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# Mesopelagic Fishes (Suborder Stomiatoidei) in the Northwest Atlantic

by

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## Abstract

The collection of mesopelagic fishes gathered during the research trips of the Polar Institute vessels into the NAFO northern areas in 1979-1985 was analyzed. The collection included 21 species of Stomiatoidei suborder (excluding Cyclothone genus); the positions of captures and some biological features were pointed out for each species. Nine species were given for the area for the first time.

## Introduction

Mesopelagic fishes are of important significance in the echosystem of the pelagic waters in the open ocean. These serve as a main transmitted link of energy from the surface into the deeper oceanic layers and are the food object for many commercial fishes (McKelvie and Haedrick,1985).

The fauna of mesopelagic fishes in the NAFO northern areas had studied insufficiently well yet. So far, both the total number of species, and the character of their inhabitance in the areas mentioned (reproduction, expatriation zone, random drifts) are unknown. The biology of the majority of species and their role in echosystem are almost absolutely unknown. Their abundance and biomass are known only in general outline (Gjösaeter and Kawaguchi,1980).

Mesopelagic fishes sometimes occurred as by-catch taken with midwater trawls during the trips of the PINRO research vessels. In recent years, when the interest to echological investigations in the World Ocean increased, more attention was paid to collecting and studying the non-commercial fish and invertebrates. As a result, a small collection of mesopelagic fish had been obtained by the PINRO specialists; some results on the analysis of these species are given in the present paper.

The paper is dedicated to the studying of Stomiatoidei suborder. The species of Cyclothone genus, which are the most predominant group almost in all areas of the ocean, are the most abundant in this suborder (Gjösaeter and Kawaguchi,1980). However, these very small fishes were absolutely not registered in the catches taken with pelagic trawls. The representatives of this genus were sometimes observed only during the ichthyoplankton surveys, in the catches taken with special nets for research purposes (Serebryakov et al.,1984; Akhtarina and Chechenin,1985). The species of this genus are not included in the present paper.

## Material and methods

The collection of mesopelagic fishes was gathered during the trips of the PINRO research vessels in 1979-1985 in the NAFO Subareas I, 2 and 3. All samples were collected from the catches taken with midwater trawls and include 586 specimens of Stomiatoidei suborder.

Species composition was determined, standard length (SL, mm) was measured, some specimens were weighted. If a specimen was not intended for further keeping in collection, then the stomach content and maturity stages of gonads were determined, old generation of eggs in mature females was completely calculated.

The determination was carried out in accordance with many literary sources, references to which were given in species description. All the most interesting specimens are kept in the PINRO collection.

Results

A number of specimens analyzed for each of 21 species is given, all positions of captures are shown on charts. The information on biology was limited by infrequent occurrence of the majority of the species, and, sometimes, by bad safe keeping because of great demage of soft tissues of mesopelagic fishes with trawl.

Gonostomatidae family

Gonostona denudatum Rafenesque,1810

Material: 4 specimens 130.0-148.9 mm long.

Well differs by small number of gill rakers (15-16), availability of adipose fin and the fact, that first two photophores of anal series (AC) are higher, but the two subsequent ones - below the level of the remainding photophores (Grey,1964; Mukhacheva,1972; Badcock,1984a).

Inhabits the tropical and subtropical waters of the Atlantic Ocean and Mediterranean Sea (Badcock,1984a). It was registered for the first time in the NAFO northern areas (Fig. 1), one of our samples (46°10'N 44°11'W) is taken at the northernmost position for this species.

Trophoplasmatic growth of some ovocytes (maturity stages II-III) was noted in the gonads of the female 141 mm long, caught on 29 June 1984 at 43°46'N 44°28'W. The ovocytes of old generation (1 283 spec., 0.6 mm dia.) occupied about one third of ovaries, the diameter of the rest portion of ovocytes was 0.20-0.25 mm. The remains of the digested food were found in the stomach of this specimen.

Gonostoma elongatum Günther,1878

Material: 46 specimens 70-223 mm long.

Differs by number of gill rakers (19-21) and well-developed

photophores of lateral series (OA), a phosphorescent glandular mass is under each of which (Grey,1964; Mukhacheva,1972; Badcock,1984a).

