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REPORT ON THE STATUS OF PELAGIC FISHES (CAPELIN OFF NEWFOUNDLAND AND IN THE GULF OF ST. LAWRENCE, AND HERRING OFF THE EAST, SOUTHEAST AND SOUTH COASTS OF NEWFOUNDLAND)

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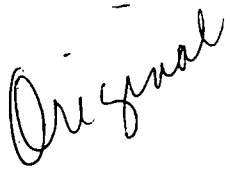

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INTRODUCTION

This report contains assessments of the status of capelin stocks in Subarea 2 and divisions 3KL, Subdivision 3Ps, and in the Gulf of St. Lawrence (Div. 4RST), in addition to herring stocks along the east and southeast coasts of Newfoundland and in Subdivision 3Pn. Scientists from Atlantic Canada and from the Headquarters of the Department of Fisheries and Oceans in Ottawa have reviewed the data and analyses used to estimate the present status of these stocks. The data used to prepare these assessments, with details of analyses used, will be published in the department's research document series dealing with the Atlantic fisheries.

STATUS OF THE CAPELIN STOCK IN SA2 + DIV. 3KL

Stock structure

Beginning in the mid-1970s, capelin off Newfoundland's east coast were assessed and managed as "northern" (NAFO SA2 + Div. 3K) and "southern" (NAFO Div. 3LNOPs) components. The "southern" stocks were further subdivided during the late 1970s and early 1980s such that separate management units in Div. 3L, 3NO and 3Ps were identified.

The original stock designations in the early 1970s were based on tenuous and circumstantial evidence from research vessel surveys. Numerous studies during the 1970s and 1980s failed to provide strong evidence to support the existing stock designations but tagging studies indicated substantial migration of mature capelin between Div. 3L and Div. 3K. There are also similarities in age structure and year-class strength of capelin between the two areas, and as a result of this accumulated evidence, scientists recommended in 1992 that capelin in SA2 + Div. 3K and Div. 3L be considered as one stock complex. Therefore, the information in the present document is presented for the stock complex of Subarea 2 + Division 3KL.

Description of the fishery **Table 1, Figure 1**

There has always been a small domestic fishery for capelin on the spawning beaches for use as food, bait and fertilizer. The annual harvest in Newfoundland has been estimated at about 25,000 tonnes (t). A directed foreign offshore fishery began in the early 1970s. This fishery was seasonal; Div. 3L was fished in the spring and Div. 2J3K was fished in the autumn. The offshore fishery was closed in Div. 3L in 1979 and in Div. 2J3K beginning in 1992. During the late 1970s, an inshore fishery for roe capelin began. This roe fishery developed more rapidly in Div. 3L than Div. 3K while catches in Div. 2J have remained very low.

The main gear types in the inshore fishery are traps and purse seines although beach seines account for a small but variable proportion of the catch. The primary market is for frozen roe-bearing female capelin in Japan. This market is limited and the demand for quality is high. Female capelin must meet quality standards for size, quality of roe, percent roe (weight of roe expressed as a percentage of total weight), absence of redfeed (presence of food, usually plankton, in the stomachs) and general physical appearance. Failure to meet these standards results in discarding. Most males are discarded. Fishers are encouraged to check their catches prior to drying up so that fish can be released alive if they do not meet market standards.

Since there is a single limited market, TACs are usually determined based on expected market demand. Except for the last few years, TACs have not been limited by the biological advice. Once the overall TAC is

determined, it is allocated by bay and gear type. The overall TAC, bay and gear allocations as well as other management practices (eg. opening dates) have been determined after consultation with representatives of the fishing industry. In recent years, opening dates in some areas have been determined by fishers and processors by monitoring test catches for marketable capelin.

Catches have usually been about the same as the TAC largely because the TAC is based on expected market demand. An exception occurred in Div. 3L in 1992 when catches of about 2,000 t were well below the 19,300t TAC. Capelin were unusually small that year and did not meet market standards. In 1991, a 50,000 t offshore allocation was given to a Canadian company in Div. 2J3K but the 70,000 t total offshore allocation was not taken. In 1992, less than 1,000 t of the 57,900 t offshore allocation in Div. 2J3K was taken because the fleet could not find capelin.

During the 1980s, there was a general seasonal progression of the fishery from the south coast of Newfoundland (St. Mary's Bay), along the east coast to the northeast coast (Notre Dame Bay and White Bay). This fishery tracked the influx of ripe capelin to the spawning beaches. Thus, the fishery usually began by mid-June in the south and finished about mid-July in the north. The fishery in any one area was usually short but intense often lasting only a few days. Because of the northward progression of the fishery, fixed gear fishers in northern areas often complained of filled markets before the fish arrived in their area, in spite of the bay allocations. Since 1991, the timing of the fishery has been later by up to four weeks because of the late arrival of capelin, probably linked with unusual water temperatures. In 1993, the capelin season was also longer than usual and some fishers identified larger (and more marketable) capelin that moved into their area after the fishery was closed. In addition, fishers stated that abundance of capelin was higher in 1993 than in 1992.

Assessment

In the inshore, catch rates and an aerial survey index were evaluated as indicators of stock status while for the offshore, acoustic estimates of abundance were considered. Catch rates in the capelin fishery and the aerial survey index have never been confirmed as indicators of stock status although research is continuing to test this possibility. Abundance estimates can be derived from acoustic surveys although the variances are large and in recent years, these surveys may not be indicators of stock abundance. Other information, some of it more qualitative in nature, was examined to help evaluate capelin stock status. These other data included by-catch data from groundfish research vessel surveys, acoustic data from a groundfish migration survey, vertical distribution data and survival estimates from capelin acoustic surveys, egg deposition data, seabird data, seal feeding data, cod feeding data, and capelin distribution data.

Inshore commercial catch rates **Figure 2**

Catch rates for purse seines and traps have been collected using a research logbook program since 1981. These logbooks have been designed by scientists and are voluntarily completed by fishers. In addition to catch and effort data, other information such as the amount of capelin discarded or released alive, reasons for discarding capelin, and other species discarded is also collected. Most of the fishers have participated in this logbook program since its inception. Information collected in the program is considered confidential and close contact with fishers has been maintained to ensure high data quality. Annual results derived from all logbooks are sent to the participants.

Purse seine catch rates follow the same trends as trap catch rates; however, the purse seine catch rate has not been considered as an abundance index because catch rates of purse seines for other pelagic fish species have not been reliable indicators of stock abundance. Trap catch rates (t/day) have risen from low values during 1981-84 and have remained at average or above average levels since 1985.

Aerial surveys of capelin schools near spawning beaches along transects in Conception and Trinity bays have been conducted since 1982. From 1982 to 1989 school surface areas were measured from aerial photographs but since 1990, school areas have been estimated from digital data collected by a Compact Airborne Spectrographic Imager (CASI). This instrument collects data on various spectral band widths and stores the images in digital form, making it more amenable to computerized image classification techniques. This process has been compared to the older technique of measuring schools and has proven superior. The index, expressed as school surface area, follows the same pattern as catch rates. The 1993 index was the lowest since 1989 and 72% of the value in 1992.

An acoustic survey for capelin from 46°N to 55°N and out to the 500 m depth contour was conducted from August 29 to October 19, 1993. This combined Div. 2J3KL survey replaces previous surveys in Div. 3L during the spring (usually May) and in Div. 2J3K during the autumn (usually October). The total biomass estimate was 45,600 t and when comparing the same survey area in Div. 2J3K, the biomass showed a further decline from 31,900 t in 1992 to 17,900 t in 1993. This is the fourth consecutive year of low biomass estimates for capelin in Div. 2J3K in the autumn and the third consecutive year of few or no capelin in Div. 2J. The average biomass estimate in Div. 2J3K, 1990-93, is about 5% of the average biomass estimated during 1981-89 (there was no estimate for 1982). Capelin older than two years were more common in Div. 3K but one-year-olds were the dominant age in survey trawl catches in Div. 3L. This pattern of older capelin in the more northerly part of the distribution area and younger capelin in the more southerly area is comparable to past observations except that the entire distribution area is shifted to the south.

