILY: Corycaeidae
SUBCLASS: Copepoda
SIZE: 1.6 mm
DESCRIPTION: cyclopoid copepods, body rounded anteriorly, with 2 large eyes, last (3rd) thoracic segment with posterior points, abdomen of 1 segment, long urosome.
LUMINESCENCE: Herring (1987) lists this genus as uncertain.
DISTRIBUTION: Atlantic, Pacific, Indian, Red Sea, Med.

Fig. CR-22

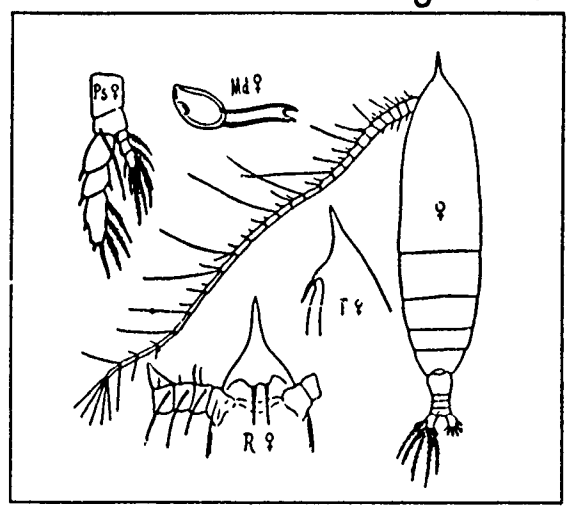


SPECIES: ***Eucalanus elongatus***

FAMILY: Eucalanidae
SUBCLASS: Copepoda
SIZE: to 8.2 mm
DESCRIPTION: elongate body, tapered anterior, very long antenna 1 with many spines and fan at ends, urosome with 1 long and several short terminal spines.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Med.

Fig. CR-23

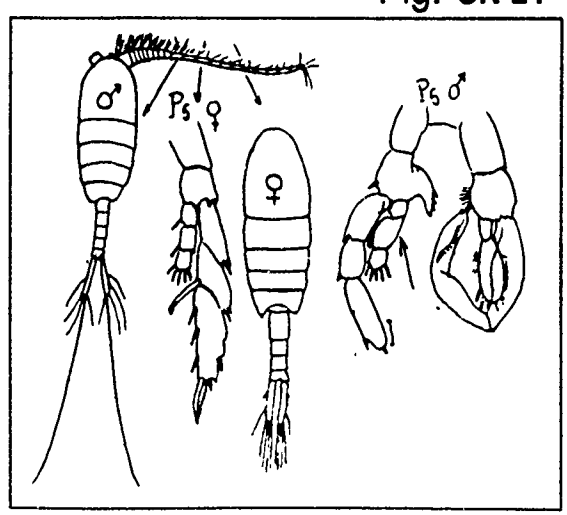


SPECIES: ***Haloptilis acutifrons***

FAMILY: Augaptilidae
SUBCLASS: Copepoda
SIZE: to 3.2 mm
DESCRIPTION: cephalothorax with sharp anterior projection, antenna 1 much longer than body.

LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Med.

Fig. CR-24

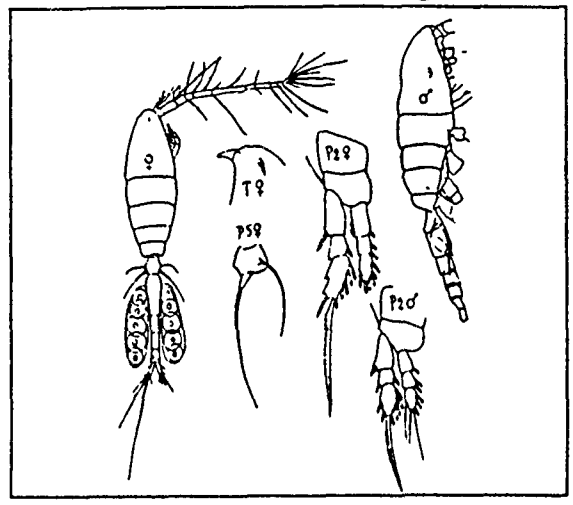


SPECIES: ***Lucicutia flavicornis***

FAMILY: Lucicutiidae
SUBCLASS: Copepoda
SIZE: 1.7 mm
DESCRIPTION: oval body, numerous spines on antenna 1, slender abdomen with long terminal spines in F.

LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

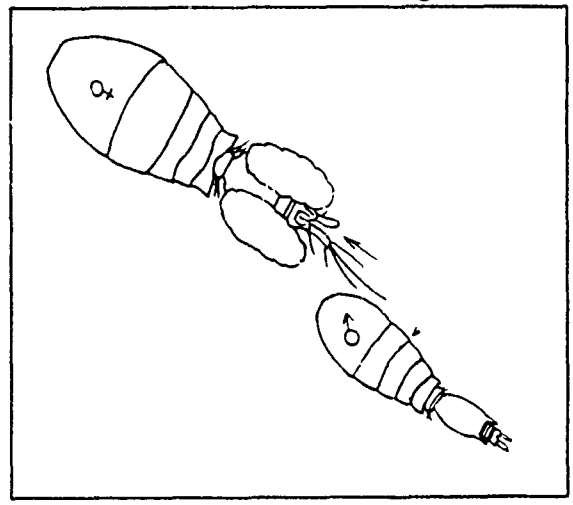
Fig. CR-25



SPECIES: ***Oithona helgolandica***

FAMILY: Oithonidae
SUBCLASS: Copepoda
SIZE: 0.7 mm
DESCRIPTION: oval cephalothorax, tapered anteiorly and posteriorly, antenna 1 with long spines, conspicuous egg sacs on abdomen in F.
LUMINESCENCE: Herring (1987) lists this genus as uncertain.
DISTRIBUTION: world-wide

Fig. CR-26

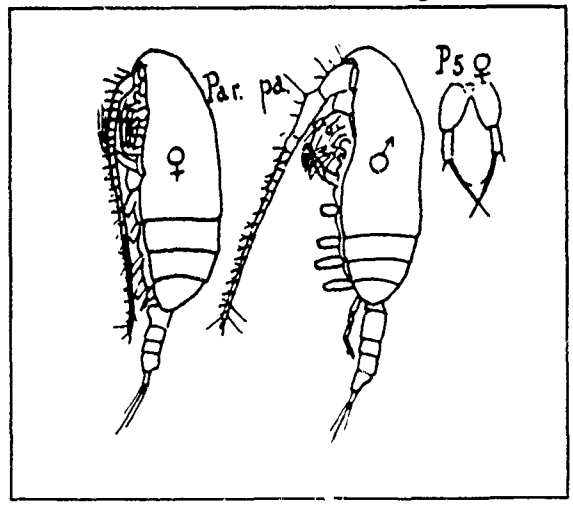


SPECIES: ***Oncaea mediterranea***

FAMILY: Oncaeidae
SUBCLASS: Copepoda
SIZE: 1.3 mm
DESCRIPTION: short, oval cephalothorax, 1st abdomen segment much longer than all others, body orange-red.

LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: world-wide

Fig. CR-27

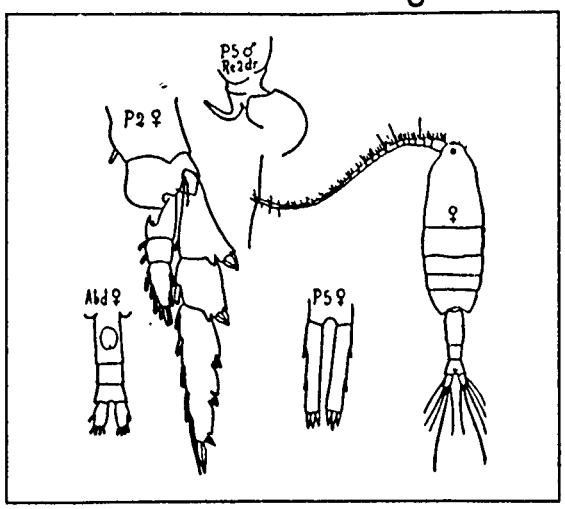


SPECIES: ***Paracalanus parvus***

FAMILY: Paracalanidae
SUBCLASS: Copepoda
SIZE: to 1.0 mm
DESCRIPTION: short body, head rounded in lateral view, F with 3 free thoracic segments, 5 abdominal, M with 5 abdominal segments, strong antenna 1.
LUMINESCENCE: unknown