Inhabits the tropical and subtropical waters of all oceans. In the North Atlantic it occurs northward up to the Denmark Strait (65°30'N) (Mukhacheva,1972). In the NAFO northern areas it is observed southwest of the Grand Bank (Geim, Scott,1966), our data are indicative of wider extension of this species here, although the majority of the captures was registered also south of the Grand Bank (Fig. 1).

The sizes of the females in our samples (131-223 mm) are obviously greater than those of males (129-153 mm). Sex was not determined in 22 specimens 70-144 mm long, no hermaphroditic specimens were found. However, it should be noted that the determination of maturity stages of gonads was made visually (by means of binocular) on the fixed material, histological investigations are necessary for more detailed discussion. The studying of the reproductive system of this species for which a protandrous hermaphroditism is typical (Fisher,1983), in specimens from the Newfoundland area was also complicated because those areas probably were the zones of sterile eviction of the species.

Of 23 dissected stomachs, 11 were empty, the rest ones contained digested crustaceans. Fresh food was found only in two specimens caught at the beginning of night (22.10-23.15 hrs) on 5 December 1985 on the southern slope of the Grand Bank (43°13'N 51°30'W). 4 shrimps Pandalus borealis were found in the stomach of one specimen, and one shrimp - in the stomach of other specimen.

The mass of our largest specimen (females 223 mm long) was equal to 39.2 g. The age judging by number of opaque and hyaline rings on otolith, was determined to be 3+ (caught on 23 August 1984).

Margrethia obtusirostra Jespersen et Taning,1919

Material: 7 specimens 61-68 mm long.

Well differs by number of rays in anal fin (21-24), one series of photophores on body sides and uneven disposition of

preventral series of photophores (PV), which rise obliquely up, except the two last low descended (Mukhacheva,1976; Parin,1982).

Occurs in tropical and subtropical waters of all oceans (Mukhacheva,1976). It is registered for the first time in the NAFO northern areas, the position of capture - 46°10'N 44°11'W -, was the northernmost one for this species (Fig. 1).

The greatest known length for this species is 66 mm (Mukhacheva,1976), two our specimens were somewhat larger: 68 mm. Four females, caught on 25 June 1984 at the northern position, were mature. The gonads of two largest females 64.5 and 68 mm long contained 1 635 and 1 723 ovocytes of old generation, respectively, which occupied three fourths of gonads and had the diameter of 0.5-0.6 mm. The remainder of ovaries contained the ovocytes of the following generation (0.2-0.3 mm). The fry of Notoscopelus sp.28 mm long was found in the stomach of one specimen, the stomachs of the rest specimens were empty.

Steroptychidae family

Argyropelecus aculeatus Valenciennes,1849

Material: 250 specimens 23-86 mm long.

Well differs by big anal postabdominal thorn, very high and short dorsal plate, pair of enlarged fangs in mandible and thorned scales below subcaudal photophores (Borodulina,1978; Badcock,1984b).

Widely spreads in tropical and subtropical waters of all oceans (Borodulina,1978), in the North Atlantic it penetrates into the north up to Norway (63°N) (Rollefsen,1960). Observed in the Grand Bank area (Leim and Scott,1966), all our samples were collected in that area (Fig. 2).

The largest known length of this species is 75 mm (Borodulina,1978), one of our specimens was slightly larger - 86 mm (43°38'N 43°44'W). The females of this species were obviously larger than the males. Mean length of males and females in two our mass samples constituted 45.7 and 55.3 mm (n - 109) and 42.5 and 48.9 mm (n - 131), respectively.

Three females caught on 26 June 1984 at position 46°10'N 44°11'W were mature. About two thirds of their gonads were occupied by ovocytes of old generation with 0.4-0.6 mm dia. (3 167, 3 574 and 2 906 ovocytes in fishes 57, 60 and 60.5 mm, respectively). The specimens with running eggs and spawned-out females were observed south of the Grand Bank in July and August 1984. Judging by our data the females become to be matured at the length over 40 mm.

Argyropelecus gigas Normann,1930

Material: 1 specimen 67 mm long.

Differs by high dorsal plate, big transparent keel under abdominal photophores and character of upper body profile which elevated between 3 and 4 thorns of dorsal plate and behind it (Borodulina,1978; Badcock,1984b).

