Arctogadus

GADI Arc

Genus with Reference : ***Arctogadus*** Drjagin, 1932, Zool.Anz., 98: 151.

Diagnostic Features : Jaws of about equal length or lower jaw protruding. Palatine teeth almost always present. Three dorsal fins, two anal fins; all separate from each other; first anal fin base short, less than one-half of preanal distance. Scales overlapping. Lateral line interrupted along its entire length. No lateral-line pores on head.

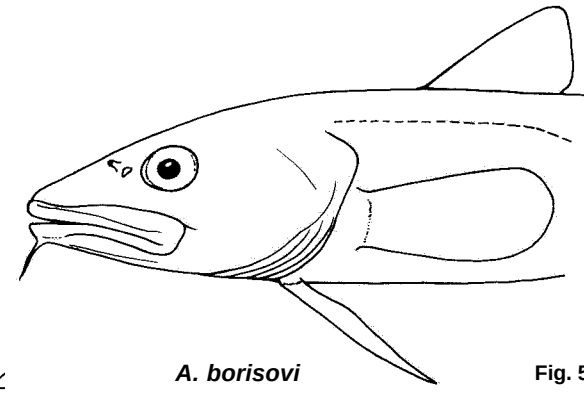
Habitat, Distribution and Biology : Pelagic, often associated with ice at sea, ***A. glacialis***, or in brackish water close to land ***(A. borisovi).***

Interest to Fisheries : See species.

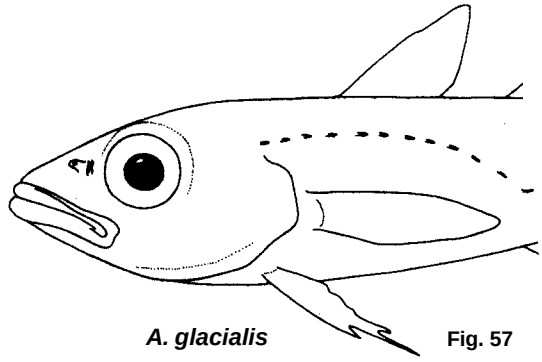
Key to species:

1a. Chin barbel well-developed (Fig. 56) . . . . . ***A. borisovi***

1b. Chin barbel rudimentary or absent (Fig. 57) . . . . . ***A. glacialis***



A. borisovi **Fig. 56**



A. glacialis **Fig. 57**

Arctogadus borisovi Drjagin, 1932

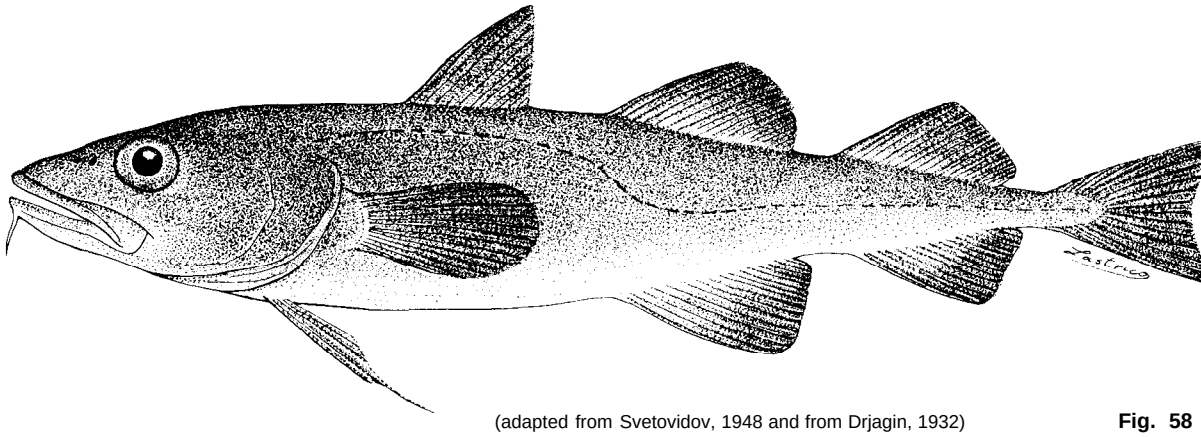
Fig. 58

GADI Arc 1

Scientific Name with Reference : ***Arctogadus borisovi*** Drjagin, 1932, Zool.Anz., 98: 151.

Synonyms : ***Boreogados pearyi*** Nichols & Maxwell, 1933.

FAO Names : **En** - East Siberian cod.



(adapted from Svetovidov, 1948 and from Drjagin, 1932) **Fig. 58**

Diagnostic Features : Chin barbel well-developed. Gill rakers on first arch 33 (31 to 35). Interorbital width 6.1% (5.1 to 7.0) of standard length; horizontal diameter of orbit 7.1% (6.2 to 8.5) of standard length. Not all specimens can be readily identified with these characters.

Geographical Distribution : Western half of Canadian Arctic coast, Arctic coasts of Siberia, also off northern and southern coasts of Greenland (Fig. 59).

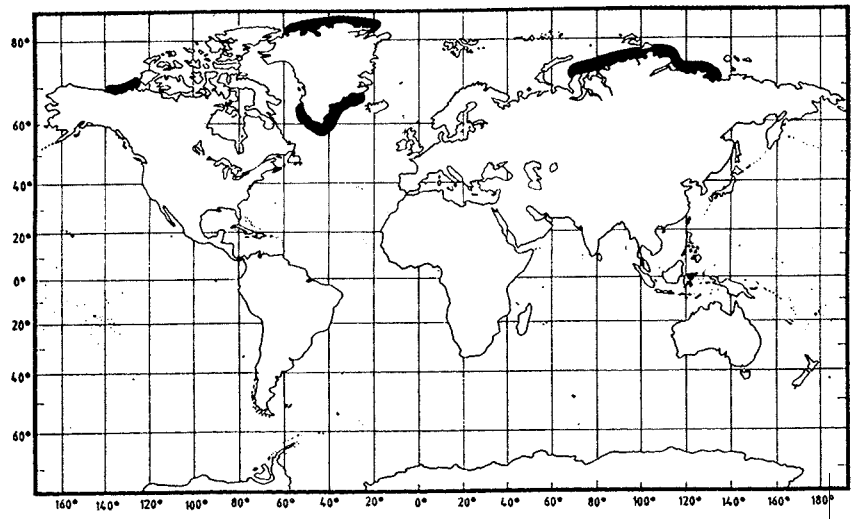


Fig. 59

Habitat and Biology : Mostly found near the bottom in littoral waters, but also far from shore, associated with pack ice. Entering low-salinity river mouths according to Andriashev (1954), avoiding low salinities according to Moskalenko (1960).

Size : Reaches at least 50 cm total length.

Interest to Fisheries : Probably taken as bycatch in trawls, but of very little economic value.

Literature : Andriashev (1954); Moskalenko (1960); Nielsen & Jensen (1967); Andriashev et al. (1980).

Arctogadus glacialis (Peters, 1874)

Fig. 60

GADI Arc 2

Scientific Name with Reference : ***Gadus glacialis*** Peters, 1874, Die seite deutsche Nordpolarfahrt., Zweiter Bd.:2.

Synonyms : ***Phocaegadus megalops*** Jensen, 1948.