DISTRIBUTION: world-wide

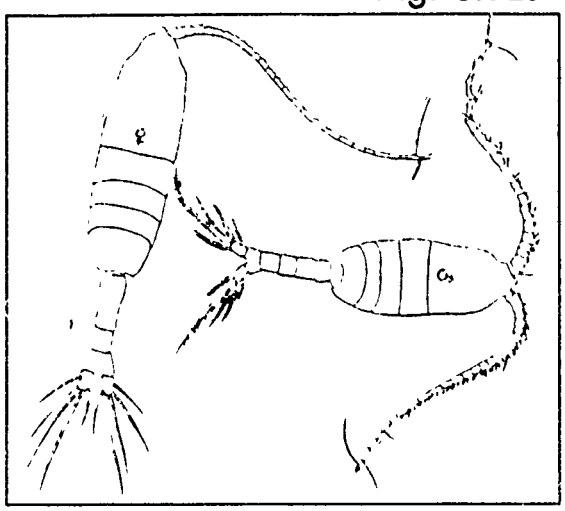
Fig. CR-28



SPECIES: ***Pleuromamma borealis***

FAMILY: Metridiidae
SUBCLASS: Copepoda
SIZE: 2.25 mm
DESCRIPTION: body with 4 thoracic segments, antenna 1 of F with hooks, pereopod 5 with 3 equal spines on each tip.
LUMINESCENCE: Herring (1987) lists this genus as definite
DISTRIBUTION: Atlantic, Med.

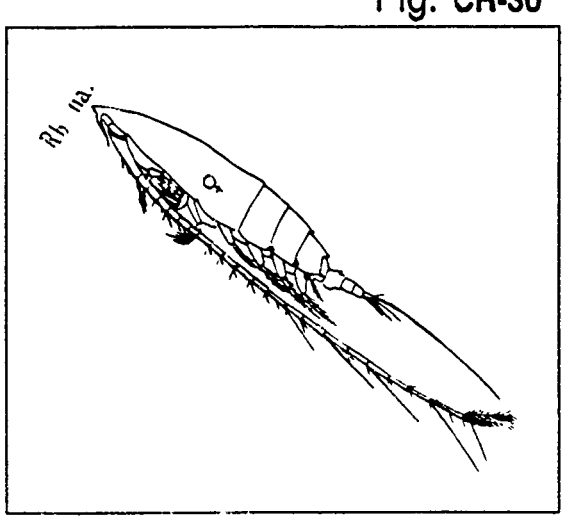
Fig. CR-29



SPECIES: ***Pleuromamma gracilis***

FAMILY: Metridiidae
SUBCLASS: Copepoda
SIZE: 2.0 mm
DESCRIPTION: dark brown spot on right side of 1st thoracic segment, M antenna 1 prehensile on left side, short spines on ends of last articles of pereopod 5.
LUMINESCENCE: Herring (1987) lists this genus as definite
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. CR-30