Widely distributes in tropical and subtropical waters of all oceans (Borodulina,1978), in the North Atlantic, it penetrates into the north up to the Denmark Strait (65°N) (Jonsson et al.,1978). It is pointed out for the first time in the NAFO northern areas (Fig. 2).

Argyropelecus hemigymnus Cocco,1829

Material: 5 specimens 22-38 mm long.

Easily differs by long caudal stem, by one large abdominal thorn with serrated edges directed backward, by lesser number of rays in dorsal and anal fins (8 and 11), than that in close species (Borodulina,1978; Badcock,1984b).

Widely inhabits the tropical and moderate waters of all oceans (Borodulina,1978). In the North Atlantic it penetrates northward up to North Norway (69°N) (Pethon,1981). It occurred earlier in the NAFO northern areas (Borodulina,1978), the knowledge on species distribution was somewhat supplemented with our materials (Fig. 2).

The specimens 26-38 mm long caught at the southern positions in June were mature (Fig. 2). Four fifths of the ovary in

female 38 mm long, caught at 46°10'N 44°11'W on 26 June 1984 were occupied with ovocytes by 0.65-0.75 mm dia. (358 spec.). The remainder of the ovary contained the ovocytes of young generation (0.2-0.3 mm).

Argyropelecus sladeni Regan,1908

Material: 2 specimens 38 and 44 mm long (Fig. 2).

Well differs by strong pigmentation, particularly, along the middle body line, low dorsal plate, the lack of enlarged fangs in mandible (Borodulina,1978).

Widely distributes in tropical and moderate waters of all oceans, it was also observed in the NAFO northern areas (Borodulina,1978).

Polyipnus asteroides Schultz,1938

Material: 3 specimens 30-42 mm long.

Differs from close species by number of photophores in the first anal series (9) (Schultz,1964).

Inhabits the tropical waters of the West Atlantic (Schultz,1964). In the north, it was observed up to the banks of Nova Scotia (Markle et al.,1980). But it was marked for the first time in the area investigated (Fig. 3).

Sternoptyx diaphana Hermann,1781

Material: 121 specimens 19-39 mm long.

Well differs from close species by low disposition of supra-anal photophore (directly near the group of anal photophores) (Borodulina,1978; Badcock,1984b).

Widely distributes in tropical and subtropical waters of all oceans (Borodulina,1978). The northernmost position of capture in the North Atlantic was 52°47'N 34°25'W (Albikovskaya et al., in press). It was registered in the Grand Bank area (Pitt, Winters,1970), due to our data this species occurred there rather widely (Fig. 3).

In June and July the mature fishes occurred. The fecundity of 8 females 24.5-37 mm long constituted 619-1 903 ovocytes of old generation (0.5-0.6 mm dia.), which occupied about two thirds of the gonads.

Crustaceans, were predominantly found in the stomachs, mainly - small Euphausiidae, Hyperiidae, Copepoda.

Sternoptyx pseudobscura Baird,1971

Material: 4 specimens 34-46 mm long.

Differs by very high disposition of supra-anal photophore (approximately on the middle body line) (Borodulina,1978; Badcock,1984b).

Inhabits the tropical and subtropical waters of all oceans (Borodulina,1978), in the North Atlantic it was observed at 50°50'N 38°24'W (Albikovskaya et al., in press). It was marked for the first time in the NAFO northern areas (Fig. 3).

The most deepwater species of this genus; our specimens were collected during trawlings at a 1 000 m depth.

2 880 ovocytes of old generation by 0.4-0.55 mm dia. were in the gonads of the mature female 38 mm long (1 August 1984), they occupied about half of the gonads.

Photichthyidae family

Ichthyococcus ovatus Cocco,1838

Material: 4 specimens 37-43 mm long.

Differs from close species by lack of photophore SO, narrow distance between eyes and smaller number of serial photophores (OA - 23-26, IC - 51-53) (Mukhacheva,1980; Badcock, 1984c).

Widely distributes in the tropical and subtropical waters of all oceans (Mukhacheva,1980), in the North Atlantic it was found at 55°55'N 19°25'W (Albikovskaya et al., in press).

The gonads of the mature female 37 mm long (29 June 1984) contained two portions of ovocytes: 523 ovocytes of old genera-

tion (0.4-0.5 mm dia.) and 634 ovocytes of the next portion (0.2-0.3 mm dia.). The other female (36.5 mm) had the running eggs.

