Fishing Vessel Replacement Regulations in the Newfoundland Fishery: Implications for the Future

by

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ABSTRACT

Since the collapse of the Northern Cod stock and the moratorium on July 2nd, 1992, considerable changes have taken place which have substantially altered the face of the traditional Newfoundland fishing industry. A diversification into other species, particularly shellfish, has resulted in lucrative returns to the fishing industry.

This study poses two questions. First, are the administrative regulations of the past governing the maximum vessel length, appropriate in today's fishery? Second, while the economic return in recent times have exceeded that of the pre-moratorium fishery, can the Newfoundland fishing industry, with its existing fleet structure, be said to have reached its maximum economic potential?

This study argues that the conditions under which the maximum length regulations were established, no longer prevail. On the basis of the literature reviewed and the evidence presented in this study, the regulations appear outdated and may well prevent the rationalization of the structure of the fishing fleet necessary for the fishery to reach its economic potential.

On the issue of safety there appears to be a trend in the number of accidents and the movement further offshore to harvest new locations. There also appears to be a persistent trend in the lower value of return for the same products from Newfoundland when compared to the other Eastern Canadian Provinces.

The fishing industry has been the primary activity that provided the original basis for the economic development of Newfoundland. Since confederation it has been argued that the longliners acquired by Newfoundland fishermen are too small. As the next century approaches, a new vessel replacement policy, which recognizes a vessel design that allows inshore fishermen to harvest resources out to and beyond the 200 mile Exclusive Economic Zone, should be considered. The main conclusion is that with clearly defined management principles in place and an evolving movement towards output controls, the maximum length restriction as an input control belongs in the past.

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Section 1.0: Introduction

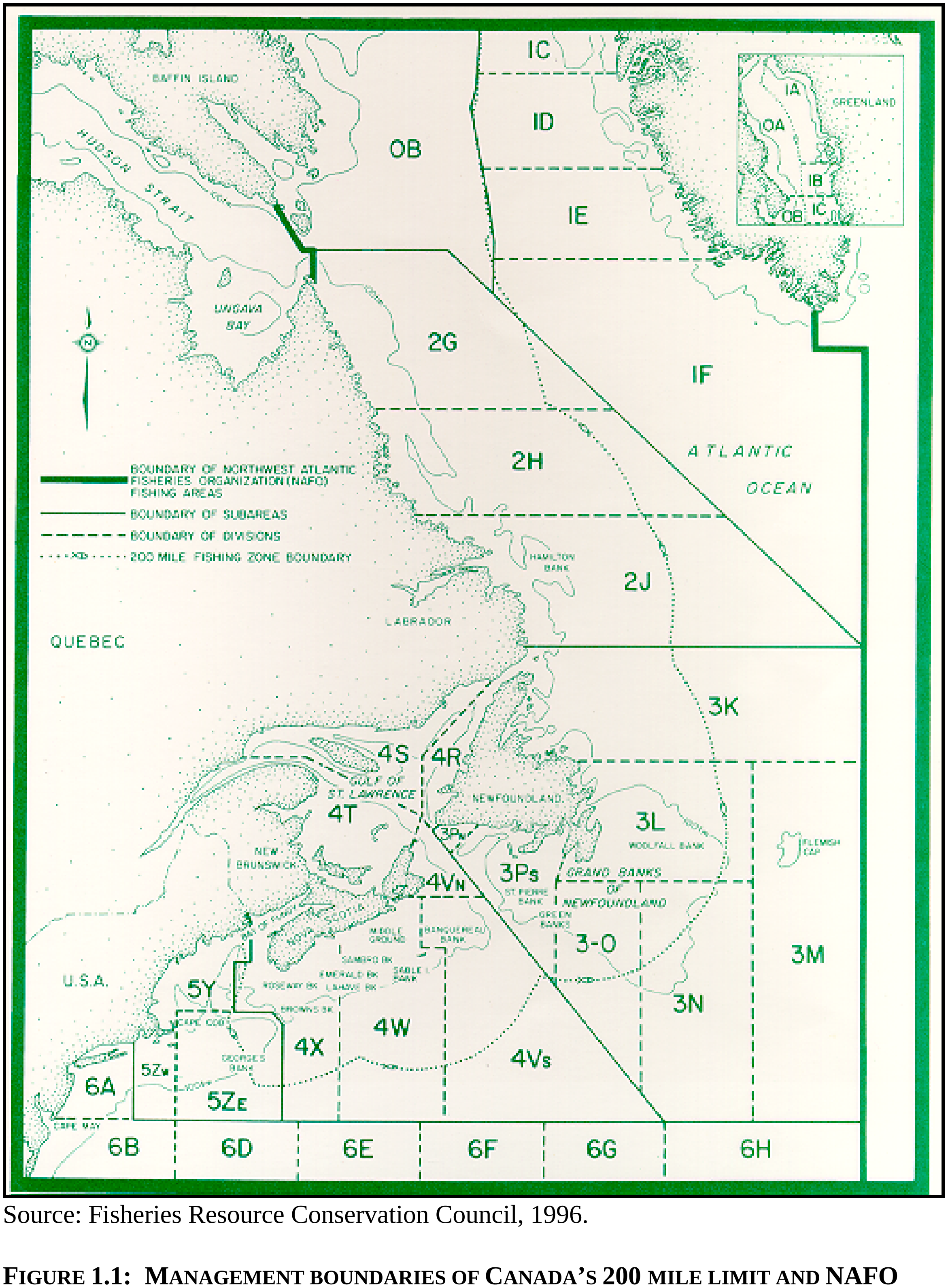
Considerable changes have taken place in the fishing industry of Newfoundland and Labrador since the initial moratorium on Northern Cod *(Gadus morhua)* was imposed on July 2nd, 1992. These changes have substantially altered the face of the industry from its initial dependence on this species of groundfish. Through necessity and ingenuity the fishery is now being restructured and diversified towards previously underutilized species and new resource opportunities. Increased demand for seafood products in lucrative Asian, European, and North American markets opens interesting if challenging opportunities for improved viability in the Newfoundland and Labrador fishery.