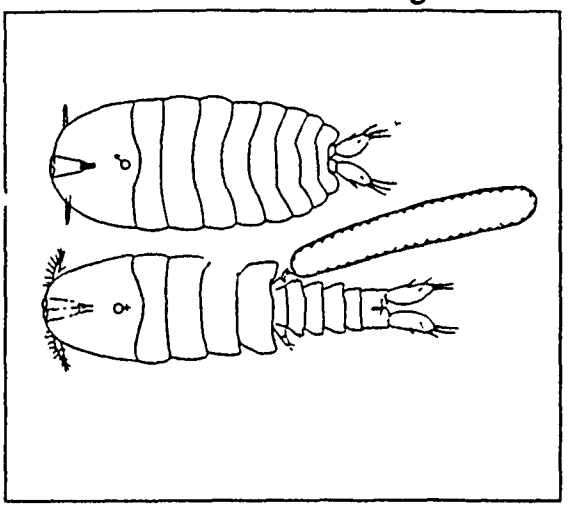


SPECIES: ***Rhincalanus nasutus***

FAMILY: Eucaianidae
SUBCLASS: Copepoda
SIZE: to 5.0 mm
DESCRIPTION: long body, triangular pointed head with concave sides, antenna 1 much longer than body, M pereopod 5 with claw-like segment.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med., often deep

Fig. CR-31

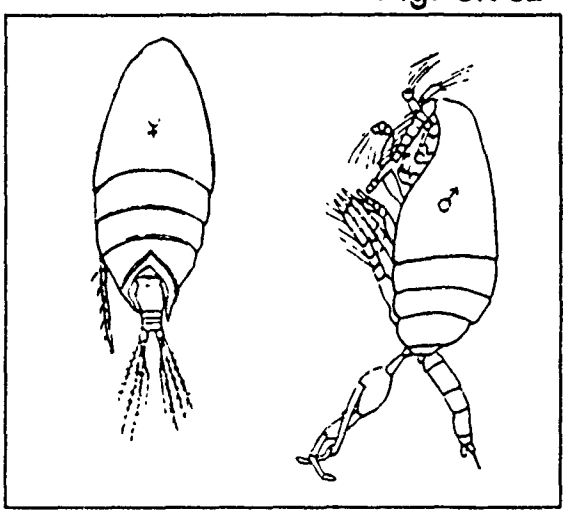


SPECIES: ***Sapphirina iris***

FAMILY: Sapphirinidae
SUBCLASS: Copepoda
SIZE: to 7.5 mm
DESCRIPTION: body very flattened dorso-ventrally, iridescent, antennae very short, 2 closely-spaced frontal eyes, body elongate in F, ovoid in M.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. CR-32

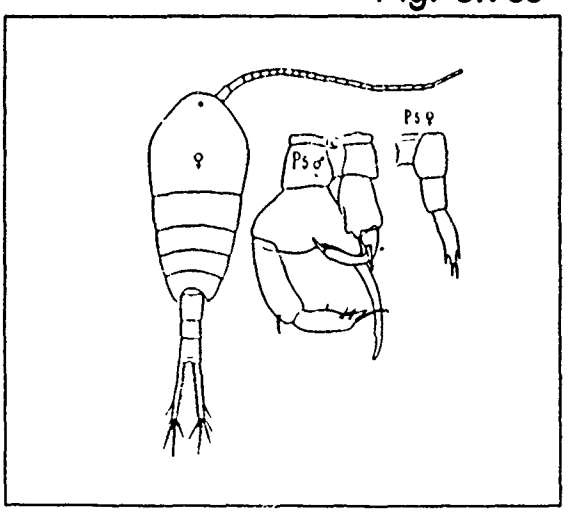


SPECIES: ***Scolecithrix bradyi***

FAMILY: Scolecithricidae
SUBCLASS: Copepoda
SIZE: to 1.4 mm
DESCRIPTION: short body, thoracic segments 4 & 5 nearly fused, antenna much shorter than body, pereopod reduced and asymmetric.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Pacific, Indian, Med.

