Fisheries Resource Conservation Council

Fishing into the future: the herring fishery in eastern Canada

A report to the Minister of Fisheries and Oceans

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Executive Summary

The herring fishery is the largest small pelagic fishery in eastern Canada with an export value of over $110 million in 2008. It is a complex fishery using many different gear types: primarily gillnet, purse seine and weir. Fishing takes place throughout much of the region, from the nearshore to offshore. The fishery has a long history both here and in Europe, where the fishery goes back hundreds of years. Many different types of management have been applied to herring, including Total Allowable Catches (TAC), Individual Transferable Quotas (ITQs) and limited entry.

Most herring stocks, with some exceptions, are well below their historical averages. Two stocks are within or near the critical zone. In the Southern Gulf of St. Lawrence, there remain persistent gear conflicts that limit the ability of the industry to make change. The economic return from the fishery, while important to many harvesters and processors, is limited. The price for herring has changed little in the last thirty years. Data collection from the fishery varies around the region, from quite good to very poor. The long-term prospects for the fishery are uncertain given the status of the resource and the systemic problems of the industry. Nonetheless, the Fisheries Resource Conservation Council (FRCC, the Council) is convinced that greater benefit could be derived from the herring fishery.

To move the fisheries forward, the following recommendations are made.

1. The FRCC recommends that all catches of herring be recorded and reported, including those for bait, as well as discards and wastage.
2. The FRCC recommends that DFO and industry ensure the provision of sufficient scientific information and advice to support the management of herring fisheries. Each stock should have at least one reliable index of stock size.
3. The FRCC recommends that DFO and industry identify priorities for expanded scientific study of herring and its role in the ecosystem. New scientific studies should include not only data collection but also analyses, reporting, and discussion with partners up to and including the formulation of advice.
4. The FRCC recommends that a harvest strategy be developed for the 4VWX herring fishery to support stock rebuilding.
5. The FRCC recommends the closure of all fishing on spring spawning herring in the Southern Gulf of St. Lawrence to allow the stock to rebuild above the limit reference point. The bycatch of spring spawning fish in all fisheries would have to be kept to a minimum.
6. The FRCC recommends development of a policy for closing areas to some or all forms of fishing, and other human activities, that is transparent and has clear long-term objectives.
7. The FRCC recommends that all *Integrated Fishery Management Plans* for herring be renewed. Revised plans should outline a decision-making process that is participatory, transparent and accountable. The goals and objectives must be clear and measurable.
8. The FRCC recommends the implementation of an Ecosystem Approach to Fisheries (EAF) for decision making to improve fisheries management in Canada. The Council recommends that this approach be initiated in an area such as 4VWX where the existing stewardship arrangements are strong and the quality of the data available is relatively good.
9. The FRCC recommends that provincial regulations be established for the chilling of fish and that they be enforced through a dockside inspection program.
10. The FRCC recommends that DFO and industry evaluate the risks that latent capacity pose to the sustainability of the herring fisheries. Effective measures should be included in the *Integrated Fishery Management Plans* to mitigate those risks.

1. Introduction

1.1 Mandate and approach

On January 16, 2008, the Honorable Loyola Hearn, then Minister of Fisheries and Oceans, asked the Fisheries Resource Conservation Council (FRCC, the Council) to develop a long-term sustainability strategy for the Atlantic herring fishery. This report follows similar studies of the Council on lobster and snow crab.

The Council was asked to identify the major risks to the sustainability of the herring fisheries and to develop a long-term strategic approach to herring conservation that would promote sustainable use of the resource. The Council was also asked to complete a review of the scientific knowledge and management regimes of all Atlantic herring fisheries.

The Council began by meeting with Fisheries and Oceans Canada (DFO) biologists and managers from the east coast working on herring. In March and April 2008, the Council held 15 public consultations with stakeholders in eastern Canada and Québec and an additional meeting with Aboriginal Peoples representatives. The Council received 18 briefs from stakeholders.

1.2 Background

The Atlantic herring fishery is the largest of the fisheries for small pelagic species in eastern Canada with annual landings of 166,000 *mt*, with an export value of over $110 million in 2008. Products from the fishery include fresh, frozen, smoked, canned (including sardines), roe and bait (fresh, frozen, and salted) and by-products including fishmeal and fish-oil. Herring provides an incremental income to a large number of inshore harvesters and is a principal income for many. The juvenile herring fishery in the Bay of Fundy and the roe fisheries throughout the region provide an important economic contribution to harvesters and the local economy. The fishery also has a large vessel component of herring seiners. It is a complex industry.

Herring is an important source of bait for fisheries such as lobster and snow crab. In total, more than 11,000 harvesters are licensed in this fishery across eastern Canada and Québec. Herring is also an important component of the ecosystem due to its abundance and role as prey for other commercially and ecologically important species. There is a strong ecosystem dimension to the management of herring fisheries and the conservation of herring resources.

The approach to both science and management varies among herring fishing areas due to differences in the history and nature of the fishery and diverse hydrographic and ecological characteristics. As with other fisheries, the resource status also varies from area to area. Although some populations show signs of stability, most are well below historical levels. The spring herring in the Southern Gulf of St. Lawrence is of particular concern as it is below the limit reference point (Box 1).

2. Principles for the herring fishery

The herring fishery has changed over the past hundred years and further change will come. Fisheries management and decision making must take place in the face of such change, one of the few constants, and must be based upon guiding principles. The fishery, including harvesters, processors and communities involved in fishing, is now more globally interdependent than it has ever been. Decision making in the fishery must be tied to a modern understanding of sustainability.

Over the past decade, the approach to sustainability has evolved from a narrow focus on the conservation of a single species to a broader perspective of conservation including the ecosystem and societal needs. There must be a balance between resource conservation and the dependency of people and communities on fisheries resources. The FRCC proposes a set of four long-term principles for the herring fishery integrating the concepts of sustainability covering the ecological, social, economic and institutional components of the fishery. Truly sustainable practices require attention to all the components. Consideration of the fishery should build upon the following four principles:

1. The herring fishery must be able to meet the needs of the present without compromising the ability of future generations to meet their needs. [Ecological]
2. The herring fishery should be robust and resilient to natural, social and economic change. [Social, Economic]
3. The herring fishery should create long-term social, cultural and economic benefits for individual and community participants. [Economic, Social]
4. Governance of the fishery should be effective, participatory, transparent, efficient and accountable. Rules and regulations should be practical and regularly monitored and reviewed. [Institutional]

The first principle addresses the overall ecological goal of sustainability which is to ensure that fishing does not influence the resource or the ocean ecosystem such that the needs of future generations cannot be met.

The second principle defines a key characteristic for a sustainable fishery – the ability to survive change. The resource should be able to withstand environmental changes, such as increased mortality, or decreased productivity, or year to year changes in water temperatures. Likewise harvesting operations should be able to absorb the ups and downs of a normal business cycle.

The third principle recognizes that fishing occurs for social and economic reasons. Social reasons for fishing include attachment to community, the status of fishing in the community and quality of life. Economic considerations include the earnings made by harvesters and processors and the marketing of fish in an ever more complex international environment. Not everyone or every community will obtain equal benefits but it is clear that the process of their allocation can be very controversial. The acceptance of allocation decisions requires an open and transparent process. The principles for allocation of the resource have been set forth in other reports and are based upon many different factors including historical, cultural and social attachment to the fishery.

The final principle addresses the need for good governance. Many reports and comments have highlighted the flaws in the existing management system. There is a growing demand for governance that is participatory and transparent and a generally held democratic presumption that it should be accountable. Fisheries managers have struggled to realize these goals and there is still no clear path forward. Improved governance requires that all participants in the fishery work together. An important aspect of improved governance is regular review of the rules and regulations to ensure that they are both practical and effective. The rules have too often been contradictory and overly complicated.

Implementation of, and adherence to, the four principles requires the participation of harvesters, government, processors, environmental stakeholders, provincial and community representations and others with an interest in the fishery. An important first step towards sustainability is the need to define clear and practical objectives for a fishery. To be useful, they must be relevant to the needs of the fishery and must reflect the important characteristics of the fishery. The necessary protocols must be developed to ensure that these objectives are realized.

This report explores the implications of these principles for the herring fishery and makes recommendations for

their implementation. Systems that do not pay proper attention to the balance between components will have less chance to achieve sustainability. Balancing the different interests and requirements of the fishery will require difficult choices addressing economic, social and institutional concerns in addition to the issues of ecological conservation. Without proper balance, the pendulum might swing from over-fishing, resulting in damage to the resource, to closures, curtailing economic benefit. The balancing point will depend on the biological productivity of the ecosystem, the economic situation and the social preferences and societal values.

There are many tough questions to be addressed. What is the balance between fish in the ecosystem and their value in other fisheries? What represents the best value from the resource? What is the appropriate balance between the economic and cultural needs of fishing? How important are the cultural and social benefits? What is a fair distribution of the economic benefit? What are the trade-offs between deriving economic benefit and the need to ensure a robust and resilient resource? These questions have received too little attention for too long.

Implementing an expanded concept of sustainability requires the involvement, accountability, and commitment of all parties. While the Council's mandate is primarily concerned with the ecological component of sustainability, the major threats to herring conservation in eastern Canada are economic, social and institutional. It is not sustainable to ignore the non-ecological drivers of the fisheries.

Photograph 1: "Overdue II" fishing for herring on the Eastern Shore, October 10, 2002. Photograph courtesy of the Eastern Shore Fisherman's Protective Association.

3. What the Council heard at consultations

The Council held open consultations to hear from all those with an interest in the herring fishery. At each consultation, the Council presented background information explaining the scope of the study as follows:

- Focus on the long-term sustainability of Canada's east coast herring fisheries
- Involve all stakeholders and interested parties
- Role of herring in the ecosystem
- Opportunities to increase value
- Lessons learned and best practices on a local and international basis.

The Council asked for the views of stakeholders on major issues including:

- Scientific priorities
- Fishing methods/practices
- Management
- Critical issues to be addressed.

The Council met with stakeholders in 15 communities as well as with Aboriginal Peoples representatives. The resulting discussions were frank and open. Many of the 18 briefs received reinforced the discussions held at consultations.

The Council heard from the weir harvesters and processors that the industry is not open to quota management because of the complexity and mixture of catch from local and US spawning areas. Weir harvesters and processors expressed concerns about light, noise and pollution from shore based industries. Another issue raised was the loss of former weir sites to aquaculture leases. Weir harvesters consider that the long history of relatively stable landings indicate a sustainable fishery that they see as threatened by the encroachment of aquaculture.

Concerns brought forward by Aboriginal Peoples were similar to those raised by other stakeholders. Because of the lack of economic opportunity related to the herring resource, the dependence of these communities on this species centers on securing bait for the more lucrative lobster and snow crab fisheries.

There was consensus that there is too little DFO science effort devoted to herring. The Council heard from such organizations as the Eastern Shore Harvesters Protective Association and from the Herring Science Council that considerable work is being done through joint initiatives between harvesters and DFO, primarily to assess the status of the resource, thus compensating for the lack of investment by DFO.

Harvesters said that the increasing seal populations were having a negative impact on the resource. Not only were seals identified as a major predator of herring, but concerns were also expressed about the potential impact of seals on the spawning behaviour and the displacement of herring from traditional bays and spawning grounds.

Harvesters noted their dependence on access to herring for bait. In areas such as the Southern Gulf (where spring spawners are in decline), this is a major issue for the spring lobster fishery.

The lack of lucrative and reliable markets for herring was noted by many. The poor reputation of herring from eastern Canada on the international market has constrained the sales of herring to Europe. Although harvesters were getting as little as $0.21 per *kg* for herring destined to secondary processing, stakeholders reported having to pay as much as $2.20 per *kg* for bait herring. Many harvesters attending consultations noted that they no longer take part in the herring fishery because of the relatively low value of the harvest and high operating costs (largely driven by fuel prices).

Before consultations, the Council was aware of the divergence of views between the inshore harvesters and the seiner fleet, an issue also evident at consultations. As the allocation and access issues are not within the FRCC's mandate, the Council chooses not to comment while recognizing the right for all licence holders to have fair access to the resource. Even in areas where there appears to be peaceful co-existence between inshore gillnet harvesters and large seiners, conflict and mistrust are present and seem to dampen progress towards improved management.

The quality of herring landed was a recurring theme during consultations. Although improvements are being made in many areas, the lack of regular tending of nets, the limited use of ice and the lack of incentive to land better quality herring were noted.

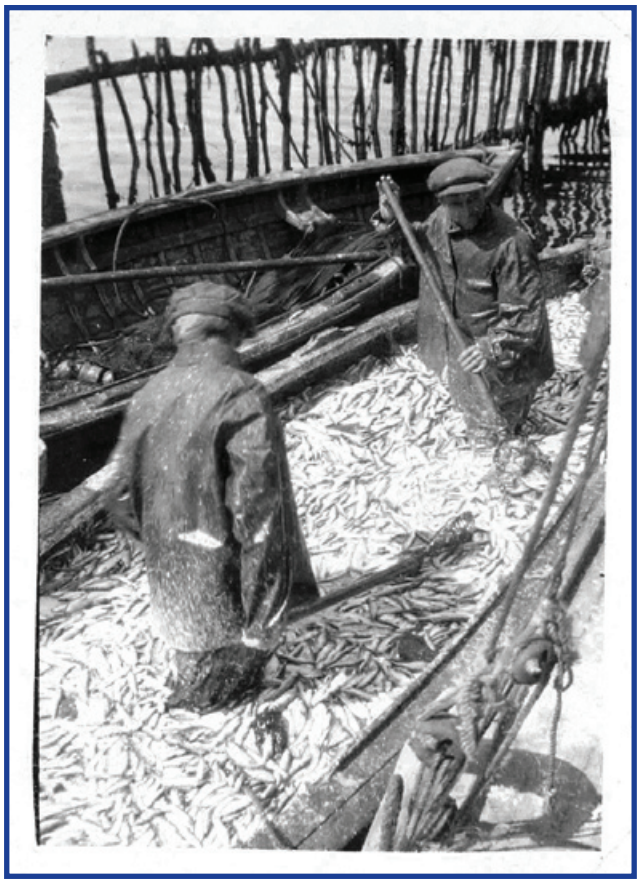
The questions regarding the place of herring in the ecosystem did not result in much feedback, except on the issue of seals. It was noted however, by those who did raise the issue that consideration should be given to the important role herring plays in the ecosystem as a forage species.

3.1 Key risks for the herring fishery

Following the consultations and review of the herring fisheries, the Council identified three key issues that pose the greatest risk to the herring fisheries of eastern Canada. This report and its recommendations focus on the issues central to the sustainability of the herring fishery. The Council determined that these are issues for which progress is possible if the industry, DFO and provincial agencies and other interested stakeholders work together. This report focuses on:

1. Status of the resource and knowledge about the resource. Without the fish, there can be no fishery, and in spite of the limited overall fishing effort most of the stocks are in poor shape relative to their long term state. In addition, there is very little data being collected on many stocks. (Section 4)
2. Decision making for management. The largest single problem, the lack of a clear and effective framework, has led to poor decision making. This problem is not specific to the herring fisheries. (Section 5)
3. Getting the best value from the resource. Overall, the direct economic return in these fisheries is low given the volume of fish caught. Different approaches, on the water, in the processing plants, and in the market place could lead to a fishery that offers much greater economic return without increasing the landings.
(Section 6)

The herring fishery of the future must be more sustainable in order to offer greater economic and social benefit to the participants. The discussion and recommendations in this report are intended to offer guidance to improve the herring fishery.



