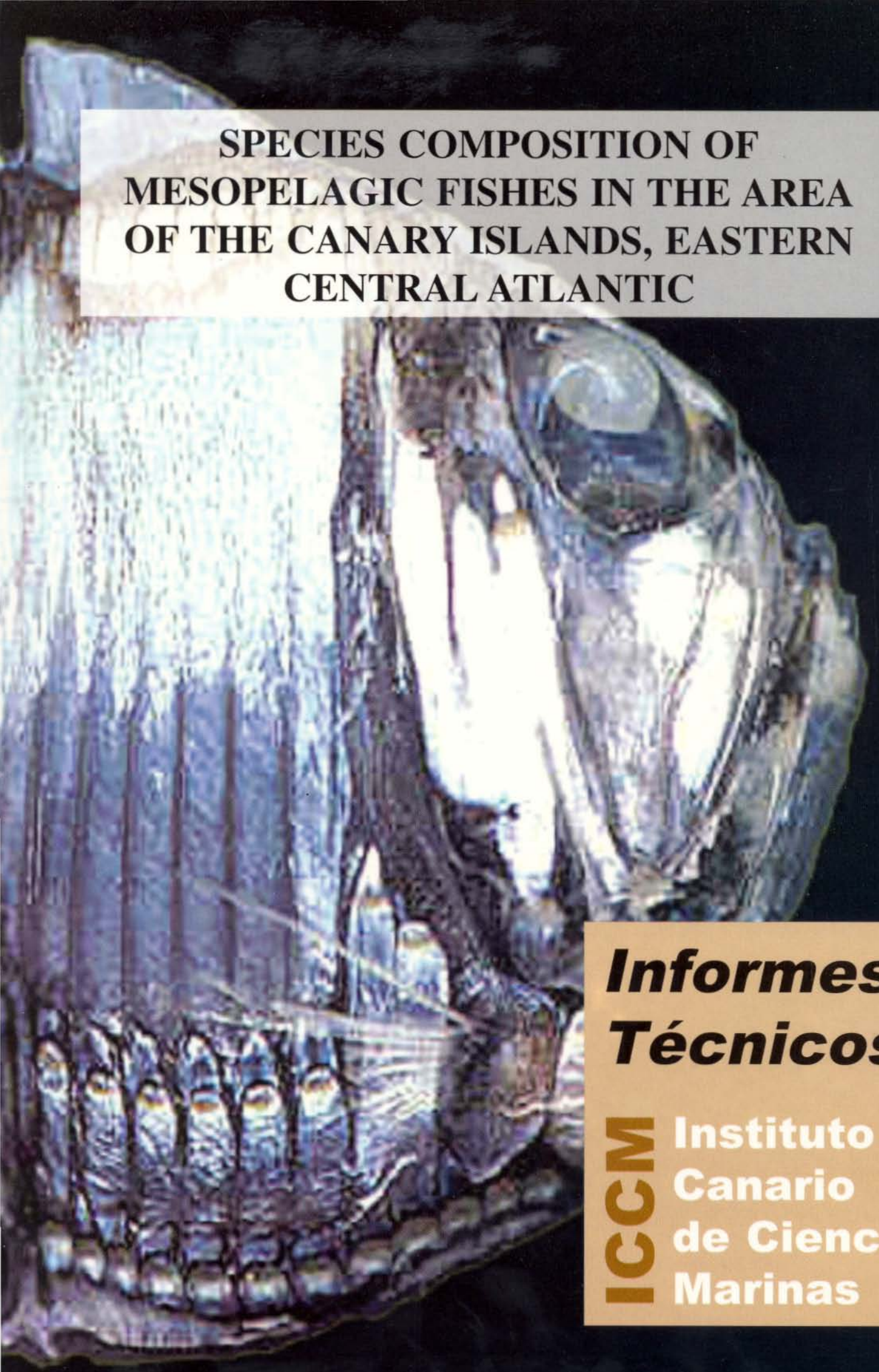
SPECIES COMPOSITION OF MESOPELAGIC FISHES IN THE AREA OF THE CANARY ISLANDS, EASTERN CENTRAL ATLANTIC



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SPECIES COMPOSITION OF MESOPELAGIC FISHES IN THE AREA OF THE CANARY ISLANDS, EASTERN CENTRAL ATLANTIC.

WIENERROITHER, Rupert M.

Institute of Zoology, University of Salzburg, Hellbrunnerstraße 34, 5020 Salzburg, Austria.

e-mail: rupert.wienerroither@sbg.ac.at

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RESUMEN

Durante las tres campañas con el barco oceanográfico "La Bocaina" ("La Bocaina 04-97", "La Bocaina 11-97" y "ECOS 04-99"), se llevaron a cabo una serie de 55 arrastres con red de arrastre comercial pelágica, entre 10 y 700 m de profundidad, en aguas cercanas y adyacentes a Lanzarote, Fuerteventura, Gran Canaria, Tenerife y La Gomera, Islas Canarias. De ellos, 48 arrastres fueron fructíferos, de los que en 34 se capturaron 13.661 peces mesopelágicos, pertenecientes a 31 familias, 83 géneros y 147 especies.

Cinco especies son nuevas citas para el área de las Islas Canarias: *Eustomias bigelowi*, *Aristostomias grimaldii* (Stomiidae), *Stemonosudis intermedia* (Paralepididae), *Diaphus vanhoeffeni* y *Lampanyctus nobilis* (Myctophidae).

Más del 50 % de los peces mesopelágicos capturados son miembros de la familia Myctophidae, con *Hygophum hygomii* y *Lobianchia dofleini* como especies más abundantes. Las familias que se han capturado con más frecuencia son: Gonostomatidae, Phosichthyidae y Stomiidae.

Se recolectaron ejemplares de peces mesopelágicos sobre la plataforma insular, lo que puede reflejar el límiete de la especial situación ecológica en bordes oceánicos, típica de islas oceánicas y montañas submarinas. Algunos mictofidos especialmente *Ceratoscopelus maderensis*, *Hygophum hygomii*, *Lobianchia dofleini* y *Notoscopelus resplendens* se encontraron en profundidades neríticas no típicas, no sólo en áreas con fenómenos hidrológicos especiales (como remolinos o afloramiento), lo que sugiere que su presencia nerítica es debida a la activa migración horizontal. Estas especies se pueden considerar como algunos de los migradores verticales y horizontales más extensivos de la fauna marina mesopelágica Canaria.

Los arrastres con un mayor número de especies tuvieron lugar en el sureste de Fuerteventura (un área probable de afloramiento local) y en el suroeste de Gran Canaria (un área con al menos un remolino). Pero los índices de diversidad (Shannon H' and J') demostraron que estas áreas no representan necesariamente las estaciones de arrastres con más diversidad. Un análisis de cluster Bray-Curtis probó que el agrupamiento va en correlación a la profundidad del fondo, con una diferencia marcada entre los arrastres neríticos y oceánicos. No se reconocen especies indicadoras para los dos grupos, ya que se llevaron a cabo algunos arrastres a varias profundidades. Arrastres espaciales muy relacionados fueron agrupados solo de foma incidental.

Un análisis de la estructura de población de tres mictofidos (*Ceratoscopelus maderensis*, *Hygophum hygomii* y *Lobianchia dofleini*) indicó que los datos históricos de la vida de una especie en una región no son necesariamente aplicables para la misma especie en otra región. Por ejemplo, *L. dofleini* parece tener una medida standard más pequeña en aguas Canarias que la registrada para esta especie en el Atlántico Central Noroccidental.

ABSTRACT

During the three cruises "La Bocaina 04-97", "La Bocaina 11-97" and "ECOS 04-99" with the research vessel "La Bocaina" a series of 55 tows with a commercial pelagic trawl at depths between 10 and 700 m were carried out in neritic and adjacent oceanic waters off Lanzarote, Fuerteventura, Gran Canaria, Tenerife and La Gomera, Canary Islands. A total of 48 trawl tows were successful, with 34 tows resulting in the capture of 13,661 mesopelagic fishes, belonging to 31 families, 83 genera and 147 species.

Five species proved to be new records for the area of the Canary Islands: *Eustomias bigelowi*, *Aristostomias grimaldii* (Stomiidae), *Stemonosudis intermedia* (Paralepididae), *Diaphus vanhoeffeni* and *Lampanyctus nobilis* (Myctophidae).

More than 50 % of the captured mesopelagic fishes are members of the family Myctophidae, with *Hygophum hygomii* and *Lobianchia dofleini* as most abundant species. Gonostomatidae, Phosichthyidae and Stomiidae are further frequently occurring families.

Several individuals of mesopelagic fishes were collected above the shelf what may reflect the specific ecological boundary situation at ocean rims, typical for oceanic islands and seamounts. Especially some myctophids (*Ceratoscopelus maderensis*, *Hygophum hygomii*, *Lobianchia dofleini* and *Notoscopelus resplendens*) proved to occur in coastal waters and not only in areas with special hydrologic phenomena (like eddies or upwellings) what suggests that their neritic occurrence is due to active horizontal migration. These species may be regarded as some of the most extensive vertical and horizontal migrators of the Canary mesopelagic fish fauna.

The tows with the highest number of individuals were trawled in the south-east of Fuerteventura (an area of probable local upwelling) and in the south-west of Gran Canaria (an area with at least one facultative eddy). But diversity indices (Shannon H' and J') showed that these areas represent not necessarily also the most diverse trawling stations. A Bray-Curtis cluster analysis proved that the clustering is correlated to bottom depth, with a remarkable difference between neritic and oceanic tows. Indicator species for the two groups were not recognisable, primarily, because several trawls were carried out at varying depths. Spatially closely related tows were only incidentally clustering.

A coarse analysis of the population structure of three myctophids (*Ceratoscopelus maderensis*, *Hygophum hygomii* and *Lobianchia dofleini*) indicates that life history data of one species in one region must not necessarily be applicable for the same species in another region. For instance, *L. dofleini* seems to attain a smaller standard length in Canary waters than is recorded for this species in the North-western Central Atlantic.

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1. INTRODUCTION

The open ocean represents the largest habitat on earth and differs a lot from coastal or terrestrial habitats by the absence of semi-permanent fine- to meso-scale structure limiting distributional ranges (such as soil or rocks on land or seabed, respectively) and by the lack of any three-dimensional biological structuring that can generate microclimates, such as forests or coral reefs (ANGEL, 1999). Nevertheless, the pelagic realm is not a biosphere with uniform conditions all around the world. Planetary forcing, ocean - atmosphere interactions and hydrodynamic processes structure the physical and chemical environment of the pelagic ocean and lead to different large-scale horizontal distribution patterns (ANGEL, 1999).

BACKUS et al. (1970) divided the Equatorial and Western North Atlantic into different pelagic regions using the distribution of mesopelagic fishes (mainly myctophids). These divisions were based on water boundaries caused by currents and temperature-salinity characteristics, and named after climatic distribution patterns (tropical, broadly tropical,...) or geographical areas (Sargasso Sea, Caribbean,...). These results were confirmed and partly broadened by KREFFT (1974). Later, BACKUS et al. (1977) and HULLEY (1981) did the same for the whole Atlantic, again based on the distribution patterns of myctophids. HULLEY (1981), for instance, divided the Atlantic in zones (high- and pseudoceanic), communities (meso-, bathypelagic and epibenthic, pelagic), groups (widespread, warm and cool water,...) and distribution patterns (tropical, broadly tropical, subtropical, temperate,...). HULLEY AND KREFFT (1985) analysed the family Myctophidae of a Sargasso Sea expedition, using abundance and the Bray-Curtis similarity measure with group-average sorting and multi-dimensional scaling ordination. They confirm the temperate and subtropical region of the North Atlantic, proposed by BACKUS et al. (1977), but suggest a closer scrutiny of the Sargasso Sea.

In the work of BACKUS et al. (1977) the Canary Archipelago is positioned in the North Atlantic Subtropical faunal region which is not fully congruent with the myctophid distribution patterns. They drew a line of zoogeographical separation between the two easternmost, and the five western islands. Therein, Lanzarote and Fuerteventura belong to the Temperate-Semisubtropical region, whereas Gran Canaria, Tenerife, La Gomera, La Palma and El Hierro are part of the Tropical-Semisubtropical region. Of course are the boundaries not sharp and straight, but broad, irregular and fluctuating. Recent research in physical oceanography confirms that very complex hydrological conditions prevail in the area of the Canarian Archipelago.

MITTELSTAEDT (1983) has described deep-water currents arriving from the North Atlantic, the Mediterranean and the Antarctic. LONGHURST (1998) indicated that the Canary Islands may induce a counterclockwise meander of the offshore part of the coastal boundary zone around the archipelago at about the 2000-m isotbath, a feature that then influences the surface temperature field. BARTON et al. (1998) examined the interactions between the north-west African coastal upwelling and offshore waters in form of filaments, eddies and island wakes. These are not constant during the

whole year, but vary depending, among other things, mostly on season and wind period. The Canary Islands present a barrier to the equator-ward flow of the Canary Current, lying in the transitional zone between the north-west African coastal upwelling region and the open ocean waters of the subtropical gyre. Eddies generated by Gran Canaria and probably other islands in the archipelago, too, which transport cold, chlorophyll-rich coastal upwelling waters into the Canary region are the main reasons for the seasonal variability of chlorophyll distribution (ARÍSTEGUI et al., 1994, 1997). As primary production and chlorophyll values are uneven throughout the year, influence on the distribution of consumers at several trophic levels must be expected, but BARNETT (1984) emphasises that the factors controlling the distribution of fishes are more likely biotic than purely physical, at least at the trophic levels of primary and secondary carnivores.

The coastal upwelling along Morocco and its effects on salinity and temperature is clearly visible in JOHNSON et al. (2000). Salinity is lowest between the coast of Morocco and Fuerteventura, increasing between Fuerteventura and Gran Canaria, becoming even higher between Gran Canaria and Tenerife, and reaching its maximum west of Tenerife. The same increase can be observed in temperature. ZELCK AND KLEIN (1995) explain in their work on the distribution of the lanternfish *Ceratoscopelus maderensis* its absence between Fuerteventura and Morocco with the spreading of higher saline waters. An additional seasonally limited, local upwelling may exist just in front of Gran Tarajal, Southeast Fuerteventura (UIBLEIN et al., 1996, 1998). Furthermore, there are indications for the existence of an eddy in the south of Gran Canaria (ARÍSTEGUI et al., 1994, 1997; BORDES et al., 1999). BARANGE et al. (1998) showed the intense influences of specific hydrological features on a pelagic community.

The SOND cruise in 1965 allowed the first detailed study of the fish composition in the mesopelagic realm around the Canarian Archipelago (BADCOCK, 1970). It was followed by the investigations of BADCOCK AND MERRETT (1976) in adjacent waters off Northwest Africa. More recently with various fishing methods and acoustic devices (e. g. BORDES et al., 1987, 1991, 1995) an intense scattering layer consisting of micronektonic and planktic organisms, as well as many different species of mesopelagic fishes has been located in depths between 400 and 700 m.

Many species forming this deep scattering layer are vertical migrants, ascending to the surface at sunset, staying there during night and descending again to deeper, less illuminated levels at sunrise (BARHAM, 1966). The upward migration is ascribed to the search for food, and the downward migration to the avoidance of predators (UIBLEIN, 2000), though CLARKE (1978) found also species, which feed regardless of their depth-residence. These migrations lead to interactions with the permanent epipelagic inhabitants, which again are intensified by the fact, that the Canaries are typical oceanic islands of volcanic origin with space-limited coastal areas and oceanic conditions encountered only a few miles offshore. This specific condition induces close interactions among neritic, oceanic, benthic, and benthopelagic organisms (UIBLEIN AND BORDES, 1999). For instance, the two typical shelf-dwelling species

Sardinella aurita and *Scomber japonicus* have been caught 1.5 - 4 miles off the shelf and 4 - 6.5 miles off the coast, above more than 1000 m bottom depth together with mesopelagic fishes, especially myctophids (BORDES et al., 1999). Quite contrary is the situation above a broad continental shelf. HULLEY AND PROSCH (1987) investigated the southern Benguela upwelling region and indicate only a single mesopelagic species encountered above a bottom depth of less than 300 m. Horizontal migrations may also be limited.

Mesopelagic fishes (primarily vertical migrants) may have considerable importance as a trophic source for commercially important epipelagic species like tunas and mackerels (ABRAMS et al., 1996) as well as for dolphins (SHOTTON, 1997; FIEDLER et al., 1998). Shotton indicates that myctophids are high in proteins, variable but lower in lipids (containing triglycerides) and uniformly low in carbohydrates. Therefore, they might become an interesting food resource for humans in the future. Nevertheless an exploitation of the stocks must be avoided as long as their ecological function (especially their role in the food web) is not completely understood. It turned out that in Shotton's investigation area, the Arabian Sea, delphinids and other cetacean species are very dependent on myctophids as food resource. Tunas, mackerels and billfishes use them as food, but the extent of their importance is unclear, as well as the effects on their zooplankton prey, their competitor species (like salps, carnivorous crustaceans and other fishes) and the co-occurring cephalopods.

Further problems derive from the many different speices concepts. MIYA AND NISHIDA (1997) found three genetically structured, isolated populations of the deep-sea fish *Cyclothone alba* in open oceans.Therfore, to know if it is really one single species or a spatially restricted population (stock) is at least as important as the knowledge about its life cycle.

The present study provides an annotated species list of all mesopelagic fishes, caught during three cruises in Canarian Waters, with remarks on new records and other interesting facts, as well as a revision of the list of mesopelagic fishes published by BORDES et al. (1999). The following questions will be covered: (1) To which degree differs the vertical migration behaviour among abundant species? (2) Are there different distribution patterns recognisable within the Canary Archipelago? (3) Are there seasonal differences with respect to occurrence, abundance, or size of distinct species?

2. MATERIAL & METHODS

2. 1. Trawling Method

The results are based on the fish material which was collected in the three following cruises: "La Bocaina 04-97", "La Bocaina 11-97", and "ECOS 04-99". The cruises were carried out within the Canarian Archipelago in two different seasons (two in April and one in November). Figures 7 and 8 show the maps of the cruises with the sampling stations, indicating the trawling depths (epi- or mesopelagic). As these figures show, most of the trawls were made off the eastern Islands Lanzarote, Fuerteventura and Gran Canaria. The third cruise "ECOS 04-99" included also six stations around La Gomera and one west of La Palma.

The research vessel used in the cruises was the B/E La Bocaina (Fig. 1). It belongs to the Canarian government and is based at the port of Arrecife, Lanzarote. It has the following characteristics: 29.7 m length, 8 m width, 3.1 m draught, 205 tons registered brutto weight, and the principal motor is equipped with 705 HP at 1,200 r/min.

For the fishing operations a commercial trawl was used. The dimensions of the net are given in Figure 6. Mesh size of the cod-end was 2 cm in cruise "La Bocaina 04-97" and 2 mm in the two remaining cruises. The opening of the cod-end was strengthened by a steel ring of 1.5 m diameter in the cruises "La Bocaina 11-97" and "ECOS 04-99". Due to these different techniques, cruise "La Bocaina 04-97" is often treated separately or excluded from certain analyses.

The tows were carried out at different times during night and day, in different depths (epipelagic: 8 to 146 m, mesopelagic: 255 to 716 m) and above different bottom depths from neritic (48 m) to oceanic (3400 m) waters. Exact data of duration, situation, trawl and bottom depth, etc. for the tows of all three cruises are shown in Table 1.

As the net has no opening-closing device, the capture of organisms during the descend and hauling-in operation was avoided through manipulations of the speed of the ship. Once the net was cast, the sinking velocity depends on the length of the released cable. During this phase, the releasing speed of the cable exceeded the speed of the ship, therefore the net remained closed and in a vertical position. After the net arrived in the targeted depth, the velocity of the ship was increased, the cable tightened, and the net opened. The opening of the net was supported by weights on the foot rope and buoyancy balloons on the upper part (Fig. 2). The trawl started at the moment as the net opened. The net sounder, positioned in the mouth of the net (Fig. 3 and 5), transmitted the data to the bridge of the ship (Fig. 4), and every five minutes trawling and bottom depth, net opening diameter and speed of the ship were recorded. The horizontal position of the net in the selected depth stratum was controlled by eventually changing the speed. At the end of a tow the speed was increased, immediately followed by the stop of the ship. This lead to a folding of the net and a closing of its

mouth, before the hauling-in operation started. The duration of the trawls lasted between 27 and 122 minutes.

2. 2. Taxonomic Part

On board the content of each haul was sorted into epipelagic and mesopelagic fishes, crustaceans, cephalopods, coelenterata, tunicates, etc. The mesopelagic fishes of cruise "La Bocaina 04-97" were conserved in ethanol to enable DNA studies (cf. MIYA AND NISHIDA, 2000), those from the remaining cruises first in 7 % Formol and transferred later to 70 % Ethanol. Species identification is based on the following literature: BADCOCK (1982), BIGELOW et al. (1964), HULLEY (1981), NAFPAKTITIS et al. (1977), NAKAMURA AND PARIN (1993), NELSON (1994), NIELSEN AND SMITH (1978), NIELSEN AND BERTELSEN (1985), ROFEN (1966), and WHITEHEAD et al. (1984-86).

The annotated species list provides the most important and best distinguishing diagnostic characters for orders, families, genera and species. No diagnostic characters are given for genus or species of which until now only this respective taxon is known from the north-eastern Central Atlantic. Monotype of groups is denoted. The classification of the species list is according to NELSON (1994), the validity of orders, families and scientific names was proofed with ESCHMAYER (1998) and by checking the online catalogue of fishes (http://research.calacademy.org/ich/fishcatsearch.html). Systematic and ecological terms are according to LINCOLN et al. (1998).

The total number of individuals per species is indicated, standard (SL) and total length (TL) of each specimen were measured (the range is given), population differences in morphometric or meristic characters (e. g. in gillraker counts) noted, and the specimens sexed, whenever possible. If necessary, vertebral counts based upon X-radiographs were made.

The remarks point out deviations from data in the literature as well as important details and information concerning the geographic distribution. If not otherwise indicated, the occurrence of the species in Canarian waters corresponds to the distribution data given in the "Checklist of the Fishes of the Eastern Tropical Atlantic" ("CLOFETA", QUÉRO et al., 1990a), the "Checklist of the Fishes of the North-Eastern Atlantic and the Mediterranean" ("CLOFNAM", HUREAU AND MONOD, 1979), and the compendium "Fishes of the North-eastern Atlantic and Mediterranean" ("FNAM", WHITEHEAD et al., 1984), respectively. Further proofs of the distribution were made using BADCOCK (1970), BADCOCK AND MERRETT (1976), BORDES et al. (1999), BRITO et al. (2002), KOTTHAUS (1972), LLORIS et al. (1991), RODRÍGUEZ (2000), and RUDYAKOV (1979). Chief attention was thereby laid upon the work of BADCOCK (1970) and BRITO et al. (2002), because these authors treat exclusively and exactly the Canarian region. LLORIS et al. (1991) provides an inventory list of fish species of the Macaronesian area (in North-South-direction between 39° 45' N and 14° 49' N and in West-East-direction between 31° 17' W and 13° 20' W) which covers the Azores, Madeira, the Canary and Cape Verde Islands, and a

a coastal segment of the African continent. Citations of species occurrence without precise locality, only given with the term "in the area" were ignored.

The collection numbers of the specimens which are already included into an ichthyological collection are given. The remaining specimens are currently located at the Natural History Museum and Institute, Chiba, Japan (most of the specimens of cruise "La Bocaina 04-97") and the Deptartment of Marine Science, University of South Florida, St. Petersburg, USA. At least one representative individual from almost each species of cruise "La-Bocaina 04-97" has been sent to the Zoological Museum, University of Copenhagen (ZMUC), Denmark. Together with the individuals of cruise "La Bocaina 11-97" and "ECOS 04-99" they are now included and registered in the Ichthyological Collection of ZMUC. In parallel, a small comparative collection was established at the Instituto Canario de Ciencias Marinas (ICCM) in Telde, Gran Canaria, Spain.

2. 3. Dominance and Diversity Analysis

According to BICK (1998) the following grading for the division of dominance has been used: abundance < 1 % = subrecedent, 1 - 2 % = recedent, 2 - 5 % = subdominant, 5 - 10 % = dominant, and abundance > 10 % = eudominant. The dominance calculation is based on all mesopelagic species.

The diversity analysis includes all trawling stations, cruise "La Bocaina 04-97" was treated separately. Only tows taken completely above a bottom depth of less than 200 m were regarded as neritic.

2. 4. Cluster Analysis and Population Structure

This analysis includes all trawls from cruise "La Bocaina 11-97" and "ECOS 04-99" which resulted in the capture of mesopelagic fishes. Specimens not determinable to the species level have been excluded. Because of the different durations of the single trawls, the trawling success was converted to a theoretical fished volume of 10,000 m^3. The new values represent the basis for the cluster analysis and the biogeographic analysis. As no speed-data from trawling stations 17 and 18 in cruise "La Bocaina 11-97" were available, the average speed of the epipelagic tows of this cruise, which resulted in the capture of mesopelagic fishes, were taken. The individuals from cruise "La Bocaina 04-97" are included in the section dealing with population structure.

2. 5. Vertical Migration

In addition to the trawl tows, an acoustic survey was carried out. The equipment and the exact methods used are described in BORDES et al. (1999).

Figure 1. B/E La Bocaina.

Figure 2. Net before it is cast.

Figure 3. Netsounder in the mouth of the net.

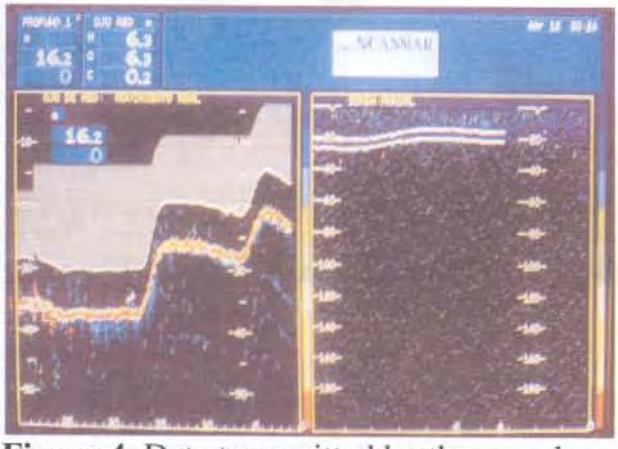


Figure 4. Data transmitted by the sounder to the bridge of the ship.

Figure 5. Netsounder.

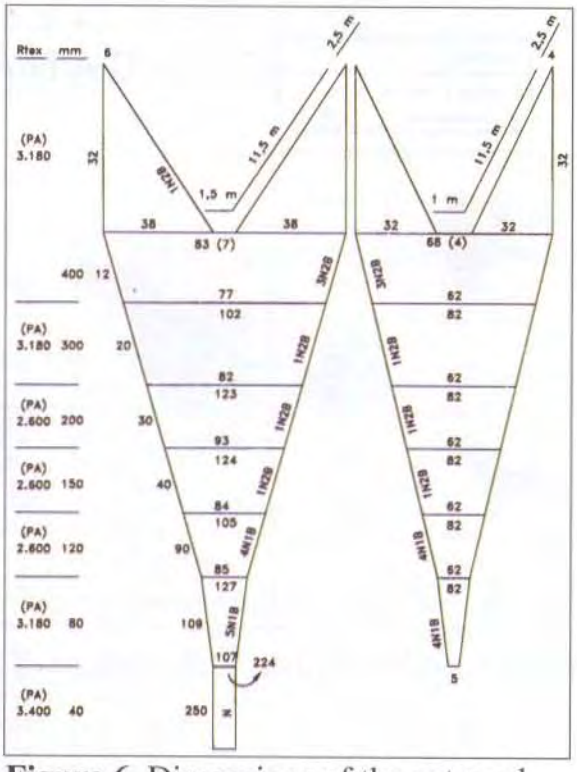


Figure 6. Dimensions of the net used.

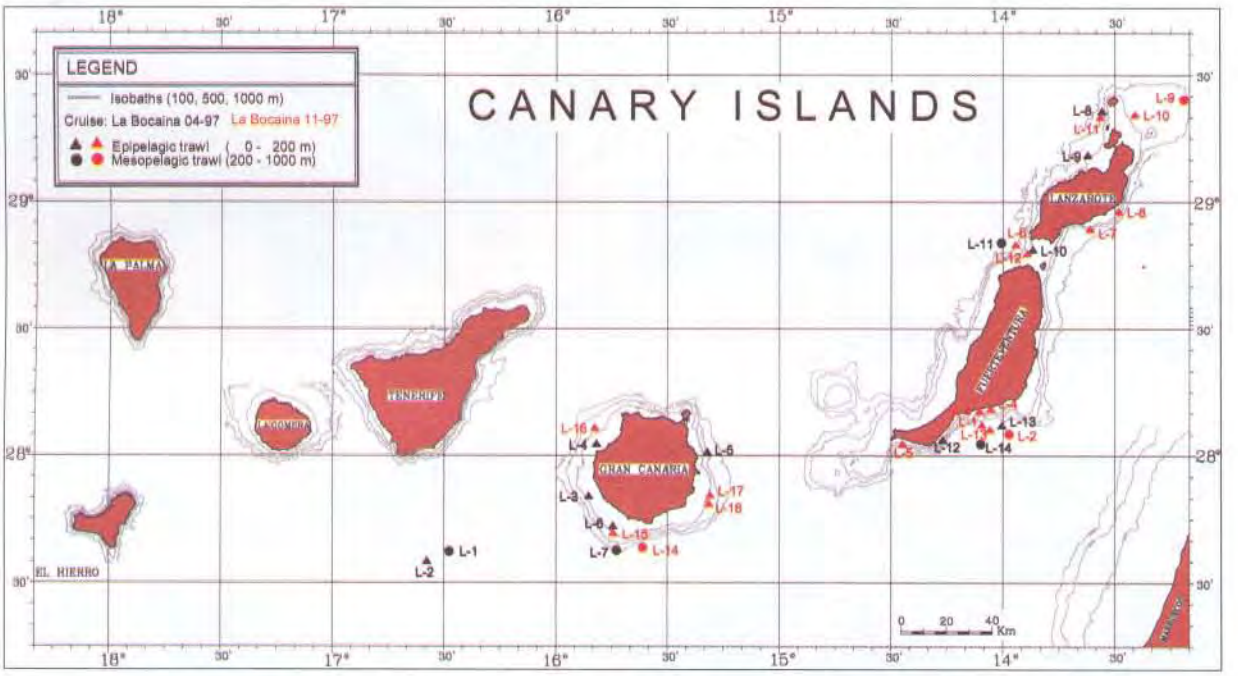


Figure 7. Overview map of the stations of cruise "La Bocaina 04-97" (black) and "La Bocaina 11-97" (red).

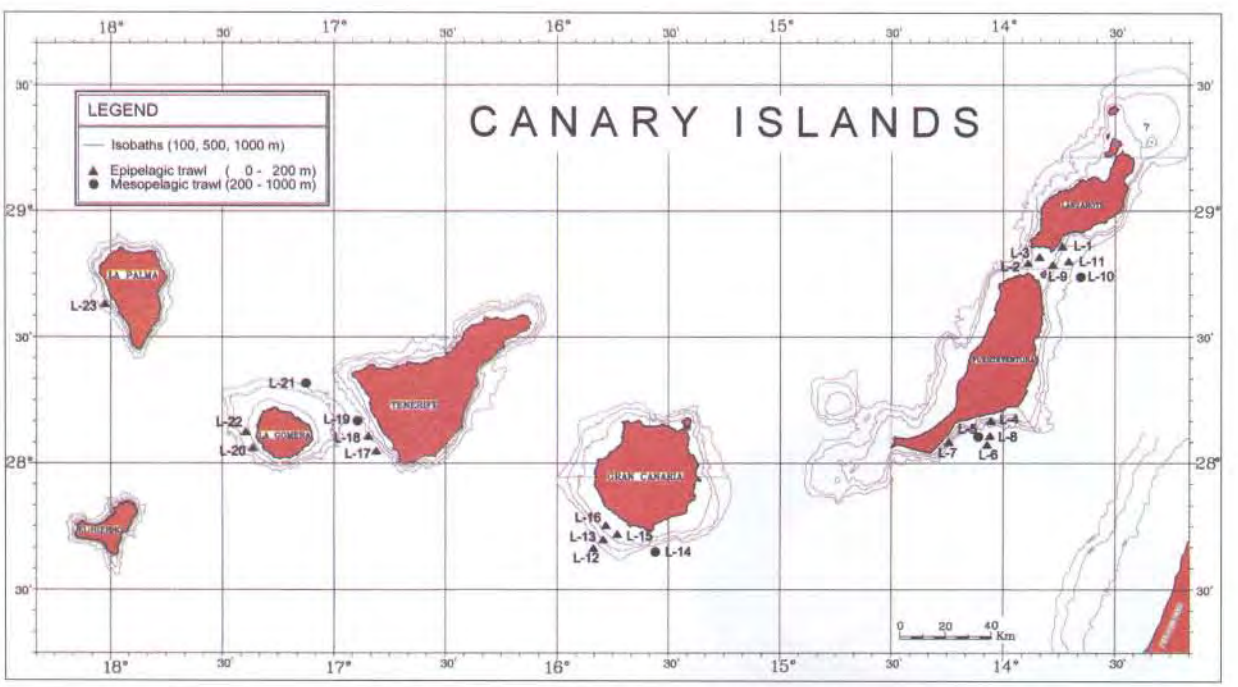


Figure 8. Overview map of the stations of cruise "ECOS 04-99".

Table 1. Characteristics of the trawl hauls for the fishes collected. Bold tow numbers indicate mesopelagic tows.

Cruise "La Bocaina 04-97"

Tow nr.	Date	Time (h)	Duration (min)	Initial position	Final position	Mean trawl depth (m)	Mean bottom depth (m)
1	03. Apr. 97	18:37-19:37	60	27°34.6' N 16°26.4' W	27°35.3' N 16°30.7' W	538	1258
2	03. Apr. 97	21:10-22:00	50	27°36.5' N 16°31.4' W	27°37.9' N 16°36.3' W	23	3400
3	05. Apr. 97	13:52-15:00	68	27°53.3' N 15°53.7' W	27°49.9' N 15°51.4' W	89	94
4	05. Apr. 97	20:35-20:55	20	28°02.3' N 15°49.8' W	28°04.3' N 15°46.5' W	64	79
5	07. Apr. 97	10:51-11:36	45	28°02.6' N 15°21.5' W	27°59.6' N 15°20.2' W	40	93
6	07. Apr. 97	23:54-01:35	101	27°42.6' N 15°42.5' W	27°42.5' N 15°44.8' W	75	98
7	08. Apr. 97	03:00-03:51	51	27°38.6' N 15°45.9' W	27°36.8' N 15°42.4' W	522	986
8	10. Apr. 97	05:11-06:05	54	29°23.3' N 13°32.7' W	29°19.2' N 13°32.9' W	57	295
9	11. Apr. 97	10:45-11:50	55	29°11.9' N 13°33.5' W	29°09.4' N 13°37.6' W	41	88
10	11. Apr. 97	04:57-05:55	58	28°50.3' N 13°52.2' W	28°47.1' N 13°54.6' W	44	115
11	11. Apr. 97	07:41-08:40	59	28°51.8' N 13°57.0' W	28°47.2' N 14°00.4' W	624	1258
12	12. Apr. 97	00:42-01:35	53	28°08.2' N 14°12.7' W	28°05.2' N 14°15.4' W	36	187
13	12. Apr. 97	04:42-05:40	58	28°08.2' N 14°01.2' W	28°06.3' N 14°04.7' W	75	1120
14	12. Apr. 97	07:48-08:44	56	28°08.2' N 14°02.2' W	28°06.0' N 14°07.7' W	520	1156

Cruise "La Bocaina 11-97"

Tow nr.	Date	Time (h)	Duration (min)	Initial position	Final position	Range of trawling depth (m)	Initial/Final bottom depth (m)	Mean speed (n)
1	09. Nov. 97	20:35-21:35	60	28°07.46' N 14°02.48' W	28°05.96' N 14°05.92' W	71-76	1360/1413	3,3
2	10. Nov. 97	17:20-18:18	58	28°06.38' N 13°57.83' W	28°05.17' N 14°00.42' W	500-523	1067/1390	2,6
3	10. Nov. 97	20:12-21:12	60	28°10.04' N 14°09.46' W	28°09.72' N 14°04.70' W	34-69	1457/616	3,4
4	10. Nov. 97	11:50-12:24	34	28°10.23' N 14°05.19' W	28°10.02' N 14°07.18' W	22-35	85/48	2,8
5	12. Nov. 97	06:40-07:10	30	28°02.50' N 14°26.28' W	28°02.21' N 14°24.23' W	40-44	130/530	3,4
6	13. Nov. 97	06:25-06:52	27	28°51.55' N 13°54.29' W	28°50.16' N 13°54.51' W	28-43	656/860	2,8
7	14. Nov. 97	14:15-15:15	60	28°55.23' N 13°54.57' W	28°54.25' N 13°38.19' W	13-42	128/217	3,5
8	15. Nov. 97	10:20-11:00	40	28°58.67' N 13°28.74' W	28°56.98' N 13°30.11' W	53-83	120/101	2,9
9	15. Nov. 97	19:25-20:25	60	29°23.12' N 13°12.23' W	29°20.37' N 13°11.96' W	527-557	1280/1350	2,85
10	16. Nov. 97	00:10-01:23	73	29°20.42' N 13°21.88' W	29°16.58' N 13°23.92' W	20-64	144/94	3,3
11	16. Nov. 97	03:05-04:05	60	29°22.50' N 13°33.36' W	29°19.72' N 13°33.59' W	34-46	692/586	3,2
12	16. Nov. 97	23:25-00:35	70	28°50.06' N 13°53.01' W	28°47.27' N 13°52.11' W	31-43	115/70	3,3
13	18. Nov. 97	06:05-07:05	60	28°07.95' N 14°01.63' W	28°06.34' N 14°04.23' W	90-107	1183/1442	3,2
14	20. Nov. 97	19:45-20:45	60	27°38.30' N 15°37.64' W	27°36.98' N 15°39.98' W	592-603	1667/1638	2,5
15	20. Nov. 97	23:50-00:50	60	27°40.99' N 15°44.21' W	27°43.36' N 15°46.66' W	28-63	344/116	3,1
16	23. Nov. 97	21:20-22:20	60	28°07.23' N 15°47.59' W	28°05.07' N 15°50.17' W	42-66	112/104	3,1
17	23. Nov. 97	22:08-23:08	60	27°50.20' N 15°19.27' W	27°52.80' N 15°18.27' W	30-52	136/231	3,1
18	24. Nov. 97	00:25-01:00	35	27°51.58' N 15°18.71' W	27°49.87' N 15°18.71' W	116-146	260/181	3,1

Cruise "ECOS 04-99"

Tow nr.	Date	Time (h)	Duration (min)	Initial position	Final position	Range of trawling depth (m)	Initial/Final bottom depth (m)	Mean speed (n)
1	08. Apr. 99	19:23-20:50	87	28°51.75' N 13°44.02' W	28°49.01' N 13°46.02' W	28-39	185/159	1,95
2	09. Apr. 99	21:17-22:00	43	28°50.30' N 13°51.52' W	28°47.30' N 13°52.67' W	8-39	68/97	2,9
3	10. Apr. 99	05:13-06:00	47	28°49.69' N 13°52.47' W	28°47.29' N 13°52.89' W	25-39	108/98	2,7
4	11. Apr. 99	21:28-23:30	122	28°10.07' N 14°00.31' W	28°09.57' N 14°07.11' W	19-50	185/102	2,9
5	11. Apr. 99	09:45-11:40	115	28°07.29' N 14°03.65' W	28°05.62' N 14°09.88' W	382-511	1167/1320	2,5
6	12. Apr. 99	22:13-23:41	88	28°05.76' N 14°03.85' W	28°04.43' N 14°08.34' W	20-52	1526/1441	2,85
7	13. Apr. 99	21:51-22:55	64	28°08.43' N 14°12.47' W	28°05.15' N 14°15.71' W	19-40	229/116	3,6
8	14. Apr. 99	05:38-06:45	67	28°07.85' N 14°02.32' W	28°06.33' N 14°06.65' W	47-67	1127/1326	3,5
9	14. Apr. 99	21:20-22:15	55	28°49.61' N 13°45.97' W	28°46.41' N 13°47.25' W	18-33	124/116	3,2
10	15. Apr. 99	10:35-12:25	110	28°49.82' N 13°37.89' W	28°45.50' N 13°41.62' W	258-600	1055/1042	2,0
11	15. Apr. 99	15:02-15:55	53	28°51.30' N 13°41.63' W	28°48.16' N 13°43.95' W	12-40	745/764	3,4
12	22. Apr. 99	22:35-23:25	50	27°42.78' N 15°49.74' W	27°39.77' N 15°48.58' W	31-49	905/1316	2,8
13	23. Apr. 99	01:05-02:05	60	27°46.05' N 15°48.70' W	27°44.15' N 15°46.49' W	33-53	93/85	2,3
14	23. Apr. 99	16:55-18:40	95	27°38.99' N 15°39.43' W	27°36.21' N 15°43.42' W	480-694	1164/1044	1,5
15	23. Apr. 99	21:50-22:45	55	27°43.08' N 15°43.70' W	27°41.13' N 15°42.58' W	24-40	56/201	2,6
16	24. Apr. 99	00:00-01:20	80	27°43.78' N 15°47.00' W	27°41.37' N 15°43.46' W	18-61	107/105	2,7
17	25. Apr. 99	22:40-23:45	65	28°11.38' N 16°50.51' W	28°07.53' N 16°47.98' W	25-47	129/74	3,0
18	26. Apr. 99	01:01-02:09	68	28°07.60' N 16°48.16' W	28°10.95' N 16°50.31' W	41-71	86/176	2,8
19	26. Apr. 99	12:10-13:50	100	28°10.71' N 16°53.77' W	28°05.89' N 16°51.04' W	553-716	1225/1333	1,9
20	30. Apr. 99	07:06-08:00	54	28°04.60' N 17°21.20' W	28°02.37' N 17°19.43' W	34-52	102/107	3,0
21	30. Apr. 99	17:13-18:20	67	28°18.98' N 17°06.61' W	28°18.09' N 17°03.89' W	255-555	1000/1197	2,1
22	30. Apr. 99	21:52-23:50	118	28°06.84' N 17°23.31' W	28°02.36' N 17°19.96' W	25-70	113/113	2,7
23	01. May 99	21:15-23:10	115	28°41.90' N 17°59.46' W	28°34.61' N 17°56.36' W	18-36	320/717	4,2

3. RESULTS

From a total of 55 (43 epipelagic and 12 mesopelagic) trawl tows in the three cruises, 48 resulted in capture of fishes. Of these, 34 (among them all mesopelagic) tows contained a total number of 13,661 mesopelagic fishes. These belong to 31 families, 83 genera and 147 species.

