Restricted

INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

Serial No. 2764
(C.c.72)

ICNAF Res.Doc. 72/36

ANNUAL MEETING - JUNE 1972

Canadian Research Report, 1971

A. Subareas 1, 2 and 3

by

Wilfred Templeman and A. M. Fleming
Fisheries Research Board of Canada
Biological Station, St. John's, Newfoundland

and

B. Subareas 4 and 5

by

J. S. Scott
Fisheries Research Board of Canada
Biological Station, St. Andrews, New Brunswick

A. Subareas 1, 2 and 3

The St. John's Biological Station of the Fisheries Research Board of Canada carried out fisheries and hydrographic researches and the Atlantic Oceanographic Laboratory of the Bedford Institute at Dartmouth engaged in charting in Subareas 1, 2 and 3.

Canadian landings data for the ICNAF area were not available when this document was prepared and any landings data are preliminary, usually for Newfoundland only and often not divided by Subarea.

Subarea 1

A. Status of the Fisheries

As far as we are aware at the present time, there was no Canadian fishery in this Subarea.

B. Special Research Studies

I. Environmental Studies

1. Hydrographic Studies. Offshore bathymetry was done for the general bathymetric chart of the ocean (gebco) program and in support of the geophysical studies.

II. Biological Studies

1. Atlantic salmon, *Salmo salar* L. Researches were continued off West Greenland during an autumn cruise of the *A.T. Cameron* to this area. One hundred and twenty-one salmon were tagged from driftnets off West Greenland in September. The tagging of 385 salmon from driftnets off West Greenland in September-October 1969 produced 30 returns, of which 17 were from Greenland (2 in the year following tagging), 7 from Canadian waters and 6 from Europe. However, the tagging of 147 salmon in the same manner from gillnets off West Greenland in September-October 1970 produced only 3 local returns in the year of tagging and no returns in 1971.

Analysis of scale patterns of Atlantic salmon smolts indicates that there are significant differences between the widths of annual growth zones and numbers of circuli on scales of smolts from rivers of widely different geographic areas. There were, however, large annual variations in the average widths of the annual zones and numbers of circuli in the second river zone of adult salmon taken in West Greenland during 1969 and 1970 and classified as of North American or European origin by using an electrophoretic technique on serum protein patterns. This may be due to annual variations in temperature or in food in the rivers from which the salmon originated or possibly because the proportions of fish originating from both North America and Europe were derived from different river systems in 1969 than in 1970. The average widths of the first ocean zone for North American salmon taken at West Greenland during 1969 and 1970 were similar as also were those of European origin. However, the first ocean zone was significantly larger in salmon of European origin.

Analysis of the scale patterns of adult salmon and grilse recaptured in the Miramichi River system and in Labrador rivers from tagging experiments indicates that there are significant differences between these two areas in the patterns of growth in the second river year. However, the patterns of growth in the first annual sea zone show no significant differences and indicate the possibility that fish from both these geographic areas share similar feeding areas and live under similar hydrographic conditions during their first year of sea life.

The magnitude of variation in these growth patterns in the scale is such that it may be impossible to take a sample of fish from the high seas or the commercial coastal fishery and determine the proportions originating in different areas on the basis of scale patterns alone. However, it may be possible to do so by using meristic or other characters in addition to scale patterns.

Studies to determine whether parasites might be useful to separate stocks of Atlantic salmon caught on the high seas continued in 1971. Emphasis was placed on continued sampling at nine Canadian stations and in West Greenland. Preliminary observations on the data support earlier conclusions that in Greenland the parasitic nematode *Anisakis* sp. is more abundant in salmon of European origin; also, that the tapeworm *Eubothrium crassum* is more abundant in salmon of Canadian origin.

Electrophoretic analyses of *Anisakis* larvae from Canadian salmon have continued and the work has been expanded to genetically controlled esterase and acid phosphatase polymorphisms in *Anisakis* larvae from salmon taken in the British Isles. Results indicate genetic heterogeneity among samples of *Anisakis* larvae from different areas of the North Atlantic.

Subarea 2

A. Status of the Fisheries

I. Cod, *Gadus morhua* L.

In the Labrador coastal fishery the cod catch remained very low, only 2,700 tons in Subarea 2.

II. Atlantic salmon

Landings of Atlantic salmon increased due to additional effort because of lack of cod.

B. Special Research Studies

I. Environmental Studies

1. Hydrographic Studies. The section off Seal Island was occupied on 3-4 August. Refer to the research document on hydrography of the Newfoundland area for details (Res. Doc. 72/31).

Small harbour surveys and chart revisory surveys were undertaken along the Labrador coast from Belle Isle to Nain.

II. Biological Studies

1. Cod. Sampling of the inshore cod fishery was continued, with 3,865 measured and 1,113 pairs of otoliths collected.

Yield per recruit calculations for Division 2J cod indicate that further increases in F will not give a long-term increase in yield-per-recruit and will further reduce the abundance of the stock.

The fishing effort in recent years has been about 95% of that necessary to produce the maximum yield-per-recruit. The reduced number of older (mature) fish in the stock has resulted in a virtual extinction of the inshore Labrador fishery which has been traditionally dependent on older mature post-spawning cod.

In a cruise of the *A.T. Cameron*, 25 April-1 May, no large concentration of cod was located on Hamilton Inlet Bank, but fishing was restricted by ice. Bottom water temperatures were generally within the range in which large catches of cod have previously been taken in these areas. Most of the cod taken were less than 40 cm in length. Cod of the 1967 year-class were most numerous in these catches. This year-class of cod should reach a length of about 40 cm in the spring of 1972 and contribute in fair numbers to the fishery.

In ICNAF Division 2J, the average length of cod increased by about 6.7 cm per year from ages 2 to 6 years and by about 4.7 cm per year from ages 7 to 11. The total mortality was estimated to be about 0.9 for ICNAF Division 2J over ages 6 to 11. Calculations based on catch and effort data for 2J cod indicate the natural mortality (M) to be in the range of 0.15-0.20. The length at which 50% of the males were mature in 2J was about 42 cm and for the females 49 cm. Cod on Hamilton Inlet Bank were feeding heavily on the deep-water shrimp *Gennadas elegans* and on deep sea fish.

2. Atlantic salmon. In May, 24 salmon from surface driftnets and 35 from surface longlines were tagged in the Labrador Sea over oceanic depths beyond the continental shelf. Two were recaptured from the fish tagged from driftnets and 6 from those tagged from longline. All returns were from Newfoundland or the Canadian mainland and in the tagging year. One hundred and forty-five salmon were tagged from driftnets in the coastal region of Labrador in July. Because tagging was in the latter part of the salmon fishing period most of the tagged fish were grilse and returns were almost entirely from the Labrador coast.