Astronesthidae family

Borostomias antarcticus (Lönnberg,1905)

Material: 5 specimens 180-240 mm long.

Fore-parts of the maxilla and mandible with fangs, which were much bigger than the other teeth, pale portion of the thickened end of the chin barbel was much longer than its width (Gibbs,1964; 1984).

Occurs in the moderate waters of all oceans (Gibbs,1964), in the North Atlantic it was found at 55°54'N 21°59'W (Albikovskaya et al., in press).

Observed in the Newfoundland area (McKelvie and Haedrick, 1985), our data were the supplement to information on species distribution (Fig. 4). All our specimens were immature. Digested shrimps and Benthosema glaciale 58 mm long were found in the stomachs.

Chauliodontidae family

Chauliodus sloani Bloch et Schneider,1801

Material: 76 specimens 117-250 mm long.

Differs from close species by fore-disposition of dorsal fin (over 4-8 photophores of lateral series) and number of photophores in series (Parin and Novikova,1974).

Widely distributes in the tropical and moderate waters of all oceans, in the North Atlantic it is observed northward up to Iceland (Parin and Novikova,1974). It is usually registered in the NAFO northern areas (McKelvie and Haedrick,1985) (Fig. 4).

The gonads of mature female 235 mm long (caught at

46°32'N 47°07'W on 28 July 1984) contained 14 389 ovocytes with 0.5-1.0 mm dia. and many small ones (0.2-0.3 mm).

Stomiidae family

Macrostomias longibarbatus Brauer,1902

Material: 1 specimen 282 mm long.

Differs by long chin barbel, which reaches three fourths of the body length and has one therminal bulb on the end, number of photophores in ventral series (172-183) and in lateral series (138-150) (Shcherbachev and Novikova,1976).

Inhabits the tropical and subtropical waters of all oceans, in the North Atlantic it is observed up to 41° (Shcherbachev and Novikova,1976). Our capture (46°10'N 44°11'W) was the northernmost location of this species (Fig. 5).

The sex of our specimen was indistinguishable. Electrona rissoi 36 mm long was found in the stomach.

Stomias boa ferox Reinhardt,1843

Material: 14 specimens 124-323 mm long.

Differs from close species by availability of 6 series of hexagonal zones over lateral series of photophores, chin barbel, the therminal bulb of which had three filaments and number of photophores in series (Shcherbachev and Novikova,1976).

Inhabits the North Atlantic waters from 28°N to 65°N (Shcherbachev, Novikova,1976), in the NAFO northern areas it is usually observed (McKelvie and Haedrick,1985) (Fig. 5).

The greatest known length of the species is 318 mm (McKelvie and Haedrick,1985), one of our specimens was somewhat larger - 323 mm.

Melanostomiidae family

Melanostomias melanops Brauer,1902

Material: 5 specimens 159-244 mm long.

Differs from close species by structure of chin barbel, which was completely pegmented only at the foundation and had thin conic filament on distal end of therminal plained zone (Gibbs Jr.,1984b).

Inhabits the tropical and subtropical waters of all oceans (Parin and Pokhilskaya,1978), in the NAFO northern areas it was found for the first time (Fig. 6). The position at 42°49'N 51°59'W was the northernmost location of the species.

Melanostomias valdiviae Brauer,1902

Material: 5 specimens 112-200 mm long.

Differs by chin barbel with plained therminal end, the length of which 2-3 times bigger than width (Gibbs Jr.,1984b).

Inhabits the tropical and subtropical waters of all oceans, in the North Atlantic it is observed northward up to 51°34'N (Parin and Pokhilskaya,1978). It is indicated for the first time in the NAFO northern areas (Fig. 6).

Pachystomias microdon Günther,1878

Material: 2 specimens 172.5 and 174.5 mm long.

Well differs by availability of long sausage-shaped suborbital organ under eye and small organs in front and behind the eye (Gibbs Jr.,1984b).

Inhabits the tropical and subtropical waters of the Atlantic and Pacific Oceans, in the North Atlantic it is observed northward up to 50°N (Gibbs Jr.,1984b). It is pointed out for the first time in the NAFO northern areas (Fig. 6).

Photonectes braueri Zugmayer,1913

Material: 1 specimen 223 mm long.