Almost all individuals were identified to the species level, some (mainly myctophids of the genus *Lampanyctus*) only to the genus level. Due to their very bad condition, 462 myctophids could not be determined. Identification of other badly damaged specimens was quite often possible, however, length measurements not. Some of the juveniles and all fish larvae have not been determined yet and hence not registered at ZMUC. They are mentioned here only for the sake of completeness. Apart from epi- and mesopelagic fish, several pelagic invertebrates were also collected, including crustaceans, cephalopods, tunicates and jellyfish.

3. 1. Annotated Species List

Table 2 provides an overview of all mesopelagic (and some bathy- to benthopelagic) species found, indicating also the number of individuals per cruise. The following annotated species list shows the systematic position of each species and contains their major diagnostic characters for identification, the reference material and occasional remarks.

Table 2. List of all mesopelagic species encountered in the three cruises.

Order	Family	Species	La Bocaina 04-97	La Bocaina 11-97	ECOS 04-99
Anguilliformes	Nemichthyidae	*Avocettina infans* (GUENTHER, 1878)		1	
		Nemichthys curvirostris (STROEMMAN, 1896)	7	1	5
		Nemichthys scolopaceus RICHARDSON, 1848	1	1	3
	Serrivomeridae	*Serrivomer beani* GILL & RYDER, 1883	52	62	66
		Serrivomer lanceolatoides (SCHMIDT, 1916)		3	1
Saccopharyngiformes	Saccopharyngidae	*Saccopharynx ampullaceus* (HARWOOD, 1827)		1	
Osmeriformes	Bathylagidae	*Bathylagus greyae* COHEN, 1958	1		3
	Opisthoproctidae	*Opisthoproctus soleatus* VAILLANT, 1888		1	
	Alepocephalidae	*Bathytroctes microlepis* GUENTHER, 1878			1
		Xenodermichthys copei (GILL, 1884)		1	1
	Platytroctidae	*Searsia koefoedi* PARR, 1937		2	
Stomiiformes	Gonostomatidae	*Bonapartia pedaliota* GOODE & BEAN, 1896		1	3
		Cyclothone braueri JESPERSEN & TÅNING, 1926	543	1,281	586
		Cyclothone livida BRAUER, 1902			5
		Cyclothone pallida BRAUER, 1902	1	4	9
		Cyclothone pseudopallida MUKHACHEVA, 1964	41	34	113
		Diplophos madeirensis (JOHNSON, 1890)			1
		Diplophos taenia GÜNTHER, 1873	3	13	2
		Gonostoma bathyphilum (VAILLANT, 1884)			2
		Gonostoma denudatum RAFINESQUE, 1810	7	11	1
		Gonostoma elongatum GÜNTHER, 1878	258	8	30
		Margrethia obtusirostra JESPERSEN & TÅNING, 1919	1	5	5
	Sternoptychidae (Maurolicinae)	*Maurolicus muelleri* (GMELIN, 1789)			5
		Valenciennellus tripunctulatus (ESMARK, 1871)		8	4
	Sternoptychidae (Sternoptychinae)	*Argyropelecus aculeatus* VALENCIENNES, 1850	5	2	4
		Argyropelecus gigas NORMAN, 1930	4	3	3
		Argyropelecus hemigymnus COCCO, 1829	28	41	23
		Argyropelecus olfersi (CUVIER, 1829)	1		
		Sternoptyx diaphana HERMANN, 1781	1	15	7
	Phosichthyidae	*Ichthyococcus ovatus* (COCCO, 1838)			2
		Vinciguerria attenuata (COCCO, 1838)		58	71
		Vinciguerria nimbaria (JORDAN & WILLIAMS, 1895)	5	1,328	260
		Vinciguerria poweriae (COCCO, 1838)		57	22

Order	Family	Species	La Bocaina 04-97	La Bocaina 11-97	ECOS 04-99
	Stomiidae (Astronesthinae)	*Astronesthes gemmifer* GOODE & BEAN, 1896	7		1
		Astronesthes indicus BRAUER, 1902	2		
		Astronesthes leucopogon REGAN & TREWAVAS, 1929		1	
		Astronesthes macropogon GOODYEAR & GIBBS, 1970	1		
		Astronesthes micropogon GOODYEAR & GIBBS, 1970	3		
		Astronesthes neopogon REGAN & TREWAVAS, 1929	1		
		Borostomias mononema (REGAN & TREWAVAS, 1929)			4
		Rhadinesthes decimus (ZUGMAYER, 1911)	1		5
	Stomiidae (Stomiinae)	*Stomias boa* (RISSO, 1810)	138	8	137
		Stomias brevibarbatus EGE, 1918			1
		Stomias longibarbatus (BRAUER, 1902)		3	4
	Stomiidae (Chauliodontinae)	*Chauliodus danae* REGAN & TREWAVAS, 1929	57	58	196
		Chauliodus sloani BLOCH & SCHNEIDER, 1801	13	17	34
	Stomiidae (Melanostomiinae)	*Bathophilus brevis* REGAN & TREWAVAS, 1930			1
		Bathophilus digitatus (WELSH, 1923)			1
		Bathophilus longipinnis (PAPPENHEIM, 1914)		2	
		Bathophilus pawneei PARR, 1927			1
		Bathophilus vaillanti (ZUGMAYER, 1911)	7	14	23
		Chirostomias pliopterus REGAN & TREWAVAS, 1930	4		
		Eustomias bigelowi WELSH, 1923			1
		Eustomias filifer (GILCHRIST, 1906)	1		
		Eustomias lipochirus REGAN & TREWAVAS, 1930	1		
		Eustomias longibarba PARR, 1927		2	
		Eustomias obscurus VAILLANT, 1884	12	39	16
		Eustomias schmidti REGAN & TREWAVAS, 1930			1
		Eustomias simplex REGAN & TREWAVAS, 1930			1
		Eustomias tetranema ZUGMAYER, 1913	1		
		Flagellostomias boureei (ZUGMAYER, 1913)	1		1
		Grammatostomias flagellibarba HOLT & BYRNE, 1910	1		
		Leptostomias gladiator (ZUGMAYER, 1911)	1	1	
		Melanostomias bartonbeani PARR, 1927		1	
		Melanostomias biseriatus REGAN & TREWAVAS, 1930	2		2
		Melanostomias tentaculatus (REGAN & TREWAVAS, 1930)	7		1
		Photonectes braueri (ZUGMAYER, 1913)	1		3
		Photonectes margarita (GOODE & BEAN, 1896)			1
	Stomiidae (Idiacanthinae)	*Idiacanthus fasciola* PETERS, 1877	90	64	115
	Stomiidae (Malacosteinae)	*Aristostomias grimaldii* ZUGMAYER, 1913	1		
		Photostomias guernei COLLETT, 1889	106	43	51
Aulopiformes	Notosudidae	*Ahliesaurus berryi* BERTELSEN, KREFFT & MARSHALL, 1976	2		
		Scopelosaurus argenteus (MAUL, 1954)	3		
		Scopelosaurus lepidus (KREFFT & MAUL, 1955)			2
	Synodontidae (Synodontinae)	*Synodus synodus* (LINNAEUS, 1758)		1	
	Paralepididae	*Lestidiops affinis* (EGE, 1930)		6	
		Lestidiops javakari (BOULENGER, 1889)		25	
		Lestidiops sphyrenoides (RISSO, 1820)			1
		Paralepis coregonoides RISSO, 1820		1	
		Stemonosudis intermedia (EGE, 1933)	1	2	
		Sudis hyalina RAFINESQUE, 1810		2	
	Evermannellidae	*Evermannella indica* BRAUER, 1906		2	
Myctophiformes	Myctophidae	*Benthosema suborbitale* (GILBERT, 1913)	2	11	20
		Bolinichthys indicus (NAFPAKTITIS & NAFPAKTITIS, 1969)	2	12	293
		Bolinichthys supralateralis (PARR, 1928)			1
		Centrobranchus nigroocellatus (GUENTHER, 1873)			1
		Ceratoscopelus maderensis (LOWE, 1839)	11	61	24
		Ceratoscopelus warmingii (LUETKEN, 1892)	42	158	153
		Diaphus adenomus GILBERT, 1905	1	132	2
		Diaphus dumerilii (BLEEKER, 1856)		41	24
		Diaphus holti TÅNING, 1918			3
		Diaphus metopoclampus (COCCO, 1829)	39	1	15
		Diaphus mollis TÅNING, 1928	3	72	24
		Diaphus perspicillatus (OGILBY, 1898)	8	24	1
		Diaphus rafinesquii (COCCO, 1838)	19	19	65
		Diaphus termophilus TÅNING, 1928		2	17
		Diaphus vanhoeffeni (BRAUER, 1906)		1	
		Diogenichthys atlanticus (TÅNING, 1928)		23	247
		Gonichthys cocco (COCCO, 1829)			5
		Hygophum benoiti (COCCO, 1838)	1	336	1
		Hygophum hygomii (LUETKEN, 1892)	13	372	1,462
		Hygophum reinhardtii (LUETKEN, 1892)	1	32	143
		Hygophum taaningi BEKKER, 1965		44	56
		Lampadena chavesi COLLETT, 1905			3
		Lampadena speculigera GOODE & BEAN, 1896			1
		Lampadena urophaos atlantica MAUL, 1969	4		10
		Lampanyctus alatus GOODE & BEAN, 1896	48	2	78
		Lampanyctus crocodilus (RISSO, 1810)			1
		Lampanyctus festivus TÅNING, 1928	1		4
		Lampanyctus nobilis TÅNING, 1928			2
		Lampanyctus photonotus PARR, 1928	4		16
		Lampanyctus pusillus (JOHNSON, 1890)	7	6	114
		Lepidophanes gaussi (BRAUER, 1906)	19	35	113
		Lobianchia dofleini (ZUGMAYER, 1911)	13	955	364
		Lobianchia gemellarii (COCCO, 1838)	5	52	29

Order	Family	Species	La Bocaina 04-97	La Bocaina 11-97	ECOS 04-99
	Myctophidae	*Myctophum nitidulum* GARMAN, 1899		13	6
		Myctophum punctatum RAFINESQUE, 1810			107
		Myctophum selenops TÅNING, 1928		1	14
		Nannobrachium atrum (TÅNING, 1928)	4	4	56
		Nannobrachium cuprarium (TÅNING, 1928)			6
		Nannobrachium lineatum (TÅNING, 1928)	1		1
		Notolychnus valdiviae (BRAUER, 1904)	1		
		Notoscopelus bolini NAFPAKTITIS, 1975			10
		Notoscopelus caudispinosus (JOHNSON, 1863)	1		
		Notoscopelus resplendens (RICHARDSON, 1845)	11	63	86
		Symbolophorus veranyi (MOREAU, 1888)	1	5	21
		Taaningichthys minimus (TÅNING, 1928)		1	3
Lampriformes	Regalecidae	*Regalecus glesne* ASCANIUS, 1772			1
Lophiiformes	Melanocetidae	*Melanocetus johnsoni* GUENTHER, 1864	1		
	Ceratiidae	*Ceratias holboelli* KROEYER, 1845		1	
Stephanoberyciformes	Melamphaidae	*Melamphaes typhlops* (LOWE, 1843)		2	5
		Poromitra capito GOODE & BEAN, 1883		3	
		Scopelogadus beanii (GUENTHER, 1887)		1	
Beryciformes	Anoplogasteridae	*Anoplogaster cornuta* (VALENCIENNES, 1833)		1	
	Diretmidae	*Diretmus argenteus* JOHNSON, 1864	2	8	9
Zeiformes	Caproidae	*Capros aper* (LINNAEUS, 1758)	3		6
Syngnathiformes	Syngnathidae (Syngnathinae)	*?Syngnathus* sp.	1		
	Centriscidae (Macroramphosinae)	*Macroramphosus scolopax* (LINNAEUS, 1758)			6
Scorpaeniformes	Setarchidae	*Setarches guentheri* JOHNSON, 1862		1	
Perciformes	Caristiidae	*Caristius opalescens* (ZUGMAYER, 1911)			4
	Chiasmodontidae	*Pseudoscopelus altipinnis* PARR, 1933		1	
	Gempylidae	*Diplospinus multistriatus* MAUL, 1948	2	116	13
		Nealotus tripes JOHNSON, 1865		4	
	Trichiuridae (Aphanopodinae)	*Aphanopus intermedius* PARIN, 1983	1		
		Benthodesmus simonyi (STEINDACHNER, 1891)			11
	Trichiuridae (Lepidopinae)	*Lepidopus caudatus* (EUPHRASEN, 1788)	1		5
	Nomeidae	*Cubiceps gracilis* (LOWE, 1843)			5

Systematic position:

→ Phylum **Chordata**

→ Subphylum **Vertebrata**

→ Superclass **Gnathostomata**

→ Class **Actinopterygii**

→ Subclass **Neopterygii**

→ Division **Teleostei**

Subdivision Elopomorpha

Order Anguilliformes

Diagnostic characters: body very elongate; dorsal and anal fins confluent with caudal fin; pelvic fins and skeleton absent.

Fam. Nemichthyidae

Diagnostic characters: jaws produced into a long, narrow, nonocclusible beak and provided with many small teeth, each bearing a posteriorly directed cusp; ripe specimens lacking the prolonged beak; dentition lacking in ripe males and reduced in ripe females; dorsal fin origin in front of anal fin origin.

Avocettina JORDAN & DAVIS, 1891
Diagnostic characters: caudal filament absent; one pore per segment forming lateral line; elongate sensory ridges behind eyes; anus well posterior to pectoral fins.

Avocettina infans (GUENTHER, 1878)
Diagnostic characters: lateral-line pores 181 - 201; predorsal pores 4 - 8; body not uniformly brown.
Reference material: 1 specimen; SL: 540 mm; La Boc. 11-97: tow 14 (ZMUC P313059).
Remarks: The principal characters separating the four species of this genus overlap in some cases. Only *A. infans* occurs in the Northern Hemisphere of the Atlantic.

Nemichthys RICHARDSON, 1848
Diagnostic characters: caudal filament present; five pores per segment forming three lateral lines; no sensory ridges on head.

Nemichthys curvirostris (STROEMMAN, 1896)
Diagnostic characters: body pale with large melanophores on belly and subcutaneous, vertical, black bars between vertebrae.
Reference material: 13 specimens; TL: 274 – 788 mm; La Boc. 04-97: tow 2 (ZMUC P313127), tow 11, tow 13, tow 14; La Boc. 11-97: tow 1 (ZMUC P313060); ECOS 04-99: tow 5 (ZMUC P313206), tow 12 (ZMUC P313207), tow 19 (ZMUC P313208), tow 21 (ZMUC P313209, ICCM P313).

Nemichthys scolopaceus RICHARDSON, 1848
Diagnostic characters: body more or less pigmented and no black bars between vertebrae.
Reference material: 5 specimens; TL: 209 - 773 mm; La Boc. 04-97: tow 14 (ZMUC P313128); La Boc. 11-97: tow 9 (ZMUC P313061); ECOS 04-99: tow 5 (ZMUC P313210), tow 12 (ZMUC P313211), tow 14 (ICCM P314).

Fam. Serrivomeridae

Diagnostic characters: jaws drawn out into a long narrow pointed beak; vomerine teeth in two or more rows; dorsal fin origin behind anal fin origin; caudal fin indistinct.
Remarks: Due to the bad condition 2 specimens (SL: 147 mm) were not determinable to the species level: ECOS 04-99: tow 14 (ZMUC P313139), tow 19 (ZMUC P313140).

Serrivomer GILL & RYDER, 1883
Diagnostic characters: see family diagnosis.

Serrivomer beani GILL & RYDER, 1883
Diagnostic characters: seven branchiostegal rays, first five rays have a process extending beyond hyoid arch.

Reference material: 180 specimens; SL: 118 – 522 mm; La Boc. 04-97: tow 1, tow 2, tow 11 (ZMUC P313129), tow 12, tow 14; La Boc. 11-97: tow 2 (ZMUC P313062-72), tow 3 (ZMUC P313073), tow 9 (ZMUC P313074), tow 14 (ZMUC P313075-3122, ICCM P311); ECOS 04-99: tow 5 (ZMUC P313141-153), tow 7 (ZMUC P313154), tow 10 (ZMUC P313155-172), tow 14 (ZMUC P313173-187, ICCM P315-316), tow 19 (ZMUC P313188-198), tow 21 (ZMUC P313199-3204).

Serrivomer lanceolatoides (SCHMIDT, 1916)
Diagnostic characters: eight branchiostegal rays, only sixth ray has anterior process extending beyond hyoid arch.
Reference material: 4 specimens; SL: 244 - 285 mm; La Boc. 11-97: tow 9 (ZMUC P313124-25, ICCM P312); ECOS 04-99: tow 14 (ZMUC P313205).
Remarks: In the eastern Central Atlantic the synonym *S. brevidentatus* ROULE & BERTIN 1929 is cited south of 40° N by BAUCHOT (1986) and between the Canary and the Cape Verde Islands by SALDANHA AND KARMOVSKAYA (1990), respectively. An additional synonym is *Platuronides danae* ROULE & BERTIN 1924, which was found by KOTTHAUS (1972) about 10° west of the Canaries.

Order Saccopharyngiformes

Diagnostic characters: jaws and hyomandibular greatly elongate, attached to small neurocranium by only one condyle; dorsal and anal fins long; caudal fin absent or rudimentary; pelvic fins absent.

Fam. Saccopharyngidae

Diagnostic characters: mouth very large, extremely distendable, jaws very protractile; teeth well developed, in 3 - 4 series; long, tapering tail with no distinct caudal fin, but a luminous caudal organ; dorsal fin origin well behind gill openings.

Saccopharynx MITCHILL, 1824
Diagnostic characters: monogeneric, see family diagnosis.

Saccopharynx ampullaceus (HARWOOD, 1827)
Diagnostic characters: skin black; distal third of tail spotted; body with filaments on trunk and tail; caudal organ slender, indistinctly expanded with smoothly curved edges and without well-developed filaments.
Reference material: 1 specimen; TL: 965 mm; La Boc. 11-97: tow 9 (ZMUC P2344414).
Remarks: This species is bathy- to abyssopelagic.

Subdivision Euteleostei

Order Osmeriformes

Diagnostic characters: maxilla included in gape of mouth (toothless maxilla is excluded from the gape in *Prototroctes*, *Lovettia* and *Aplochiton*).

Fam. Bathylagidae

Diagnostic characters: mouth smaller than eye diameter, ending before the eye; gill membranes broadly united and separate from isthmus; normal gillrakers present; photophores absent; dorsal adipose fin present or absent.

Bathylagus GUENTHER, 1878
Diagnostic characters: see family diagnosis.
Remarks: Kobylyansky reintroduced and erected in 1990 seven other genera, revision is needed.

Bathylagus greyae COHEN, 1958
Diagnostic characters: anal fin base equal to or shorter than caudal peduncle; gill opening extends more than halfway up side of body.
Reference material: 4 specimens; SL: 48 - 82 mm; La Boc. 04-97: tow 2 (ZMUC P19873); ECOS 04-99: tow 6 (ZMUC P191121, ICCM P191), tow 12 (ZMUC P191122).

Fam. Opisthoproctidae

Diagnostic characters: eyes usually tubular; photophores present on dorsal part of body; normal gillrakers present; adipose dorsal fin present.

Opisthoproctus VAILLANT, 1888
Diagnostic characters: body laterally compressed and rather short; belly with a flat, scale-covered sole.

Opisthoproctus soleatus VAILLANT, 1888
Diagnostic characters: snout short, 15 % or less of standard length; no dark patches on sole.
Reference material: 1 specimen; SL: 65 mm; La Boc. 11-97: tow 14 (ZMUC P2010999).

Fam. Alepocephalidae

Diagnostic characters: dorsal fin set far back on body; anal fin similar to dorsal fin, their bases about equal in length and most often opposite of each other; adipose dorsal fin absent; photophores present in some genera (not arranged in distinct rows or

clearly distinguishable groups), but absent in most genera; all fins with soft rays exclusively; lateral line absent or indistinct; caudal fin forked.

Bathytroctes GUENTHER, 1878
Diagnostic characters: body with scales; teeth present on maxilla and lower jaw, teeth near anterior tips of upper and lower jaws in single series; dorsal fin origin in advance of anal fin origin; upper jaw ends approximately below posterior margin of eye; 13 - 17 anal finrays.

Bathytroctes microlepis GUENTHER, 1878
Diagnostic characters: see genus diagnosis.
Reference material: 1 specimen; SL: 38 mm; ECOS 04-99: tow 14 (ZMUC P17732).
Remarks: This species is bentho- to bathypelagic, occurring below 1,100 m. The present specimen is a juvenile and caught in the mesopelagic realm. This suggests, that juvenile *B. microlepis* are (like many juveniles of benthopelagic species) probably living in shallower (mesopelagic) depths.

Xenodermichthys GUENTHER, 1878
Diagnostic characters: body black and completely scaleless; light organs present, nodular, not on stalks; 26 - 33 anal finrays.

Xenodermichthys copei (GILL, 1884)
Diagnostic characters: see genus diagnosis.
Reference material: 2 specimens; SL: 19 - 137 mm; La Boc. 11-97: tow 9 (ZMUC P17723); ECOS 04-99: tow 14 (ZMUC P17733).
Remarks: The small, juvenile specimen (P177333) has only very few and tiny photophores above the lateral line, whereas they are conspicuous and numerous in the other one (P17723).

Fam. Platytroctidae

Diagnostic characters: resembling Alepocephalidae, but possess a black shoulder sac apparatus (= shoulder organ) which is located under the shoulder girdle and produces blue-green luminous fluid, the opening to the exterior through tubular papilla just below lateral line and above pectoral fin base; no adipose dorsal fin; photophores can be present.

Searsia PARR, 1937
Diagnostic characters: lateral line scales unmodified; mouth small, upper jaw not reaching back beyond eye; light organ on underside of caudal peduncle double; widest part of head behind eye; no pits behind gill opening; scales small; no spines at tip of lower jaw.
Searsia koefoedi PARR, 1937
Diagnostic characters: monospecific, see genus diagnosis.
Reference material: 2 specimens; SL: 105 - 135 mm; La Boc. 11-97: tow 9 (ZMUC P17724), tow 14 (ICCM P171).

Order Stomiiformes

Diagnostic characters: luminescent organs (photophores) present; chin barbel can be present; premaxilla and maxilla with teeth, both included in the gape of mouth; mouth extending past eye in most; colour in most is dark brown or black, some are silvery.

Fam. Gonostomatidae

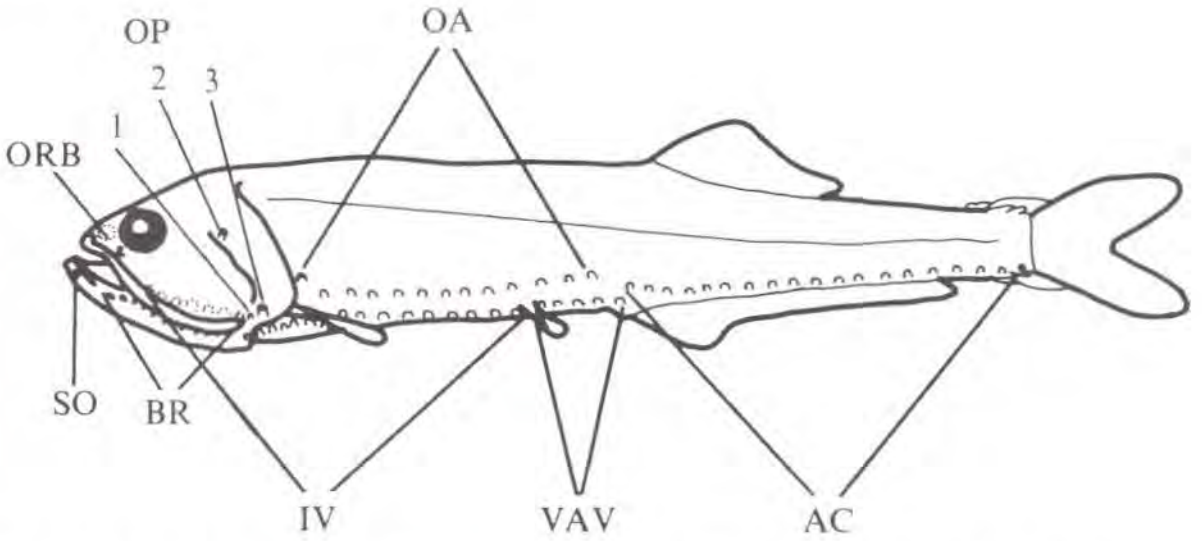


Figure 9. Gonostomatidae, Phosichthyidae [modified after: BADCOCK (1984)].

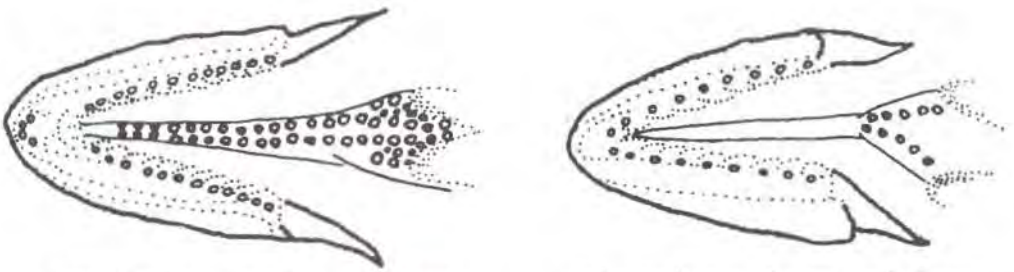


Figure 10. Gonostomatidae, Phosichthyidae: Ventral view of head [modified after: BADCOCK (1984)].

Diagnostic characters: body elongate; no photophores on isthmus (Fig. 10) or, if present on isthmus, total ventral series of photophores (IC = IV + VAV + AC, see Fig. 9) numbering more than 65; no chin barbel; all photophores single; photophores on ventral part of body present; normal gillrakers present; dorsal adipose fin present or absent.

Bonapartia GOODE & BEAN, 1896
Diagnostic characters: no photophores on isthmus; OA ending at or about anal fin origin; AC photophores less than 25; body with a single row of photophores; dorsal fin origin slightly behind of anal fin origin; dorsal adipose fin absent and body more elongate (unlike *Margrethia*).

Bonapartia pedaliota GOODE & BEAN, 1896
Diagnostic characters: monospecific, see genus diagnosis.
Reference material: 4 specimens; SL: 54 - 67 mm; La Boc. 11-97: tow 9 (ZMUC P2010956); ECOS 04-99: tow 10 (ZMUC P2011073-74, ICCM P2022).

Cyclothone GOODE & BEAN, 1883
Diagnostic characters: no photophores on isthmus; OA ending at or about anal origin; AC photophores less than 25; body with two rows of photophores; anus nearer to pelvic fin bases than to anal fin origin or at midway with 1 - 2 VAV anterior to anus (unlike *Gonostoma*).
Remarks: Because most of the specimens are in very bad condition, species identification is mainly based on the pattern of the meningeal pigment (dorsal aspect between and behind the eyes). Important distinguishing characters like the number of gillrakers in the articulation of epi- and ceratobranchial or the structure of the gill filaments are in any case very difficult to recognise.

Cyclothone braueri JESPERSEN & TÅNING, 1926
Diagnostic characters: premaxillary teeth even; meningeal pigment comprised dorsoanteriorly of few discrete stellate melanophores.
Reference material: 2,410 specimens; SL: 12 - 30 mm; La Boc. 04-97: tow 1, tow 11, tow 14 (ZMUC P2011000); La Boc. 11-97: tow 2 (ZMUC P2011856-868), tow 9 (ZMUC P2011869-12745), tow 14 (ZMUC P2012746-13136); ECOS 04-99: tow 5 (ZMUC P2011075-1262, ICCM P2023-26), tow 10 (ZMUC P2011263-1443), tow 14 (ZMUC P2011444-1522), tow 19 (ZMUC P2011523-1655), tow 21 (ZMUC P2011656).

Cyclothone livida BRAUER, 1902
Diagnostic characters: premaxillary teeth even, none greatly enlarged; meningeal pigment diffuse, extends forwards to at least level of posterior margin of eye; many punctate melanophores; teeth on posterior half of upper jaw not strongly curved forwards but enlarging irregularly caudad with long teeth separated by 2 - 4 small teeth (unlike *C. acclinidens*); resembling *C. microdon* but differs from this species in the higher number of gillrakers (23 - 27 versus 12 - 14).
Reference material: 5 specimens; SL: 24 - 31 mm; ECOS 04-99: tow 14 (ZMUC P2011657-59, ICCM P2027), tow 19 (ZMUC P2011660).

Cyclothone pallida BRAUER, 1902
Diagnostic characters: premaxillary teeth uneven with at least one tooth, usually the fourth, greatly enlarged; meningeal pigment diffuse, extends forwards to at least level of posterior margin of eye; many punctate melanophores.

Reference material: 14 specimens; SL: 22 - 46 mm; La Boc. 04-97: tow 11 (ZMUC P2011001); La Boc. 11-97: tow 9 (ZMUC P2013137-38), tow 14 (ZMUC P2013139-40); ECOS 04-99: tow 5 (ZMUC P2011661), tow 14 (ZMUC P2011662-67, ICCM P2028), tow 19 (ZMUC P2011668).

Cyclothone pseudopallida MUKHACHEVA, 1964
Diagnostic characters: premaxillary teeth even; meningeal pigment comprised dorso-anteriorly of many discrete punctate melanophores; pigment restricted to level well behind posterior margin of eyes.
Reference material: 188 specimens; SL: 18 - 39 mm; La Boc. 04-97: tow 1, tow 11 (ZMUC P2011002); La Boc. 11-97: tow 9 (ZMUC P2013141-46), tow 14 (ZMUC P2013147-174); ECOS 04-99: tow 5 (ZMUC P2011669-675), tow 10 (ZMUC P2011676-695), tow 14 (ZMUC P2011696-1759, ICCM P2029-30), tow 19 (ZMUC P2011760-779).

Diplophos GUENTHER, 1873
Diagnostic characters: adipose dorsal fin absent; photophores present on isthmus; OA extending over anal fin; AC photophores more than 27; gillrakers on first arch less than 16; pre-dorsal length more than 40 % standard length.

Diplophos maderensis (JOHNSON, 1890)
Diagnostic characters: 28 - 30 AC, evenly spaced; dorsal fin origin nearer caudal fin base than snout; body less elongate.
Reference material: 1 specimen; SL: ~73 mm; ECOS 04-99: tow 4 (ZMUC P2014129).

Diplophos taenia GUENTHER, 1873
Diagnostic characters: 45 - 51 AC, interspace between last two AC considerably less than that between preceding AC pair; dorsal fin origin nearer snout than caudal fin base; body more slender.
Reference material: 18 specimens; SL: 78 - 146; La Boc. 04-97: tow 1 (ZMUC P2011003); La Boc. 11-97: tow 1 (ZMUC P2010961-971, ICCM P201, ICCM P2013); ECOS 04-99: tow 6 (ZMUC P2011780), tow 8 (ZMUC P2011781).

Gonostoma RAFINESQUE, 1810
Diagnostic characters: photophores absent on isthmus; OA extending at or about anal fin origin; AC photophores less than 25; body with two rows of photophores; anus nearer to anal fin origin than to pelvic fin bases; three or more VAV anterior to anus (unlike *Cyclothone*).

Gonostoma bathyphilum (VAILLANT, 1884)
Diagnostic characters: body black; photophores small; white glandular masses associated with ORB and OA photophores; gillrakers on first arch more than 24 - 28; OA irregularly arranged, majority close to horizontal mid line of body.
Reference material: 2 specimens; SL: 24 - 29 mm; ECOS 04-99: tow 14 (ZMUC P2011782, ICCM P2031).

Gonostoma denudatum RAFINESQUE, 1810
Diagnostic characters: body colour: back dark, flanks silvery; no glandular masses associated with ORB or OA photophores; gillrakers on first arch: 3 + 7 + 5 (6); dorsal adipose fin present; 1st and 2nd AC above, 3rd and 4th below level of remaining AC photophores.
Reference material: 19 specimens; SL: 22 - 122 mm; La Boc. 04-97: tow 1 (ZMUC P2011004), tow 11, tow 13; La Boc. 11-97: tow 1 (ZMUC P2010974-980, ICCM P200, ICCM P2014), tow 2 (ZMUC P2010983), tow 14 (ZMUC P2010984); ECOS 04-99: tow 5 (ZMUC P2011783).

Gonostoma elongatum GUENTHER, 1878
Diagnostic characters: body dark, flanks thinly silvered; white glandular masses associated with ORB and OA photophores (whereat the glandular mass at the first OA is distinctly less developed); gillrakers on first arch: 19 (18 - 21); first OA photophore elevated, remainder level and low on body.
Reference material: 296 specimens; SL: 17 - 169 mm; La Boc. 04-97: tow 1 (ZMUC P20110005), tow 2, tow 7, tow 11, tow 14; La Boc. 11-97: tow 1 (ZMUC P2010997-98), tow 2 (ZMUC P2010986-88), tow 14 (ZMUC P2010989-991); ECOS 04-99: tow 5 (ZMUC P2011784-793), tow 10 (ZMUC P201794-97), tow 12 (ZMUC P2011798-1800, ICCM P2032-33), tow 14 (ZMUC P2011801), tow 19 (ZMUC P2011802-09), tow 21 (ZMUC P2011810-11).

Margrethia JESPERSEN & TÅNING, 1919
Diagnostic characters: photophores absent on isthmus; OA extending at or about anal origin; AC photophores less than 25; body with a single row of photophores; dorsal fin origin slightly in advance of anal fin origin; adipose dorsal fin present and body deeper (unlike *Bonapartia*).

Margrethia obtusirostra JESPERSEN & TÅNING, 1919
Diagnostic characters: see genus diagnosis.
Reference material: 11 specimens; SL: 38 - 72 mm; La Boc. 04-97: tow 1 (ZMUC P2011006); La Boc. 11-97: tow 2 (ZMUC P2010992-94), tow 9 (ZMUC P2010995), tow 14 (ZMUC P2010996); ECOS 04-99: tow 10 (ZMUC P2011812-15, ICCM P2034).

Fam. Sternoptychidae

Diagnostic characters: some photophores compound, with common photogenic mass; 3 - 7 (usually 6) branchiostegal photophores present; adipose dorsal fin present; AC photophores in groups.