Subarea 3

A. Status of the Fisheries

I. Cod

Total cod landings in Newfoundland, mainly from the coastal fishery in Subarea 3, were about 8% below the 1970 landings of 153,000 tons which in turn were 15% below the 1969 landings of 179,000 tons. The decrease is principally the result of generally low catches in the coastal fisheries. About 50% of the coastal catch of cod comes from traps in shallow water; in each of 3 monitoring localities the average catch per haul was less than half the 1970 level. There was also a marked decrease in the average catch by bottom gillnet in many areas.

On the northeast coast of Newfoundland the trend continued for larger coastal boats to fish by bottom gillnets in water of 180 m and deeper, further seaward and for a greater variety of fish - cod, plaice, witch, Greenland halibut, wolffish and redfish. Whereas formerly by far the greatest landings for these large meshed gillnets consisted of cod, the scarcity of large cod now makes the total weight of other species from these nets usually far greater than that of cod.

The traps catch the youngest recruits to the commercial cod fishery. In 1971 the 1966 to 1968 year-classes dominated, contributing 70-90% of the numbers caught. The deep water gillnets in the east coast area catch a larger proportion of older fish, over 40% were more than 10 years old in 1971, and the 1955, 1961, and 1966 year-classes were still quite strong. In areas off St. John's and in St. Mary's Bay, where the gillnet fishery is in shallower water, the 1963 to 1965 year-classes made up 65-70% of the numbers caught, and there were relatively few fish over 10 years old.

In research vessel otter-trawl catches with lined codend on the northern part of the Grand Bank (Division 3L) in June and October 1971, the 1968 year-class formed 45-50% of the numbers. There were relatively few cod older than 6 years.

The inshore cod fishery in 3Ps has been somewhat more productive in the past few years than in the middle 1960's and this is probably because of poorer recruitment of the 1956-60 year-classes and better recruitment of the 1961-67 year-classes as indicated by analysis of research vessel survey data. Catch per unit effort by trap in this Division decreased from a high level of 2,300-2,700 kg per haul in 1958-60 to a low level of less than 900 kg in 1964-66 but then increased to 1,400-1,800 kg in 1967-70 except for 1969 when the catch per haul was 900 kg. Similarly the average catch per line for linetrawl decreased from 16 kg in 1957-60 to 7-9 kg in 1962-66 and then increased to 18 kg per line in 1967-70. The multifilament and more recently the monofilament bottom gillnet fishery since its inception in 1962 has maintained itself at a level of 50-59 kg per net except for 1964-65 when the catch was 36-41 kg per net.

II. Haddock, *Melanogrammus aeglefinus* L.

Newfoundland haddock landings, probably mainly from Division 3Ps, were 22% below the 1970 landings of 2,075 tons.

III. Redfish, *Sebastes mentella* Travin and *Sebastes marinus* L.

Newfoundland redfish landings from Subareas 4 and 3, mainly Division 4R and almost entirely *Sebastes mentella*, decreased 35% from the 1970 landings of 42 thousand tons.

IV. American plaice, *Hippoglossoides platessoides* (Fabricius); Witch flounder, *Glyptocephalus cynoglossus* (L.); Yellowtail flounder, *Limanda ferruginea* (Storer); and Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum).

Newfoundland landings of flounders, almost all from Subarea 3, fell by 7% from the 1970 landings of 92,000 tons. Newfoundland landings of Greenland halibut decreased 13% from the 1970 landings of 11,000 tons.

V. Herring, *Clupea harengus* L.

Herring landings in Newfoundland, mainly from the southern Gulf of St. Lawrence spawning stock occupying the western part of Division 3P in winter-spring, fell 13% from the 1970 landings of 158,000 tons.

Prior to the 1970-71 season the herring landings of the mobile fleet were utilized almost entirely for reduction into meal and oil. However, during the 1970-71 season the high prices offered for food herring resulted in 20% of the catch being diverted to the food processing plants. This trend is expected to continue during the 1971-72 season. Population estimates from tag returns indicate that the stock size of the southwest Newfoundland herring population in the 1970-71 season was only 60% of that present in the area during the 1969-70 season. Unless recruitment is more substantial than is indicated by our age and length composition data a further decline in landings can be expected for the 1971-72 season.

VI. Atlantic salmon

Newfoundland commercial landings of Atlantic salmon fell slightly from 1,595 tons in 1970 to 1,576 tons in 1971. (The Newfoundland salmon landings of 1,770 metric tons reported in the preliminary ICNAF statistics for 1970 were in error.)

VII. Short-finned squid, *Illex illecebrosus* LeSueur

Squid, which had been very scarce in the Newfoundland coastal fishery for several years, showed a modest increase in landings to about 1,600 tons, almost all from Subarea 3.

B. Special Research Studies

I. Environmental Studies

1. Hydrographic Studies. The five standard sections across the continental shelf and Labrador Current east of Newfoundland were occupied by the Fisheries Protection vessel, *Cape Freels*, at the usual times in

July-August. The year-round monitoring Station 27 off Cape Spear was occupied monthly or oftener during the year. The results of these hydrographic observations are presented in a separate document (Res. Doc. 72/31).

Offshore navigational and natural resource charting continued in the Flemish Cap/Virgin Rocks areas. Coastal charting continued in the Fogo Island area.

II. Biological Studies

1. Cod. The commercial fishery for cod, both inshore and offshore, was sampled in important Newfoundland fishing ports. Information was gathered on size, age, growth, sexual maturity, spawning, food, location of catch and catch per unit effort.

Virtual population assessments of cod were carried out for ICNAF Divisions 3K, 3L and 3Ps.

For Division 3K, estimates of average fishing mortality (F) in fully recruited age-groups ranged between 0.24 and 0.40 in 1961-66 except for 1964 for which the estimate was 0.63. Very few 3-year-old fish were caught and fish were fully recruited at 7 years of age, the 50% recruitment age being about 5 years. Yield per recruit calculations incorporating partial recruitment indicated that in the 1961-66 period the fishing mortality was within 95-100% of that necessary to generate the maximum sustainable yield per recruit at about F = 0.4. Only in 1964 did the level exceed the maximum. Extrapolation based on the correlation between catch and F indicated that for the years 1967-70 only the 1968 level was beyond the maximum and even at this level the yield per recruit was still within 98% of maximum.