FAO Names : **En -** Artic cod; **Fr** - Morue arctique; **Sp -** Bacalao del Artico.

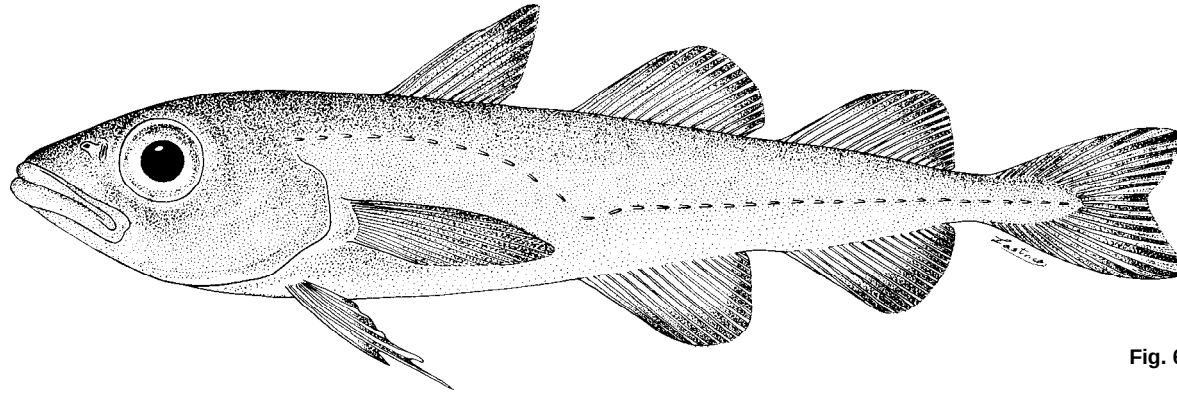


Fig. 60

Diagnostic Features : Chin barbel rudimentary of absent. Gill rakers on first arch 30 (27 to 34). Interorbital width 5.6% (4.4 to 6.8) of standard length; horizontal diameter of orbit 9.0% (8.0 to 11.0) of standard length. Not all specimens can be readily identified with these characters.

Geographical Distribution : Apparently widely distributed in western part of arctic basin, also northwest and northeast coasts of Greenland (Fig. 61).

Habitat and Biology : A pelagic species, associated with ice, found mainly in offshore waters, at or beyond the edge of the continental shelf, from the surface to about 1 000 m depth. No information is available on its biology.

Size : Reaches at least 32.5 cm total length.

Interest to Fisheries : Caught by Norway with trawls between 230 and 930 m depth. The major fishing grounds are located in the northeastern part of the East Siberian Sea, off East Greenland (Sabine Island), and north of the Baffin Sea (74 to 77ºN). It is used as fish meal and oil, and has little importance as food.

Literature : Nielsen & Jensen (1967); Andriashev et al. (1980).

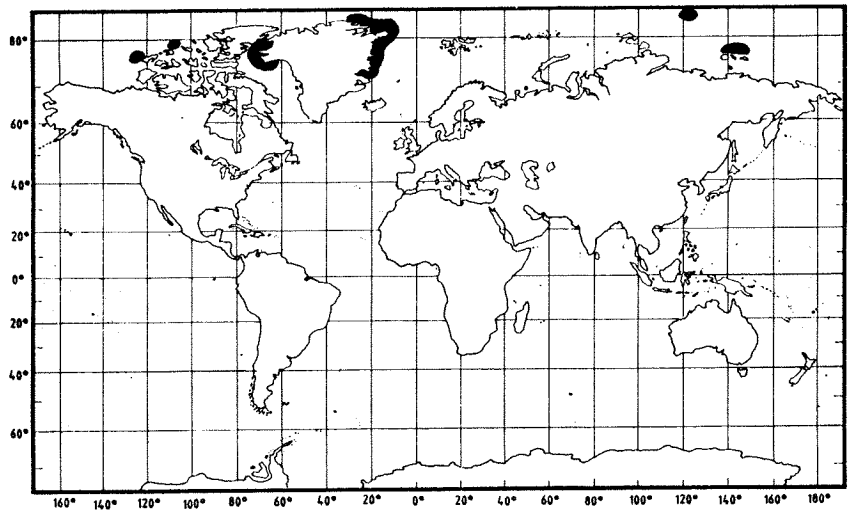


Fig. 61

Boreogadus

GADI Bor

Genus with Reference : ***Boreogadus*** Günther, 1862, Cat.Fish., 4:336.

Diagnostic Features : See species.

Remarks : A single species presently recognized (see Andriashev, 1954).

Boreogadus saida (Lepechin, 1774)

Fig. 62

GADI Bor 1

Scientific Name with Reference : ***Gadus saida*** Lepechin, 1774, Novi Comment.Acad.Sci.Petropol., 18:512

Synonyms : ***Merlangus Polaris*** Sabine, 1824; ***Gadus fabricii*** Richardson, 1836; ***Gadus agilis*** Reinhardt, 1838; ***Pollachius Polaris,*** Gill, 1862; ***Boreogadus Polaris,*** Gill, 1863.

FAO Names : **En** - Polar cod; **Fr** - Morue polaire; **Sp** - Bacalao polar

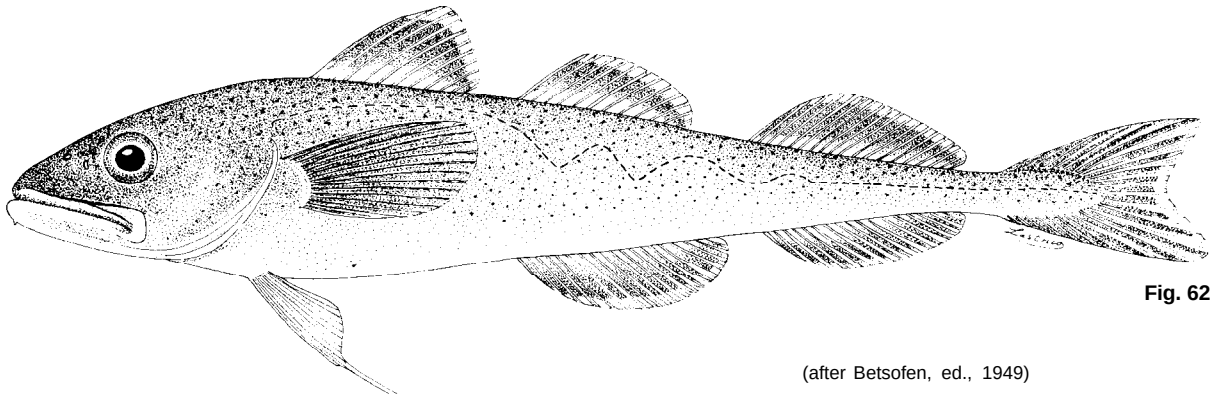


Fig. 62

(after Betsofen, ed., 1949)

Diagnostic Features : Jaws of about equal length or lower jaw slightly longer. Chin barbel very small. Palatine teeth always absent. Three dorsal fins, two anal fins, all separate from each other; first anal fin base short, less than one-half of preanal distance; caudal fin deeply concave. Pectoral fin reaching beyond end of first dorsal fin; pelvic fin with a slightly elongated ray. Lateral line interrupted along its entire length, variable in position. No lateral line pores on head. Scales small and embedded, not overlapping. **Colour** : along back brownish, with many fine dark points; sides and belly silvery; fins dusky, with pale margins.

