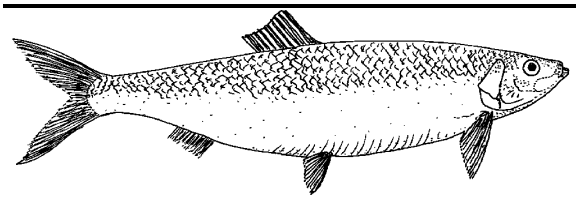
Pêches et Océans Canada | Fisheries and Oceans Canada
Sciences | Science
Laurentian Region

DFO Science
Stock Status Report B4-01



West Coast of Newfoundland Atlantic Herring (Division 4R)

Background

Both spring- and autumn-spawning herring are found along the west coast of Newfoundland (4R). These stocks are exploited annually from April to December mainly by large and small purse seiners and to a lesser extent by fixed gillnetters. The 1997 assessment indicates that their stock status is generally healthy. Relatively young yearclasses are in abundance among both the spring- and autumn-spawning herring in the purse seine fishery, as well as in the research surveys, and a high proportion of very old fish still appear in the catch. The 1995 fall acoustic survey estimated the minimum abundance of herring available along the west coast at that time at approximately 84,000 t.

It is concluded that the current TAC of 22,000 t of spring- and autumn-spawning herring would not appear to be excessive. Catches in recent years have been below this level due mainly to the closure of the St. George's Bay spring fishery and poor fishing conditions in the fall. The appearance of the strong 1990 yearclass in the spring gillnet fishery in 1996 suggests that there is no longer a biological rationale for the continued exclusion of commercial fishing from St. George's and Port-au-Port Bays. It is recommended that the reopening of these bays to commercial fishing proceed with caution, with areas of known spawning activity remaining closed to intensive fishing. It is further recommended that fishing effort be spreadout along the coast and throughout the year as much as possible to avoid directed fishing on any one local spawning component.

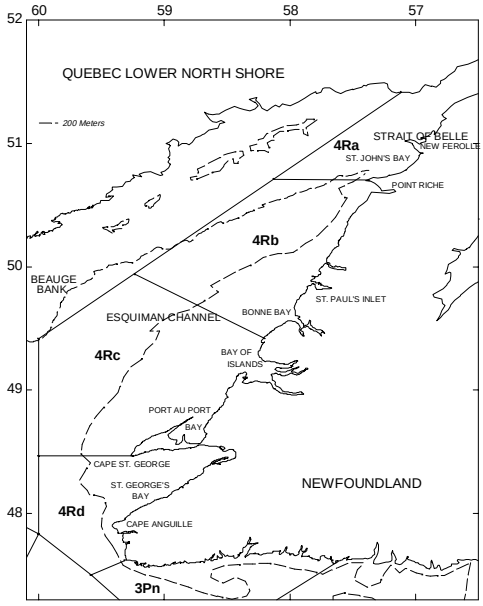


Figure 1. West coast of Newfoundland unit areas.

Introduction

Herring (*Clupea harengus*) are found throughout the waters of the northwest Atlantic from Labrador to Cape Hatteras. In Canada, they are fished mainly in southwestern Nova Scotia and the Bay of Fundy, within the Gulf of St. Lawrence, and in eastern and southern Newfoundland.

The herring is a migratory species which over the course of a year, will travel extensively throughout its area of distribution from traditional nearshore spawning grounds, to feeding and overwintering areas, repeating these patterns year after year with considerable regularity. Within most of the distributional range of northwest Atlantic herring, we can find populations which spawn either in the spring (April to June) or in the autumn (July to October). Each seasonal-spawning population is considered to be a separate stock for fisheries management. In addition, within each seasonal-spawning stock, there are local spawning components

associated with specific spawning areas. The interrelationship between these local components has yet to be clearly established, although most evidence suggests that once an individual spawns in a given area, it will return to spawn in that area year after year. Therefore, the repeat spawners of a local spawning component are subject to overexploitation if fishing effort is concentrated on them disproportionately to the rest of the stock. Furthermore, a local component may not rebuild at the same rate as the overall stock if the recruitment to that component is not in proportion to the overall recruitment to the stock.