Capelin are a normal by-catch in bottom trawls in groundfish surveys conducted immediately after the capelin survey. These groundfish surveys cover a wider area and a comparison of distribution of capelin detected in both surveys did not suggest that there were large concentrations of capelin outside the area covered during the acoustic survey.

The vertical distribution patterns of capelin observed during eleven years of acoustic surveys during the spring in Div. 3L have now been documented. Capelin clearly rise toward the surface at night and descend deeper in the water column during the day. The extent of this vertical migration varies from year to year but the overall patterns are consistent. Densities were different between day and night. However, a change in depth distribution pattern in recent years with a concomitant change in density could not account for the low biomass estimates since late 1990. The maximum change in density was about 58% which could not explain a 70-fold decrease in biomass estimated in Div. 3L between 1990 and 1991.

Status of the stock in 1993 and prognosis for 1994

Catch rates from the inshore fishery and the aerial survey index were at least average in 1993. While they have not been shown to be directly related to spawning abundance, these measures did not decline to the extent that would have been predicted from the previous year's acoustic surveys. Furthermore, the egg deposition abundances and the generally positive comments concerning the abundance of capelin from participants in the inshore fishery, suggest that the prognosis presented in last year's assessment was overly pessimistic.

The 1993 acoustic survey estimate was again low, even though this was the most extensive synoptic survey ever conducted in this area. These acoustic surveys have been designed to provide a recruitment index and therefore, were expected to provide a basis for prediction of the spawning biomass inshore the following year. In recent years, these expectations have not been met. Consistently low biomasses have been estimated offshore but there have been no decreases in catch rates or aerial survey indices inshore of the magnitude that would be expected from the low acoustic indices. In addition, egg depositions have been consistent through the same time period, indicating that spawning escapement has been occurring. As a result of these inconsistencies, the acoustic biomass in 1993 cannot be used to predict stock status in 1994. However, this does not mean that the survey estimate is invalid; in fact, there is no technical reason to discount the results of the acoustic survey. The low abundance estimates since the autumn of 1990 over a very large area of the Newfoundland Shelf and Grand Banks, including an almost complete absence of capelin in Div. 2J for the last three years is perplexing and continues to be a cause for concern. There is no doubt that capelin behaviour has changed over the same period as evidenced by the late spawning times and unusual distribution patterns. It is possible that changes in behaviour have biased the biomass estimates since most of the surveys have been fixed spatially and temporally. However, this effect has not been quantified. Therefore, the hypothesis that the decline in the biomass estimates in the survey area also reflect a decline in population abundance could not be evaluated.

There is a statistically significant relationship between catch rate of younger fish in the inshore fishery and catch rate of the same year-classes one year later. The high catch rates of younger fish (ages 2 and 3) in the fishery in 1993 implies that the catch rate of the dominant age groups (ages 3 and 4) in the 1994 fishery will be good. However, as previously noted, a direct relationship between catch rate and spawning biomass has not been confirmed and the possibility exists that the catch rates could remain average or better at low stock abundances.

In the past, a conservative exploitation rate of 10% of the spawning stock biomass has been advised and followed as a management objective. This conservative strategy was recommended because of the importance of capelin as a forage species and because of the potentially large variability in abundance indices. There are no biological reasons to deviate from a conservative management approach although it is not possible to provide a quantitative comparison of recent catch levels and the target exploitation rate. There is also merit in continuing some of the present management practices. For example, allocations based on market demand and opening and closing fisheries to maintain quality through monitoring of fish size should prevent excessive discarding and thereby provide a measure of stock protection. The distribution of effort by enacting bay and gear quotas has the potential to protect individual spawning components.

STATUS OF CAPELIN IN SUBDIVISION 3Ps

The provisional catch in 1993 of 2,064 t was just below the 2,090 t quota and much higher than the 1990 and 1991 catches which were less than 100 t. The 1993 catch was comparable to the 1988-90 catches which ranged from 1,200 to 3,000 t.

No fishery or biological data were available for this stock and therefore, the status of this stock could not be assessed. Because catches for this stock are low relative to other areas and biomass estimates probably will not be available, it is unlikely that this stock will be reviewed annually.

STATUS OF CAPELIN IN DIV. 4RST Table 1, Figure 3

With declining groundfish stocks, fishing effort on capelin has increased steadily in the Gulf of St. Lawrence. Historically, landings in Div. 4R have been the largest in the Gulf. They have been increasing since 1987 and are now over 9,000 t. Purse seiners account for the majority (73% in 1993) of the landings in this division. Trap nets, exclusively utilized in the northern part of the division, landed approximately 2,500 t in 1993. In Div. 4S, the issuing of new licenses led to a major increase in landings in 1989, followed by a sharp drop in the next two years, and increases in 1992 and 1993 to reach 1,262 t in 1993. Landings all came from the Lower North Shore where the main gear is the trap net. In Div. 4T, the fish are too small for the Japanese roe market. The principal target markets are thus products for animal consumption, and accordingly more limited. However, in 1993, purse seine tests were conducted in Chaleur Bay to supply a new roe market in Taiwan. Landings reflect the scope of markets and the exploitation of the resource in this division has to date been fairly low.

The fishery for capelin in the Gulf of St. Lawrence is expanding and should be monitored closely. Capelin recruitment is variable and the fishery is accordingly subject to fluctuations. In 1993, the catches of age 2 females in Div. 4R were by far the highest seen over the last five years. Consequently, the 1991 year-class is expected to contribute significantly to the fishery in 1994 at age 3.

In 1994, an index fishers program for capelin will be implemented. In addition, acoustic monitoring will be performed during the summer shrimp-groundfish bottom trawling survey. A stock discrimination study will be initiated in 1994, which will examine stock structure on the basis of the type of parasites found in different areas.

STATUS OF HERRING IN SUBDIVISION 3Pn

From the mid-1960s to the early-1970s, a substantial purse seine fishery in 3Pn was supported largely by catches of overwintering southern Gulf 4T spring and autumn spawners, as determined by tagging-recapture experiments (Winters and Beckett, 1978), length frequency and age distribution comparisons. Landings by purse seiners in 3Pn ranged from 10,000 t in 1964 to nearly 140,000t in 1968-69, subsequently declining to 25,000 t by 1972. The catches were dominated by two large year-classes (1958 autumn and 1959 spring spawners) which were the main contributors to the fishery from 1964 to 1970. The proportion of southern Gulf 4T herring stock migrating to 3Pn increased with age, with 100% migration in the older age groups. Studies in the mid-1970s (Winters and Hodder, 1975) concluded that the abundance of 4T herring in 3Pn would have declined significantly even if there had been no fishery because subsequent recruitment had been poor. No major purse seine fishery has taken place in southwestern Newfoundland's 3Pn area since the late 1970s.

A 24 hour acoustic survey was conducted in 3Pn on January 12, 1994. Coverage started in the Connoire Bay area and stopped in the Rose Blanche area to the west, with an incursion into La Poile Bay. Transects were run perpendicular to the coast, out to a distance of 5 nautical miles; approximately 100 nautical miles were surveyed. No acoustic backscatter was detected. However, a more extensive survey would be required to cover the entire historic distribution of herring in the 3Pn area.

Stock composition in the area is thought to be a mixture of 4R, 4T, 3Ps and local stocks. Considering that no recent information on stock status is available and that request for access to this area comes from

industry, an exploratory fishery might be appropriate to gain knowledge on the present timing, distribution, stock composition and biomass of herring available in 3Pn. Close monitoring of the fishery in order to gain information from biological and acoustic samples using commercial fleet vessels would be required to meet this objective.

References:

Winters G.H. and V.M. Hodder, 1975. Analysis of the Southern Gulf of St. Lawrence herring stock and implications concerning its future management. ICNAF Res. Bul. No. 11, p 43-59.