Geographical Distribution : Found throughout the entire north polar basin, around Greenland and Iceland, into Hudson Bay and in the north and northwest Bering Sea (Fig. 63).

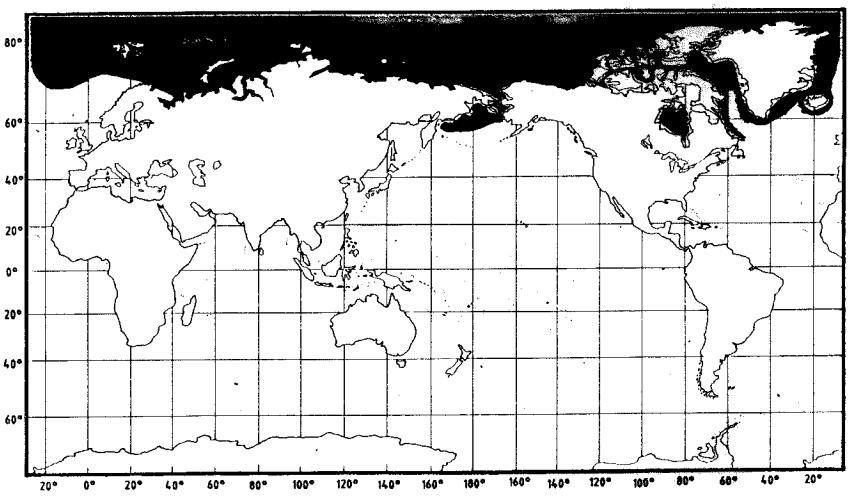


Fig. 63

Habitat and Biology : The Arctic cod is circumpolar and occurs in coastal habitats during both summer and winter. In the Beaufort Sea, it is also found in brackish lagoons and in almost fresh water in river mouths. Although associated with the occurrence of ice (White Sea), the Arctic cod is present in ice-free nearshore waters (Alaska); also found at 50-175 km offshore in the Beaufort and Chukchi Seas, at depths of 40 to 400 m. This fish is tolerant of widely fluctuating temperatures, salinities, and turbidities.

Migration patterns are unknown, except for a prespawning migration to nearshore waters in late summer in the Beaufort Sea. The Barents Sea stock also undertakes winter mass migrations into the White Sea for spawning.

In the Beaufort Sea, most mature males are 2 to 3 years old, whereas most mature females are 3 years old. These ages at first maturity are similar to those reported for the northwest Atlantic and Soviet stocks. In Cheshskaya Bay (White Sea), sexual maturity occurs in the 4th to 5th year of life. A predominance of females among older fish is reported in most populations of Arctic cod (74% females in populations of 3 to 6 years old fish).

Arctic cod spawns once in its lifetime Its fecundity is 9 000 to 21 000 eggs, on average 11 900 eggs per females. The spawning season extends from late November to early February in the Beaufort Sea, from end of December to February in Soviet waters, and from January to February (sometimes April) in the White Sea. Although spawning occurs in the coastal areas of the Beaufort Sea and under the shore ice of the White and Barents Seas, the relative importance of nearshore sites compared with regions farther offshore for spawning remains unknown.

Because of the unpredictable conditions of its environment, Arctic cod is an r-selected species with early maturity, rapid growth, production of larger numbers of offspring at a given parental size, small body size, high rates of mortality, and shorter life span. Lagoon and coastal fish are larger at each age than those from deep offshore waters, since warmer coastal waters provide more favourable growth conditions. In Simpson lagoon (Beaufort Sea), a 1 year individual may attain 60 mm total length (usually 21 mm), and older fish vary from 45-257 mm (usually 60-170 mm) while the largest fish offshore usually vary from 60 - 110 mm; the maximum age is 6-7 years.

Arctic cod feed mostly on epibenthic mysids and also on amphipods and copepods. For those that are under the ice surface in offshore waters, fish is the principal food item during the winter. Although they prefer to eat mysids, the dietary importance and proportions of the major groups of prey are based on prey availability. For example, the food of some of the specimens examined in the White Sea consisted exclusively of young shrimp.

It is an important food-fish for many of the larger mammals and birds of the Arctic seas.

Size : Reaches 40 cm total length; common to 25 cm

Interest to Fisheries : Arctic cod used to be intensively fished by USSR, Norway, Danish and German Dm Rp vessels using bottom- and mid-water trawls. The fishing grounds are the European part of USSR, Barents and White Seas, and the northwest Atlantic. The fish is pursued from January through May producing massive catches during February. In 1984, world catches totalled 23 709 metric tons, and after that year they declined steadily, although the stocks are little affected by-fishing because r-selected species can support higher levels of fishing mortality and have a quicker recovery time. The total catch reported for 1987 in the FAO Yearbook for Fishery Statistics is 11 713 metric tons, all taken by USSR.

In Canadian waters, Arctic cod has a limited commercial value because it is small and apparently not abundant. The flesh is said to be of low quality. It is exploited in a minor way as an industrial fish, but has great potential for increased catches. Its major utilization by Norwegians is for fish meal and oil.

Local Names : CANADA: Arctic cod, Polar cod; DENMARK : Polartorsk; GERMANY : Polardorsch; NORWAY : Polartorsk; USA: Arctic cod, Polar cod; USSR : Saika.

Literature : Jensen (1948); Andriashev (1954); Moskalenko (1964); Leim & Scott (1966); Wheeler (1978); Altukhov (1979); Craig et al. (l982).

Brosme

GADI Bro

Genus with Reference : ***Brosme*** Cuvier in Oken, 1817, Isis: 1182.

Diagnostic Features : See species.

Remarks : A single species in the genus.

Brosme brosme (Ascanius, 1772)

Fig. 64

GADI Bro 1

Scientific Name with Reference : ***Gadus brosme*** Ascanius, 1772, Icones Rerum, 2:7.

Synonyms : ***Gadus torsk*** Bonnaterre, 1788; ***Gadus lubb*** Euphrasen, 1794; ***Blennius torsk,*** Lacepède; ***Enchelyopus brosme*** Bloch & Schneider, 1801; ***Brosmius flawesny*** LeSueur, 1819; ***Brosmius vulgaris*** Fleming, 1828; ***Brosmius scotica*** Swainson, 1839; ***Brosmius flavescens*** Günther, 1862; ***Brosmius americanus*** Gill, 1863; ***Brosmius brosme,*** Gill, 1863.