For Division 3L, estimates of F ranged between 0.19 and 0.39 during 1955-63 but increased to 0.67 and 0.63 in 1964-65 coincident with an increase in landings in these years. F in 1966 was again low (0.36) although landings were still high. Very few 3-year-olds are caught but cod are fully recruited at 7 years of age, the 50% recruitment age being slightly less than 5 years. Yield per recruit calculations indicate that in the period 1959-66 the level of F was at or beyond that necessary to generate the maximum sustainable yield per recruit at about F = 0.3. Extrapolation based on the correlation between catch and F indicated that for the years 1967-70, the level of F was beyond that necessary to generate the maximum.

It should be pointed out that in both these divisions, the growth curve used was for the period 1960-62 and is therefore outdated. Some increase in growth has apparently taken place since then and will undoubtedly affect the yield curve somewhat but it is felt that the general conclusions will not be altered.

Virtual population analyses on ICNAF Division 3Ps cod indicated that fishing mortality estimates (F) for ages 3-11 fluctuated only moderately between 0.3 and 0.4 during 1959-68 except for 1966 when the estimate of F was unusually high (0.55) especially for cod older than 6 years. There is some reason to doubt the validity of the estimates for this year, however, since neither catch nor effort increased proportionately. The cod in this area are fully recruited at age 7 with very few 3-year-olds being taken, the 50% recruitment age being approximately 4.5 years. The total stock size of cod 3 years old and older decreased from about 200 million fish in 1959 to a low of 100 million fish in 1964 and then increased to 175 million in 1968. This resulted from lower recruitment from the 1956-60 year-classes and higher recruitment from the 1961-65 year-classes. The numbers of age 6+ fish have declined fairly steadily from 34 million in 1959 to 14 million in 1967 and 17 million in 1968. Yield per recruit calculations indicated the point of maximum sustained yield to be at an F-level of 0.3. The level of F for fully recruited age-groups prevailing in the 1960's was between 0.3 and 0.55 and thus was beyond this maximum level, being in the range of 90-100% of it. Further increases in fishing effort on this stock therefore will not result in long-term increases in yield, may result in long-term decreases in catch per unit effort and, depending on the stock-recruitment relationship, in stock size. In fact, some reduction in fishing effort would probably not impair the yield and may result in improved catch per unit effort.

During two *A.T. Cameron* cruises to ICNAF Divisions 3N and 3O during February-March and early June 1971, 65-70% of the cod catches were composed of the 1968 year-class confirming previous estimates of the relative strength of this year-class. Average catch per 30-minute haul in the February-March cruise was 337 kg while in June the average was 27 kg. Five sets during a fall cruise near 44°N in 45-185 m produced only 45 cod. If the 1968 year-class had been fished as heavily in 1971 at 3 years of age as the very abundant 1964 year-class was in 1967, then its major contribution to the catches will be limited to not more than two years.

2. Haddock. *A.T. Cameron* cruises to ICNAF Divisions 3N and 3O in the early spring of 1971 failed to produce any significant quantities of adult or pre-recruit haddock indicating once again that the adult stock is at an extremely low level and that year-classes up to 1970 have been poor.

During the 1971 inshore fishing season, reports were again received of significant quantities of haddock being caught along the south and east coasts of Newfoundland. Samples of these were obtained.

3. American plaice. An assessment of American plaice from the Grand Bank (3L and 3N) was completed using the virtual population method. This method permits the calculation of fishing mortality (F) for each age of the various year-classes independent of effort data. For 3L, data from 1955 to 1970 were available and for 3N the 1956-70 period was used. Natural mortality (M) has been estimated at 0.25 for males and 0.20 for females. For fully exploited age groups, fishing mortality (F) increased in Division 3L from 0.15 for males and 0.14 for females in 1955 to 0.60 for males and 0.48 for females in 1967, and in 3N from 0.12 for males and 0.10 for females in 1956 to 0.58 for males and 0.60 for females in 1968.

Yield curves, calculated for various values of F of fully recruited plaice, indicated that in 1968 the stock in 3L was being exploited at a level equivalent to 82-86% of the apparent maximum sustainable yield. The effort in 1968 was 63,200 hours producing 570 kg per hour. In 1969 the effort was 92,700 hours giving a projected value of F that would raise the yield level to about 90% of the maximum. The catch per hour was 520 kg. In 1970 at about the same level of exploitation the catch per hour decreased to 450 kg. It is suggested for the type of yield curves produced, which apparently would reach a maximum beyond the 2.0 fishing level, that 80% of the maximum yield, i.e. F = 0.50, is perhaps an appropriate level of exploitation. This would apparently produce between 32 and 36 thousand tons.

For 3N the 1968 estimate of F was about 0.60 which is about 90% of the maximum yield. The effort in 1968 was 37,700 hours and the catch per hour 570 kg. In 1969 and 1970 the effort was 33,600 and 59,000 hours respectively producing catches of 460 and 340 kg per hour. Extrapolating the probable F for the 1970 fishing effort gives an F value between 0.65 and 0.80 or 92-95% of the maximum yield. If 80% of the maximum yield is an acceptable level of exploitation, then a fishing mortality of 0.40, which was close to 1965 level, should be recommended. In 1965 about 23,000 tons were landed from this division. However, 3N is a relatively small area and apparently does not have a large reserve of pre-recruit plaice as in 3L although they grow faster than in 3L. There is also the strong possibility that 3N is, in part at least, stocked by larval drift from the north and we have no knowledge of how a reduction in stock size in 3L will affect this. It was therefore suggested that landings in 3N probably should not exceed 18,000 tons.

Two groundfish surveys were carried out on the Grand Bank with the *A.T. Cameron* using the stratified random method of fishing station selection, one in June and the second in October 1971. The June cruise, which was a 24-hour fishing operation, surveyed a major portion of the

Grand Bank with a total of 86 successful 30-minute tows. Several relatively good catches of plaice were recorded in Division 3L, ranging from 320 to 640 kg; mostly from the north and northwestern slopes of the bank. Plaice were generally scarce south of 45°N on the east and southeast slopes with catches all less than 230 kg.

The October cruise surveyed some of the deeper strata on the north and northeast parts of the bank that were omitted from the June cruise and in addition repeated some strata sampled earlier in order to compare spring and fall distribution. Catches of plaice up to 900 kg for a 30-minute set were recorded but average catches of plaice per set were in the 180-270 kg range.