Winters G.H. and J.S. Beckett, 1978. Migrations, biomass and stock interrelationships of southern Newfoundland-southern Gulf herring from mark-recapture experiments. ICNAF Res. Bul. No. 13, p. 67-79.

STATUS OF EAST AND SOUTHEAST COAST NEWFOUNDLAND HERRING

Description of the fishery **Table 2, Figure 4**

Herring landings from east and southeast Newfoundland herring stocks peaked at 31,000 t in 1979. The increased landings through the late 1970s coincided both with the recruitment of the very strong 1968 year-class and with increased markets due to the collapse of the North Sea herring stocks. Commercial fisheries were closed, or reduced to bait fisheries only, during the early 1980s due to a decline in abundance caused by poor recruitment subsequent to the 1968 year-class. Stock sizes increased through the 1980s with the recruitment of the moderately sized 1982 year-class and the somewhat smaller 1987 year-class. Landings over the last five years have been controlled by available markets; TACs have not been a limiting factor. During this time, annual landings have been between 6,000 - 8,000 t, with the exception of 1991, when landings increased to 17,000 t due to a government subsidy program paid to fishers and processors.

Landings in 1993 were approximately 6,000 t. Similar to recent years, most fish were landed in White Bay - Notre Dame Bay and Bonavista Bay - Trinity Bay during the autumn purse seine fishery. There was also a limited winter purse seine fishery in St. Mary's Bay - Placentia Bay. The fisheries in the remaining two areas, Conception Bay - Southern Shore and Fortune Bay were negligible (<300 t) and were spring gillnet fisheries for bait only. There was little effort exerted in the autumn purse seine fishery in the two northern areas due to the low price of herring. In White Bay - Notre Dame Bay, the purse seine fleet directed their efforts towards mackerel because of its higher value. Herring were taken when fish of the required market size were encountered. This was confounded by the presence of numerous concentrations of small fish, primarily of the 1991 year-class. Similarly, in Bonavista Bay - Trinity Bay, fishers reported that their operations during the autumn fishery were hampered by concentrations of small herring. The market requirements in both areas were for large herring, greater than 300 g (age 9+); the combination of the presence of small fish and low prices reduced the fishing effort in Bonavista Bay - Trinity Bay.

Environmental considerations

Most herring from the east and southeast Newfoundland stocks are spring spawners. Due to the cold oceanographic conditions in recent years, spawning has been delayed. This was again evident in 1993 but not as pronounced as in 1991 and 1992 when spawning along the northeast coast was delayed by four to six weeks. Cold environmental conditions have also affected herring growth rates; mean weights at age have declined during the past three years.

Assessment data sources

Target strength experiments Table 3

The target strength, or echo intensity, of different sizes of fish must be known to quantify the results of acoustic biomass-estimation surveys. Although it is desirable to quantify acoustic survey estimates with fish in their natural environment , this has been very difficult during herring surveys due to the dense schooling behavior of the fish. From 1988 to 1992, the results of east and southeast Newfoundland herring acoustic surveys were quantified from an experimentally derived target strength-fish length relationship. A detailed reanalysis of these experimental data during the winter of 1993 indicated that there had been errors in the hydroacoustic system calibration. As it was impossible to quantify these errors, a detailed series of experiments was conducted in 1993 within a net enclosure in Holyrood, Conception Bay. The purpose of these experiments was to measure the target strengths of a broad length range of live herring and to derive a target strength-fish length relationship to quantify the results of all east and southeast Newfoundland herring acoustic surveys.

Although there are still concerns regarding the applicability of an experimentally derived target strength-fish length relationship to survey results, the 1993 Holyrood relationship was considered the best available to apply to all east and southeast Newfoundland herring acoustic surveys until it is possible to use in situ measurements.

Acoustic surveys

Results were available from 1992 acoustic surveys of White Bay - Notre Dame Bay and Bonavista Bay - Trinity Bay and 1993 surveys of Conception Bay - Southern Shore and Bonavista Bay - Trinity Bay.

The 1992 acoustic survey estimate of White Bay - Notre Dame Bay was 113,500 t. By number, the 1992 year-class was dominant, occurring along several transects on the eastern side of White Bay and accounting for 87% of the population estimate. However, by weight, the 1987 year-class dominated accounting for 41% of the population estimate. Herring aged 6+ accounted for 33% of the biomass estimate.

During the 1992 Bonavista Bay - Trinity Bay acoustic survey, herring concentrations were detected acoustically throughout the area. However, it was impossible to derive a biomass estimate as no biological samples were obtained to determine length, weight, and age distributions of the population.

No herring were detected during the 1993 acoustic survey of Conception Bay - Southern Shore. This survey was conducted in January to measure overwintering herring concentrations. It is possible that there were either no overwintering fish or, due to the small population size, that they were not detected.

The 1993 acoustic survey estimate of Bonavista Bay - Trinity Bay was 24,400 t. The 1991 year-class dominated both in numbers and weight, accounting for 80% of population numbers and 61% of population weight. Herring aged 6+, including the 1987 year-class, accounted for only 22% of the biomass estimate.

Research gillnet program Table 4, Figure 5

The research gillnet program was initiated in the Newfoundland Region in 1980 to derive an abundance index independent of the commercial fishery. Commercial fishers in each of the five stock areas are provided with a fleet of five standardized gillnets, with mesh sizes ranging from 2" to 3". They are contracted to fish these nets for a period of one month each year, to maintain an accurate daily log record of their catches, and to collect samples of their catch at specified intervals.

During the spring of 1992, a total of 25 fishers participated in the spring research gillnet program. In addition, 1993 research gillnet catch rates were available from Bonavista Bay - Trinity Bay only; biological samples from other areas were not yet processed.

Age distributions, by number, from 1992 and 1993 showed the continued dominance of the 1987 year-class in White Bay - Notre Dame Bay and Bonavista Bay - Trinity Bay. The percentage of older fish (ages 6+) was less in these areas than in the three southern areas. There was no evidence of the 1988 or 1989 year-classes in any of the areas. More recent year-classes would not be recruited to the research gillnets.

Catch rates decreased from 1991 to 1992 in four of the five stock areas. Similarly, there has been a declining trend in catch rates in most areas since the late 1980s. There is evidence in all areas from catch rates at ages 4 and 5, that the 1987 year-class is much smaller (10% - 50%) than the 1982 year-class; other year-classes are very small. For two areas from which there are research gillnet catch rates from the early 1970s, there is some evidence that the 1982 year-class is also much smaller than the very large 1968 year-class.

Resource status

East and southeast Newfoundland herring stocks rebuilt through the 1980s with the recruitment of the 1982 and 1987 year-classes. However, acoustic biomass estimates and research gillnet catch rates at age suggest that stocks have not increased to the levels observed during the 1970s. There are good indications of small herring (the 1991 and 1992 year-classes) in most areas, but sizes of these year-classes cannot yet be quantified.

The most recent acoustic biomass estimate of the White Bay - Notre Dame Bay stock in 1992 indicated a mature biomass (ages 5+) of approximately 100,000 t. Research gillnet catch rates increased consistently from 1988 to 1991 and remained at a high level in 1992. Catches in the order of recent TACs are not expected to exert excessive exploitation rates.

The mature biomass estimate for Bonavista Bay - Trinity Bay from the two most recent acoustic surveys was low, approximately 13,000 t from the 1990 acoustic survey and approximately 6,500 t from the 1993 survey. Research gillnet catch rates have fluctuated through the late 1980s with recruitment of the 1982 and 1987 year-classes but have declined in each of the past two years. Recent exploitation rates may have been high and catches in the order of recent TACs could cause excessive exploitaiton rates. Caution should be exercised in setting catch levels for this stock.