Fig. CR-33

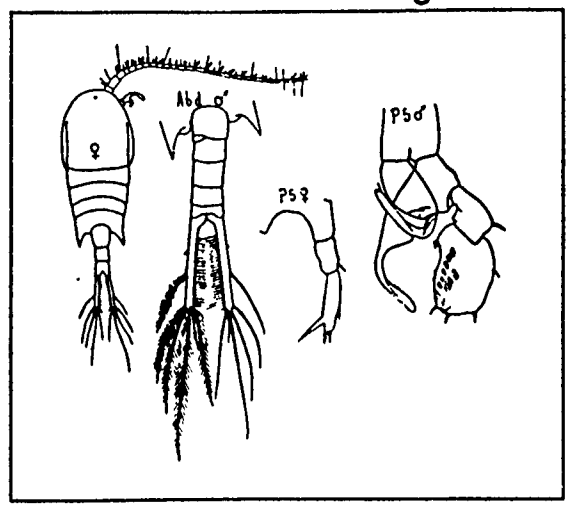


SPECIES: ***Temora longicornis***

FAMILY: Temoridae
SUBCLASS: Copepoda
SIZE: to 1.5 mm
DESCRIPTION: short, oval body with mid-anterior eyespot, 4 thoracic segments, M antenna 1 geniculate on right, M pereopod 5 with clawlike end.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Indian, Med.

Fig. CR-34

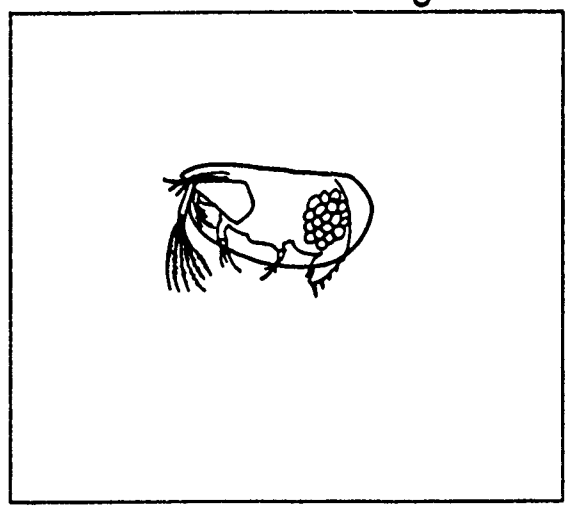


SPECIES: ***Temora stylifera***

FAMILY: Temoridae
SUBCLASS: Copepoda
SIZE: to 1.9 mm
DESCRIPTION: short, broad body with rounded head, prolonged back corners of 5th thoracic segment, M with geniculate antenna 1, grasping claw on pereopod 5.
LUMINESCENCE: unknown

DISTRIBUTION: Atlantic, Indian Med.

Fig. CR-35

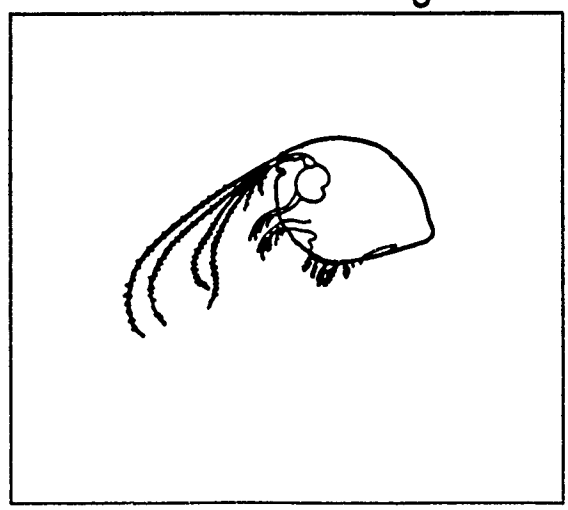


SPECIES: ***Conchoecia obtusata***

FAMILY: Halocyprididae
CLASS: Ostracoda
SIZE: to 2.0 mm
DESCRIPTION: valves with straight dorsal margin and nearly rectangular outline.

LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION:

Fig. CR-36

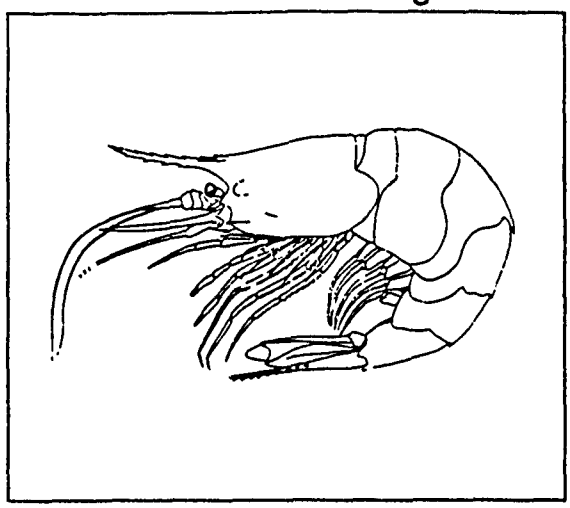


SPECIES: ***Cypridina castanea***

FAMILY: Cypridinidae
CLASS: Ostracoda
SIZE: to 7.0 mm
DESCRIPTION: valves with strongly curved dorsal margin, nearly oval outline, antennae extend well beyond shell margin.

LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION:

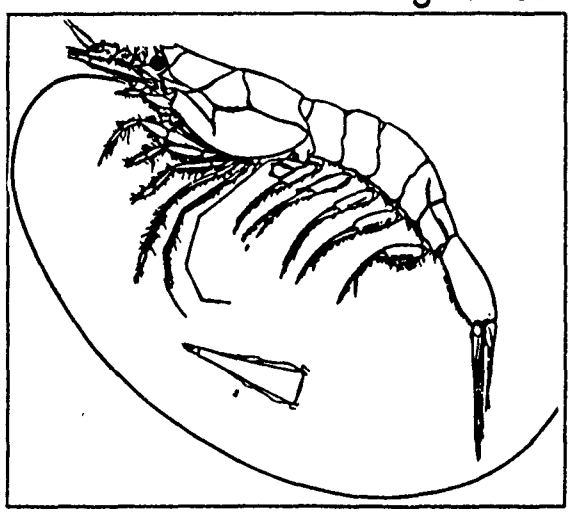
Fig. CR-37



SPECIES: ***Acanthephyra pelagica***

FAMILY: Oplophoridae
ORDER: Decapoda
SIZE: to 147 mm total length
DESCRIPTION: orange-red color overall, toothed rostrum extends well forward of small eyes, all legs simple, 7-11 pairs of spines on telson.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Med. mesopelagic

Fig. CR-38

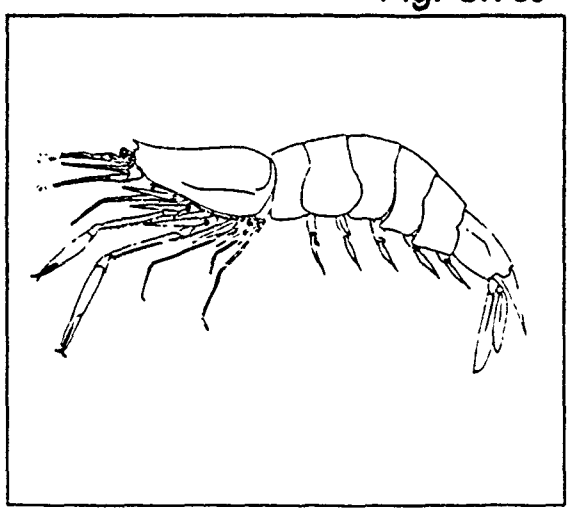


SPECIES: ***Gennadas elegans***

FAMILY: Penaeidae
ORDER: Decapoda
SIZE: to 40 mm
DESCRIPTION: body red with blue spots, very long first antennae, no rostral projection

LUMINESCENCE: Herring (1987) lists this genus as uncertain
DISTRIBUTION: Atlantic, Med.