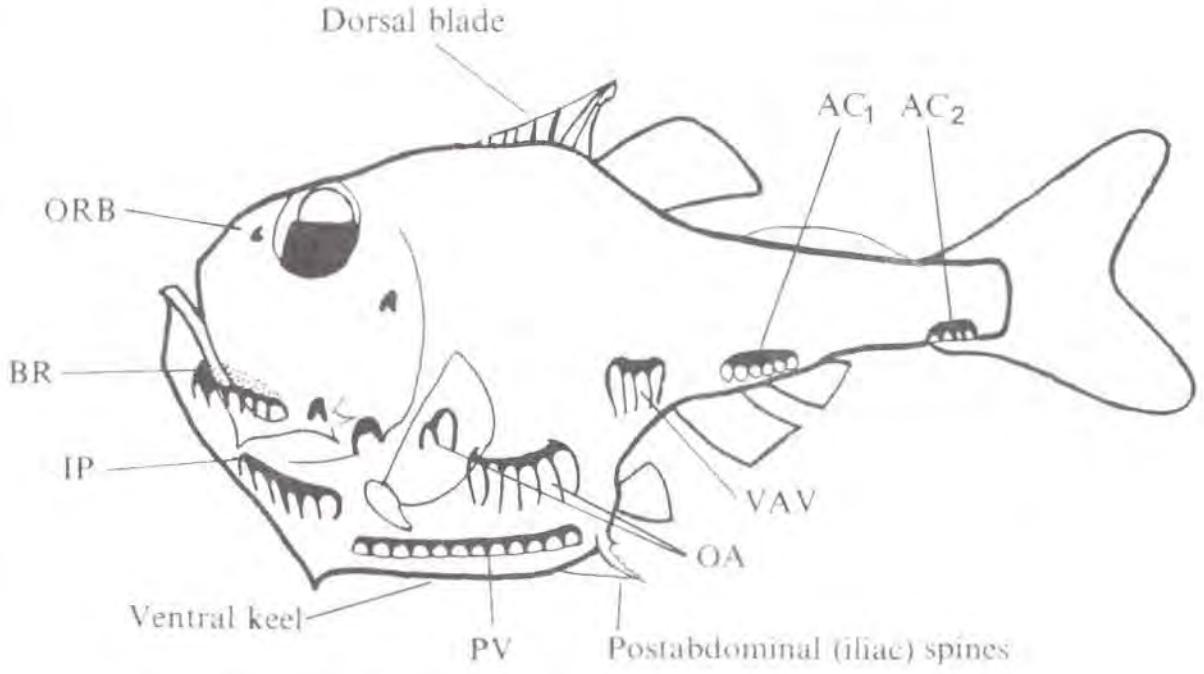


Figure 11. Sternoptychidae [modified after: BADCOCK (1984)].

Subfam. Maurolicinae

Diagnostic characters: body elongate, fusiform, not extremely compressed; greatest body depth 3.7 - 7.7 in standard length; dorsal blade absent.

Maurolicus COCCO, 1838
Diagnostic characters: AC with 2 or 3 groups of 5 or more photophores; anal fin origin behind dorsal fin origin.

Maurolicus muelleri (GMELIN, 1789)
Diagnostic characters: see genus diagnosis and remarks.
Reference material: 5 specimens; SL: 14 - 20 mm; ECOS 04-99: tow 6 (ZMUC P2011842), tow 12 (ZMUC P2011843), tow 14 (ZMUC P2011844), tow 16 (ZMUC P2011845, ICCM P2041).
Remarks: Of this genus probably only *M. muelleri* occurs in the Canarian region. For a long time this genus was considered to be monospecific, but in 1993 several additional species were described or reintroduced by Parin and Kobyliansky, but without occurrence in the Eastern Central Atlantic.

Valenciennellus JORDAN & EVERMANN, 1896
Diagnostic characters: AC in 3 - 6 groups each of 2 - 4 photophores; anal fin origin in advance of dorsal fin origin.

Valenciennellus tripunctulatus (ESMARK, 1871)
Diagnostic characters: see genus diagnosis.
Reference material: 12 specimens; SL: 21 - 29 mm; La Boc. 11-97: tow 9 (ZMUC P209434-39, ICCM P2017-18); ECOS 04-99: tow 5 (ZMUC P2011852), tow 10 (ZMUC P2011853-54), tow 21 (ZMUC P2011855).

Subfam. Sternoptychinae

Diagnostic characters: unique physique (Fig. 11); body deep and extremely compressed laterally, greatest body depth 0.8 - 2.0 in standard length; dorsal blade well developed; mouth nearly vertical; eyes sometimes tubular; colour silvery.

Argyropelecus COCCO, 1829
Diagnostic characters: dorsal blade well developed and of several spines; eyes tubular, directed dorsally; 12 PV photophores.

Argyropelecus aculeatus VALENCIENNES, 1850
Diagnostic characters: VAV, AC_1 and AC_2 photophore groups well separated and elevated relative to posterior 6 OA; anal finrays in two distinct groups separated by central AC_1 photophores; two separate post abdominal spines; posterior dorsal blade spines without hooks; enlarged caniniform teeth in lower jaw; postero-ventrally directed post-abdominal spine longer, markedly larger than antero-ventral one.
Reference material: 11 specimens; SL: 25 - 74 mm; La Boc. 04-97: tow 1, tow 7 (ZMUC P2011007), tow 11; La Boc. 11-97: tow 9 (ZMUC P209373); tow 13 (ZMUC P209374); ECOS 04-99: tow 10 (ZMUC P2011816), tow 19 (ZMUC P2011817-18), tow 21 (ICCM P2037).

Argyropelecus gigas NORMAN, 1930
Diagnostic characters: VAV, AC_1 and AC_2 photophore groups not well separated and on about same level as posterior 6 OA; anal finrays superficially not in two distinct groups; body profile with fleshy elevation between 3rd and 4th blade spines and raised markedly posterior to blade.
Reference material: 10 specimens; SL: 19 - 111 mm; La Boc. 04-97: tow 1; La Boc. 11-97: tow 9 (ZMUC P209375-76), tow 14 (ZMUC P209377); ECOS 04-99: tow 5 (ZMUC P2011819-820), tow 19 (ICCM P2038).

Argyropelecus hemigymnus COCCO, 1829
Diagnostic characters: VAV, AC_1 and AC_2 photophore groups well separated and elevated relative to posterior 6 OA; anal finrays in two distinct groups separated by central AC_1 photophores; a single posteriorly directed post-abdominal spine with serrated edges; posterior pair of fused dorsal blade spines with hooks forming barbs.
Reference material: 92 specimens; SL: 17 - 34 mm; La Boc. 04-97: tow 1, tow 7, tow 11, tow 14 (ZMUC P2011008); La Boc. 11-97: tow 2, tow 9, tow 14 (ZMUC P209413-18); ECOS 04-99: tow 5 (ZMUC P2011821-832), tow 6 (ZMUC P2011833), tow 10 (ZMUC P2011834-36), tow 14 (ZMUC P2011837), tow 19 (ZMUC P2011838-840, ICCM P2039-40), tow 21 (ZMUC P2011841).

Remarks: 17 specimens from tow 2 and 18 specimens from tow 9, cruise "La Bocaina 11-97", have been given to Tracey Sutton, Department of Marine Science, University of South Florida. One specimen ("ECOS 04-99", tow 6) was found in 20 - 52 m depth, although BADCOCK (1984) indicates no adults above 100 m during the night and KINZER AND SCHULZ (1988) consider Sternoptychidae as limited or partial migrants.

Argyropelecus olfersi (CUVIER, 1829)
Diagnostic characters: VAV, AC_1 and AC_2 photophore groups well separated and elevated relative to posterior 6 OA; anal finrays in two distinct groups separated by central AC_1 photophores; two separate post abdominal spines; posterior dorsal blade spines without hooks; enlarged caniniform teeth in lower jaw; post-abdominal spines equal in size and length.
Reference material: 1 specimen; SL: 18 mm; La Boc. 04-97: tow 14.
Remarks: Verification of this species was not possible, as the only representative from the three cruises is deposited in Chiba, Japan. BADCOCK (1984) restricts this species to east of 35° W and between 35° and 65° N, but QUÉRO et al. (1990b) cite already the Canary Islands as its southernmost occurrence in the Northern Hemisphere.

Sternoptyx HERMANN, 1781
Diagnostic characters: dorsal blade of one single spine with serrate anterior projection; eyes normal, directed laterally; 10 PV photophores.
Remarks: As the development of the photophores is not completed before 13 - 18 mm SL, and the determination of smaller individuals is hard (BADCOCK AND BAIRD, 1980) one individual with a standard length of 8 mm was not determined to the species level: ECOS 04-99: tow 21 (ZMUC P2011851). Depth occurrence of the species suggests that it is also *S. diaphana*.

Sternoptyx diaphana HERMANN, 1781
Diagnostic characters: supra-anal photophore low on body, nearer to antero-ventral margin of AC_1 than to trunk midline.
Reference material: 23 specimens; SL: 13 - 34 mm; La Boc. 04-97: tow 7 (ZMUC P2011009); La Boc. 11-97: tow 14 (ZMUC P209419-432, ICCM P206); ECOS 04-99: tow 5 (ICCM P2042), tow 10 (ZMUC P2011846-48), tow 19 (ZMUC P2011849, ICCM P2043), tow 21 (ZMUC P2011850).

Fam. Phosichthyidae

Diagnostic characters: body shape resembling Gonostomatidae; photophores on isthmus present (see Fig. 10); total number of photophores in ventral series (IC = IV + VAV + AC, see Fig. 9) numbering more than 65; no chin barbel; dorsal adipose fin present.

Ichthyococcus BONAPARTE, 1840
Diagnostic characters: 2 ORB; anal fin origin well behind end of dorsal fin; pelvic fin base posterior to vertical from dorsal fin origin; eyes tubular; dorsal adipose fin base about as long as anal fin base.

Ichthyococcus ovatus (COCCO, 1838)
Diagnostic characters: body short and deep; small mouth; SO absent; no dark pigment patch at dorsal fin origin.
Reference material: 2 specimens; SL: 31 mm; ECOS 04-99: tow 19 (ZMUC P2013770-71).

Vinciguerria JORDAN & EVERMANN, 1896
Diagnostic characters: 2 ORB; anal fin origin beneath or close behind vertical from last dorsal finray-base; anal and dorsal fin bases about equal in length; eyes normal.
Remarks: In cruise La Boc. 11-97 several small (SL 14 - 17 mm) specimens of this genus were caught. As they are, according to the determination literature, too small for having the adult photophore complement (especially the SO is missing), they have been classified only to the generic level: 74 specimens; 14 - 17 mm SL; La Boc. 11-97: tow 6 (ZMUC P2010882-894), tow 13 (ZMUC P2010895-0955). The question is, whether they are *V. nimbaria* (with SO) or *V. poweriae* (without SO). Because there are several individuals of *V. nimbaria*, with a standard length of 16 - 18 mm and a clearly visible SO, it seems to be reasonable to regard these small specimens as *V. poweriae*. The ratio of the accurately determinable *V. nimbaria* to *V. poweriae* would also support this assumption. A further difference, the gillraker number, is hard to examine. The non-determinability of six *Vinciguerria*-specimens in cruise "ECOS 04-99": tow 13 (ZMUC P2013772-77), derives from the bad condition of the individuals. Supposably they remained in the meshes of the net from tow 12, as no other *Vinciguerria* showed up in tow 13.

Vinciguerria attenuata (COCCO, 1838)
Diagnostic characters: SO absent; anus under sixth to seventh VAV; pigment lacking at lower jaw symphysis.
Reference material: 129 specimens; SL: 17 - 42 mm; La Boc. 11-97: tow 9 (ZMUC P209441-451), tow 14 (ZMUC P209452-495, ICCM P203); ECOS 04-99: tow 5 (ZMUC P2013778-3820), tow 10 (ZMUC P2013821-837, ICCM P2035), tow 12 (ZMUC P2013838-39), tow 14 (ZMUC P2013840-42), tow 14 (ZMUC P2013843-44), tow 21 (ZMUC P2013845-47).

Vinciguerria nimbaria (JORDAN & WILLIAMS, 1895)
Diagnostic characters: SO present; anus under eighth to ninth VAV; elongate dark pigment streak present at lower jaw symphysis.
Reference material: 1,593 specimens; SL: 16 - 46 mm; La Boc. 04-97: tow 2, tow 13 (ZMUC P2011010); La Boc. 11-97: tow 1 (ZMUC P209497-98), tow 2 (ZMUC P209499), tow 6 (ZMUC P209500-593), tow 9 (ZMUC P209594-97), tow 13 (ZMUC P209598-9674, ZMUC P209596-P2010763, ICCM P204), tow 14 (ZMUC P2010764-777), tow 17 (ZMUC P2010778-784), tow 18 (ZMUC P2010785-0824); ECOS 04-99:

tow 5 (ZMUC P2013848-859, ICCM P2036), tow 6 (ZMUC P2013860-3925), tow 7 (ZMUC P2013926-944), tow 8 (ZMUC P2013945-991), tow 10 (ZMUC P2013992-14015), tow 12 (ZMUC P2014016-4106).

Vinciguerria poweriae (COCCO, 1838)
Diagnostic characters: SO absent; anus under eighth to ninth VAV; elongate dark pigment streak present at lower jaw symphysis.
Reference material: 79 specimens; SL: 16 - 36 mm; La Boc. 11-97: tow 9 (ZMUC P2010825-26), tow 13 (ZMUC P2010827-877, ICCM P205, ICCM P2015-16), tow 14 (ZMUC P2010881); ECOS 04-99: tow 5 (ZMUC P2014107-110), tow 10 (ZMUC P2014111-16), tow 12 (ZMUC P2014117-120), tow 19 (ZMUC P2014121-24), tow 21 (ZMUC P2014125-28).

Fam. Stomiidae

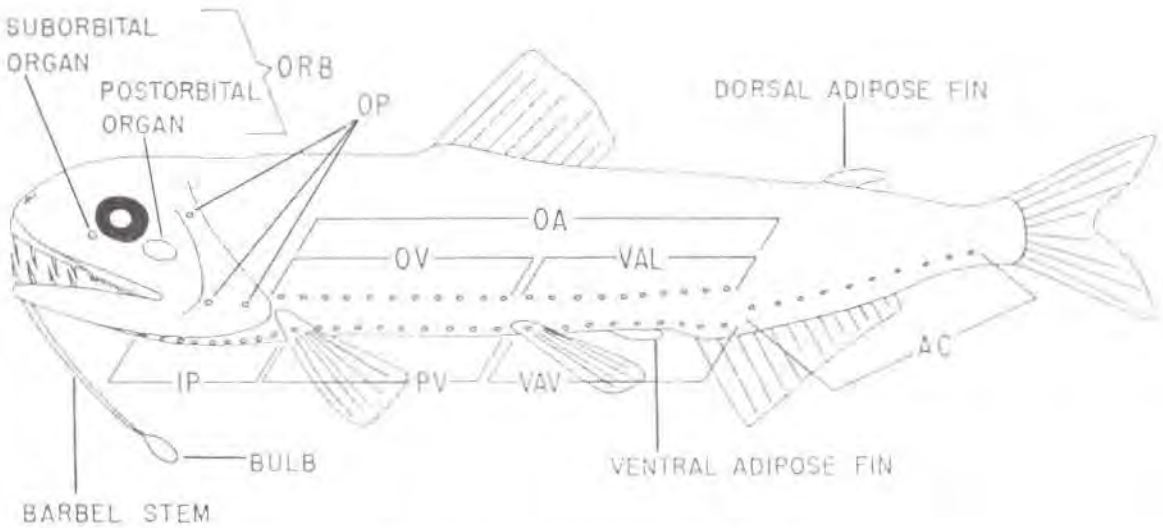


Figure 12. Stomiidae [modified after: MORROW (1964)].

Diagnostic characters: enlarged teeth (fangs); body mostly dark in colour; chin barbel present in most; no true gillrakers in adults.

Subfam. Astronesthinae

Diagnostic characters: chin barbel present; dorsal fin mostly or entirely before anal fin, its origin at or behind mid-point of body; dorsal adipose fin present (absent in *Rhadinesthes*); two rows of photophores on body.

Astronesthes RICHARDSON, 1845
Diagnostic characters: teeth on maxilla comb-like, closely spaced, slanting rearward; gill arches with separated groups of short spines anteriorly along their length.

Astronesthes gemmifer GOODE & BEAN, 1896
Diagnostic characters: chin barbel with a slender stem, tip swollen, pigmented on one side (unlike all other species).
Reference material: 8 specimens; SL: 26 - 65 mm; La Boc. 04-97: tow 1, tow 13, tow 14 (ZMUC P2011011); ECOS 04-99: tow 10 (ZMUC P2013175).

Astronesthes indicus BRAUER, 1902
Diagnostic characters: serial photophores few and relatively widely spaced: IP 5, PV 5 - 6, VAV 7 - 9, OV 5 - 6, VAL 6 - 8, AC 7 - 9.
Reference material: 2 specimens; SL: 26 - 29 mm; La Boc. 04-97: tow 1 (ZMUC P2011012).

Astronesthes leucopogon REGAN & TREWAVAS, 1929
Diagnostic characters: ventral row of photophores (= IC) forming a pronounced U-shaped bend at level of pectoral fins; 43 - 47 photophores from isthmus to tail; 10 - 11 between pectoral and pelvic fin insertions (PV).
Reference material: 1 specimen; SL: 93 mm; La Boc. 11-97: tow 9 (ZMUC P209120).

Astronesthes macropogon GOODYEAR & GIBBS, 1970
Diagnostic characters: ventral row of photophores (= IC) forming a pronounced U-shaped bend at level of pectoral fins; IC 51 - 55; PV > 12; tip of chin barbel without swelling (unlike *A. niger*).
Reference material: 1 specimen; SL: 31 mm; La Boc. 04-97: tow 1 (ZMUC P2011013).

Astronesthes micropogon GOODYEAR & GIBBS, 1970
Diagnostic characters: IC series forming a straight line; chin barbel a tiny rudiment.
Reference material: 3 specimens; SL 21 - 37; La Boc. 04-97: tow 1 (ZMUC P2011014).

Astronesthes neopogon REGAN & TREWAVAS, 1929
Diagnostic characters: IC series forming a straight line; chin barbel wide, its base laterally flattened, tapering distally.
Reference material: 1 specimen; SL: 70 mm; La Boc. 04-97: tow 1 (ZMUC P2011015).

Borostomias REGAN, 1908
Diagnostic characters: gill arches with separated groups of short spines anteriorly along their length; teeth on maxilla distinctly separated, not slanting rearward (unlike *Astronesthes*); greatest body depth more than 10 % in standard length (unlike *Rhadinesthes*); some anterior jaw teeth forming moderately to well-developed fangs.

Borostomias mononema (REGAN & TREWAVAS, 1929)
Diagnostic characters: AC photophores straight; fangs not much longer than other teeth; pale portion of swelling at tip of chin barbel not more than about twice as long as wide.

Reference material: 4 specimens; SL: 34 - 86 mm; ECOS 04-99: tow 5 (ZMUC P2013176), tow 10 (ZMUC P2013177-78, ICCM P2044).

Rhadinesthes REGAN & TREWAVAS, 1929
Diagnostic characters: dorsal adipose fin absent; gill arches with separated groups of short spines anteriorly along their length; teeth on maxilla distinctly separated, not slanting rearward (unlike *Astronesthes*); body very long and slender, greatest body depth less than 10 % standard length (unlike *Borostomias*); origin of dorsal fin considerably behind pelvic fin insertion.

Rhadinesthes decimus (ZUGMAYER, 1911)
Diagnostic characters: monospecific, see genus diagnosis.
Reference material: 6 specimens; SL: 46 - 102 mm; La Boc. 04-97: tow 11 (ZMUC P2011016); ECOS 04-99: tow 10 (ZMUC P2013179-182, ICCM P2045).

Subfam. Stomiinae

Diagnostic characters: a pattern of hexagonal areas covers the body; dorsal and anal fins far back, close to tail and lying opposite each other; adipose dorsal fin absent and chin barbel present (unlike Subfam. Chauliodontinae); two rows of photophores on body.
Remarks: FINK AND FINK (1986) united the two genera of this subfamily *Stomias* CUVIER, 1816 and *Macrostomias* BRAUER, 1902. The former diagnostic characters of the genus *Macrostomias* are now given as the diagnostic characters for the species *Stomias longibarbatus*.

Stomias CUVIER, 1816
Diagnostic characters: monogeneric, see subfamily diagnosis and remarks.

Stomias boa (RISSO, 1810)
Diagnostic characters: chin barbel more than 1/2, but only slightly longer than head length, with 3 short filaments at end of bulb; body moderately long, 10 - 20 times its depth; 82 - 91 photophores in ventral series from isthmus to tail (IC); six rows of hexagonal areas above lateral series of large photophores, each area of lowest three rows with 2 - 4 small photophores.
Reference material: 283 specimens; SL: 26 - >370 mm; La Boc. 04-97: tow 1, tow 2, tow 7 (ZMUC P2011020), tow 11 (ZMUC P2011021), tow 13, tow 14; La Boc. 11-97: tow 1 (ZMUC P209365-66), tow 2 (ZMUC P209367-68), tow 9 (ZMUC P209369-370), tow 14 (ZMUC P209371-72); ECOS 04-99: tow 4 (ZMUC P2013425-27), tow 5 (ZMUC P2013428-453), tow 6 (ZMUC P2013454-468), tow 8 (ZMUC P2013469-470), tow 10 (ZMUC P2013471-79), tow 12 (ZMUC P2013480-3549, ICCM P2061-64), tow 13 (ZMUC P2013550), tow 19 (ZMUC P2013551-55), tow 21 (ZMUC P2013556-57).
Remarks: GIBBS (1984) and MORROW (1964) indicate the standard length for this species as more than 300 mm. GIBBS (1990) quotes the largest known specimen as 322 mm, but in cruise "La Bocaina 11-97" one individual with more than 370 mm SL

showed up: tow 14 (ZMUC P209371). Unfortunately the head of this specimen is missing.
This species contains two valid subspecies: *Stomias boa boa* and *Stomias boa ferox* REINHARDT, 1843, which differ in the total number of IC photophores (82 - 88 in *S. boa boa* and 85 - 91 in *S. boa ferox*). Most individuals were in such a bad condition, that counting the photophores was impossible, but in all cases, in which it was possible, they were *Stomias boa boa.* This corresponds with the distribution of this subspecies, which occurs in the Mediterranean and off West Africa southward to about 20° N (GIBBS, 1984). *S. boa ferox* is associated with colder water (MORROW, 1964) and distributed in the whole North Atlantic (off the Canaries west of 20° W). *Stomias boa ferox* is not mentioned for the Eastern Central Atlantic (GIBBS, 1990).

Stomias brevibarbatus EGE, 1918
Diagnostic characters: chin barbel less than 1/2 head length, with 4 short filaments at end of bulb; body moderately long, 10 - 20 times its depth; 72 - 76 photophores in ventral series from isthmus to tail (IC); five rows of hexagonal areas above lateral series of large photophores, each area of lowest three rows with more than 5 small photophores.
Reference material: 1 specimen; SL: 68 mm; ECOS 04-99: tow 10 (ZMUC P2013558).

Stomias longibarbatus (BRAUER, 1902)
Diagnostic characters: chin barbel much longer than head, up to 3/4 of standard length; body very long, 20 - 35 times its depth; more than 170 photophores in ventral series from isthmus to tail (IC); hexagonal areas above lateral series of large photophores, each area of the lowest two rows with only one small photophore.
Reference material: 7 specimens; SL: 38 - 435 mm; La Boc. 11-97: tow 1 (ZMUC P209362), tow 9 (ZMUC P209363-64); ECOS 04-99: tow 5 (ICCM P2049), tow 12 (ICCM P2050), tow 14 (ZMUC P2013423-24).

Subfam. Chauliodontinae

Diagnostic characters: a pattern of hexagonal areas covers the body; dorsal fin close to head, adipose dorsal fin present and chin barbel absent (unlike Subfam. Stomiinae); first dorsal fin ray greatly elongated, but most often broken off; two rows of photophores on body.

Chauliodus BLOCH & SCHNEIDER, 1801
Diagnostic characters: monogeneric, see subfamily diagnosis.
Remarks: Due to the bad condition 12 specimens could not be measured and identified to the species level: ECOS 04-99: tow 5 (ZMUC P2013183-87), tow 10 (ZMUC P2013188-191, tow 14 (ZMUC P2013192), tow 19 (ZMUC P2013193-94).

Chauliodus danae REGAN & TREWAVAS, 1929
Diagnostic characters: dorsal fin origin over ninth to eleventh photophore in lateral series; (pre-dorsal length 24 - 33 % of standard length).

Reference material: 311 specimens; SL: 20 - 262 mm; La Boc. 04-97: tow 1 (ZMUC P2011017), tow 2, tow 7, tow 11, tow 13, tow 14; La Boc. 11-97: tow 1 (ZMUC P209121-134), tow 2 (ZMUC P209135-38), tow 9 (ZMUC P209139-143), tow 14 (ZMUC P209144-177, ICCM P207); ECOS 04-99: tow 5 (ZMUC P2013195-3307), tow 6 (ZMUC P2013308-311), tow 10 (ZMUC P2013312-343), tow 12 (ZMUC P2013344), tow 14 (ZMUC P2013345-353, ICCM P2046), tow 19 (ZMUC P2013354-389), tow 21 (ZMUC P2013390).
Remarks: GIBBS (1984), MORROW (1964) and PARIN (1990) indicate the maximum standard length of this species as 150 mm. But both, in the new material from the Canaries (La Boc. 11-97: tow 14, ZMUC P209144 with 262 mm SL and ECOS 04-99: tow 10, ZMUC P2013312 with 176 mm SL) and in the ichthyological collection of the ZMUC (ZMUC P207227-32 with 190, 210 and 230 mm SL, ZMUC P204807 with 210 mm SL and ZMUC P207220-25 with 177 mm SL) several specimens with a standard length up to 262 mm occur.

Chauliodus sloani BLOCH & SCHNEIDER, 1801
Diagnostic characters: dorsal fin origin over fourth to eighth photophore in lateral series; (pre-dorsal length 17 - 28 % of standard length).
Reference material: 64 specimens; SL: 26 - 241 mm; La Boc. 04-97: tow 7 (ZMUC P2011018); tow 11, tow 14; La Boc. 11-97: tow 1 (ZMUC P209179-182), tow 2 (ZMUC P209183-87, ICCM P208), tow 9 (ZMUC P209189-193), tow 14 (ZMUC P209194-95); ECOS 04-99: tow 5 (ZMUC P2013391-3404), tow 10 (ZMUC P2013405-411), tow 12 (ZMUC P2013412), tow 14 (ZMUC P2013413), tow 19 (ZMUC P2013414-17), tow 21 (ZMUC P2013418-422, ICCM P2047-48).

Subfam. Melanostomiinae

Diagnostic characters: dorsal and anal fins placed opposite each other, positioned near base of caudal fin, originating well behind midpoint of body; chin barbel present; dorsal adipose fin absent (a small one present in *Chirostomias*); two rows of photophores on each side along lower part of body.

Bathophilus GIGLIOLI, 1882
Diagnostic characters: pelvic fin bases high on body, closer to midlateral than to midventral line.
Remarks: Due to bad condition one specimen (SL: 56 mm) could only be identified to the genus level: ECOS 04-99: tow 10 (ZMUC P2013559).

Bathophilus brevis REGAN & TREWAVAS, 1930
Diagnostic characters: body depth 36 - 45 % of standard length (other species: less than 25 %), bases of pelvic fins nearer to dorsal than to ventral profile.
Reference material: 1 specimen; SL: 43 mm; ECOS 04-99: tow 5 (ZMUC P2013560).

Bathophilus digitatus (WELSH, 1923)
Diagnostic characters: 9 - 10 pelvic finrays; 11 - 13 pectoral finrays in two groups.
Reference material: 1 specimen; SL: 66 mm; ECOS 04-99: tow 5 (ZMUC P2013562).

Bathophilus longipinnis (PAPPENHEIM, 1914)
Diagnostic characters: 11 - 14 pelvic finrays, 5 - 8 pectoral finrays in a single group.
Reference material: 2 specimens; SL: 66 mm; La Boc. 11-97: tow 2 (ZMUC P209303), tow 14 (ICCM P2019).

Bathophilus pawneei PARR, 1927
Diagnostic characters: pectoral fin with two separate rays placed close together.
Reference material: 1 specimen; SL: 72 mm; ECOS 04-99: tow 19 (ZMUC P2013561).

Bathophilus vaillanti (ZUGMAYER, 1911)
Diagnostic characters: 4 - 6 (usually 5) pelvic finrays, 3 - 5 (usually 2 + 1) pectoral finrays.
Reference material: 44 specimens; SL: 27 - 149 mm; La Boc. 04-97: tow 1, tow 7 (ZMUC P2011024), tow 14; La Boc. 11-97: tow 1 (ZMUC P209305-08), tow 2 (ZMUC P209309), tow 14 (ZMUC P209310-17, ICCM P2011); ECOS 04-99: tow 5 (ZMUC P2013563-575), tow 6 (ZMUC P213576), tow 10 (ZMUC P2013577-79), tow 12 (ZMUC P2013580-81, ICCM P2053), tow 19 (ZMUC P2013582-83), tow 21 (ICCM P2054).

Chirostomias REGAN & TREWAVAS, 1930
Diagnostic characters: small adipose dorsal fin present; post-orbital luminous organ less than 1/3 eye diameter; terminal bulb of barbel swollen and very complex, with numerous filaments.

Chirostomias pliopterus REGAN & TREWAVAS, 1930
Diagnostic characters: monospecific, see genus diagnostic.
Reference material: 4 specimens; SL: 39 - 54 mm; La Boc. 04-97: tow 1 (ZMUC P2011025), tow 14.

Eustomias VAILLANT, 1884
Diagnostic characters: anal fin base much longer than dorsal fin base, its origin much before dorsal origin; zero to sixteen pectoral finrays, none markedly longer than others; snout tapering, slender, protrusible (unlike *Flagellostomias*).
Remarks: One specimen of genus *Eustomias* was in such a bad condition that it could not be identified: ECOS 04-99: tow 10 (ZMUC P2013584).

Eustomias bigelowi WELSH, 1923
Diagnostic characters: two pectoral finrays; terminal bulb globular; barbel with three branches arising from the main stem; branches are very much shorter to slightly longer than the rest of the main stem and have few side branches.
Reference material: 1 specimen; SL: 73 mm; ECOS 04-99: tow 14 (ZMUC P2013585).
Remarks: New record for the Canaries. GIBBS AND BARNETT (1990) cite only two records of this species in the Eastern Central Atlantic: at 02° S, 18° W and 22° S, 02°

W. They indicate further occurrence in the North Atlantic between 15° N and 37° N west of 30° W and in the Gulf of Mexico.

Eustomias filifer (GILCHRIST, 1906)
Diagnostic characters: one developed pectoral finray and one rudimentary ray; three branches arising proximal to bulb; barbel distal to branches with a single large bulb followed by a slender stem ending in a small bulb (unlike *E. tetranema*).
Reference material: 1 specimen; SL: 122 mm; La Boc. 04-97: tow 11 (ZMUC P2011026).

Eustomias lipochirus REGAN & TREWAVAS, 1930
Diagnostic characters: pectoral fins absent (unlike all other *Eustomias*-species); a nipple-like projection on one side of distal end of bulb.
Reference material: 1 specimen; SL: 130 mm; La Boc. 04-97: tow 13 (ZMUC P2011027).

Eustomias longibarba PARR, 1927
Diagnostic characters: three pectoral finrays; terminal bulb of barbel with a finger-like projection on its tip; photophores in ventral row from isthmus to tail (IC) 74 -78; in lateral row to above anal fin (OA) 49 - 53 (unlike *E. simplex*).
Reference material: 2 specimens; SL: 97 - 113 mm; La Boc. 11-97: tow 2 (ZMUC P209319, ICCM P2020).

Eustomias obscurus VAILLANT, 1884
Diagnostic characters: photophores of lateral row mainly in pairs (unlike all other *Eustomias*-species); terminal bulb of barbel bearing several short filaments on its tip.
Reference material: 67 specimens; SL: 67 - 214 mm; La Boc. 04-97: tow 2, tow 7, tow 13; La Boc. 11-97: tow 1 (ZMUC P209321-341, ICCM P2012), tow 2 (ZMUC P209343-358), tow 14 (ZMUC P209359); ECOS 04-99: tow 6 (ZMUC P2013586), tow 12 (ZMUC P2013587-89), tow 14 (ZMUC P2013590-92), tow 19 (ZMUC P2013593-99, ICCM P2055-56).

Eustomias schmidti REGAN & TREWAVAS, 1930
Diagnostic characters: two pectoral finrays; barbel with three branches arising together from stem proximal to terminal bulb, the middle one short, bulbous; terminal bulb divided by a constriction into a long proximal and a small distal part.
Reference material: 1 specimen; SL: 94 mm; ECOS 04-99: tow 8 (ZMUC P2013600).

Eustomias simplex REGAN & TREWAVAS, 1930
Diagnostic characters: three pectoral finrays; terminal bulb of barbel either with a single slender filament or without filaments or projection; barbel stem with a row of small black external spots on its distal half; photophores in ventral row (IC) 66 - 70, in lateral row (OA) 43 - 45 (unlike *E. longibarba*).
Reference material: 1 specimen; SL: 100 mm; ECOS 04-99: tow 14 (ZMUC P2013601).

Eustomias tetranema ZUGMAYER, 1913
Diagnostic characters: one pectoral finray and one rudimentary ray; three branches arising proximal to bulb; barbel distal to branches with two or more relatively small bulbs followed by a slender stem ending in a small bulb (unlike *E. filifer*).
Reference material: 1 specimen; SL: 126 mm; La Boc. 04-97: tow 11.
Remarks: Verification of this species was not possible, as the only representative from the three cruises is deposited in Chiba, Japan.

Flagellostomias PARR, 1927
Diagnostic characters: anal fin base much longer than dorsal fin base, its origin well in front of dorsal origin; first pectoral finray separate, much longer than others; snout blunt, not protrusible (unlike *Eustomias*).

Flagellostomias boureei (ZUGMAYER, 1913)
Diagnostic characters: monospecific, see genus diagnosis.
Reference material: 2 specimens; SL: 67 - 104 mm; La Boc. 04-97: tow 11 (ZMUC P2011028); ECOS 04-99: tow 6 (ICCM P2057).

Grammatostomias GOODE & BEAN, 1896
Diagnostic characters: luminous loop on flank above and behind pectoral fin; PV 15 - 17; 4 - 11 pectoral finrays.

Grammatostomias flagellibarba HOLT & BYRNE, 1910
Diagnostic characters: luminous loop elongated, its posterior margin reaching about to pelvic fin insertion, its lower portion forming zigzags.
Reference material: 1 specimen; SL: 95 mm; La Boc. 04-97: tow 11 (ZMUC P2011029).
Remarks: This species is cited as a new record for the Canaries in BORDES et al. (1999). GIBBS (1984) indicates its distribution between 43° N and 50° N, further south only in the Western Atlantic.

Leptostomias GILBERT, 1905
Diagnostic characters: body long and slender, its depth 10 times or more in length; at least 39 PV.
Remarks: see species.

Leptostomias gladiator (ZUGMAYER, 1911)
Diagnostic characters: one or two filaments present at base of barbel stem; other filaments usually present on barbel stem along its length and at base of terminal bulb.
Reference material: 2 specimens; SL: 140 - 225 mm; La Boc. 04-97: tow 14 (ZMUC P2011030); La Boc. 11-97: tow 2 (ICCM P2021).
Remarks: The presence of a large post-orbital luminous organ serves in the key of WHITEHEAD et al. (1984) as a diagnostic character for this genus. However, one individual of the new material (ICCM P2021) lacks this organ, in the only specimen of the same species deposited at the ZMUC, this organ is very small and inconspicuous. HULLEY (1972) quotes the postorbital organ as absent. The organ is also absent in

one of the two specimens studied by MORROW AND GIBBS (1964). They stated, that this luminous organ is also missing in other species of *Leptostomias*.

Melanostomias BRAUER, 1902
Diagnostic characters: post-orbital luminous organ equal to larger than 1/2 eye diameter; terminal bulb of barbel variously modified; 5 - 6 pectoral rays.

Melanostomias bartonbeani PARR, 1927
Diagnostic characters: terminal flattened end of barbel with a prominent, tapering filamentous extension (unlike *M. biseriatus*) and mostly unpigmented; barbel stem fully pigmented; PV seldom more than 25, OV seldom more than 24.
Reference material: 1 specimen; SL: 191 mm; La Boc. 11-97: 9 (ZMUC P209363).

Melanostomias biseriatus REGAN & TREWAVAS, 1930
Diagnostic characters: terminal flattened end of barbel rounded, without a filamentous extension (unlike *M. bartonbeani*) and mostly unpigmented; barbel stem fully pigmented (unlike *M. melanops*); PV seldom fewer than 27, OV seldom fewer than 26.
Reference material: 4 specimens; SL: 54 - 84 mm; La Boc. 04-97: tow 1 (ZMUC P2011031), tow 14; ECOS 04-99: tow 10 (ZMUC P2013603-04).

Melanostomias tentaculatus (REGAN & TREWAVAS, 1930)
Diagnostic characters: barbel with a terminal ovoid bulb and a slender, finger-like tentacle beside the bulb; barbel length about 2.5 to 2.75 times in standard length.
Reference material: 8 specimens; SL: 62 - 138 mm; La Boc. 04-97: tow 1, tow 7 (ZMUC P2011032), tow 14; ECOS 04-99: tow 10 (ZMUC P2013602).

Photonectes GUENTHER, 1887
Diagnostic characters: lower jaw strongly curved upward, long and projecting beyond snout; pectoral fin with 0 - 2 finrays.

Photonectes braueri (ZUGMAYER, 1913)
Diagnostic characters: terminal bulb of barbel with a small, bulbous appendage; PV 22 - 24; two pectoral finrays.
Reference material: 4 specimens; SL: 37 - 57 mm; La Boc. 04-97: tow 1 (ZMUC P2011033); ECOS 04-99: tow 10 (ZMUC P2013605, ICCM P2058), tow 14 (ZMUC P2013606).

Photonectes margarita (GOODE & BEAN, 1896)
Diagnostic characters: dorsal and anal fins covered with thick black skin except for the tips of the rays; IV 41 - 46; one pectoral finray (sometimes even missing).
Reference material: 1 specimen; SL: 49 mm; ECOS 04-99: tow 10 (ZMUC P2013607).

Subfam. Idiacanthinae

Diagnostic characters: body very long and slender; dorsal fin very long, its origin far anterior to midpoint of body; anal fin about half as long as dorsal fin, both reaching almost to caudal fin; two rows of prominent photophores on ventral part of body on each side; chin barbel and pelvic fins present in females, absent in males; pectoral fins present in larvae, absent in adults.

Idiacanthus PETERS, 1877
Diagnostic characters: monogeneric, see subfamily diagnosis.

Idiacanthus fasciola PETERS, 1877
Diagnostic characters: see subfamily diagnosis.
Reference material: 269 specimens; SL: 41 - 305; La Boc. 04-97: tow 1, tow 7 (ZMUC P2011019), tow 11, tow 13, tow 14; La Boc. 11-97: tow 2 (ZMUC P209196-9254, ICCM P209), tow 14 (ZMUC P209256-59); ECOS 04-99: tow 6 (ZMUC P2013657), tow 8 (ZMUC P2013658-59), tow 10 (ZMUC P2013660-684), tow 12 (ZMUC P2013685-86), tow 14 (ZMUC P2013687-3765), tow 19 (ZMUC P2013766-69, ICCM P2049-50).
Remarks: All the individuals are female. Males of this species differ also very much in size from the females by never growing larger than about 70 mm of SL, and most of them occur apparently at 1,000 to 2,000 m at all times. Only the females undergo diel vertical migrations (KRUEGER, 1990).