There is limited information available for Conception Bay - Southern Shore. No herring were detected during the most recent acoustic survey. The only other acoustic estimate, from 1988, was 1,400 t. Research gillnet catch rates have fluctuated in recent years but decreased by a factor of three between 1991 and 1992. Stock affinity is also not clear, especially during the autumn when herring from adjacent stock areas frequent the area. Historically, this stock complex has been small. Caution should also be exercised in setting catch levels for this area.

The 1992 acoustic biomass estimate for St. Mary's Bay - Placentia Bay was 12,000 t, 72% of which was mature fish. Research gillnet catch rates have declined since the late 1980s but remained stable between 1991 and 1992. This stock may be in gradual decline but catches in the order of recent TACs are not expected to exert excessive exploitation rates.

The 1992 acoustic biomass estimate for Fortune Bay was 18,600 t, 96% of which was mature fish. Although research gillnet catch rates have declined in recent years, they continue to remain at relatively high levels. Catch levels from this stock over the past decade indicate that it is the least exploited of the Newfoundland stocks. Increasing exploitation to recent TACs of 1,500 t for this stock is not expected to exert excessive exploitaiton rates.

Outlook for the future

The outlook for the future will depend upon the recruitment of the 1991 and 1992 year-classes. The importance of the 1982 year-class has declined as it has passed through in most areas. The 1987 year-class, estimated to be much smaller than the 1982 year-class, will have to sustain the fisheries until at least 1996 or 1997 when the 1991 and 1992 year-classes are recruited.

Market requirements must also be considered in the outlook for the future. In recent years, the autumn purse seine fishery in the two northern areas has been targeting larger fish (>300 g). Most of the mature fish in these areas are of the 1987 year-class. In 1994, these fish will range from 275 - 300 g and may or may not meet market requirements. Based upon acoustic survey estimates, herring greater than 300 g (ages 9+) will account for approximately 30% of the biomass in White Bay - Notre Dame Bay and less than 5% in Bonavista Bay - Trinity Bay. Targeting older fish may be complicated by the presence of the 1991 and 1992 year-classes. Unless market requirements change, this problem will continue for the near future.

Report on the status of pelagic fishes (capelin off Newfoundland and in the Gulf of St. Lawrence and herring off the east, southeast and south coasts of Newfoundland)

Table 1. Catches ('000 t) since 1972 for capelin in SA2 + divisions 3KL, Div. 4RST and Div. 3Ps.

	SA2 + Div. 3K			Div. 3L			Div. 4RST	Div. 3Ps		
Year	Offshore	Inshore	Total	Offshore	Inshore	Total		Offshore	Inshore	Total
1972	45162	461	45623	430	811	1241		21	2501	2522
1973	135928	494	136422	1356	2520	3876		32	1324	1356
1974	125596	1343	126939	49817	7747	57564		0	2248	2248
1975	144171	698	144869	31863	2234	34097		0	1583	1583
1976	214642	1684	216326	31256	2567	33823		29	32	61
1977	150273	2136	152409	21532	5270	26802		1	1015	1016
1978	52528	2420	54948	18285	6420	24705		0	8	8
1979	10817	671	11488	0	12316	12316		0	69	69
1980	4795	1354	6149	0	14447	14447		0	2835	2835
1981	10195	1803	11998	0	24440	24440		0	151	151
1982	9685	3860	13545	0	27436	27436		0	174	174
1983	10497	3768	14265	0	25074	25074		0	147	147
1984	17366	7118	24484	0	33261	33261		0	1140	1140
1985	16838	7412	24250	0	25451	25451		0		98
1986	16757	11803	28560	0	48427	48427	3969	11	2307	2318
1987	31131	8955	40086	22	19481	19503	974	0	262	262
1988	16825	26820	43645	46	53588	53634	5090	3	3031	3034
1989	22445	27801	50246	84	51634	51718	9999	4	2350	2354
1990[1]	57000	35140	92140	0	47992	47992	6522	0	1236	1236
1991[1]	500	19938	20438	0	22307	22307	7406	0	79	79
1992[1]	0	18353	18353	0	2993	2993	9479	0	127	127
1993[1]	0	12231	12231	0	22739	22739	10543	0	2064	2064

[1] Preliminary

Table 2. Recent catches and TACs ('000 t) for herring in east and southeast Newfoundland.

Area	WB-NDB		BB-TB		CB-SS		SMB-PB		FB	
YEAR	Catch	TAC	Catch	TAC	Catch	TAC	Catch	TAC	Catch	TAC
1974	4.0		2.3		2.7		6.5		2.3	
1975	5.6		5.9		3.5		6.7		0.9	
1976	12.5		9.9		2.5		4.1		0.5	
1977	11.6	10.0	12.0	9.5	2.2	2.1	3.3	3.3	0.6	3.4
1978	13.4	7.9	8.0	7.8	1.9	1.8	3.5	4.0	1.0	1.0
1979	15.7	11.5	9.8	8.4	0.9	0.9	3.6	3.4	1.2	1.0
1980	6.5	5.3	5.4	4.4	0.5	0.4	2.5	2.5	0.5	1.0
1981	4.7	5.3	4.0	4.8	0.2	0.5	0.6	1.2	0.1	0.2
1982	2.0	1.2	0.5	0.7	0.1	0.2	0.1	0.0	0.1	0.0
1983	0.4	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0
1984	1.5	1.5	0.2	0.4	0.1	0.1	0.1	0.0	0.1	0.0
1985	1.8	2.0	0.6	0.8	0.1	0.2	0.1	0.6	0.1	0.3
1986	2.8	5.5	1.8	3.8	0.2	0.6	0.1	2.1	0.1	0.7
1987	13.5	32.5	6.1	13.7	1.0	3.5	0.3	2.5	0.1	2.4
1988	7.3	34.7	11.7	16.2	0.3	0.6	1.2	8.9	0.1	4.7
1989	3.4	14.0	4.9	6.9	1.2	1.5	0.4	1.5	0.1	1.5
1990	4.5	16.5	3.0	23.4	0.3	1.5	0.5	1.5	0.1	1.5
1991	7.7	13.5	8.9	10.0	0.4	1.5	1.0	1.5	0.1	1.5
1992	3.2	13.5	2.9	10.0	0.1	1.5	0.8	1.5	0.1	1.5
1993	1.6	13.5	3.1	10.0	0.1	1.5	1.1	1.5	0.2	1.5

WB-NDB = White Bay-Notre Dame Bay
BB-TB = Bonavista Bay-Trinity Bay
CB-SS = Conception Bay-Southern Shore
SMB-PB - St. Mary's Bay-Placentia Bay
FB = Fortune Bay

Table 3. Summary of herring biomass estimates, by stock area and year, from acoustic surveys within the Newfoundland Region.

Stock Area	Year	1993 Holyrood TS relationship	m^2/sr
WB-NDB	1988	22700	21100
	1990	-	15400
	1992	113500	151100
BB-TB	1988	30800	32600
	1990	54000	62000
	1992	-	40800
	1993	24400	37500
CB-SS	1988	1400	1700
	1993	0	0
SMB-PB	1990	39800	40200
	1992	12000	12800
FB	1990	15200	16400
	1992	18600	19000

Holyrood target strength relationship - TS = 20 logL - 65.5
- calculated from 1993 net enclosure experiments

m^2/sr - total acoustic backscatter
- unscaled (no target strength applied)

Table 4. Unstandardized research gillnet catch rates for herring (number per day fished) spring spawners only by stock area.