4. Yellowtail flounder. Landings of yellowtail flounder from the Grand Bank increased rapidly from less than 900 tons annually prior to 1965 to a total of about 26,700 tons in 1970.

The age composition of commercial landings and research catches indicate a succession of year-classes of approximately equal strength. The fishery appears to be dependent primarily on 6-, 7- and 8-year-olds; however, the 1970 landings from 3L were dominated by 6- and 7-year-olds.

Total mortality estimates from ICNAF Division 3N from research vessel catch curves for 1951-52 were 0.89 (59%) for males and 0.62 (46%) for females and 0.77 (54%) for males and females combined. These were from samples taken before the large commercial fishery began. Catch curves (research) for 1970 gave estimates as follows: males 1.82 (83%) and for females 1.27 or a combined estimate of 1.57 (79%). For commercial catch curves total mortality estimates increased from 0.83 (56%) in 1965 to 1.25 (71%) in 1969. The high total mortality estimates for the pre-exploited period would seem to suggest a high natural mortality rate. However, during this period small yellowtail were probably caught and discarded by the commercial fleet and the larger ones included as American plaice. In addition, if the yellowtail stocks are increasing in abundance, which appears to be the case, mortality estimated from catch curves gives too high estimates of total mortality. With data available from 1971 it might be possible to get estimates of total mortality from catch curves of year-classes which would eliminate the effects of combining a number of year-classes of unequal strength.

In a groundfish survey cruise of the *A.T. Cameron* to the Grand Bank in June, records of yellowtail catches indicated that this species has spread to most of the parts of the bank less than 90 m in depth and 30-minute catches of about 230 kg were obtained at several localities.

5. Greenland halibut. Four hundred and ten Greenland halibut were tagged in Trinity Bay using 1/2 inch Petersen discs, 28 October-18 November 1971. The fish were caught on longline gear using capelin as bait. A further 7 returns were recovered from the 1969 White Bay tagging bringing the total recoveries to 27 from 249 tagged. Two of the 1971 recoveries were from USSR factory ships fishing on the edge of the continental shelf.

6. Herring. In the 1970-71 season, the southwest Newfoundland fishery was still dependent on pre-1960 year-classes with over 50% of number and much more by weight of the herring sampled being 11 years old or older. Subsequent to the very successful fall-spawning year-class of 1958 and the successful spring-spawning year-class of 1959, no very successful year-class has entered the fishery. Since the purse-seine fishery began in 1965, the average total length of the herring caught has increased from 31.6 cm in 1965-66 to 33.9 cm in 1970-71.

A total of 708 tags (2.8%) has been recaptured from the 25,000 herring taken in a bar seine and tagged with internal metal tags in March 1970 on the southwest Newfoundland coast. The majority of these tags were recovered from the Newfoundland winter fishery but a significant proportion was also recovered from the Magdalen Islands-St. Pauls area and the Chaleur Bay-Gaspé region of the southern Gulf. Complementary taggings in the southern Gulf area by the St. Andrews Station have confirmed the return migration to the Newfoundland coast.

In January 1971, 10,000 herring taken by bar seine were tagged with internal metal tags at Bay de Loup on the southwest coast of Newfoundland. Four hundred and five of these were taken in the winter fishery of 1971 on the southwest coast, 6 in 1971 near the Magdalen Islands and 14 in the summer fishery of 1971 in the southern Gulf of St. Lawrence. The results from the Bay de Loup tagging also confirmed the migratory path of herring from the Newfoundland coast to their spawning grounds in the southern Gulf of St. Lawrence.

From 3,400 herring tagged with internal metal tags at Hawke's Bay on the northern part of the west coast of Newfoundland in December 1970, three were taken in the winter-spring fishery of 1971 on the southwest coast of Newfoundland and 2 in the summer of 1971 in the southern Gulf of St. Lawrence. There was apparently a high tagging mortality in these herring which were obtained from a purse seine and exhibited a high degree of scale loss.

Tag returns from the March 1970 and January 1971 releases have been adjusted for tagging mortality and recovery efficiencies and stock sizes have been estimated. The stock size of the southwest Newfoundland herring population was estimated at 400,000 tons at the start of the 1969-70 season and about 250,000 tons at the beginning of the 1970-71

season. Over the same period the landings decreased 26% which attests somewhat to the reliability of the population estimates. The monthly exploitation rate was estimated at 4 to 5% and if a similar rate applies for the summer fisheries in the southern Gulf of St. Lawrence the annual rate for the stock as a whole would be about 40-50%. This is the level at which the Atlanto-Scandian stock began to collapse. Unless recruitment to the exploited stock is considerably more than is evident from present data, herring landings from the southwestern Newfoundland-south Gulf fisheries will continue to decline.

To evaluate further the use of meristic characters as indices for racial separation, the technique of discriminant function analysis was applied to herring meristic data for spring and autumn spawners. From 79 to 91% of individual spring- and autumn-spawning herring were correctly classified to their respective spawning groups by the use of a linear discriminant function based on three meristic characters - pectoral and anal fin rays and gill rakers. The results of the discriminant function analyses confirm that the spring- and autumn-spawning components of the southwest Newfoundland-southern Gulf of St. Lawrence herring stock complex are not members of a homogeneous group but constitute distinct breeding populations which develop at different times of the year under different environmental conditions. This clearly demonstrates that the vast majority of autumn spawners are the progeny of herring which spawned in the autumn and spring spawners of herring which spawned in the spring. The amount of interchange between the two spawning groups is probably slight.

In the Newfoundland area there are geographic trends in the mean numbers of gill rakers and anal fin rays which appear to be correlated with water temperature during early development. Spring-spawning herring from the generally cold waters of eastern Newfoundland have higher gill-raker averages than spring spawners from southeastern Newfoundland where water temperatures are somewhat intermediate. The lowest gill-raker averages occur along southwest Newfoundland and in the southern Gulf of St. Lawrence, with warmer water in the upper layers. The mean number of anal fin rays is also higher for eastern Newfoundland spring spawners than for spring spawners from southern Newfoundland and the Magdalen Islands. Hawke's Bay (on the northern part of the west coast of Newfoundland) spring spawners are somewhat anomalous in that they are similar in mean number of gill rakers to southeastern Newfoundland spring spawners but are similar to eastern Newfoundland spring spawners in the mean number of anal fin rays. No such geographic trends are evident among autumn spawners. It is possible that temperature conditions on the spawning grounds and in the larval nursery areas are more uniform throughout the Newfoundland area during the autumn than during the spring or early summer.