Photograph 2: Herring harvesters. Photograph courtesy St. Andrews Biological Station Photo Archives.

4. History and biology of herring

Atlantic herring (*Clupea harengus*) is a pelagic, schooling species that occurs in coastal waters on both sides of the Atlantic, and in the Baltic Sea. In the Northwestern Atlantic herring are distributed from Cape Hatteras (North Carolina) to northern Labrador. Spawning is restricted to specific grounds in inshore waters and on offshore banks. Herring typically form dense schools that migrate among spawning grounds, overwintering sites, and summer feeding areas. Herring are noted to undertake extensive vertical movements, generally deeper during the day and nearer the surface at night. Fishing takes place on dense summer feeding, overwintering, and spawning aggregations.

Herring can reach a maximum size of 40 *cm* and 650 *g* at an age of 14-16 years, however, the average size in catches is substantially smaller (e.g. typically 26 *cm*, 250 *g* for a Bay of Fundy purse seine catch). Herring first mature and spawn at three or four years of age (23 to 28 *cm*). The herring is the only member of the family *Clupeidae* that lays its eggs directly on the seabed and for this purpose the fish select areas where the bottom is firm. Herring spawn once per year at discrete locations to which they return each year (Figure 1). The eggs are heavier than water and stick in layers on the bottom where they settle. Each egg is approximately 1 *mm* in diameter and each female deposits from 20,000 to over 100,000 eggs depending on its size. The larvae hatch from the eggs in 10-30 days, depending on the water temperature. The newly hatched larvae are about 4-6 *mm* in size and rely on a yolk sac before first feeding.

Herring is an important component of the ecosystem because of its abundance and its role as a “forage species”, transferring energy and organic material up the food chain from zooplankton to many species of fish (e.g. cod, tuna), birds (e.g. gannets) and marine

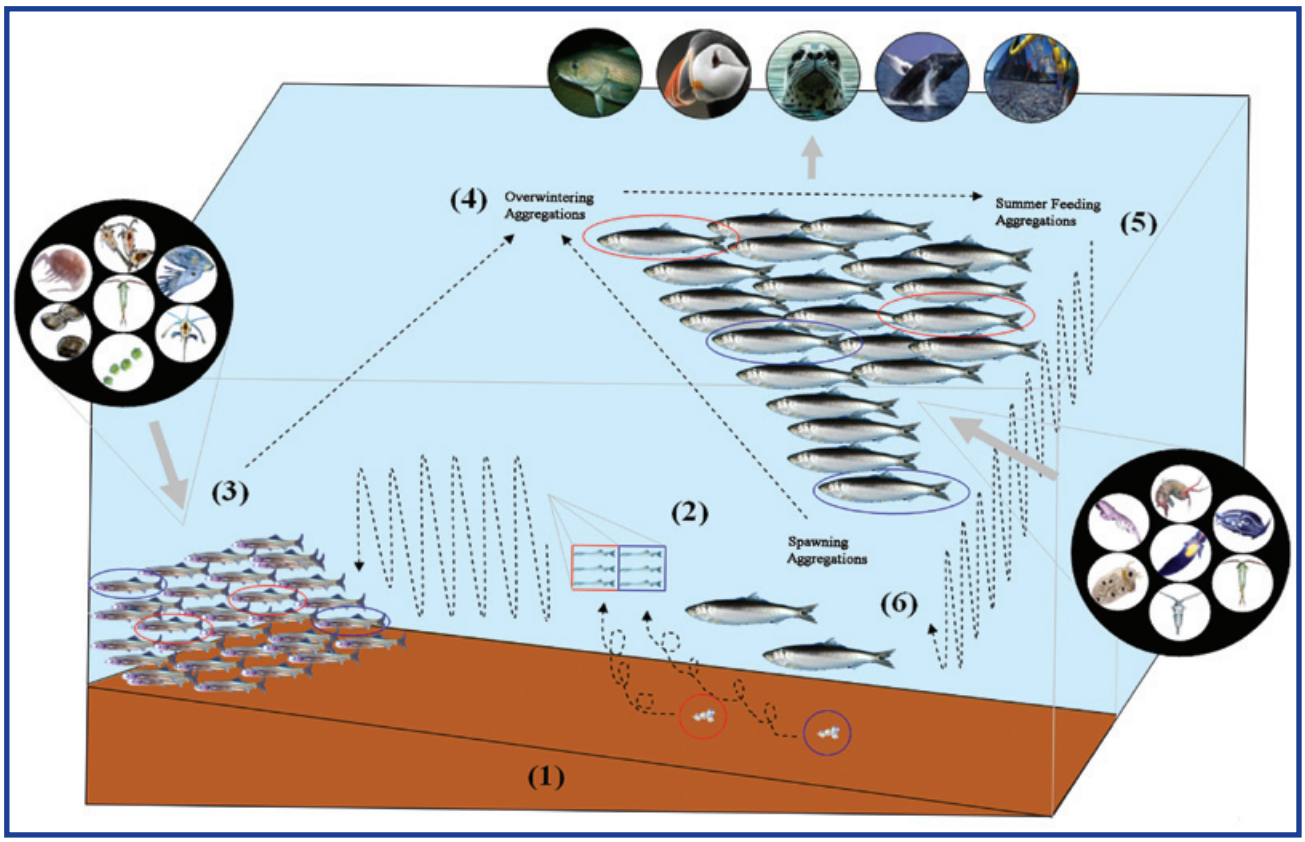


Figure 1: Atlantic herring is a pelagic species found on both sides of the North Atlantic. (1) Herring spawn in discrete locations, to which they return and are presumed to home. Eggs are sticky and adhere to the bottom. (2) Larvae are pelagic, and remain aggregated in dense aggregations (larval retention areas). (3) Juveniles form dense schools, often near shore. (4), (5) & (6) Herring mature and first spawn at three or four years of age (23 to 28 cm or 9 to 11 in), then begin an annual pattern of spawning, overwintering, and summer feeding, which often involves considerable migration and mixing with members of other spawning groups. Herring feed predominantly on zooplankton, and are themselves prey for other fish, marine mammals and birds. Herring typically undertake significant vertical movement, staying near the bottom by day and near the surface at night.

mammals (e.g. baleen whales, grey seals, harp seals). In addition, the eggs of herring are laid in large, dense mats that are fed upon by many bottom-dwelling animals, such as winter flounder. The importance of herring as prey is probably greater towards the southern parts of eastern Canada than in more northern parts, where the dominant forage fish is capelin. Within each geographic area, the importance of herring as prey has probably varied substantially over time, as the abundance of herring itself and that of other forage species have varied. There is no evidence that any predator species has diminished productivity during a period of low herring abundance, but this may reflect insufficient scientific study. In addition to its importance as food, herring have significant ecological impacts through its role as a predator on the eggs and larvae of fish. For example, it has been suggested that when herring are abundant, they may reduce the recruitment of species such as cod. Because food webs are complex, the impacts of changes in herring abundance may be unsuspected and surprising. European scientists have hypothesized that strong year-classes of herring in the Barents Sea (northeastern Atlantic) may prey intensively upon the larvae of capelin, thereby contributing to the collapse of the capelin stock, which in turn might lead to a severe reduction in cod productivity and starvation in some birds and marine mammals.

Because herring is an important forage species, there is much interest and concern regarding competition for herring between natural predators and fisheries. Ecosystem considerations suggest that harvesters should not take so much herring that the well-being of predators is compromised. The food requirements of the predators may be so high that there is relatively little herring left over for harvesting by humans. In recent decades the quantity of food consumed by cod and other groundfish has declined as the stocks of these groundfish have declined. During the same period, populations of grey seals, harp seals and some baleen whales have increased. There is little quantitative understanding of how these changes in predator populations have resulted in changes in total consumption of herring. Changes in predator populations may have other consequences for herring. For example, there are reports that grey seals are affecting the behaviour of herring on spawning grounds.

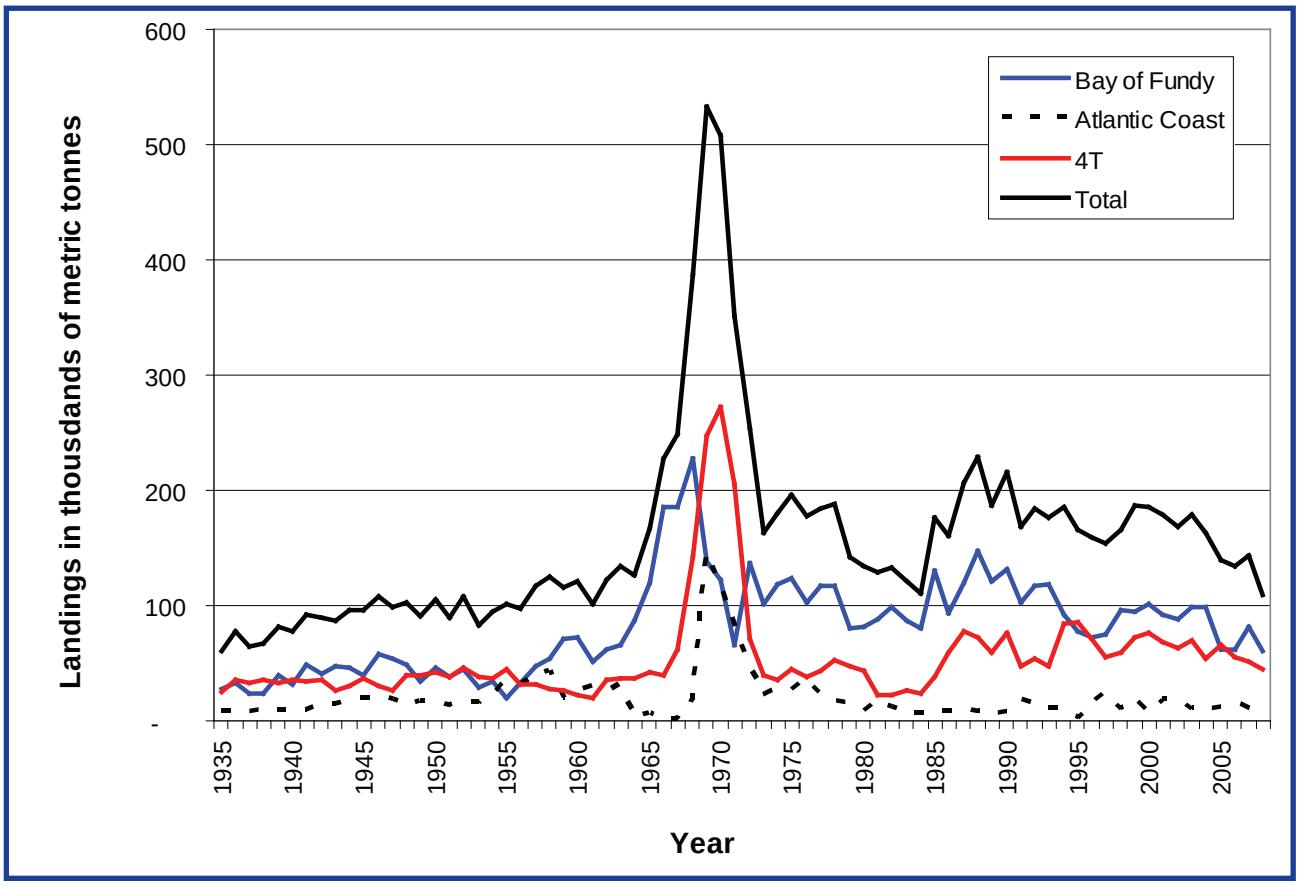


Figure 2: Landings for the Bay of Fundy (blue line), the Atlantic Coast of Nova Scotia (dashed line), Southern Gulf of St. Lawrence (4T) (red line) and the total of the three (solid black line).

Herring has supported commercial fisheries in Canada for over a century (Figure 2) and has been important to several coastal nations in Europe for at least 1500 years. Advances in salt preservation and in fishing technology allowed herring to be a major factor in the economies and politics of European nations, most notably from the 13th to the 17th centuries. As a result of the importance of herring and its long period of exploitation, herring has been among the best studied marine species and herring fisheries have been relatively well documented. Research on herring has been the basis for several major developments in fisheries science and management including understanding of population structure, explanation for variability in year class strength and hydroacoustic survey methods.

In Canada, herring has a long history of use by aboriginal communities, and in the traditional weir fishery that dates back more than a century. Herring has been fished by many different gear-types including weir, purse seine, traps, and gillnet. The herring fishery in Canada has been the subject of innovative management initiatives, including early limited entry, Total Allowable Catches (TACs) and Individual Transferable Quotas (ITQs), and more recently collaborations among industry sectors and government in fishery documentation, surveys and management.

Recent landings in eastern Canada have been less than 200,000 *mt* (see Figure 3 and Section 4.2) with a landed value in the order of $30 million and an export value greater than $110 million in 2008. Landings in Canada make up a small fraction of the North Atlantic landings of Atlantic herring. As a comparison, the Norwegian spring spawning herring fishery had recent landings of greater than 1 million tonnes from a spawning stock biomass of 10 million tonnes.

Herring populations are subject to large and rapid changes in abundance. In spite of early management, and considerable regulation, there have been several instances of fishery collapses including the large Norwegian spring spawning, North Sea, Georges Bank, and Icelandic summer-spawning herring fisheries. In each of these cases stock collapse has been rapid (a few years), and stock recovery has been slow (typically more than a decade). Some herring stocks have suffered episodes of mass mortality caused by disease. This occurred in the Gulf St. Lawrence in the 1950s and has been reported recently in Iceland.

4.1 Economics of the herring fishery

The economics of herring fisheries in eastern Canada are perplexing. The landed value of herring at $0.21 per *kg*, in 2008, is the same as it was almost thirty years ago – without accounting for inflation - and among the lowest priced species on the east coast. It is difficult to understand how the fishery is economically sustainable.

One common complaint heard at consultations was the lack of markets for herring products. Some believe that the low demand was due to quality problems and that current markets are not open to the product coming out of eastern Canada.

Nonetheless, herring is economically important. The total 2008 export value for product derived from herring was over $110 million with an average exported value of $2.21 per *kg*. Herring oil exported from Québec has fetched as much as $32.00 per *kg*; smoked herring from N.B. has yielded over $13.00 per *kg*. Québec has the highest average value per kilogram of herring products exported (at $3.93 per *kg*) and New Brunswick has the largest share of exported herring from eastern Canada and over 65% of export value. So it appears that high quality herring products from eastern Canada do indeed find their way to the international marketplace. Many feel that there is even more potential if harvesters and processors work in concert to develop higher quality herring products. The question needs to be asked whether alternative product forms for herring would provide more value. There appears to be great potential for value-added products with high fat content.

It is important to recognize that herring provide an important economic contribution to many complementary fisheries on the east coast of Canada. As one of the major sources for bait, herring contribute significantly to the reduction of costs for lobster, snow crab and tuna harvesters. The economic contribution of the bait fishery to the independence of harvesters can be very significant, especially at times when lobster prices are low and operating costs are high.