Year	WB-NDB	BB-TB	CB-SS	SMB-PB	FB
1970				1349.4	397.5
1971	1309.5	145.1		1028.1	345.6
1972		1306.8			
1973				302.4	
1980		690.2	44		
1981		209.4			
1982		63.5		11.9	10.3
1983		233.8		48.4	128.7
1984		221.7		115.6	137.9
1985		84.8	171	143.1	463.6
1986		174.2	217.3	172.5	400.1
1987		116	317.9	210.4	690.2
1988	157	52.6	978.7	140.9	515.6
1989	529.7	96	232	123.3	934.9
1990	740.1	135.1	106.3	139.5	479.4
1991	1135.6	286.8	161.6	55.1	733.5
1992	858.6	137.6	64.8	54.8	331.4
1993		113.5			

WB-NDB = White Bay-Notre Dame Bay
BB-TB = Bonavista Bay-Trinity Bay
CB-SS = Conception Bay-Southern Shore
SMB-PB - St. Mary's Bay-Placentia Bay
FB = Fortune Bay

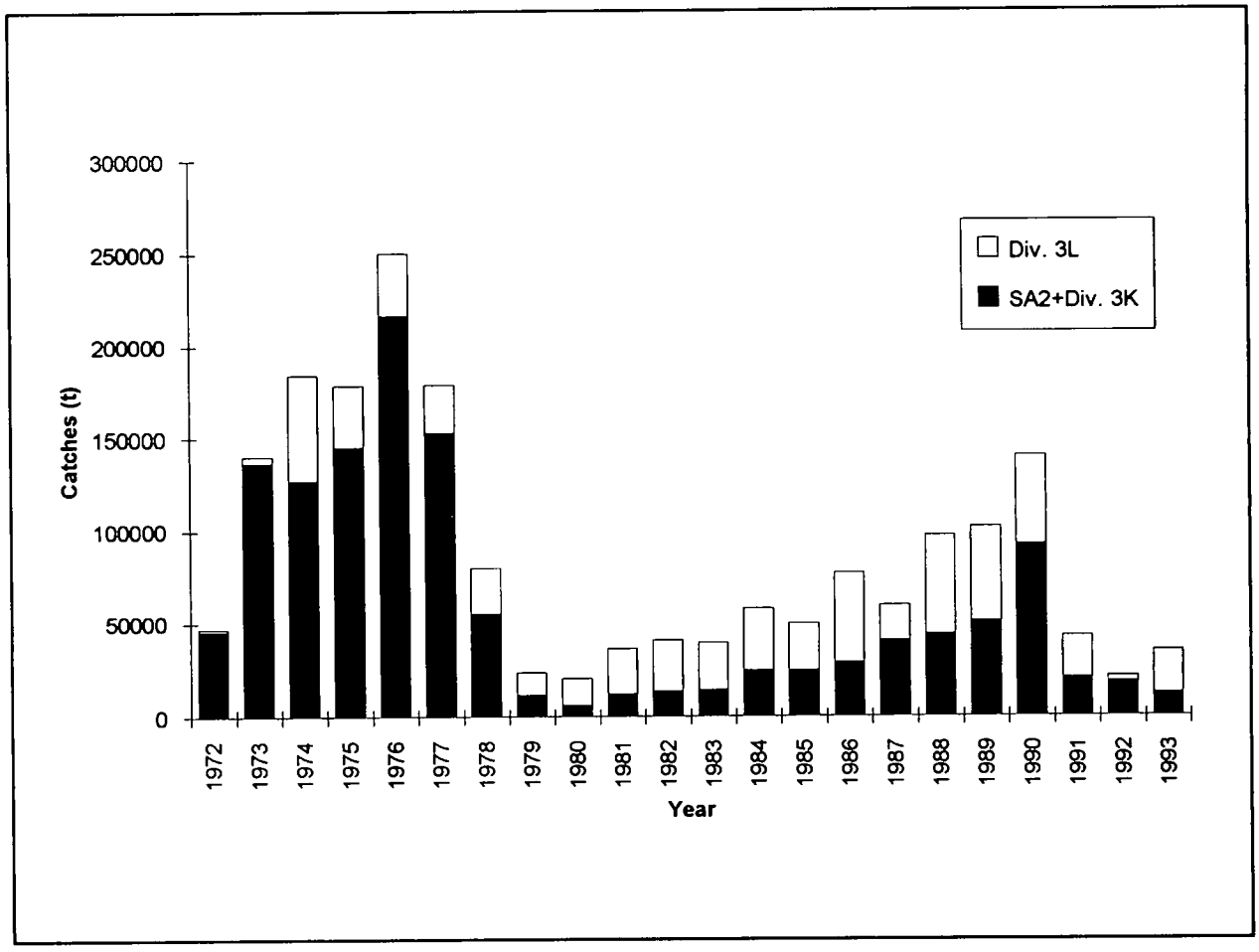

Fig. 1. Total landings of capelin in SA2+3KL

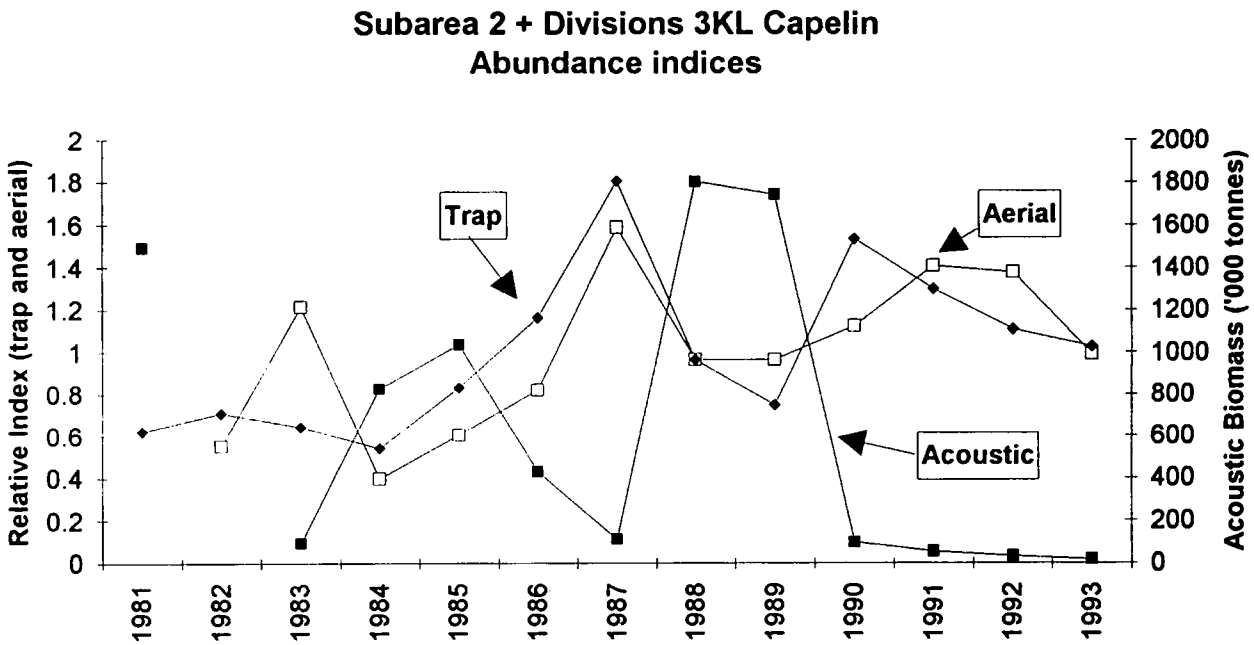

Fig. 2. Subarea 2 + Divisions 3KL capelin abundance indices

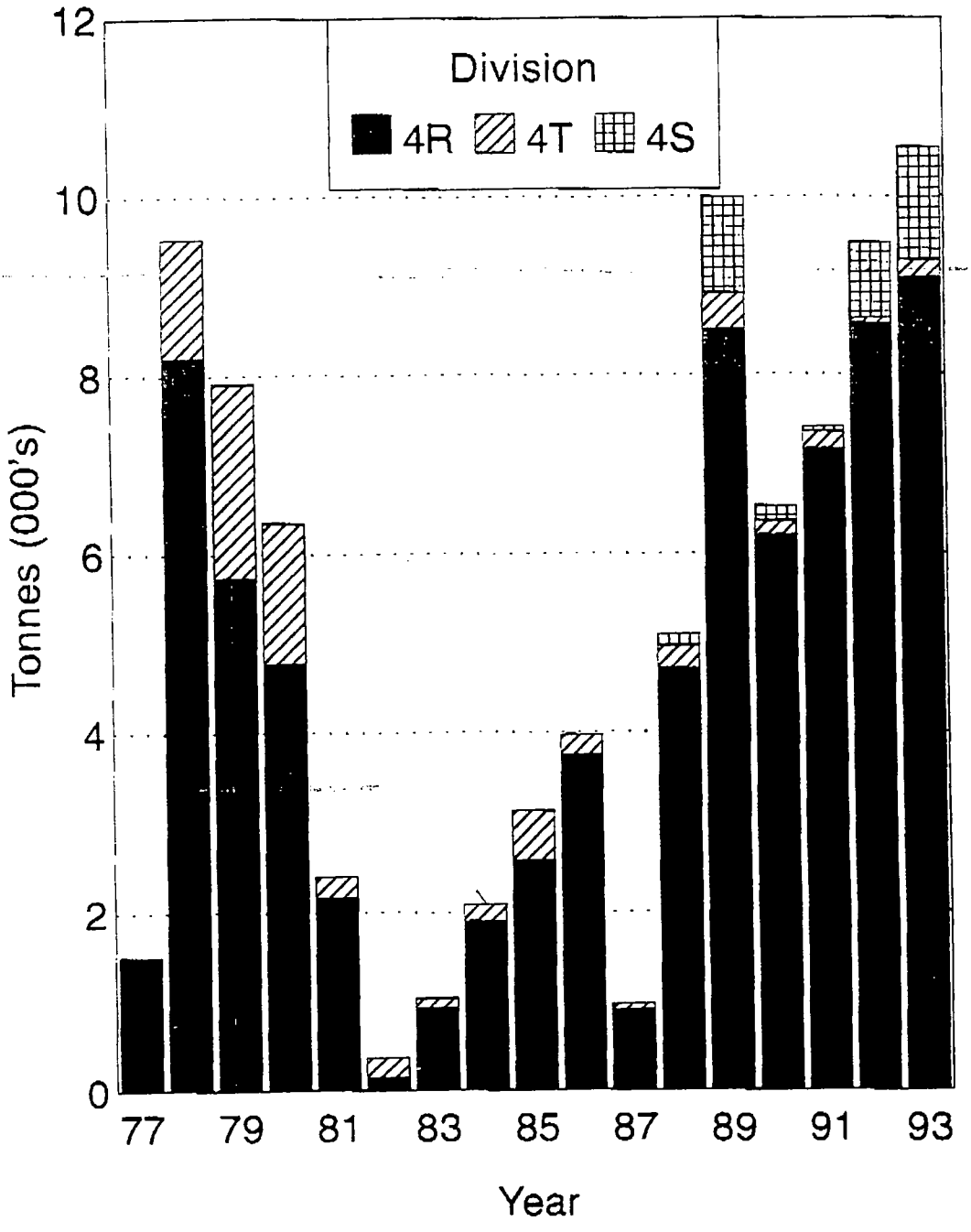

Fig. 3. Reported landings of capelin in divisions 4RST.

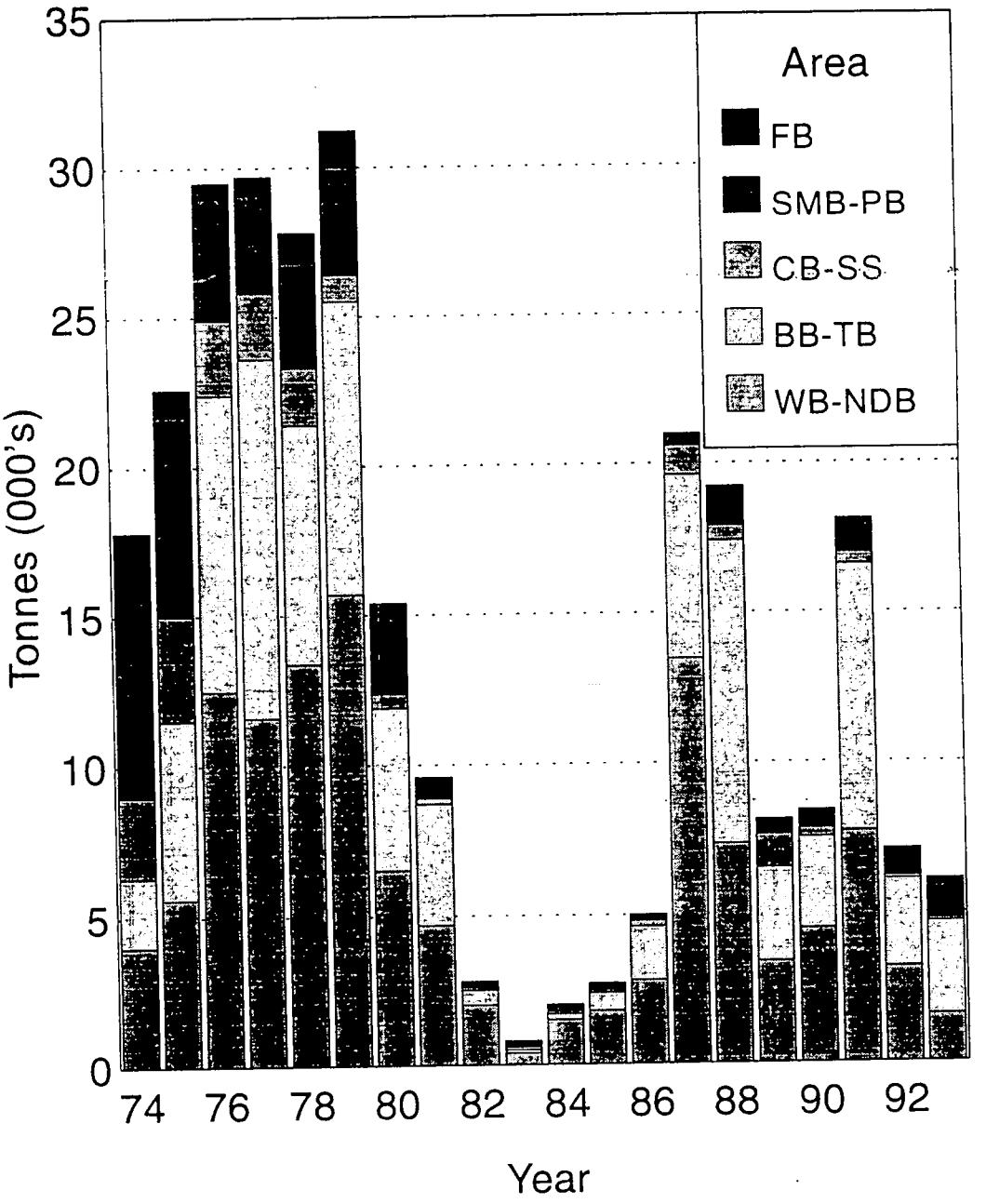

Fig. 4. Reported landings of east and southeast Newfoundland herring by stock area.