Both spring- and autumn-spawning herring are found along the west coast of Newfoundland (4R). These seasonal-spawning stocks are fished both in mixed schools and singularly in spawning aggregations. The major spring-spawning areas are located at the southern end of the coast in and around St. George's Bay (4Rd) and Port-au-Port Bay (4Rc) although several other spawning sites are known along the coast towards the north (Figure 1). Mature herring arrive and congregate in these areas from the end of April to the middle of June, spawning on several traditional grounds before dispersing. Autumn spawning is concentrated mainly north of Point Riche (4Ra) from mid-July to mid-September. At other times of the year, these two spawning stocks are mostly found in mixed schools in either feeding or overwintering areas. The major feeding areas (off St. George's Bay in the spring, off Point Riche and in the Strait of Belle Isle in the summer, and in and around the major bays in the fall) are associated with concentrations of copepods (red-feed) and/or euphausiids (krill) which are their main food items. Based upon winter research survey data, they are believed to overwinter in the deeper waters of the Esquiman Channel (Figure 2).

You will find in the following sections specific information concerning the 4R herring stocks which was prepared, presented and reviewed during a meeting of the Zonal Working Group of scientific experts held between March 25-27, 1997 in Moncton, New Brunswick.

The fishery

Nominal catches

The herring stocks in 4R are exploited from April to December mainly by large (>75') purse seiners, small (<65') purse seiners and to a lesser extent by fixed gillnetters. Since 1985, the proportion of the total catch taken by all purse seines has been in excess of 80%, and even reached 98% in 1993.

Since 1986, total herring landings from the west coast of Newfoundland averaged 17,300 t (from 12,400 t to 26,400 t) as compared to an average of 14,100 t for the previous decade (Figure 3). In 1996, total landings were limited to 14,700 t (Table 1) due mainly to the closure of the St. George's Bay spring fishery, and to poor fishing conditions in the fall (e.g. herring close to bottom and high winds).

Table 1. West Coast of Newfoundland herring (t) by Gear sectors since 1988.

	Year								
Gear	1988	1989	1990	1991	1992	1993	1994	1995	*1996
Purse Seine	16353	16660	16301	25594	14667	15061	11488	14206	12232
Gillnet	1792	1027	983	842	669	247	893	1806	2430
Total	18145	17687	17284	26437	15336	15308	12380	16012	14662