4.2 Stock assessment and status

The commercial fishery for herring started centuries ago in eastern Canada. The pattern of landings has varied considerably among areas and information is not consistently available for all areas. Longer time series are available for the Southern Gulf of St. Lawrence, for the Bay of Fundy and for the Scotian Shelf. These show

relatively low and stable landings from the beginning of the 20th century to the mid 1960s. The landings increased with the introduction of purse seining in the 1960s followed by a rapid decrease in landings in the late 1960s – early 1970s as a result of overexploitation (Figure 3).

Landings of herring for commercial sale are generally considered to be well documented, but there is concern about the unrecorded landings of herring used for bait. For lobster and snow crab harvesters alone, over 3.4 million traps are used each day during their respective seasons. Landings for bait may be high relative to total documented landings for some stocks, such as the White Bay – Notre Dame Bay in northeastern Newfoundland and the spring-spawning stock in the Southern Gulf of St. Lawrence. For the latter stock, which is in a critical state, there has probably been an increase in the ratio of bait landings to stock size in recent years. If bait catches are underestimated, the impact of fishing would be greater than indicated in the stock assessment.

With unreliable recording of bait catches and close to 8000 bait licence holders in eastern Canada, the amount of herring being landed for bait is unknown. The danger of these unreported landings is greater in areas where there is a combination of poor stocks and a high number of active lobster and snow crab harvesters.

There are many different possible approaches to determining the amount of herring taken as bait. The first and most immediate step would be to have bait harvesters record and report their catches. This could be done voluntarily through associations, or it could be made a condition of licence.

The FRCC recommends that all catches of herring be recorded and reported, including those for bait, as well as discards and wastage.

Understanding stock status

The application of the Precautionary Approach (PA) is now seen as essential to sustainability. In following the PA, it is necessary to be more cautious when uncertainty is high, for example, when there is little information available, as is true for some herring fisheries. Canada has developed a Harvest Strategy Framework (HSF) incorporating the PA (Box1) which is an essential component of the *Integrated Fishery Management Plan* (IFMP) for each fishery (see Section 5.2).

In the Framework developed by DFO (Box 1), stock status is placed within three zones (critical, cautious and healthy) separated by two reference points: a limit

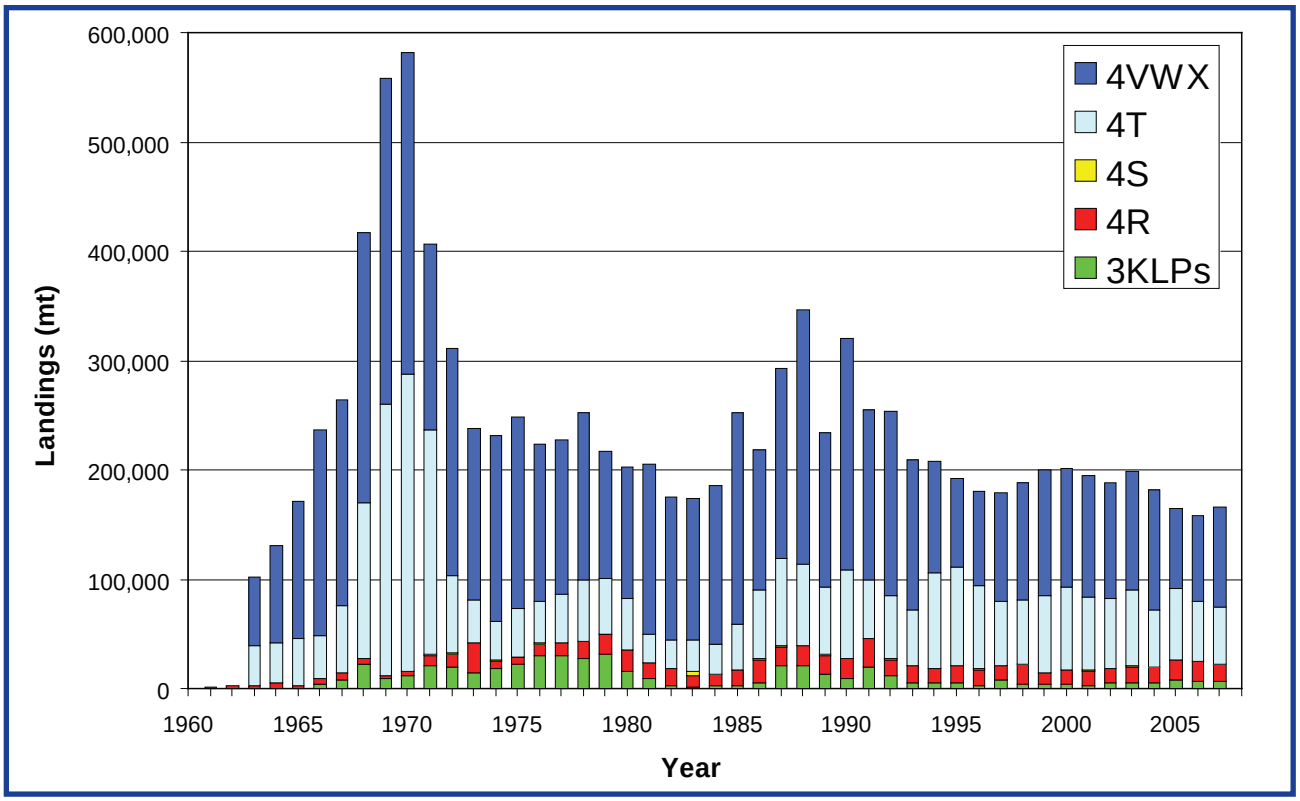
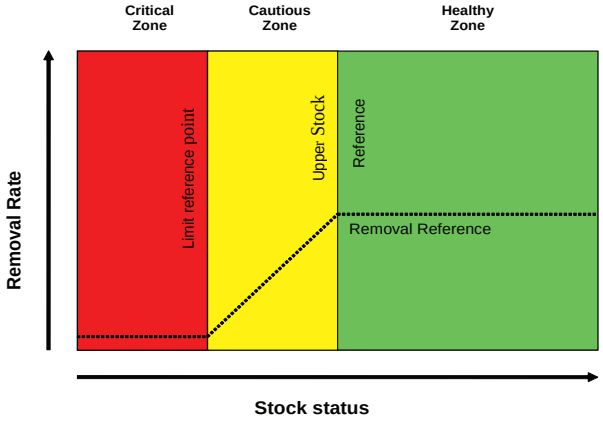


Figure 3: Landings by area. Note that some time-series do not go back as far as others.

Harvest Strategy Framework (Box 1)

Harvest Strategy Frameworks (HSF) that are compliant with the PA have been adopted by many countries and management agencies. The generalized framework adopted by Canada is shown below.



The goal of the PA is to reduce the risk of serious or irreversible harm to the stock by determining the spawner biomass below which recruitment (the number of young produced each year) tends to be consistently poor. The point at which this occurs is called the limit reference point (LRP) and the stock is considered to be in the critical (red) zone when the spawner biomass is below that point. To reduce the risk that the stock will fall below the LRP, an upper stock reference point (USR) is set sufficiently above the LRP that stock declines can be recognized and corrective measures taken to reduce the risk of the stock declining into the critical zone. If the spawner biomass is above the LRP but below the USR, the stock is said to be in the cautious zone (yellow). If the spawner biomass is above the USR, the stock is said to be in the healthy zone (green).

The HSF assumes that the only major factor influencing stock status that we can control is fishing and is expressed as the ratio of catch to stock size - called, removal rate. For a stock in the healthy zone, the removal rate is a predetermined upper limit not to be exceeded. If the stock size falls into the cautious zone, the removal rate is lowered to promote stock rebuilding with the removal rate progressively declining if the stock continues to decline. If the stock size falls into the critical zone then the removal rate is further lowered to promote stock growth.

The Framework described here could be extended to include target reference points associated with economic or social objectives or broader biological considerations, such as the importance of the species as prey. Such target reference points could be set at the USR but they would usually be established higher within the healthy zone.

reference point and an upper stock reference point. If a stock is in the healthy zone, that is, higher than the upper stock reference point, TACs are set at a target removal rate. If the stock declines into the cautious zone, the removal rate is reduced to promote a return to the healthy zone. If the stock declines into the critical zone, as has the spring herring in 4T, then the removal rate should be set as close to zero as possible to prevent further decline and promote population growth.

Data for assessing stock status

Different types of data are used in the assessment of stock status for herring. Stock size indices are derived from commercial catches or are generated from surveys that are independent of the fishery. The non-fisheries indices are provided by DFO, by industry, or by collaboration between them. Other types of information that may assist in determining status include demographic properties, such as size/age structure and geographic substructure or distribution, and population processes such as individual growth rate and age/size at maturation. The scientific data used to assess each herring stock or stock component is variable in eastern Canada (Appendix I).

The lack of scientific data, information and analyses to support fisheries management was often identified as an issue at the consultations held by the FRCC. The scientific effort in support of the management of herring fisheries appears to have decreased relative to the late 1980s and early 1990s (Appendix I). Modelling was widely used in the past but is now used to estimate stock size only in 4T. Aerial and / or acoustic surveys were conducted on a regular basis for most stocks while acoustic surveys are now conducted only in 4T by DFO and in 4VWX mostly by herring harvesters. Research gillnet surveys and opinion surveys are also conducted. While there is some form of monitoring, either by DFO or by harvesters, in most areas, in 4R there appears to be no data to evaluate the status of herring or the effect of the fisheries. The FRCC notes that there is no information on current or historic biomass for herring in 4S off the Québec North Shore in the Northern Gulf of St. Lawrence although there are apparently new acoustic surveys funded by DFO that should start in 2009/2010. A new tagging study in 4R should also begin in 2009/2010. It is thought that exploitation is currently low, but information on stock status is required to confirm that this is the case.

The FRCC finds that DFO is not living up to expectations that its stock assessment program should

be providing conservation advice to support the implementation of the Precautionary Approach to fisheries management. There is a widespread view that DFO should ensure that there is adequate data collection and analyses to support stock assessment and that DFO should maintain a core capacity in this area. A guideline of **at least one** reliable abundance index (e.g. fishery independent survey) per stock (DFO or client) is reasonable, recognizing that additional abundance indices are desirable and should be obtained if possible. The FRCC is concerned that, in some areas, such as in Newfoundland and the Northern Gulf, data collection and analyses may be insufficient to monitor stock status and evaluate the effects of fishing on herring.

Who monitors stock status?

During consultations, the FRCC repeatedly heard complaints about the lack of sufficient DFO scientific work on herring. Many commented on the reduction in monitoring, especially the cessation of acoustic surveys in several areas.

Partnering has become a significant component of the stock assessment program within Canada, but the extent of partnering in herring assessment varies considerably among areas of eastern Canada. Because the status of herring and other pelagic fish cannot be well-determined from existing bottom-trawl surveys, other approaches are necessary. It seems that DFO expects industry to be involved where property rights are more clearly defined. This process is well advanced in some areas, particularly southwestern Nova Scotia (see Box 2), but in some other areas there is no direct involvement by industry, typically where property rights are less clearly defined.

What happens if industry feels it does not have the resources to contribute to monitoring? This might be the case in areas where most harvesters rely on herring as just a part of their annual cycle of fishing, such that profit from herring fishing is small but nevertheless important to individual enterprises. It might also be the case in areas where most herring are taken as bait. Even if industry does take on a major role in the collection of data, there is no assurance that it would continue such work if economic circumstances were to deteriorate. Presumably, the working agreement between DFO and industry must include the understanding that if monitoring of stock status is inadequate and the impact of the fishery upon stock dynamics is highly uncertain, then the risk to the stock might be high. Under such circumstances the PA would lead to quite conservative management measures. Industry might be able to gain greater access to fish by contributing more to the monitoring of stock status, thereby reducing uncertainty and risk.

Whatever the role of industry in contributing to the monitoring of stock size, there is a general expectation that DFO should maintain sufficient capacity to hold and maintain data sets, ensure quality control of data and analyses for stock assessments, operate peer review and advisory processes, and communicate results. To assist in strategic assessment of the scientific program

Partnerships for understanding stock status (Box 2)

Partnerships between DFO and industry have become important to the provision of scientific advice for several herring stocks in eastern Canada.

In southwestern Nova Scotia, the Herring Science Council (HSC) coordinates acoustic surveys that have been conducted by purse seiners on several herring spawning grounds since the late 1990s. The HSC and some harvesters have purchased acoustic data recording systems, with which they log acoustic data collected during multiple surveys of each spawning ground using a survey plan provided by DFO. The HSC covers the at-sea costs of the surveys and pays for the preliminary analysis of the data which are passed to DFO for inclusion into stock assessments.

A similar system exists along the east coast of Nova Scotia, where the Eastern Shore Fisherman's Protective Association (ESFPA) has purchased acoustic data recording systems for surveys conducted by dedicated inshore harvesters on herring spawning grounds. They too pay for the preliminary analysis of the acoustic data which are then passed to DFO.

For these two sectors, the biomass estimates provided by industry surveys are the only abundance indicators of stock status. As with all indicators, there are limitations to these acoustic estimates. One important gap is the lack of information on the size of incoming year-classes. The relative abundance of incoming year-classes is one of the many types of information provided by another type of monitoring, the research gillnet surveys conducted throughout eastern and southeastern Newfoundland. Under this program, harvesters are contracted by DFO to conduct experimental fishing with gillnets of varied size for a set period of time each year, and to record the number of herring caught per net and to provide samples for analyses by DFO. Harvesters are provided with all the fishing gear and with funding to offset a portion of their costs. The research gillnet program is currently the major source of information for stock assessment in eastern and southeastern Newfoundland.

for the assessment of each stock, DFO has moved towards assessment framework meetings. A framework review for the 4VWX herring complex was started in 2006 and has yet to be completed. The report of the first two meetings (DFO CSAS Proc. Ser. 2007/002) illustrates the value of the process, as it identified a large number of unresolved issues, including some specific to the measurement of biomass via acoustic surveys on spawning grounds, and specified problems that needed to be addressed in the short term.

The FRCC recommends that DFO and industry ensure the provision of sufficient scientific information and advice to support the management of herring fisheries. Each stock should have at least one reliable index of stock size.

Improved understanding of herring in the ecosystem

Beyond the needs to manage the herring fishery, there are other reasons to collect information on herring. They need to be studied and monitored because of the role of herring as prey for many species of fish, birds and mammals, including some species that have special status because they are endangered. Herring fisheries should not threaten the conservation of the many species of fish, birds and mammals that prey on herring. Improved quantitative understanding of the trophic interactions involving herring, and the impact of fisheries on those interactions, will require additional support for data collection and modelling. It appears that DFO has reduced the resources devoted to the assessment of individual stocks in favour of an ecosystem approach. However, in order to promote the ecological component of an ecosystem approach, good knowledge is needed on the abundance/biomass of the major species in the ecosystem and the impact of fisheries upon them. Ecosystem considerations of herring need to consider their importance as prey to other species and the impact of predators on herring. For example, in Icelandic waters and the Barents Sea, a portion of the capelin biomass is set aside to ensure that there are sufficient capelin prey for other species.

