RESTRICTED

INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

Serial No.2064
(D.c.3)

ICNAF Res.Doc.68/75

ANNUAL MEETING - JUNE 1968

Area Reviews on Living Resources of the World's Ocean

Northwest Atlantic

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1. TOPOGRAPHY

The area is the concern of the International Commission for the Northwest Atlantic Fisheries (ICNAF). The region is divided in five sub-areas as follows (in brackets the approximate area of shelf, down to about 200 m):

1. West Greenland (85,000 sq.km)
2. Labrador (ca 100,000 sq.km)
3. Newfoundland (419,000 sq.km)
4. Nova Scotia and Gulf of St. Lawrence (264,000 sq.km)
5. New England (158,000 sq.km)

The figures for areas 3, 4 and 5 are taken from Graham and Edwards (1962). That for area 1 is rather greater than the area down to 200 m, to include all depths inhabited by cod, as suggested by Horsted. In other areas also catches are now being taken below 200 m, though the greater part of the catch, and probably also of the fish production occurs in water shallower than 200 m.

2. HYDROGRAPHY

The main features of the hydrography of the ICNAF area have been described by Hachey, Hermann and Bailey (1954). Accounts of the year to year fluctuations in these features can be found in the National Research Reports published in the ICNAF redbooks, the Annales Biologiques published by ICES, and the Annual Reports of the International Ice Patrol Service (U.S. Coast Guard Bulletins). Since Hachey, Hermann and Bailey published their monograph two international surveys have added considerably to our detailed knowledge of the physical and chemical oceanography of the Northwest Atlantic. In 1957-8 during the International Geophysical Year a survey was made of the Polar Front region of the North Atlantic Ocean. The main findings have been summarized by Dietrich (1964 and 1965). Later, in April-July, 1963, ICNAF carried out the NORWESTLANT Surveys which allowed three quasi-synoptic pictures to be obtained of the Irminger and Labrador Seas including the Denmark and Davis Straits. The results of these surveys will be published by ICNAF in its Special Publications series.

The dominating oceanographic feature is the close juxtaposition of warm and cold current systems. The Gulf Stream system is the source of water of high temperature. It enters the ICNAF area from the south [T_0 = 15-24°C, T_{200} = 16°C] and is found off the American coast to as far as the Tail of the Grand Bank, where part of the warm current turns to flow northwards parallel to the eastern edge of the Grand Bank. At about latitude 50°N this changes direction to the northeast and leaves the ICNAF area. In the neighbourhood of the Mid-Atlantic Ridge, however, some of it assumes a northward direction again and flows towards Iceland to form the Irminger Current. This current proceeds along the south and west coasts of Iceland and in the Denmark Section it bifurcates, one part passing southwards along the east coast of Greenland, so that warm water re-enters the ICNAF area at Cape Farewell, [T_0= 3-8°C, T_{200} = 5°C] and flows northwards along the edge of the West Greenland banks.

Cold water with sub-zero temperatures is supplied from various sources. The East Greenland Current brings some from the North Polar Basin, over the East Greenland shelf and between the coast and area and flows northwards over the West Greenland banks. With the Irminger component, running outside it, the East Greenland component forms the West Greenland Current, which is therefore a current composed of two sharply contrasting water masses. Another source of cold water to the ICNAF area is the Baffin Land Current which flows south from Baffin Bay to eventually become the Labrador Current. This latter receives a contribution of warmer water from the West Greenland Current, which has a tendency to turn westwards, and cold water from Hudson Bay through Hudson Strait. Cold water originating from the Labrador Current rejoins it from the Gulf of St. Lawrence through Belle Isle Strait, after having flowed round Newfoundland. On reaching the Grand Banks the Labrador Current splits, part flowing along the outside slope of the bank and part flowing between the bank and the shore. The former is therefore next to part of the Gulf Stream system, and cold water is brought alongside warm. Large scale mixing occurs and a characteristic slope water is formed which is found along the edge of the shelf [T_{200} = 2-4°C, T_{400} = 3.8°C].

Within the Gulf of St. Lawrence [T_0 =-1-18°C, T_{200} = 3-5°C] there is an anti-clockwise circulation in the upper layers, with water entering from off the south-west Newfoundland coast and leaving past Cape Breton Island. Its most striking feature is the Gaspé Current on the southern side of the gulf: this contains the discharge of the St. Lawrence River. The water leaving Cabot Strait occupies most of the eastern part of the Scotian Shelf, but as it moves southwestwards it becomes confined to an inshore band. Between these coastal waters and the Gulf Stream is a well-defined band of slope water [T_{200} = 6-9°C]. A mixture of the inshore and offshore waters passes Cape Sable and enters the Gulf of Maine and Bay of Fundy to form part of the anti-clockwise circulation there [T_0 = 2-17°C, T_{200} = 6-8°C]. Water leaves the Gulf of Maine along the American coast past Cape Cod, giving a generally clockwise circulation around Georges Bank.

A considerable part of the ICNAF area is subject to pack ice transported by the cold currents. The East Greenland Current brings heavy ice from the North Polar Basin: it moves up the West Greenland coast and is maximal in April-June, at times reaching as far as Godthåb. The Baffin Land Current brings ice from Baffin Bay southwards and in some years it extends across the Davis Strait to Greenland. This ice, together with that from Foxe Channel, is transported by the Labrador Current to the Grand Bank, which it reaches in January-March. Some of it enters the Gulf of St. Lawrence through Belle Isle Strait. Ice also leaves the Gulf past Cape Breton Island to move southwards towards Sable Island. Another part travels directly south and southwest from off southeastern Newfoundland. In addition to the pack ice there are icebergs.

Some of these originate from East Greenland glaciers and travel northwards over the West Greenland banks to as far as Holsteinborg. The West Greenland glaciers north of Holsteinborg are a major source of bergs and these travel in the Labrador Current to the Grand Bank.

Various oceanographic factors point to the ICNAF area being a region of high productivity. Strong winter cooling of the surface layers causes vertical mixing to great depths, 1400 m in the case of the Labrador Sea. Th[illegible] ensures that the nutrient salt supply in the surface layers is replenished annually. In the spring and early summer ice melting causes a marked reduction in salinity, and hence density, in the surface layers. Stabilization of the water column is thus provided and it allows phytoplankton produ[illegible]ion to start. Some upward movement of nutrient salts continues during spring and summer. The generally cyclonic circulation in the Labrador and Irminger Seas gives a divergent flow pattern in the surface layers leading to an upwards transport in the central parts of those seas. Again, off West Greenland, Labrador and Newfoundland where sharply contrasting water masses occur flowing side by side, either in the same direction or in opposite directions, pronounced turbulence occurs and in places, particularly along the continental slopes, this brings about an upward movement of nutrient-rich water from below.