* Preliminary statistics

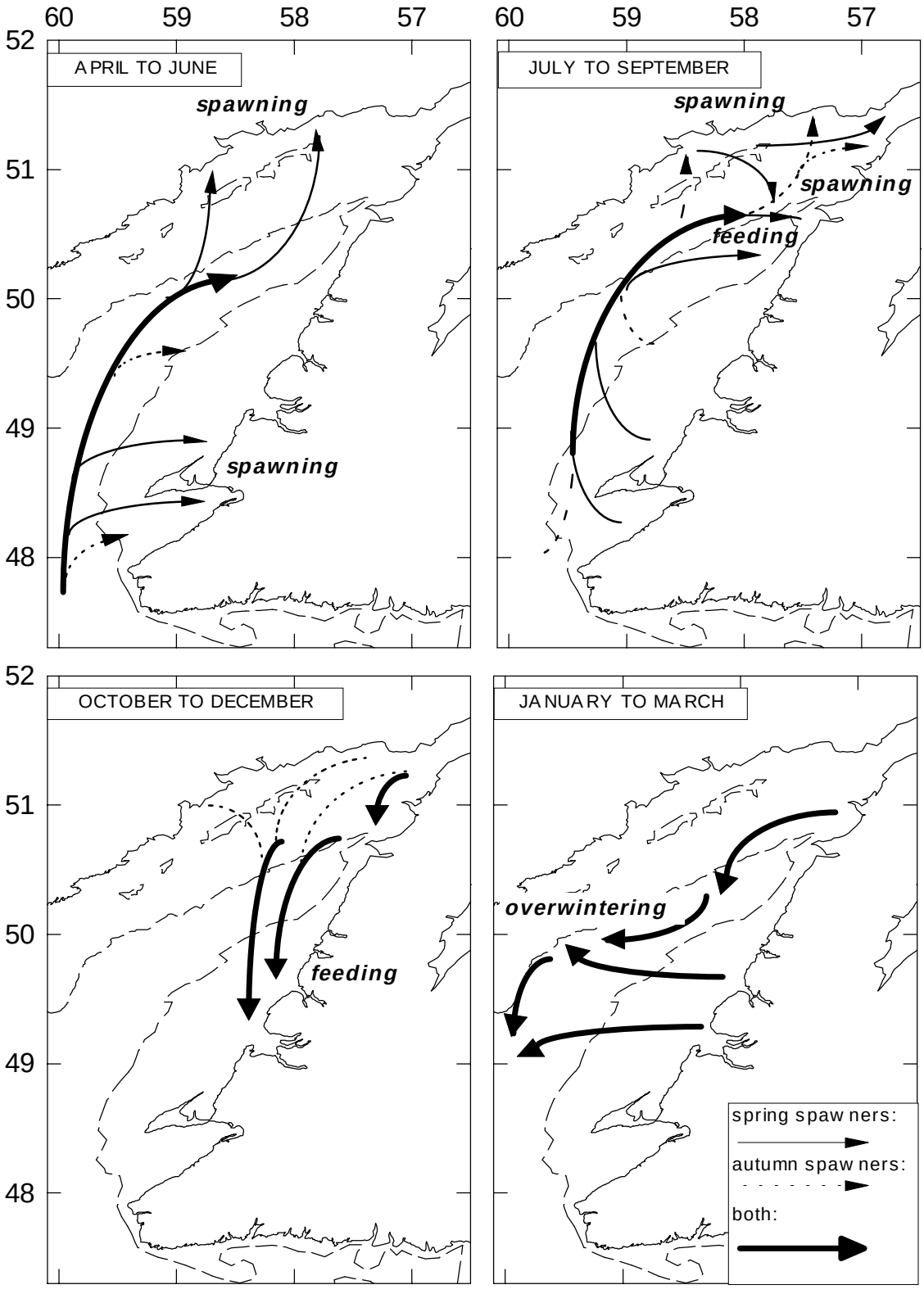


Figure 2. Probable annual migration pattern of spring- and autumn-spawning herring in the north-eastern Gulf of St. Lawrence.

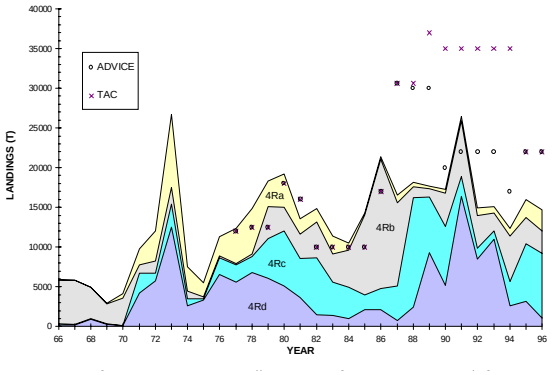


Figure 3. Cumulative commercial herring landing (t) by unit area in NAFO Division 4R from 1966 to 1996 (TAC and assessment advice are indicated).

The Purse Seine Fleet

From 1984 to 1987, up to 80% of the purse seine catches were taken from October to December on over-wintering concentrations of herring in areas 4Rb and 4Rc. In 1988, the development of an over-the-side market to Russian vessels contributed to a considerable increase in landings in the spring fishery from 4Rc and 4Rd, from approximately 2,000 t in 1987 to 12,400 t in 1991. This spring purse-seine fishery accounted for over 70% of the total catch in 1990 and 1993. This proportion has diminished to below 40% since 1994 when St. George's and Port-au-Port Bays were closed to commercial fishing during the spawning season.