Differs from close species by structure of chin barbel, the therminal bulb of which had small, bulb-shaped adventive and number of photophores in series PV (22-24) (Gibbs Jr.,1984b).

Inhabits the tropical and subtropical waters of the Atlantic Ocean and western Indian Ocean (Gibbs Jr.,1984b). It is pointed out for the first time in the NAFO northern areas. The position at 48°12'N 44°55'W was the northernmost location of species (Fig. 7).

Trigonolampa miriceps Regan et Trewaves,1930

Material: 11 specimens 215-338 mm long.

Well differs by large spot of the phosphorescent tissue separate backward into the gill lid (Gibbs Jr.,1984b).

Occurs in the subtropical and moderate waters of the North Atlantic, in the north it was marked at 54°55'N (Albikovskaya et al., in press). It is pointed out for the Georges Bank (Leim and Scott,1966), but it is indicated for the first time for the NAFO northern areas (Fig. 6).

The greatest known length of the species is 320 mm (Albikovskaya et al., in press), one of our specimens is slightly larger - 338 mm (its mass - 270.5 g - measurements on fresh sample).

Malacosteidae family

Malacosteus niger Ayres,1848

Material: 19 specimens 80-198 mm long.

Differs from close species by the lack of the chin barbel, availability of pectoral fins, small serial photophores and short snout, which was less than eye's diameter (Gibbs Jr., 1984c).

Inhabits the tropical and subtropical waters of all oceans, in the North Atlantic, it penetrates northward up to the Denmark Strait (65°) (Jonsson et al.,1978. It is usually observed in the NAFO northern areas (Leim and Scott,1966; Kelvie and Haedrick,1985) (Fig. 7).

Gonads of mature female 166 mm long (caught on 8 August

1984, at 42°39'N 49°47'W) contained 18 063 ovocytes by 0.82-0.92 mm dia.

Discussions

Fauna list of suborder Stomiatoidei in the area investigated is not far settled by the species from our collection above mentioned. The list has to be supplemented with some species of Cyclothone genus, Maurolicus muelleri, Grammatostomias and Idiacanthus fasciola (Leim and Scott,1966) already known for this area. Besides, in our collection there are some fishes greatly demaged and not determined by species from genuses Gonostoma and Aristontomias. By all means, the list will be added and by other species, mainly, by those from Astronesthidae and Melanostomiidae families, poorly studied generally.

The problem of zoogeographical subdivision of the area is rather complicated. The division by areas applied at present time for mesopelagic waters of the North Atlantic is considered to be only preliminary (Backus et al.,1977). The majority of mesopelagic species of fish, if not all, is to be considered as plankton forms that is necessary to take into account while the zoogeographical dividing. In principle, almost all species of mesopelagic fishes, inhabiting in subtropical waters can be occurred off Labrador, the area of which, however, is probably only the area of sterile eviction for majority of the species. Therefore, to our opinion, the principle of reproduction areas separation, but not the fauna composition of any areas has to serve as a basis for zoogeographical division in mesopelagic waters.

However, there are some problems in this field. As our data show, the pre-spawning specimens of Gonostoma denudatum, Margrethia obtusirostra, Argyropelecus aculeatus, A.hemigymnus, Sternoptyx diaphana, S.pseudobscura, Ichthyococcus ovatus occurred rather far north, almost up to the Flemish Cap area. Nevertheless, the analysis of the captures showed that all these referred to the warm ring waters of the North Atlantic Current, which passed through that area in June-July 1984. Outside the

warm rings and the current itself, as a rule, only large immature specimens occurred. Except this, the captures of pre-spawning and even spawning specimens in any areas are not the evidence of reproduction as yet the larvae and fry of these fishes would be found.