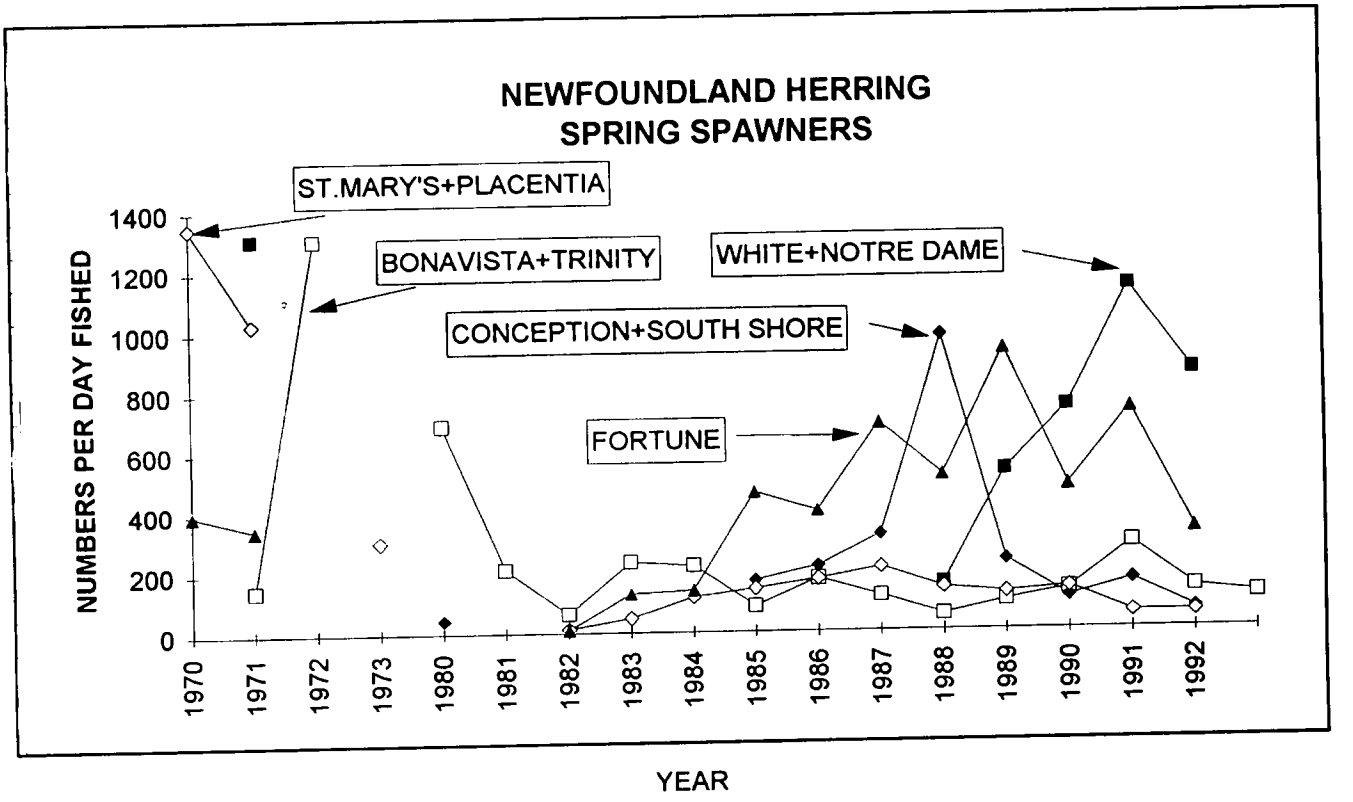

Fig. 5. Unstandardized research gillnet catch rates for Newfoundland herring by stock area.

Capelin in SA2 + Div. 3KL
Summary

Year	1986	1987	1988	1989	1990	1991	1992	1993	Min.	Max.	Mean
SA2 + Div. 3K Reference Level											
Offshore	50	47	[1]	200-250	107	57	-	-			
Inshore	60	29	[1]	200-250	107	33	[2]	[2]			
Total	110	76	[1]	200-250	107						
Offshore TAC	17	31	17	20	71	57	0	0			
Inshore TAC	19	9	21.5	24.1	29	29	17	11			
Total TAC	36	40	38.5	44.1	100	86	17	11			
Offshore catches	17	31	17	22	57	0.5	0	0			
Inshore purse seine catches	4	3	10	7	10	1	6				
Inshore trap catches	5	5	13	18	21	16	11				
Inshore beach seine catches	3	2	4	3	4	3	1				
Total catch	29	41	44	50	92	20.5	18	12	14	34	92
Div. 3L Reference Level	130	283	990	335	350	[3]	[3]	[2]			
Div. 3L TAC	55	25	45	46	56	56	19.3	21			
3L Purse seine catches	21	6	19	20	15	9	2				
3L Trap catches	26	13	34	32	33	13	+				
3L Beach seine catches	1	+	1	+	+	+	+				
Total 3L catch	48	19	54	52	48	22	3	23	3	33	54
SA2 + Div. 3KL Total catches	77	61	98	102	140	68.5	21	44			
Biomass SA2 + Div. 3K	431	112	1804	1744	96	55	34	18	18	568	1804
Biomass Div. 3L	3697	2576	4551	3829	6958	116	206		84	2387	6958

All catch and biomass numbers are in '000 tonnes (t). Biomasses are from acoustic surveys, spring in Div. 3L and autumn in SA2 + Div. 3K. Min., max., and mean biomass values are 1983-1992 for SA2 + Div. 3K, 1982-92 for Div. 3L. Min., max., and mean catches from 1982 to 1992.

[1] data not adequate to calculate a reference level. CAFSAC indicated that 1987 harvest level would not have an adverse effect

[2] lowest possible level

[3] STACFIS concluded that a catch of 50,000 t as in recent years would not exceed a 10% exploitation rate

Forecast: Acoustic surveys have been used as a basis for projections but poor performance as predictors in recent years has resulted in less reliance on them for 1994. Inshore catch rates of younger fish are positively correlated with catch rates of older fish one year later. Catch rates of younger fish in 1993 were good indicating 1994 catch rates of mature fish could also be good.

Catches: All offshore fishing has been stopped. Catches are inshore predominantly by purse seine and traps. TACs and catches are influenced by Japanese markets for roe bearing females.

Data and assessments: Acoustic surveys have been designed to measure recruitment and have been used to calculated stock and catch projections. These surveys have shown low biomass since November 1990. Catch rates and aerial survey index, both inshore indicators, have remained at or above average for several years. Because of these discrepancies, less reliance has been placed on acoustic surveys for 1994.

Fishing mortality: Not estimated but believed to be very low.

Recruitment: Not estimated. Usually measured during acoustic surveys but these surveys are considered less reliable at present.

State of the stock: Biomass increased during early 1980s and remained at high levels during the late 1980s. Present status is uncertain although inshore indicators have remained at or above average while offshore acoustic estimates were very low.

Environmental factors: Spawning has been delayed by at least three weeks beginning in 1991. Capelin have appeared on Flemish Cap since 1990 and have increased on Scotian Shelf since late 1980s. These unusual occurrences are probably linked to anomalous hydrographic conditions.

Long-term prospects: The short life span of capelin makes long-term prospects impossible to predict. Recruitment is variable and biomass will fluctuate but fluctuations will likely be natural variations since fishing mortality is not believed to have had influenced recruitment.

Capelin in 3Ps
Summary

Year	1986	1987	1988	1989	1990	1991	1992	1993	Min.	Max.	Mean
3Ps Reference level			1000	2000							
3Ps TAC	2000	1300	3400	3100	3600	3600	2090	2090			
Purse seine catches	234	4	192	-	5	-	-		0	59	234
Trap catches	2048	277	2844	2291	1164	20	70		20	898	2844
Beach seine catches	113	111	147	59	67	59	57		11	69	147
Total catches	2395	392	3183	2350	1236	79	127	2064	79	1026	3183

All catch and biomass numbers are in tonnes (t). Min., max., and mean values are from 1982-92.

Forecast: Not enough data available to assess the stock.

Catches: Ripe female capelin are caught during the spawning season and sold to the Japanese roe market.

Data and assessment: Only catches and some catch rate data are available for some years .

Fishing mortality: No estimates but probably low.

Recruitment: No estimates.

State of the stock: Not known but fluctuations in biomass are probably due to natural factors.

Environmental factors: Spawning has been delayed beginning in 1991 probably due to anomalous hydrographic conditions.

Long-term rospects: Not able to predict long-term prospects. Fishing mortality is expected to be low and therefore any stock fluctuations will be due to natural factors.