The ICNAF area has experienced marked long-term variations in climatic and oceanographic conditions. Most attention has been paid to air and sea temperature fluctuations. Sea surface temperatures off West Greenland showed a marked increase of about 1.8°C in the 1930s and they reached a maximum in the early 1930s, but fell by 0.8°C to a minimum in the early 1950s. Since then sea surface temperatures have been rising again. Also, a remarkable rise in temperatures at 200-300 m depth seems to have taken place between the early 1950s and the present time: it amounts to 2-3°C. In the coastal and shelf areas off New England and the Maritime Provinces a rise in sea surface temperature of 2.5°C seems to have taken place between the early 1920s and the early 1950s. It was most marked in the early 1950s, but during the last decade there has been a rapid downward trend in both surface temperatures and bottom temperatures. There is evidence that other changes in the oceanic circulation have accompanied these temperature fluctuations. For example, the salinity of the Irminger component of the West Greenland Current was at a high level between 1928 and 1948, but not again until after 1958.

Footnote

In this paper the symbol T_z denotes the average annual temperature at depth z except in the case of T_0. In any region T_0 varies markedly both in space and time. It has therefore been given a range: the lower figure is the average February temperature in the coldest part of the region and the higher figure is the average August temperature in the warmest part.

3. PRIMARY PRODUCTION (based on a note by G. A. Riley)

The fingers of one hand are more than enough to count all the studies of phytoplankton productivity that have been carried out in this region with the use of modern methods, including ch[illegible]hyll analyses and experimental measurements of C^{14} uptake. Such a study is curre[illegible]derway in St. Margaret's Bay, N.S., by the Marine Ecology Laboratory of the [illegible] Institute, and there is another in Baie des Chaleurs, P.Q., by Louise Lege[illegible], a graduate student in the Dalhousie Institute of Oceanography. Neither has thus far been published (Dr. Dickie, personal communication, gives a first estimate of 125 gC/m.sq./year for St. Margaret's Bay).

A few measurements of chlorophyll and C^{14} uptake were obtained in oceanic waters of the northwest Atlantic during the IGY. (Crawford Cruise 16; Discovery II Cruise 1, see Doty and Capurro, 1961); however, in general, coverage of this area was poor during the IGY, nor is the writer aware of any more extensive work subsequently. Krey (1967) has described some collections made in this area during the IGY, which consisted of weight determinations of total particulate matter and protein analyses. These may have some pertinence to the problem.

With regard to phytoplankton systematics and species distribution, a key reference is Brunel (1962). His monograph is particularly concerned with the phytoplankton of the Baie des Chaleurs, but it contains notes on ecology and more general distributions of species, and it provides an excellent list of references to the older literature.

Holmes (1956) has described the seasonal cycle of phytoplankton at a station in the Labrador Sea in terms of cell counts and species composition. Well to the south, similar work has been done in the Gulf of Maine (Bigelow, Lillick and Sears, 1940, and the earlier papers by Bigelow) and Georges Bank (Sears, 1941). Riley (1941) made estimates of phytoplankton productivity on Georges Bank by methods then in vogue but which have been superseded by better techniques.

In the long reach between the Labrador Sea and the Gulf of Maine we have only incidental information on species distribution. This area contains a remarkable variety of water masses - the Gulf of St. Lawrence, shelf and bank waters, slope water, Gulf Stream and Labrador Current. We have no detailed knowledge of seasonal cycles or the general level of productivity in any of these areas except the local inshore spots mentioned above. We can guess, on the basis of general knowledge of physical oceanography, that there may be some fairly large regional variations in productivity. It would be an intriguing venture to investigate some of these variations and their physical causes.

Because of this regional variations and the lack of extensive observations, it is not useful at present to attempt any estimate of the total primary production for the region as a whole, or for any individual sub-area.

4. SECONDARY PRODUCTION (Zooplankton and Benthos)

There are very few if any observations on the production of zooplankton or benthos. In the northern sub-areas the most extensive observations on the standing stock of zooplankton are those made during the NORWESTLANT surveys, principally off West Greenland. The report of these surveys is now being published. Other reports on zooplankton abundance have been published or submitted to ICNAF annual meetings, and there are some few observations on benthos, especially in the south. However, the observations are rather scattered, and in view of the probably large regional differences, no quantitative estimate of production is attempted.

5. FISH STOCKS AND FISHERIES

5.1 Statistics - Detailed statistics are published annually by ICNAF (Statistical Bulletin). The data are broken down by species, area, month, and gear and include effort data. This is probably the best series of statistical data in any major sea area and is kept under regular review by ICNAF. Present (1965) catches, by sub-area, and major species were (in thousands of tons):

Table 1. 1965 catches from the ICNAF area

	Greenland 1	Labrador 2	Newfoundland 3	Gulf and Nova Scotia 4	New England 5	Total 1/
Cod	360	333	496	225	42	[illegible]
Haddock	-	-	9	85	155	249
Silver Hake	-	-	-	50	323	373
Redfish	19	23	112	68	8	231
Flounders	3	7	81	48	57	196
Halibut	-	1	2	2	-	5
Herring	-	-	8	180	74	263
Other ground fish 3/	13	13	17	57	110	210
Other pelagic fish 3/	-	-	1	13	9	23
Other fish 3/	2	1	6	16	23	53
Total 2/	404	377	740	777	890	3197

1/ Includes ten thousand tons, area not known.
2/ Includes shellfish.
3/ Definitions are used by ICNAF. "Other fish" includes some species which are mainly pelagic e.g. salmon and cepelin.

A good systematic review of the fish species in the area, with some notes on their economic importance, is given by Leim and Scott (1966).

5.2. The fisheries - The main fisheries in the ICNAF area have been the demersal fisheries by trawls and lines. Three groups of species - cods, flatfishes, and redfish are mentioned in the ICNAF Convention as being of special interest to the Commission.

Cod (*Gadus morhua*) - This fishery is very old, and is carried out by large vessels from Europe, including an increasing number of large freezing and factory trawlers and smaller vessels from North America, using a range of gears, though with an increasing proportion of medium trawlers. The fisheries in sub-areas 3 and 4 have always been large, but that in sub-area 1 has increased greatly in the last 10 years, whilst the trawl fishery in sub-area 2 has increased from very little in 1959 to one of the most important (300 thousand tons) in 1965.