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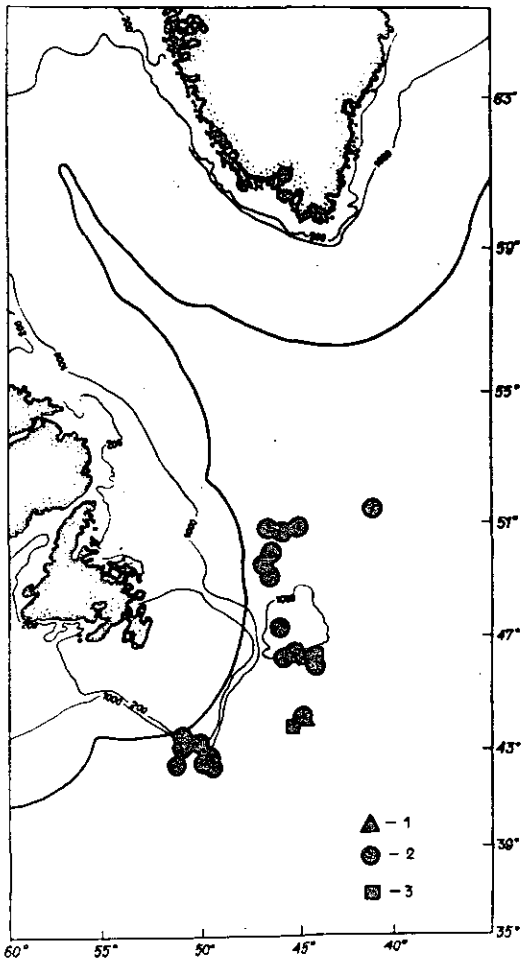


Fig. 1 Chart of species distribution:
1 - Gonostoma denudatum;
2 - Gonostoma elongatum;
3 - Margrethia obtusirostra.

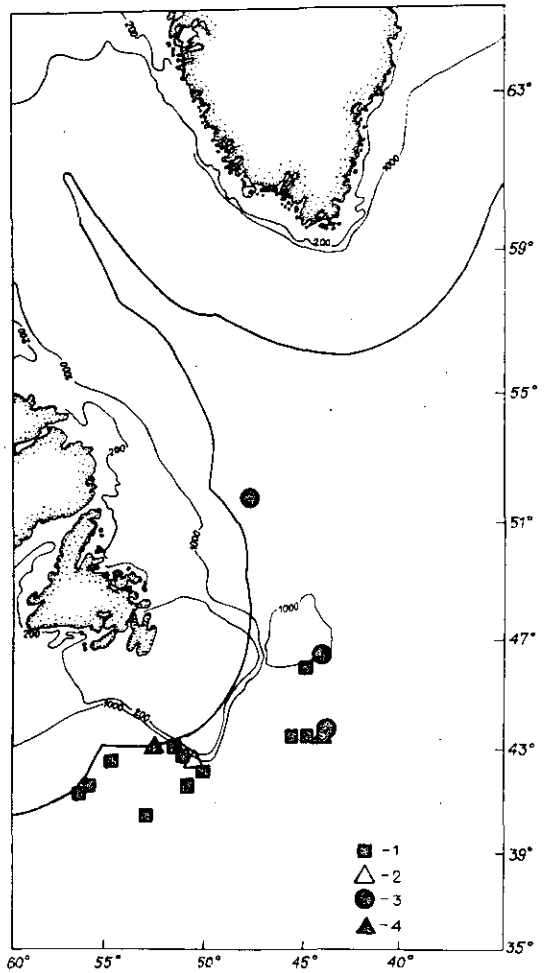


Fig. 2 Chart of species distribution:
1 - Argyropelecus aculeatus;
2 - A.gigas;
3 - A.hemigymnus;
4 - A.sladeni.