Fig. CR-39

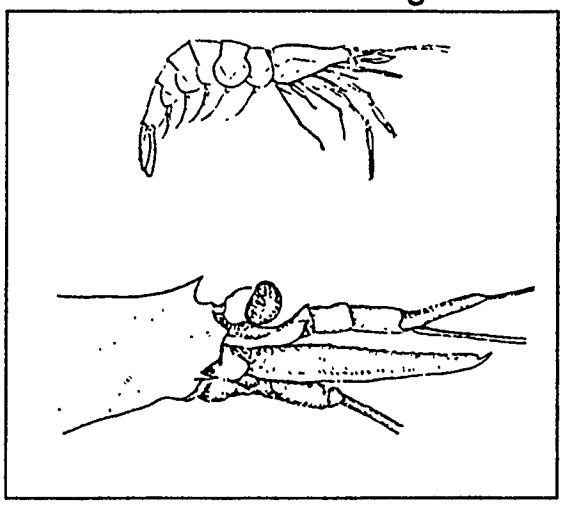


SPECIES: ***Pasiphaea multidentata***

FAMILY: Pasiphaeidae
ORDER: Decapoda
SIZE: to 100 mm
DESCRIPTION: carapace shorter than abdomen, rostrum short, pereopods 4,5 elongate and chelate, telson forked.

LUMINESCENCE: Herring (1987) lists one genus in this family as definite and one as uncertain
DISTRIBUTION: Atlantic, Med.

Fig. **CR-40**

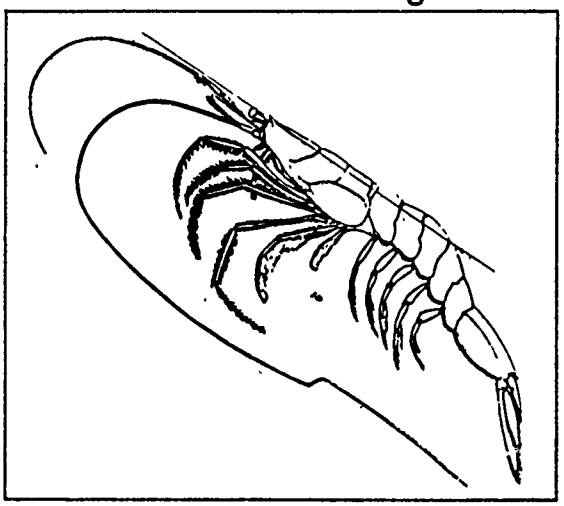


SPECIES: ***Pasiphaea sivado***

FAMILY: Pasiphaeidae
ORDER: Decapoda
SIZE: to 100 mm
DESCRIPTION: like P. multidentata, but telson not forked, with 2 longer lateral and 6 shorter medial spines.

LUMINESCENCE: Herring (1987) lists one genus in this family as definite and one as uncertain
DISTRIBUTION: Atlantic, Med.

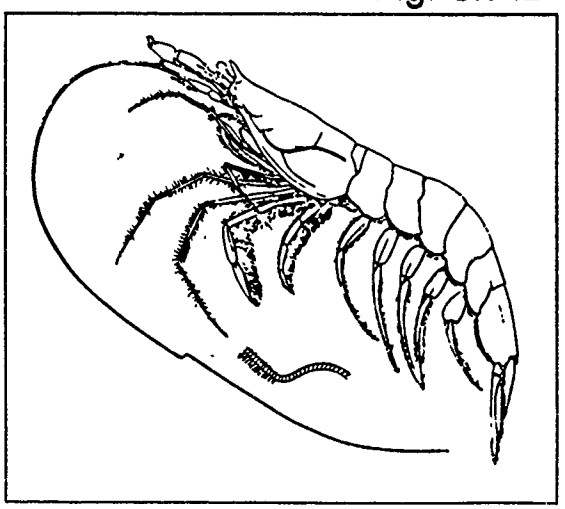
Fig. **CR-41**



SPECIES: ***Sergestes arcticus***

FAMILY: Sergestidae
ORDER: Decapoda
SIZE: 50 mm
DESCRIPTION: body half red, 3rd maxilliped subequal with 3rd pereopod, setae on uropod outer margins end in tooth, 1st segment of antenna longer than 3rd.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Indian, Pacific, Med.