Haddock (*Melanogrammus aeglefinus*) - Until 1965, haddock were fished in quantity only by three countries; by US (and some Canadian) trawlers on Georges Bank (sub-area 5), and by Canada, Spain and US (and USSR in 1960-1) in sub-areas 3 and 4; the catches in sub-area 3 depend greatly on the strength of year-classes; recent year-classes have been very weak, and catches have been low. In 1965, due in part to an outstanding year-class, there has been a large USSR fishery on Georges Bank.

Redfish (*Sebastes*) - Redfish are caught almost exclusively by trawl. In the southern areas, fishing by US and Canada has continued for many years; there have been fluctuations in the total catch, and in its geographical distribution, but not on the scale of the redfish fisheries further north.

In the northern areas, fishing by European trawlers started in the late 1950s and has fluctuated greatly; on a succession of individual grounds, catches built up very rapidly, lasted two or three years, and declined to a relatively low level. More recently catches seem to have been more stable.

Silver Hake (Merluccius bilinearis) - For a long time there has been a US trawl fishery in sub-area 5, remaining rather stable around 40-50 thousand tons. Since 1962 a large USSR fishery has developed, first in sub-area 5 and later in sub-area 4, reaching over 300 thousand tons in 1965.

Flounders - These include several species. Much of the catch has been taken incidentally by vessels trawling for cod and haddock, but a number of US and Canadian vessels, using trawls and Danish seines, fish specially for flounders, and these catches have recently been increasing quite rapidly.

Herring (Clupea harengus) - The inshore fishery by Canada and US with a variety of gears has fluctuated around 150 thousand tons for a long time. In 1960, an offshore trawl fishery by USSR developed in sub-area 5 reaching a peak catch of 160 thousand tons in 1961. A Canadian purse-seine fishery has been increasing recently.

Other fish - A variety of other fish are caught, especially in sub-areas 4 and 5. The more important of these are as follows: Shark, sword fish and tuna, argentines and hakes (Urophycis spp.)

Molluscs and crustaceans - These will be dealt with in detail in another report dealing with the total world resources of these varieties. Important shellfish fisheries in the ICNAF area include the lobster, clams and scallops in sub-areas 4 and 5, and shrimps in sub-area 1.

5.3 Assessments - Regular assessments of the state of the important exploited stocks have been made by the Research and Statistics Committee of ICNAF, especially lately by its Assessment Sub-Committee (see ICNAF Annual Reports, especially supplement to Vol. 11 and scientific reports in the annual ICNAF Redbooks).

Cod - All the stocks in the ICNAF region are heavily fished; good assessments have been made for most stocks, though in sub-area 2 the recent and rapid development of the fishery has made good assessment difficult until the last year or two. The detailed results are given in numerous ICNAF documents, summarised in various reports of the Assessment Sub-Committee. In no area can any substantial increase in sustained yield per recruit be expected from an increase in effort, but for few areas is the present fishing close to the maximum (if a maximum exists) in the yield per recruit curve. Some moderate increase in yield per recruit, perhaps of 10-20%, may, therefore, be achieved by proper management - use of larger meshes, moderate reduction in fishing, etc. - as appropriate for each stock.

Fluctuations in recruitment are important in some areas, e.g. West Greenland, but do not cause any great variation in the total catch from the whole area. The potential annual yield, ie, therefore slightly above the present annual catch - perhaps 1500-1750 thousand tons. However, it is possible that a small decrease in the water temperature at West Greenland could cause a substantial sustained decrease in year-class strength, or conversely, an increase in temperature increase the yield. At the worst, it appears that a sustained decrease in temperature at West Greenland of a few degrees could eliminate the cod stocks there, and would reduce the total cod yield from the ICNAF region by 300-400 thousand tons. Such a climatic change would probably also adversely affect the Labrador cod stocks, and there are likely to be associated changes in other areas, both favourable and unfavourable.

Haddock - These stocks are also heavily fished and detailed assessments made especially of the Georges Bank (sub area 5) stock (see several ICNAF documents and publications of US Bureau of Commercial Fisheries). A limited increase in yield per recruit could be achieved by suitable regulations.

Year-class fluctuations are, however, very important in these fisheries; sub-area 3 catches have been reduced from 104 thousand tons to 9 thousand tons between 1955 and 1965 and sub-area 5 catches increased from 70 thousand tons in 1964 to 155 thousand tons in 1965, partly due to changes in year-class strength. The causes of these changes are not known. Precise estimates of the potential yield, therefore, cannot be used, but if future year-classes are not very different from the average of those in the fishery between 1960 and 1964, then the potential yield would be a little above the 1960-64 average (149 thousand tons) i.e. 160-175 thousand tons.

Redfish - Though several assessments have been made of some of the redfish fisheries in the ICNAF area (e.g. Beverton and Hodder 1962, Rikhter 1965), the conclusions reached, especially on the relation between effort and average long-term yield, have not been conclusive. Some of these uncertainties relate to the biology, especially the growth rate, and the interrelationships between different stocks. It appears that redfish are very slow growing (Rollefsen 1961), so that when fishing starts on a virgin stock the catches in the first year or so may represent the accumulated production of 10 years or more. Thus the first year's catch may be very much greater than the possible long-term annual catch. This is in agreement with the development of several redfish fisheries, especially in the northern areas, e.g. the successive annual redfish catches in sub-area 2 since 1957 have been (in thousand tons) 0, 77, 53, 83, 26, 8, 6, 27, 25. However, the decline from the peak may in some areas have been as much a reduction in effort, or a change in attention from redfish to cod, as to a real decrease in stocks. Thus in sub-area 5 Gulland (1961) noted that the relation between catch per unit effort and effort is not as clear as might be expected from the history of the fishery (rapid rise to a peak, and then decline); nor has there been a pronounced change in size composition. A reduction in average size following increased fishing has been found in division 4 X (Beverton and Hodder 1962), though the resulting estimates of fishing and natural mortality suggested that the latter was the greater. Detailed analysis for one area of the Gulf of Maine (XXII F), however, gave an estimate of fishing mortality about twice that of natural mortality. Similar analyses have not yet been done for the more northern area.

The bigger uncertainty, however, concerns the identity of unit stocks, and especially the relation between the redfish exploited on the shelves, and the very large number of redfish larvae found over the deep oceans (e.g. Henderson 1965). Rough calculations suggest that the number of larvae found is about equal to the number that could be produced by the adult females present and exploited on the shelves; thus there would be no need to make hypotheses concerning separate oceanic stock if there was no mortality of larvae between extrusion and time of sampling.