7. Atlantic salmon. The program of sampling salmon from commercial catches to provide quantitative data on the sizes and ages was continued in 1971. A total of 2,962 salmon was sampled for length, weight, scales and where possible for sex from the commercial fisheries at Port-aux-Basques, Bonavista, the eastern portion of the Great Northern Peninsula including St. Anthony, various fishing communities along the southern Labrador coast and near St. John's. Samples of viscera and blood were also obtained from representative samples of the fish.

Analysis of the smolt ages of salmon and grilse sampled during 1969-70 shows that most of the fish caught along the Labrador coast had spent 4 to 5 years in the river and indicate that it is highly probable that they were of Labrador or northern Newfoundland origin. Fish sampled from St. Anthony and the eastern part of the Great Northern Peninsula had lower smolt ages (averages 3.56-4.07) than those of Labrador (averages 4.25-4.59) but were in many cases significantly higher than those of Bonavista (averages 2.80-2.99), Port-aux-Basques and Rose Blanche (averages 3.16-3.24), and Miramichi Bay (average 2.88).

Analysis of the salmon length data from fish sampled during June 1971 at Bonavista confirms that the ratio of grilse to older salmon changes significantly as the season progresses. The percentage of fish less than 62 cm (fork length) increased from 17.5% during 8-11 June to 46.4% during 15-19 June and to 54.9% during 21-22 June.

8. Pink salmon, *Oncorhynchus gorbuscha* (Walbaum). Research on the pink salmon transplant at North Harbour River in St. Mary's Bay on the eastern part of the south coast of Newfoundland continued in 1971. A Wolf fry trap was operated at the mouth of the egg channel from 6 April to 17 May. A counting fence with the trap set for downstream migrating fish was installed in fishing order on 3 May, approximately 100 feet above the head of tide. The trap was reversed for upstream migration on 10 June and remained in good fishing order until 12 October when the nets were removed.

To determine the time of hatching and survival rate of pink salmon fry from the 1970 spawning, 12 perforated plastic boxes containing 25 eggs each were distributed in the spawning areas on 15 September 1970. A sample was examined weekly until hatching and monthly thereafter. The eggs had all eyed by 15 October and hatching occurred during the period 13-19 November. This was three weeks earlier than for the previous year and the earliest record for North Harbour River.

The fry run at the mouth of the spawning channel, 4.3 km from the river mouth, began 12 April and ended 2 May with the peak on 24 April. The fry run at the mouth of the river (fyke trap sampling), began 14 April and ended 5 May with the peak on 27 April.

To obtain an estimate of the total number of fry migrating to sea, small fyke traps were fished just above the head of tide from 5 April to 17 May. The total number of fry was estimated by the mark and recapture method. The percentage survival of pink fry for 1969, 1970 and 1971 is as follows:

	1969	1970	1971
Egg samples (actual count)	80.4	77.0	78.5
Spawning channel (actual count)	77.8	75.2	76.4
River (mark-recapture estimate)	75.8	71.7	70.0

The estimated total fry run from the spawning channel was 126,795 from an estimated 161,600 eggs deposited by 101 females in 1970. To determine the extent of predation on fry during their migration to sea, a nylon gillnet was fished near the head of tide at various times during the run. Only 8 brook trout, 2 brown trout and 147 smelt were caught. None of these had any fry in their stomachs. The fry run ended before the trout migration began.

The adult pink salmon run to the river began 17 July and ended 28 September. The total was 468 fish (235 M, 233 F), of which 296 were counted at the fence, 141 were seined below the fence and 31 spawned below the fence. All fish seined below the fence and some that passed through the fence were placed in the channel, both ends of which were screened to prevent escape. The total placed in channel was 330 fish (162 M, 168 F).

Water temperature at the fence during the run ranged from 8.5°C to 24.5°C and water heights from 0.3 to 0.9 m. Every tenth salmon of each sex passing through the fence was measured, weighed and a scale sample taken.

Except for a few late running fish, spawning occurred between 10 and 25 September with the greatest concentration 15-18 September. Although only 138 fish (73 M, 65 F) spawned in the main river, spawning was distributed over 5½ km of river. At the completion of spawning 231 redds were counted, 65 in the main river and 166 in the channel.

The total number of adult returns to date is 622 as follows: 468 in North Harbour River, 117 in the commercial fishery, 36 in four other rivers and 1 in the sport fishery in salt water. Of the total reported returns, 95.8% had entered St. Mary's Bay.

9. Short-finned squid. The *E.E. Prince* conducted a squid survey on the shelf off southern Newfoundland and Nova Scotia, 12-22 July. Fifty-eight otter-trawl sets were made at locations fished in the 1970 surveys. Squid were taken in all areas except the southern tip of the Grand Bank. Largest catches were made in the Halibut Channel (860 and 133 specimens in 135 and 275 m respectively), on

Banquereau (186 specimens in 180 m) and south of Sable Island (268 specimens in 180 m). Total catch for the cruise was 2,100 specimens, up considerably from the 1970 surveys. Standard biological sampling was conducted and specimens collected for electrophoretic study.

Squid were first reported inshore at North Harbour, Placentia Bay on 17 June, the earliest inshore appearance on record. First east coast records were strandings on 24 June at Ferryland and first commercial landings were made there on about 28 June. In spite of the encouraging start, total landings for the year were only 1,600 tons, up considerably from 75 tons in 1970 but still far below average. The jigging ground at Holyrood in Conception Bay accounted for 20% of the Newfoundland landings; catches at Holyrood were greatest in July and August, no squid being landed 12 September-11 October after which low landings continued to 10 November.

The surface temperature at Holyrood was 7.0-7.4°C on 5 July at the time of first landings. The time of absence of squid from the grounds coincided with the highest temperature conditions, ca 10-12°C. On 12 October, when the squid returned, surface temperatures were 7.6-9.5°C; their departure coincided with the first drop of temperature below 5°C.

Size distributions, growth, maturity and parasites were monitored throughout the season at Holyrood and several population samples were obtained from other areas for comparison.

Tagging was accomplished with a small metal clip tag fastened to the tail fin, the technique being similar to that employed in Japanese research on a closely related species. A return of 18.7% was obtained from a tagging of 402 squid at Holyrood. Although the experiment was publicized by radio and through distribution of posters, all returns were from Holyrood. Nearly all recaptures were made within two days of tagging but a few were reported captured up to 86 days after release.