Concurrent with changes to the fishing pattern of the large purse seine fleet has been an increase in the activity of the smaller purse seiners along the west coast since 1989. Annual landings from this gear sector had not exceeded 800 t until 1992, when they landed 2,200 t. From 1993 to 1995, this fleet has landed from 3,100 t to 3,800 t per year.

The Gillnet Sector

Due to a limited market demand for gillnetted herring, reported landings from the fixed gear sector have generally been below 10% of the total 4R landings since 1985. Between 1991 and 1994, the late fall (October-December) fishery was extremely limited, accounting for less than 200 t annually. A market has recently developed in 4Ra which has resulted in a steady increase in total gillnet landings from 900 t in 1994 to 2,400 t in 1996.

The resource

Biological Indicators

Spawning Stock Proportions in the Catch

In the spring, herring schools in and around the major bays in the south (near the spawning beds) are typically dominated by spring spawners, while the autumn spawners are more prevalent in deeper waters outside of St. George's Bay or north of Cape St. George. In the summer and fall, autumn spawners dominate nearshore towards the north. In the late-fall purse-seine fishery, catches are approximately 50/50 spring and autumn spawners.

Spring spawners have dominated the catch in every year since at least 1973, averaging 72% of the catch in numbers. This percentage increased to over 80% between 1988 and 1990 due to the active spring fishery in St. George's Bay, which exploited mainly pre-spawning and spawning herring. With the closure of St. George's Bay to commercial fishing in 1994, the percentage of spring spawners in the total catch has since decreased to under 60%.

Age Composition of the Catch

Since the mid-1980's, the 1980 and 1982 spring-spawner yearclasses have been important contributors to the total catch. In 1991, the 1987 yearclass recruited strongly to the purse seine fishery. From 1993 to 1995, the 1990 yearclass became increasingly more important in the overall spring-spawner

catch (Figure 4) although more so in the north than on the southern spawning grounds. In 1996, the 1990 yearclass dominated the purse seine catch, although the 1987 and older yearclasses were still present. Biological samples supplied by the index fishermen revealed that the 1990 yearclass was also present for the first time in the gillnet catches inside of St. George's Bay and Port-au-Port Bay in the spring of 1996. Recruiting yearclasses are always seen 2-3 years later in the gillnet fishery than in the purse-seine fishery due to the different gear selectivities.

Since 1983, the 1979 autumn-spawning yearclass has been the most important contributor to the fishery from this stock and is still dominant in 4Ra. Since 1990, the 1986 yearclass has strongly recruited to the autumn-spawner purse-seine catch. The 1988 and 1990 yearclasses have also contributed significantly to the total autumn-spawner catch in recent years (Figure 5). These three yearclasses have gradually increased in importance in the gillnet fishery since 1994.

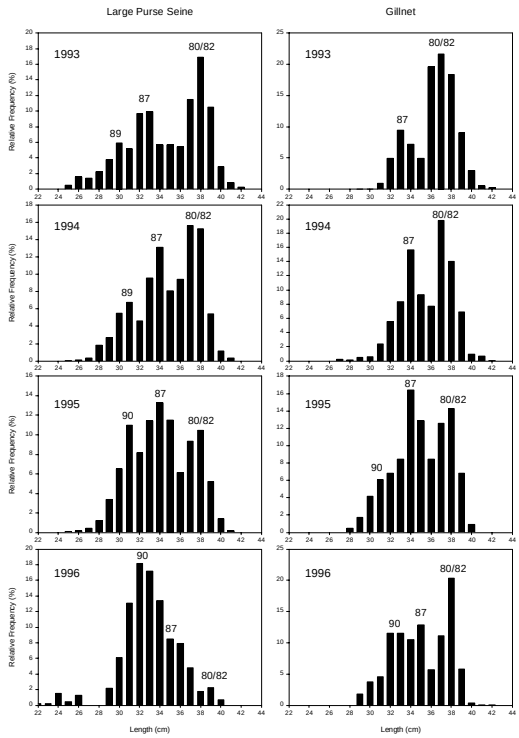


Figure 4. Annual large purse seine and gillnet catch-at-length (%) of 4R spring-spawning herring from 1993 to 1996 (major yearclasses are indicated)