FAO Names : En - Tusk (= Cusk); Fr - Brosme; Sp - Brosmio

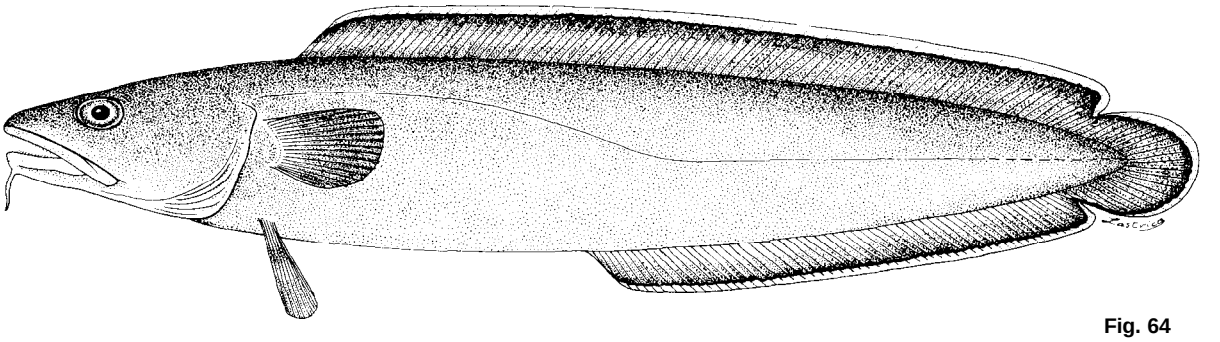


Fig. 64

(after Bigelow & Schroeder, 1953)

Diagnostic Features : Upper jaw slightly longer than lower. Barbel present on chin; none on snout. Single, long-based dorsal and anal fins, partly connected at their posterior ends to the rounded caudal fin; pectoral fin falling far short of anal fin origin. No elongated rays in the fleshy pelvic fin. Lateral line continuous until slightly before the caudal peduncle. Lateral line pores present on head. **Colour :** variable; dorsally dark red-brown or green-brown to yellow shading into pale colour on belly. Young fish may have six transverse yellow bands on sides. The most characteristic colour pattern is on the vertical fins, which have dark margin rimmed with white.

Geographical Distribution : Western north Atlantic from New Jersey to the Strait of Belle Isle and on the Grand Banks of Newfoundland. Rare at the southern tip of Greenland. Found off Iceland, in the northern North Sea, and along the coasts of Scandinavia to the Murmansk Coast and at Spitzbergen (Fig. 65).

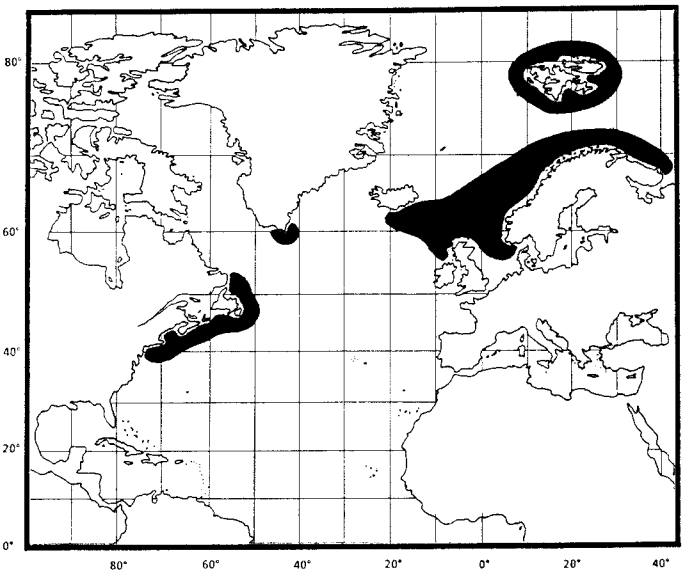


Fig. 65

Habitat and Biology : The tusk lives alone or in small shoals on rough, rock, gravel, or pebble bottoms of both sides of the North Atlantic. In the Gulf of Maine, it is occasionally found on mud with hakes, and in Norwegian waters, it often lurks among gorgonian corals. Seldom found on smooth, clean sand.

Generally keeps far from the shore, near the bottom, at depths from 20 to 1 000 m, mostly between 150 and 450 m in the northeastern Atlantic (except in the Faeroe Channel where it has been caught at 954 m), and between 18 and 549 m in the northwestern Atlantic. Never found near the shore or at depths of less than 20-30 m. It tolerates a temperature range from 0 to 10°C.

The tusk moves little from bank to bank and there is no definite evidence of seasonal onshore or offshore migrations. While remaining in the same region, it undertakes only local migrations from greater to lesser depths. It is found alone or in small aggregations, not forming large schools such as do other gadoids.

First maturity is reached at 8-10 years (50 cm length). Tusk is among the more prolific of fishes and a female of medium size can lay up to 2 million eggs which develop close to the surface. Spawning occurs in spring and early summer (April to July) on both sides of the Atlantic. Spawning grounds are distributed practically throughout the entire range, but the most important ones are between Scotland and Iceland. In the eastern Atlantic, they are located on the edge of the Shetland Islands, Faeroes and Iceland slopes, from 200 to 500 m depth, and in the northern part of the North Sea, along the 100-200 m isobaths. However, in the Gulf of Maine, the chief production of eggs probably takes place in shallower waters (but not less than 50 m) since most of the stock lives in lesser depths there. Some individuals probably even spawn close inshore in Cape Cod, Provincetown Harbour, and the Isles of Shoals. Up to 5 cm length, young are pelagic, then becoming benthic.

The growth rate is slow: at age 6 the fish is about 22 cm; at 7 it varies from 26 to 37 cm; at 8 from 36 to 48 cm; and at 15 from 60 to 80 cm. It lives for a maximum of about 20 years.

It feeds mostly on crustaceans and shellfishes, and also on benthic fishes (flatfishes and gurnard) and even on starfishes.

Size : The maximum size is 110 cm although cusk is more common from 60 to 95 cm in the eastern, and from 50 to 80 cm in the western North Atlantic.

Interest to Fisheries : The total catch reported in the FAO Yearbook of Fishery Statistics for 1987 is 46 254 metric tons. Tusk is fished by Canada (3 960 t in 1987) and USA (1 390 t in 1987) in the North West Atlantic, especially in the Gulf of Maine. Off Cape Cod, it is mostly caught incidental to cod fishing. In its eastern distribution, it is mostly taken by Norway (30 082 t in 1987), Faeroe Islands (6 600 t), Iceland (2 984 t), with major fishing grounds off the north coast of the British Isles, Denmark, the Northern part of the North Sea, Kattegat to Iceland, and the Murmansk coast. Along USSR shores, it is rare and cannot be considered a commercial fish.

The decreased landings of the North American fisheries in recent years are due to the change from longlining to otter trawls; tusk is not a good trawl fish since it frequents rough bottoms.

Tusk is caught with otter trawls and on hard bottoms, with longlines. It is also taken in the Gulf of Maine by sportsmen fishing for groundfish in general.

Utilization: fresh or frozen as fillets, but also dried, salted, and in brine

Local Names : BELGIUM: Lom; CANADA: Cusk, Torsk, Tusk; DENMARK: Brosme; FRANCE: Brosme; GERMANY : Lumb; NETHERLANDS: Lom; NORWAY : Brosme; SWEDEN : Lubb, Lumb; UK: Cusk, Torsk, Tusk; USA: Cusk, Torsk, Tusk; USSR : Menek, Menyok.

Literature : Bigelow & Schroeder (1953); Andriashev (1954); Svetovidov (1962); Leim & Scott (1966); Quero (1984).

Ciliata

GADI Cil

Genus with Reference : ***Ciliata*** Couch, 1832, Mag.nat.Hist., 5:15.

Diagnostic Features : A barbel on chin and four or more barbels on snout. First dorsal ray followed by a row of small, fleshy filaments; anal fin single, not indented; pectoral fin falling far short of anal fin origin. Lateral line interrupted along its entire length.