The distribution and dynamics (recruitment, individual growth and mortality) of herring are influenced by many environmental factors, both biological and physical. Better understanding of these factors would aid in understanding current trends in herring and to predict the consequences of future environmental change. Exploration of such issues will require additional scientific study.

Scientific study can also be relevant to issues such as the impact of different gear on bycatch species and the benthic habitat, the extent to which lost herring gear continues to catch herring and other species, the reasons why some spawning areas are currently unused or under-used, the advantages and disadvantages of managing at the level of individual spawning components, the impact of fishing on spawning grounds, and the intent and effectiveness of size restrictions, which vary geographically. The Council noted that the integration of scientific results for the Atlantic zone is lacking and should be given attention by the department.

The FRCC recommends that DFO and industry identify priorities for expanded scientific study of herring and its role in the ecosystem. New scientific studies should include not only data collection but also analyses, reporting, and discussion with partners up to and including the formulation of advice.

It was clear from consultations with harvesters that there is a wide-spread view that the increasing seal population is having a negative impact on the resource. Not only were seals identified as a major predator of herring, but concerns were also expressed that seals were changing the behaviour of herring on the spawning grounds and causing the dispersal of herring outside their traditional grounds in the inner bays. DFO scientists do recognize that the number of seals has increased significantly over the past four decades (more than one hundred fold for grey seals) and that the increase in spatial distribution has also been significant. Unfortunately, there is little scientific information on which to develop management options. With respect to the impact of seals on spawning behaviour and migratory patterns, there is virtually no quantitative data.

Status of herring stocks

The times series of landings (Figure 4) and abundance (Appendix II) reveal that the abundance of most herring stocks in eastern Canada, with the exception of the 4T fall herring, is low relative to their historical average. The information available for the different stocks varies significantly and confidence in the state of some stocks is rather low.

In eastern and southeastern Newfoundland, three of the five stocks (White Bay - Notre Dame Bay, Bonavista Bay – Trinity Bay, and St. Mary's Bay – Placentia

Bay) are at low levels relative to their historical highs in the 1970s. The fourth assessed stock (Fortune Bay) is substantially lower than during the late 1990s. The Conception Bay – Southern Shore stock is small and has not been assessed recently. Landings from each of these stocks have been relatively stable in recent years, but very low relative to historical highs.

In the eastern portion of the Northern Gulf of St. Lawrence (western Newfoundland - 4R), the little recent information available on stock abundance suggests that the spring stock is low relative to the historical average while the fall stock is close to the historical average. Landings have remained relatively stable in recent years.

In the northern portion of the Northern Gulf of St. Lawrence (Québec North Shore - 4S), there is no information on current or historic abundance. Landings are very low.

Probably the herring stocks with the best information are the 4T stocks in the Southern Gulf. In the Southern Gulf of St. Lawrence (4T), the abundance of spring spawners is close to the historical low, as are landings. The biomass, assessed at 20,300 *mt* in 2009, is below the limit reference point of 22,000 *mt*. The perception of low abundance is supported by reports that spawning is absent or much reduced on many spawning grounds. The stock is in the critical zone and any removals will reduce the likelihood of stock rebuilding.

The fall spawning stock in 4T is considered to be in the healthy zone. The FRCC notes, however, that considerably higher biomasses occurred in the 1960s, and that from this perspective, the stock is not near its

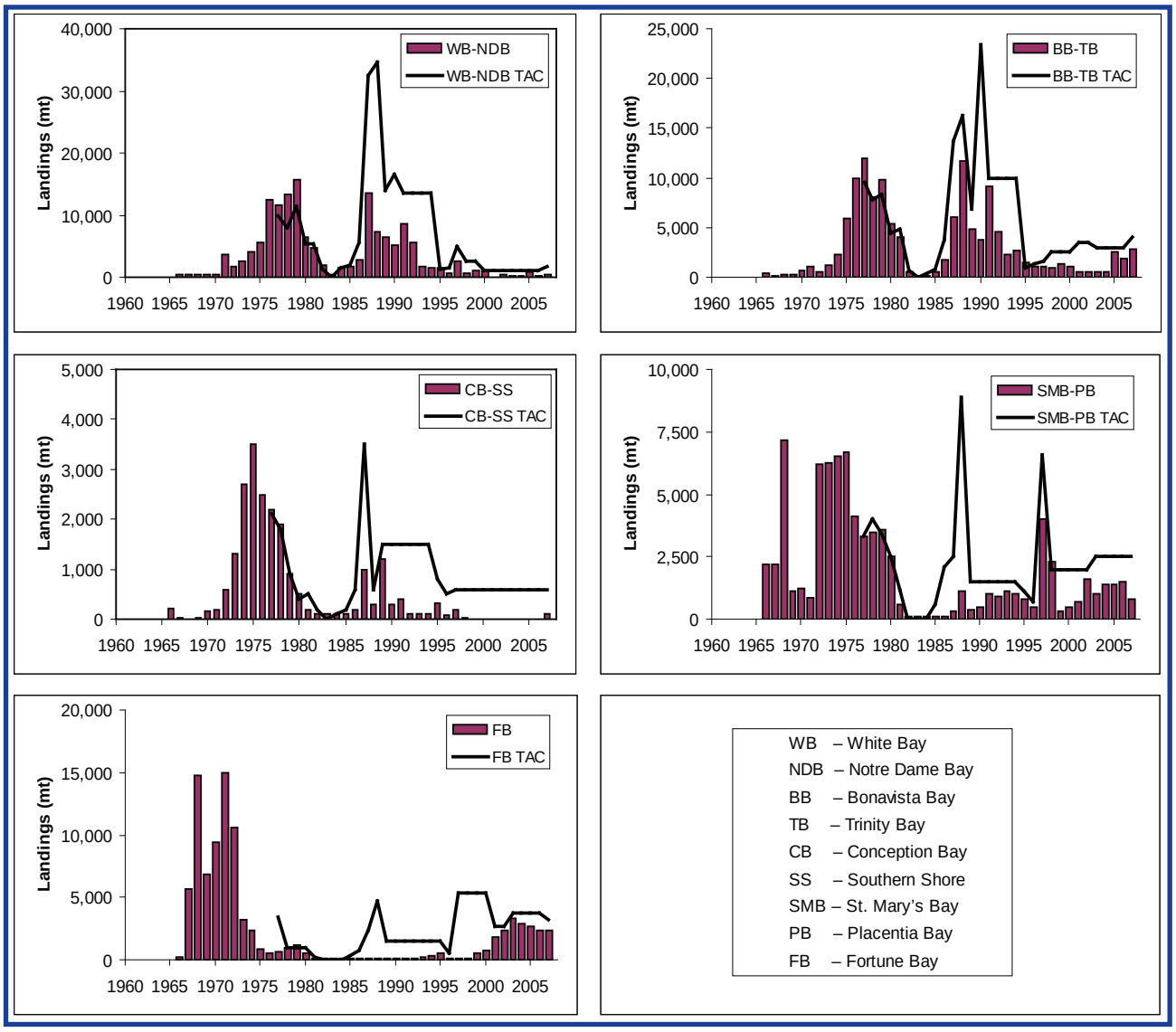


Figure 4: Landings (as coloured histogram) and the Total Allowable Catch (TAC) (in solid line) for different regions of eastern Canada from 1960-2007.

highest biomass. At one time, large numbers of older herring from the spring and fall stocks in the Southern Gulf of St. Lawrence overwintered in southwestern Newfoundland. This migration no longer occurs, which may be further evidence that the abundance of older, larger herring is lower than it was.

The Nova Scotia / Bay of Fundy (4VWX) complex has four components. Biomass of the SW Nova Scotia / Bay of Fundy component is relatively low, although there is uncertainty about the current biomass because of differences in biomass derived from population modelling and acoustic surveys. Acoustic biomass estimates are near the lowest in the time series and the overall spawning biomass is at the lowest for the time series. Additional evidence that abundance is below historic levels includes reduced or no spawning on some spawning grounds. TACs and landings have been reduced in recent years in response to concerns about stock status.

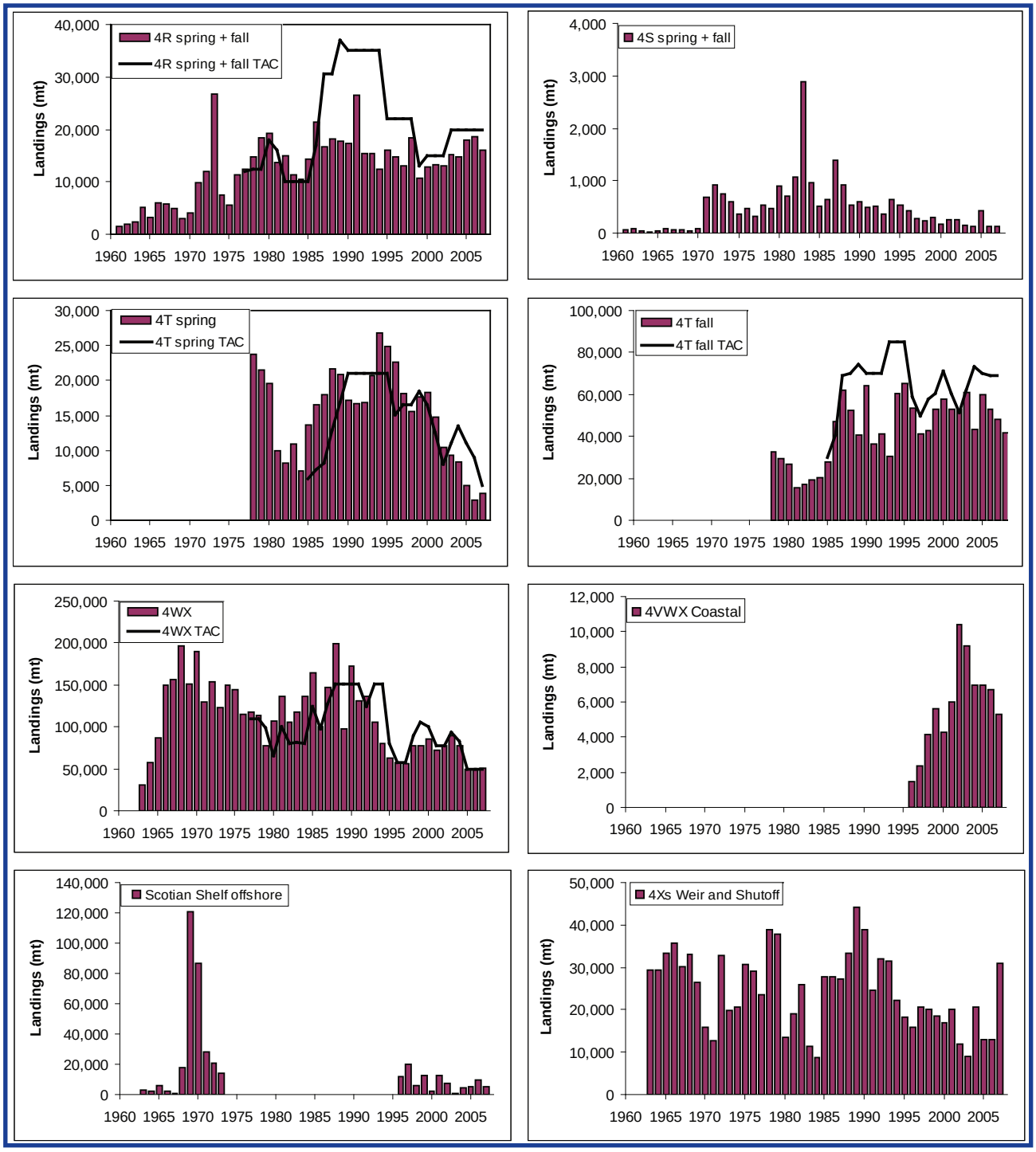


Figure 4: Continued

There is much less information available for the other components of the 4VWX complex. Portions of the coastal Nova Scotia component are surveyed acoustically, but there are no historic estimates for comparison. The Bras d'Or Lakes have been surveyed only twice and are currently closed to herring fishing. Information on historic biomass on the offshore Scotian Shelf is scanty, and there are no recent estimates. Fish caught in the SW New Brunswick migrant juvenile fishery are considered to come from several areas, predominantly Subarea 5. These fish are assessed by the United States as part of the Georges Bank and Gulf of Maine assessment and are excluded from the 4VWX quota.

Although some of the conservation objectives are being met in 4VWX, there remain concerns about the spawning areas other than German Bank. Relative exploitation rates appear to be going up, and the spawning biomass is at a low level. The most recent stock status report (2009) indicates that there is little improvement in the resource in recent years and recommends a cautious harvest strategy aimed at rebuilding.

The FRCC recommends that a harvest strategy be developed for the 4VWX herring fishery to support stock rebuilding.

This summary suggests that except for autumn spawners in 4T and possibly in 4R, all stocks are presently at or near their lowest level. Although reference points have only been defined for 4T herring, the FRCC considers that it would be precautionary to assume that the herring stocks of eastern Canada are either in the critical zone or in the lower part of the cautious zone until proven otherwise. Fishing plans should be developed following the PA and where necessary rebuilding plans should be developed. Even in areas such as eastern and southeastern Newfoundland, where catches are very low, the Council is concerned by the lack of information on the state of the resource. The Council notes that the 4T spring spawning herring is in the critical zone and is concerned that the SW Nova Scotia / Bay of Fundy component may be very close to the critical zone.

During its consultations in 2008, the FRCC heard considerable concerns about the status of Southern Gulf of St. Lawrence spring spawning herring, particularly with respect to the Escuminac, Northumberland Strait and the Magdalen Islands areas which previously were important spawning grounds but from which herring have disappeared. In addition, the Council notes that the limit reference point for Southern Gulf of St. Lawrence spring spawning herring is 22,000 *mt* and that both the 2008 and 2009 assessments indicate that the stock is below the limit reference point and that it is predicted to remain below the limit reference point even with no catches in 2009.

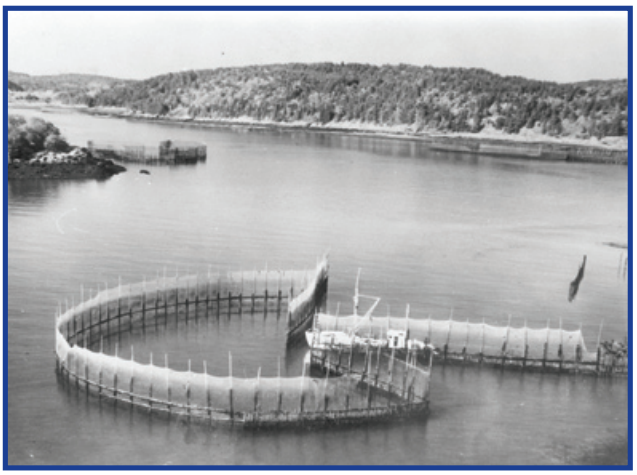
The FRCC recommends the closure of all fishing on spring spawning herring in the Southern Gulf of St. Lawrence to allow the stock to rebuild above the limit reference point. The bycatch of spring spawning fish in all fisheries would have to be kept to a minimum.

The FRCC is aware that closing the spring herring fishery in the Southern Gulf of St. Lawrence will have an effect on fisheries using herring as bait, but the FRCC considers that there are alternate sources of bait and that conservation concerns must take priority.