Other species - Few detailed assessments have been made for other important fisheries some of which (e.g. silver hake and herring) have developed or increased very recently. Preliminary assessments of the silver hake in sub-area 5 (Gulland, MS) suggest that the fishing effort in 1965 reached a level beyond which no substantial increase in average catch could be expected, and that the greatest average catch from this sub-area would be 300-400,000 tons. Studies of the yellowtail flounder in sub-area 5 (Royce et al 1959, Lux 1967) suggest that much of the fluctuations in this fishery are natural, especially due to year-class changes, and not to fishing. Simple correlation between effort and catch per unit effort may be misleading because effort declines when year-classes are poor (i.e. producing a positive rather than a negative correlation), though it appears fishing is now a major cause of mortality.

6. ESTIMATES OF POTENTIAL

6.1 Sub-area 1 - West Greenland

Non-commercial catches - There are no data available of substantial catches of fish other than those already exploited. Commercial trawlers few fish other than cod and redfish, mainly Greenland halibut and wolf fish. A few American plaice are caught, but these are poor quality as food, being very watery. Some Macrurids have been caught in deep water (Meyer, personal communication). Shrimp trawlers catch numbers of *Lycodes* spp. (Horsted, personal communication).

Food of commercial species - Cod eat large quantities of capelin (*Mallotus villosus*) and sand-eel (*Ammodytes lancea*) (Hansen, 1949) though it is not certain what proportion of the total food of cod are these fish; cod also eat euphausiids, squid, etc. Prawns also occur commonly in stomachs. Capelin is also eaten by whales and seals, to a total estimated by Sergeant (MS) as 0.23 million tons.

Eggs and larvae - Data from NORWESTLANT surveys will soon be available and presumably give good information on the abundance of eggs and larvae in winter and spring.

General - There are not enough data for any good assessment, but the observations of Horsted and Smidt (1965) on capelin coming into the fjords suggest that an expansion of the present small scale industrial fishery for these species is possible. If 50% of the food of cod is capelin and sand-eel and the consumption of cod is five times the present annual catch, then cod eat not much less than 1 million tons of capelin and sand-eel. Most of the sand-eels occur on the off-shore banks, whereas the capelin are most common, or at least most readily caught in the fjords. A small scale fishery for sand-eels began in 1967, with some promising catches of up to 50 tons in 4-5 hours.

6.2 Sub-area 2 - Labrador

Lightly fished stocks - Apart from cod and redfish, species caught in the area are wolf fish (*Anarhicas* spp.) and flounders (mostly Greenland halibut, *Reinhardtius hippoglossoides*, and American plaice *Hippogloissoides platessoides*). It is unlikely that the stock of wolf fish is very large. Flounders occur quite regularly, and the trawls used are probably not the most efficient for flatfish, so that the potential might be quite large. In deep water, catches of Macrurids, *Coryphanoides rupestris* have been reported by Dr. Meyer. A. May also reports that *Macrourus berglax* may be taken in quantity in 175-200 fms.

Food of commercial species - Cod have been reported feeding on capelin and lancet fish (*Paralepis coregonoides*) (Templeman, 1965) as well as on invertebrates, including shrimp (*Pandalus*) (UK Research report for 1962). No quantitative data are available. Over deep water, salmon have been found feeding on lancet fish (*Notoscopelus* spp.) and *Paralepis coregonoides* (Templeman, 1967).

Eggs and larvae - Serebryakov (1965) reported catching eggs and larvae of myctophids, as well as cod, redfish and American plaice, in sub-area 2, but without details of how many of the numerous eggs and larvae of the latter caught in the whole ICNAF area were in sub-area 2. Large quantities of larval squid (*Gonatus* spp.) were found in deep water east of Labrador by the Godthaap expedition.

6.3 Sub-area 3 - Newfoundland

Lightly fished stocks - A general review of the Newfoundland resources has been given by Templeman (1966). Other than cod, haddock and redfish, demersal catches include substantial quantities of flounders, especially American plaice (*Hippoglossoides platessoides*). Assessments of these have not been completed, but studies now in hand and the recent increases in fishing will soon produce reasonable assessments. Length data showed that, at least until recently, only the biggest fish caught were landed, this suggests that the stock as a whole was only incompletely utilized. Squid are sometimes caught in quantities by trawl incidentally to other fish, as well as by jigging; the resource seems large. Ammodytes, and some capelin are reported by Messtorff to be meshed in appreciable numbers over most of the Grand Bank in Spring. Catches of herring in sub-area 3 have increased rapidly, 3,000 tons in 1964 to nearly 23,000 tons in 1966 - following the development of a fishery for reduction - and the stock may well be only lightly exploited. Saury (*Scomberesox saurus*) has occasionally been reported inshore in quantities, but the occurrence is very variable (Templeman and Fleming, 1953). There may be substantial quantities offshore.

Food of commercial species - At, and soon after sprawning, when the cod are inshore and feeding most intensively, 95% of their food is reported by Templeman to consist of capelin. Sand launce (Ammodytes) are an important food for cod on the off-shore banks. Sperm whales have been recorded eating a variety of fish, - capelin, cod, halibut, squid, wolffish, and a "small black fish" (Sergeant, 1966). Capelin is a major item of food for whales and seals, and their total consumption has been estimated at ca 0.5 million tons (Seageant MS).

6.4 Divisions 4 R, S, T - Gulf of St. Lawrence

Lightly fished stocks

Besides the cod and haddock, which are presumed to be fairly fully exploited, and the redfishm which may also, though with less confidence, be presumed to be fully exploited, demersal catches include quantities of flounders, and some hake (reported as red hake, but probably white hakd, Musick, 1967) in 4 T. Quantities of herring (44,000 tons in 1965) and mackarel are also caught. It has not yet been shown that these are fully exploited, and probably the catches of herring at least could be increased.