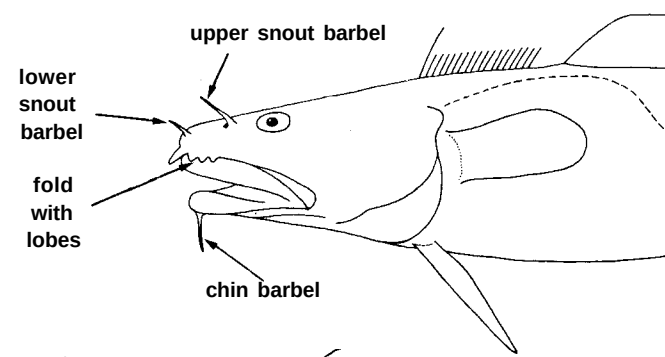
Habitat, Distribution and Biology : Found in the northeastern Atlantic, from the intertidal zone to 90 m depth, living on the bottom.

Interest to Fisheries : Practically none.

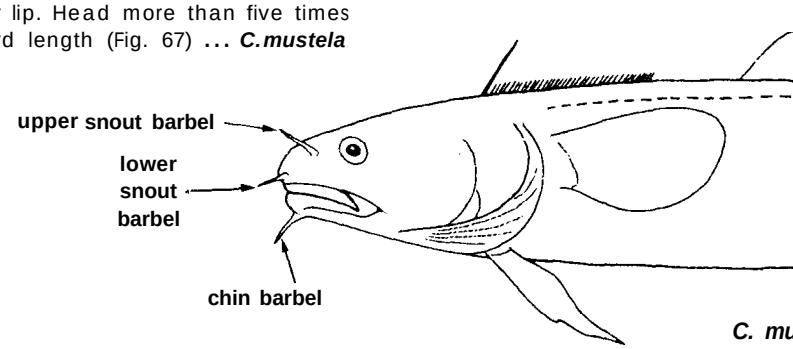
Key to species:

1a. A fold of skin above the upper lip wit three pairs of lobes or snout barbels. Head less than five times in standard length (Fig. 66) . . . . . ***C. septentrionalis***

1b. No fold of skin with lobes or barbels above the upper lip. Head more than five times in standard length (Fig. 67) ... ***C.mustela***



C. septentrionalis **Fig. 66**



C. mustela **Fig. 67**

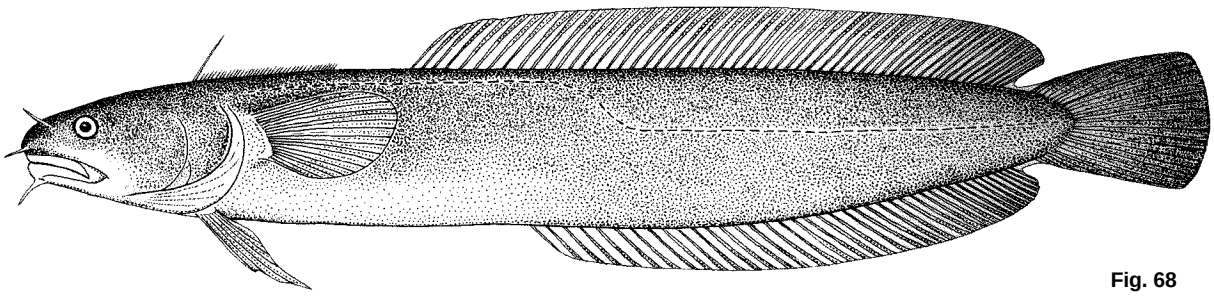
Ciliata mustela (Linnaeus, 1758) **Fig. 68**

GADI Cil 1

Scientific Name with Reference : ***Gadus mustela*** Linnaeus, 1758, Syst.Nat., ed X:255

Synonyms : ***Ciliata glauca*** Couch, 1832; ***Motella (Couchia) argenteola*** Duben & Koren, 1846; ***Enchelyopus*** mustela, Gronow, 1854; ***Couchia minor*** Thompson, 1856; ***Couchia glauca*** Thompson, 1856; ***Molvella borealis*** Kaup, 1858; ***Motella mustela,*** Moreau, 1881**;** ***Onos mustela,*** Smitt, 1893; ***Gaidropsarus mustela,*** Lozano Rey, 1960.

FAO Names : **En -** Fivebeard rockling; **Fr -** Motelle à cinq barbillons.



(after Svetovidov, 1948)

Fig. 68

Diagnostic Features : Head relatively small, more than five times in standard length. No lobed fold of skin above upper lip. **Colour** : dark brown dorsally, reddish to blackish shading to pale grey-brown ventrally.

Geographical Distribution : From Lisbon north to Finnmark, around the British Isles, in the Skagerrak and Kattegat and Iceland (Fig. 69).

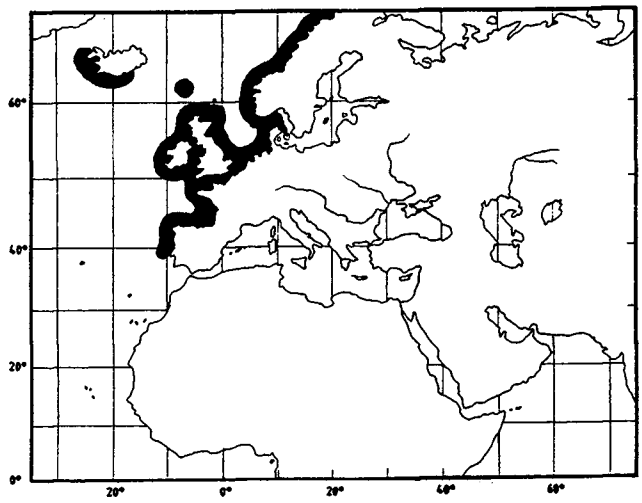


Fig. 69

Habitat and Biology : A common fish in the intertidal zone. Generally keeps close to the shore, not descending to great depths beyond the limits of the distribution of green algae (20 m), preferring rock bottoms but also living on sandy, muddy, and shell gravel bottoms**.**

Both males and females reach first maturity at 1 year and depending on their size, females lay 9 000 to 30 000 eggs. Breeds in deeper waters from February to May off the West Irish coast. Eggs and larvae are pelagic.

Female growth rate is higher than that of males: at 1 year, females are 14 cm long and males 11-13 cm, and at 2 years , they measure 20 and 17 cm respectively. Lives up to 3 years**.**

Feeds on crustaceans, mostly isopods, amphipods, crabs, shrimps, copepods and ostracods. Sometimes also on algae, polychaetes, gastropods and occasionally, small fish**.**

Size : Maximum to 25 cm total length

Interest to Fisheries : No commercial value

Local Names : BELGIUM: Lompje, Zeepuitaal; DENMARK: Femtradet Hawkvabbe; FRANCE: Motelle à cinq barbillons; GERMANY: Fünfbärtelige Seequappe; NETHERLANDS: Lompje, Zeepuitaal; NORWAY: Firtraadet Tang-Brosme; UK: Fivebeard rockling.

Literature : Svetovidov (1948); Wheeler (1969, 1978); Quero (1984)

Ciliata septentrionalis (Collett, 1875)

Fig. 70

GADI Cil 2

Scientific Name with Reference : ***Motella septentrionalis*** Collett, 1875, Ann.Mag.nat.Hist., (4)15:82

Synonyms : ***Onos septentrionalis,*** Collett, 1880**;** ***Gaidropsarus septentrionalis,*** Collett, 1903.