4.3 Gear issues in the herring fishery

Several different types of gear are used in the herring fishery in eastern Canada. The most commonly used gear is a gillnet. These gillnets are "set" to intercept fish during their normal migrations, either along the shore, on the spawning grounds or as they move in and out of an area. Herring nets are typically fished from the bottom up.

A herring weir is a fixed and passive gear that has been used in eastern Canada for over one hundred years. It is a large trap with a long leader that runs to shoal water usually located at the end of a point of land or ledge. Long poles are stuck in the bottom and small mesh seine netting is draped vertically from the surface to the bottom forming a "bowl".



Photograph 3: Weir fishery. Photograph courtesy St. Andrews Biological Station Photo Archives.

A purse seine is a long rectangular barrier net equipped with floaters on the top and small lead weights at the lower end allowing it to stay in an upright position during fishing. Although seines do occasionally touch the bottom, the impact of fishing on the benthic habitat is considered to be minimal. Purse seining is done at night when herring swim near the surface. No lights are used until the seine is closed.

Midwater trawl fishing for herring is popular in Europe and was used in the Gulf of St. Lawrence quite a few years ago. In midwater trawling, a net is deployed and towed at a chosen depth in the water column to catch schooling fish such as herring and mackerel. This differs from "bottom" (benthic) trawling in which a net is dragged along the ocean bottom where fish such as cod, haddock, and flounders live. A midwater trawl, however, can be towed close to the bottom.

Depending on the stated objectives of a particular fishery, consideration should be given to which is the most appropriate fishing gear to achieve the best results. The gear should be assessed based upon its delivery of quality fish, economic efficiency, bycatch retention, habitat impacts, and ultimately the price achieved for the product (Table 1). Under Canada's Ocean to Plate initiative processors should be working collaboratively with the harvesters to extract the optimum value from the herring resource. The table below reviews the characteristics of the four different gear types in four categories: efficiency, limitations and strengths, ecosystem impacts and catch characteristics.

4.4 Fisheries closed areas

In previous reports, the FRCC has noted the uncertainty in fisheries science and management and how, even with the best of intentions and efforts, stock collapses can and do occur. One management tool that can act as a buffer to the unintended consequences of decisions made with imperfect knowledge and can enhance the biological element of sustainability is the effective use of spatial and/or temporal closures. Closures can be targeted at particular components of the stock such as spawning or juvenile fish or migration patterns.

Closed areas are also a useful management tool in providing for an orderly harvest by separating fleets to avoid gear conflicts and minimize disputes. These measures provide for a sharing of the fishing grounds and the resource. Embayment areas in Nova Scotia would be an example of such closures that have helped to maintain order and minimize disagreements in the herring fishery. However, requests for closed areas must be carefully scrutinized to ensure that they achieve a valid objective.

Fishery	Efficiency	Limitations/Strengths	Ecosystem Impacts	Catch Characteristics
Purse Seine	• High catch rate - up to 300 tons/night • Multiple sets per night • Can sample catch and release • Can transfer excess catch to other vessels or release live	• Depth of seine restricts fishing • Night fishing / surface fishery • Herring can evade seine • Cannot set if depth too shallow • Gear tears can take days to fix • Not size selective • Expensive to gear up	• Potential for bottom impact • Minimal bycatch • Live release (with some mortality) • All sizes captured • Not area specific fishing • No ghost fishing	• Potential for high quality • RSW / refrigerated holds • Retains all sizes • Food grade herring
Gillnet	• Can be set or drift - nets can be left unattended - drift nets attended/attached to vessel • Mesh size determines catch composition (size selective) • Can deploy nets on schools	• Limited holding capacity (<10t) • Inexpensive to gear up • No catch and release of live fish • Bycatch in certain areas/conditions	• Lost nets/ghost fishing • Area specific, activity on spawning herring • Size selective catch • Bycatch of salmon a concern in certain areas	• Quality problems with unattended nets/ and shaking • Potential for good quality with ice proper tending and containers • Few refrigerated fish holds • Size selective catch
Midwater Trawl	• High efficiency • Herring caught surface to bottom • Active fishing on schools • Can offload at any port • Carry up to 300-1800 t /trip • Can fish night or day/multiple sets • Cod end sensors limit catch/set • Bycatch in certain areas/conditions	• Not size selective • Expensive to gear up • High fuel costs / lb of catch • Can transfer to other vessels • Need larger vessel with high horse power	• No bottom impact • Bycatch issues in certain areas/condition • Live release not possible • Not areas specific fishing method • No ghost fishing	• Potential for high quality • Predominant gear used in Europe for herring / mackerel • RSW / refrigerated fish holds • Not size selective • Food grade herring
Weir	• Passive gear / waits for herring • Works well when herring are present • Live catch can be harvested days later - catering to market • Gear fishes unattended • Less variable costs (fuel) • Can use carriers for large catches	• Netting must be removed / cleaned • Expensive to set up • Migration dependent • Large daily/annual catch fluctuations • Not size selective	• Impact of weir footprint localized • Bycatch of salmon, pollock, mackerel, tuna, sharks, whales, porpoises (can be released alive) • No ghost fishing	• High quality live catch • Requires handling / transport to processing plant • Few large herring in the catch

Table 1: Overview of four different gear types used in the herring fishery – purse seine, gillnet, midwater trawl and weir – according to efficiency, limitations and strengths, ecosystem impacts and catch characteristics.

The Council believes that the east coast herring fishery should take a long-term strategic approach to closed areas through development of clear and transparent policy guidelines. A well understood policy would force participants to focus on valid goals and would preclude attempts to restrict or provide access for political reasons. The use of closed areas will need to be considered in the renewed IFMPs.

The FRCC recommends development of a policy for closing areas to some or all forms of fishing, and other human activities, that is transparent and has clear long-term objectives.

Photograph 4: Gillnet fishery. Photograph courtesy K. Leclair of Tignish, P.E.I.

5. Decision making

Good management is really about good decision making. The process by which decisions are made is important, particularly given today's expectations of participation and transparency. There is a lack of trust in the present fisheries and a general malaise associated with the feeling that the present institutions are failing. While there is general agreement about the many problems facing the fisheries, there seems little agreement about what to do. It is clear that greater acceptance of decisions (an essential aspect of effective management) requires better approaches to decision making, ones that are more inclusive and transparent.

There are two important areas for improvement that are possible in the herring fishery. The first is in the framework that guides decision making – the *Integrated Fishery Management Plans* (IFMPs). These documents should define the process by which management decisions are made. There are problems with the present plans and much scope for improvement.

The other opportunity for improvement lies in the development of an ecosystem approach to decision making that allows consideration of factors covering not only the conservation of the resource but also the social, institutional and economic conditions. The recommended approach is not complicated; it is a practical approach to making decisions that covers the important factors affecting the fishery. It is increasingly understood that the fishery is influenced by many different factors and that management is basically about managing human behaviour and not fish. The goal is to manage human behaviour so that the maximum economic benefit is gained while causing the least harm to the marine ecosystem.

5.1 Governance

The modern concept of a sustainable fishery requires that the four pillars of sustainability - ecological, social, economic, and institutional - be in reasonable balance.

With respect to institutional sustainability, the first step is the establishment of processes for decision making and control. This is termed governance. Good governance involves a process that is open and transparent and allows all participants to have meaningful input. The rules must be practical and enforceable. For decision making to be effective, it must be viewed as valid by those whom the decision affects. If the process and the rules are clear and seen to be equitable, decisions stand a better chance of being respected by the participants.

DFO has adopted principles, through the *Atlantic Fisheries Policy Review* (AFPR), that should improve decision making for fisheries management. Three such principles are:

- Fisheries management decision-making processes must be, and must be seen to be, fair, transparent and subject to clear and consistent rules and procedures.
- Fisheries management decision-making processes will be more inclusive so that resource users and others will have appropriate opportunities to participate.
- Operational decision making affecting specific fisheries will normally be made as close to those fisheries as possible and will primarily involve resource users.

The FRCC strongly supports these goals and believes that sustainability of fisheries can be enhanced through their implementation. Good governance is difficult when harvesters are organized into small associations that do not speak with a unified voice on important issues and where the processing sector is unorganized and under represented. The lack of consensus on critical issues in the fishery places DFO in the difficult position of deciding between differing views or doing nothing. In some areas, such as Newfoundland and 4VWX, there are well organized associations that formulate positions and influence policies in the interests of the majority of the participants in the fishery.

The current fisheries management structures in place for Atlantic herring do not meet the principles of the AFPR. Although meetings of formal advisory committees do take place, they lack two essential elements. First, there is no real participation in decision making – expressing opinions at the advisory committee falls short of that goal. Second, the deliberations, analyses and final recommendations following the end of the advisory process occur within DFO. Accountability is often lacking and the rationale for decisions is often left unexplained.

The Council has observed varied success with the current governance models across eastern Canada. Management in some herring fisheries appears to be working well while other areas are experiencing more

difficulty. In the Southern Gulf the positions seem the most entrenched and the industry seems to have the greatest difficulty in moving forward. The conflict goes back to the 1960s with the introduction of large herring seiners followed by a poorly regulated fishery, declining catches, near stock collapse and a restructuring of the seiner fleet in the early 1980s. Conflicts remain that make it difficult for harvesters to work together. This situation illustrates how management of a fishery can deteriorate in the absence of rules-based decision making in an open, transparent process.

The Council has reviewed the many studies and reports of the issues facing the Gulf fishery and the positions of the parties were also clearly outlined to the Council during consultations. Tension is high. The present challenge for the parties is to reduce the tension to the point where they begin to achieve compromise and work productively towards the collective well being of the fishery. It is difficult however to envision a way forward through existing structures and mechanisms. The advisory process has broken down and the parties refuse to work together. Some good reports have been written with recommendations for change. It is time for the parties to work together to build a better fishery.

5.2 Integrated Fishery Management Plans (IFMPs)

In the development, management and regulation of an enterprise as complex as the fishery, it is crucial to have goals. Section 2 of this report outlines four fundamental principles for the herring fishery. The stated principles offer useful overall guidance but operational plans for day-to-day decision making are needed.

Fisheries and Oceans Canada has long recognized the need for guideline plans for fisheries and there are many guideline documents written in the form of an IFMP. These documents are meant to define the objectives for fishery and management approaches along with a framework for decision making. The objectives must be measurable and it should be possible to determine whether progress is being made towards achieving them.

The Council reviewed the existing IFMPs for the east coast herring fisheries and found them wanting. The five IFMPs reviewed are those for the Southern Gulf (4T), the Scotian Shelf and Bay of Fundy (4WX, 4VN and 5Z), for the Northern Gulf and Western Newfoundland (4R, 4S) and for the east and south coasts of Newfoundland. While the IFMP for the Southern Gulf has lapsed, it does still serve as an informal guide to management.

The IFMPs are uneven in detail and varied in their practical utility. They do not follow any fixed format and take very different approaches to the definition of goals. In some plans, the goals are very specific to the fishery, while others are overly general. There are few cases in which there is any indication of how progress towards the goals can be achieved. There is little indication of how progress towards goals will be monitored. Strikingly, there is almost no guidance in these plans as to how decisions should be made. On one central aspect of management decision making, the setting of the TAC, there is little guidance; that is, there are few explicit harvest control rules.

Objectives of the fisheries

The establishment of realistic, measurable goals and objectives is perhaps the most fundamental requirement of any long-term fishery management plan. The existing plans present very different types of objectives, both short and long term, sometimes mixed together. They are not always clearly differentiated nor are they well balanced. Some plans included objectives for conservation and management; some do not distinguish between the two. Most include some mention of economic and social objectives for the fishery but none provides any indication how these goals would be addressed.

Much of the discussion of the conservation and protection of herring stocks is vague although in 4VWX, for example, there is the clear goal to maintain the reproductive capacity of herring in each management unit. Some are mixed, such as the protection of the various spawning components and the development of a self-sustaining inshore and mid-shore fishery capable of competing world-wide. While some goals were clearly stated, for example, to prevent growth overfishing and to maintain ecosystem integrity/ ecological relationships, there was little discussion as to how they would be monitored or the factors that would be considered in moving towards the goals. There was little mention as to how progress towards achieving social and economic goals would be achieved or monitored. As an example, the need to meet treaty rights of aboriginals is mentioned in the 4VWX plan, as was the goal of providing opportunities for aboriginals in Newfoundland, but with no indication of how the

fishery could or would be structured to ensure that such rights are met or opportunities provided.

Two plans mention co-management and the goal of developing an industry that would be self-regulating but with no indication as to how this would happen. The existing plans are broadly consistent with the AFPR but provide little practical guidance for management. They do offer broad endorsement of good management principles committing to ensure conservation and sustainable use of the herring resource to be achieved through adoption of the PA to management and by taking ecosystem considerations into account. But there is little indication of any concrete actions to achieve these goals or analysis to gauge progress in moving forward.

The primary management activity in herring fisheries is the setting of the TAC. The TAC is monitored in most regions by determining the weight of fish landed by species through reporting or monitoring at the dock. In some regions, logbooks are required. Most of the decision rules associated with the fishery such as:

- How much fish to catch?
- When to start?
- What size of fish to catch?
- What areas to fish?

are based upon historical considerations. In many cases, these decisions are simply based upon past practices. The present approach seems to be to adjust the quota from the previous year based upon a qualitative assessment of the fishery. The Southern Gulf has the most explicit set of guidelines, based upon an assessment of $F_{0.1}$ applied through a sequential population model to determine different catch scenarios, but the plan is no longer formally accepted. Population models are only used in the Gulf, where there is enough information, although the FRCC notes that quantitative guidelines for the setting of the TAC can be developed even in the absence of such models.

The allocation of quotas between different gear sectors, such as the seiners and the inshore fleet, is based upon historical agreements with no indications of any guidelines that could be used to adjust these allocations to achieve objectives that are agreed upon. There is little indication of the history behind the present divisions or discussion of the considerations that would go into any changes in the allocation.

Decision making within IFMPs

The frameworks for decision making in the present IFMPs are not effective. Ironically, the clearest guidelines exist in 4T for which there is no formal IFMP. Nonetheless, even in 4T, the recommendations for reduced fishing pressure on the spring spawners are overridden by the need for the bait fishery and the practical difficulty of separating spring and fall spawners in the fall fishery. In other areas, where there is little formal structure to the decision making, there is also relatively little controversy and little pressure on the decision making. These herring fisheries could face serious challenges to conservation if there were greater pressure on the resource, for example, if the price or the demand for herring increased.

The information available is not used in an explicit framework for making decisions. For many objectives, in particular those around economic and social concerns, there is no decision making and no apparent collection or consideration of information. The broader ecosystem objectives that are set in some of the plans are left unaddressed.

What is missing?