B. Subareas 4 and 5

Canadian researches in Subareas 4 and 5 on oceanography and fish stocks were carried out by the Fisheries Research Board of Canada from the following institutions: St. Andrews Biological Station, Marine Ecology Laboratory (Dartmouth), St. John's Biological Station, Arctic Biological Station (Ste Anne de Bellevue). The Bedford Institute of Oceanography and Quebec Ministry of Industry and Commerce also contributed. Data for preliminary surveys of 1971 landings were obtained from the Fisheries Service of the Canadian Department of the Environment.

This report was prepared from submissions by many scientists engaged in research into problems of ICNAF interest.

Harp and Hooded seals are dealt with in Appendix 1 for combined Subareas 2, 3, and 4.

Subarea 4

A. Status of the Fisheries

I. Groundfish General

Total groundfish landings in Subarea 4 (Maritimes and Quebec) increased by approximately 4% from 1970 to about 296,000 metric tons. This was mainly due to a 30% increase in redfish landings. However, if the effect of the 1970 fishworkers' strike is taken into account (an estimated loss of 32,000 metric tons in 1970), there was an effective 4% decrease in production.

II. Cod

Cod landings were down by 5% from 1970 and also formed a smaller proportion of total groundfish landings, from 40 to 35%. Landings from Gulf of St. Lawrence and Cape Breton (Div. 4R, 4S, 4T, 4V north) dropped almost 10%, a reversal of the trend since

1967. Landings from the remainder of Subarea 4 (Div. 4V south, 4W, 4X) recovered partly from the 1970 low level, but were still 10% below 1969 landings. This is probably due to a combination of closure of part of 4X in March and April, and low availability.

III. Haddock

Total haddock landings were up by 12% from 1970 but were still more than 30% below 1969 level. The major improvement was a 75% increase from Div. 4W but Divisions 4X and 4V south also showed slight gains. Landings from Gulf of St. Lawrence (Div. 4R, 4S, 4T) and Cape Breton (4V north) declined to lowest levels since 1967, reversing the general trend of the past five years, although the decrease is insignificant in relation to total landings from Subarea 4.

IV. Flatfish

Total landings (plaice, witch, yellowtail, winter flounder) again showed a fall from the previous years. The 8% decrease was due mainly to a 25% drop in landings from Gulf of St. Lawrence (Div. 4R, 4S, 4T) which more than offset 50% gains in Divisions 4V south and 4W. The fall in landings from 1970 level is even more serious than overall figures indicate, as it does not take into account the effect of the 1970 fishworkers' strike.

Atlantic halibut landings were about the same as in 1970.

V. Redfish

Landings rose by almost 30% over 1970 level reflecting the great increase in effort for redfish. Gulf of St. Lawrence (Div. 4R, 4S, 4T) and Cape Breton (Div. 4V north) landings went up almost 13% while landings from each of Divisions 4V south, 4W, 4X also rose, particularly 4Vs which showed a fivefold increase.

VI. Pollock

Pollock landings increased by 10% from 1970.

VII. Other groundfish

Landings increased by 30% from 1970 level to form about 13% of total groundfish. The increase was due mainly to improved hake landings (up 70%) but cusk, wolffish, and unspecified or mixed groundfish also went up.

VIII. Sea scallop, *Placopecten magellanicus*

Total landings were almost 8,700 metric tons whole weight (1,050,000 kg meats), a decrease from 1970 of about 40%. Landings decreased in all Divisions to: 4T — 6,445; 4V, W — 238; 4X — 1,999 (metric tons whole weight).

IX. Herring

Herring landings from Subarea 4 (excluding Div. 4R) were approximately 280,000 metric tons — a decrease of about 38,000 tons (12% from 1970). Division 4X landings decreased from 132,000 to 94,000 tons and Div. 4T from 169,000 to 134,000 tons. Division 4W landings increased from 17,000 to 47,000 tons and Div. 4V about 200 tons to over 5,000 tons. Total landings are expected to decline further in 1972.

X. Swordfish

The swordfish fishery ceased abruptly in January, with the discovery of unacceptable levels of mercury, and there is no immediate prospect for its re-activation.

XI. Mackerel

Preliminary estimates of mackerel landings in Subarea 4 were 13,200 metric tons, a decrease of 1,500 tons (10%) from 1970. Landings in Div. 4X, 4V, and 4T were slightly lower but small increases were recorded for Div. 4W and 4V. Landings will probably increase in 1972 with some diversion of effort from herring.

XII. Tuna

Landings of tuna were unchanged from 1970 at 3,900 metric tons. Nearly 2,800 metric tons were yellowfin, skipjack, and bigeye from eastern Pacific; the remainder, bluefin (900 tons and skipjack (200 tons) from western Atlantic, about equally divided between Div. 5Z and 6A. Tuna landings are expected to remain at about the same level in 1972.

XIII. Sharks

Incidental landings of sharks (10 to 100 tons) have been made annually since 1965 but disappeared in 1971 with the closure of the swordfish fishery. No shark landings are expected in 1972.

XIV. Atlantic salmon

Total catch for Subarea 4, exclusive of Div. 4R which is reported with Subareas 2 and 3, dropped to 342 metric tons from 651 tons in 1970. Commercial catch in Div. 4S-X declined by 49% from 1970, the decrease spread fairly evenly over all Divisions. The angling catch (87 tons) was about 56% of the 1970 catch and included 69% grilse as compared to about 60% in 1970.

XV. Harp and Hooded Seals : See Appexdix I.

B. Special Research Studies

I. Environmental Studies

1. Hydrographic studies. Charting was completed for Northumberland Strait and studies continued off coastal Nova Scotia (Div. 4W, 4X). The 1970 wave-climate study of the Canadian Atlantic coast and continental shelf was completed. Results showed wave-energy encountered by month and area in Subareas 4 and 5.

2. Plankton studies. Data on seasonal distribution and dispersion pattern of larval herring from the Bay of Fundy–Gulf of Maine area (Div. 4X, 5Y, Z) for 1967-70 showed no evidence of substantial exchange between the two major spawning areas of Georges Bank and southwest Nova Scotia.

Monitoring of distribution of fish eggs and larvae in southwest Gulf of St. Lawrence (Div. 4T) continued. Studies of larval fish feeding showed good correlation between abundances of small planktonic organisms, particularly cladocerans and copepods, and stomach contents of larval fish.

3. Other environmental studies. A long-term sampling program for petroleum hydrocarbons and other oceanic pollutants, based on quarterly cruises in sea-area Halifax-Bermuda, was started.