6.5 Divisions 4 V, W, X - Nova Scotia

Other than cod and haddock (200,000 tons between them in 1965), the catches of demersal fish in 1965 included 50,000 tons of silver hake, and smaller quantities of flounders, redfish, pollock and red hake. Russian catches of argentines were 5,600 tons in 1965, but increased to 15,000 tons in 1966. Other species occasionally caught in quantity, but not generally landed, include skate and dogfish. The evidence on the state of the stocks of these species is not so clear as for cod and haddock, and probably the catches of some at least (e.g. argentines) could be increased by increased fishing. The history of the silver hake fishery, which increased from nearly nothing in 1961 to 123,000 tons in 1963, only to decline to a mere 10,000 tons in 1966 does not, however, suggest that this stock will provide a high sustained catch. The fishery is almost exclusively by USSR vessels, and the violent changes in catch reflects much more the changes in effort than changes in stock, though the most recent reduction in effort is probably due to a reduction in stock, which may itself have been caused by increased effort in the immediately preceding years It is therefore in no way certain that the big catches in 1963-65 represented more than the stock could stand. Previous Canadian research trawl catches indicated larger fluctuations in the silver hake stock in earlier years, which could not have been directly due to fishing.

Among pelagic fish, mackerel may be an important under-exploited resource both in this area and adjacent areas. Total catches by US and Canada have fluctuated widely - from up to 100,000 tons occasionally in the 19th century, to ca 30,000 tons in the 1930s (Sette and Needler, 1934; Hoy and Clarke, 1967), and 15,000 tons now. The cause of these changes is not known, but if they are due to changes in fishing, and not changes in the stock the opportunities for increasin the catches are obvious. Other under-exploited stocks probably include Ammod. and possibly also myctophids.

6.6 Sub-area 5 - New England and Georges Bank

Unlike in other sub-areas, cod and haddock catches make up only a minor part of the total catch (ca 20% in 1966). The fisheries on some other species (redfish, yellowtail flounder) have continued long enough for reasonably good assessments to have been made, and these stocks seem to be fairly heavily exploited (Beverton and Hodder, 1962; Lux, 1967).

For some of the most important stocks (silver hake, and red and white hake, herring) no assessments have yet been completed by ICNAF. A preliminary assessment of the silver hake stocks has been made (Gulland, MS), which suggests that this species is about fully exploited. As pointed out by Musick (1967), there has been considerable confusion concerning the species breakdown in catches of Urophycis spp. USSR reports no catches of white hake (Urophycis tenuis), although some must be caught, if only incidentally to other species. It is probable that the bulk of the USSR catches, taken in winter on the south-west slopes of Georges Bank, were in fact red hake.

It is likely that the red hake has been heavily fished. Red hake is strongly concentrated in the winter, so that a large proportion of the stock might be taken with relatively low effort. Following the large USSR catches in 1965 and the beginning of 1966, the US catches in 1966 were very low (in the industrial fishery 12,900 tons in 1965 and 2,900 tons in 1966) (Graham, 1967). However, since only 2 year-classes are present in the stock, and hence at most the accumulated production of two years, it is unlikely that the high total catches of 72,000 tons in 1965 and 87,000 tons in 1966 represent substantially more than the possible annual average catch, and may still be less than the potential catch. This, therefore, probably lies in the range 70-100,000 tons.

Data on herring are not yet so conclusive, but it appears that fishing is having an effect, and estimates of stock size and fishing mortality from data on the quantity of spawn, though showing great variation from year to year, do suggest that fishing is a major source of mortality (Noskov and Zinkevich, 1967).

Independent, non-commercial, information on the abundance of fish available to bottom trawling is available from the results of the US research vessel surveys (Fritz, 1965). This covers an area rather greater than sub-area 5 - from the Hudson Canyon to southern Nova Scotia. The distribution in terms of numbers caught per unit time is shown as contours for 20 species. The area of these contours, and the mean catch rate within each contour can be used to give an index of abundance for each species for that part of the ICNAF area (5, and part of 4 X) included in the charts. These, together with the reported average length (in inches) and 1965 catches in sub-area 5, are given in Table 2 below:

Table 2. Indices of abundance of certain species from trawl surveys and total international catch

Species	Length inches (cm)	Index	Catch (tons)
Sculpin	10 (25)	450	(c)
Goosefish (Angler)	24 (60)	70	205
Redfish	12 (30)	8,300	8,057
Scup	10 (25)	200	6,509
Butterfish	8 (20)	6,000	1,794
Witch flounder	18 (45)	60	2,162
Yellowtail flounder	14 (35)	400	37,397
Four-spot flounder	12 (30)	300	(c)
American dab (plaice)	24 (60)	1,000	3,[illegible]23
Thorny skates	24 (60)	250	2,340(b)
Long-finned hake	10 (25)	750	(c)
Squirrel (Red) hake	12 (30)	2,700	72,068(a)
White hake	28 (70)	1,000	2,611(a)
Pollock	24 (60)	1,200	8,998
Haddock	18 (45)	8,500	154,725(d)
Cod	32 (80)	600	42,261
Silver hake	14 (35)	20,000	323,242
Argentine	12 (30)	600	9,453
Herring	10 (25)	2,000	74,303
Spiny dogfish	30 (75)	7,000	nil

Notes: (a) Red and white hake are probably not properly separated in the statistics; see text.

(b) Includes all skates.

(c) Not recorded separately in ICNAF statistics.

(d) Average annual catches are much less.

No very precise analysis can be done with these figures, since the species composition of the catch of a trawl always depends on hos it is rigged. These surveys were carried out primarily for haddock, so haddock and similar species (e.g. cod, pollock) are probably better represented in the catches than others. Also only depths down to about 400 m were fished, so stocks in deeper water are under-estimated. Of the species in the table probably argentine and herring, at least, are under-represneted because of depth or gear.

The table is also of standing crop in numbers, while the major interest here is in potential production in weight. Despite that, there is a certain agreement between the figures of standing crop, and the actual total catches. Agreement is better within similar groups of fish, than between groups, e.g. the high total catch of yellowtail flounder suggest (as is very likely) that the gear used underestimated the abundance of flatfishes relative to haddock and hakes - the presence or absence of tickler chains in front of the ground rope makes a big difference to chatches of flatfish.

If this understimate applies to all flatfish, then it appears that the catches of American plaice could be greatly increased, possibly by ten times. A comparison between the cod, haddock and pollock shows a relatively large cátch of cod which is probably accounted for by the larger size of the individual fish, though also the 1965 cod catches were well above the previous average. Pollock catches are relatively low; the table suggests they might be increased to around the same level as cod.