FAO Names : **En -** Northern rockling.

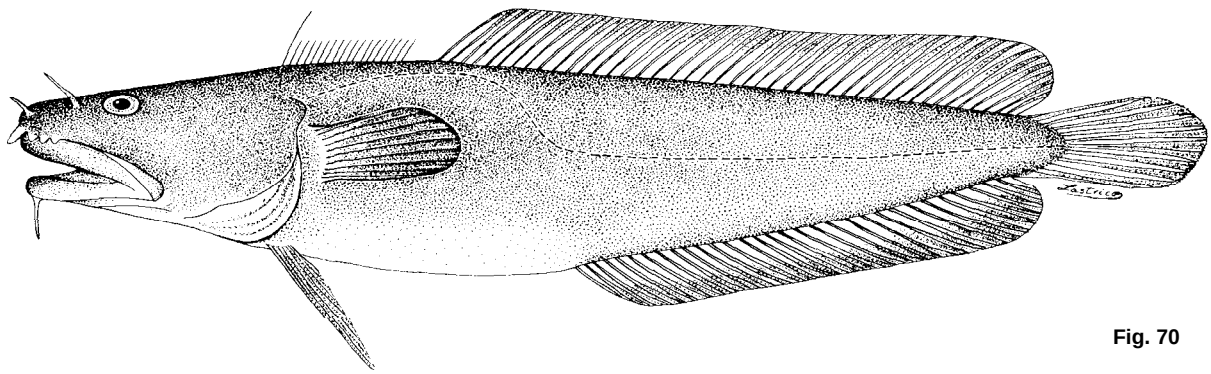


Fig. 70

Diagnostic Features : Head relatively large, less than five times in standard length. A fold of skin above the upper lip with three pairs of lobes or small barbels. In males, the jaw extends well past the eye; in females, only slightly past the eye.

Geographical Distribution : Around the British Isles and northward along the European coast to northern Norway; also at the Faeroe Islands and Iceland (Fig. 71).

Habitat and Biology : From the sublittoral zone to 90 m depth, but most common from 10 to 50 m on rock, sand or mud bottoms.

Size : Reaches 20 cm total length.

Interest to Fisheries : Practically none.

Local Names : NORWAY: Nordisk Tangbrosme; UK : Northern rockling.

Literature : Wheeler (1969, 1978)

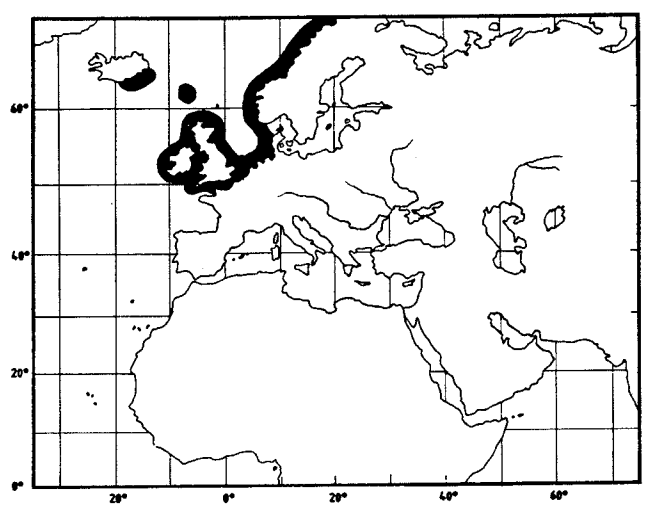


Fig. 71

Eleginus

GADI Ele

Genus with Reference : ***Eleginus*** G. Fischer, 1812-13, Mem.Soc.Nat.Moscou, 4:252-57

Diagnostic Features : Upper jaw slightly longer than lower. Three dorsal and two anal fins, distinctly separated from each other; first anal fin base short, less than one-half of preanal distance; pectoral fins falling short of anal fin origin; pelvic fins with a slightly elongated ray; rear margin of caudal fin nearly straight**.** Lateral line continuous to about origin of second dorsal fin. Head lacking lateral-line pores. Tips of parapophyses on some vertebral centra swollen and hollow, containing outpouchings of swimbladder**.**

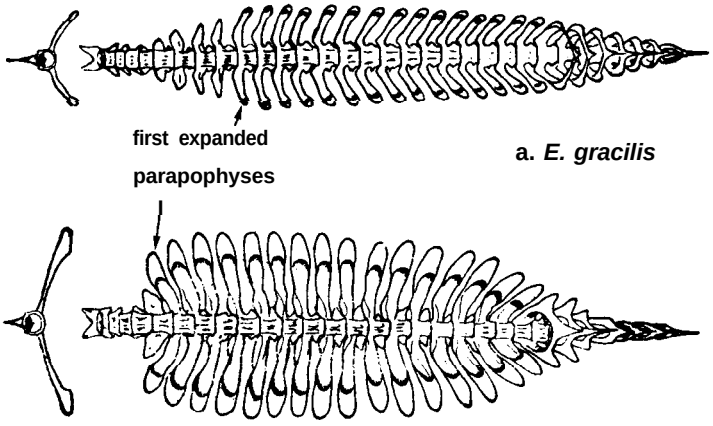
Habitat, Distribution and Biology : Coastal areas to 60 m depth. Also found in brackish to fresh tidal waters. Boreal North Pacific and adjacent Arctic waters, including Arctic coast of Europe.

Interest to Fisheries : Abundant fishes in some parts of their range.

Key to species:

1a. Expanded parapophyses begin on about centrum 9 or 10 (Fig. 72a). Gill rakers on first arch 14 to 25 ..... ***E. gracilis***

1b. Expanded parapophyses begin on about centrum 5 (Fig. 72b). Gill rakers on first arch 19 to 31 ..... ***E. navaga***



a. *E. gracilis*

b. *E. navaga*

Ventral view of vertebral column showing parapophyses
(from Svetovidov, 1948)

Fig. 72

Eleginus gracilis (Tilesius, 1810)

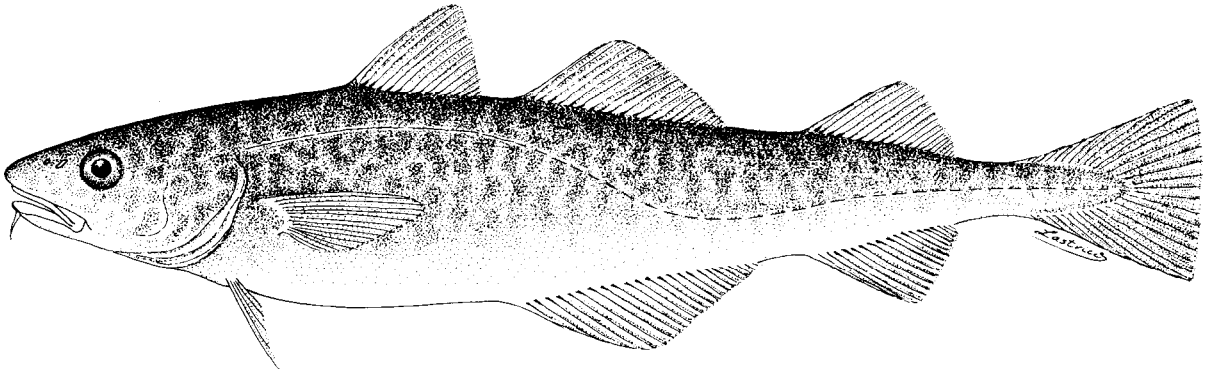
Fig. 73

GADI Ele 1

Scientific Name with Reference : ***Gadus gracilis*** Tilesius, 1810, Mem.Acad.Sci.Petersb., 2:354

Synonyms : ***Gadus wachna*** Pallas, 1811; ***Eleginus navaga gracilis,*** Schmidt, 1904.