Biological Condition

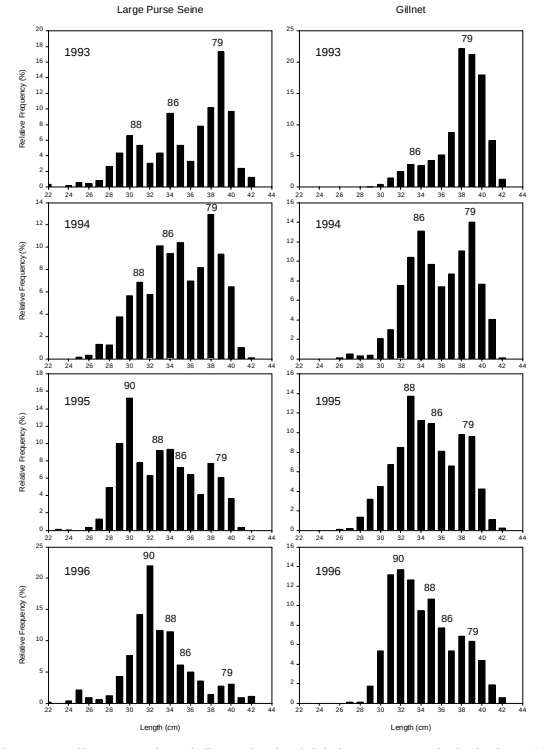


Figure 5. Annual large purse seine and gillnet catch-at-length (%) of 4R autumn-spawning herring from 1993 to 1996 (major yearclasses are indicated

The overall condition (weight vs length) of west coast of Newfoundland herring showed a major decrease in 1993 and 1994 (Figure 6), corresponding with a general decrease in annual water temperatures noted for the northern Gulf of St. Lawrence. However, when put into the context of the last 27 years, average condition was much lower from 1973 to 1976. In 1995 and 1996, overall condition rebounded, although the recov-

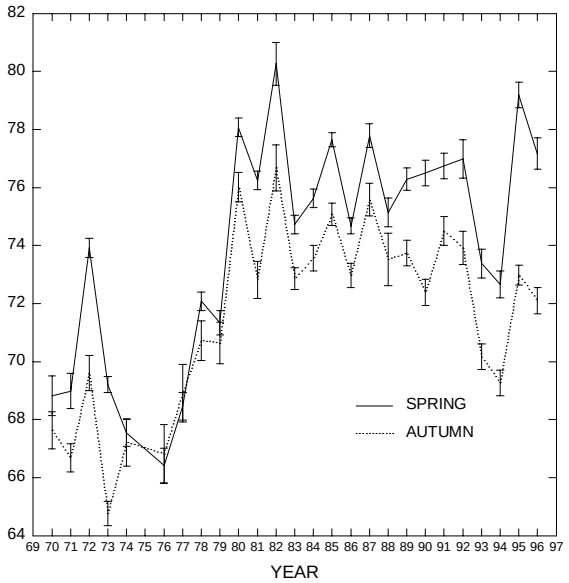


Figure 6. Mean condition factor for spring- and autumn-spawning 4R herring in late fall (Oct-Dec) from 1970 to 1996.

ery of the autumn spawners was somewhat less than for the spring spawners.