The Food and Agriculture Organization (FAO) of the United Nations does offer a Code of Conduct for the management of fisheries. This document provides a range of suggestions in the consideration of the necessary characteristics for effective fisheries management. The key issues that they recommend be addressed include:

- Excess fishing capacity is avoided and exploitation of the stocks remains economically viable
- The economic conditions under which fishing industries operate promote responsible fisheries
- The interests of all harvesters, including those engaged in subsistence, small-scale and artisanal fisheries, are taken into account
- Biodiversity of aquatic habitats and ecosystems is conserved and endangered species are protected
- Depleted stocks are allowed to recover or, where appropriate, are actively restored
- Adverse environmental impacts on the resources from human activities are assessed and, where appropriate, corrected

- Pollution, waste, discard, ghost fishing and catch of non-target species are minimized
- Impacts of environmental factors on target species and the relationship among the species in the ecosystem should be assessed

The existing IFMPs are not functional guides to effective management. They must be more effective and practical. New and clear guidelines should be developed to indicate what should be in the plans and to ensure that they are useful guides in decision making. The Council notes that DFO is well underway in the process of reviewing IFMPs in the context of its *Sustainable Fisheries Framework*.

The FRCC recommends that all *Integrated Fishery Management Plans* for herring be renewed. Revised plans should outline a decision-making process that is participatory, transparent and accountable. The goals and objectives must be clear and measurable.

5.3 Improved decision making through an ecosystem approach

The FRCC's report, *Sustainability Framework for Atlantic Lobster 2007*, included a discussion of ecosystem based management. The approach presented was to consider fish in the broader context of the marine ecosystem and the effects of human activity on the ecosystem. The three goals of the framework presented there were to maintain productivity, preserve biodiversity and protect habitat. Here the Council explores another important aspect of an ecosystem approach, the need for improved decision making. One of the challenges in modern fisheries is how to make decisions given the many different factors that need to be considered, from the complexity of the ecosystem to the social and economic influences on fishing.

Need for improved decision making in fisheries management

It is often said that conventional fisheries management has failed since it has led to the severe overexploitation or the collapse of so many fisheries. As a result, several new approaches, including Objectives Based Fisheries Management (OBFM), the Precautionary Approach (PA), Integrated Ocean Management (IOM) and many others, have been proposed in recent years to overcome the perceived failure of conventional fisheries management.

Fisheries management has struggled for many reasons, among them the lack of consideration of the diverse factors that influence the single fish that is most commonly considered in management plans. So the things that are often left out are the economic and social factors that influence fishing or the interactions with the rest of the marine ecosystem by the fish being targeted. The Ecosystem Approach to Fisheries (EAF) presented here is broad and its greatest strength is its ability to balance many different concerns in a framework that guides decision making. Improved decision making is the key to improving management. Ecosystem considerations can be included in this approach, but so too can economic and social issues. The EAF is quite flexible in its ability to incorporate different types of considerations.

The FRCC believes that harvesters are well aware of the need to broaden the perspective on fisheries management. There is now quite general awareness of the complexity of factors that influence a single species of fish in the ocean including human activity and other parts of the ocean ecosystem. Human factors include aquaculture, tourism, transportation, dredging, and oil and gas exploration. During its consultations, the FRCC heard that without broader considerations of multi-species and ecosystem interactions, single species management will be unsuccessful.

The implementation of the EAF proposed below aims at making progress under the four components of sustainability (ecological, economic, social and institutional) by improving the decision-making process in a risk management framework. The approach is consistent with recent initiatives under Canada's *Oceans Act*, ecolabeling and the PA.

What is an ecosystem approach to fisheries?

The phrase 'ecosystem approach to fisheries' can have many different meanings.

The FAO proposes a pragmatic view based on assessing the risk of not meeting agreed biological, social, economic and institutional management objectives using existing knowledge (www.fao.org/fishery/topic/2880/en). Likewise, the FRCC considers that EAF is not about understanding in detail the functioning of the ecosystem. The EAF does not necessarily require the acquisition of additional knowledge about the structure and functioning of the ecosystem. The FRCC sees the EAF as improving decision making in an ecosystem context recognizing that decisions have to be

made with the information available. Decision making in the fishery cannot wait for a complete understanding of all the processes.

The approach is essentially a risk assessment and risk management process. It recognizes that the ecosystem influences fishery resources, that fishing influences the ecosystem and that the ecosystem and fishing are influenced by other human activities. Thus in an EAF, human activities other than fishing that have an impact on the ecosystem, and therefore on fishery resources, need to be taken into account and mechanisms must exist or be created to make decisions on competing uses of the marine environment.

Five steps of the ecosystem approach to fisheries decision making

The EAF can be applied at various scales, from single fisheries in small geographical areas to all the fisheries in large marine ecosystems. The overarching objective of the EAF is to achieve improvements on the components of sustainability (ecological, social, economic, and institutional) and the FRCC believes that the EAF is likely to deliver improved performance for Canada's east coast fisheries. The EAF is above all a process and can be applied to the following groups of considerations:

- Retained species
- Non-retained species
- Ecosystem impacts and general environment
- Community well-being
- Institutions and governance and
- External drivers

The five main steps involved in applying an EAF involve:

(1) **Determining the scope** – What is it that is being managed – fisheries, or a spawning area, or a stock complex (e.g. 4T spring spawners), or the entire herring fishery for eastern Canada?

(2) **The second step is the identification**, through a structured process, of all existing issues related to the six groups of considerations outlined above. For each consideration, such as biomass of the stock, measurable objectives are defined. It is important that all relevant interested parties be involved in this step. Issues are identified based on the results of specific scientific studies, or through the existing body of knowledge of scientists, harvesters or the general public.

(3) **The third step is an evaluation of the issues** that need to be managed through an examination of the risk each issue poses to the achievement of the objectives as agreed to in Step 2. Risk is the product of the impact of an issue with the probability that it will occur. If the probability is remote and the impact is minor then the risk is negligible. However, if the probability is unlikely and the impact is extreme then the risk would be medium (Table 2).

(4) **The fourth step is the development of a management response** to the medium and high risk issues identified in Step 3. This management response includes for each issue a description of what is considered acceptable performance, the management arrangements that will be used to achieve acceptable performance, and the review processes needed to assess performance.

(5) **The fifth step is the development of an operational plan** based on the management response developed in Step 4. The operational plan should specifically identify the activities and resources needed to achieve the

		Impact			
Probability		Minor	Moderate	Major	Extreme
	Remote	Negligible	Negligible	Low	Low
	Unlikely	Negligible	Low	Medium	Medium
	Possible	Low	Medium	High	High
	Likely	Low	Medium	High	High

Table 2: Risk is determined by the relationship between the probability of an event and its impact.

performance standards agreed in Step 4. The operational plan also includes monitoring, control and surveillance as well as an evaluation of the effectiveness of the plan against performance measures, periodic review and adjustment of the plan.

These steps are not particular to the EAF; they are very similar to those that would be followed in any risk based project management process (Figure 5).

How does EAF relate to other management approaches?

The Precautionary Approach (PA) has been recommended in fisheries management since the mid 1990s and endorsed by Canada (see Box 1). The PA recognizes that decisions have to be made without complete knowledge and that the lack of scientific certainty should not be used to delay management action; on the contrary, greater uncertainties should imply greater precaution. The PA encourages the adoption of a decision-making framework using reference points where pre-agreed management measures would be triggered, for example, decrease fishing mortality when biomass drops below a pre-agreed value. Limit reference points are created below which fishing should be substantially curtailed because there are serious threats to the productive capacity of the resource; precautionary (or buffer) reference points are created at which management measures are taken in order to avoid reaching the limit reference points, and there may also be target reference points.

The EAF proposed above is fully compatible and complementary with the PA : reference points identified under the conventional interpretation of the PA could be used as some of the measurable objectives for the ecological components of sustainability. Quantifiable objectives would need to be identified and agreed for the other components of sustainability. The EAF

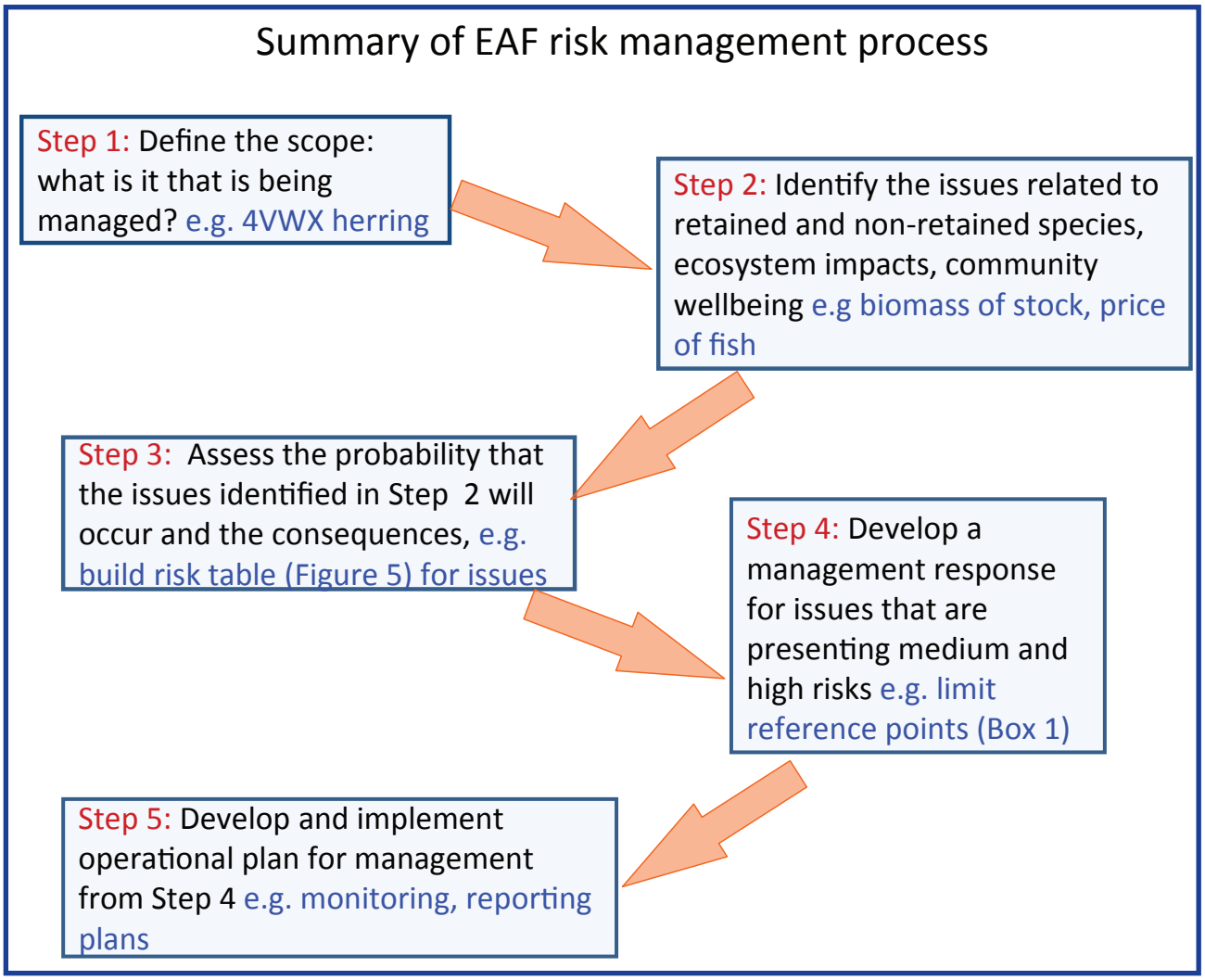


Figure 5: Diagrammatic summary of the EAF risk management process.

is therefore a natural extension of the concept of the PA of identifying reference points from target species to ecosystems in order to avoid major ecosystem changes and maintain ecosystem structure, processes and functions. The EAF described here is also fully compatible with market certification and other ecolabeling schemes that are being applied in more and more fisheries. These schemes set standards related to stock status, the impact of the activity on the ecosystem, and the effectiveness of the management system.

The EAF and Atlantic herring

The EAF described here is a structured approach to identify the risk that particular issues pose to the achievement of management objectives. Implementing an EAF would improve management because it would require the identification and adoption of measurable operational objectives. Identifying and agreeing to such objectives could be difficult but is necessary.

Fisheries management should benefit from an ecosystem approach to decision making. Fishing depends on healthy marine ecosystems and an EAF will address the impact of human activities on marine ecosystems and the fish in the ecosystem. The impacts need to be managed in order to protect fisheries and marine ecosystems. In implementing the EAF as suggested above, it is not necessary that all parties be involved in all steps, but it is necessary that all relevant interested parties be involved in the relevant steps. Properly implemented, an EAF could achieve the recovery and maintenance of healthy marine ecosystems.

While fisheries management must obviously contribute to an ecosystem approach to fisheries, it cannot do it alone because the process must integrate all human activities that have an impact on the ecosystem. Given the importance of fisheries to communities of eastern Canada, DFO should take the lead in implementing an EAF and undertake the overall integrated risk assessment and risk management of human interactions with the marine environment for eastern Canada.

The FRCC recommends the implementation of an Ecosystem Approach to Fisheries (EAF) for decision making to improve fisheries management in Canada. The Council recommends that this approach be initiated in an area such as 4VWX where the existing stewardship arrangements are strong and the quality of the data available is relatively good.

5.4 The relation between IFMPs and the EAF

Integrated fishery management planning includes both a process and a document. As a process it allows for the input of resource users and other stakeholders in sustainability issues related to the resource. The document created at the end of the process serves as a summary of the characteristics required for considerations of the resource status and ecosystem state, the fisheries, the management objectives and the necessary management and conservation measures that guide decision making used to achieve the objectives.

The EAF described in this report, offers an approach to determining the key characteristics of the fishery but also offers a mechanism for guiding decision making. The five step process presented here could be used in the process of developing an IFMP for the identification of the key issues in the fishery. The risk decision making discussed under the EAF offers a necessary tool for management in fisheries and offers a framework that can be incorporated into the IFMP for the fishery.

The IFMP and EAF processes outlined in this report are complementary. The EAF approach to decision making, presented here, could be incorporated into an IFMP. It is also possible that some other risk-based decision making approach could be used.

Many of the issues discussed in this section are also addressed in the new *Sustainable Fisheries Framework* recently announced by DFO.

The development of the IFMP will involve the participation of resource users, First Nations and other aboriginal groups, scientists, government representatives, and other stakeholders. In particular, the development of objectives for the fisheries will require stakeholders to carefully consider what type of fishery they want. All parties should contribute to the development of the IFMP. A team approach should lead to greater effectiveness and acceptance of the plan.

6. Preparing for the Future

World-wide demand for fish products is increasing. The Food and Agriculture Organization of the United Nations (FAO) projects growing needs for fish products over the next three decades to supply projected global population increases. In addition, the health benefits of eating fish high in omega-3 fatty acids such as herring and mackerel are now well recognized. Such trends provide opportunities for herring harvesters and the herring industry of eastern Canada.

Many are not able to take advantage of these opportunities because of the inconsistent supply of quality products while others are well-positioned to respond to a demand for a higher end product. For example, the herring weir industry in the Bay of Fundy generates a value-added canned product and serves as a prime example of "best use" of the resource, providing consistent quality and strong economic return. Similar examples exist in the fillet and smoked product trade.

On the other hand, while the market for flavoured roe seems to show promise, the demand for traditional east coast herring roe is decreasing and is perhaps oversupplied by as much as twice the demand, as younger Japanese turn away from traditional roe and towards western diets.

The present overall market trends will likely be long-term. The world-wide demand for protein will increase and there is therefore a need for the Canadian industry and governments to focus on a strategy that will enable its fishery to respond to market trends and increase benefits for participants while maintaining a focus on the conservation of the resource.