Mass mortalities of herring at North Sydney, Nova Scotia (Div. 4V) in April of 1968 have been attributed to an intermediate oil from coke production. Oil concentrations in tissues (µg/g) were: muscle 5.2 , intestines 9.2 , skin 17.5 , indicating oil absorption through body surface. Laboratory determinations of time to 50% mortality were 0.25, 0.87, 3.7, and 93 hours for 100, 10, 8, and 6 ppm of oil, respectively.

A detailed analysis of BT profiles at the Canadian Oceanographic Data Centre has been started to determine temporal and vertical evolutions of the Gulf of St. Lawrence thermocline.

II. Biological Studies

1. Groundfish general. The second annual groundfish survey program was carried out in July-August of 1971, covering Div. 4X to 4T. Abundance indices for some major species derived from results show good agreement with those derived from commercial data and show encouraging agreement with comparable surveys by

USA and USSR, and with 1970 results. Abundance estimates of main groundfish species by ICNAF Divisions and depth strata in 4V-W-X were derived from historical data for 1958-68.

2. Cod. Commercial landings in the Gulf of St. Lawrence (Div. 4T) comprised mainly 4-, 5-, and 6-year-old fish (peak size 46 cm), as in 1970, but with a stronger representation of 7-year-olds than has been noted since 1965. This was confirmed by research vessel catches which also indicated that in the recruitment area in the southwestern part of the Gulf, 3-year-old fish (peak length 34 cm) predominated. This should assure adequate recruitment to the 1972 fishery.

Research vessel survey data indicate that there are no strong year-classes to improve the fishery in Div. 4X for the next few years.

3. Haddock. Quantitative research vessel surveys in 1969 and 1970 indicate that recruitment from 1967-69 year-classes to the fishery in eastern Scotian Shelf (Div. 4V-W) in 1971-1973 will be poor, probably numbering less than 10 million fish, reflecting a fishing mortality $F = 1.12$. This is much below previous estimates (22 million for 1972-73; $F = 0.50$) and fishing mortality at about the 1970 level of effort (9,000 tons) may well reduce the stock further.

In Div. 4X, imposition of the 18,000 metric tons catch quota for 1971 failed to reduce the fishing mortality below the high level of previous years ($F = 0.60$) and stock abundance continued to decline. Poor 1968-70 year-classes indicate that there can be no improvement in recruitment to the fishery before 1975.

The recommended reduced quota for 1972 (9,000 tons) may result in closure of the fishing by May 1972 but even greater reductions, to 6,000 tons, may be advisable. This would close the fishery as the quota would be filled by catches of haddock incidental to other fisheries.

Historical data (1958-71) for Div. 4W haddock indicate that the centre of spawning occurs persistently in a small area between Emerald and Western Banks and to the south of Emerald Bank, unaffected by variations in hydrographic conditions. The spawning period varies and there are differences in maturation cycles between males and females.

4. Yellowtail flounder (*Limanda ferruginea*. Analysis of tagging returns indicated little movement of stocks. Ninety-five percent of the recoveries were within 30 miles of the tagging area. Two separate groups were delineated on the Nova Scotia Banks: (1) Middle Ground-Sable Island (4W); (2) Banquereau (4Vs).

Analysis of stomach contents show main items were amphipods and polychaetes. Sand launce, sand dollars, and herring eggs were regionally and seasonally abundant.

5. Sand launce (*Ammodytes*). Biological characteristics of various sand launce groups were examined. They indicate environmental determination of characteristics which results in significant differences in growth rates and meristics between groups. Larval development, feeding habits, and general ecology were also investigated.

6. Flatfish parasites. Assessment of intestinal parasites for use in separating populations of yellowtail flounder, American plaice, and greysole was started. There is considerable variation in parasite incidence and intensity between ICNAF Divisions. In particular 4X was characterized by very high incidence of acanthocephalans and comparitively low incidence of certain trematodes.

7. Food resource and digestion rates. Studies of sea raven stomach contents, rates of gastric emptying and estimates of abundance of sea ravens and yearling cod indicate that sea ravens consume 5-10% of yearling cod in Passamaquoddy Bay, New Brunswick (4x).

Most of the young cod, in turn, feed almost entirely on krill from August to October. From instantaneous rates of gastric emptying determined in laboratory experiment, it was estimated that they consumed 49 kg of krill per kg cod per day. This was verified by an energy budget study.

8. Sea scallop (*Placopecten magellanicus*). Submersible studies of scallop dredging effects showed roughening of sea bottom, dislodging of boulders up to 40 cm diameter and probable lethal damage to about 17% of uncaught scallops left in the dredge track.

9. Herring. Returns from 1970 herring taggings in the Gulf of St. Lawrence continued with the Newfoundland winter fishery yielding 397 returns — 40 from releases off the Magdalen Islands in May and 357 from releases off the Gaspé coast in August. The Gulf of St. Lawrence summer fishery yielded 265 returns (22 from Magdalen Island releases and 243 from Gaspé releases). Total returns now number 129 (0.36%) from Magdalen Island taggings and 928 (4.53%) from Gaspé taggings. Results clearly indicate that the same stocks are being exploited in three general areas at different seasons: southwest coast of Newfoundland in winter, southern part of Div. 4T in spring, and western part of Div. 4T in late summer and early autumn. Results also indicate a high fishing mortality.

Comparison of morphological characters and parasitic (larval *Anisakis*) infection levels of Nova Scotia Banks herring with those of southwest Newfoundland-southern Gulf of St. Lawrence,

indicates that the two stocks do not intermingle to any great extent. Canso Bank (4W) and Banquereau (4Vs) herring appear to be one stock, adults overwintering offshore on Banquereau, younger herring inshore in Canso Bank-Chedabucto Bay area.

Examination of more than 1,000 herring from different Northwest Atlantic fisheries indicates that otoliths can be used as 'natural tags' for identifying herring stocks. Two types are recognized: an S-type characterizing spring-spawners and an A-type characterizing autumn-spawners. These two otolith types provided positive evidence that, in the Gulf of St. Lawrence, spring- and autumn-spawning stocks of herring mix on American Bank (Div. 4T) for feeding. In the Chedabucto Bay (Div. 4W) area, spring and autumn stocks are found mixed during the winter.

10. Swordfish. Commercial records of swordfish longlining show that both catch rate (fish caught per 100 hooks set) and average weight of fish have declined from 2.88 fish averaging 168.1 lb (dressed) in 1963 to 1.03 fish averaging 99.9 lb in 1969.