Subfam. Malacosteinae

Diagnostic characters: floor of mouth open, no membrane connecting right and left halves of lower jaw to isthmus; lower jaw with long fangs, much longer than any upper jaw teeth; dorsal and anal fins located at hind end of body near tail, their bases about equal in length and origins opposite; no dorsal adipose fin; two rows of prominent photophores on ventral part of body on each side.

Aristostomias ZUGMAYER, 1913
Diagnostic characters: chin barbel present; snout longer than eye; pale luminous patches present on head; pectoral fins present.

Aristostomias grimaldii ZUGMAYER, 1913
Diagnostic characters: photophores in PV row 15 in 5 groups; in OV row 16 in 5 groups.
Reference material: 1 specimen; SL: 73 mm; La Boc. 04-97: tow 1 (ZMUC P2011022).
Remarks: New record for the Canaries. Near the Canarian Archipelago only one record in GIBBS (1984) and GOODYEAR (1990), respectively. The specimens are most probably the same, as the locations are given as follows: 31° N, 26° W (Gibbs) and 30° 45' N, 25° 47' W (Goodyear). PORTEIRO et al. (1999) cite *A. grimaldii* for the Azores.

Photostomias COLLETT, 1889
Diagnostic characters: pectoral fins absent; pelvic fins very long; chin barbel absent.

Photostomias guernei COLLETT, 1889
Diagnostic characters: monospecific; see genus diagnosis.
Reference material: 200 specimens; SL: 31 - 118 mm; La Boc. 04-97: tow 1, tow 7, tow 11 (ZMUC P2011023), tow 14; La Boc. 11-97: tow 2 (ZMUC P209260-286, ICCM P2010), tow 9 (ZMUC P209288-89), tow 14 (ZMUC P209290-9302); ECOS 04-99: tow 10 (ZMUC P2013608-619), tow 12 (ZMUC P2013620-22), tow 14 (ZMUC P2013623-652, ICCM P2051-52), tow 19 (ZMUC P2013653-56).

Order Aulopiformes

Diagnostic characters: specialisation in the gill arches, with posterolaterally greatly elongated second pharyngobranchial; elongated uncinate process of second epibranchial contacting third pharyngobranchial.

Fam. Notosudidae

Diagnostic characters: eye egg-shaped and larger than 4 % of standard length; premaxillary teeth uniserial in juveniles, and two or three series in adults; coloration of body uniformly dark with or without silvery scales; dorsal fin with 9 - 14 rays; mouth equal to or longer than eye diameter; gillrakers rather long and lath-like; photophores absent, adipose dorsal fin present.

Ahliesaurus BERTELSEN, KREFFT & MARSHALL, 1976
Diagnostic characters: pelvic fins originating below or just in front of dorsal fin.

Ahliesaurus berryi BERTELSEN, KREFFT & MARSHALL, 1976
Diagnostic characters: see genus diagnosis.
Reference material: 2 specimens; SL: 37 - 39 mm; La Boc. 04-97: tow 1 (ZMUC P2344546-47).

Scopelosaurus BLEEKER, 1860
Diagnostic characters: pelvic fins distinctly in front of dorsal fin.

Scopelosaurus argenteus (MAUL, 1954)
Diagnostic characters: no silvery scales at any size; 15 - 16 gillrakers; pectoral fins short to moderately long.
Reference material: 3 specimens; SL: 32 - 39 mm; La Boc. 04-97: tow 1.
Remarks: The specimens were identified by N. Merret, and have not been deposited yet. Juveniles of this species live in the mesopelagic realm, whereas the adults show a benthopelagic form of living. The present individuals are juvenile.

Scopelosaurus lepidus (KREFFT & MAUL, 1955)
Diagnostic characters: pectoral fins very long, although short in this material - they are probably broken off, or shorter in small (juvenile) specimens; more than 16 gillrakers.
Reference material: 2 specimens; SL: 53 - 61 mm; ECOS 04-99: tow 10 (ZMUC P2348366-67).
Remarks: Adults of this species are living bentho- to mesopelagic, whereas juveniles are mesopelagic to almost epipelagic. The present individuals are juveniles.

Fam. Synodontidae

Diagnostic characters: eyes large and normally formed; upper jaw dominated by the premaxilla, maxilla reduced or modified and unapparent; jaws armed with numerous long, sharp, often depressible teeth; snout typically pointed in dorsal profile; photophores absent; adipose dorsal fin present or absent.

Subfam. Synodontinae

Diagnostic characters: scales along lateral line not enlarged; dorsal fin rays 10 - 15; anal fin rays 8 - 16; dorsal adipose fin usually present.

Synodus SCOPOLI, 1777
Diagnostic characters: 8 pelvic finrays; vomer absent; head not strongly depressed, snout narrow; dorsal fin base shorter than or equal to anal fin base; caudal fin deeply forked; adipose dorsal fin present but very small in some species.

Synodus synodus (LINNAEUS, 1758)
Diagnostic characters: four to six rows of complete scales between lateral line and dorsal fin.
Reference material: 1 specimen; SL: 60 mm; La Boc. 11-97: tow 8 (ZMUC P23444159).
Remarks: Adults of this species are bottom dwellers, primarily found in shallow inshore waters. The present individual is juvenile.

Fam. Paralepididae

Diagnostic characters: premaxilla not extending beyond a vertical through posterior margin of eye; normal gillrakers absent; dorsal fin origin in midline of trunk; photophores absent, adipose dorsal fin present.

Lestidiops HUBBS, 1916
Diagnostic characters: ventral adipose fin between pelvic fins and anal fin present; distance snout to anus less than 63 % of standard length; pelvic fin origin well before dorsal fin origin; body without scales; pectoral fins short, less than anal fin base.

Lestidiops affinis (EGE, 1930)
Diagnostic characters: anus distinctly before dorsal fin origin; 75 - 83 vertebrae.

Reference material: 6 specimens; SL: 41 - 75 mm; La Boc. 11-97: tow 1 (ZMUC P2344406-08, ICCM P2376), tow 9 (ZMUC P2344411), tow 18 (ZMUC P2344410).

Lestidiops jayakari (BOULENGER, 1889)
Diagnostic characters: anus below or behind dorsal fin origin; 76 - 85 vertebrae.
Reference material: 25 specimens; SL: 31 - 62 mm; La Boc. 11-97: tow 6 (ZMUC P2344416-426), tow 9 (ZMUC P2344427), tow 13 (ZMUC P2344428-37, ICCM P2321, ICCM P2377-78).
Remarks: There are two valid subspecies. POST (1990) indicates the occurrence of *L. jayakari pseudosphyraenoides* (EGE, 1918) in the Mediterranean and the northern subtropical Atlantic. He cites *L. jayakari jayakari* for the subtropic and tropic waters of all oceans.

Lestidiops sphyrenoides (RISSO, 1820)
Diagnostic characters: anus below or behind dorsal fin origin; 88 - 94 vertebrae.
Reference material: 1 specimen; SL: 52 mm; ECOS 04-99: tow 13 (ZMUC P2348368).

Paralepis CUVIER, 1816
Diagnostic characters: ventral adipose fin absent; pelvic fin origin below dorsal fin origin; anal fin rays 25 or less; body with scales; pectoral fins short, less than anal fin base.

Paralepis coregonoides RISSO, 1820
Diagnostic characters: hind tip of premaxilla under nostril; if gillrakers and teeth on jaws and palatines present, head 3.4 - 4.5 times in SL;
Reference material: 1 specimen; SL: 46 mm; La Boc. 11-97: tow 14 (ZMUC P2344441).
Remarks: This species consists of two valid subspecies. *Paralepis coregonoides coregonoides* is, with lower anal finray and vertebral counts, endemic in the Mediterranean and *Paralepis coregonoides borealis* REINHARDT, 1837 occurs in the Atlantic (POST, 1984). POST (1990) cites *Paralepis coregonoides* from only one locality near the Canary Islands.

Stemonosudis HARRY, 1951
Diagnostic characters: see species diagnosis.

Stemonosudis intermedia (EGE, 1933)
Diagnostic characters: This is the only species of Paralepididae which has such a high number of vertebrae (111 - 121) and occurs in the Atlantic (ROFEN, 1966).
Reference material: 3 specimens, with 117, 119 and 121 vertebrae; SL: 123 - 172; La Boc. 04-97: tow 2 (ZMUC P2344548); La Boc. 11-97: tow 1 (ZMUC P2344442, ICCM P2379).
Remarks: New record for the Canaries. POST (1990), quotes it for the tropical and subtropical Atlantic, with an observed maximum size of 152 mm SL. On page 382 he writes: "this species has not been reported from the CLOFETA area yet; unpublished

material from the area is represented in the ISH (Institut für Seefischerei, Hamburg) collection". Incorrectly cited in BORDES et al. (1999) as *Macroparalepis nigra*.

Sudis RAFINESQUE, 1810
Diagnostic characters: pectoral fins elongate, longer than anal fin base.

Sudis hyalina RAFINESQUE, 1810
Diagnostic characters: see genus diagnosis.
Reference material: 2 specimens; SL: 47 - 112 mm; La Boc. 11-97: tow 2 (ICCM P2380), tow 13 (ZMUC P2344413).

Fam. Evermannelidae

Diagnostic characters: 11 - 13 dorsal, 26 - 37 anal fin rays; one series of small or minute teeth on premaxilla, which extends beyond a vertical through posterior margin of eye; normal gillrakers absent, replaced by gill teeth fixed on bony plates; photophores absent, adipose dorsal fin present.

Evermannella FOWLER, 1901
Diagnostic characters: eyes tubular, directed upward and slightly forward; front palatine fang and at least some dentary fangs distinctly lanceolate and barbed.

Evermannella indica BRAUER, 1906
Diagnostic characters: 27 - 31 anal finrays.
Reference material: 2 specimens; SL: 45 - 53 mm; La Boc. 11-97: tow 2 (ICCM P2381), tow 14 (ZMUC P2344405).

Order Myctophiformes

Diagnostic characters: head and body compressed; eye lateral; mouth usually large and terminal; dorsal adipose fin present; pharyngobranchials normal (unlike those of Aulopiformes).

Fam. Myctophidae

Diagnostic characters: photophores on head and ventral part of body present and arranged in clearly distinguishable groups (see Fig. 13), (photophores absent in *Taaningichthys paurolychnus*), the abbreviations in the text refer to this figure; origin of anal fin under or a short distance behind dorsal fin base; adipose dorsal fin present; supra- (SUGL) and/or infra-caudal (INGL) glands may be present and can in some genera be used for the determination of the sexes.

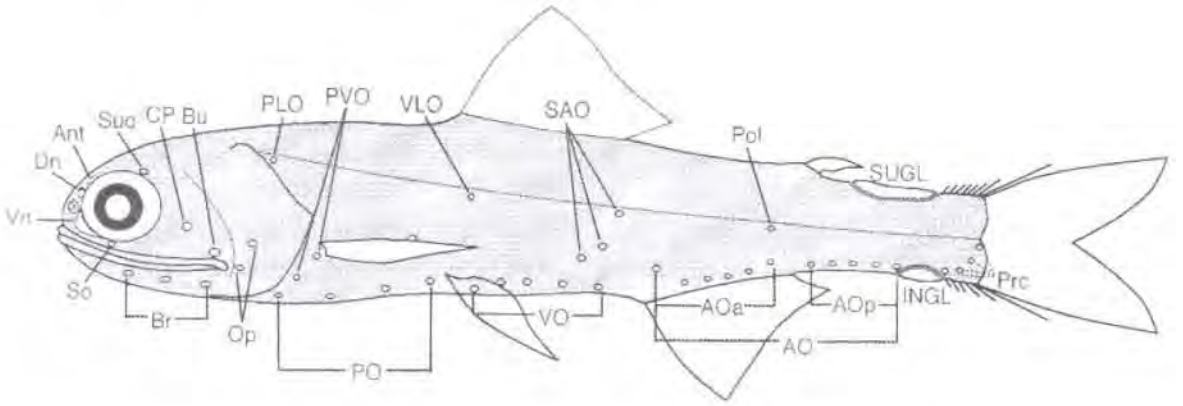


Figure 13. Myctophidae [modified after a drawing received from Motoomi Yamaguchi].

Remarks: If not otherwise indicated the following features are valid for all genera listed below: photophores present; VLO, SAO_3, $Pol_{(2)}$ and Prc_2 below lateral line; PLO more than its own diameter above level of upper end of pectoral fin; PVO_2 at or below level of upper end of base of pectoral fin.
Due to being in extremely bad condition, 462 specimens were unidentifiable. La Boc. 11-97: tow 14 (ZMUC P2344349-350); ECOS 04-99: tow 4 (ZMUC P2348370), tow 6 (ZMUC P2348369).

Benthosema GOODE & BEAN, 1896
Diagnostic characters: PVO_2 on a horizontal line with PVO_1; 4 VO, VO_2 elevated; 2 Prc, Prc_2 near lateral line (unlike *Diogenichthys*).

Benthosema suborbitale (GILBERT, 1913)
Diagnostic characters: SAO angulate; VO_2, SAO_1 and SAO_2 almost on a line (or with SAO_1 slightly above but touching a line through VO_2 and SAO_2); GR: 3 + 1 + 10 (9 - 11); VLO above line PLO-SAO_1; males with large single supra-caudal gland, females with two small infra-caudal glands, coalescing to one with age; caudal glands occur in both sexes at about 19 mm SL.
Reference material: 33 specimens; SL: 15 - 30 mm; La Boc. 04-97: tow 1 (ZMUC P2344444), tow 2; La Boc. 11-97: tow 1 (ZMUC: P2341884-86, ICCM: P231), tow 9 (ZMUC P2341888-891), tow 14 (ZMUC P2341892-94); ECOS 04-99: tow 6 (ZMUC P2344556-561), tow 8 (ZMUC P2344562-63), tow 12 (ZMUC P2344564-65), tow 19 (ZMUC P2344566-570, ICCM P2322-23), tow 21 (ZMUC P2344571-73).

Bolinichthys PAXTON, 1972
Diagnostic characters: 3 Prc (Prc_1 and Prc_2 close together at ventral contour of body); PLO, SAO_3, Pol_2 and Prc_3 slightly above lateral line; PO_4 highly elevated; 5 VO with VO_2 elevated; supra and infra-caudal glands small and consisting of a series of overlapping scale-like structures, although easily rubbed of and showing no sexual dimorphism; patches of luminous tissue at bases of median and paired fins present (unlike

Lampanyctus); crescent of whitish tissue on posterior half of iris, eye relatively large (unlike *Lepidophanes*).

Bolinichthys indicus (NAFPAKTITIS & NAFPAKTITIS, 1969)
Diagnostic characters: luminous tissue at base of ventral fins present; VLO at lateral line; GR: 4 (3 - 5) + 1 + 11 (10 - 12).
Reference material: 307 specimens; SL: 20 - 43 mm; La Boc. 04-97: tow 1 (ZMUC P2344445); La Boc. 11-97: tow 2 (ZMUC P2341895), tow 9 (ZMUC P2341896), tow 14 (ZMUC P2341987-905, ICCM P232); ECOS 04-99: tow 5 (ZMUC P2344574-582), tow 6 (ZMUC P2344583-590), tow 10 (ZMUC P2344591-4791, ICCM P2324-25), tow 14 (ZMUC P2344792-4800), tow 19 (ZMUC P2344801-863), tow 21 (ZMUC P2344864).

Bolinichthys supralateralis (PARR, 1928)
Diagnostic characters: no luminous tissue at base of ventral fins; VLO 3 - 4 times its own diameter below lateral line; GR: 6 (5 - 7) + 1 + 13 (12 - 14).
Reference material: 1 specimen; SL: 41 mm; ECOS 04-99: tow 10 (ZMUC P2344865).

Centrobranchus FOWLER, 1904
Diagnostic characters: PLO at level to slightly above (about its own diameter) of upper end of base of pectoral fin; mouth sub-terminal; caudal peduncle markedly slender; gillrakers absent, reduced to spiny knobs (unlike all other genera); 2 Prc, level at ventral contour of body.
Remarks: see *Gonichthys*.

Centrobranchus nigroocellatus (GUENTHER, 1873)
Diagnostic characters: SAO_1 above (or in front of) VO_3; AOa_2-AOa_3 interspace somewhat enlarged (compared to the other AOa interspaces); adult males with a series of 5 - 6 well defined, separated, rounded luminous organs supra-caudally, females with a series of 4 - 5 non-overlapping oval luminous patches infra-caudally.
Reference material: 1 specimen; SL: 30 mm; ECOS 04-99: tow 19 (ZMUC P2344866).

Ceratoscopelus GUENTHER, 1864
Diagnostic characters: 4 Prc; supra- and infra-caudal glands consisting of a series of overlapping scale-like structures with no sexual dimorphism; 5 PO, level (unlike *Lampadena*, *Bolinichthys*, *Lepidophanes*); luminous structures mid-ventrally at pelvic fins (although easily rubbed off together with the scales).

Ceratoscopelus maderensis (LOWE, 1839)
Diagnostic characters: supra-orbital spine present; GR: 5 (4 - 6) + 1 + 13 (12 - 14) Total: 19 (18 - 21); scale-like luminous structures midventrally at the bases of ventral fins.
Reference material: 96 specimens; SL: 18 - 61 mm; La Boc. 04-97: tow 2, tow 8 (ZMUC P2344446-48), tow 13 (ZMUC P2344449-455); La Boc. 11-97: tow 11

(ZMUC P2341907-964, ICCM P233), tow 12 (ZMUC P2341966-68); ECOS 04-99: tow 4 (ZMUC P2344687-870), tow 5 (ZMUC P2344871), tow 6 (ZMUC P2344872-79, ICCM P2326-27), tow 7 (ZMUC P2344880-82), tow 8 (ZMUC P2344883-85), tow 10 (ZMUC P2344886-87), tow 16 (ZMUC P2344888).

Ceratoscopelus warmingii (LUETKEN, 1892)
Diagnostic characters: supra-orbital spine absent; GR: 4 (3 - 5) + 1 + 9 (8 - 10) Total: 14 (13 - 15); scale-like luminous structures midventrally between the bases of pelvic fins and the anus.
Reference material: 353 specimens; SL: 17 - 64 mm; La Boc. 04-97: tow 2 (ZMUC P2344456), tow 7, tow 13 (ZMUC P2344457-59); La Boc. 11-97: tow 1 (ZMUC P2341969-978), tow 2 (ZMUC P2341979-982), tow 9 (ZMUC P2341983-42080, ICCM P234), tow 13 (ZMUC P2342082-83), tow 14 (ZMUC P2342084-2119), tow 18 (ZMUC P2342120-25); ECOS 04-99: tow 6 (ZMUC P2344889-45009, ICCM P2328-29), tow 8 (ZMUC P2345010-034), tow 14 (ZMUC P2345035-38), tow 19 (ZMUC P2345039).

Diaphus EIGENMANN & EIGENMANN, 1890
Diagnostic characters: 4 Prc; 5 PO; 5 VO; PO_1, PVO_1 and PVO_2 as well as VO_1 - VO_3 on a straight ascending line; no infra- or supra-caudal glands developed but more than one pair of luminous glands on head (unlike *Lobianchia*), these are very diverse and often sexually dimorphic.
Remarks: Determination of the species within this genus is very hard to impossible if the head is in bad condition. Therefore, one specimen, 28 mm SL, ECOS 04-99: tow 13 (ZMUC P2345040) was unidentifiable to the species level. As no other myctophid appeared in this tow it seems reasonable to assume that this specimen remained from tow 12 (cf. remarks on *Vinciguerria*). Furthermore, it is confusing that the sexually dimorphic (i. e. larger) headlights of males are seldom considered in the keys.

Diaphus adenomus GILBERT, 1905
Diagnostic characters: Suo present, extended longish along the entire supra-orbital margin (unlike all other *Diaphus*-species); Vn very elongate, reaching from relative small Dn to about vertical of posterior margin of pupil; So absent.
Reference material: 135 specimens; SL: 20 - 107 mm; La Boc. 04-97: tow 11; La Boc. 11-97: tow 16 (ZMUC P2342126-142), tow 18 (ZMUC P2342143-2257, ICCM P235); ECOS 04-99: tow 5 (ZMUC P2345041), tow 19 (ZMUC P2345042).
Remarks: BORDES et al. (1999) cite this species as a new record for the Canaries. Its distribution pattern is pseud-oceanic (land associated), and therefore HULLEY (1984a, 1990) recorded it only from off the north-west African coast, although the open waters between the Canary Islands as well as between the islands and the African coast seem to be no distributional barrier. Occasionally occurs the species more than 500 m above the bottom depth ("ECOS 04-99"). This is contrary to the statements of NAFPAKTITIS (1974), who restricts the species close to the bottom.

Diaphus dumerilii (BLEEKER, 1856)
Diagnostic characters: Dn and Vn very small (although Dn very large in adult males); PLO, SAO_3 and Pol at or close to lateral line; AOa_1 is on level with all AOa (the combination of these characters makes it very easy to distinguish this from all other *Diaphus* species).
Reference material: 65 specimens; SL: 17 - 67 mm; La Boc. 11-97: tow 3 (ZMUC P2342259-263), tow 6 (ZMUC P2342264-65), tow 9 (ZMUC P2342266-68), tow 11 (ZMUC P2342269), tow 13 (ZMUC P2342270-71), tow 16 (ZMUC P2342272-74), tow 17 (ZMUC P23422759; tow 18 (ZMUC P2344370-393, ICCM P236); ECOS 04-99: tow 5 (ZMUC P2345043), tow 6 (ZMUC P2345044-46), tow 7 (ZMUC P2345047-49), tow 10 (ZMUC P2345050), tow 14 (ZMUC P2345051), tow 16 (ZMUC P2347178-189, ICCM P2330-31), tow 19 (ZMUC P2345053).

Diaphus holti TÅNING, 1918
Diagnostic characters: So present (in advance of vertical through posterior margin of pupil); Vn elongate, shorter than horizontal diameter of pupil; 4 AOp; AOa level; GR: 6 (5 - 7) + 1 + 12 - 13 Total: 19 - 20.
Reference material: 3 specimens; SL: 30 - 39 mm; ECOS 04-99: tow 5 (ZMUC P2345054-55), tow 14 (ZMUC P2345056).

Diaphus metopoclampus (COCCO, 1829)
Diagnostic characters: head as deep as long or nearly so and body photophores noticeably small (unlike all other *Diaphus* species); Vn extending along ventral margin of orbit to somewhat behind vertical through centre of pupil, its posterior end expanded and protruding on to iris; So absent; Ant present but hard to recognise.
Reference material: 55 specimens; SL: 25 - 78 mm; La Boc. 04-97: tow 1 (ZMUC P2344460-495, ICCM P237), tow 14 (ZMUC P2344497); La Boc. 11-97: tow 2 (ZMUC P2342300); ECOS 04-99: tow 5 (ZMUC P2345057-060, ICCM P2332-33), tow 10 (ZMUC P2345061-62), tow 14 (ZMUC P2345063-64), tow 19 (ZMUC P2345065-66), tow 21 (ZMUC P2345067-69).

Diaphus mollis TÅNING, 1928
Diagnostic characters: So present (but hard to recognise); Vn elongate, shorter than horizontal diameter of pupil; AOa_1 slightly raised, 4 AOp; gillrakers on first arch short, broad-based and leaf-like, 5 (4 - 6) + 1 + 11 - 12 Total: 17 - 18.
Reference material: 99 specimens; SL: 18 - 60; La Boc. 04-97: tow 2 (ZMUC P2344498); La Boc. 11-97: tow 1 (ZMUC P2342301-02), tow 2 (ZMUC P2342303), tow 9 (ZMUC P2342304-328), tow 13 (ZMUC P2342329-368, ICCM P238), tow 14 (ZMUC P2342370-72); ECOS 04-99: tow 5 (ZMUC P2345070-72), tow 8 (ZMUC P2345073), tow 10 (ZMUC P2345074-084, ICCM P2334-35), tow 14 (ZMUC P2345085-090), tow 21 (ZMUC P2345091).

Diaphus perspicillatus (OGILBY, 1898)
Diagnostic characters: So present, Dn equal in size to larger than nasal rosette, Ant present (hardly to recognise in small specimens); ventral portion of Vn not reaching vertical through posterior margin of pupil; SAO_3 and Pol near lateral line; GR: 9 - 10 +

1 + 16 - 17 Total: 26 - 28, this is the highest gillraker-count in all *Diaphus*-species occurring in the Atlantic.
Reference material: 33 specimens; SL: 15 - 58 mm; La Boc. 04-97: tow 2 (ZMUC P2344499), tow 14; La Boc. 11-97: tow 11 (ZMUC P2342373), tow 13 (ZMUC P2342374-79), tow 14 (ZMUC P2342380-82), tow 17 (ZMUC P2342383-85), tow 18 (ZMUC P2342386-395, ICCM P239); ECOS 04-99: tow 6 (ZMUC P2345092).

Diaphus rafinesquii (COCCO, 1838)
Diagnostic characters: So present (although often hard to recognise); AOa_1 highly elevated, its ventral margin above a line through dorsal margins of AOa_2 and AOa_3; 4 AOp; luminous tissue at PLO large; GR: 7 - 8 + 1 + 14 - 15 Total: 22 - 24.
Reference material: 103 specimens; SL: 18 - 82 mm; La Boc. 04-97: tow 1 (ZMUC P2344500), tow 7, tow 11, tow 14; La Boc. 11-97: tow 2 (ZMUC P2342397-2402), tow 9 (ZMUC P2342403-09, ICCM P2310), tow 14 (ZMUC P2342411-15); ECOS 04-99: tow 5 (ZMUC P2345093-5106), tow 6 (ZMUC P2345107-122, ICCM P2336), tow 8 (ZMUC P2345123-29), tow 10 (ZMUC P2345130-144, ICCM P2337), tow 12 (ZMUC P2345145-46), tow 14 (ZMUC P2345147-151), tow 19 (ZMUC P2345152-55).

Diaphus termophilus TÅNING, 1928
Diagnostic characters: So absent; Vn roundish or oval and located on ventral orbital margin about under centre of pupil and limited to the infra-orbital area; SAO_1 on level with VO_5.
Reference material: 19 specimens; SL: 52 - 80 mm; La Boc. 11-97: tow 14 (ZMUC P2342416-17); ECOS 04-99: tow 5 (ZMUC P2345156-58), tow 14 (ZMUC P2345159-170, ICCM P2338-39).

Diaphus vanhoeffeni BRAUER, 1905
Diagnostic characters: So present but small, located somewhat behind vertical through centre of lens; Dn very small and inconspicuous, almost completely fused with Vn; Vn very large and upward spreading, its posterior margin at about vertical through anterior margin of pupil; triangular Ant immediately above the Vn-Dn present in adult males.
Reference material: 1 specimen; SL: 28 mm; La Boc. 11-97: tow 13 (ZMUC P2342418).
Remarks: New record for the Canaries. HULLEY (1990) cites it as tropical species, endemic in the Eastern Atlantic between 20° N to 15° S and a western limit at about 30° W.

Diogenichthys BOLIN, 1939
Diagnostic characters: 2 Prc, horizontal or with Prc_2 only very slightly raised (unlike *Benthosema*); PVO_1 and PVO_2 on a horizontal line; 4 VO with VO_2 elevated; males with large supra-caudal and females with smaller infra-caudal luminous glands.

Diogenichthys atlanticus (TÅNING, 1928)
Diagnostic characters: Prc_1-Prc_2 interspace wide, more than one-half the space between last AOp and Prc_1; 3 AOp; GR: 2 + 1 + 9 - 11 (last two characters make it easy

to distinguish between the similar-looking genera *Diogenichthys* and *Benthosema* even if other important features due to bad condition are missing).
Reference material: 270 specimens; SL: 14 - 24 mm; La Boc. 11-97: tow 9 (ZMUC P2342419-429, ICCM P2311), tow 11 (ZMUC P2342431), tow 13 (ZMUC P2344351-56), tow 14 (ZMUC P2342437-440); ECOS 04-99: tow 6 (ZMUC P2345171-5272), tow 8 (ZMUC P2345273-5334), tow 10 (ZMUC P2345335-361), tow 12 (ZMUC P2345362-5412, ICCM P2340-41), tow 14 (ZMUC P2345413), tow 19 (ZMUC P2345414-15).

Gonichthys GISTEL, 1850
Diagnostic characters: PLO at or slightly above level of upper end of base of pectoral fin; mouth subterminal; caudal peduncle markedly slender; 5 - 7 AOp over base of anal fin; bases of dorsal and anal fin not or only slightly overlapping; males with a series of scale-like luminous structures bordered by black pigment supra-caudally; females with non-overlapping luminous patches infra-caudally.
Remarks: The scales of this and the closely related genus *Centrobranchus* seem to be not so deciduous than those of the other genera. They are known to be nyctoepipelagic at surface, *C. nigroocellatus* exclusively feeding on gastropods (HOPKINS et al., 1996; SUTTON et al., 1995) and *G. coccoi* also on terrestrial insects. Therefore their scales probably have to be more resistant against physical strains deriving from the sea surface. According to the literature *Centrobranchus nigroocellatus* and *Gonichthys coccoi* are the most abundant mesopelagic species in tows taken at the very surface at night. In the Canaries they seem to be rare, but the most shallow towing depth of average 20 m in the three cruises should be taken into account. A neuston net would probably lead to a catch of more specimens of these species (BACKUS et al., 1977).

Gonichthys coccoi (COCCO, 1829)
Diagnostic characters: origin of anal fin behind vertical through base of last dorsal fin-ray.
Reference material: 5 specimens; SL: 34 - 51 mm; ECOS 04-99: tow 5 (ZMUC P2345416-18), tow 19 (ZMUC P2345419), tow 21 (ZMUC P2345420).

Hygophum BOLIN, 1939
Diagnostic characters: 2 Prc; PVO_1 and PVO_2 on an inclined line; 4 VO, level; 2 Pol (unlike *Myctophum, Symbolophorus*); males with single supra-caudal gland, females with smaller but more infra-caudal glands.

Hygophum benoiti (COCCO, 1838)
Diagnostic characters: Prc_2 midway between lateral line and ventral contour of body (unlike all other *Hygophum*-species); Pol_1, Pol_2 and last AOa on a straight line or Pol_1 at least in contact with a line through last AOa and Pol_2; caudal peduncle normal (distance from snout to pelvic fin base larger than distance between posterior end of base of dorsal fin and Prc_2); VOL about midway between lateral line and base of ventral fin; SAO_1 between VO_2 and VO_3; SAO_2, SAO_3 and VO_4 on a straight line.
Reference material: 338 specimens; SL: 21 - 46 mm; La Boc. 04-97: tow 2, La Boc. 11-97: tow 1 (ZMUC P2342441), tow 3 (ZMUC P2342442-47), tow 9 (ZMUC

P2342448-451); tow 11 (ZMUC P2342452-2740, ICCM P2312), tow 13 (ZMUC P2342742-767), tow 14 (ZMUC P2344395-4403); ECOS 04-99: tow 8 (ZMUC P2345421).
Remarks: Two specimens have an additional (sixth) PO-photophore between PO_3 and PO_4.

Hygophum hygomii (LUETKEN, 1892)
Diagnostic characters: VLO at or just below lateral line (unlike all other *Hygophum*-species); Prc_2 at lateral line; Pol_1 far in front of line through last AOa and Pol_2; SAO_1 between VO_1 and VO_2; SAO_2 slightly in front of line through VO_4 and SAO_3.
Reference material: 1,847 specimens; SL: 15 - 66 mm; La Boc. 04-97: tow 1, tow 2 (ZMUC P2344501), tow 13; La Boc. 11-97: tow 1 (ZMUC P2342769-786), tow 2 (ZMUC P2342787-791), tow 3 (ZMUC P2342792-2802), tow 6 (ZMUC P2342803), tow 9 (ZMUC P2342804-843), tow 11 (ZMUC P2342844-2944, ICCM P2313), tow 12 (ZMUC P2342946-951), tow 13 (ZMUC P2342952-43022), tow 14 (ZMUC P2343023-039), tow 15 (ZMUC P2343040-45), tow 17 (ZMUC P2343046-088), tow 18 (ZMUC P2343089-3139; ECOS 04-99: tow 5 (ZMUC P2345422-5516), tow 6 (ZMUC P2345517-46431), tow 7 (ZMUC P2346432), tow 8 (ZMUC P2346433-6676), tow 10 (ZMUC P2346677-6723), tow 12 (ZMUC P2346724-747), tow 14 (ZMUC P2346748-764), tow 16 (ZMUC P2346765-67), tow 19 (ZMUC P2346768-6964, ICCM P2342-44); tow 21 (ZMUC P2346965-980).
Remarks: Quite a few individuals have a normally sized infra-caudal and an additional small supra-caudal gland. These are probably females.

Hygophum reinhardtii (LUETKEN, 1892)
Diagnostic characters: Pol_1, Pol_2 and last AOa on a straight line; Prc_2 at lateral line (unlike *H. benoiti*); VLO about midway between lateral line and base of ventral fin; caudal peduncle long and slender (distance from snout to pelvic fin base smaller than distance between posterior end of base of dorsal fin and Prc_2) and therefore more AO photophores.
Reference material: 176 specimens; SL: 18 - 48 mm; La Boc. 04-97: tow 2; La Boc. 11-97: tow 9 (ZMUC P2343140-150, ICCM P2314), tow 13 (ZMUC P2343152-59), tow 14 (ZMUC P2344363-370), tow 17 (ZMUC P2343167-68), tow 18 (ZMUC P2343169-170); ECOS 04-99: tow 6 (ZMUC P2346981-47078, ICCM P2345-46), tow 8 (ZMUC P2347079-091), tow 12 (ZMUC P2347092), tow 14 (ZMUC P2347093-7119), tow 19 (ZMUC P2347120-21).

Hygophum taaningi BECKER, 1965
Diagnostic characters: VLO about midway between lateral line and base of ventral fin; Prc_2 at lateral line; SAO_2 directly above (sometimes behind) VO_3; a straight line through SAO_2 and SAO_3 passes always behind VO_4; Pol_1 slightly in front of line through last AOa and Pol_2; SAO_1 below a straight line through VLO and SAO_2; supra-caudal gland very large.
Reference material: 100 specimens; SL: 19 - 43 mm; La Boc. 11-97: tow 2 (ZMUC P2343171), tow 9 (ZMUC P2343172-184), tow 13 (ZMUC P2343185-3205, ICCM P2315), tow 14 (ZMUC P2343207-214); ECOS 04-99: tow 12 (ZMUC P2347122-24),

tow 14 (ZMUC P2347125-172, ICCM P2347-48), tow 16 (ZMUC P2347173), tow 19 (ZMUC P2347174-75).

Lampadena GOODE & BEAN, 1893
Diagnostic characters: 2 + 1 Prc; large and singular supra- and infra-caudal glands in both sexes present; 3 SAO and origin of dorsal fin directly above or somewhat in advance of base of pelvic fin (unlike *Taaningichthys*).

Lampadena chavesi COLLETT, 1905
Diagnostic characters: Prc_1-Prc_2 interspace large; crescent of whitish tissue on dorsal half of iris; infra-caudal gland longer than depth of caudal peduncle; last 2 (3) AOa behind end of base of anal fin.
Reference material: 3 specimens; SL: 57 - 60 mm; ECOS 04-99: tow 5 (ZMUC P2347176-77), tow 10 (ZMUC P2347190).

Lampadena speculigera GOODE & BEAN, 1896
Diagnostic characters: Prc_1 and Prc_2 close together; no whitish tissue on dorsal half of iris; infra-caudal gland shorter than depth of caudal peduncle; no AOa behind end of base of anal fin; 3 - 5 AOp; 19 - 22 gillrakers.
Reference material: 1 specimen; SL: 26 mm; ECOS 04-99: tow 14 (ZMUC P2347199).

Lampadena urophaos atlantica MAUL, 1969
Diagnostic characters: Prc_1 and Prc_2 close together; no whitish tissue on dorsal half of iris; infra-caudal gland shorter than depth of caudal peduncle; no AOa behind end of base of anal fin; 2 AOp; 13 - 15 gillrakers.
Reference material: 14 specimens; SL: 39 - 128 mm; La Boc. 04-97: tow 1, tow 14 (ZMUC P2344502); ECOS 04-99: tow 10 (ZMUC P2347191-97, ICCM P2349-50), tow 14 (ZMUC P2347198).

Lampanyctus BONAPARTE, 1840
Diagnostic characters: 4 Prc; PO_4 highly elevated (unlike *Ceratoscopelus*); luminous tissue (except photophores) is restricted to the supra- and infra-caudal glands (unlike *Bolinichthys*, *Lepidophanes*) and consists of overlapping scale-like structures, present in both sexes; pectoral fins well developed and long, reaching beyond base of pelvic fins (unlike *Nannobrachium*); cheek photophores present or absent.
Remarks: ZAHURANEC (2000) removed several species of this genus and arranged them, together with some new species, into the reintroduced genus *Nannobrachium* GUENTHER, 1887. The following features concern both genera. *Lampanyctus* and *Nannobrachium* seem to have extremely deciduous scales, also the photophores are more easily rubbed off - what makes the determination of specimens belonging to these genera harder. The body is very thin, the flesh flaccid and darker (shadowed) than this of other myctophids. The caudal peduncle expands to the dorsal and ventral body profile at the area where the procurrent caudal rays are inserting. These special body characters differ quite a lot from other genera and support the genus identification. In many species lies the PVO_2 above and before the PVO_1.

The bad condition made it impossible to measure and identify 71 specimens to the species level: ECOS 04-99: tow 6 (ZMUC P2347200-252), tow 8 (ZMUC P2347253-264), tow 14 (ZMUC P2347265-271).

Lampanyctus alatus GOODE & BEAN, 1896
Diagnostic characters: branchiostegal membrane with minute serial photophores between branchiostegal rays; luminous gland at origin of adipose dorsal fin present; VLO at or just below lateral line; one cheek photophore present.
Reference material: 128 specimens; SL: 15 - 57 mm; La Boc. 04-97: tow 1 (ZMUC P2344503-06), tow 7 (ZMUC P2344507), tow 13 (ZMUC P2344508), tow 14 (ZMUC P2344509-512); La Boc. 11-97: tow 2 (ZMUC P2343215), tow 14 (ZMUC P2343216); ECOS 04-99: tow 6 (ZMUC P2347272-7303), tow 8 (ZMUC P2347304-311), tow 12 (ZMUC P2347312-14), tow 14 (ZMUC P2347315-347, ICCM P2351-52).