FAO Names : **En -** Saffron cod; **Fr -** Morue boréale; **Sp -** Bacalao boreal.



(after Masuda et al., 1984)

Fig. 73

Diagnostic Features : Expanded parapophyses beginning on about vertebral centrum 9 or 10 swollen and hollow, containing outpouchings of the swimbladder; gill rakers 14 to 25**. Colour** : dorsally dark grey-green to brown, mottled; pale ventrally.

Geographical Distribution : North Pacific from the Yellow Sea in the southwest to Sitka in the southeast. Beyond the Bering Strait in the Chukchi Sea and east to Dease Strait (south coast of Victoria Island). Precise delimitation of the range depends on additional taxonomic study (Fig. 74).

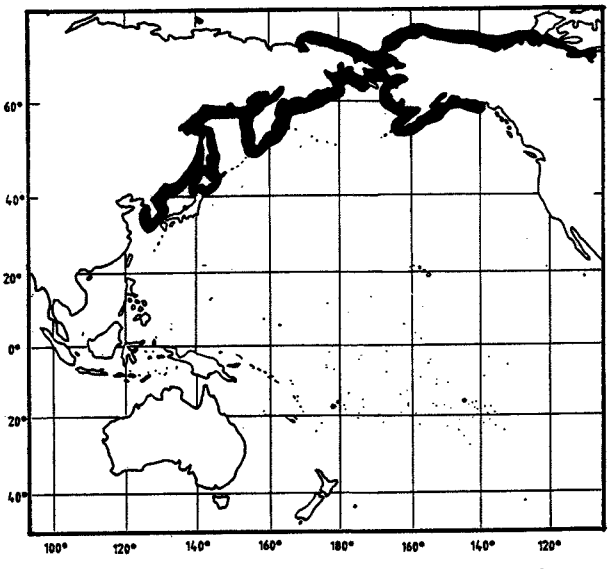


Fig. 74

Habitat and Biology : Occurs in shallow coastal waters at less than 60 m depth in the Arctic and western Pacific, and at less than 50 m depth in the northeastern Bering Sea and western Alaska, Norton Sound. It has been found, however, off northern Japan, on the continental shelf edge at 200 m depth. The Saffron cod also enters brackish and even fresh waters, occurring quite far up rivers and streams, but remaining within regions of tidal influence.

Migrations are not extensive. The juveniles are not migratory and stay in shallow water throughout the year, whereas adults undertake restricted seasonal migrations associated with spawning, feeding and changes in water temperature. The migration pattern could be summarized as winter inshore and summer offshore (or less inshore): in early winter, the fish move from the coast or estuaries into adjacent sand-pebble areas for spawning. After spawning, they return to silty bottoms or estuarine areas where they feed. They spend the winter under the ice cover and in early spring, when the water warms up, they move offshore to the cold and highly saline waters of the open sea. However, the southern Kuril population spends the autumn-winter period in the open sea at depths of 100 to 200 m because the absence of temperature conditions necessary for spawning in August-October in the coastal shallow zone compels the fish to migrate into colder waters.

The Saffron cod begin to mature during their third year of life in Norton Sound, western Alaska. Similar observations made in the western Pacific, northern Tatar Strait, and northern Sea of Okhotsk report the first maturity to occur at 2 to 3 years of life for both sexes.

Fecundity varies with geographical region. It decreases from east to west in the European Arctic and from south to north in western Pacific waters. Furthermore, individual fecundity increases with body length, weight and age. In the Gulf of Sakhalin, a two year-old fish (17 cm length) has a minimum fecundity of 4 900 eggs while a 9 year-old individual (47 cm length) in the Gulf of Terpenie can lay a maximum of 680 000 eggs. Thus, the maximum fecundity is 139 times higher than the minimum. For example, a 20-35 cm fish along the USSR Pacific coast (Tatar Strait) has an estimated fecundity of 29 000-124 000 eggs.

The Saffron cod spawns once a year, 5 to 7 times in its life, and sometimes even 9-10 times for those fish that live up to I0-14 years. Throughout its distribution area, spawning occurs during January-February in coastal zones of bays and inlets, on sand -gravel substrate and in strong tidal currents, at depths of 2-10 m, with the exception of the Gulf of Terpenie stock that spawns at depths of 25-32 m. There are indications that the eggs are adhesive. Although spawning occurs at the same temperatures and salinities, larvae hatch out in early spring (April-May) in the Arctic or northernmost portions of the western Pacific, and somewhat later (during warming) in waters farther south, such as the Sea of Japan.

The growth rate differs by sex and depends on the amount of forage available. Highest growth rates occur in fish that mature earlier. Generally speaking, growth is relatively slow; it is somewhat faster in the western Pacific stocks (except in parts of the Sea of Okhotsk, where it is slow in comparison with some Arctic stocks) than in the Arctic ones, although they die younger. In the western Pacific distribution of the species, the size of a 3 year-old fish varies from 18.8 to 35.4 cm (mostly 29-35 cm), while in the Barents and Kara seas, it ranges between 16.5 and 20.7 cm. An 8-9 year-old fish in the western Pacific is about 53 cm long while the largest specimen found in Arctic waters was 44 cm The rate of natural mortality is high, 60-80% annually, and less than 1% of the stock survives past 5 years. The maximum age decreases southward: 11-12 years in Yama inlet and the Gulf of Terpenie; 9-10 years in the other regions of Sakhalin; 7-8 years in Gulf of Peter the Great and off the southern Kurils.

Juveniles and adults are opportunistic epibenthic feeders; juveniles feed on fish, mysids, decapods, and amphipods. Feeding starts in summer and goes on until the winter spawning. It is then reduced and resumes in mid-winter after reproduction.

Size : Reaches at least 55 cm total length.

Interest to Fisheries : Taken commercially in many areas of the northwestern Pacific and harvested for almost 100 years. Until 1973, total catches fluctuated between 6 600-22 300 t annually, they increased continuously in recent years to an average of 39 000 t/year between 1977 and 1980. The major fishing grounds are in the western North Pacific: Peter the Great Bay, Sakhalin region, Sea of Okhotsk and Kamchatka waters. Fishing is carried out during late autumn and winter by the USSR and, in Norton Sound, by Alaskan fishermen. Fishing gear used are not highly mechanized and include hook and line, beach and danish seines, gill nets, hoop-nets, fyke nets, and trawls. The catch reported for 1987 in the FAO Yearbook of Fishery Statistics is 27 929 t, all taken in the northwestern Pacific by USSR.