11. Tuna. Size compositions of small bluefin landed from the 1971 purse seine fishery off the mid-Atlantic coast of the United States again changed considerably as the season progressed. Age groups 1 and 2 (1970 and 1969 year-classes) dominated early catches, while older fish (ages 3-7) made up the bulk of later catches. The 1966 year-class has been poorly represented since 1969.

I. Environmental Studies

12. Atlantic salmon. Over 216,000 hatchery-reared and 30,000 wild smolts were tagged and liberated in stock evaluation and utilization studies. Almost 4,000 adult grilse and salmon were tagged and liberated in fishery areas or as they ascended rivers.

Of 302 adults tagged in a drift-net fishery in Div. 4T in 1970, 35% were recaptured in that year and about 10% in 1971.

Annual numbers of salmon ascending an important salmon stream studied since 1950, have decreased to less than 10% of salmon and 30% of grilse compared with 1950-55 figures. Estimated egg deposition and populations of juvenile salmon were much below normal. Deterioration is attributed to environmental degradation, aggravated by heavy fisheries exploitation both in home waters and in the Greenland-Davis Strait area.

Examination of returns from tagged, wild Northwest Miramichi smolts shows utilization of 2-sea-year salmon in Greenland to be about the same as in intensive commercial fisheries within 50 miles of the home river. This results in an increase in the grilse-salmon ratio for spawners entering the river (22:1) as compared to the grilse/salmon ratio for yield (fisheries + escapement from a given smolt year-class) (3:1). About two thirds of the returning grilse are males, which contributes to low potential egg deposition.

Returns from wild smolts given experimental sublethal treatment with DDT were about 57% of those from a control group. DDT-treated fish showed relatively higher returns as 2-sea-year salmon than as grilse. Returns as grilse from wild and hatchery-reared smolts given 24-hour sublethal treatment with a copper-zinc solution were about 75% of those from a control group.

II. Biological Studies

12. Atlantic salmon. Identification of genetic polymorphism of blood transferrins was extended to differentiate between native stocks from southwestern and northeastern New Brunswick and between juveniles from headwaters (early-run) and lower reaches (late-run) of the Northwest Miramichi.

13. Harp and Hooded Seals. See Appendix I.

III. Gear and Selectivity Studies

Research on fluid mechanics of netting, including experiments with round-wire and textile netting screens, showed that existing theory cannot be applied to trawls, where angles of attack are usually less than 30°. New theory for trawls is being developed in this field and in rational design of bottom and midwater trawls.

A prototype trawl-door instrument package for determination of six variables was tested at sea. Tilt- and heel-angle meters worked very well; tension meters in towing and groundwarps were satisfactory except when overloaded during 'hang-ups'; angle of attack sensor requires minor modification; door spread meter requires further development.

Subarea 5

A. Status of the Fisheries

I. Cod

Landings increased from 1970 by 20% to just over 3,000 tons. This is still only 50% of 1969 landings.

II. Haddock

Haddock landings showed a further decrease of 10% from 1970, continuing decline of the past few years to less than 10% of 1966 landings. Part of the decrease is due to the closed season on Georges Bank (5Z).

III. Sea scallop

Landings from Div. 5Z, about 32,750 metric tons whole weight (3,950,000 kg meats) continued to decline, showing a 2% decrease from 1970 for approximately the same but more widespread fishing effort, and a 34% decrease from peak year 1964.

IV. Herring

Total Canadian catch in Subarea 5 was about 32,000 metric tons of which about 15,000 tons was sold directly to U.S. buyers and hence is not included in Canadian landing statistics. Catches were about equally divided between Jeffrey's Ledge (Div. 5Y) and Georges Bank (Div. 5Z). Probable restrictions (quotas) on landings will have a major influence on the 1972 herring fishery in Subarea 5.

V. Swordfish

The swordfish fishery was stopped because of unacceptably high mercury levels in the fish.

B. Special Research Studies

I. Biological Studies

1. Swordfish. Investigations of heavy metal contamination of swordfish are reported under section on Subarea 4.

2. Sea scallop. Underwater photographic studies of an offshore scallop-dredge on Georges Bank (Div. 5Z) indicated that about 15% of all scallops in the path of the dredge were captured. Escapement after entering the dredge was about 50%, mainly through inter-ring spaces and belly.

Appendix I

Harp and Hooded Seals (Subareas 2, 3 and 4)

A. Status of the Fisheries

CANADIAN ATLANTIC SEAL CATCH

Year	Harp Seals			Hooded Seals			Grand Total
	Young	Older	Total	Young	Older	Total	
1970							
Gulf	72,512	5,463	77,375	405	8	413	78,388
Front	53,363	10,957	64,320	1,653	803	2,456	66,776
Total	125,875	16,420	142,295	2,058	811	2,869	145,164
1971							
Gulf	70,131	5,577	75,708	13	1	14	75,722
Front	53,051	6,456	59,507	219	191	410	59,917
Total	123,182	12,033	135,215	232	192	424	135,639

In 1971, for the first time, a quota of 145,000 harp seals was imposed on the seal fishery: 100,000 for Canadian ships, and 45,000 for Canadian landsmen. This quota was not attained mainly because of shortage fo seals available to ships round the Magdalen Islands. Of 70,000 young seals taken in the southern Gulf of St. Lawrence, landsmen and small craft took 31,000 and ships, 39,000.

B. Special Research Studies

1. From a study of the strength of recent year-classes of harp seals compared with the catch of each year-class as young, production was estimated as lying between 260,000 and 295,000 for median year 1968, with a decrease of about 25,000 annually.

2. From aerial survey in 1970, and the fishery in 1971 (see section A), production in the Gulf was estimated at 70,000 to 75,000 young harp seals. It is believed that, following poor ice conditions in the Gulf in 1969, a part of the Gulf adults transferred to the Front herd. However, age samples from the Gulf area in 1971 show considerable strength of year-classes 1966 and 1968, which were immature age-classes in 1969 and so unaffected by the poor ice conditions for whelping. It is therefore believed that the Gulf herd will show some recovery as these year-classes recruit to the whelping stock beginning at age 5.

3. Age samples from the Front area so far show no strong recent year-classes save that of 1968, a year when catching was voluntarily reduced.

4. Samples collected from a winter net fishery for harp seals in northern Newfoundland show the food of adults at the coast in late March and early April to consist mainly of benthic Crustacea with some fish.

5. Ovaries from females on the Front indicate median age at sexual maturity to be between 4 and 5 years, compared to 4.5 years for Gulf females.

   Male harp seals now mature sexually between 4 and 6 years, as compared with 6 to 9 years in 1951-54 before the fishery reduced the population.