Lampanyctus crocodilus (RISSO, 1810)
Diagnostic characters: VLO distinctly below lateral line; 2 - 3 cheek photophores; luminous tissue at base of adipose dorsal fin present; 5 - 7 AOa; a line through anterior 2 AOa passing above AOa_3; infra-caudal luminous gland occupying the whole caudal peduncle.
Reference material: 1 specimen; SL: 31 mm; ECOS 04-99: tow 6 (ZMUC P2347479).

Lampanyctus festivus TÅNING, 1928
Diagnostic characters: VLO distinctly below lateral line; no cheek photophores; SAO_1 in front of (over) VO_3; 15 - 16 AO; infra-caudal gland extends along the entire length of the caudal peduncle; no luminous gland at base of adipose dorsal fin.
Reference material: 5 specimens; SL: 48 - 73 mm; La Boc. 04-97: tow 11; ECOS 04-99: tow 5 (ZMUC P2347486-87), tow 14 (ZMUC P2347488-89).

Lampanyctus nobilis TÅNING, 1928
Diagnostic characters: VLO distinctly below lateral line; no cheek photophores; SAO_1 behind VO_3; Pol_2 in advance of base of adipose dorsal fin; Prc separate from AOp.
Reference material: 2 specimens; SL: 73 mm; ECOS 04-99: tow 5 (ZMUC P2347491), tow 6 (ZMUC P2347492).
Remarks: New record for the Canaries. HULLEY (1990) indicates the tropical distribution of this species between 20° N and 13° S.

Lampanyctus photonotus PARR, 1928
Diagnostic characters: VLO distinctly below lateral line; 2 cheek photophores; no luminous tissue at base of adipose dorsal fin; infra-caudal luminous gland extending along entire length of caudal peduncle; dorsal and anal fins not overlapping.
Reference material: 20 specimens; SL: 21 - 62 mm; La Boc. 04-97: tow 13 (ZMUC P2344515), tow 14; ECOS 04-99: tow 6 (ZMUC P2347493-98, ICCM P2355-56), tow 8 (ZMUC P2347499-7501); tow 12 (ZMUC P2347502), tow 14 (ZMUC P2347503-06).

Lampanyctus pusillus (JOHNSON, 1890)
Diagnostic characters: branchiostegal membrane with minute serial photophores between branchiostegal rays; luminous gland at origin of adipose dorsal fin absent; VLO distinctly below lateral line; one cheek photophore; infra-caudal luminous gland occupying not more than half of length of caudal peduncle.
Reference material: 127 specimens; SL: 20 - 55 mm; La Boc. 04-97: tow 1, tow 13 (ZMUC P2344515), tow 14; La Boc. 11-97: tow 2 (ZMUC P2343221), tow 14 (ZMUC P2343222-26); ECOS 04-99: tow 5 (ZMUC P2347507-522), tow 6 (ZMUC P2347523-555, ICCM P2357-58), tow 8 (ZMUC P2347556-58), tow 10 (ZMUC P2347559-590), tow 12 (ZMUC P2347591-94), tow 14 (ZMUC P2347595-7606), tow 19 (ZMUC P2347607-617), tow 21 (ZMUC P2347618).
Remarks: Typically this species has 3 + 1 + 8 (rarely 9) gillrakers. A few of the above listed individuals have 4 + 1 + 9 gillrakers.

Lepidophanes FRASER-BRUNNER, 1949

Diagnostic characters: four Prc; supra- and infra-caudal glands, consisting of overlapping scale-like structures, are present in both sexes; PO_4 highly elevated (unlike *Ceratoscopelus*); five VO with VO_2 elevated; patches of luminous tissue at bases of median and paired fins (unlike *Lampanyctus*); no crescent of whitish tissue on posterior half of iris, eyes relatively small (unlike *Bolinichthys*).

Lepidophanes gaussi (BRAUER, 1906)
Diagnostic characters: gillrakers 3 + 1 + 8; luminous tissue at origin of ventral fin present; small round photophores on midline between posterior end of dorsal fin and origin of adipose fin (usually rubbed off).
Reference material: 167 specimens; SL: 20 - 42 mm; La Boc. 04-97: tow 1 (ZMUC P2344516), tow 2 (ZMUC P2344517-533), tow 11; La Boc. 11-97: tow 1 (ZMUC P2343227-240, ICCM P2316), tow 9 (ZMUC P2343242-48), tow 13 (ZMUC P2344357-362), tow 14 (ZMUC P2343255-59).

Lobianchia GATTI, 1904
Diagnostic characters: four Prc; PO_1, PVO_1 and PVO_2 as well as VO_1 - VO_3 on a straight ascending line; males with supra-caudal and females with infra-caudal glands; only a small Dn is present on head (unlike *Diaphus*).

Lobianchia dofleini (ZUGMAYER, 1911)
Diagnostic characters: Prc_3-Prc_4 interspace larger than between other Prc; Prc_4 lying at base of middle caudal rays; SAO forming a gentle arc, convexity directed posteroventrally; Pol nearer lateral line than ventral profile.
Reference material: 1,332 specimens; SL: 11 - 58 mm; La Boc. 04-97: tow 1, tow 2, tow 13 (ZMUC P2344534); La Boc. 11-97: tow 1 (ZMUC P2343260-3303), tow 6 (ZMUC P2343304-313), tow 9 (ZMUC P2343314-3609), tow 11 (ZMUC P2343610-16), tow 12 (ZMUC P2343617), tow 13 (ZMUC P2343618-44122, ICCM P2317), tow 14 (ZMUC P2344124-197), tow 18 (ZMUC P2344198-4214); ECOS 04-99: tow 5 (ZMUC P2347730-742), tow 6 (ZMUC P2347743-7866), tow 7 (ZMUC P2347867-

69), tow 8 (ZMUC P2347870-885), tow 10 (ZMUC P2347886-7905), tow 12 (ZMUC P2347905-48039), tow 14 (ZMUC P2348040-071, ICCM P2361-63), tow 19 (ZMUC P2348072-75), tow 21 (ZMUC P2348076-090).
Remarks: Disproportionately many specimens of *L. dofleini* are affected by parasitic copepods. In these specimens the trunk of the parasite protrudes the body-wall of the host usually ventrally at the end of the isthmus. The externally detectable parasites have achieved the ovigerous adult stage, though primarily the paired genital apertures and the egg-sacs are visible (BOXSHALL, 2000). Very occasionally the infestation with the parasitic copepods befell other lanternfish species like *Ceratoscopelus warmingii*, *Lepidophanes gaussi*, and *Bolinichthys indicus*. Possible reasons for this inequality are discussed in SAKAMURA et al. (1999).

Lobianchia gemellarii COCCO, 1838
Diagnostic characters: Prc-series evenly spaced; SAO forming a gentle arc, convexity directed anterodorsally; Pol midway between lateral line and ventral profile.
Reference material: 86 specimens; SL: 25 - 82 mm; La Boc. 04-97: tow 1, tow 7, tow 11, tow 14 (ZMUC P2344535); La Boc. 11-97: tow 2 (ZMUC P2344215-258, ICCM P2318), tow 9 (ZMUC P2344260-62), tow 14 (ZMUC P2344263-65); ECOS 04-99: tow 5 (ZMUC P2348091-8101, ICCM P2364), tow 10 (ZMUC P2348102-03), tow 14 (ZMUC P2348104-05), tow 19 (ZMUC P2348106-112, ICCM P2365), tow 21 (ZMUC P2348113-17).
Remarks: This species shows in the Atlantic a latitudinal variation in the gillraker count. Between 20° and 40° N (which includes the Canary Islands) the gillraker formula is 4 (5) + 1 + 10 (11, rarely 12), (HULLEY, 1984a). HULLEY (1980) explains the lower gillraker count in this area with the currents of cold water origin (including the Canary Current). However, all of the 79 caught specimens had 6 + 1 + 14 (13) gillrakers, which is quoted for individuals occurring north of 40° N. It is known that the Atlantic population between 40° and 60° N consists almost exclusively of expatriates with a varying degree of development of secondary sexual characteristics, i. e. primarily caudal glands (O'DAY AND NAFPAKTITIS, 1967; HULLEY, 1980, 1984a). In the specimens of the present material the caudal glands are missing or reduced, too. HULLEY (1980) indicates further that these sterile expatriates occasionally penetrate waters of lower latitudes. Nevertheless it is astonishing, that no specimen with the - according to the literature - typical gillraker count of the Canaries was encountered.

Myctophum RAFINESQUE, 1810
Diagnostic characters: two Prc; PVO series on an inclined line; VO series level; one Pol (unlike *Hygophum*); SAO on a straight or slightly angulate line, SAO_1 behind VO_3 (unlike *Symbolophorus*) supra-caudal luminous glands in males and infra-caudal luminous glands in females present (except *M. selenops*).

Myctophum nitidulum GARMAN, 1899
Diagnostic characters: 5 (4 - 7) AOp with AOp_1 only above end of base of anal fin; posterodorsal margin of operculum angulate.
Reference material: 19 specimens; SL: 17 - 76 mm; La Boc. 11-97: tow 2 (ZMUC P2344266-68, ICCM P2319), tow 3 (ZMUC P2344270), tow 9 (ZMUC P2344271),

tow 14 (ZMUC P2344272-73), tow 17 (ZMUC P2344274-76), tow 18 (ZMUC P2344277-78); ECOS 04-99: tow 6 (ZMUC P2348118), tow 14 (ZMUC P2348119-121), tow 19 (ZMUC P2348122-23).

Myctophum punctatum RAFINESQUE, 1810
Diagnostic characters: 9 (8) AOp with first 3 - 4 AOp over end of base of anal fin; posterodorsal margin of operculum evenly rounded.
Reference material: 107 specimens; SL: 18 - 59 mm; ECOS 04-99: tow 6 (ZMUC P2348124-8206, ICCM P2366-67), tow 8 (ZMUC P2348207-211), tow 12 (ZMUC P2348212-223), tow 14 (ZMUC P2348224-25), tow 16 (ZMUC P2348226-28).

Myctophum selenops TÅNING, 1928
Diagnostic characters: body short and deep, with body depth about 3 times in standard length; 3 AOp; only supra-caudal luminous glands present in both sexes (5 - 7 large ones in males, 2 - 4 smaller ones in females).
Reference material: 15 specimens; SL: 41 - 62 mm; La Boc. 11-97: tow 14 (ZMUC P2344279); ECOS 0499: tow 10 (ZMUC P2348229-239, ICCM P2368-69), tow 19 (ZMUC P2348240).
Remarks: Apart from the body shape this species differs from other myctophids also in the colour of the body. In preserved specimens the colour is less pale, rather reddish-orange. In addition, the scale-pockets are more distinct.

Nannobrachium GUENTHER, 1887
Diagnostic characters: 4 Prc; PO_4 highly elevated (unlike *Ceratoscopelus*); luminous tissue (except photophores) is restricted to the supra- and infra-caudal glands (unlike *Bolinichthys*, *Lepidophanes*) and consists of overlapping scale-like structures, present in both sexes; pectoral fins short (or even missing), with a narrow base in adults (unlike *Lampanyctus*); no photophores on cheek.
Remarks: ZAHURANEC (2000) reintroduced this genus, based on the original description of genus and species, combined with additional characters. Previously, the three species listed below belonged to the genus *Lampanyctus* and were therefore entered into the database of ZMUC as *Lampanyctus ater*, *Lampanyctus cuprarius* and *Lampanyctus lineatus*, respectively. See also *Lampanyctus*.

Nannobrachium atrum (TÅNING, 1928)
Diagnostic characters: VLO close to lateral line; SAO_1 between VO_3 and VO_4; origin of anal fin behind vertical through middle of base of dorsal fin; Pol_2 below adipose origin; 12 - 15 AO; Prc separate from AOp.
Reference material: 64 specimens; SL: 23 - 99 mm; La Boc. 04-97: tow 11 (ZMUC P2344513), tow 14; La Boc. 11-97: tow 9 (ZMUC P2343217-18); tow 14 (ZMUC P2343219-220); ECOS 04-99: tow 12 (ZMUC P2347348-49), tow 14 (ZMUC P2347350-399, ICCM P2353-54), tow 19 (ZMUC P2347400-01).

Nannobrachium cuprarium (TÅNING, 1928)
Diagnostic characters: VLO close to lateral line; SAO_1 between VO_3 and VO_4; 9 - 12 AO; Prc continuous with AOp.

Reference material: 6 specimens; SL: 40 - 57 mm; ECOS 04-99: tow 14 (ZMUC P2347480-85).
Remarks: The drawing of the photophore group VO is not correct in NAFPAKTITIS et al. (1977) and HULLEY (1984a). In the present material the four VO are evenly spaced, like in the drawing of ZAHURANEC (2000).

Nannobrachium lineatum (TÅNING, 1928)
Diagnostic characters: VLO close to lateral line; SAO_1 between VO_3 and VO_4; origin of anal fin in front of vertical through middle of base of dorsal fin; 12 - 16 AO; Pol_2 in front of base of adipose dorsal fin; Prc not continuous with AOp.
Reference material: 2 specimens; SL: 41 - 47 mm; La Boc. 04-97: tow 11; ECOS 04-99: tow 14 (ZMUC P2347490).

Notolychnus FRASER-BRUNNER, 1949
Diagnostic characters: VLO, SAO_3 and Pol close to dorsal contour of body; two Prc with Prc_2 above lateral line.

Notolychnus valdiviae (BRAUER, 1904)
Diagnostic characters: monospecific, see genus diagnosis.
Reference material: 1 specimen; SL: 22 mm; La Boc. 04-97: tow 11.
Remarks: Verification of this species was not possible, as the only representative from the three cruises is deposited in Chiba, Japan.

Notoscopelus GUENTHER, 1864
Diagnostic characters: PVO_2 well above level of upper end of base of pectoral fin; 2 (seldom 3) horizontally arranged Pol; 5 PO showing a distinct 1 + 3 + 1 grouping; males with supra-caudal luminous glands (except *N. bolini*), females without caudal glands.

Notoscopelus bolini NAFPAKTITIS, 1975
Diagnostic characters: GR: 9 (8) + 1 + 18 (17 - 19), total: 28 (26 - 29); adult males with luminous tissue on cheeks and above eyes (unlike all other *Notoscopelus*-species), but no supra-caudal luminous gland.
Reference material: 10 specimens; SL: 20 - 94 mm; ECOS 04-99: tow 6 (ZMUC P2348241-47, ICCM P2370-71); tow 16 (ZMUC P2348248).

Notoscopelus caudispinosus (JOHNSON, 1863)
Diagnostic characters: GR: 4 + 1 + 9 (8 - 10), total: 14 (13 - 15).
Reference material: 1 specimen; SL: 31 mm; La Boc. 04-97: tow 2.
Remarks: Verification of this species was not possible, as the only representative from the three cruises is deposited in Chiba, Japan.

Notoscopelus resplendens (RICHARDSON, 1845)
Diagnostic characters: GR: 6 (5 - 7) + 1 + 13 - 14 (12 - 15), total: 20 - 21 (19 -23).
Reference material: 160 specimens; SL: 19 - 80 mm; La Boc. 04-97: tow 2 (ZMUC P2344536-37), tow 4 (ZMUC P2344538), tow 8, tow 13 (ZMUC P2344539-545); La

Boc. 11-97: tow 1 (ZMUC P2344280-296, ICCM P2320), tow 2 (ZMUC P2344298-299), tow 9 (ZMUC P2344300-04), tow 11 (ZMUC P2344305-311), tow 12 (ZMUC P2344312-13), tow 13 (ZMUC P2344314-331), tow 14 (ZMUC P2344332-38), tow 17 (ZMUC P2344339-341), tow 18 (ZMUC P2344342); ECOS 04-99: tow 5 (ZMUC P2348249-250), tow 6 (ZMUC P2348251-275), tow 8 (ZMUC P2348276-291), tow 10 (ZMUC P2348282-85), tow 12 (ZMUC P2348286-8303), tow 14 (ZMUC P2348304-332, ICCM P2372-73).
Remarks: A revision showed that the specimen P2344538 deposited at ZMUC cannot be a result of tow 4 ("La Bocaina 04-97"), but of tow 8 or 13. Nevertheless is it now registered with the data of tow 4.

Symbolophorus BOLIN & WISNER, 1959
Diagnostic characters: two Prc; PVO series on an inclined line; VO series level; one Pol (unlike *Hygophum*); SAO strongly angulate, SAO_1 in advance of (seldom directly over) VO_3 (unlike *Myctophum*).

Symbolophorus veranyi (MOREAU, 1888)
Diagnostic characters: SAO_1 directly over or in advance of VO_2 and midway between VLO and SAO_2; a line through SAO_2 and SAO_3 passing in front of VO_4; Pol well in advance of base of dorsal adipose fin.
Reference material: 27 specimens; SL: 24 - 96 mm; La Boc. 04-97: tow 13; La Boc. 11-97: tow 11 (ZMUC P2344343-46), tow 14 (ZMUC P2344347); ECOS 04-99: tow 6 (ZMUC P2348333-341, ICCM P2374-75), tow 8 (ZMUC P2348342-45), tow 10 (ZMUC P2348346-48), tow 12 (ZMUC P2348349-350), tow 14 (ZMUC P2348351).

Taaningichthys BOLIN, 1959
Diagnostic characters: 2 + 1 Prc; large and singular supra- and infra-caudal glands present in both sexes; origin of dorsal fin behind base of pelvic fin; a large crescent of whitish tissue on posterior half of iris; one SAO (unlike *Lampadena*).

Taaningichthys minimus (TÅNING, 1928)
Diagnostic characters: 8 - 10 VO; Pol on or anterior to vertical through origin of adipose fin.
Reference material: 4 specimens; SL: 19 - 47 mm; La Boc. 11-97: tow 14 (ZMUC P2344348); ECOS 04-99: tow 10 (ZMUC P2348352), tow 14 (ZMUC P2348353), tow 19 (ZMUC P2348354).

Order Lampriformes

Diagnostic characters: unique type of protrusible upper jaw; premaxilla excludes maxilla from gape; no true spines in fins.

Fam. Regalecidae

Diagnostic characters: body ribbon-like, very elongate and extremely compressed; dorsal fin long-based originating behind tip of snout, first rays on nape very elongate;

pelvic fins consisting of a single, sometimes extremely long ray with fleshy membrane at tip; anal fin absent; caudal fin present; no teeth; eyes and mouth small.

Regalecus ASCANIUS, 1772
Diagnostic characters: see family diagnosis.

Regalecus glesne ASCANIUS, 1772
Diagnostic characters: see genus diagnosis, probably monospecific.
Reference material: 1 specimen; SL: -; ECOS 04-99: tow 8 (ZMUC P38117).
Remarks: The specimen is a very badly damaged juvenile.

Order Lophiiformes

Diagnostic characters: first ray of spinous dorsal fin (if present) on head and transformed into illicium (line) and esca (bait): a device for attracting prey to mouth; pelvic fins (if present) in front of pectoral fins; gill opening small and tubelike positioned at or behind pectoral fin base.

Fam. Melanocetidae

Diagnostic characters: pelvic fins absent; 12 - 17 dorsal finrays, three or four anal finrays; longest rays of dorsal and anal fins less than 60 % standard length;

Melanocetus GUENTHER, 1864
Diagnostic characters: monogeneric; see family diagnosis.

Melanocetus johnsoni GUENTHER, 1864
Diagnostic characters: escal bulb slightly compressed with a distinct posterior crest, width of bulb 4.3 - 8.6 % of standard length; anterior margin of vomer nearly straight.
Reference material: 1 specimen; SL:41 mm; La Boc. 04-97: tow 7 (ZMUC P922465).
Remarks: dwarf males without illicium and esca.

Fam. Ceratiidae

Diagnostic characters: pelvic fins absent; four to five dorsal and anal finrays; longest rays of dorsal and anal fins less than 60 % standard length; cleft of mouth vertical to very oblique; females with two or three caruncles (lumps of tissue, containing luminous secretion; represent modified dorsal fin rays) in front of the dorsal fin.

Ceratias KROEYER; 1845
Diagnostic characters: two caruncles in front of soft-rayed dorsal fin.

Ceratias holboelli KROEYER, 1845
Diagnostic characters: a single, simple or branched escal appendage in front of escal pore.

Reference material: 1 specimen; SL: 79 mm; La Boc. 11-97: tow 14 (ZMUC P922464).
Remarks: parasitic dwarf males without caruncles, illicium and esca.

Order Stephanoberyciformes

Diagnostic characters: body usually roundish; palate toothless; skull bones in general exceptionally thin; supramaxilla absent or reduced.

Fam. Melamphaidae

Diagnostic characters: head large with an enlarged cephalic laterosensory apparatus; blunt, short snout; long, abruptly narrowed caudal peduncle; scales moderate to very large, deciduous and cycloid; spiny rays present in vertical fins; pelvic fins thoracic or subthoracic; photophores and adipose dorsal fin absent.
Remarks: this family is bathypelagic.

Melamphaes GUENTHER, 1864
Diagnostic characters: more than 20 scale rows from nape to caudal base; ridges on head not crest-like, margin smooth; total elements in dorsal fin 17 or more; 13 - 30 gillrakers; 2 scales on cheek, but usually lost.

Melamphaes typhlops (LOWE, 1843)
Diagnostic characters: 14 - 15 gillrakers; I + 7 pelvic and III + 14-15 dorsal finrays; no post-temporal spine.
Reference material: 7 specimens; SL: 20 - 26 mm; La Boc. 11-97: tow 9 (ZMUC P412222), tow 14 (ZMUC P412223); ECOS 04-99: tow 19 (ZMUC P412228-230, ICCM P412), tow 21 (ZMUC P412231).

Poromitra GOODE & BEAN, 1883
Diagnostic characters: more than 20 scale rows from nape to caudal base; ridges on top of head crest-like with serrate margins; conspicuous spine between nostrils; 23 - 33 gillrakers; 3 - 4 (usually lost) scales on cheek.

Poromitra capito GOODE & BEAN, 1883
Diagnostic characters: depth of caudal peduncle more than one third its length; eye less than one sixth head length; retrorse spine at postero-ventral angle of preopercle strong; upper cheek ridge vertical.
Reference material: 3 specimens; SL: 45 - 72 mm; La Boc. 11-97: tow 2 (ZMUC P412224), tow 9 (ZMUC P412225, ICCM P411).

Scopelogadus VAILLANT, 1888
Diagnostic characters: less than 15 scale rows from nape to caudal base; no scales on cheek.

Scopelogadus beanii (GUENTHER, 1887)
Diagnostic characters: see genus diagnosis.
Reference material: 1 specimen; SL: 29 mm; La Boc. 11-97: tow 9 (ZMUC P412227).

Order Beryciformes

Diagnostic characters: pelvic fins usually with more than five soft rays; 16 or 17 branched caudal fin rays (or 18 or 19 principal rays).

Fam. Anoplogasteridae

Diagnostic characters: body short, deep and compressed; caudal peduncle slender; head deeper than long with an enlarged cephalic laterosensory apparatus; eyes small; mouth deep and oblique; vertical fins without spines; scales ctenoid, small and embedded in skin; lateral line an open groove, bridged by scales at intervals; photophores and adipose dorsal fin absent.

Anoplogaster GUENTHER, 1859
Diagnostic characters: monogeneric, see family diagnosis.

Anoplogaster cornuta (VALENCIENNES, 1833)
Diagnostic characters: see genus diagnosis.
Reference material: 1 specimen; SL: 116 mm; La Boc. 11-97: tow 9 (ZMUC P412221).
Remarks: WHITEHEAD et al. (1984) characterise in their key this family incorrectly as having spiny rays in dorsal, anal and pelvic fins, although in the diagnosis of the species all fins are indicated having soft spines.

Fam. Diretmidae

Diagnostic characters: body high, compressed; eyes large; mouth deep, oblique, teeth minute; pelvic fins thoracic; caudal fin forked; no spines in vertical fins; scales ctenoid; photophores and adipose dorsal fin absent; lateral line missing; body colour silvery.

Diretmus JOHNSON, 1864
Diagnostic characters: body shape round; anus immediately anterior to first anal finray or only separated from it by 1 or 2 scutes; ventral midline anterior to pelvic fins keeled and covered by scutes.

Diretmus argenteus JOHNSON, 1864
Diagnostic characters: monospecific, see genus diagnosis.
Reference material: 19 specimens; SL: 45 - 105 mm; La Boc. 04-97: tow 1 (ZMUC P40316), tow 7 (ZMUC P40317); La Boc. 11-97: tow 2 (ZMUC P40308), tow 9 (ZMUC P40309-312, ICCM P401), tow 14 (ZMUC P40314-15); ECOS 04-99: tow 5 (ZMUC P40318-19), tow 10 (ZMUC P40320-25, ICCM P402).

Setarches JOHNSON, 1862
Diagnostic characters: lateral line forms a broad groove without tubular scales; dorsal fin with 12 spines; 5 anal soft rays.

Setarches guentheri JOHNSON, 1862
Diagnostic characters: see genus diagnosis.
Reference material: 1 specimen; SL: 34 mm; La Boc. 11-97: tow 18 (ZMUC P791354).
Remarks: This is an offshore species, living on or near the bottom. The present individual is juvenile.

Order Perciformes

Remarks: NELSON (1994) indicates the classification of this largest order of vertebrates as unsettled and emphasises the need for changes. He gives no diagnostic characters.

Fam. Caristiidae

Diagnostic characters: body deep, compressed; mouth terminal, teeth minute; dorsal, anal and pelvic fins very large; caudal fin truncate; a groove along dorsal and ventral profile, for reception of depressed fins; scales cycloid; pelvic fins in advance or behind pectoral fin base; photophores and adipose dorsal fin absent.

Platyberyx ZUGMAYER, 1911
Diagnostic characters: lateral line present; eye diameter distinctly less than three times in head length.

Platyberyx opalescens ZUGMAYER, 1911
Diagnostic characters: monospecific, see genus diagnosis.
Reference material: 4 specimens; SL: 50 - 61 mm; ECOS 04-99: tow 14 (ZMUC P40326-28, ICCM P403).
Remarks: The validity of this genus and species is unclear. In some works *Platyberyx* is regarded as a synonym of *Caristius* GILL & SMITH, 1905. But recently the validity of *Platyberyx* was confirmed by several authors. Anyhow, the lateral line in the present material is not twisting and close to the dorsal profile, like in the drawing of POST (1984), but straight. Pectoral fins contain 18 (1 individual) and 17 (3 individuals) rays, respectively.

Fam. Chiasmodontidae

Diagnostic characters: body elongate; mouth large with long teeth, premaxilla and maxilla long and slender; mouth and stomach highly distensible; spiny dorsal fin well separated from soft-rayed dorsal fin; photophores present only in one genus; dorsal adipose fin absent.

Pseudoscopelus LUETKEN, 1892
Diagnostic characters: head and body with rows of small photophores (unlike all other genera); snout short and rounded.

Pseudoscopelus altipinnis PARR, 1933
Diagnostic characters: see genus diagnosis.
Reference material: 1 specimen; SL: 121 mm; La Boc. 11-97: tow 9 (ZMUC P65170).
Remarks: This species is not cited in QUÉRO et al. (1990) although the distribution drawing in JOHNSON AND KEENE (1986) indicates its occurrence in Canarian waters and further south.

Fam. Gempylidae

Diagnostic characters: body elongate and compressed; two nostrils on each side of snout (unlike Trichiuridae); mouth large, protruding lower jaw, maxilla exposed; two dorsal fins, the first longer than the second; detached finlets behind dorsal and anal fin present in most genera.

Diplospinus MAUL, 1948
Diagnostic characters: colour silvery with numerous narrow dark lines along the body; body depth more than 15 times in standard length; no detached dorsal and anal finlets; scales absent.

Diplospinus multistriatus MAUL, 1948
Diagnostic characters: monospecific, see genus diagnosis.
Reference material: 131 specimens; SL: 10 - 173 mm; La Boc. 04-97: tow 1 (ZMUC P73325), tow 14 (ZMUC P73326); La Boc. 11-97: tow 2 (ZMUC 73205-08), tow 13 (ZMUC P73209-3313, ICCM P731-735), tow 18 (ZMUC P73319-20); ECOS 04-99: tow 5 (ZMUC P73329-330, ICCM P737), tow 10 (ZMUC P73331), tow 12 (ZMUC P73332), tow 13 (ZMUC P73333-340).

Nealotus JOHNSON, 1865
Diagnostic characters: body depth less than 12 times in standard length; one or two separated spines before anal fin; pelvic fins with only one spine, inserted a little behind base of pectoral fin; most of body naked but large deciduous scales may be present at some places.

Nealotus tripes JOHNSON, 1865
Diagnostic characters: monospecific, see genus diagnosis.
Reference material: 4 specimens; SL: 36 - 113 mm; La Boc. 11-97: tow 6 (ZMUC P73321), tow 13 (ZMUC P73322-23, ICCM P736).

Fam. Trichiuridae

Diagnostic characters: body very elongate and extremely compressed; one nostril on each side of snout (unlike Gempylidae); mouth large, protruding lower jaw, maxilla

concealed by preorbitals; gillrakers undeveloped; dorsal fin single, running almost entire length of body, consisting of spinous and soft portions; anal fin preceded by two free spines behind anus (first inconspicuous, second enlarged); pectoral fins small to moderate; pelvic fins absent or vestigial, reduced to a flattened spine and 0 - 2 rays; caudal fin either small and forked or completely absent; scales absent.

Subfam. Aphanopodinae

Diagnostic characters: caudal fin small and forked; pelvic fins present (may be absent in adults), with scalelike spine and one rudimentary soft ray; spinous dorsal fin with 38 - 46 rays, slight notch at division of spinous and soft portions.

Aphanopus LOWE, 1839
Diagnostic characters: pelvic fins present in juveniles (a single spine inserted before base of pectoral fins), absent in adults; head profile rising very gradually from tip of snout to origin of dorsal fin without forming a sagital crest; spinous part of dorsal fin only slightly shorter than the soft part.

Aphanopus intermedius PARIN, 1983
Diagnostic characters: 95 - 102 dorsal fin elements; 102 - 108 vertebrae.
Reference material: 1 specimen; SL: 153 mm; La Boc. 04-97: tow 14 (ZMUC P73327).
Remarks: BORDES et al. (1999) cited this species already as new record for the Canaries. PARIN (1990) cites it from off western Sahara, Congo and Angola, further from Sierra Leone submarine rise and Pilsberry Seamount. The specimen was identified by N. V. Parin.

Benthodesmus GOODE & BEAN, 1882
Diagnostic characters: pelvic fins diminutive, composed of a scale-like spine and a rudimentary soft ray; head profile rising very gradually from tip of snout to origin of dorsal fin without forming a sagital crest; spinous part of dorsal fin about half as long as the soft part.

Benthodesmus simonyi (STEINDACHNER, 1891)
Diagnostic characters: pelvic fins insert behind pectoral fin base; 148 - 155 dorsal fin elements; anal fin with 89 - 101 soft rays; 153 - 158 vertebrae; head length in juveniles and adults (SL > 20 cm) 7.0 to 8.0 times in SL.
Reference material: 11 specimens; SL: 87 - 277 mm; ECOS 04-99: tow 5 (ZMUC P73341-47, ICCM P738-739), tow 6 (ZMUC P73348), tow 21 (ZMUC P73349).
Remarks: determination of this specimen questionable, revision needed.

Subfam. Lepidopinae

Diagnostic characters: caudal fin small and forked or absent; pelvic fins present, rudimentary; spinous dorsal fin usually with 3 - 10 rays, spinous and soft portions continuous; lateral line descending gradually behind the pectoral fin.

Lepidopus GOÜAN, 1770
Diagnostic characters: pelvic fins with one small scale-like spine and 1 to 2 tiny soft rays; head profile with a prominent sagital crest.

Lepidopus caudatus (EUPHRASEN, 1788)
Diagnostic characters: posterior confluence of frontal crests behind middle of orbits; sagital crest confined to nape; orbits nearly touching dorsal profile; upper head profile concave; 98 - 110 dorsal fin elements; 59 - 66 soft anal fin elements; 105 - 114 vertebrae; second anal fin spine plate-like, twice or more shorter than pupil.
Reference material: 6 specimens; SL: 70 - 204 mm; La Boc. 04-97: tow 12 (ZMUC P73328), ECOS 04-99: tow 4 (ZMUC P73350-51), tow 5 (ZMUC P73352, IC CM P7310), tow 7 (ICCM P7311).
Remarks: Determination of this specimens is questionable, revision needed.

Fam. Nomeidae

Diagnostic characters: mouth and teeth small; two dorsal fins, the first with 9 - 12 slender spines at least as long as any ray in the second dorsal fin, which follows almost immediately; soft dorsal and anal fins never falcate, their bases nearly equal in length; 0 - 3 anal fin spines.

Cubiceps LOWE, 1843
Diagnostic characters: origin of first dorsal fin behind or, in small specimens directly over origin of pectoral fins; body usually elongate; origin of pelvic fins under end or behind base of pectoral fins; teeth on tongue present.

Cubiceps gracilis (LOWE, 1843)
Diagnostic characters: see genus diagnosis.
Reference material: 5 specimens; SL: 25 - 90 mm; ECOS 04-99: tow 6 (ZMUC P691553), tow 8 (ICCM P691), tow 13 (ZMUC P691555), tow 14 (ZMUC P691556), tow 19 (ZMUC P691554).

3. 2. Species Lists of the three Cruises

The following Tables 3, 4 and 5 provide the complete list of the fish material collected in each cruise, indicating the amount of individuals per taxon and per tow. This allows a comparison of trawling success in general and of the three different types of trawl tows: epipelagic-neritic, epipelagic-oceanic and mesopelagic-oceanic. The tables include epi-, meso-, (bathy-) and benthopelagic species as well as the unidentified juveniles and larvae. Those, marked with an asterisk (*) are mesopelagically living juveniles of benthopelagic species.

BORDES et al. (1999) published already a rather preliminary species list of cruise "La Bocaina 04-97". Due to lack of comparative material, experience, taxonomic literature, and financial means, the species identification had to be carried out

by Franz Uiblein during extensive travels, based on invited visits to a total of five research institutions and with the assistance of several specialists (cf. BORDES et al., 1999). In accordance with a co-operation agreement with Masaki Miya, most of the material was stored in Japan for genetic studies and only representatives of the more common species could be sent to the Zoological Museum of Copenhagen. The revision of the material from this first cruise deposited at the ZMUC showed, compared to BORDES et al. (1999), the following new results: One *Bathylagus sp.* turned out to be a *Bathylagus greyae*. Two more *Eustomias* species, *E. filifer* and *E. lipochirus* were noticed. The *Aristostomias* specimen turned out to be *A. grimaldii* and *Macroparalepis nigra* was rectified as *Stemonosudis intermedia*.

No specimens of the following 13 species collected during the first cruise were sent from Japan to Copenhagen: *Argyropelecus gigas*, *A. olfersi*, *Eustomias obscurus*, *E. tetranema*, *Scopelosaurus argenteus*, *Diaphus adenomus*, *Hygophum benoiti*, *H. reinhardtii*, *Lampanyctus festivus*, *Nannobrachium lineatum*, *Notolychnus valdiviae*, *Notoscopelus caudispinosus* and *Symbolophorus veranyi*. These specimens are either stored at the Natural History Museum and Institute, Chiba, Japan or still in use for ongoing molecular studies (Masaki Miya and Motoomi Yamaguchi, personal communication with Franz Uiblein). The five species *A. olfersi*, *E. tetranema*, *S. argenteus*, *N. valdiviae* and *N. caudispinosus* were not caught again in the two following cruises. Therefore, verification of these species was impossible and no material could be included into the collections at ZMUC or ICCM.

3. 2. 1. "La Bocaina 04-97"

Table 3. Revised list of the families and species collected during cruise "La Bocaina 04-97" (*...mesopelagic living juveniles of benthopelagic species).

Number of the trawl station		6	8	10	12	2	13	1	7	11	14	Total
Day- or Nighttime		N	N	N	N	N	N	D	N	D	D	number
Trawling depth		20 - 100 m						400 - 700 m				of indivi-
Bottom depth		90 - 300m				950 - 3400 m						duals per
Family	*Species*	Number of individuals										species
Epipelagic												
Clupeidae	*Sardinella aurita*				8		1					9
Carangidae	*Trachurus picturatus*	12	1									13
Scombridae	*Scomber japonicus*	207	96	81	4		29					417
Mesopelagic												
Nemichthyidae	*Nemichthys curvirostris*					1	2			2	2	7
	Nemichthys scolopaceus										1	1
Serrivomeridae	*Serrivomer beani*				1	6		40		3	2	52
Bathylagidae	*Bathylagus* sp.					1				1		2
	Bathylagus greyae					1						1
Gonostomatidae	*Cyclothone braueri*							273		44	226	543
	Cyclothone pallida									1		1
	Cyclothone pseudopallida							10		31		41
	Diplophos taenia							3				3
	Gonostoma denudatum						4	2		1		7
	Gonostoma elongatum					4		245	3	2	4	258
	Margrethia obtusirostra							1				1
Sternoptychidae	*Argyropelecus aculeatus*							2	2	1		5
	Argyropelecus gigas							4				4
	Argyropelecus hemigymnus							4	11	1	12	28
	Argyropelecus olfersi										1	1
	Sternoptyx diaphana								1			1
Phosichthyidae	*Vinciguerria nimbaria*					1	4					5

	Number of the trawl station / Species	6	8	10	12	2	13	1	7	11	14	Total
Astronesthinae	*Astronesthes gemmifer*						?	?			?	7
	Astronesthes indicus							2				2
	Astronesthes macropogon							1				1
	Astronesthes micropogon							3				3
	Astronesthes neopogon						1					1
	Rhadinesthes decimus									1		1
Stomiinae	*Stomias boa*					7	6	104	1	10	10	138
Chauliodontinae	*Chauliodus danae*					3	1	44	2	2	5	57
	Chauliodus sloani								2	8	3	13
Melanostomiinae	*Bathophilus vaillanti*							3	3		1	7
	Chirostomias pliopterus							3			1	4
	Eustomias filifer									1		1
	Eustomias lipochirus						1					1
	Eustomias obscurus					10	1		1			12
	Eustomias tetranema									1		1
	Flagellostomias boureei									1		1
	Grammatostomias flagelibarba									1		1
	Leptostomias gladiator										1	1
	Melanostomias biseriatus							1			1	2
	Melanostomias tentaculatus							4	1		2	7
	Photonectes braueri							1				1
Idiacanthinae	*Idiacanthus fasciola*						3	65	2	12	8	90
Malacosteinae	*Aristostomias grimaldii*							1				1
	Photostomias guernei							28	2	61	15	106
Notosudidae	*Ahliesaurus berryi*							2				2
	*Scopelosaurus argenteus**							3				3
Paralepididae	*Stemonosudis intermedia*					1						1
Myctophidae	*Benthosema suborbitale*					1		1				2
	Bolinichthys indicus							2				2
	Ceratoscopelus maderensis		3			1	7					11
	Ceratoscopelus warmingii					38	3		1			42
	Diaphus adenomus									1		1
	Diaphus metopoclampus							37			2	39
	Diaphus mollis					3						3
	Diaphus perspicillatus					7					1	8
	Diaphus rafinesquii							15	1	1	2	19
	Hygophum benoiti					1						1
	Hygophum hygomii					11	1	1				13
	Hygophum reinhardtii					1						1
	Lampadena urophaos atlantica							1			3	4
	Lampanyctus alatus						38	5	1		4	48
	Lampanyctus festivus									1		1
	Lampanyctus photonotus						3				1	4
	Lampanyctus pusillus						2	1			4	7
	Lepidophanes gaussi					17		1		1		19
	Lobianchia dofleini					1	11	1				13
	Lobianchia gemellarii							1	1	1	2	5
	Nannobrachium atrum									2	2	4
	Nannobrachium lineatum									1		1
	Notolychnus valdiviae									1		1
	Notoscopelus caudispinosus					1						1
	Notoscopelus resplendens		2			3	6					11
	Symbolophorus veranyi						1					1
Melanocetidae	*Melanocetus johnsoni*								1			1
Diretmidae	*Diretmus argenteus*							1	1			2
Syngnathidae	? *Syngnathus* sp.						1					1
Gempylidae	*Diplospinus multistriatus*							1			1	2
Trichiuridae	*Aphanopus intermedius**							1				1
Benthopelagic												
Caproidae	*Capros aper*							2		1		3
Trichiuridae	*Lepidopus caudatus*				1							1
Larvae	Leptocephali					15		13				28
Total number of individuals		219	102	81	14	135	128	935	37	195	320	2,166
Total number of epipelagic individuals		219	97	81	12		30					439
Total number of mesopelagic individuals			5		1	120	98	920	37	194	320	1,695
Total number of benthopelagic individuals					1			2		1		4
Total number of Larvae						15		13				28

3. 2. 2. "La Bocaina 11-97"

Table 4. List of the families and species collected during cruise "La Bocaina 11-97".