Abundance indices

Index-Fisherman Catch Rates

Detailed logbooks of daily catch and effort data from index gillnet fishermen were analyzed to generate abundance indices for both the spring- and the autumn-spawning stocks. These fishermen set their nets in the vicinity of either the major spring-spawning sites around St. George's Bay and Port-au-Port Bay or the autumn-spawning areas north of Point Riche. The standardized spring-spawner catch rates indicated that the 1987 yearclass was not sufficiently abundant in the southern bays to rebuild this local spawning component given the heavy fishing effort exercised on it in the early 1990's. In 1996 this catch-rate index increased for the first time since 1992, simultaneous with the recruitment of the 1990 yearclass to this fishery (Figure 7). The next year or two will indicate

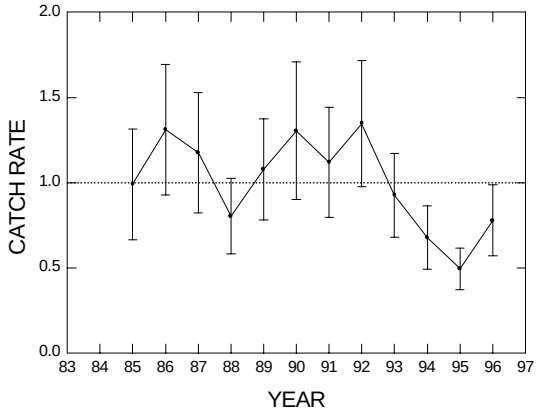


Figure 7. Standardized gillnet catch per unit effort and 2xS.E. for spring-spawning herring in NAFO division 4Rc and 4Rd as calculated from index-fisherman logbook data (reference line = mean of the series).

whether the recruitment of this yearclass will be strong enough to rebuild this component.

The 1986 autumn-spawning cohort appeared quite strong in the index-fisherman catch rates in 1992 and seemed at that time to be well above the 10-year average. However, it declined sharply in 1993 and 1994, and stabilized at a low level (Figure 8). Although this catch rate index seemed to reflect the strong recruitment of the 1986 yearclass, its sharp decline was unexpected given the low

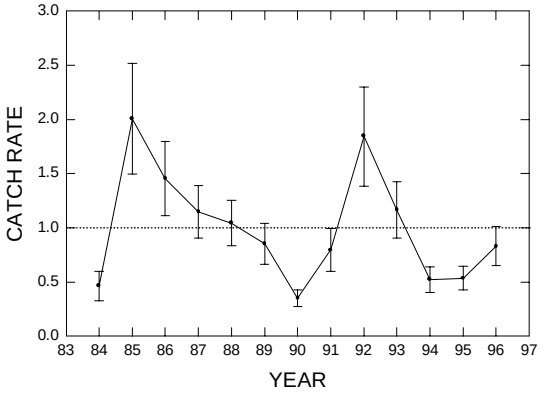


Figure 8. Standardized gillnet catch per unit effort and 2xS.E. for autumn-spawning herring in NAFO division 4R as calculated from index-fisherman logbook data (reference line = mean of the series).

fishing effort on the autumn-spawning stock. In addition, the recent recruitment of the 1988 and 1990 yearclasses has not been reflected in the index, which puts in doubt its usefulness as a measure of abundance. It is possible that this index is more a reflection of a change in availability, since it is known that autumn herring spawn farther offshore and are less available to inshore fixed gear than are the spring spawners.

Questionnaires

Comments collected from written questionnaires sent to all licensed inshore herring fishermen in 4R as well as those collected from our index fishermen indicated some improvement in the abundance of spring spawners around Port-au-Port Bay and in St. George's Bay, although it is felt that spawning activity had not yet improved significantly (Figure 9). There were also comments