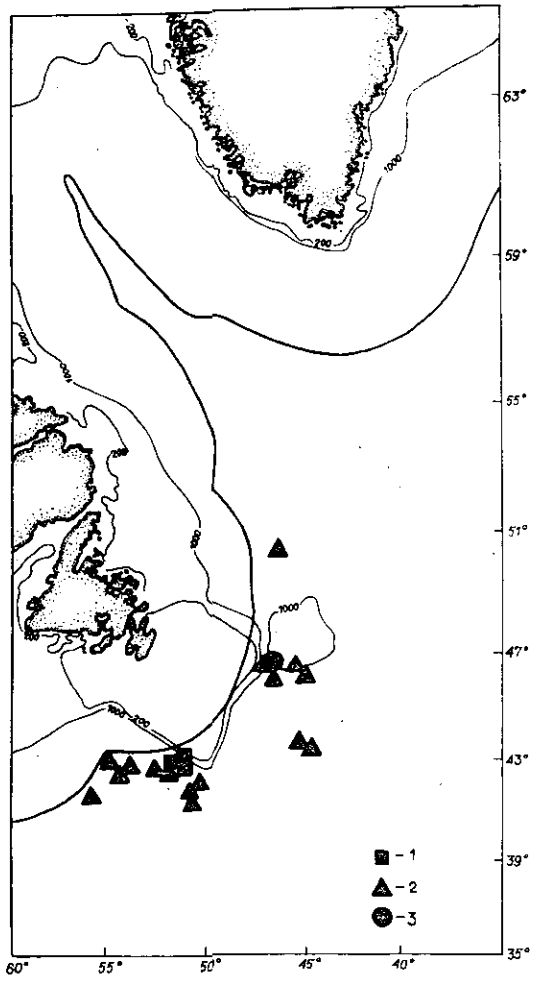


Fig. 3 Chart of species distribution:
1 - Polyipnus asteroides;
2 - Sternoptyx diaphana;
3 - S.pseudobscura.

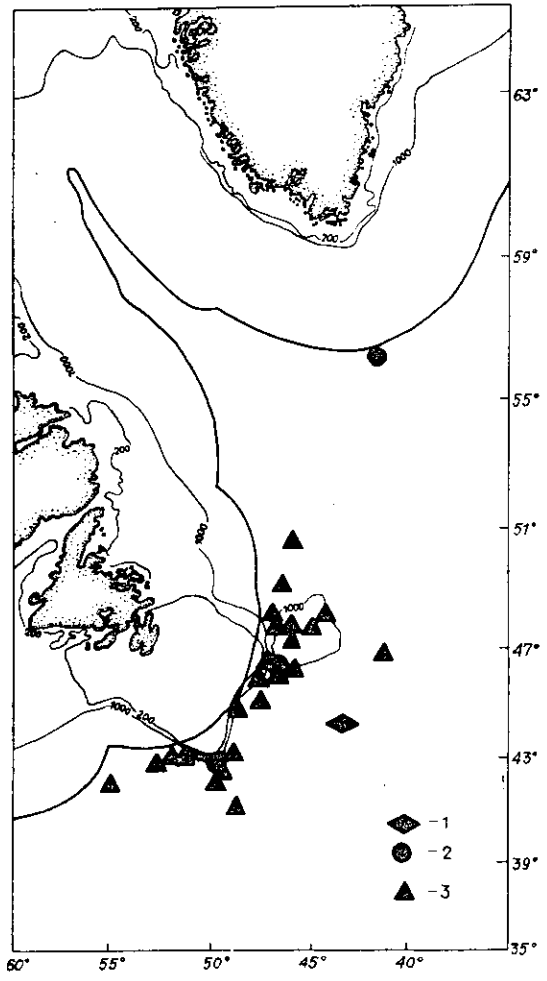


Fig. 4 Chart of species distribution:
1 - Ichthyococcus ovatus;
2 - Borostomias antarcticus;
3 - Chauliodes sloani.

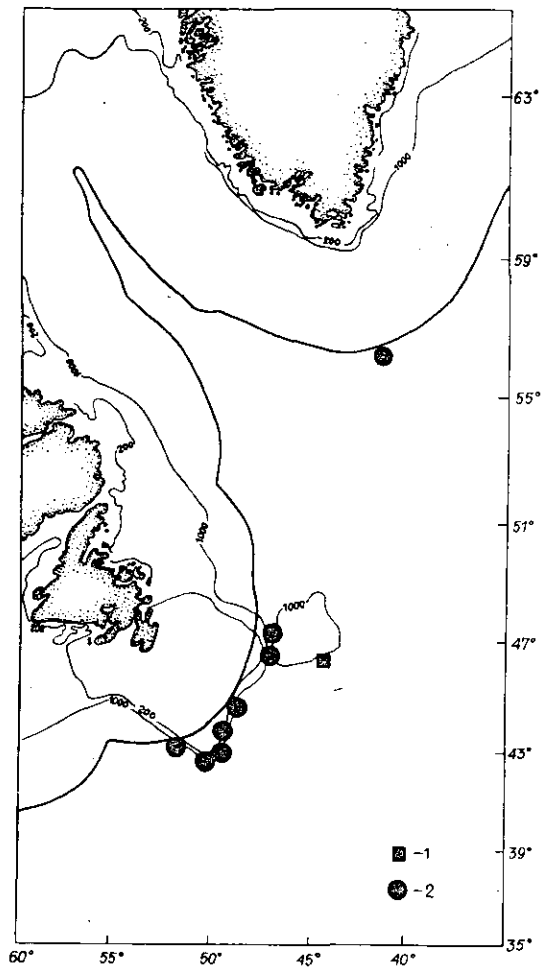


Fig. 5 Chart of species distribution:
1 - Macrostomias longibarbatus;
2 - Stomias boa ferox.