The size of the saffron cod does not permit its substitution into existing Pacific cod and walleye pollock markets and costs would not permit it to be profitably used in the pet food industry. It is used for human consumption in USSR, fresh or frozen

Local Names: USSR: Navaga

Literature : Svetovidov (1965); Safronov (1981); Wolotira (1985)

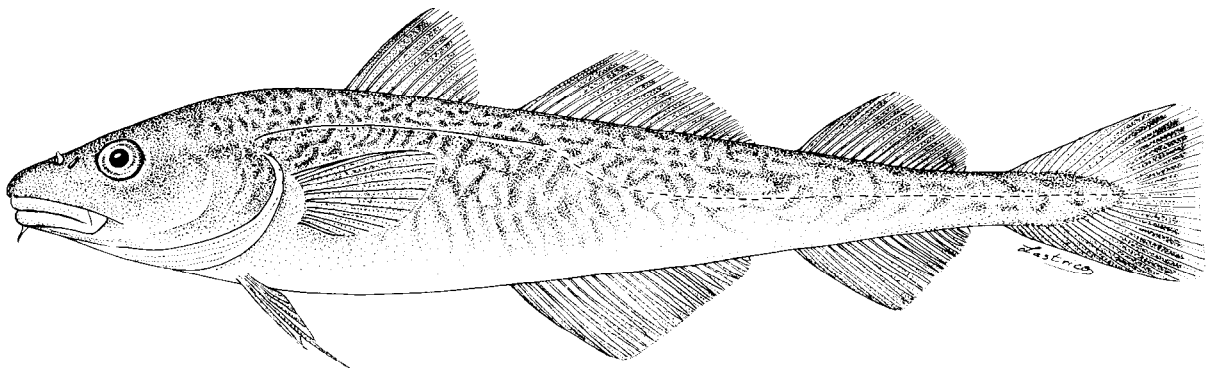
Remarks : Taxonomic problems remain to be solved.

Eleginus navaga (Pallas, 1811) **Fig. 75** **GADI Ele 2**

Scientific Name with Reference : ***Gadus navaga*** Pallas, 1811, Zoogr.- Rosso Asiat., 3: 19.

Synonyms : ***Eleginus navaga navaga*** Esipov, 1941; ***Eleginus navaga karaensis*** Esipov, 1941

FAO Names : **En -** Navaga; **Fr** - Morue arctique; **Sp -** Bacalao del Artico.



(after Svetovidov, 1948) **Fig. 75**

Diagnostic Features : Expanded parapophyses beginning on about vertebral centrum 5, swollen and hollow, containing outpouchings of the swimbladder; gill rakers 19 to 31. **Colour:** brownish dorsally, with small dark blotches; pale ventrally.

Geographical Distribution : Arctic Ocean in the White, Barents and Kara Seas. Precise delimitation of the range depends upon additional taxonomic research (Fig. 76).

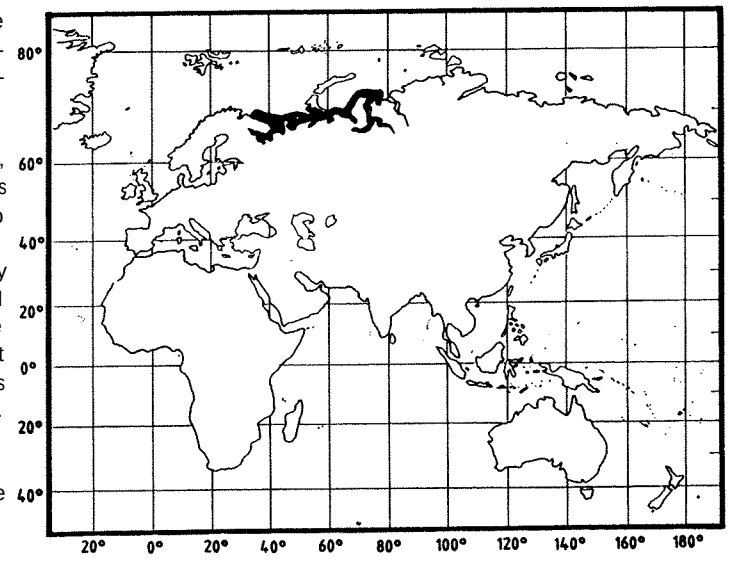


Fig. 76

Habitat and Biology : Lives in the coastal, sublittoral zone of the White Sea and Arctic coasts of Europe where it reflects a broad adaptation to the ecological conditions of the Arctic. It is found at shallow depths, along shores with soft ,muddy bottoms, close to the ice and on the continental shelf. It sometimes forms large schools under the ice. It is often caught in greatly freshened and at times completely fresh water, entering the mouths and tidal zones of rivers and traveling upstream. Not found in the open sea or at great depths.

This species does not undertake extensive migrations except for daily feeding.

Reaches sexual maturity in the third or fourth year. Females produce between 6 000 and 90 000 eggs per year.

In winter, before spawning, it gathers in great numbers close to shore, and enters the mouths and upper parts of rivers into areas that are under tidal influence. For spawning, the Navaga moves from the shores and river mouths to greater depths (8-10 m) over sandy or rocky bottoms, usually in January. Spawning sites are distributed in channels between islands or in depressions between the shore and shallow banks with strong tidal currents.

Eggs sink to the sea-bed, but are not adhesive. Development of the eggs occurs only in salt water; they perish in fresh water.

Under normal temperature conditions, the main mass of spawning Navaga consists of 2 to 4 year- olds whose dimensions are: 18 cm total length at 2 years, and 21 cm (Unshaya Inlet) at 3 years. Usual sizes in the White Sea are 15-23 cm, but the species reaches 35 cm and more; in Mezen Bay at the western shores of Kanin Peninsula, it attains the greatest size (to 40-42 cm) and age (7 years). Sizes are not always identical over the entire region; the Dvina Bay stock grows slower and fish are smaller than those from other White Sea bays. Apparently, in the other bays, local races or schools are formed.

It feeds mainly on crustaceans and worms, but eats small fishes as well, including stickleback, capelin, sandeels, saika, small cod, flounder, and navaga, which play the greatest role in the sustenance of larger navaga. In summer, with the rise of water temperature to 10°C and higher, they eat very poorly. It is in turn eaten by a wide range of larger fishes and Arctic mammals, and young are preyed upon by sea-birds.

Size : Reaching at least 42 cm total length.

Interest to Fisheries: Navaga is commercially fished by the Soviet fleet in the White Sea with “ryuzh” (local name for a type of net used in northwestern Russia) and partially on hook and line. The industrial catch takes place during mass gatherings for spawning beneath the ice, near shore. It begins in November and the greatest catches coincide with the peak of spawning in January, after which hungry, post-spawning Navaga are caught and the catch figure drops rapidly. Main fishing grounds are Dvina, Onega and Mezen bays of the White Sea and Cheshskaya Inlet.

In the past, the greatest quantity of Navaga was caught in Mezen Bay along the western coast of Kanin Peninsula, but in recent years, its numbers have greatly diminished. The total catch reported for 1987 in the FA0 Yearbook of Fishery Statistics was about 3 765 metric tons, all taken by USSR in the Arctic Ocean (Fishing Area 27).

Local Names : USSR: Navaga.

Literature : Svetovidov (1948, 1965); Wheeler (1969); Girsa (1986)

Remarks : Taxonomic problems remain to be solved.