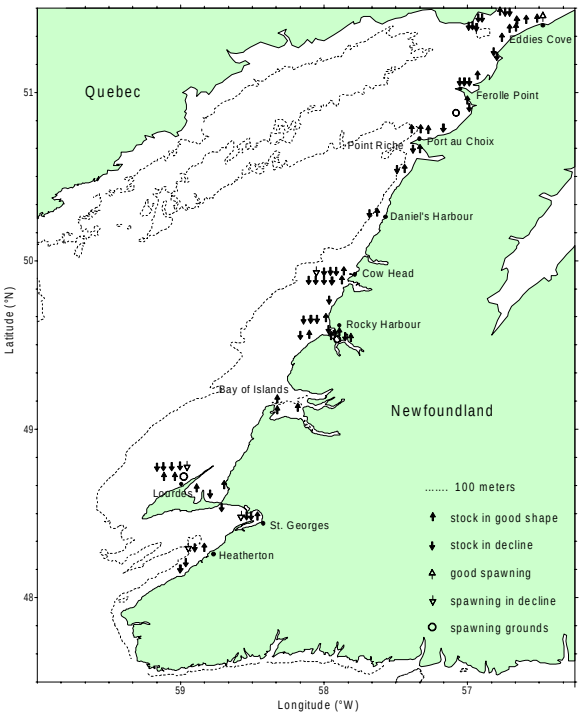


Figure 9. Distribution of inshore fishermen's opinions concerning the state of herring stocks and spawning in NAFO division 4R from 1996 written questionnaires.

to the effect that the spring-spawning stock had improved in the Bay of Islands. The 1990 yearclass, which has been captured in the fall gillnet fishery since 1995, has started to spawn in these southern bays. These observations are consistent with the catch rate data from index-fishermen in these areas.

North of Point Riche in 4Ra, the general opinion was that herring abundance was average to good especially in the summer and fall, although along the Quebec shore comments indicated that the stock was in decline. Spawning in the fall was noted mainly south of Ferolle Point. Biological samples from the Newfoundland shore showed a predominance of young (1988 and 1990 yearclasses) fish at that time.

Acoustic Surveys

Fall acoustic surveys have been conducted biannually since 1989 with the last survey in 1995. This latter survey was undertaken in close collaboration with the west coast large seiner fleet. A scientific staff was invited aboard four of these seiners over a two week period to take temperature profiles and to collect biological samples while our research vessel, the F.G. Creed, collected the acoustic data. This survey included the entire west coast of Newfoundland from St. George's Bay to St. Barb Bay which adequately covered the stock area.

The 1995 acoustic minimum biomass estimate of 84,000 t (38,000 t of spring spawners and 46,000 t of autumn spawners) was an increase over the 1993 estimate of 66,000 t (31,000 t of spring spawners and 35,000 t of autumn spawners). However, the 1993 estimate was considered to be low as two northern strata were not surveyed due to bad weather, and fishing activity at that time confirmed the presence of herring schools in these strata. In 1995, 64% of the herring biomass surveyed was in these two northern

strata. The distribution of herring in the remaining strata was similar from 1993 to 1995, even though the survey was conducted three weeks earlier in 1995.

Outlook

The 1997 assessment of the west coast of Newfoundland herring indicates that the status of these stocks is generally healthy. The fall 1995 acoustic abundance survey indicated a minimum total stock biomass of approximately 84,000 t in October-November of 1995, with 38,000 t of spring-spawning (45 %) and 46,000 t of autumn spawners (55 %).

Spring Spawners

The 1990 spring-spawning yearclass, which has been an important component of the purse seine catch since 1994, has now recruited to the gillnet fishery, including the southern spawning areas. The spring-spawner catch rates increased between 1995 and 1996, suggesting that the mature biomass in the southern spawning grounds had improved, primarily due to the recruitment of the 1990 yearclass to these areas. Comments received from index fishermen and from the written questionnaires suggest some improvement in abundance over 1995 in St. George's Bay and Port-au-Port Bay. Continued improvement is expected as the 1990 yearclass becomes fully recruited to the gillnet fishery. In addition, older yearclasses (1980, 1982 and 1987) are still present in both the purse seine and gillnet catches, indicating a relatively low overall fishing mortality.

Autumn Spawners

The autumn-spawning stock has historically received less fishing effort than the spring spawners (less than 28% of the total catch) since it occurs more in the northern areas farther from the principle landing ports. This has resulted in a wide age distribution in this stock, where in some areas the 1979 yearclass is still dominant. The sharp decline in the logbook catch-rate data in 1993 is in contradiction with other indices which show this stock to be in relatively good condition: (1) the fall acoustic survey estimate of at least 46,000 t, (2) the light exploitation of this stock over the past decade, and (3) responses to a written questionnaire indicating that the situation with this spawning component along the Newfoundland shore north of Point Riche is relatively good. It is quite possible that the index-fisherman catch-rate series has become less reliable due to (1) a decrease in participation in the program (three to four logbooks annually since 1993) and (2) the decrease in availability to inshore gillnets as the herring have moved farther offshore.