Number of the trawl station		4	5	7	8	10	12	15	16	17	18	1	3	6	11	13	2	9	14	Total number of individuals per species
Day- or Nighttime		D	N	D	D	N	N	N	N	N	N	N	N	N	N	N	D	N	N	
Mean trawling depth		10 - 150 m															500 - 610 m			
Mean bottom depth		50 - 400 m										600 -1700 m								
Family	Species	Number of Individuals																		
Epipelagic																				
Carangidae	*Auxis rochei*							44												96
	Trachurus picturatus		25				59		12											
Scombridae	*Scomber japonicus*						11	70	17				8							150
Mesopelagic																				
Nemichthyidae	*Avocettina infans*																		1	1
	Nemichthys curvirostris											1								1
	Nemichthys scolopaceus																	1		1
Serrivomeridae	*Serrivomer beani*												1				11	1	49	62
	Serrivomer lanceolatoides																	3		3
Saccopharyngidae	*Saccopharynx ampullaceus*																	1		1
Opisthoproctidae	*Opisthoproctus soleatus*																		1	1
Alepocephalidae	*Xenodermichthys copei*																	1		1
Platytroctidae	*Searsia koefoedi*																	1	1	2
Gonostomatidae	*Bonapartia pedaliota*																	1		1
	Cyclothone braueri																13	877	391	1,281
	Cyclothone pallida																	2	2	4
	Cyclothone pseudopallida																	6	28	34
	Diplophos taenia											13								13
	Gonostoma denudatum											9					1		1	11
	Gonostoma elongatum											2					3		3	8
	Margrethia obtusirostra																3	1	1	5
Maurolicinae	*Valenciennellus tripunctulatus*																	8		8
Sternoptychinae	*Argyropelecus aculeatus*															1		1		2
	Argyropelecus gigas																	2	1	3
	Argyropelecus hemigymnus																17	18	6	41
	Sternoptyx diaphana																		15	15
Phosichthyidae	*Vinciguerria* sp.													13		61				74
	Vinciguerria attenuata																	11	47	58
	Vinciguerria nimbaria									7	40	2		94		1,166	1	4	14	1,328
	Vinciguerria poweriae															54		2	1	57
Astronesthinae	*Astronesthes leucopogon*																	1		1
Stomiinae	*Stomias boa*											2					2	2	2	8
	Stomias longibarbatus											1						2		3
Chauliodontinae	*Chauliodus danae*											14					4	5	35	58
	Chauliodus sloani											4					6	5	2	17
Melanostomiinae	*Bathophilus longipinnis*																1		1	2
	Bathophilus vaillanti											4					1		9	14
	Eustomias longibarba																2			2
	Eustomias obscurus											22					16		1	39
	Leptostomias gladiator																1			1
	Melanostomias bartonbeani																	1		1
Idiacanthinae	*Idiacanthus fasciola*																60		4	64
Malacosteinae	*Photostomias guernei*																28	2	13	43

Paralepididae	*Lestidiops affinis*										1	4						1		6
	Lestidiops javakari													11		13		1		25
	Paralepis coregonoides																		1	1
	Stemonosudis intermedia											2								2
	Sudis hyalina															1	1			2
Evermannelidae	*Evermannella indica*																1		1	2
Myctophidae	Myctophidae sp.																		2	2
	Benthosema suborbitale											4						4	3	11
	Bolinichthys indicus																1	1	10	12
	Ceratoscopelus maderensis						3								58					61
	Ceratoscopelus warmingii										6	10				2	4	99	37	158
	Diaphus adenomus								17		115									132
	Diaphus dumerilii								3	1	25		4	2	1	2		3		41
	Diaphus metopoclampus																1			1
	Diaphus mollis											2				41	1	25	3	72
	Diaphus perspicillatus									3	11				1	6			3	24
	Diaphus rafinesquii																6	8	5	19
	Diaphus termophilus																		2	2
	Diaphus vanhoeffeni															1				1
	Diogenichthys atlanticus														1	6		12	4	23
	Hygophum benoiti											1	6		290	26		4	9	336
	Hygophum hygomii						6	6		43	51	18	11	1	102	71	5	40	18	372
	Hygophum reinhardtii									2	2					8		12	8	32
	Hygophum taaningi															22	1	13	8	44
	Lampanyctus alatus																1		1	2
	Lampanyctus pusillus																1		5	6
	Lepidophanes gaussi											16				7		7	5	35
	Lobianchia dofleini						1				17	44		10	7	506		296	74	955
	Lobianchia gemellarii																46	3	3	52
	Myctophum nitidulum									3	2		1				4	1	2	13
	Myctophum selenops																		1	1
	Nannobrachium atrum																	2	2	4
	Notoscopelus resplendens						2			3	1	18			7	18	2	5	7	63
	Symbolophorus veranyi														4				1	5
	Taaningichthys minimus																		1	1
Ceratiidae	*Ceratias holboelli*																		1	1
Melamphaidae	*Melamphaes typhlops*																	1	1	2
	Poromitra capito																1	2		3
	Scopelogadus beanii																	1		1
Anoplogasteridae	*Anoplogaster cornuta*																	1		1
Diretmidae	*Diretmus argenteus*																1	5	2	8
Chiasmodontidae	*Pseudoscopelus altipinnis*																	1		1
Gempylidae	*Diplospinus multistriatus*										2					110	4			116
	Nealotus tripes													1		3				4
Benthopelagic																				
Synodontidae	*Synodus synodus*				1															1
Setarchidae	*Setarches guentheri*										1									1
Larvae	Leptocephali			2		9			1		3			30	30	107			4	186
	Pisciformes	3,493	4	20		348			53		26			46	31	201		3		4,225
	Pleuronectiformes			1		1								3		3				8
Total number of individuals		3,493	29	23	1	358	82	120	103	62	303	193	31	211	532	2,436	251	1,510	853	10,591
Total number of epipelagic individuals			25				70	114	29				8							246
Total number of mesopelagic individuals							12	6	20	62	273	193	23	132	471	2,125	251	1,507	849	5,924
Total number of benthopelagic individuals					1						1									2
Total number of Larvae		3,493	4	23		358			54		29			79	61	311		3	4	4,419

3. 2. 3. "ECOS 04-99"

Table 5. List of the families and species collected during cruise "ECOS 04-99" (*...mesopelagic living juveniles of benthopelagic species).

Number of the trawl station		2	3	4	7	9	13	15	16	17	18	22	6	8	12	23	5	10	14	19	21	Total number of individuals per species
Day- or Nighttime		N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D	D	D	D	D	
Mean trawling depth		8 - 80 m															250 - 750 m					
Mean bottom depth		50 - 250 m											300 - 1600 m									
Family	*Species*	Number of individuals																				
Epipelagic																						
Engraulidae	*Engraulis encrasicolus*	2,366		736	22			5		1,160	1,413	595				57						6,354
Clupeidae	*Sardina pilchardus*							14		29												43
Clupeidae	*Sardinella maderensis*					17		15		1												33
Carangidae	*Trachurus picturatus*			3	1	2		252	1	9		3	6	9		196						482
Carangidae	*Trachurus trachurus*							426	1								1					428
Scombridae	*Scomber japonicus*	173		493	49	9		56		9		57	24	756		396						2,022
Mesopelagic																						
Nemichthyidae	*Nemichthys curvirostris*														1		1			1	2	5
	Nemichthys scolopaceus														1		1		1			3
Serrivomeridae	*Serrivomer* sp.																		1	1		2
	Serrivomer beani				1												13	18	17	11	6	66
	Serrivomer lanceolatoides																		1			1
Bathylagidae	*Bathylagus greyae*												2		1							3
Alepocephalidae	*Bathytroctes microlepis**																		1			1
	Xenodermichthys copei																		1			1
Gonostomatidae	*Bonapartia pedaliota*																	3				3
	Cyclothone braueri																192	181	79	133	1	586
	Cyclothone livida																		4	1		5
	Cyclothone pallida																1		7	1		9
	Cyclothone pseudopallida																7	20	66	20		113
	Diplophos maderensis			1																		1
	Diplophos taenia												1	1								2
	Gonostoma bathyphilum																		2			2
	Gonostoma denudatum																1					1
	Gonostoma elongatum														5		10	4	1	8	2	30
	Margrethia obtusirostra																	5				5
Maurolicinae	*Maurolicus muelleri*								2				1		1				1			5
	Valenciennellus tripunctulatus																1	2			1	4
Sternoptychinae	*Argyropelecus aculeatus*																	1		2	1	4
	Argyropelecus gigas																2			1		3
	Argyropelecus hemigymnus												1				12	3	1	5	1	23
	Sternoptyx sp.																				1	1
	Sternoptyx diaphana																1	3		2	1	7
Phosichthyidae	*Ichthyococcus ovatus*																			2		2
	Vinciguerria sp.						6															6
	Vinciguerria attenuata														2		43	18	3	2	3	71
	Vinciguerria nimbaria				19								66	47	91		13	24				260
	Vinciguerria poweriae														4		4	6		4	4	22
Astronesthinae	*Astronesthes gemmifer*																	1				1
	Borostomias mononema																1	3				4
	Rhadinesthes decimus																	5				5

Stomiinae	*Stomias boa*			3			1						15	2	74		26	9		5	2	137
	Stomias brevibarbatus																	1				1
	Stomias longibarbatus														1		1		2			4
Chauliodontinae	*Chauliodus* sp.																5	4	1	2		12
	Chauliodus danae												4		1		112	32	10	36	1	196
	Chauliodus sloani														1		14	7	1	4	7	34
Melanostomiinae	*Bathophilus* sp.																1					1
	Bathophilus brevis																1					1
	Bathophilus digitatus																1					1
	Bathophilus pawneei																			1		1
	Bathophilus vaillanti												1		3		13	3		2	1	23
	Eustomias sp.																	1				1
	Eustomias bigelowi																		1			1
	Eustomias obscurus												1		3				3	9		16
	Eustomias schmidti													1								1
	Eustomias simplex																		1			1
	Flagellostomias boureei												1									1
	Melanostomias biseriatus																	2				2
	Melanostomias tentaculatus																	1				1
	Photonectes braueri																	2	1			3
	Photonectes margarita																	1				1
Idiacanthinae	*Idiacanthus fasciola*												1	2	2			25	79	6		115
Malacosteinae	*Photostomias guernei*														3			12	32	4		51
Notosudidae	*Scopelosaurus lepidus**																	2				2
Paralepididae	*Lestidiops sphyrenoides*						1															1
Myctophidae	Myctophidae sp.			12									448									460
	Benthosema suborbitale												6	2	2					7	3	20
	Bolinichthys indicus												8				9	203	9	63	1	293
	Bolinichthys supralateralis																	1				1
	Centrobranchus nigroocellatus																			1		1
	Ceratoscopelus maderensis			4	3				1				10	3			1	2				24
	Ceratoscopelus warmingii												123	25					4	1		153
	Diaphus sp.						1															1
	Diaphus adenomus																1			1		2
	Diaphus dumerilii				3				14				3				1	1	1	1		24
	Diaphus holti																2		1			3
	Diaphus metopoclampus																6	2	2	2	3	15
	Diaphus mollis													1			3	13	6		1	24
	Diaphus perspicillatus												1									1
	Diaphus rafinesquii												17	7	2		14	16	5	4		65
	Diaphus termophilus																3		14			17
	Diogenichthys atlanticus												102	62	53			27	1	2		247
	Gonichthys coccoi																3			1	1	5
	Hygophum benoiti													1								1
	Hygophum hygomii				1				3				815	244	24		95	47	17	200	16	1.462
	Hygophum reinhardtii												100	13	1				27	2		143
	Hygophum taaningi								1						3				50	2		56
	Lampadena chavesi																2	1				3
	Lampadena speculigera																		1			1
	Lampadena urophaos atlantica																	9	1			10
	Lampanyctus sp.												53	12					7			72
	Lampanyctus alatus												32	8	3				35			78
	Lampanyctus crocodilus												1									1
	Lampanyctus festivus																2		2			4
	Lampanyctus nobilis												1				1					2
	Lampanyctus photonotus												8	3	1				4			16
	Lampanyctus pusillus												35	3	4		16	32	12	11	1	114
	Lepidophanes gaussi								1				18	27	16			24	21	6		113

	Lobianchia dofleini				3							124	16	134		13	20	35	4	15	364
	Lobianchia gemellarii															12	2	2	8	5	29
	Myctophum nitidulum											1						3	2		6
	Myctophum punctatum								3			85	5	12				2			107
	Myctophum selenops																13		1		14
	Nannobrachium atrum													2				52	2		56
	Nannobrachium cuprarium																	6			6
	Nannobrachium lineatum																	1			1
	Notoscopelus bolini								1			9									10
	Notoscopelus resplendens											25	6	18		2	4	31			86
	Symbolophorus veranyi											11	4	2			3	1			21
	Taaningichthys minimus																1	1	1		3
Regalecidae	*Regalecus glesne*												1								1
Melamphaidae	*Melamphaes typhlops*																		4	1	5
Diretmidae	*Diretmus argenteus*															2	7				9
Centriscidae	*Macroramphosus scolopax**					1					1					2		2			6
Caristiidae	*Caristius opalescens*																	4			4
Gempylidae	*Diplospinus multistriatus*					8								1		3	1				13
Trichiuridae	*Benthodesmus simonyi**											1				9				1	11
Nomeidae	*Cubiceps gracilis*					1						1	1					1	1		5
Benthopelagic																					
Caproidae	*Capros aper*															6					6
Centriscidae	*Macroramphosus scolopax*			2					3		4				1						10
Sparidae	*Boops boops*							166		2	25	2									195
	Pagellus acarne							17													17
	Pagellus erythrinus							11													11
Trichiuridae	*Lepidopus caudatus*			2	1											2					5
Larvae	Leptocephali			1			1		28							4		6			135
	Pisciformes		2		1		3		19				5	13		2	1	12	1	1	60
	Pleuronectiformes						1		1				2	1		1		1			8
Total number of individuals		2,539	2	1,257	104	28	24	962	79	1,210	1,438	662	2,201	1,302	510	650	695	829	697	591	83	15,863
Total number of epipelagic individuals		2,539		1,232	72	28		768	2	1,208	1,413	655	30	765		649	1					9,362
Total number of mesopelagic individuals				20	30		19		26			1	2,132	497	472		679	828	678	590	82	6,054
Total number of benthopelagic individuals				4	1			194	3	2	25	6				1	8					244
Total number of Larvae			2	1	1		5		48				39	40	38		7	1	19	1	1	203

3. 3. Abundance

Four families were highly dominant, as their representatives account for more than 95 % of all specimens: Myctophidae (50.5 %), Gonostomatidae (21.7 %), Phosichthyidae (13.3 %) and Stomiidae (9.8 %). The same dominance is more or less valid for the three cruises, although there are several differences in the percentages of the families: "La Bocaina 04-97": Gonostomatidae (50.4 %), Stomiidae (27.0 %), Myctophidae (15.4 %) and Phosichthyidae (0.3 %); "La Bocaina 11-97": Myctophidae (42.4 %), Phosichthyidae (24.7 %), Gonostomatidae (23.1 %) and Stomiidae (4.3 %); "ECOS 04-99": Myctophidae (68.2 %), Gonostomatidae (12.4 %), Stomiidae (10.1 %) and Phosichthyidae (6.0 %). Among the families few or even only one species are/is dominant: *Cyclothone braueri* (81.4 %) in Gonostomatidae; *Vinciguerria nimbaria* (88.4 %) in Phosichthyidae; *Stomias boa* (21.5 %), *Chauliodus danae* (23.7 %), *Idiacanthus fasciola* (20.5 %) and *Photostomias guernei* (15.2 %) in Stomiidae; *Hygophum hygomii* (29.1 %) and *Lobianchia dofleini* (21.0 %) in Myctophidae. With few exceptions these species are also the only eudominant in the single cruises. In cruise "La Bocaina 11-97" *Eustomias obscurus* (15.4 %, Stomiidae) and *Hygophum benoiti* (13.6 %, Myctophidae) are also eudominant, but not *S. boa* (3.2 %, Stomiidae). In cruise "ECOS 04-99", in addition to the former species *Cyclothone pseudopallida* (15.0 %, Gonostomatidae) is eudominant, but not *P. guernei* (8.5 %, Stomiidae). In cruise "La Bocaina 04-97" *Gonostoma elongatum* (30.1 %, Gonostomatidae), *Ceratoscopelus warmingii* (16.0 %), *Diaphus metopoclampus* (14.9 %) and *Lampanyctus alatus* (18.3 %, all Myctophidae) are eudominant, but not *H. hygomii* (5.0 %) and *L. dofleini* (5.0 %, both Myctophidae).

With respect to this three-cruise investigation the following species characterise the mesopelagic realm of the Canary Islands: *C. braueri* (Gonostomatidae), *V. nimbaria* (Phosichthyidae), *H. hygomii* and *L. dofleini* (Myctophidae) are eudominant (abundance > 10 %, or more than 1,300 individuals); no species can be categorised as dominant (abundance 5 - 10 %, or 650 - 1,299 individuals); *G. elongatum* (Gonostomatidae), *C. danae*, *I. fasciola*, *S. boa* (all Stomiidae), *Bolinichthys indicus*, *C. warmingii*, *Diogenichthys atlanticus* and *H. benoiti* (all Myctophidae) are subdominant (abundance 2 - 5 %, or 260 - 649 individuals); *Serrivomer beani* (Serrivomeridae), *C. pseudopallida* (Gonostomatidae), *P. guernei* (Stomiidae), *Diaphus adenomus*, *Hygophum reinhardtii*, *Lepidophanes gaussi*, *Notoscopelus resplendens* (all Myctophidae), and *Diplospinus multistriatus* (Gempylidae) are recedent (abundance 1 - 2 %, or 130 - 259 individuals). The big remainder of 127 species is subrecedent (abundance < 1 %, or less than 130 individuals).

Table 6 lists the K-Dominance of the three most abundant species for each tow. It is subdivided into all mesopelagic species and Myctophidae. Almost all of the three listed species are eudominant, only a few dominant. Mesopelagic tows are dominated by non-migrating *Cyclothone* ("La Bocaina 04-97": tow 1, 14; "La Bocaina 11-97": tow 9, 14; "ECOS 04-99": tow 5, 14;), or stomiiforms ("La Bocaina 04-97": tow 7, 11; "La Bocaina 11-97": tow 2), occasionally also myctophids ("ECOS 04-99": tow 10, 19, 21). Almost all other tows are dominated by the myctophids. Exceptions are tow

12 ("La Bocaina 04-97), tow 13 and tow 22 ("ECOS 04-99"), which contain no myctophids at all. *V. nimbaria* is dominant in tow 7 ("ECOS 04-99"), tow 6 and tow 13 ("La Bocaina 11-97). *H. hygomii* is the most abundant myctophid species, as it belongs in 20 out of 24 tows to the three most abundant species (only cruise "La Bocaina 11-97" and "ECOS 04-99"), and in 9 tows it is even the dominating fish. Also *L. dofleini* is frequent, dominating the catches 6 times and being 9 times among the three most abundant species. In four tows the myctophids are poorly represented both in number of species and individuals ("La Bocaina 11-97": tow 16, "ECOS 04-99": tow 4 and 7) or show a high diversity and even distribution ("ECOS 04-99": tow 14).

Table 6. K-Dominance of the three most abundant species of all trawl stations which succeeded in the capture of mesopelagic species or myctophids, respectively. Bold tow numbers indicate the mesopelagic and grey ones the neritic zone.

Cruise	Tow	K-Dominance in cumulative percentage			
		All mesopelagic species		Myctophidae	
La Bocaina 04-97	**1**	29.67	*Cyclothone braueri*	56.06	*Diaphus metopoclampus*
		56.30	*Gonostoma elongatum*	78.79	*Diaphus rafinesquii*
		67.61	*Stomias boa*	86.36	*Lampanyctus alatus*
	2	31.93	*Ceratoscopelus warmingii*	44.71	*Ceratoscopelus warmingii*
		46.22	*Lepidophanes gaussi*	64.71	*Lepidophanes gaussi*
		55.46	*Hygophum hygomii*	77.65	*Hygophum hygomii*
	7	29.73	*Argyropelecus hemigymnus*	25.00	*Ceratoscopelus warmingii*
		37.84	*Gonostoma elongatum*	50.00	*Diaphus rafinesquii*
		45.95	*Bathophilus vaillanti*	75.00	*Lampanyctus alatus*
	8	60.00	*Ceratoscopelus maderensis*	60.00	*Ceratoscopelus maderensis*
		100	*Notoscopelus resplendens*	100	*Notoscopelus resplendens*
	11	31.61	*Photostomias guernei*	22.22	*Lampanyctus ater*
		54.40	*Cyclothone braueri*	33.33	*Diaphus adenomus*
		70.47	*Cyclothone pseudopallida*	44.44	*Diaphus rafinesquii*
	12	100	*Serrivomer beani*		
	13	38.78	*Lampanyctus alatus*	52.78	*Lampanyctus alatus*
		50.00	*Lobianchia dofleini*	68.06	*Lobianchia dofleini*
		57.14	*Ceratoscopelus maderensis*	77.78	*Ceratoscopelus maderensis*
	14	70.63	*Cyclothone braueri*	19.05	*Lampanyctus alatus*
		75.31	*Photostomias guernei*	38.10	*Lampanyctus pusillus*
		79.06	*Argyropelecus hemigymnus*	52.38	*Lampadena uroph. atlant.*
La Bocaina 11-97	1	22.80	*Lobianchia dofleini*	38.94	*Lobianchia dofleini*
		34.20	*Eustomias obscurus*	54.87	*Hygophum hygomii*
		43.52	*Hygophum hygomii*	70.80	*Notoscopelus resplendens*
	2	23.90	*Idiacanthus fasciola*	63.01	*Lobianchia gemellarii*
		42.23	*Lobianchia gemellarii*	71.23	*Diaphus rafinesquii*
		53.39	*Photostomias guernei*	78.08	*Hygophum hygomii*
	3	47.83	*Hygophum hygomii*	50.00	*Hygophum hygomii*
		73.91	*Hygophum benoiti*	77.27	*Hygophum benoiti*
		91.30	*Diaphus dumerilii*	95.46	*Diaphus dumerilii*
	6	79.99	*Vinciguerria nimbaria*	76.92	*Lobianchia dofleini*
		88.24	*Lestidiops jayakari*	92.31	*Diaphus dumerilii*
		96.64	*Lobianchia dofleini*	100	*Hygophum hygomii*
	9	58.20	*Cyclothone braueri*	55.33	*Lobianchia dofleini*
		77.84	*Lobianchia dofleini*	73.83	*Ceratoscopelus warmingii*
		84.41	*Ceratoscopelus warmingii*	81.31	*Hygophum hygomii*
	11	61.57	*Hygophum benoiti*	61.57	*Hygophum benoiti*
		83.23	*Hygophum hygomii*	83.23	*Hygophum hygomii*

La Bocaina 11-97	11	95.54	*Ceratoscopelus maderensis*	95.54	*Ceratoscopelus maderensis*
	12	50.00	*Hygophum hygomii*	50.00	*Hygophum hygomii*
		75.00	*Ceratoscopelus maderensis*	75.00	*Ceratoscopelus maderensis*
		91.67	*Notoscopelus resplendens*	91.67	*Notoscopelus resplendens*
	13	56.49	*Vinciguerria nimbaria*	70.67	*Lobianchia dofleini*
		81.01	*Lobianchia dofleini*	80.59	*Hygophum hygomii*
		86.34	*Diplospinus multistriatus*	86.31	*Diaphus mollis*
	14	46.16	*Cyclothone braueri*	34.91	*Lobianchia dofleini*
		54.90	*Lobianchia dofleini*	52.36	*Ceratoscopelus warmingii*
		60.69	*Serrivomer beani*	60.85	*Hygophum hygomii*
	15	100	*Hygophum hygomii*	100	*Hygophum hygomii*
	16	85.00	*Diaphus adenomus*	85.00	*Diaphus adenomus*
		100	*Diaphus dumerilii*	100	*Diaphus dumerilii*
	17	69.36	*Hygophum hygomii*	78.18	*Hygophum hygomii*
		80.65	*Vinciguerria nimbaria*	83.64	*Diaphus perspicillatus*
		85.48	*Diaphus perspicillatus*	89.09	*Myctophum nitidulum*
	18	42.13	*Diaphus adenomus*	50.00	*Diaphus adenomus*
		60.81	*Hygophum hygomii*	72.17	*Hygophum hygomii*
		75.46	*Vinciguerria nimbaria*	83.04	*Diaphus dumerilii*
ECOS 04-99	4	50.00	*Ceratoscopelus maderensis*	100	*Ceratoscopelus maderensis*
		87.50	*Stomias boa*		
		100	*Diplophos maderensis*		
	5	29.05	*Cyclothone braueri*	51.08	*Hygophum hygomii*
		45.99	*Chauliodus danae*	59.68	*Lampanyctus pusillus*
		60.36	*Hygophum hygomii*	67.20	*Diaphus rafinesquii*
	6	49.97	*Hygophum hygomii*	53.09	*Hygophum hygomii*
		57.57	*Lobianchia dofleini*	61.17	*Lobianchia dofleini*
		65.11	*Ceratoscopelus warmingii*	69.19	*Ceratoscopelus warmingii*
	7	63.33	*Vinciguerria nimbaria*	30.00	*Ceratoscopelus maderensis*
		73.33	*Ceratoscopelus maderensis*	60.00	*Diaphus dumerilii*
		83.33	*Diaphus dumerilii*	90.00	*Lobianchia dofleini*
	8	50.31	*Hygophum hygomii*	56.74	*Hygophum hygomii*
		63.09	*Diogenichthys atlanticus*	71.16	*Diogenichthys atlanticus*
		72.78	*Vinciguerria nimbaria*	77.44	*Lepidophanes gaussi*
	10	24.67	*Bolinichthys indicus*	48.22	*Bolinichthys indicus*
		46.66	*Cyclothone braueri*	59.38	*Hygophum hygomii*
		52.37	*Hygophum hygomii*	66.98	*Lampanyctus pusillus*
	12	28.39	*Lobianchia dofleini*	48.38	*Lobianchia dofleini*
		47.67	*Vinciguerria nimbaria*	67.51	*Diogenichthys atlanticus*
		63.35	*Stomias boa*	76.17	*Hygophum hygomii*
	13	66.67	*Diplospinus multistriatus*		
		75.00	*Stomias boa*		
		83.33	*Lestidiops sphyrenoides*		
	14	11.81	*Cyclothone braueri*	14.99	*Lampanyctus ater*
		23.62	*Idiacanthus fasciola*	29.40	*Hygophum taaningi*
		33.48	*Cyclothone pseudopallida*	39.48	*Lampanyctus alatus*
	16	53.85	*Diaphus dumerilii*	58.33	*Diaphus dumerilii*
		65.39	*Hygophum hygomii*	70.83	*Hygophum hygomii*
		76.92	*Myctophum punctatum*	83.33	*Myctophum punctatum*
	19	34.07	*Hygophum hygomii*	62.11	*Hygophum hygomii*
		56.73	*Cyclothone braueri*	81.68	*Bolinichthys indicus*
		67.46	*Bolinichthys indicus*	85.09	*Lampanyctus pusillus*
	21	19.75	*Hygophum hygomii*	34.78	*Hygophum hygomii*
		38.27	*Lobianchia dofleini*	67.39	*Lobianchia dofleini*
		46.91	*Chauliodus sloani*	78.26	*Lobianchia gemellarii*
	22	100	*Macroramphosus scolopax*		

3. 4. Vertical Migration

In figure 14, an echogram, taken between 03.52 a.m. and 10.40 a.m., illustrates two scattering layers: one between the surface and 200 m, and a denser one between 400 and 700 m depth. Clearly the downward movement of the shallow layer shortly after sunrise and the coalescence with the deep scattering layer can be seen. A contrary upward movement can be observed during dusk. Tow 13 and 14 from cruise "La Bocaina 04-97" were taken during this acoustic survey.

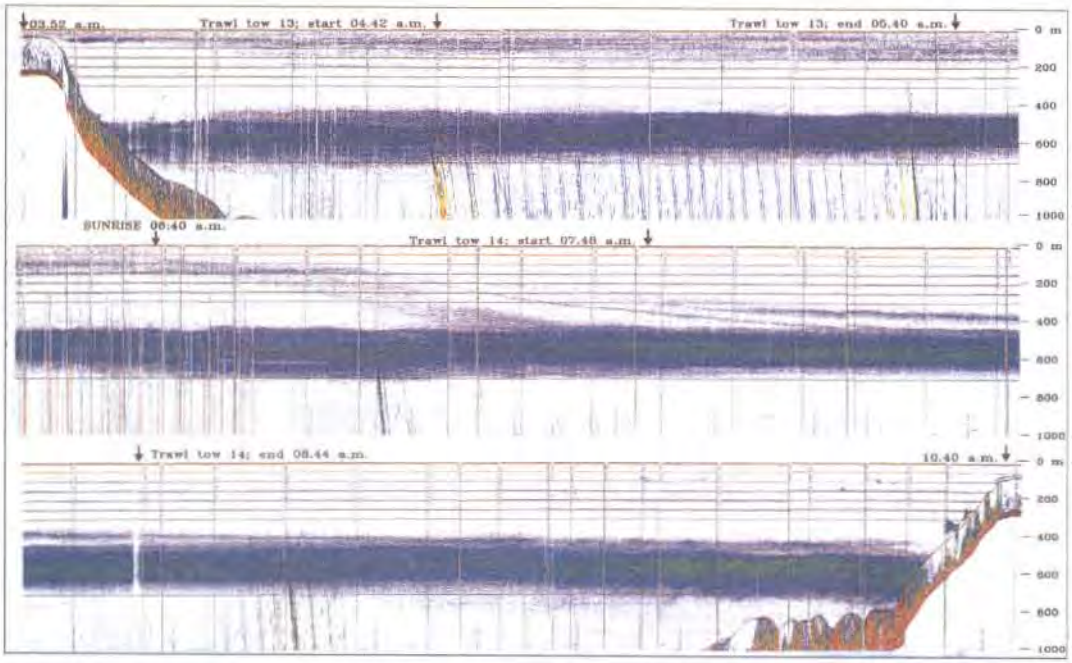
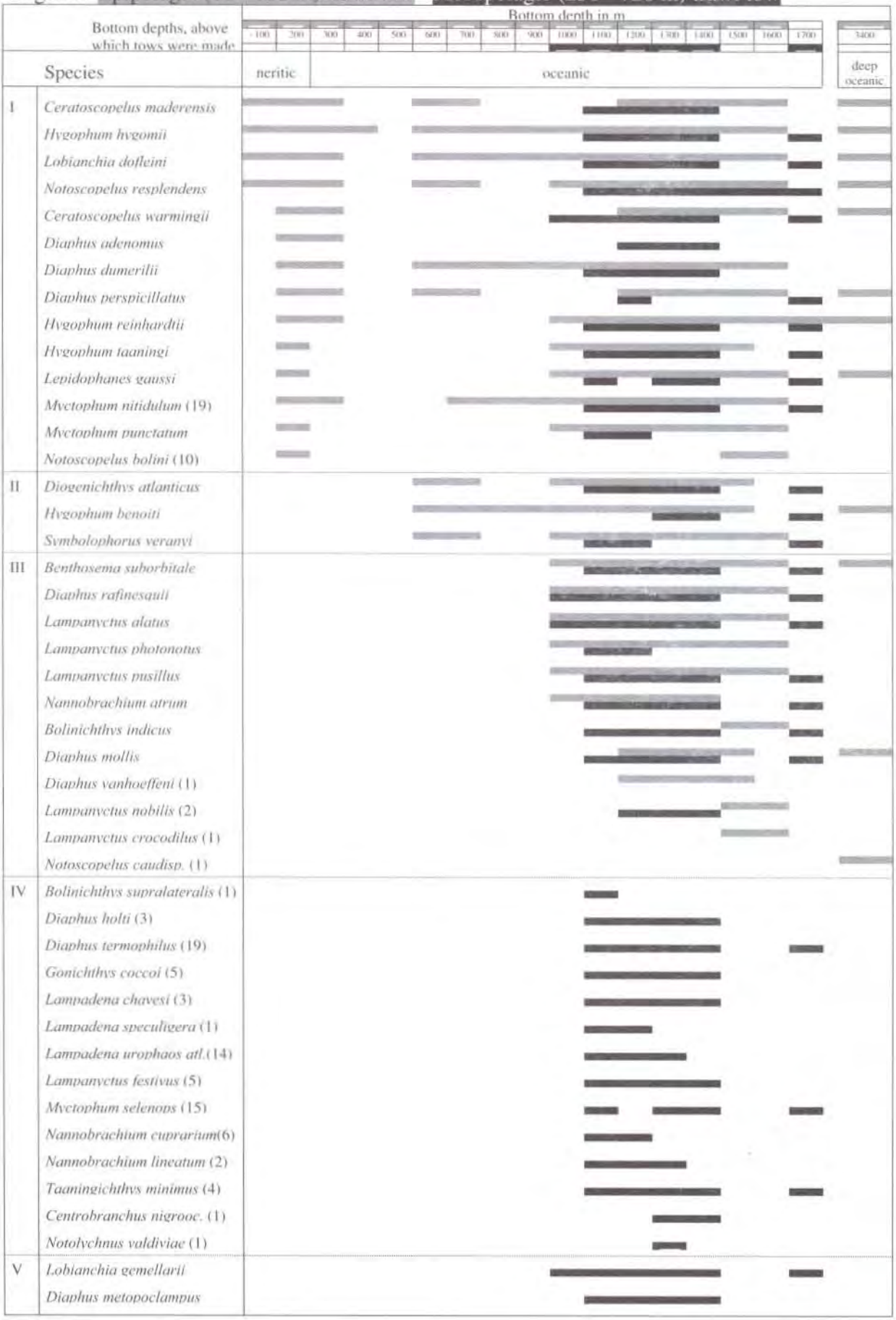


Figure 14. Echogram taken during the morning, off SW Fuerteventura (April 12th, 1997).

Tables 3, 4 and 5 already provide a simple overview of the migratory behaviour. Summarised for all three cruises, Table 7 shows the bottom depths of all collection sites where lanternfishes were encountered, illustrating also their migration behaviour. Different ecological groups can be distinguished: (I) species which occur in neritic waters during night, (II) those, which show a horizontal migration towards the coast, but do not occur in neritic waters, (III) myctophids, which migrate vertically without being transported or actively migrating towards the shelf. The non-migrators, due to the very low abundance in some cases were split up in (IV) potential migrators and (V) real non-migrators which remain completely in mesopelagic depths during night. The number of individuals undergoes a severe reduction when moving towards the coast (Tables 3, 4 and 5).

Table 7. Depth distribution of the myctophid species found, in relation to the bottom depth. Rare species (abundance < 20) are indicated by the number of individuals in parentheses. (I = neritic-pseudoceanic-oceanic species, II = pseudoceanic-oceanic species, III = oceanic migrators, IV = oceanic potential migrators, V = oceanic non-migrators).

Legend: Epipelagic (10 - 150 m) trawl tow Mesopelagic (250 - 720 m) trawl tow



Other mesopelagic species encountered in neritic waters during night are: *Diplophos maderensis* (Gonostomatidae), *Maurolicus muelleri* (Sternoptychidae), *Stomias boa* (Stomiidae), *Lestidiops sphyrenoides* (Paralepididae), juvenile *Macroramphosus scolopax* (Centriscidae), *Diplospinus multistriatus* (Gempylidae) and *Cubiceps gracilis* (Nomeidae). However, all have been caught in very low numbers and *D. maderensis* and *L. sphyrenoides* are only represented by a single specimen. If *Serrivomer beani* (Serrivomeridae), *Vinciguerria nimbaria* (Phosichthyidae), and *Lestidiops affinis* (Paralepididae) were caught above or only close to the shelf is difficult to identify, as the tows in which they were found, were carried out above varying bottom depths (116 -260 m).

There are further species executing vertical migrations, of course. But, as obvious in Tables 3, 4 and 5 are their migrations restricted to the oceanic part of the sea.

3. 5. Diversity Analysis

An analysis of the catches by means of the intrinsic diversity indices, Shannon H', Shannon J' and K-Dominance (see above) gives information about richness, evenness and dominance within the tows. For all mesopelagic species together and for the myctophids Shannon H' and J' (Evenness) are provided in Table 8. H' is highest in mesopelagic and epipelagic tows, which were carried out in oceanic waters and in particular in the following tows: "La Bocaina 11-97", tow 1; "ECOS 04-99", tow 6, 8 and 12; "La Bocaina 04-97", tow 2 and 13. Within the lanternfishes the same trend occurs. Tows 14 of "La Bocaina 11-97" and "ECOS 04-99", respectively, carried out in the same area south of Gran Canaria show the highest diversity. Shannon H' is highest in mesopelagic tows followed by epipelagic tows which were taken in the oceanic zone. Species diversity in tows carried out in the neritic zone is generally low.