The comparison of the hakes is made difficult by the confusion of red and white hakd (and perhaps also long-finned hake), in the published statistics (Musick 1967). Allowing for the difference in sizes of the individual fish, there is good agreement in Table 2 between red and silver hake, but the catches of white hake are very low. No white hake are reported in the USSR catches, and although their biggest catches of Urophycis spp. are taken from the winter concentrations on the edge of the banks, which are probably all red hake, it is certain that the USSR must catch some white hake. Allowing for this would give better agreement between all three hakes, though it would still appear that catches of white hake could be increased; since they are large fish, the potential catch should be rather larger than immediately suggested from the index of numbers, perhaps 25-30,000 tons. It appears, however, that white hake does not appear in the same concentations as red hake, suitable for the operations of an industrial fishery or of factory ships. Catches of long-finned hake (Urophycis chesteri) could also be increased, but this is a small fish, and the potential is less, perhaps 10,000 tons.

The index of abundance in the table probably is an underestimate for argentine and herring, so that although present catches fit well with the index of abundance, this is not evidence that a further increase in catches could not be attained. With sampling restricted to depths less than 200 m, the abundance of argentines, which are generally found deeper, would be particularly underestimated.

Of the other species in Table 2, redfish, butterfish and dogfish occur in the survey in sufficient numbers to suggest that their catches could be increased substantially. The occurrence of redfish in this list is surprising, since the history of this fishery in sub-area 5 - a rapid expansion in catches, reaching a peak of ca 60,000 tons in 1941, followed by a steady decline - suggests that it has been heavily fished. Part of the discrepancy may be explained by the slow growth and long life of redfish, so that the potential production is only a small fraction of the standing stock. Also, as pointed out by Gulland (1961) and by Beverton and Hodder (1962), there has not been such a marked decrease either in catch per unit effort or average size of fish as would be expected of a very heavily fished stock. Probably, therefore, redfish catches could be increased, though not to the extent suggested by the standing crop.

Sustained production of dogfish, too, because of their slow growth, and low fecundity, is likely to be a small fraction of the standing crop. Comparison with haddock and silver hake suggest a standing crop of the order of 100-200,000 tons, but the sustainable yield might be only 10% of this, 10-20,000 tons. Dogfish are well known predators, and a reduction of the dogfish stocks might well lead to increased catches of other fish. This cannot be estimated at present nor indeed is it known whether reduction of other predators, including invertebrate predators of larval fish, might not have much greater effects.

Butterfish (Poronotus triacanthus) is a southern semi-pelagic species, mainly a summer and autumn migrant into ICNAF waters, at least insh re (Edwards, 1966). Catches could certainly be increased, but they may be mostly outside the ICNAF area.

6.7 Eggs and larvae (all areas) - Serebryakov (1965) gave summaries of the catches of USSR surveys in March, April and May in sub-areas 2-5. The most numerous species were as follows:-

Table 3. Catches of eggs and larval fish in the ICNAF area, compared with the commercial catches

	Sub-areas in which caught	Eggs	Larvae	1965 catches (thousand tons) SUB-AREA Total	2	3	4	5
Ammodytes spp.	3,4	-	12,500	-	-	-	-	-
Redfish	2,3,4,5,	-	2,725	212	23	112	68	8
Cod	2,3,4,5,	11,759	110	1,096	333	496	225	42
Myctophids	2,3,4,5	-	190	-	-	-	-	-
Capelin	3	-	162*	5	-	4	1	-
Chirolophis ascanii	4,5	-	57	-	-	-	-	-
Herring	5	-	52	262	-	8	180	74
American Plaice	2,3,4,5	2,090	18	69	-	50	15	4
Neoliparis atlanticus	4	-	51	-	-	-	-	-
Yellowtail flounder (Limanda ferruginea)	3,4,5	1,250	3	45	-	3	5	37
Silver hake	3,4,5	467	20	373	-	-	50	323
Haddock	3,4,5	390	6	249	-	9	85	155
Witch (Glyptocephalus cynoglossus)	3,4	405	10	15	-	2	11	2
Cusk (Brosme brosme)	4,5	426	-	6	-	-	5	1
Pollock (saithe)	3	2	12	38	-	1	28	9
Urophycis spp.	4,5	11	5	92	-	2	15	75
Halibut	4	10	18	5	1	2	2	-

*Capelin spawn in July/August so that the larvae are poorly represented in these samples.

No other species occurred in quantity either in the plankton or in the commercial catches.

For those species which are known or belived to be rather fully exploited (cod, haddock, silver hake, some flounders) there is a degree of agreement between the numbers of eggs and/or larvae and the catches. Quantitatively for these species, the ratio of the catch in tons to the number of larvae varied from between 4,000 (for American plaice) and 40,000 (for haddock). For no species were there large catches without there being also a substantial catch of larvae. Equally, abundant larvae correspond either to a major established fishery, or belong to species which are at present not commercially attractive. The exception is the halibut, which is heavily fished, but has relatively large numbers of larvae, though this may well be a sampling effect.

The table suggests very strongly that there are several species which can supply greatly increased catches, especially launce (Ammodytes spp.), Myctophids (if they can be effectively harvested) and capelin. A comparison with other species suggests that the catches of launce might be of the order of millions of tons and of the other species of hundreds of thousands of tons. Redfish stocks may be particularly difficult to assess in this way. Redfish larvae are second only to Ammodytes in abundance; however, because there are no losses in the egg stage, the numbers of redfish larvae in the sea per unit weight of adult females may be considerably greater than for egg-producing species despite the generally lower fecundity. Cod eggs were much more abundant than redfish larvae (about in proportion to the catch) and in proportion to the respective parent stocks, the standing crop of redfish larvae may be more nearly equal to the standing crop of cod eggs than to the standing crop of cod larvae. More studies are need on fecundity, survival, and duration of the various stages