Management considerations

The present analyses indicate that in general, fishing mortality on these stocks over the past 20 years has not been excessive and that status quo harvest levels would not likely exceed $F_{0.1}$. However, the concentration of fishing in the early 1990's in the southern bays did harvest disproportionately more spring spawners from this local component and resulted in a sharp decrease in its abundance. The fact that special measures were undertaken in time to protect the spring spawners on the St. George's Bay/Port-au-Port Bay spawning grounds was undoubtedly a factor in their relatively rapid recovery. The closure of these bays in 1995 had the desired affect of concentrating fishing on the autumn spawners outside of St. George's Bay, of decreasing the quantity of spring spawners in the total catch and of allowing these fish to spawn undisturbed.

The present analyses of the available commercial and research data has allowed us to conclude that these stocks are generally in good health. Relatively young yearclasses are in abundance among both the spring- and autumn-spawning herring in the purse seine fishery, as well as in the research surveys, and a high proportion of very old (16-17 years) fish still appear in the catch. The 1995 fall acoustic survey estimated the minimum abundance of herring available along the west coast at that time at approximately 84,000 t.

St. George's Bay/Port-au-Port Bay

The strong recruitment of the 1990 yearclass to the purse seine fishery since 1994, and its appearance in the spring gillnet fishery in 1996 suggests that there is no longer a biological rationale for the continued exclusion of commercial fishing from St. George's and Port-au-Port Bays. However, the lessons learned from the reduction in abundance of spawning herring in St. George's Bay and Port-au-Port Bay underline the importance of protecting local spawning components from disproportionately high fishing effort. The conservation of each individual local spawning component ensures the continuation of the local fisheries dependent upon them and maintains the reproductive potential of the entire stock. It is recommended that the reopening of the closed areas proceed with caution, with no concentrated fishing on or near the spawning grounds. For this reason, areas of known spawning activity should remained closed to intensive fishing.

The fishery in St. George's Bay must continue to be watched closely. Although it is expected that the 1990 yearclass will bolster these local components, it is nonetheless recommended that a harvest limit be imposed for St. George's Bay and Port-au-Port Bay to allow fishing to proceed in a prudent manner, and that the distribution and composition of catches from within these bays be closely monitored. The continuation and enhancement of the index-fisherman program in this area is essential for the monitoring of spawning activity and as a local abundance index.

The widespread appearance of the 1990 yearclass in both the spring and autumn stocks in 1996, as well as the observation of an abundance of 2 year-old herring in the Bay of Island in the late fall are encouraging signs for the medium term outlook of these stocks. It is therefore concluded that the current TAC of 22,000 t of spring- and autumn-spawning herring should be maintained. However, to avoid a repetition of intensive fishing on any one local spawning component, it is recommended that fishing effort be spreadout along the coast and throughout the year as much as possible.

For further information:

McQuinn, I.H. and L. Lefebvre. 1997. An assessment of the West Coast of Newfoundland (NAFO Division 4R) Herring Stocks (1973 to 1996). DFO Atlantic Fisheries Res. Doc. 97/, in preparation.

McQuinn, I.H. and L. Lefebvre. 1996. An evaluation of the acoustic backscatter of western Newfoundland herring with a comparison of classical statistics and geostatistics for the estimation of varance. DFO Atlantic Fisheries Res. Doc. 96/58.

Prepared by:

Ian McQuinn
Tel: (418) 775-0627
Fac: (418) 775-0740
E-mail: mcquinni@dfo-mpo.gc.ca

Published by

Regional Stock Assessment Office,
Department of Fisheries and Oceans,
Maurice-Lamontagne Institute,
P.O. Box. 1000, Mont-Joli,
Quebec, Canada
G5H 3Z4

Additional copies can be obtained from the above address.

La version française de ce document est disponible à l'adresse ci-dessus.