Shannon J', the measure for the evenness, should always be regarded together with Shannon H'. For instance, a tow with few species, each with only some specimens, leads to a high J', but a low H' (see tow 4 of "ECOS 04-99" or, concerning the lanternfishes, tow 7). A perfectly even distribution is given for the myctophids in tow 7 of cruise "La Bocaina 11-97": each of the four occurring species is represented by a single individual only. This abnormal distribution is clearly the result of the trawling method and represents pure chance, not the real situation. A low J' indicates the dominance of one or more species, the lowest values found in tows 6, 9, 11, 13 (all "La Bocaina 11-97") and, concerning the myctophids, tows 11, 13, 17 ("La Bocaina 11-97") and tow 19 ("ECOS 04-99").

Within the family Myctophidae the differences of Shannon H' are significant (t-test) between mesopelagic – epipelagic ($p < 0.01$), as well as between neritic – mesopelagic ($p < 0.01$) tows. Concerning all mesopelagic species significance is given between mesopelagic – epipelagic ($p < 0.001$), neritic – mesopelagic ($p < 0.001$), neritic – oceanic ($p < 0.01$) and oceanic-epipelagic – oceanic-mesopelagic ($p < 0.01$)

tows. No significant differences are obvious between neritic-epipelagic – oceanic-epipelagic trawl tows.

Table 8. The diversity indices Shannon H' (Log Base 2.781) and Shannon J' (Evenness) for all stations of cruise "La Bocaina 11-97" and "ECOS 04-99" which resulted in the capture of mesopelagic fishes. The list is ordered in ascending values of the indices. Tows in the neritic zone are printed grey, epipelagic trawls in the oceanic realm normal, and mesopelagic trawl tows in bold letters. Missing values indicate that only a single mesopelagic species occurred in this tow.

La Bocaina 04-97							
All mesopelagic species				Myctophidae			
Tow	Shannon **H'**	Tow	Shannon **J'**	Tow	Shannon **H'**	Tow	Shannon **J'**
Tow 8	0.673	**Tow 14**	**0.437**	Tow 8	0.673	**Tow 1**	**0.587**
Tow 14	**1.458**	**Tow 1**	**0.589**	**Tow 7**	**1.386**	Tow 2	0.685
Tow 11	**2.143**	**Tow 11**	**0.650**	**Tow 1**	**1.407**	Tow 13	0.701
Tow 1	**2.158**	Tow 13	0.765	Tow 13	1.541	**Tow 14**	**0.954**
Tow 13	2.290	Tow 2	0.771	Tow 2	1.702	Tow 8	0.971
Tow 2	2.349	**Tow 7**	**0.876**	**Tow 11**	**2.043**	**Tow 11**	**0.983**
Tow 7	**2.533**	Tow 8	0.971	**Tow 14**	**2.095**	**Tow 7**	**1**
La Bocaina 11-97 and ECOS 04-99							
All mesopelagic species				Myctophidae			
Cruise and Tow	Shannon **H'**	Cruise and Tow	Shannon **J'**	Cruise and Tow	Shannon **H'**	Cruise and Tow	Shannon **J'**
11-97: T. 15	-	11-97: T. 15	-				
04-99: T. 22	-	04-99: T. 22	-				
11-97: T. 16	0.423	**11-97: T. 9**	**0.410**	04-99: T. 4	-	04-99: T. 4	-
11-97: T. 6	0.764	11-97: T. 6	0.426	04-99: T. 13	-	04-99: T. 13	-
04-99: T. 4	0.974	11-97: T. 13	0.467	11-97: T. 16	0.423	11-97: T. 13	0.458
11-97: T. 11	1.093	11-97: T. 11	0.497	11-97: T. 6	0.687	**04-99: T. 19**	**0.461**
04-99: T. 13	1.099	04-99: T. 6	0.560	11-97: T. 17	0.862	11-97: T. 17	0.481
11-97: T. 17	1.117	11-97: T. 17	0.574	11-97: T. 11	1.093	11-97: T. 11	0.497
11-97: T. 12	1.199	04-99: T. 8	0.587	11-97: T. 3	1.151	**11-97: T. 9**	**0.556**
04-99: T. 7	1.207	**11-97: T. 14**	**0.595**	11-97: T. 13	1.176	04-99: T. 6	0.563
11-97: T. 3	1.280	11-97: T. 16	0.610	11-97: T. 12	1.199	04-99: T. 8	0.572
11-97: T. 13	1.398	**04-99: T. 19**	**0.616**	04-99: T. 7	1.314	**11-97: T. 2**	**0.583**
04-99: T. 16	1.530	04-99: T. 12	0.650	04-99: T. 16	1.364	11-97: T. 16	0.610
11-97: T. 9	**1.605**	**04-99: T. 5**	**0.669**	**04-99: T. 19**	**1.404**	11-97: T. 6	0.625
11-97: T. 18	1.713	04-99: T. 7	0.674	**11-97: T. 2**	**1.449**	04-99: T. 12	0.628
04-99: T. 8	1.867	04-99: T. 13	0.683	11-97: T. 18	1.461	**04-99: T. 5**	**0.649**
04-99: T. 6	1.990	11-97: T. 18	0.689	**11-97: T. 9**	**1.576**	**04-99: T. 10**	**0.649**
04-99: T. 12	2.254	**04-99: T. 10**	**0.712**	04-99: T. 8	1.621	11-97: T. 18	0.665
04-99: T. 19	**2.345**	04-99: T. 16	0.736	**04-99: T. 21**	**1.663**	04-99: T. 16	0.701
11-97: T. 14	**2.350**	**11-97: T. 2**	**0.742**	11-97: T. 1	1.675	**11-97: T. 14**	**0.744**
11-97: T. 1	2.542	**04-99: T. 14**	**0.774**	04-99: T. 12	1.700	**04-99: T. 21**	**0.757**
04-99: T. 5	**2.545**	11-97: T. 3	0.795	04-99: T. 6	1.802	**04-99: T. 14**	**0.801**
11-97: T. 2	**2.618**	11-97: T. 1	0.835	**04-99: T. 5**	**1.876**	11-97: T. 1	0.806
04-99: T. 21	**2.703**	**04-99: T. 21**	**0.840**	**04-99: T. 10**	**1.911**	11-97: T. 3	0.831
04-99: T. 10	**2.772**	11-97: T. 12	0.865	**11-97: T. 14**	**2.334**	11-97: T. 12	0.865
04-99: T. 14	**3.101**	04-99: T. 4	0.887	**04-99: T. 14**	**2.698**	04-99: T. 7	0.948

3. 6. Cluster Analysis

Figure 15 shows the similarity of single trawl hauls concerning the composition of the species community of mesopelagic species. All trawl stations from cruise "La Bocaina 11-97" and "ECOS 04-99", which resulted in the capture of mesopelagic fishes are included. Two main clusters can be distinguished.

The same analysis, but based only on the myctophids is shown in Figure 16. In this dendrogram tows with less than 20 individuals and species with less than 5 representatives have been excluded. This should avoid too much influence of these outliers on the results and lead to a clearer clustering.

Figure 17 includes all tows which resulted in the capture of more than 5 mesopelagic species. Unlike the Bray-Curtis method this Jaccard Cluster does not take the number of individuals into account, but only the presence/absence data of species. It provides a method to show similarity in species composition without considering dominance phenomena.

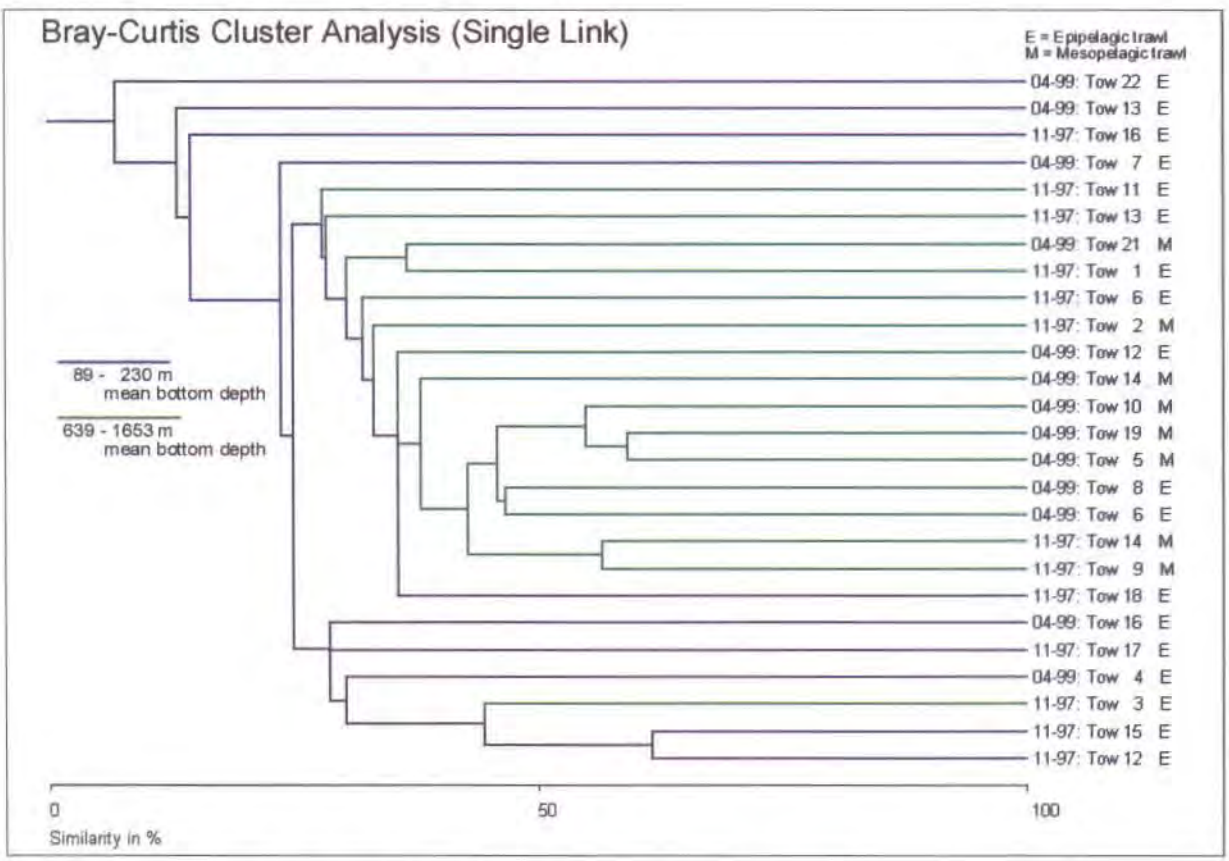


Figure 15. Cluster analysis, based on all mesopelagic species.

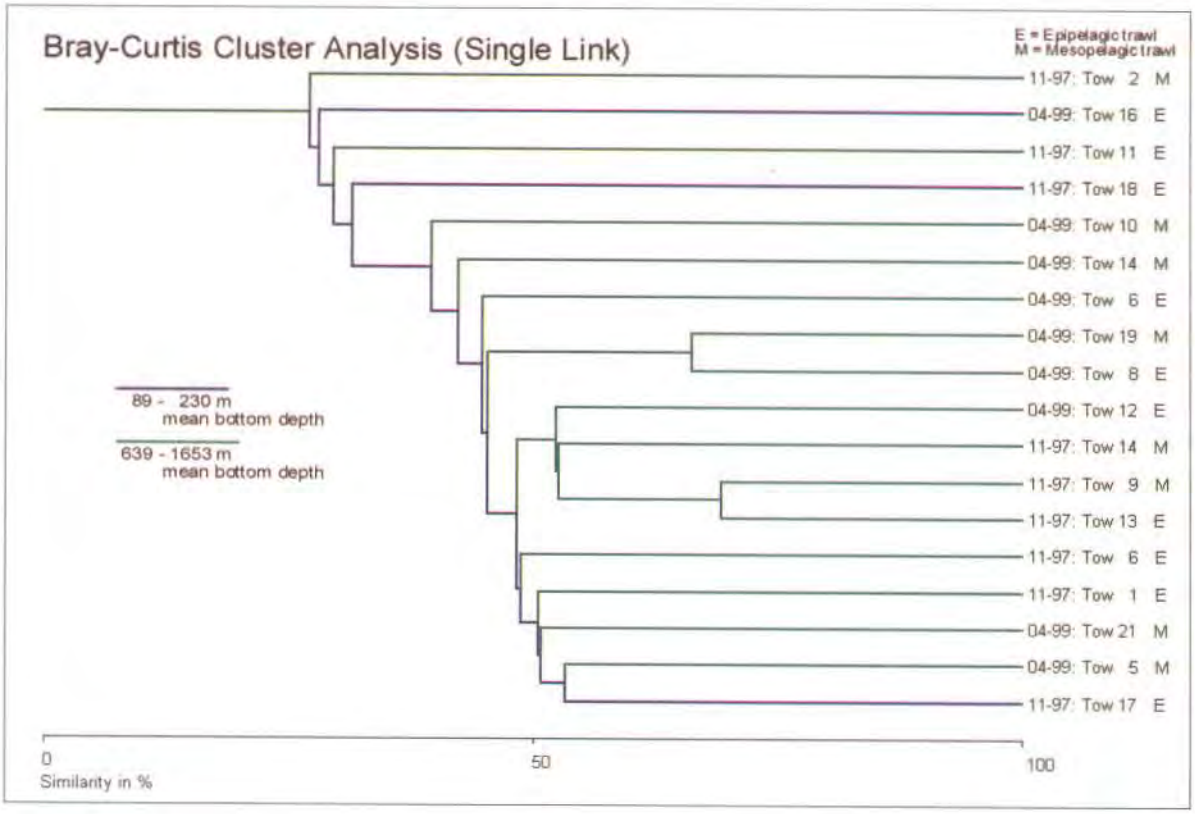


Figure 16. Cluster Analysis for Myctophidae, based on tows resulting in the capture of more than 20 specimens of the abundant (> 5 individuals) species.

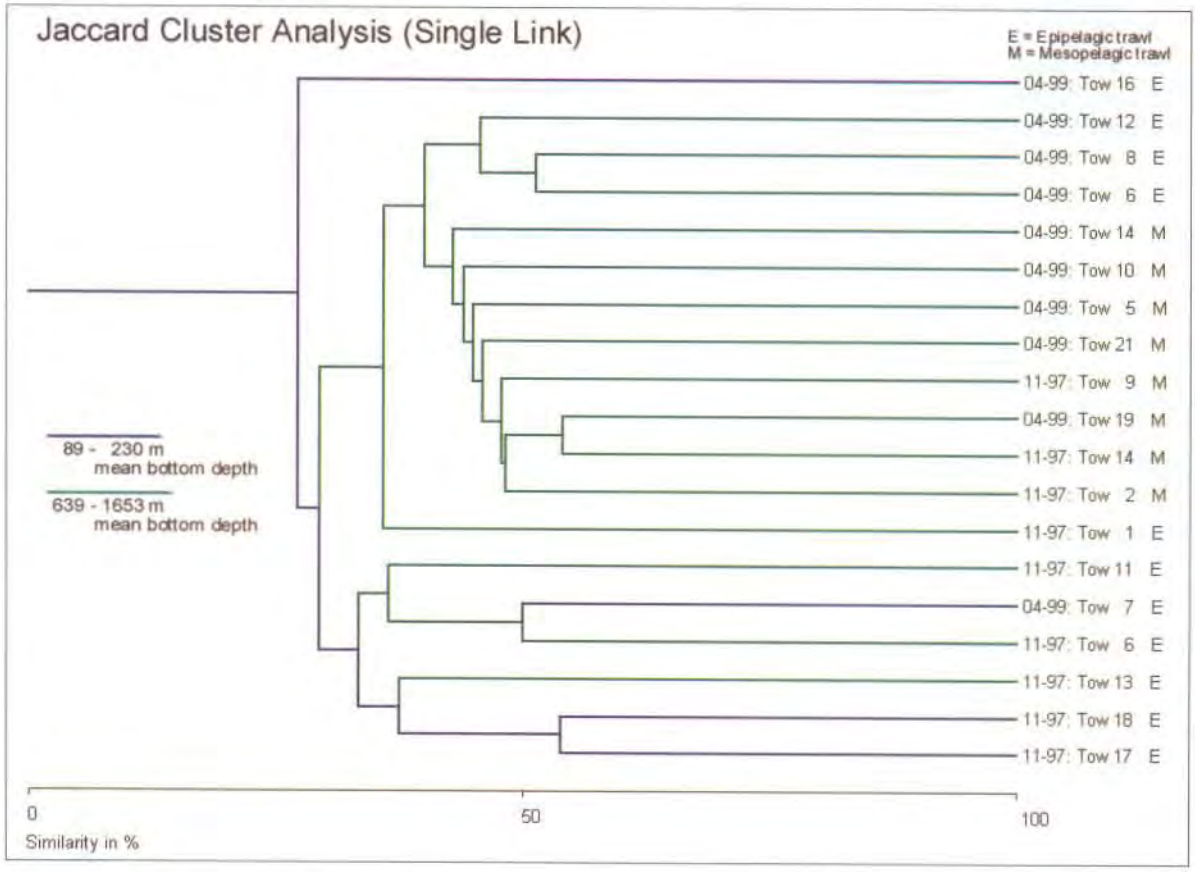


Figure 17. Cluster Analysis for all tows with more than 5 mesopelagic species, only presence/absence data provide the basis.

3. 7. Population Structure

3. 7. 1. *Ceratoscopelus maderensis*

This species is one of the more rare lanternfishes, but nevertheless interesting because it migrates closer towards the coast than most of the other lanternfishes (BACKUS et al., 1968). In the present material this was also the case (trawl stations 4 and 7 of cruise "ECOS 04-99"). In addition, a larger portion of individuals seem to migrate, as there is a smaller difference in the amount of individuals between neritic and oceanic tows or epi- and mesopelagic tows, respectively. The standard lengths are quite different between the two cruises (Fig. 18), and as opposed to *H. hygomii* the individuals of *C. maderensis* are larger in April than in November. The 11 specimens from cruise "La Bocaina 04-97" have a standard length range of 52 - 58 mm. *Ceratoscopelus maderensis* shows no external sexual differences. Figure 19 illustrates the biogeographic distribution of this species within the Canary Islands.

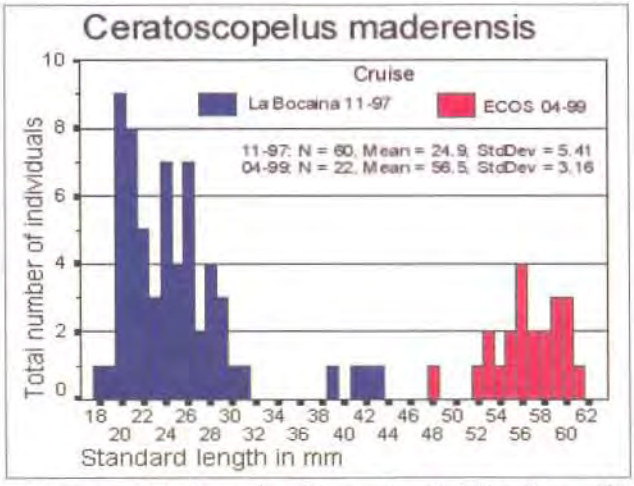


Figure 18. Standard length distribution of *Ceratoscopelus maderensis.*

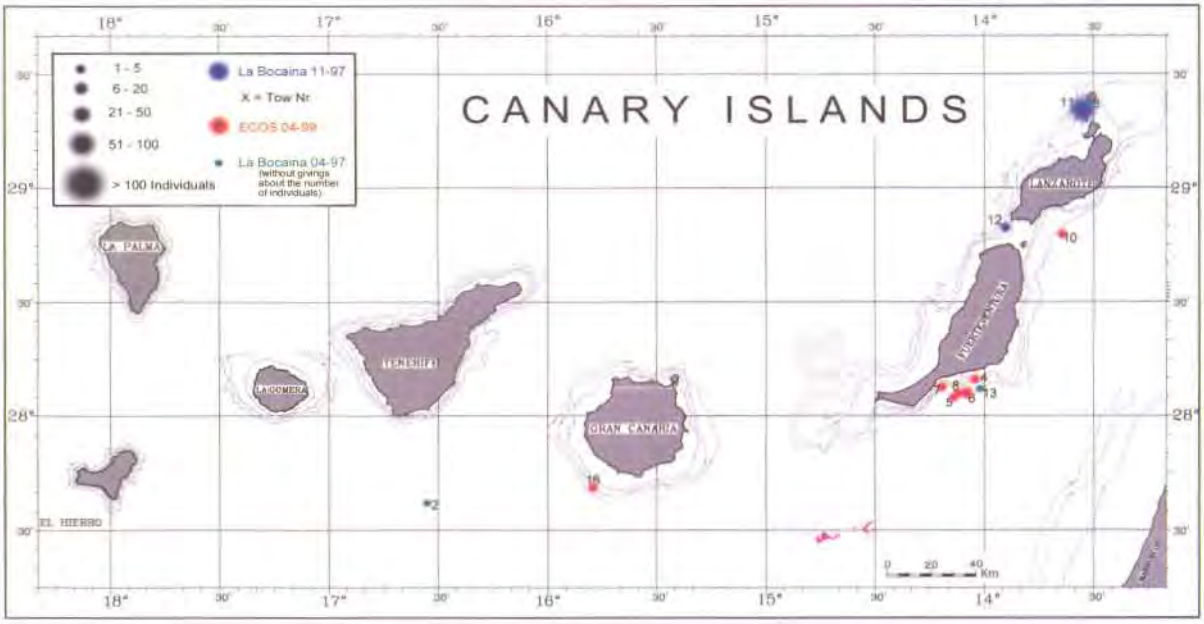


Figure 19. Biogeographic analysis of *C. maderensis* within the Canarian archipelago.

3. 7. 2. *Hygophum hygomii*

Hygophum hygomii is the most abundant lanternfish and an intense vertical and horizontal migrator (see the foregoing chapters). In all tows with capture of mycto-phids only two tows ("La Bocaina 11-97", tow 16 and "ECOS 04-99", tow 4) did not result in the collection of *H. hygomii*. The length and sex distribution of this species is shown in Figure 20. A clear difference in the standard length between the November and the April cruise occurs. It can be excluded that these differences derive from spa-tial variation of sampling or that they are an expression of a size-depth-stratification (Fig. 21). The range in standard length of the 13 individuals caught in the first cruise "La Bocaina 04-97" is 29 - 63 mm. The micro-biogeographic distribution of *Hygo-phum hygomii* in the Canarian archipelago is shown Figure 22.

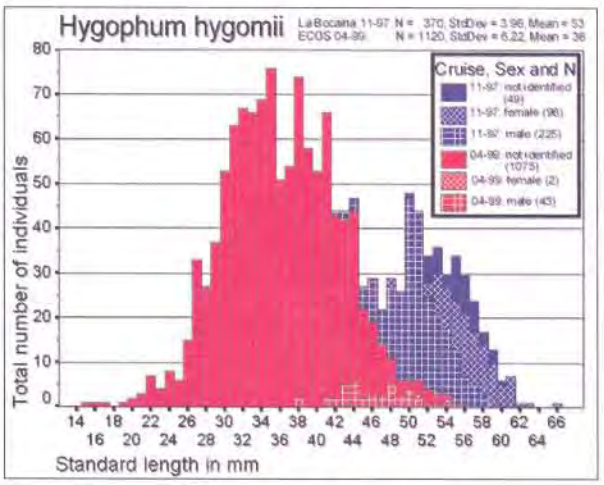


Figure 20. SL and sex distribution of *H. hygomii*.

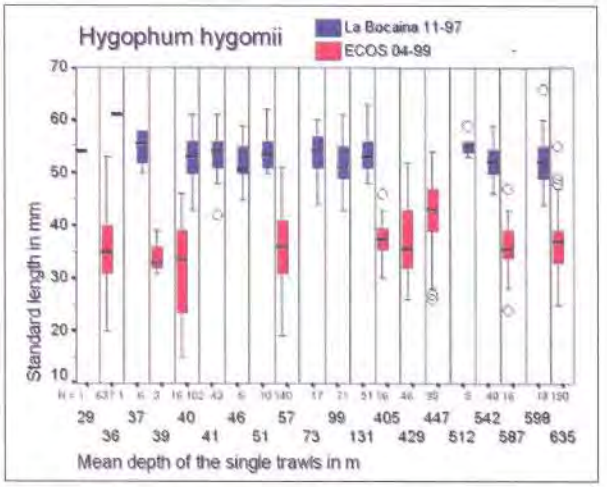


Figure 21. Boxplot of SL of *H. hygomii*, depending on trawling depth and cruise.

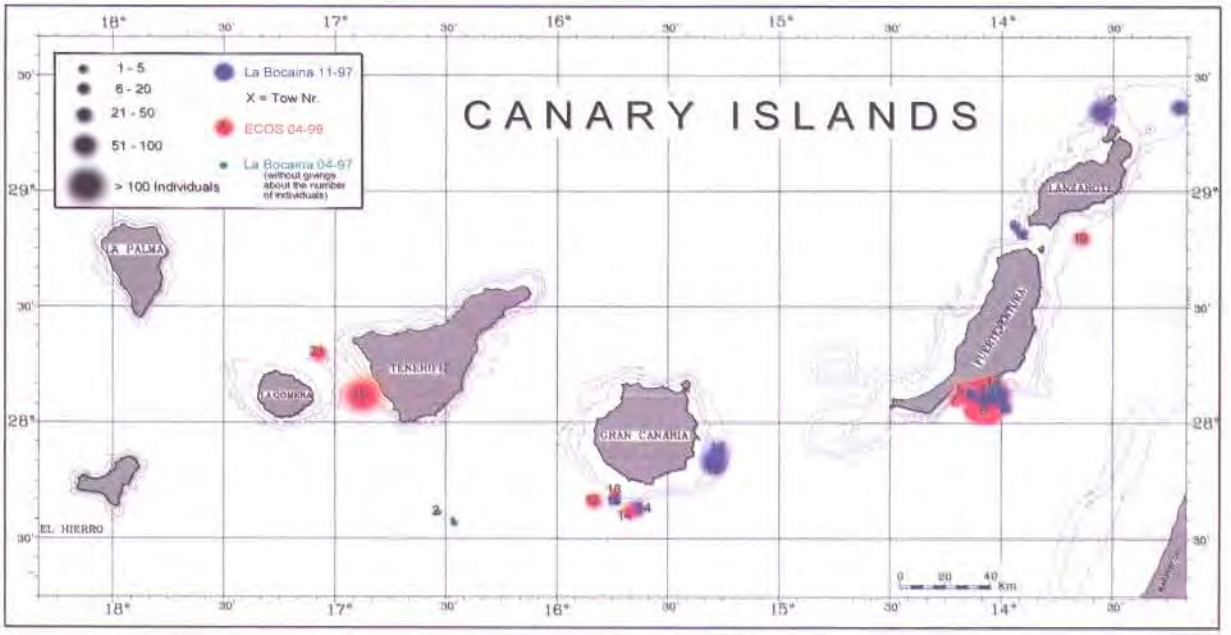


Figure 22. Biogeographic analysis of *H. hygomii* within the Canarian archipelago.

3. 7. 3. *Lobianchia dofleini*

This also very abundant species shows only little difference in the size distribution between the spring and autumn cruise (Fig. 23), with a little smaller individuals in April. The boxplot (Fig. 24) indicates the standard length and its independence from mean trawling depth and cruise. The 13 individuals of cruise "La Bocaina 04-97" have a standard length range of 22 - 58 mm. Figure 25 shows the biogeographic distribution of *L. dofleini* within the Canarian archipelago.

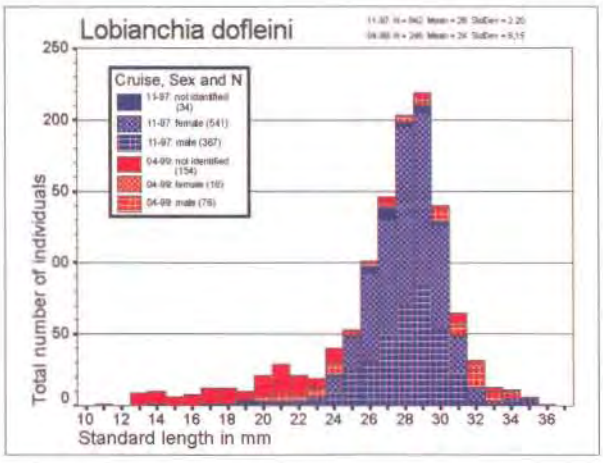


Figure 23. SL and sex distribution of *L. dofleini.*

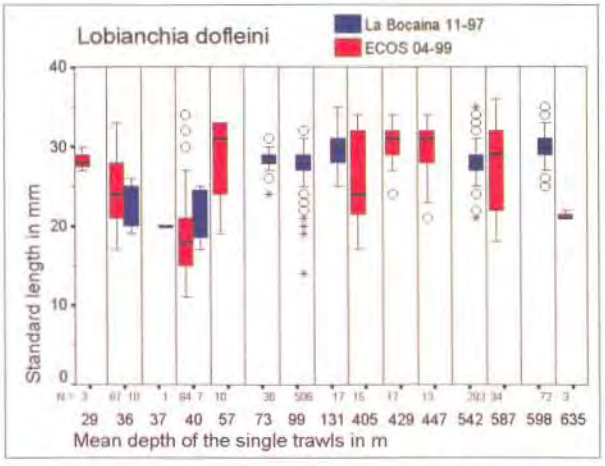


Figure 24. Boxplot of SL of *L. dofleini,* depending on trawling depth and cruise.

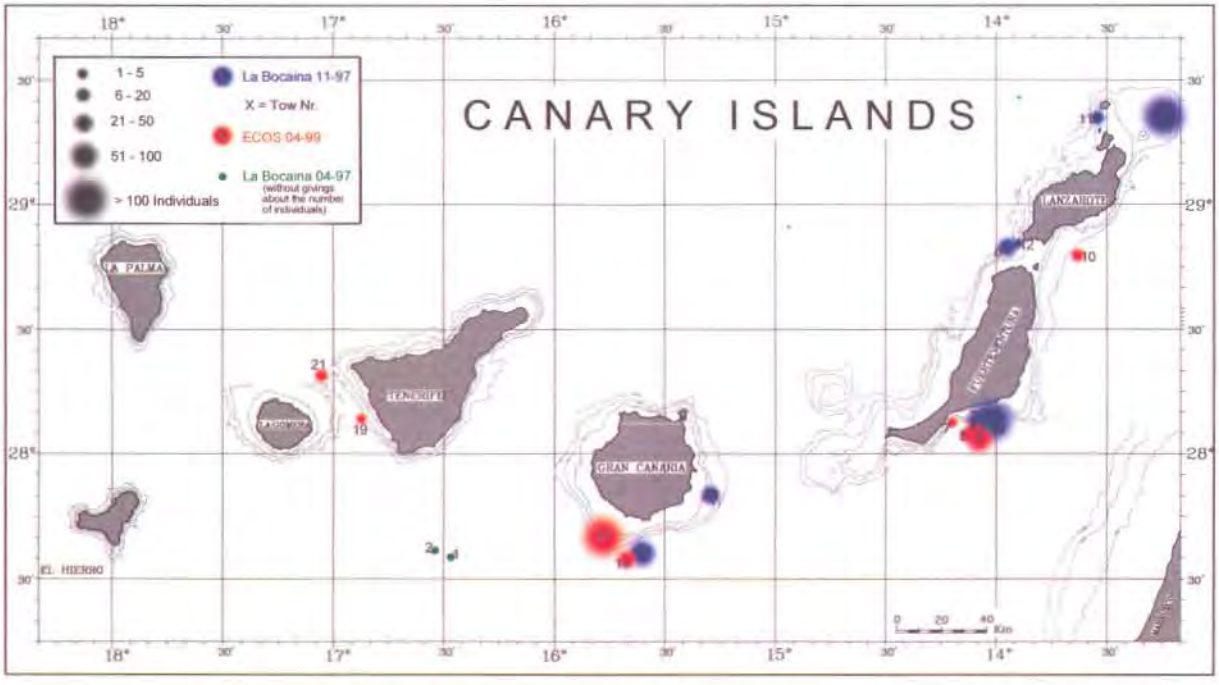


Figure 25. Biogeographic analysis of *L. dofleini* within the Canarian archipelago.

4. Discussion

4. 1. Trawling and Sampling Method

The smaller mesh size of the cod-end in the cruises "La Bocaina 11-97" and "ECOS 04-99" led to a greater fishing success concerning the mesopelagic species. There is a remarkable difference in number of individuals and species between the first cruise "La Bocaina 04-97" and the latter two. In "La Bocaina 04-97", specimens with a standard length below 20 mm are an exception and species with a small maximum size like *Vinciguerria* sp., *Diogenichthys atlanticus, Lobianchia dofleini* are rare or missing, although they turn out to be abundant in the latter cruises. The low number of individuals in this first cruise indicates that the specimens have been rinsed out of the net or even got not caught at all. HOPKINS AND BAIRD (1985) point out that juvenile stages of many species may escape through the meshes and larger individuals possibly avoid the trawl, why populations are probably often underestimated. Members of the genus *Cyclothone* are, despite of their small size, frequent as their flaccid body gets very easy clung in the meshes of the net.

Conservation of the specimens with Formol, and confinement in the storage containers leads to bent and stiff individuals. This makes the handling, especially length measurements more difficult. As the material of cruise "La Bocaina 04-97" did not came in contact with Formol, remained the specimens soft and flexible. Influence of the preservation on the standard length are at least for small specimens negligible, as shown by KRISTOFFERSEN AND SALVANES (1998).

The trawling depths and duration of the tows in cruise "ECOS 04-99" show a much higher range than those of the previous cruises. This makes comparisons harder and provision of exact details about the depth occurrence of species impossible. Many mesopelagic species show a size-depth stratification (e. g. CLARKE, 1972, 1974; HULLEY, 1984a, 1990) but with such a high range in trawling depth are statements about the correctness in Canarian waters impossible. "ECOS 04-99" contains also the highest number of individuals which were impossible to identify, especially many myctophids.

The difficulties deriving by a net without opening-closing device or estimating the volume of water filtered by the net have already been pointed out. Changes in the net speed can affect the catch composition (ANGEL, 1977). But not only the pure fishing method influences the catch. BADCOCK AND MERRETT (1977) state that currents modify the net speed through the water and bias therefore the volume of water filtered, by an unknown amount. Furthermore is the behaviour of the individuals not stiff but variable, as ROE (1974) has shown, that at a given depth, species composition and abundance change continuously over the 24 hour period. BARHAM (1970) examined the effects on the orientation of fishes. He noticed that horizontally and vertically orientated fishes react in different ways to horizontally towed nets. CLARKE (1972, 1974) discussed avoidance and escape behaviour of species with respect to the trawl

type used, as well as the effects of the phases of the moon. Also BADCOCK AND MERRETT (1977) concluded that different methods may result in different species and if quantitative estimates should be made, the value of the use of different techniques is indisputable.

4. 2. New Records

The following five species can be regarded as new records for the Canaries: *Eustomias bigelowi*, *Aristostomias grimaldii* (Stomiidae), *Stemonosudis intermedia* (Paralepididae), *Diaphus vanhoeffeni*, and *Lampanyctus nobilis* (Myctophidae). Three of this five new species are only represented by a single individual, *L. nobilis* by two and *S. intermedia* by three.

For *Eustomias bigelowi*, *Stemonosudis intermedia*, *Diaphus vanhoeffeni* and *Lampanyctus nobilis* are the Canaries the northernmost citations in the Eastern Central Atlantic. The recorded distribution area of these four species was until now 10° or more south of the Canarian archipelago. *Eustomias bigelowi* is further known from the Canarian latitude in the Western Atlantic, and also for *Aristostomias grimaldii* are therefore the Canaries the easternmost citation in the northern Atlantic.

BRITO et al. (2002) quotes in his catalogue 56 lanternfish species for the Canary Islands of which 13 were not found in these three cruises. According to BACKUS et al. (1977) six of these 13 missing species have a tropical, two a tropical-semisubtropical, and three a tropical-subtropical distribution pattern within the North Atlantic. One species is said to be subtropical and one is missing in the analysis of BACKUS et al. (1977). *Diaphus vanhoeffeni* and *Lampanyctus nobilis* are tropical species (BACKUS et al., 1977), but like many other so-called tropical species (mainly representatives of the genus *Diaphus*) now found within the Canarian archipelago.

Compared with HULLEY (1981) the two new cited myctophids show a tropical pattern (*L. nobilis* with holotropical subpattern and *D. vanhoeffeni* with east tropical subpattern). All lanternfish species which are cited in BRITO et al. (2002) for the Canaries, but not found in this three cruises belong to the warm water group with a broadly tropical or tropical pattern, respectively. Two exceptions are the bisubtropical *Diaphus effulgens* and the bathypelagic *Taaningichthys bathyphilus*. From Hulley's cool water group are now all for the Canaries relevant species cited (boreal, mediterranean and temperate-subtropical subpattern).

All these results lead to the assumption that tropical species (warm water group) can adapt to the specific environmental conditions in Canary waters better than temperate species (cool water group) and more species immigrate from the south although facing the Canarian current. BACKUS et al. (1977) drew a line of zoogeographic separation between the two easternmost islands Lanzarote and Fuerteventura and the remaining five islands. The results from this work cannot support this division, as these tropical species are either encountered throughout the archipelago (*D. dumerilii*) or caught in too low numbers. HULLEY (1980) indicates in the Eastern Atlantic for

broadly tropical species a northern limit at 35° to 40° N. All three subpatterns (holo-eurytropical, thermophilic-eurytropical and thermophobic-eurytropical) extend southward from this limit and all species belonging to these subpatterns are found in Canarian waters.

4. 3. Abundance and Species Distribution Patterns

4. 3. 1. Eudominant Species (Abundance > 10 %, more than 1,300 individuals)

The eudominant lanternfish species *Hygophum hygomii* (bisubtropical distribution subpattern) and *Lobianchia dofleini* (widespread distribution pattern) (HULLEY, 1984a, 1990) occur in almost every oceanic tow in considerably high numbers and, especially *H. hygomii* also in neritic tows. Tows with a very high abundance of these species correspond in the main part with the areas of special hydrology. Further considerations (population data) of these species are given in chapter 4. 7. 2. and 4. 7. 3.

Cyclothone braueri is a very abundant species, occurring circumglobally (BADCOCK, 1984). As non-diel vertical migrator it was only caught in mesopelagic tows, but the number of individuals is not definite and can certainly regarded to be even higher. The high dominance of *Vinciguerria nimbaria* is caused by one tow ("La Bocaina 11-97": tow 13 with 1,166 individuals), although this species is quite frequent also in other tows. As other *Vinciguerria* species are known to have their peak spawning in spring-summer (BADCOCK, 1984) it seems reasonable to regard this large aggregation of specimens as result of the upwelling phenomenon off Gran Tarajal, which leads to a high productivity off South East Fuerteventura.