Table 4

	Estimated potential, by subearea, (in thousand tons) 1	2	3	4	5	Total	Actual catch 1965	Notes
Cod	350–460	300–400	450–600	250–300	20–30	1400–1800	1463	)Actual catch depends criti-
Haddock	–	–	10–70	50–60	50–70	100–200	249	)cally on year-classes
Pollock	–	–	(5)?	30–50	20–30	50–75	38	
Silver Hake	–	–	+	50–150	300–400	350–500	373	(a)
White Hake	–	–	(5)?	(10)?	25–30	40–60	3	
Red Hake	–	–	–	(20)?	70–100	100–120	88	
Halibut	1	+	2	3	+	7–10	5	(b)
American Plaice	(x10)?	(x10)?	(100+)?	(50+)?	(10+)?	100–300	68	(c)
Greenland Halibut	(20)?	(20)?	(20)?	+	–	50–100	12	?Good stocks in deep water
Yellowtail Flounder	–	–	5?	10?	50?	50–100	46	
Witch	–	–	(10)?	(30)?	(10)?	20–50	15	
Other bottom fish	(x10)	(x10)	(x10)	(x10)	(x10)	(x100)	80	)Other flounders, sharks,)wolffish, etc.
Redfish	50+?	50?	100+?	75+?	15–30	250+?	231	(d)
Butterfish	–	–	–	–	(50)?	(50)?	2	
Argentines	–	–	–	x10?	x10?	(x10)?	15	)Historic catches up
Mackerel	–	–	+	(50)?	(50)?	(100)?	16	)to 100,000 t. Possibly)a single stock
Capelin	(x100)?	(x100)?	(x100)?	–	–	(x100)	7	(e)
Herring	–	–	(x10)?	150–300?	150–300?	300–1000	263	
Ammodytes	(x100)?	?	(x100)?	(x100)?	?	(x100)	–	Very big larval catches
Squid	–	–	(x100)?	(x100)?	?	(x100)	–	
Myctophids	?	?	?	?	?	(x100)	–	
Macrurids	(x10)?	(x10)?	(x10)?	?	?	(x10)	–	In deep water
Saury	–	–	?	?	?	–	–	(f)
Total (A)	480	420	800	920	1000			
Total (B)	1200	800	1800	1600	1100	6500		

Notes

(a) Silver hake potential in sub-area 4 estimated in comparison with sub-area 5. These are probably large variations in stock, with only very few fish present in some years (McCracken, personal communication).

(b) Increased catches would require special protection of small fish. Large quantities are caught incidentally by other trawlers (Kohler, 1967).

(c) Incidental catches of American plaice, and larval data, suggest a moderately large stock.

(d) There is a major uncertainty concerning the redfish on the continental shelves, and their relation to the large quantities of larvae caught over deep water. The short duration of some of the intense redfish fisheries suggests local potentials no greater than given here.

(e) Certainly a large stock. The feasibility of economic harvesting seems to depend on annual changes in distribution (Templeman, 1948).

(f) The existence of a major oceanic stock of saury has been suggested (Ricker 1962) but there is no firm evidence.

of both eggs and larvae. Also much more needs to be known about the relation of the redfish larvae - most of which are caught over deep water (Henderson, 1965) - to the stocks of redfish presently exploited on the continental shelf. Studies by Templeman (1967) on small numbers of redfish caught by long-lines over the deep water suggest on the basis of parasite infestation, that these oceanic redfish are indeed one or more stocks separate from the redfish on the shelves.

On the other hand, the table shows that in relation to the number of larvae, catches of hake (both silver hake, and other hakes - Urophycis spp.) are already high, though being summer spawners they are likely to be under-estimated by egg and larvae surveys in the spring. This suggests that these stocks may now be rather fully exploited.

6.8 Marine mammals

Seals support important fisheries in the northern part of the area. The most important species commercially is the harp seal, though other species - hood seal, bearded seal, grey seal and harbour seal - are found. The state of the two principal stocks - the Gult and Front herds - of harp seals has been well studied (see papers and reports of the 1967 ICNAF meeting, especially the report of the Seal Assessments Working group). The Front herd in particular has been drastically reduced in recent years, the estimated production of pus having fallen from 473,000 in 1950 to 230,000 in 1966 (Sergeant, 1966). The production of pups in the Gulf herd is around 250,000, and the sustainable yield around 85-90,000 pups, or rather less in terms of numbers of animals, if juvenile and adults are taken as well as pups. If the Front herd is rebuilt to its 1960 level a potential yield of perhaps as much as 250,000 pups could be taken.

At the optimum population attendance the number of adult harp seals could be around 1 - 1½ million; the average weight of an adult is 350 pounds (160kg) or more (Templeman, 1966), so that the population biomass, including immatures would be around 250,000 tons. The consumption of these animals must be large; capelin is known to be one important element in the diet (Sergeant, MS). Further examination of the food might suggest possible resources unexploited by man, of fish or zooplankton.

Most species of large whales are found in the ICNAF area and have been intermittently hunted. Templeman (1966) suggests a sustainable yield of around 400 large baleen whales (blue, fin. and sei). Pilot (or pothead) whales are taken in larger numbers (nearly 10,000 in 1956), but there is not sufficient data to estimate the potential yield.

6.9 Crustaceans and molluscs

These are to be the subject of separate analyses under the ocean resources side of IWP which will deal with entire world resources of these groups; the first draft crustacean analysis is completed, and is being revised following the world meeting on shrimps biology at Mexico City, June 1967. The molluscan review will exclude squids, etc; the resources of these may be substantial, but at present difficult to assess quantitatively. In the ICNAF area the most promising unexploited resources are probably of Pandalus (it is already exploited in sub-areas 1 and 5).

7. SUMMARY

7.1 Estimates of potential yield

Parts of the area are very highly productive and this is reflected in the importance of the area as a fishing ground to many nations. However, many of the stocks are now heavily exploited, and many of the lightly exploited stocks are less immediately attractive. The probable potential yields of the more important species may be as follows.

In Table 4 a definite figure has been given whenever possible. For some stocks only an order of magnitude can be suggested. The figures for the total have been shown, (A) giving the sum of the potential yields for those stocks for which enough is known to give a definite estimate. Total (B) includes all stocks; the potential for those stocks for which only an order of magnitude can be suggested have been included by taking (x10)? as 30, (x100)? as 300, etc. The figures have been rounded off.

These estimates have been summarized in Table 5, and the potential yields expressed as yields per area of the shelf. These range from 44 to 121 kg per hectare, which are very similar to the estimates in North East Atlantic. The high value for West Greenland is probably due to much of the fish production coming from primary and secondary production occurring off the banks, and brought in by currents.

Table 5 Summary of potential yields in the ICNAF sub-areas.

	Sub-area 1	2	3	4	5	
	W. Greenland	Labrador	New-foundland	Nova Scotia	New England	
Area ('000 sq.km)	85	100	418	264	158	
Potential catches ('000 tons)						
Pelagic	600	300	900	900	400	
Demersal	600	500	900	700	700	Total
Total	1,200	800	1,800	1,600	1,100	6,500
Potential (kg/kectare)						
Pelagic	71	30	22	27	25	
Demersal	71	50	22	34	44	
Total	121	80	44	61	70	
Ratio:						
Pelagic/Demersal	1.0	0.6	1.0	1.3	0.6	
(1965 catches ('000 tons)						
Pelagic	2	-	22	209	99	
Demersal	397	377	717	536	703	
Molluscs	-	-	-	13	69	
Crustaceans	5	-	1	18	15	Total
Total	404	377	740	777	890	3,199 (b)

(a) excluding cephalopods (included with pelagic).
(b) including 10 thousand tons, sub-area not known.