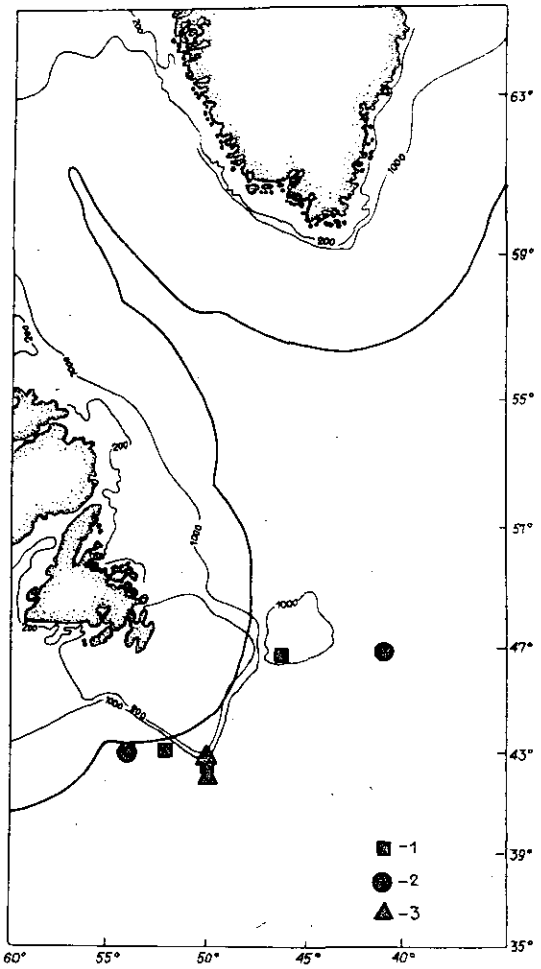


Fig. 6 Chart of species distribution:
1 - Melanostomias melanops;
2 - M.valdiviae;
3 - Pachystomias microdon.

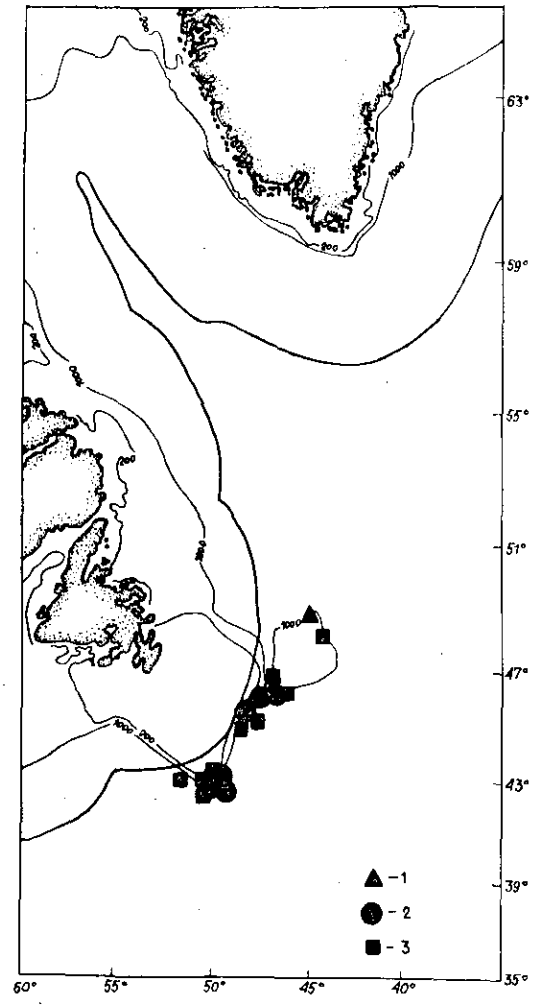


Fig. 7 Chart of species distribution:
1 - Photonectes braueri;
2 - Trigonolampa miriceps;
3 - Malacosteus niger.