Fig. **CR-42**

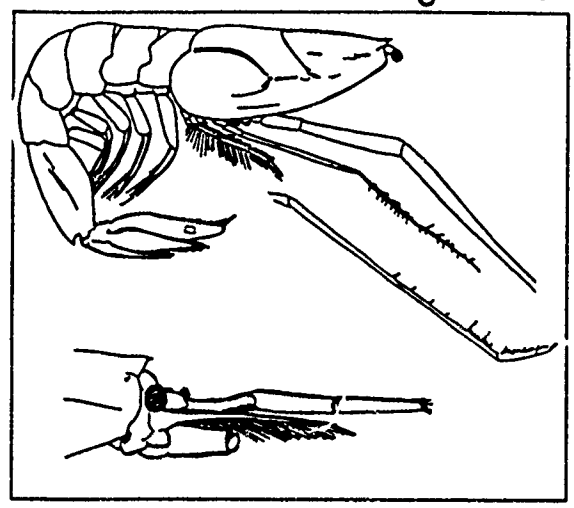


SPECIES: ***Sergestes robustus***

FAMILY: Sergestidae
ORDER: Decapoda
SIZE: to 94 mm total length
DESCRIPTION: body red all over, photophores without lenses on uropods and antennal scale only

LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Pacific, Indian, Med.

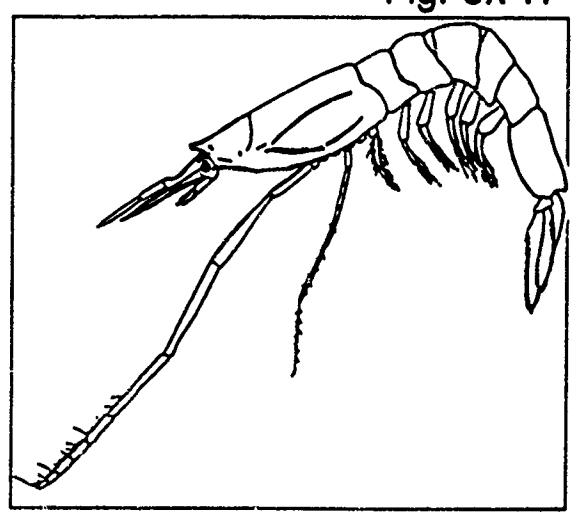
Fig. CR-43



SPECIES: ***Sergestes sargassi***

FAMILY: Sergestidae
ORDER: Decapoda
SIZE: 30 mm
DESCRIPTION: body half-red, 3rd maxilliped longer than 3rd pereopod, its distal segment divided into 5 parts with irregular spines.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Med.

Fig. CR-44



SPECIES: ***Sergestes vigilax***

FAMILY: Sergestidae
ORDER: Decapoda
SIZE: 30 mm
DESCRIPTION: body half red, 3rd maxilliped longer than 3rd peropcd, its distal segment divided in 4 parts, rostrum blunt except apical spine.
LUMINESCENCE: Herring (1987) lists this genus as definite.
DISTRIBUTION: Atlantic, Med.

Acknowledgments

I must initially thank Dr. Edith Widder for commissioning this project in the first place, and express my hope here that it meets her needs. Thanks also to N. Copley, R. Harbison, M. Omori and P. Wiebe for the loan of source material, and especially to K. Madin for invaluable and timely assistance in all stages of the project. Preparation of this report was supported by a subcontract from the Harbor Branch Oceanographic Institution to the Woods Hole Oceanographic Institution, with principal contract support to E. Widder at Harbor Branch (Grant No. N000 14-91-C6007) from the Naval Oceanic and Atmospheric Research Laboratory.

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16. Abstract (Limit: 200 words)

This is a survey of literature records for occurrence and taxonomy of zooplankton in the Western Mediterranean, with particular emphasis on the Alboran Sea. It is intended to give a general background on the fauna, and facilitate identification of specimens collected or observed. A description of the hydrography of the Alboran Sea is followed by a general account of zooplankton biomass distribution, and more detailed lists of the occurrence of 361 species of medusae, siphonophores, ctenophores, worms, tunicates and crustaceans in 7 regions of the Western Mediterranean. Bioluminescent properties of the organisms are indicated where known. An illustrated taxonomic guide provides capsule descriptions and illustrations of 254 of the listed species.

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