These totals should not be considered as simply additive; sufficiently large catches of capelin, for example, will tend to decrease the food supply to, and hence ultimately the catches from, the cod stock. Equally the cod fishery must have, to some extent, reduced the production on capelin, and hence increased the potential catches by man of capelin, and other species. However, there is no evidence to suggest the cod catches would be adversely affected to any measurable degree by even quite a substantial capelin fishery. Table 4 does, however, suggest that while the catches of the traditional species may not be greatly increased, the total catch from the ICNAF area might well be doubled in weight by fishing for other species though at present these species are less valuable than those now being heavily exploited. Apart from the myctophids, which would present some technical problems of both catching and processing, the most promising species, or closely related species (capelin, Ammodytes, and squid), are the objectives of major fisheries in other areas. For many of these a closer examination of the data presently available on distribution and likely density and a comparison with other areas should provide better estimates than the rough figures above.

Acknowledgements

A first draft of this review was presented at the 1967 ICNAF meeting, and a second draft circulated to many scientists active in the ICNAF area. Those whose comments have been used in preparing this revised version include: S. A. Horsted, R. C. Hennemuth, F. D. McCracken, W. M. Chapman, A. May, H. W. Graham, R. L. Fritz, A. C. Kohler, L. Lauzier, O. Cendrero, A. M. Fleming, B. B. Parrish and D. E. Sergeant. Particular thanks are due to A. J. Lee for drafting the section on hydrography, and to G. A. Riley for the note on primary production.

Appendix 1 Recent catches of fish from the Northwest Atlantic (from ICNAF Statistical Bulletin) (thousand tons, live weight)

	1954	55	56	57	58	59	60	61	62	63	64	65
Sub-area 1												
Cod	302	265	321	259	320	234	243	345	451	[illegible]	[illegible]	359
Redfish	15	32	14	28	18	33	44	54	61	47		21
Total	323	305	343	304	346	274	296	417	528	476	[illegible]	404
Sub-area 2												
Cod	22	26	34	32	40	60	188	265	255	216	213	333
Redfish	–	–	–	–	77	53	83	26	8	6	27	25
Total	22	26	34	32	119	114	280	297	266	223	261	377
Sub-area 3												
Cod	472	429	392	449	294	425	471	461	389	466	581	498
Haddock	56	104	84	68	44	35	67	79	35	15	12	9
Halibut	1	1	1	2	2	2	3	2	2	1	2	2
American Plaice	3a/	15	14	18	21	21	22	18	17	26	39	[illegible]
Redfish	37	18	30	58	159	246	99	90	61	69	95	109
Capelin	–	–	–	7	9	5	6	5	4	5	4	4
Herring	7	5	4	8	11	4	6	4	5	6	3	8
Total	599	591	540	631	555	768	711	694	535	609	784	740
Sub-area 4												
Pollock	2b/	19	22	22	29	13	30	29	33	31	32	28
Cod	149	160	198	188	214	214	218	212	219	218	229	225
Haddock	51	43	51	48	49	53	46	47	44	51	60	65
Silver Hake	–	–	–	–	–	2	–	–	9	123	81	50
Halibut	2	2	2	3	3	3	3	2	2	2	2	2
American Plaice	–c/	12	9	6	9	9	11	9	7	9	10	15
Other flounders	18c/	2	2	3	4	4	5	9	9	11	14	22
Redfish	55	59	64	55	55	42	50	42	43	58	53	68
Mackerel	12	11	9	8	7	4	6	4	6	6	10	11
Herring	85	82	78	91	92	102	105	81	116	112	140	181
Total	451	462	511	491	522	524	549	498	578	753	740	777
Sub-area 5												
Cod	12	12	13	13	16	16	14	18	26	30	29	42
Haddock	55	51	59	55	45	41	46	52	59	60	70	155
Pollock	8	10	7	8	14	10	10	8	6	6	9	[illegible]
Silver Hake	41	46	40	57	49	50	47	43	86	147	221	[illegible]
Other hakes	6	6	7	4	4	4	6	5	5	9	31	75
Yellowtail flounder	5	6	6	10	15	13	14	17	26	35	37	37
Other flounders	12	12	14	13	11	12	14	13	13	12	19	20
Redfish	13	14	14	16	16	15	12	14	14	10	6	8
Mackerel	1	1	2	1	2	2	1	1	1	2	2	4
Herring	58	–	66	73	81	48	69	94	223	167	159	74
Total	414	428	470	514	459	459	443	489	693	714	756	890

a/ Considerable quantities included with various flounders.
b/ Considerable quantities are included with other groundfish (species not known).
c/ Other flounders include American plaice and witch.

Appendix 2

1965 Catches of molluscs and crustaceans from the Northwest Atlantic (from ICNAF Statistical Bulletin) (not considered in detail in this report) (metric tons, live weight)

		SUB-AREAS					
		1	2	3	4	5	Total
Squid	*Loligo* and *Ilex* spp.	-	-	7,831	433	563	8,827
Quahog	*Mercenaria mercenaria*	-	-	-	219	10,192	10,411
Razor Clam	*Ensis directus*	-	-	-	-	9	9
Soft Clam	*Mya arenaria*	-	-	-	1,340	5,708	7,048
Surf Clam	*Spisula solidissima*	-	-	-	227	2	229
Ocean Quahog	*Arctica islandica*	-	-	-	-	307	307
Mussels	*Mytilus* and *Volsella* spp.	-	-	-	35	372	407
Oyster	*Crassostrea virginica*	-	-	-	1,568	324	1,892
Sea Scallop	*Placopecten magellanicus*	-	-	132	9,883	50,335	60,350
Bay Scallop	*Aequipecten irradians*	-	-	-	-	1,692	1,692
Conchs	*Strombus* and *Busycon* spp.	-	-	-	-	122	122
Periwinkles	*Littorina* spp.	-	-	-	126	96	222
Lobster	*Homarus americanus*	-	-	884	17,364	12,647	30,895
Crabs	*Callinectes* and *Cancer* spp.	-	-	-	251	1,072	1,323
Prawn (shrimp)	*Pandalus borealis*	5,051	-	-	-	953	6,004
Worms	-	-	-	-	13	720	733
Sea Urchins	-	-	-	-	-	57	57
Seaweeds	-	-	-	-	-	2,107	2,107
	Total	5,051	-	8,647	31,459	87,278	132,635

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