A good start to the development of such a strategy is to focus on high quality products, market demand and industry structure.

6.1 Quality Issues

High quality fish products are critical to the economic and social sustainability of fisheries. Sophisticated modern-day consumers have the luxury of choosing from a variety of fish products from many sources. A quick-frozen fish fillet from half a world away competes with freshly landed local fish. The days of selling low quality fish in the marketplace are disappearing. Success is tied to producing high quality products.

Several recent reports have commented on the quality of herring in the eastern Canadian fishery:

> *"....we do not fish for quality, we fish for quantity." (Pierre-Marcel Desjardins, "Long Term Vision for the Herring and Mackerel Fisheries in the Southern Gulf of Saint Lawrence: Socio-economic aspects of the herring and mackerel fisheries". July, 2005*
>
> *" The roe and flesh markets for herring caught by inshore fishers may be severely affected in the short term if herring quality issues persist." (MacKinnon Consulting & Market Development Ltd. 2005. Proceedings from the Southern Gulf Herring Workshop: The Future of Herring as a Food Fishery, Caribou, NS, February 10th, 2005.)*

While the above studies refer to the herring fishery in the Southern Gulf of St. Lawrence, the Council received similar feedback during its consultations throughout eastern Canada. The quality problems are well known – long soak times, improper temperature control, bruised fish, poor transportation methods, unsatisfactory processing controls, etc. Such quality problems are not restricted to any particular gear type.

There is consensus on the quality issues of eastern Canadian herring:

- A need to improve and promote high quality products
- Herring landed by seiners using Refrigerated Sea Water (RSW) is generally of good quality
- Quality of herring landed by gillnets generally requires significant improvement

There is no magic to improving quality although achieving it may be difficult. It simply requires that the fish be harvested in a proper manner and then be treated properly through the processing and transport from vessel to market. This begins with proper fishing methods and temperature control as soon as the fish is removed from the water. An RSW system or the proper mixture of fish and ice will substantially improve quality of the final product. Quality cannot be recovered. If one player in the chain between vessel and market fails to pay proper attention to quality, there is nothing that any subsequent player can do to save the end product.

Effecting change is difficult, especially when there is little incentive to land a top-quality product. Harvesters pay attention to the bottom line. Why would they increase expenses and employ time-consuming handling practices when the price at dockside is the same? On the other side of the wharf, some buyers feel they have to purchase herring of any quality to protect their lobster supply from those same harvesters. This situation is unfortunate as there is a market for high quality herring at a good price but efforts must be made to improve quality to service those markets.

While the issues surrounding quality are shared with the provincial jurisdiction, only a few provinces are paying much attention to fish quality. Provincial jurisdiction starts at the dock and the provinces need to assume their responsibility. The government of Newfoundland and Labrador has implemented quality and other requirements from the landing point through transportation and pre-production including a requirement to keep fish below 4ºC (which mirrors the requirements of *Schedule III of the federal Fish Inspection Regulations*). The province has followed that up recently with a ticketing mechanism for offences. Offenders will be required to pay fines from $100 to $500, depending on the nature of the violation. The system applies to all harvesters, processors, graders and any individual or company handling seafood products. There is a need for the other provinces to review their roles in the improvement of fish quality.

Improving quality, in the final analysis, is up to harvesters, processors and transporters, but must start on the boat. Measures must be implemented to offer the market a quality product. Only then will it be possible to extract higher value from the fishery. The commitment of all parties will lead to common rewards. At present the herring fishery yields poor economic return. The current small portion of inshore harvesters' revenue that comes from herring, coupled with the variety of the economic objectives being pursued (reduce bait costs, extend overhead coverage, generate EI coverage, etc.) impede advances in improving the quality of herring. This may not be the best strategy to extract the greatest benefit from the herring fishery. More effort is required to take advantage of market opportunities presented by the world demand for high quality fish products.

The FRCC recommends that provincial regulations be established for the chilling of fish and that they be enforced through a dockside inspection program.

6.2 Resource use

The social and economic components of sustainability focus on the creation of sustainable benefits, their reasonable distribution, and the maintenance of sustainable enterprises within local and global economies. The licence holders are not the only stakeholders in this context. Processing, transport and marketing sectors along with fishing communities and others also have a stake in the sustainability of the system. In addition, the role of herring as a forage species and the potential impact of the fishery on other fisheries must be considered. A long-term focus on obtaining the best value for fisheries resources will provide jobs, economic opportunities and food. Achieving these goals will increase the viability and stability of communities.

The eastern Canadian herring industry has traditionally provided a wide range of secondary products (Table 3). Given current trends, it is likely that the variety and availability of products will continue to decline under present strategies. Poor markets, decreasing viability of fleets and processing plants, increasing need for bait and the shortage of supply of good quality herring to plants are formidable challenges.

In April of 2007 DFO announced its "Ocean to Plate Approach to Commercial Fisheries and Aquaculture", whereby;

> *"all stakeholders, including government agencies and those involved in all levels of the seafood value chain, are working towards a common goal of a sustainable, economically viable, and internationally competitive industry."*

Product Type	Primary Destination
Smoked	Caribbean
Livers/Roe	Japan/China
Pickled/Cured	United States
Canned	United States
Frozen Fillets	Europe
Salted/Dried	United States
Fish Oil	United States/Europe
Whole Dressed	USA/Europe/Korea

Table 3: Different market products and destinations for herring from eastern Canada.

This challenging vision for the Canadian fishery industry will require the commitment of all participants if greater value is to be extracted from the fishery. In practical terms, the ocean to plate approach actually begins at the end – the plate. It is the market that determines the value of the fish, not the harvester.

Consumers are important to the fishery. Once the goals of the fishery are changed then the players in the fishery can focus on how to get the highest quality product into the preferred product form in the most cost-effective manner. To increase the value of the fishery, an assessment of how and when fishing is conducted, what gear type is used and how the product is processed and transported needs to take place. An industry structured to service a high quality international food market would look significantly different from one structured to service a bait market and lower quality products.

The industry needs to look critically at its present approach to the fishery. A frank and critical analysis would reveal the limitations of the present fishery. In addition to quality, the east coast fisheries will face strong international competition as stocks recover elsewhere and quality remains a priority in the marketplace. Certification is also becoming a factor in product acceptance. Investors will not risk the development of costly means to market product without assurance that the industry will be able to count on a sustainable resource and sustainable economic benefits.

The industry needs an analysis to review the critical limiting factors. Once done such an analysis would lead to decisions as to what type of fishery should be employed. Government and industry require a clear idea of where to take the fishery and a strategy for getting there. They should ask questions such as – What is the right product mix? What is the best mechanism that captures trends in existing markets? How can new markets be developed? What are the best fishing, handling and holding technologies? How should the greatest value be extracted from the fishery? The greatest value is not necessarily restricted to total revenue but must consider such things as the impact on other fisheries, communities, bait and forage requirements.

6.3 Fishing capacity

There are more than 11,000 inshore commercial licences in the Eastern Canadian herring fishery (Figure 6). Of these, only 13% were active in 2007 (considered to be typical year). More than 9,500 commercial participants in the herring fishery were inactive. It is not known how many of the almost 8,000 bait licences were active. While some latent capacity in a fishery is healthy and necessary to introduce effort when required, such an enormous number of inactive participants can wreak havoc on a fishery under certain circumstances. The latent capacity in the herring fishery poses a significant risk to the viability of the fishery.

If quotas are properly set and harvesters do not exceed them then effort is not a concern. However the economic pressures to earn money and the pressure to catch more fish can be immense. The Council supports the concept that harvesters have a portfolio of licences to increase their resilience against the unavoidable ups and downs of the fishery but also recognizes the danger of rapid increases in effort. Abrupt changes in price can occur as witnessed recently in the lobster fishery. While the current market situation for herring may not be robust, the price of herring could increase substantially over a short period of time, especially if a collapse of other herring stocks took place, as has happened in the past. Such an occurrence would drive increased effort including activation of unused licences. Although this may increase revenues in the short term, it could have a negative impact on the long-term viability of all participants.

The potential for big jumps in participation also discourages development and investment. Active players are reluctant to invest for fear that their return would be jeopardized by an influx of new participants. Similarly, active harvesters have little incentive to apply long-term measures to improve the fishery if they feel that their sacrifices would result in benefits going largely to recent entrants.

Given improving efficiencies and technological advances, matching fishing capacity to the available resource is an ongoing challenge for the harvesting sector. The numbers in the herring fishery clearly show that fishing capacity is not aligned with the state of the resource. Before limited entry, when income dropped or more attractive job opportunities presented themselves, people would leave the fishery. Today, with licences having a value, because they are limited, people will not walk away from their investment without adequate compensation. The current climate of high

and increasing fishing costs and constant or decreasing landings coupled with the economic downturn is putting downward pressure on fishing income. Many, if not most, harvesters conclude that there are too many fishing enterprises to provide an adequate income for all.

Major mechanisms that have been used to address this problem include buybacks, some sort of licence combining and the introduction of individual transferable quotas (ITQs). The positives of buybacks are that they are voluntary, quick, target those who wish to leave and compensate them acceptably. The benefits of ITQs are that they work in reducing capacity and with ownership of quota provide more flexibility to plan the harvest and to shift from increasing catch to maximizing the value of the catch. The drawbacks are that it can be difficult to divide up quotas in the first place and the licences never really disappear.

Governments have been reluctant to participate in licence buybacks because the approach does not foster responsible stewardship or planning. Industry does not feel, however, that they have enough money to finance a buyback and besides there is no adequate mechanism to spread the costs over all participants. The owner-operated fishery has always rejected ITQs because of the win/lose aspect of quota division. Any increase in the price of herring will bring in more participants resulting in little or no financial gain per enterprise. As well, increasing participants will tax the ability of the current processing capacity to properly handle product to receive highest prices. The harvesting sector must come to grips with this capacity problem if it hopes to prosper. The FRCC recognizes and supports the multipurpose aspect of the inshore fleet but the Council does not support harvesters working with no hope of an adequate income.

The FRCC recommends that DFO and the industry evaluate the risks that latent capacity pose to the sustainability of the herring fisheries. Effective measures should be included in *Integrated Fishery Management Plans* to mitigate those risks.

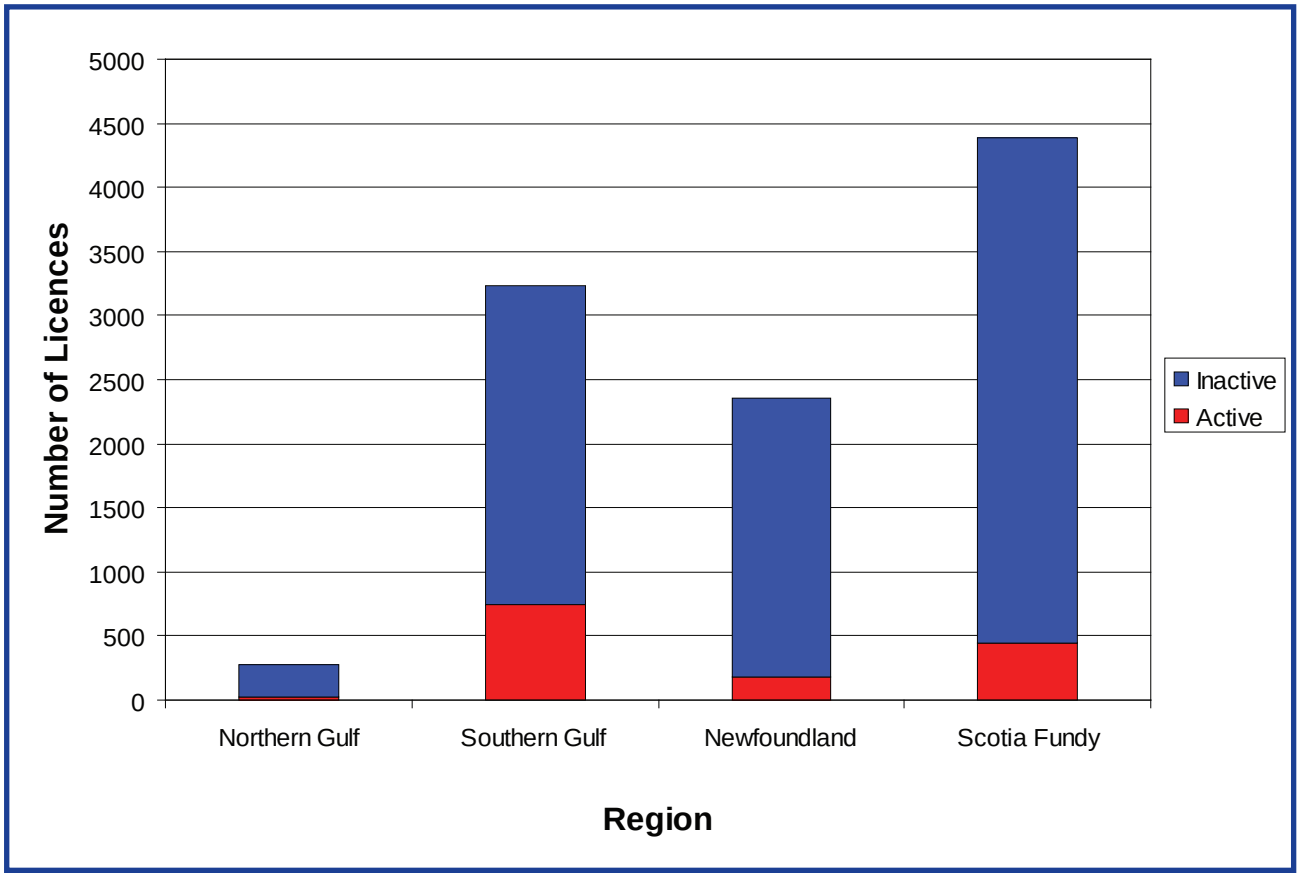


Figure 6: The number of active and inactive herring licences in eastern Canada in 2007.

7. Looking forward

This report is designed to provide guidance for an improved herring fishery, one that is more sustainable and provides greater benefits to harvesters, processors and the communities of eastern Canada. The herring fishery of eastern Canada could be much more than it presently is. Most stocks are below their historical averages and the economic return is generally poor. Change leading to a better fishery is possible.

The FRCC sees three fundamental impediments to an improved fishery:

1. There is inadequate information about the status of the resource and herring itself in the ocean ecosystem.
2. The framework for decision making is neither clear nor effective.
3. The economic return from the fish caught is generally poor.

This report recommends a change of direction. The recommendations made in this report will not be easy to implement. They will require the cooperation and participation of all stakeholders – harvesters, processors, the federal and provincial governments and others who play a role or have an interest in these fisheries. No single group can resolve all the problems. Change will only come about through stakeholders working together.

This report promotes a vision of the benefit that can come from change. The recommendations provided should lead to a better fishery, one that offers stronger conservation and greater economic return to the participants.

Photograph 5: Herring gillnet fishery. Photograph courtesy K. Leclair of Tignish, P.E.I.

APPENDIX I: DATA COLLECTED IN THE HERRING FISHERIES

Data and models considered during assessments of herring stocks in eastern Canada. Red text indicates time-series that have been discontinued (at least temporarily) or are considered to be unrepresentative of stock size. For most stocks, there is also consideration of information such as size/age composition, growth rate, size and age at maturation, and occupancy of spawning grounds.