4RST capelin
SUMMARY

Year	1986	1987	1988	1989	1990	1991	1992	1993	Min.[1]	Max.[1]	Mean[1]
4R TAC (mobile)[2]	5300	4400	3900	4875	16250	10250	11770	6770			
4R TAC (fixed)[2]	700	600	1400	2825	8250	7750	8255	2255			
4ST TAC	3000	2000	5000	3000	2900	2000	2000	1725			
Total TAC	9000	7000	10300	10700	27400	20000	22025	10750			
4R Purse seine catches	3539	841	3259	6010	4214	6952	7488	6664	841	7488	4299
4R Trap catches	204	65	1454	2502	1991	214	1079	2419	65	2502	796
4S Catches	< 1	< 1	129	1078	164	58	856	1262	0	1262	355
4T Catches	226	68	248	409	153	182	56	198	56	545	227
Total catches	3969	974	5090	9999	6522	7406	9479	10543	974	10543	5919

All catches are in tonnes (t). 1993 catches are provisional

[1]Min, max and mean values are from 1984 to 1993.

[2]TACs from 1990 to 1992 include Over-the-side and Over-the-Wharf TACs.

Catches: The catches in Division 4R have historically been the largest in the Gulf. They have been steadily increasing since 1987 and are now over 9000 t. Purse seine accounts for the majority of the catches (73% in 1993) in this division. In Division 4S, the main gear is the trap net, and the catches have reached their maximum value in 1993. In Division 4T, catches reflect the scope of markets and the exploitation of the resource in this division has to date been fairly low.

Data and assessment: Total catch at age for males and females have been calculated in Division 4R from 1989 to 1993.

Recruitment: Capelin recruitment is variable and the fishery is accordingly subject to fluctuations. In 1993, the catches of age 2 females in Division 4R were by far the highest seen over the last five years.

Short-term prospects: In Division 4R, the 1991 year-class is large and is expected to contribute significantly to the fishery in 1994 at age 3.

East and Southeast Newfoundland Herring
Summary

White Bay - Notre Dame Bay ('000 t)

Year	1986	1987	1988	1989	1990	1991	1992	1993	Min.[1]	Mean[1]	Max.[1]
Reference Level	5.5	32.5	34.7	14.0	16.5	13.5	13.5	13.5			
TAC	5.5	32.5	34.7	14.0	16.5	13.5	13.5	13.5			
Purse Seine Catches	1.3	10.9	6.2	5.0	2.9	6.3	1.8	0.7	0.0	3.2	10.9
Gillnet Catches	1.3	1.4	0.8	1.1	1.4	1.3	1.4	0.9	0.4	2.5	9.9
Total Catches[2]	2.8	13.5	7.3	3.4	4.5	7.7	3.2	1.6	0.4	6.4	15.7
Total Biomass [3]			23				114		23	68	114
Spawning Biomass [3]			15				100		15	58	100

Bonavista Bay - Trinity Bay ('000 t)

Reference Level	3.8	13.7	16.2	6.9	23.4	10.0	10.0	10.0			
TAC	3.8	13.7	16.2	6.9	23.4	10.0	10.0	10.0			
Purse Seine Catches	1.1	5.6	11.0	4.6	2.0	8.1	2.6	2.8	0.0	3.5	10.9
Gillnet Catches	0.6	0.4	0.2	0.1	0.2	0.2	0.2	0.3	0.1	0.7	3.1
Total Catches[2]	1.8	6.1	11.7	4.9	3.0	8.9	2.9	3.1	0.1	4.9	12.0
Total Biomass [3]			31	54				24	24	18	54
Spawning Biomass[3]			22	13				7	7	14	22

Conception Bay - Southern Shore ('000 t)

Reference Level	0.6	3.5	0.6	1.5	1.5	1.5	1.5	1.5			
TAC	0.6	3.5	0.6	1.5	1.5	1.5	1.5	1.5			
Purse Seine Catches	0.1	0.6	0.2	1.2	0.3	0.4	0.1	<0.1	0.0	0.4	1.7
Gillnet Catches	0.1	0.2	<0.1	0.1	0.1	<0.1	<0.1	0.1	<0.1	0.1	0.5
Total Catches[2]	0.2	1.0	0.3	1.2	0.3	0.4	0.1	0.1	<0.1	0.6	2.2
Total Biomass [3]			1								
Spawning Biomass[3]			<1								

[1] Min., mean and max. catches for the period 1977-1992.
[2] Total catches include bar seine and trap catches. Catches for 1991, 1992 and 1993 are preliminary.
[3] From acoustic surveys.

St. Mary's Bay - Placentia Bay ('000 t)											
Year	1986	1987	1988	1989	1990	1991	1992	1993	Min[1]	Mean[1]	Max[1]
Reference Level	2.1	2.5	8.9	1.5	1.5	1.5	1.5	1.5			
TAC	2.1	2.5	8.9	1.5	1.5	1.5	1.5	1.5			
Purse Seine Catches	<0.1	<0.1	0.9	0.3	0.4	0.7	0.7	1.0	0.0	0.8	2.5
Gillnet Catches	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	<0.1	0.3	0.7
Total Catches[2]	0.1	0.3	1.1	0.4	0.5	1.0	0.8	1.1	<0.1	1.1	3.6
Total Biomass [3]					40		12		12	26	40
Spawning Biomass[3]					27		9		9	18	27
Fortune Bay ('000 t)											
Reference Level	0.7	2.4	4.7	1.5	1.5	1.5	1.5	1.5			
TAC	0.7	2.4	4.7	1.5	1.5	1.5	1.5	1.5			
Purse Seine Catches	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.8
Gillnet Catches	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	<0.1	0.1	0.1
Total Catches	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	<0.1	0.3	1.2
Total Biomass [3]					15		19		15	17	19
Spawning Biomass[3]					9		18		9	14	18

[1] Min., mean and max. catches for the period 1977-1992.
[2] Total catches include bar seine and trap catches. Catches for 1991, 1992 and 1993 are preliminary.
[3] From acoustic surveys.

Forecast for 1994: Catches in the order of recent TACs are not expected to exert excessive exploitation rates in White Bay - Notre Dame Bay. In Bonavista Bay - Trinity Bay, recent exploitation rates may have been high; caution should be exercised in setting catch levels for this stock. Historically, the Conception Bay - Southern Shore stock complex has been small; caution should also be exercised in setting catch levels for this area. Although the St. Mary's Bay - Placentia Bay stock may be in gradual decline, catches in the order of recent TACs are not expected to exert excessive exploitation rates. The Fortune Bay stock is the least exploited in the Newfoundland Region and increasing exploitation to recent TACs is not expected to exert excessive exploitation rates.

Catches: The major commercial fishery is by purse seine, occurring during the autumn in the two northern areas. Markets have been a limiting factor and consequently catches have been below TACs in recent years.

Data and assessment: Biomass estimates from acoustic surveys and research gillnet age distributions and catch rates are used for the basis of the assessment. Acoustic biomass estimates were available for four of the five stocks from 1992 or 1993. Research gillnet catch rates have declined in most areas since the late 1980s consistent with the passage of the 1982 year-class through the populations.

Fishing mortality: Recent fishing mortalities may have been high in Bonavista Bay - Trinity Bay. However, in the other four stock areas, recent catch levels have probably not exerted excessive exploitation rates.

Recruitment: The 1987 year-class dominated in the research gillnet catches in most areas. However, from research gillnet catch rates, this year-class is estimated to be much smaller than the 1982 year-class. There are good indications of 1991 and 1992 year-classes in most areas but the sizes of these year-classes cannot yet be quantified.

State of the stocks: Biomass increased during the 1980s with the recruitment of the 1982 and 1987 year-classes. However, there are indicators that suggest that stocks have not increased to levels observed during the 1970s.

Environmental factors: Most herring from the five stock complexes are spring spawners. Spawning has been delayed in recent years due to the cold environmental conditions. Growth rates have also been affected by cold environmental conditions; mean weights at age have declined within the past three years.

Long-term prospects: The importance of the 1982 year-class has declined as it has passed through in most areas. The 1987 year-class, estimated to be much smaller than the 1982 year-class, will have to sustain the fisheries until at least 1996 or 1997 when the 1991 and 1992 year-classes are recruited.