4. 3. 2. Subdominant Species (Abundance 2 - 5 %, 260 - 649 individuals)

The dominant species of Stomiidae (*Chauliodus danae*, *Idiacanthus fasciola* and *Stomias boa*) are in the literature described as being quite common. They occur mainly in mesopelagic tows, small specimens of *C. danae* and *S. boa* migrate to epipelagic depths at night, which corresponds with GIBBS (1984). The dominance of *Gonostoma elongatum* (Gonostomatidae) is only based on one single tow („La Bocaina 04-97": tow 1). The tow could have caught a spawning aggregation of *G. elongatum*, which spawns in spring-summer (BADCOCK, 1984), or, as the species is deep mesopelagic (BADCOCK, 1984) it might prefer the deeper oceanic waters, which are found just next to this station (tow 2 of "La Bocaina 04-97" was trawled above 3,400 m bottom depth). In addition, CLARKE AND WAGNER (1976) indicate that larger individuals of this species appear to remain at depth during the night. Anyhow, the unique (far offshore) trawling station of tow 1 ("La Bocaina 04-97") led generally to a high number of species and individuals.

Ceratoscopelus warmingii (Myctophidae) is not evenly found in all tows, but quite frequent in some. This could indicate that this species forms spatially restricted, clumped aggregations or shoals. HULLEY (1981, 1984a) suggests that *C. warmingii* spawns in spring and that it is not migrating in the Canaries in October-November.

The results of cruise „La Bocaina 11-97" are not confirming this. As this special behaviour in migration and also the spawning peak of this circumglobally occurring species are differing from region to region (HULLEY, 1984a), this could be traced back to a high mobility. The dominance patterns of *Bolinichthys indicus* and *Hygophum benoiti* (Myctophidae) appear in a single tow each. This supports also the assumption that the species are distributed patchily or form shoals even outside the spawning period. In addition, *H. benoiti* is in the spring cruises only represented by a single specimen each.

The small sized lanternfish *Diogenichthys atlanticus* is a widespread, circumglobally distributed species. The difficulty in assessing the extent of its distribution, deriving from its small size has already been pointed out by HULLEY (1981). The upwelling activity off Gran Tarajal could be a plausible factor for the high density observed, as HULLEY (1990) indicates less abundance of *D. atlanticus* in regions of low productivity. The productivity hypothesis could also account for the higher abundance of this species in tow 12 („ECOS 04-99"), as there are signs for the existence of an eddy in the south-west of Gran Canaria (BORDES et al., 1999). But this does not explain the absence of the species in adjacent tows.

4. 3. 3. Recedent Species (Abundance 1 - 2 %, 130 - 259 individuals)

Lepidophanes gaussi and *Notoscopelus resplendens* (Myctophidae) occur in quite a lot of tows, with no outlier in respect to the number of individuals. They seem to be evenly distributed throughout the archipelago. *L. gaussi* is associated with waters of low productivity, which is unlike many other lanternfishes (HULLEY, 1981). At least in the small-scale investigation area of the Canaries can this not be testified, as the species is also found off Gran Tarajal, and in the area of the eddy in the south-west of Gran Canaria. On the other hand there is also no increase in number of individuals like in so many other species.

Hygophum reinhardtii (Myctophidae) belongs to the species which are only frequent because in one tow a high number of individuals occurred. This trawl station was located in the possible upwelling area off Gran Tarajal, which in general resulted in a capture of a lot of individuals. *Diaphus adenomus* (Myctophidae) was only in the November cruise caught in high numbers. In tow 18 („La Bocaina 11-97") the standard lengths of the individuals show a remarkable distribution: 24 specimens have a SL-range of 59 - 94 mm (mean = 82 mm), the rest of 91 specimens a range of 20 - 48 mm (mean = 35 mm). This could indicate that two generations of the species form one aggregation (the three individuals from the April cruises are quite large: SL = 98 - 107 mm). Data about the sexual maturity are not available, but the incomplete development of the headlights in specimens smaller than about 50 mm SL, and the high maximum length of 207 mm (HULLEY, 1984a) suggest that this is not necessarily a spawning aggregation.

The non-migrating *Cyclothone pseudopallida* (Gonostomatidae) is like its relative *C. braueri* only found in mesopelagic tows, but by far not so abundant as the lat-

ter. The discussions made above for *C. braueri* may also be correct for *C. pseudopallida*. *Photostomias guernei* (Stomiidae) occurs in almost every mesopelagic tow, but is only represented by three individuals in one epipelagic tow. GIBBS (1984) indicated that some individuals of some species of the subfamily Malacosteinae (Stomiidae) migrate to shallower depths at night. The quite frequent *P. guernei*, member of this subfamily, seems to be one of these species.

Only few individuals of *Serrivomer beani* (Serrivomeridae) have been caught in epipelagic depths. As there are several in the epipelagic tow 2 („La Bocaina 11-97") it seems to be reasonable that the species is more related to deeper water. The occasional findings in neritic waters could be derived to drift, after all because these specimens have been found next to the hydrologically very active areas, Gran Tarajal and the south-west of Gran Canaria. Adults of this genus are abysso- to mesopelagic, only larvae are found at higher levels and exhibit a vertical rise during the night (BAUCHOT, 1984; SALDANHA AND KARMOVSKAYA, 1990). As they give no exact data about the maturity, but indicate a maximum length of 700 mm, seems it reasonable to regard the specimens found in epipelagic depths (170 - 280 mm standard length) as juvenile. Submersibles have observed the members of the close related family Nemichthyidae hanging vertical in the water (NIELSEN, 1986). The individuals of *S. beani* are almost exclusively found enmeshed in the net and only occasionally in the cod-end. This could indicate that the verified observations of Nemichthyidae are also applicable for Serrivomeridae. Only 2.8 % of the caught specimens of Serrivomeridae are longer than 400 mm. Larger specimens occur probably even deeper and/or farther offshore.

PARIN (1986, 1990) postulates *Diplospinus multistriatus* (Gempylidae) as oceanic, mesopelagic species, which migrates upwards at night. At least some juvenile, respectively small individuals (< 65 mm SL) are also migrating or drifting towards the coast into neritic waters (2 specimens from „La Bocaina 11-97" tow 18 and 8 specimens from „ECOS 04-99" tow 13). As the trawling stations are farther away from the assumed upwelling or eddy areas, seem passive drifts to be rather unlikely.

4. 3. 4. Subrecedent Species (abundance < 1 %, less than 130 individuals)

127 species are subrecedent, and 96 species show even an abundance of less than 0.1 %, which equals less than 13 individuals (42 species with only one specimen). Some of these subrecedent species are known to be not abundant (e. g. *B. supralateralis* or *D. perspicillatus;* NAFPAKTITIS, 1977) or occur also in other cruises, which explore the species of the mesopelagic realm in low numbers (e. g. *Taaningichthys* sp., GARTNER et al., 1987). The method of trawling can be another explanation for the number of individuals caught. The following three species lie only just below the border recedent - subrecedent: *Vinciguerria attenuata* (Phosichthyidae), *Lampanyctus alatus* and *Lampanyctus pusillus* (Myctophidae). Like most of the species which have not an extreme high or low abundance are they more or less even distributed among several trawl tows.

4. 4. Vertical and Horizontal Migration

As myctophids occurred in high numbers (individuals and species) the vertical and horizontal migration behaviour of this family can be analysed into more detail and different ecological groups can be distinguished.

Among the quite large group of neritic-pseudoceanic-oceanic migrators a horizontal movement towards the coast can be observed. The species of this group are all quite abundant, including *Hygophum hygomii* and *Lobianchia dofleini*. Together with *Ceratoscopelus maderensis* and *Notoscopelus resplendens* the former two species were encountered above a bottom depth of less than 100 m. Of course a passive drift cannot be excluded, but their occurrence in areas without special hydrological phenomena (e. g. eddies, upwellings) like in cruise "La Bocaina 11-97", tow 12, suggests an active horizontal migration of these species towards the coast.

As also the other species belonging to this group are found in comparatively high numbers in the neritic zone, an active horizontal movement cannot be totally rejected. Of course the abrupt changeover of depth around islands of volcanic origin (UIBLEIN AND BORDES, 1999) contributes to the occurrence of mesopelagic species in such shallow waters. To what extent the specimens can assess the bottom depth is still not known. It remains also unclear, if they start their downward movement with the horizontal migration before they descent into mesopelagic depths or if they orientate themselves on the seabed, which they follow into the depth. TORGERSEN AND KAARTVEDT (2001) assume that *Maurolicus muelleri* (Sternoptychidae) alternates between vertical and horizontal swimming, without swimming obliquely. This could also be a feature of lanternfish swimming behaviour. UIBLEIN AND BORDES (1999) postulated that mesopelagic specimens migrating into neritic waters, are trapped and serve as food for epipelagic species. If all these specimens are really inevitably lost or if they can find their way back to the mesopelagic realm is just as interesting as hard to answer. *In situ* observations of swimming behaviour of mesopelagic fishes indicate that they may be more active swimmers than is generally assumed (TORGERSEN AND KAARTVEDT, 2001). Anyway, sometimes species are encountered outside their recorded main distribution area (e. g. NIJSSEN, 1972) and also expatriatism phenomena (e. g. O'DAY AND NAFPAKTITIS, 1967) require extensive migrations.

The small group of pseudoceanic-oceanic migrators is not found in the neritic zone, but occurs during the night closer to the coast than during the day. *Diogenichthys atlanticus*, *Hygophum benoiti* and *Symbolophorus veranyi* are rather frequently occurring representatives of this group and hence the absence of these species in neritic waters seems evident. However, a more exact localisation of the spatial preferences of this group is difficult, as mesopelagic tows in waters with a bottom depth of less than 900 meters were not made.

The group of oceanic migrators is highly diverse. All these species avoid waters shallower than 900 meters and as most of them show an intermediate frequency of occurrence, this statement seems to be reliable. The remaining 16 species were only

found in mesopelagic tows. Only two of them, *Lobianchia gemellarii* and *Diaphus metopoclampus* are frequent enough to be regarded as non-migrators. Nevertheless, they do not remain completely in the same depth. HULLEY (1984a, 1990) indicates them as little migrating species seldom found shallower than 200 meters during night.

All the species of group IV (potential migrators) show diurnal vertical migrations, but at differing degrees. For instance, *Nannobrachium cuprarium* shows its maximum abundance during the night below 200 meters (HULLEY, 1984a), *Bolinichthys supralateralis* occurs during the night between 201 and 250 meters, whereas large specimens are non-migratory (HULLEY, 1990). HULLEY (1990) indicates for *Lampanyctus nobilis* a maximum abundance between 300 and 500 meters during the night. As one of the two specimens was found in 20 to 52 meters depth, this species ascends to the epipelagic, too.

Four species are only represented in epipelagic tows. During the day *Notoscopelus bolini* and *Notoscopelus caudispinosus* inhabit depths below 1000 meters and *Lampanyctus crocodilus* has its maximum abundance below 700 meters (HULLEY, 1984a, 1990). The absence of *Diaphus vanhoeffeni* in mesopelagic tows can be explained by its distribution pattern. As a tropical species (HULLEY, 1990) it is a new record for the Canaries and heretofore not known north of 20° N. It seems to be rare and there was only one rather small specimen (28 mm SL). The specimen could be an expatriate, as O'DAY AND NAFPAKTITIS (1967) indicate expatriation in the genus *Diaphus*, with a varying degree of external visible effects on the body e. g. caudal glands. The species has a maximum standard length of about 42 mm and attains sexual maturity with about 27 mm (HULLEY, 1990).

CLARKE (1972) indicates that some lanternfish species build fractions (e. g. *Notolychnus valdiviae*, *Nannobrachium nigrum*) with one being migratory active and the other one not. However, there were no obvious differences between the fractions of the populations, according to size, sex or maturity. HULLEY (1984a) supports the formation of fractions but postulates further that interspecific variations in migration behaviour are an ontogenetic feature. HULLEY (1986) pointed out that certain oceanic species may be caught on upper-slope and outer-shelf regions in potentially economic quantities. Other oceanic species (e. g. also *Diaphus dumerilii*) may possess pseudoceanic populations. All these interspecific disparities make delineation of species behaviour so complicate.

Species belonging to the same genus may not show the same migration behaviour. Members of the genus *Diaphus* are represented in each group, the two species of *Lobianchia* are completely different in their migration behaviour, too. However, *Hygophum* species are strong migrators and genus *Lampanyctus* is uniformly restricted to the oceanic part of the investigation area.

The results confirm the data known from literature, but they show also the difficulties in examining the migration behaviour of mesopelagic fishes. The limits of interpretation are soon reached and many other interesting questions arise. For instance,

the range of the bottom depth above which trawls were carried out in the mesopelagic realm is to small. The gaps in the occurrence lines of species in Table 7 are likely the result of under-represented tows above such bottom depths. Echograms (cf. Fig. 14.) prove that the deep scattering layer (DSL) extends to the slope. It would be interesting to know if there is a remarkable faunal change in the DSL close to the slope. More epipelagic trawl tows in the neritic zone, as well as more trawls (of both types) in the deep oceanic area (like tow 2 of "La Bocaina 04-97") are necessary for a better understanding of the spatial distribution of the different species during day and night.

The echogram (Fig. 14) shows further that during the night the DSL is almost as mighty as during the day. Therefore, a mesopelagic trawl during the night would be interesting and allow the calculation of the percentage of migrating specimens per species, if at the same position in the same night an epipelagic trawl is also made. An additional mesopelagic daytime trawl in the same area would result in the best possible data. Little migrating species, during the day normally occurring deeper, could also be encountered in a nighttime mesopelagic tow. The phases of the moon should receive attention too, as CLARKE (1972, 1974) noticed an intensified vertical migration at new moon and a reduced one at full moon.

All non-myctophid species, which were encountered in neritic depths or above the neritic/oceanic border are, although represented in few numbers, known to be inhabitants of the epipelagic realm during the night. *Maurolicus muelleri* migrates at night into the upper 100 meters (BADCOCK, 1984; QUÉRO et al., 1990b). HULLEY AND PROSCH (1987) cite *M. muelleri* even as pseud-oceanic species in the southern Benguela upwelling region. *Diplophos maderensis* reaches often even the surface at night (BADCOCK, 1984). The individuals of *Lestidiops affinis* and *Lestidiops sphyrenoides* are juveniles, which commonly occur in epipelagic depths (POST, 1984, 1990) and may show no diel vertical migrations. Juveniles of *Macroramphosus scolopax* and *Cubiceps gracilis* have been recorded in epipelagic oceanic waters (EHRICH, 1986, 1990; HAEDRICH, 1986, 1990).

All these species were encountered close to regions with special hydrologic phenomena. Therefore it is hard to say if they migrate actively to neritic waters or if they were drifted. As the species of family Macroramphosidae and Nomeidae as well as genus *Lestidiops* are no diel vertical migrators, it seems more reasonable to assume that their occurrence in neritic waters is self-determinated.

Serrivomer beani, *Stomias boa*, *Vinciguerria nimbaria* and *Diplospinus multistriatus* got as more abundant species already further consideration in chapter 4.3. Most of the other species, which were encountered in epipelagic oceanic tows are known as vertical migrators (WHITEHEAD et. al, 1984-86; QUÉRO et. al, 1990). Although not indicated by GIBBS (1984, 1990), smaller individuals of *Stomias longibarbatus* seem to migrate into epipelagic depth, like other members of the subfamily Stomiinae. *Sudis hyalina* has been characterised as a mesopelagic to bathypelagic species (POST, 1984, 1990), but small specimens apparently occur also in shallower depths. The occurrence of *Syngnathus* sp. is rather unexpected, as members of this ge-

nus are seldom found in offshore waters or associated with floating plants, respectively. (DAWSON, 1986, 1990). According to PARIN (1986) live juveniles of the genus *Benthodesmus* in the mesopelagic realm, but apparently some specimens occur shallower.

4. 5. Diversity Analysis

It is not surprising that the mesopelagic (followed by oceanic-epipelagic) tows showed the highest diversity. Non- and little migrating species or fractions (cf. chapter 4. 4.) and the high abundance of individuals, respectively, result in the high values of Shannon H'. Epipelagic tows with a high Shannon H' were carried out south of Gran Canaria and off Gran Tarajal, south-west Fuerteventura. This confirms the supposed hydrological peculiarity of these areas.

The single types of trawl tows (neritic, oceanic-epipelagic and oceanic-mesopelagic) are quite uniformly distributed over the whole range of the evenness index Shannon J'. Therefore, dominance seems to be hardly a feature of the trawl type, although the uniform very low number of species and individuals in neritic tows has to be considered. Furthermore, the numerical dominance of *Cyclothone* in the mesopelagic realm is partly weakened by high numbers of species and individuals leading to more evenness.

Statistical comparison is difficult due to relatively low sample size of most tow types. Neritic tows are underrepresented and additional tows in the deep oceanic area are even missing, although the tows 1 and 2 of cruise "La Bocaina 04-97" contain many species and individuals and would therefore provide an interesting comparative data set.

Concerning the myctophids, Shannon H' is significantly different between mesopelagic and epipelagic tows which is mainly due to the deviating species composition and abundance of neritic tows. That there is no significant difference in lanternfish diversity between oceanic-epipelagic and mesopelagic trawl tows proves once more the extensive diel vertical migrations of myctophids.

Regarding the diversity index Shannon H' of all mesopelagic species, significant differences found between the neritic and the oceanic realm as well as between oceanic-epipelagic and mesopelagic tows are likely the consequence of a restricted depth occurrence of the non- or less migratory species (e. g. WHITEHEAD et al., 1984-86; QUÉRO et al., 1990). (However, the low species number and abundance in several oceanic-epipelagic trawl tows (e. g. "La Bocaina 11-97": tows 12, 15 and 16; "ECOS 04-99": tows 4 and 13), leads to non-significant differences to neritic tows.)

Varying diversity, depending on the season is not obvious. BARNETT (1983) studied species composition and temporal stability of mesopelagic fishes in the North and in the South Pacific Gyre over six years. He noticed only changes in biomass, not in species composition, degree of dominance or species rank of relative abundance.

4. 6. Cluster Analysis

The Bray-Curtis Cluster Analysis proves, that oceanic tows are clustering, as well as those made in the neritic realm. Towing depth (epi- or mesopelagic in the oceanic) plays a minor role. In each of the two main clusters occurs one exception. Tow 18 of cruise "La Bocaina 11-97" is closer related with the oceanic trawling stations, although it is with a mean bottom depth of 221 m rather shallow. What this tow makes unique, is the mean trawling depth of 131 m, all other epipelagic tows were made in shallower depths, independent from the bottom depth. This suggests a remarkable difference in species composition in the depth strata of the epipelagic zone, as probably not all specimens of all migrating species migrate to the same extent, and this is not necessarily combined with standard length or age, respectively (CLARKE, 1972; HULLEY, 1986). A connection with the phases of the moon can be excluded, as full moon was the 14th of November and the tow was taken on the 24th.

Also tow 3 from cruise "La Bocaina 11-97" is stepping out of line. As epipelagic tow, taken in relatively deep waters, is the result resembling neritic tows, low in number of individuals and species. The species occurring in this tow are not unusual, mainly representatives of the dominant and abundant species, which are also encountered in many of the neritic tows. There are also tows which contain no mesopelagic fish at all (e. g. "La Bocaina 11-97" tow 4, 5, 7, 10 or "ECOS 04-99" tow 2, 3, 15, 18) or are not clustering, because of a hardly comparable species composition ("La Bocaina 11-97" tow 16, "ECOS 04-99" tow 7, 13, 22). This shows, that the sea is not even inhabited by fishes or other organisms. Of course can also the trawling method or problems with the net lead to an unsuccessful trawl.

The most closely related tows are those made with the same method (primarily the mesopelagic tows 5, 10 and 19 of cruise "ECOS 04-99"), however, only occasionally are also those tows which are spatially close together (tow 6 and 8 of cruise "ECOS 04-99") clustering. These may further reflect the rather patchy distribution pattern of mesopelagic fishes in the study area. The similarity of tow 12 and 15 of cruise "La Bocaina 11-97" results from the low number of species and the same number of individuals per species in one case.

Avoiding this problem was the aim of the modified dendrogram for the myctophids (Fig. 16). Therefore tow 9 and 13 from cruise "La Bocaina 11-97" have a similarity of almost 70 per cent. The very dominating species *Lobianchia dofleini* in each of the two tows is probably too much influencing the result. Consequently one should consider to exclude also the highest extreme values. Anyhow, leaving out tows or species with few specimens leads only to a little better result. Figure 16 shows that tow 8 and 19 of cruise "ECOS 04-99" are very similar. But this is also evident from Table 5, which further shows that this dendrogram analysis attaches too much importance to the absolute number of individuals per species instead of their proportional occurrence in a tow.

Concerning the Bray-Curtis Cluster Analysis one could expect, that spatially related tows are clustering, but this occurs only occasionally (e. g. tow 17 and 18 from cruise "La Bocaina 11-97" and tow 6 and 8 from cruise "ECOS 04-99"). The differences between the tows may result rather from little variations in the trawling method (depth, hardly verifiable net foldings) and/or derive from temporal phenomena. The above mentioned tows have been made within a short period, what supports this assumption. Therefore, it is hardly possible to make statements about microbiogeographic areas within the Canarian archipelago, as even tows in the hydrologically influential areas (upwellings, eddies) show only limited similarity.

That in the Jaccard Cluster Analysis all mesopelagic tows are clustering is not surprising, as they contain the highest species richness and also the non-migrating species. Tow 1 from "La Bocaina 11-97" and tow 6, 8 and 12 from "ECOS 04-99" are known to be very diverse (Table 8), their possible connection with the upwelling or eddy areas has been mentioned already. The most interesting result from Figure 17 is the cluster which is formed by epipelagic tows (6, 11, 13, 17 and 18 from cruise "La Bocaina 11-97" and 7 from cruise "ECOS 04-99"). They are a mixture of tows in the neritic and in the oceanic, therefore an active horizontal migration of certain species towards the coast seems to be plausible (cf. chapter 4. 4.).

HULLEY AND LUTJEHARMS (1989) used the Bray-Curtis similarity measure with group average sorting and multidimensional scaling. Their clustering was correlated to bottom depth, their interface is best demarcated by the 800 m isobathe. Admittedly, their investigation was carried out above a broad continental shelf and a less steeply descending upper slope area, which may not lead to the high spatial interaction of neritic and oceanic species like those around islands of volcanic origin.

The calculation of the theoretically sampled water volume can contain a certain source of error. It starts from the assumption that the steel ring of the cod-end hangs during the whole trawl vertically in the water or is perpendicular to the towing direction, respectively. But this can hardly be influenced and verified.

4. 7. Populations Structure

4. 7. 1. *Ceratoscopelus maderensis*

Ceratoscopelus maderensis is known to form shoals (BACKUS et al., 1968) and also to be associated with the sound scattering layer of slope waters, south of New England (HULLEY, 1990). It has a maximum size of 81 mm, reaches sexual maturity with about 62 mm and has its spawning peak in spring-summer (HULLEY, 1984a). The histogram of the standard length (Fig. 18) supports this spawning data. The length histogram with the two peaks (unlike *Hygophum hygomii* and *Lobianchia dofleini*) may be typical for a species with a one-year life cycle. BACKUS et al. (1968) observed schools of this species, all roughly having the same size. Therefore it could be possible that missing lengths were just not caught, and the two-peak distribution was achieved by chance.

The results (Fig. 19) support the assumption of BORDES et al. (1999) that the absence of *Ceratoscopelus maderensis* in the east of the islands is traceable to a former sampling gap and not to a higher salt concentration produced by Mediterranean water lenses as hypothesised earlier by ZELCK AND KLEIN (1995).

4. 7. 2. *Hygophum hygomii*

Hygophum hygomii has a maximum standard length of 68 mm, reaches sexual maturity with about 58 mm, males develop supra-caudal glands at 35 - 40 mm, females infra-caudal glands at 45 - 50 mm (HULLEY, 1984a). He indicates sexually dimorphic growth rates, therefore he assumes an development of the secondary sex characteristics at the same age. The data suggest for the Canaries a later development of the caudal glands, as hardly a specimen smaller than 40 mm or 50 mm, respectively, is sexually determinable.

In the autumn cruise more than twice as many males than females were caught. Quite often occurred specimens with a small supra- and an additional infra-caudal gland. Although the infra-caudal gland is sometimes also relatively small, it seems reasonable to regard these specimens as females (HULLEY, 1981). This increases the portion of females in the catches a little (undeveloped and in the caudal region damaged specimens are included in the "not identified" group of the histogram of Fig. 20, too). CLARKE (1983) noticed in many myctophids and other mesopelagic fish species an uneven sex ratio, favouring females. This derives partly from real differences (e. g. *Nannobrachium nigrum*), but most often from different growth rates or size at maturity. Anyhow, biomass of mature females in a population is often greater than that of mature males. Hermaphroditism (proterandric) is not reported for the myctophids.

In the Mediterranean the species spawns in late summer-autumn and in the area of the Bermudas in late autumn-winter (HULLEY, 1984a). As the specimens of cruise "La Bocaina 11-97" have an average SL of 53 mm it can be assumed that spawning peak in the Canaries is in late autumn-winter, too. In the more recent cruise "MESOPELAGIC 11-00" (Moreno, Wienerroither and Uiblein, unpublished data) *H. hygomii* was very frequent, too, and the SL of comparable size, but analysis of this cruise is not completed so far.

Remarkable is the big overlap of lengths between the spring and the autumn cruises. Life cycle data for myctophids are seldom given, some species are recorded to have a one-year life cycle (CLARKE, 1972; KARNELLA AND GIBBS, 1977). If this applies also to *H. hygomii*, than this species must haven a very uneven growth rate. To assume that *H. hygomii* has a two-year life cycle would explain the results of the lengths data better. No exact ageing data are currently available.

Figure 22 reflects more or less the trawl station maps (Fig. 7 and 8), but emphasises the upwelling area off Gran Tarajal and indicates other areas, which are worth more detailed investigations, e. g. west of Tenerife.

4. 7. 3. *Lobianchia dofleini*

Lobianchia dofleini has a maximum standard length of 50 mm in the eastern North Atlantic and South Atlantic, whereas it grows only to 38 mm in the western North Atlantic (HULLEY, 1981, 1984a, 1990). Males develop supra-caudal glands at 19 mm, females infra caudal glands at 22 mm, this species is sexually mature from about 31 mm, spawning takes place from January to June with a peak in winter (Bermuda) or throughout the year with peak in February to June (Mediterranean) (HULLEY, 1984a).

KARNELLA AND GIBBS (1977) analysed the life history of *L. dofleini* in waters off Bermuda and pointed out that the same data won't necessarily apply to populations of that species in another area. They indicate a one-year life cycle, with distinct difference of the length distribution throughout the year. This cannot be confirmed for the Canaries (Fig. 23). The mean of SL is little larger in the autumn cruise, but the range is almost the same. Therefore, statements about life cycle data of *L. dofleini* in the Canaries are difficult to make.

All this requires that the Canarian populations are smaller in size than those of other study areas. The lengths encountered are remarkable, as the largest specimen measured only 36 mm, although the maximum length is given with 50 mm (only in cruise "La Bocaina 04-97" occurred at least one unverified specimen with 58 mm SL). That this is a result of the recorded size-depth-distribution is unlikely, as HULLEY (1984a) indicates no occurrence below 500 m and the tows covered these depths. One explanation could be that *L. dofleini* forms strict schools of spawning individuals, which possibly were not caught or that sexually mature adult specimens spawn in other areas than close to the Canaries. But this can be excluded, as RODRÍGUEZ (2000) found larvae of *L. dofleini* in the Canary region. The assumption of a smaller growth in the Canaries, comparable to that of the Bermudas (KARNELLA AND GIBBS, 1977) would be most plausible explanation. HULLEY (1984b) found off South Africa no specimen larger than 36 mm, he indicates female sexual maturity with 34 mm. Unfortunately further details about the exact location of trawling stations are not available. The species seemed to be rare as only 20 individuals were caught in approximately 200 trawl stations. Anyway, further examinations including the gonads, are needed. Figure 25 shows that this frequent species spreads throughout the Canarian archipelago.

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INDEX
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REFERENCES
APPENDIXES

The first page (not numbered) should include the title of the work (capital, bold letters); the full name of the author(s) (bold letter type, small for names and capital for surnames); the author(s) affiliation(s) and the address(es) (capital letters). Date of submission and reference of the work should appear at the lower end of the page, in bold, capital, italic letters.

The **SUMMARY** and **INDEX** should be typed in two separate, not numbered sheets, with centred headings (bold, capital letters). **INDEX** should include the different headings and sub-headings, with their corresponding starting page numbers. Text shall be numbered from page 4 (**INTRODUCTION**), with centred headings (bold, capital letters). One tab should be used at the start of every paragraph, and double space between different sections. No tabs will be required for sub-headings (capital, bold letters).

The full Latin specific name, including the authority with correct taxonomic disposition, should appear at least once for each species when first mentioned in the text or elsewhere, thus: Parrot fish *Sparisoma cretense* (Linnaeus, 1758). Latin names should appear in italic.

References in the text should be cited as: SMITH AND BROWN (1995) or (SMITH AND BROWN, 1995). Use only recommended SI units, e.g., mm, mm^3, s, g, m l^{-1}, with no plural "s" and full stops. Scientific Publication abbreviations should follow the guidelines of "World List of Scientific Publications". Decimal numbers should be typed with a period (0.25), numbers with more than three digits should be typed with a space (1 034), and calendar years without space (1995).

REFERENCES

The list of references should be arranged alphabetically according to the following order: author (surname, name initials- in capital letters), year of publication (if more than one reference by the same author published in the same year is cited, use "a"," b", etc. after the year in both text and list, e.g. (1994a, 1994b), full name of the work; name of the Publication in italics (full or abreviated); number and pages. When books are cited, their titles should appear in italics, and editors and city should also be typed.

FIGURES, TABLES AND MAPS

Figures, tables and maps should not be larger than 17 x 22.5 cm once reduced, including legends. Figures, tables and map legends will be submitted in separate sheets if not included in the reduction. Headings and footnotes of figures, tables and maps should be single-spaced (italic letters). Figures and tables should be numbered in arabic. Extra footnotes to tables should be typed single-spaced (Times New Roman 10 pt letters).

SUBMISSION AND REVIEW OF MANUSCRIPTS

Works will be considered for publication only if they have not been published or submitted elsewhere. Original and two copies, plus a word processor disk of the manuscript (Word Perfect 6.0 Win) must be submittted to Secretaria Técnica de Informes Técnicos del ICCM, Apdo. 56, 35200 Telde, Gran Canaria, Canary Islands, Spain, by means of registered item and acknowledgement of receipt. The author(s) submitting a manuscript do so on the understanding that, if it is accepted for publication, exclusive copyright in the paper shall be assigned to the editor of Informes Técnicos.

All manuscripts will be subject to referee and editorial review. When a manuscript is returned to the author for corrections prior to final acceptance, the revised manuscript must be submitted within 10 days of the authors' receipt of the referees' report. First authors will receive 10 free reprints of their papers.

INSTRUCTIONS AUX AUTEURS (Pour travaux en français)

TEXTE

Le texte sera dactylographié sur DIN-A4, en lettre Times New Roman 13 pt, à 1 espace, laissant une marge de 2.5 cm de chaque côté. Les pages seront numéroté au centre de la marge inférieure. Les lettres majuscules seront aussi accentuées. La structure des rapports doit s'ajuster le plus possible aux suivants chapitres:

RÉSUMÉ-RESUMEN
INDEX
INTRODUCTION
MATÉRIEL ET MÉTHODES
RÉSULTATS ET DISCUSSION
CONCLUSIONS
REMERCIEMENTS
BIBLIOGRAPHIE
ANNEXES

En première pages iront le titre du rapport (en caractère gras et majuscule) et le(les) nom(s) de l'(des) auteur(s) (en caractère gras, minuscule le prénom et petite capitale le nom); leur(s) addresse(s), institution, addresse, ville, pays (en majuscule), date d'envoi et la référence du Rapport au bas de la page en caractère gras, majuscule et italique.

Le **RÉSUMÉ** et le **RESUMEN** iront seul, les titres centrés (en français et en espagnol) et sans numérotage. L'**INDEX**, aussi sans numérotage, contiendra les titres des chapitres et sous-chapitres et le numéro de page où ils commencent. Le numérotage commencera dans la page 4 avec l'**INTRODUCTION**. Les titres des chapitres iront centrés, en caractère gras et majuscule. L'écriture commencera avec une tabulation. On laissera une ligne blanche aprés les points à la ligne et deux lignes blanches entre chapitres. Les sous-chapitres seront numéroté selon leur ordre, et s'écriront en caractère gras, majuscule et sans tabulation.

Quand le nom vulgaire d'une espèce est cité pour la première fois dans le texte, il devra être suivit par son nom scientifique, l'auteur et l'année entre parenthèse (la pêche artisanale du poisson perroquet *Sparisoma cretense* (Linnaeus, 1758)). Les noms scientifique doivent s'écrire en italique (*Sparisoma*).

Les références à d'autres travaux seront faites en citant entre parenthèse uniquement le nom du(des) auteur(s) en petite capitale et l'année de la publication, separés par une virgule (GONZÁLEZ ET LOZANO, 1992).

Les symboles et signaux chimique, physiques ou mathématiques, seront écrits suivant les règles internationales en vigueur, sans points et sans pluriel. SI (Système d'Unités International). Les abréviations des publications scientifiques s'ajusteront aux indications de la "World List of Scientific Publications". Les nombres décimales s'écriront avec un point (0.25), les nombres de plus de trois chiffres au lieu d'un point auront un espace (1 034) et les années n'auront ni point ni espace (1995).

BIBLIOGRAPHIE

Les références bibliographiques s'écriront par ordre alphabétique selon l'ordre suivant: auteur (nom et initiales du prénom en petite capitale), année de la publication (au cas où un même auteur aurait plus d'une publication on ajoutera des lettres minuscules à l'année, 1994a, 1994b), titre complet du travail, nom de la publication en italique (complet ou abrégé), numéro et pages. Si c'est un livre, le titre doit s'écrire en italique spécifiant l'édition et la ville.

FIGURES, TABLEAUX ET CARTES

Les figures, tableaux ou carte une fois réduits ne doivent pas dépasser les 17x22.5 cm, légende inclue. Les légendes de figures, tableaux ou cartes iront dans une page à part s'il ne sont pas inclus dans la réduction. Les titres et les légendes des figures, tableaux et cartes s'écriront en français et en espagnol (en italique) séparés par une ligne blanche. Les figures et les tableaux seront numérotés avec des chiffres arabes; les rappels s'écriront au bas séparés d'un espace et d'une ligne (en lettre Times New Roman 10 pt).

ENVOI ET ACCEPTATION

Uniquement les travaux originaux non édités ni envoyé simultanément à d'autres publications seront acceptés. Les travaux (original et deux copies) et le support informatique en WordPerfect 6.0 Win devront s'envoyer par poste recommandé avec accusé de réception à Secretaria Técnica de Informes Técnicos del ICCM. Apdo. 56, 35200 Telde, Gran Canaria, Îles Canaries, Espagne. Le(les) auteur(s) par l'envoi de l'original acceptent que les droits de copyright de leur travail sont tranférés à l'éditeur des Informes Técnicos s'il est accepté pour publier, ceci comprend les droits d'exclusifs pour reproduire et distribuer le travail.

Les rapports seront révisés par le Comité Éditorial et au moins par deux évaluateurs du Conseil Éditeur. En cas d'exister des corrections, le travail se remettra à l'auteur pour introduire les modifications dans l'original dans un délai de 10 jours. Les auteurs recevront 10 exemplaires du Rapport.S'il figure plus d'un auteur les exemplaires seront envoyés au premier auteur.

INSTRUCCIONES A LOS AUTORES

TEXTO

El original se mecanografiará en DIN-A4, letra tipo Times New Roman 13 pt, a 1 espacio, dejando un margen de 2,5 cm de margen por cada lado. La paginación irá centrada en el margen inferior. Las mayúsculas también se acentuarán. La estructura de los informes debe ajustarse lo más posible a los siguientes apartados:

RESUMEN-SUMMARY
ÍNDICE
INTRODUCCIÓN
MATERIAL Y MÉTODOS
RESULTADOS Y DISCUSIÓN
CONCLUSIONES
AGRADECIMIENTOS
BIBLIOGRAFÍA
ANEXOS

En la primera página irá el título del Informe (en negrita y mayúscula) y el(los) nombre(s) del (los) autor(es) (en negrita, minúscula el nombre y versalita el apellido); su(s) dirección(es), institución, dirección, ciudad, país (en mayúscula), la fecha de envío y la referencia del Informe a pie de página en negrita, mayúscula y cursiva.

El **RESUMEN** y **SUMMARY** irán solos, con los títulos centrados (en español e inglés) y sin numeración. El **ÍNDICE** va sin numerar y contendrá los títulos de los apartados y subapartados con la página donde comienzan. La numeración comenzará en la página 4 con la **INTRODUCCIÓN**. Los títulos de los apartados irán centrados, en negrita y mayúscula. Se comenzará a escribir dejando una tabulación. En los puntos y aparte se dejará un espacio y entre apartados se dejarán dos espacios. Entre un título y el texto se dejará un espacio. Los subapartados se numerarán siguiendo su orden correspondiente. Se mecanografiarán en mayúscula, negrita y sin tabulación.

El nombre vulgar de las especies cuando se cite por primera vez en el trabajo debe ir seguido por su nombre científico, el autor y el año entre paréntesis (pesquería artesanal de la vieja *Sparisoma cretense* (Linnaeus, 1758). Los nombres científicos tienen que ir en cursiva (*Sparisoma*).

Las referencias a otros trabajos se harán citando entre paréntesis sólo el apellido del (los) autor(es) en versalita y el año de publicación, separados por una coma (GONZÁLEZ Y LOZANO, 1992).

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FIGURAS, TABLAS Y MAPAS

Las figuras, tablas o mapas no deben sobrepasar una vez reducidos los 17X22.5 cm incluyendo la leyenda del pie. Los pies de figuras, tablas o mapas irán en hoja aparte si no están incluidos en la reducción. Los títulos y pies de las figuras, tablas y mapas irán en español e inglés (en cursiva) separados por un espacio. Tanto las figuras como las tablas se numerarán con números arábigos; si hubiese llamadas irán debajo del pie separadas por un espacio y una línea (letra tipo Times New Roman 10 pt).

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Species composition and depth distribution of fish species collected in the area of the great Meteor Seamount, Eastern Central Atlantic, during Cruise M42/3, with seventeen new records. F. UIBLEIN, A. GELDMACHER, F. KÖSTER, W. NELLEN & G. KRAUS. Diciembre 1998. Pags. 47-85.

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7.- **ESTOC data report 1995-96. Editors:** O. LLINÁS, A. RODRÍGUEZ DE LEÓN, G. SIEDLER & G. WEFER. Agosto 1999. Pags. 1-152.

8.- **Bioeconomía del cultivo de dorada (Sparus aurata).** E. GASCA-LEYVA. Enero 2000. pags. 1-88.
Economic of commercial gilthead seabream (Sparus aurata) production. E. GASCA-LEYVA, C. LEÓN & J.M. VERGARA. Enero 2000. pags. 89-106.

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