Stock name	Within NAFO region	Indices of abundance/biomass			Population model	Notes
		From fishery	Fishery independent			
			By DFO	By industry		
Newfoundland east and southeast coasts						
White Bay - Notre Dame Bay	3K	GN CPUE (1996-present)	acoustic survey (1983-2000)	research GN program (1988-present); gillnet and purse seine harvester opinion surveys (1996-present)	1971-2000	overall performance index (1998-present) (traffic light approach)
Bonavista Bay - Trinity Bay	3L	GN CPUE (1996-present)	acoustic survey (1984-1999)	research GN program (1988-present); gillnet and purse seine harvester opinion surveys (1996-present)	1971-2000	overall performance index (1998-present) (traffic light approach)
Conception Bay - Southern Shore	3L					not assessed (insufficient information)
St. Mary's Bay - Placentia Bay	3LPs	GN CPUE (1996-present)	acoustic survey (1984-2000)	research GN program (1982-present);gillnet and purse seine harvester opinion surveys (1996-present)	1970-1999	overall performance index (1998-present) (traffic light approach)
Fortune Bay	3Ps	GN CPUE (1996-present)	acoustic survey (1986-2001)	research GN program (1982-present); purse seine harvester opinion survey (1996-present)		overall performance index (1998-present) (traffic light approach)
Newfoundland west coast						
Spring spawners	4R	GN CPUE (1985-2004)	autumn acoustic survey (6 times during1991-2002);bottom trawl "probability of catching herring" (1990-present)		1965-2004	no indices or biological indicators in recent years. TAC being "rolled over" from one year to next
Fall spawners	4R	GN CPUE (1985-1993)	autumn acoustic survey (6 times during1991-2002); bottom trawl "probability of catching herring" (1990-present)		1973-2003	no indices or biological indicators in recent years. TAC being "rolled over" from one year to next
Québec north shore						
	4S		bottom trawl "probability of catching herring" (1990-present)			very little information.; small preventative TAC.
Southern Gulf of St. Lawrence						
Spring spawners	4TVn	GN CPUE (1990-present)	autumn acoustic survey (1994-present)	gillnet harvester opinion survey (1987-present)	1978-present	
Fall spawners	4TVn	GN CPUE (1978-present)	autumn acoustic survey (1994-present)	gillnet harvester opinion survey (1987-present)	1978-present	
4VWX complex						
Bras D'or	4Vn			acoustic surveys (1999-2000)		closed to commercial fishing
Coastal Nova Scotia	4VnWX			acoustic surveys in areas of major gillnet roe fisheries (1998 to present)		
Offshore Scotian Shelf Banks	4VsWX		summer bottom-trawl mean number per tow (1983-present)	no industry surveys since 2001		
SW Nova Scotia/Bay of Fundy	4X	purse seine CPUE		acoustic surveys in main spawning areas (1999 to present)	1965-2005	

APPENDIX II : ABUNDANCE OF HERRING IN EASTERN CANADA

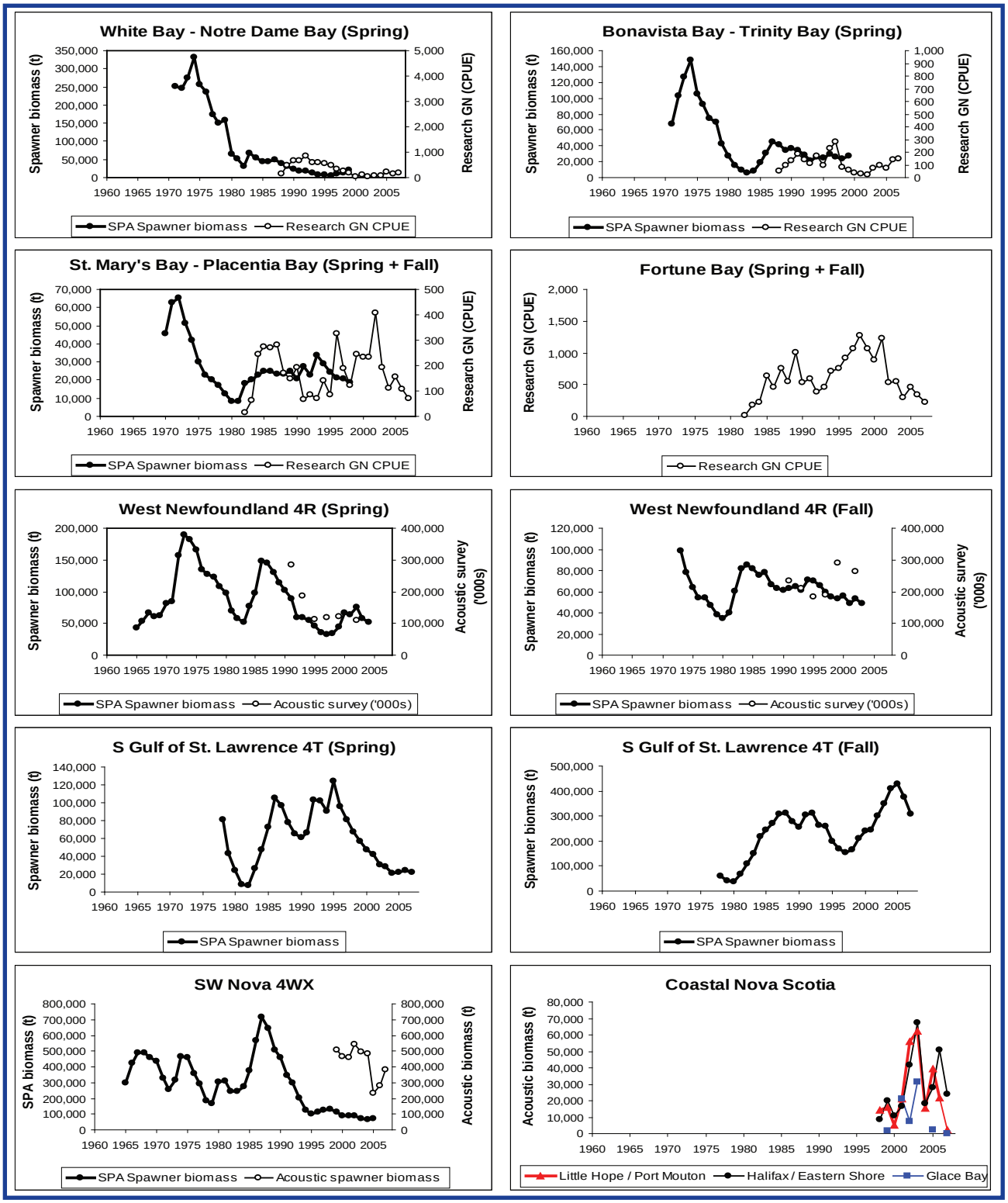


Figure A-1: Herring abundance in different regions of eastern Canada.

Appendix III: Glossary

Assessment, stock assessment: The process of determining what the status of a stock is in relation to exploitation.

Benthic: Bottom-living; adult lobsters are examples of benthic organisms.

Distribution, spatial: Patterns in space, e.g. numbers of herring over and around a bank.

Distribution, temporal: Patterns in time, e.g. changes in the numbers of herring with time.

Effective effort: A measure of the effect of the effort that is applied, that is directly related to fishing mortality.

Effort, fishing effort: The amount of fishing used to obtain the catch; can be expressed in numbers of nets, hours etc. (See also effective effort.)

Exploitation rate: The percentage of herring vulnerable to the fishery which are harvested in a given year. Exploitation rate is another way of expressing fishing mortality.

Forage species: these species provide a significant source of food for other dependent predators particularly fish, marine mammals and birds. Examples of forage species are herring, capelin and shrimp.

IQ/ITQs: Individual quota / Individual transferable quotas. Annual quotas assigned to fishing enterprises that set a limit on how much of the resource the enterprise is permitted to catch. Transferable refers to quotas that can be readily transferred from one enterprise to another.

Limited entry: A management tool whereby the number of licensed vessels or harvesters in the fishery is restricted or capped.

Limit reference point (LRP): The point of the spawner biomass below which the recruitment tends to be consistently poor.

Model: A simplified description of phenomena allowing a practical analysis. Mathematical models involve a set of relationships to quantify those phenomena; they are commonly used in assessments of the status of fish stocks.

Overfishing: The situation when a stock is being exploited beyond its long-term productive capacity; put simply, when the capital is being reduced rather than when the interest is being cropped. Two kinds of overfishing are often considered: growth overfishing, when animals are caught at a size where more growth would provide better production (fishing at too young an age results in yield waste); and, recruitment overfishing, when fishing reduces the stock to a level where subsequent recruitment is lowered.

Pelagic: Any part of the water column from the surface down to just above the bottom.

Recruitment: The process of becoming vulnerable to the fishery. For herring, the fish grow in size and also move into areas where fishing takes place.

RSW: Refrigerated Sea Water. System for rapid chill-down and storage of catch.

Stakeholders: All those who have an interest (a stake) in a fishery.

Trophic level: The position that an organism occupies in a food chain, determined by what eats it and what it eats.

Upper stock reference point (USR): the point of spawner biomass above which the stock is said to be in the healthy zone.

Appendix IV: Briefs received

Nova Scotia:

Malcom Read (Read Enterprises Ltd.) – 2008-010-00025

The Yarmouth Herring Management Committee – 2008-010-00027

Francis Boyd – 2008-010-00029

Guysborough County Inshore Fishermen's Assoc. – 2008-010-00030

Norma Richardson (Eastern Shore Fisherman's Protective Assoc.) – 2008-010-00031

Norma Richardson (Eastern Shore Fisherman's Protective Assoc.) – 2008-010-00032

Jay Lugar (Herring Science Council) – 2008-010-00033

Stanley Stanton – 2008-010-00034

Ron Nash – 2008-010-00035

New Brunswick:

Tony Hooper – 2008-010-00017

Christian Brun (Maritime Fishermen's Union) – 2008-010-00023

Prince Edward Island:

Robert Jenkins (Southern Kings and Queens Fishermen's Assoc.) – 2008-010-00018

Brodie Creed (Southern Kings and Queens Fishermen's Assoc.) – 2008-010-00019

Ed Frenette (Prince Edward Island Fishermen's Assoc.) – 2008-010-00021

Sara Roach-Lewis (Women for Environmental Sustainability) – 2008-010-00022

Fisheries and Aquaculture – 2008-010-00026

Québec:

Regroupement des Pêcheurs Professionnels du Sud de la Gaspésie – 2008-010-00024

Newfoundland:

Barry Group – 2008-010-00056

APPENDIX V: FRCC MEMBERSHIP, AT TIME OF PUBLICATION

COUNCIL

Jean Guy d'Entremont, Chairman
Gerard Chidley, Vice Chairman
John Angel
Walter Bruce
Omer Chouinard
Shelley Denny
Brad de Young
George Lilly
Jean-Jacques Maguire
Gregory Thompson
Donald Walker

DFO EX-OFFICIOS

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Georgine Pastershank
Barry Rashotte
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Marc Vachon

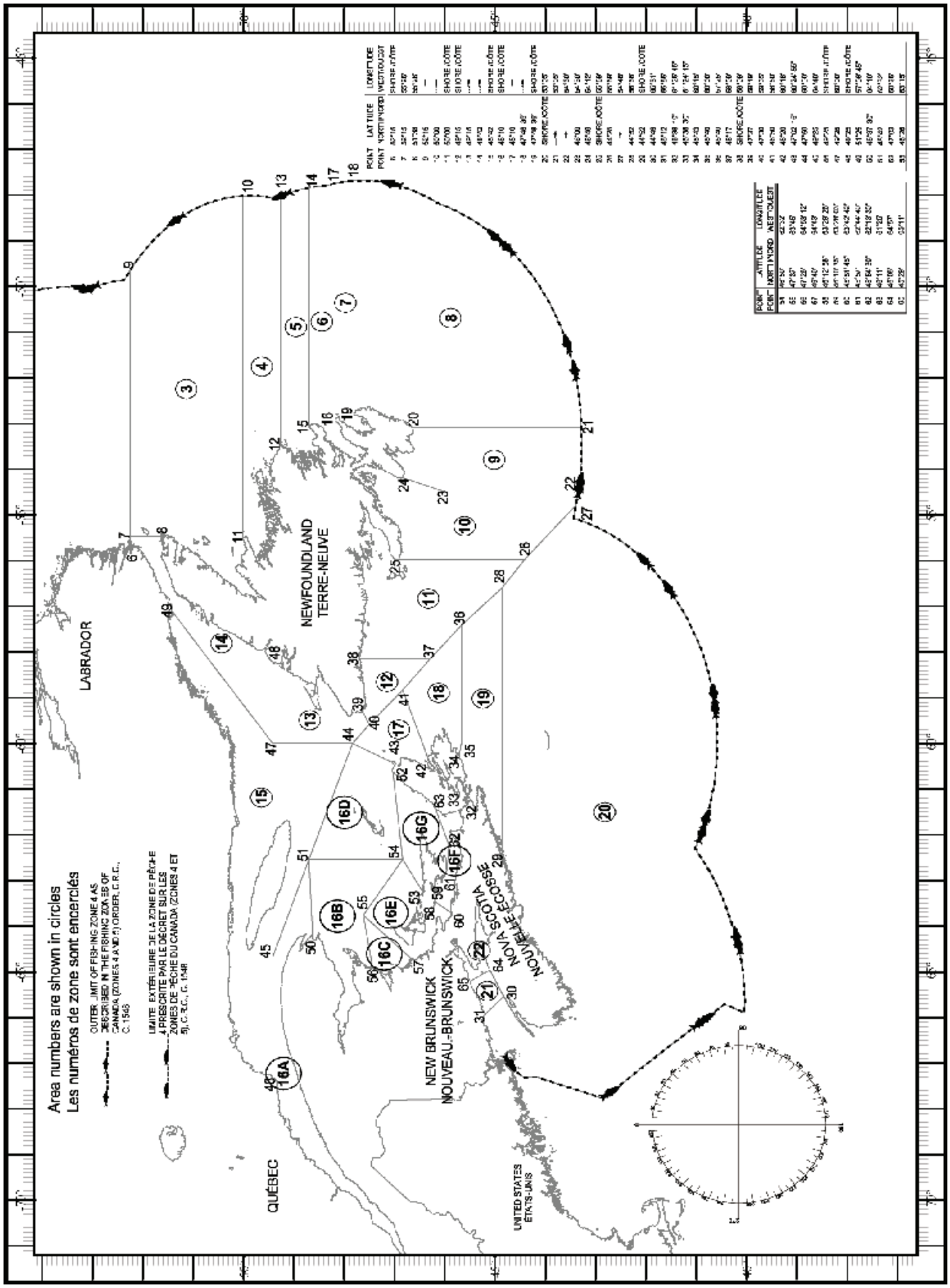
PROVINCIAL DELEGATES

Tom Dooley
Joseph LaBelle
David MacEwen
François Montminy-Munyan
Clary Reardon

FRCC SECRETARIAT

Arthur Willett, Executive Director
Helena Da Costa
Tracey Telik

Herring Fishing Areas



Canada