The diversification of the fishing industry has largely been driven by the dramatic growth of the shellfish fisheries. Since cod is a major predator of both snow crab *(Chinoecetes opilio)* and northern shrimp *(Pandalus borealis)*, it is perhaps not surprising that a significant increase in the abundance of these species has been observed since the collapse of the groundfish stocks.

In addition to snow crab and northern shrimp, there has also been an increasing interest in pursuing Greenland halibut or turbot *(Reinharditus hippoglossoides),* and Icelandic scallops *(Chlamys islandica)* on the Grand Banks off Newfoundland. These are notable examples of fisheries that have evolved since the cod moratorium. As well, new markets for seal products that utilize the whole animal, not just the pelts, have generated renewed interest in the seal fishery. This transition from historic reliance on a single groundfish species to an aggressive development of underutilized species places new demands on both fishing effort and the capital stock in the Newfoundland fishery.

Regulation of the emerging multispecies fisheries is a vast subject and covers a wide geographical region of Canada's Atlantic coast (Figure 1.1). This paper is concerned with one narrow but important aspect of fisheries regulation, namely the administrative regulations governing vessel size. These regulations were introduced in the past under conditions that were very different from those of the emerging fisheries of today. Yet some of these regulations are still being implemented with little apparent consideration given to their economic and social implications for fisheries development as we enter the twenty-first century. This report will argue that certain existing vessel size regulations are outdated and impede development. The evidence examined in this study suggests that they need to be revised in the interest of efficiency, safety and prosperity.

In particular, very little consideration has been given to the impact of vessel size regulations upon the marketing of the product or indeed the implications for management of the biological resource itself. It can be expected that the need for more flexible regulations will grow rapidly in the new fishery given that the marketing of the catch is an integral part of the activity of fishing (MacSween, 1983). This report seeks to identify and



Source: Fisheries Resource Conservation Council, 1996.

FIGURE 1.1: MANAGEMENT BOUNDARIES OF CANADA'S 200 MILE LIMIT AND NAFO FISHING ZONES.

analyze key considerations in determining an appropriate and efficient size of fishing vessel, which can harvest and market distant resources in an optimal manner.

1.1 Purpose and scope of the study

The purpose of this study is to examine the appropriateness of existing maximum length restrictions for vessels 45 foot to 64 foot 11 inches (henceforth the 45'-65' vessel class) in the context of the restructured Newfoundland fishery. In particular, this report will focus on the implications of existing vessel length restrictions for the diversification of the fisheries now prosecuted by this class of fishing vessel. Although the thrust of the argument is applicable to most if not all vessel classes in the Newfoundland fishery, the scope of the present study is limited to the 45'-65' vessel class. The reason is that the vessel size regulations as they affect this particular, albeit small size class, take on an economic significance that can be readily demonstrated.

The study begins by tracing the origins of the existing vessel restriction in order to uncover its exact rationale as a means to control fishing effort. We then turn to the implications this type of fishing effort control may have on future resource management, new resource developments, safety at sea, and access to new domestic and global markets as we enter the next century. The specific objectives are to:

1. establish the existing rationale of using 64'11" as the maximum length restriction,
2. identify potential safety problems with the design of such vessels due to the length restriction,
3. highlight inadequacies for diversifying into new resources and market opportunities,

4. address the management implications of relaxed vessel restrictions for the overall fleet size and fisheries resource management,
5. make tentative recommendations for vessel replacements suited for fishing the multiple species found out to and beyond Canada's 200 mile Exclusive Economic Zone (EEZ),[1]
6. identify further research needs and suggest directives for future research.

1.2 Nature of the problem

Since the cod moratorium of 1992, the Newfoundland fishery has been undergoing a process of restructuring and reorientation away from the time honored inshore groundfishery for cod toward more distant offshore species. The location of the resources now being developed, and the demanding product quality considerations expressed in discerning international markets pose a fundamental challenge for the adaptation of the vessels used to prosecute these new fisheries. The fundamental problem of concern in this paper is this: are the existing vessel size restrictions, originated in the 1940's under vastly different circumstances, consistent with the safe, efficient, and fair development of the new Newfoundland fisheries sector? Specifically, will the legislated length restrictions of the 45'-65' vessel class allow the industry to harvest, process at sea, and deliver to market a product of a quality that will maximize the industry's economic potential? This problem has arisen because the target species are no longer found three or twelve miles from shore as prior to the establishment of the 200 mile EEZ in 1977. The present day resources are found distributed over an area 70 nautical miles offshore out to

[1] Sometimes referred to as the Exclusive Fishing Zone.

and beyond Canada's 200 mile limit. However, vessel length classifications derived from subsidy programs during
1942-68 still underlie fishery resource management policies today. The economic future of Newfoundland's fishing industry depends on its flexibility and ability to compete with high quality products in global markets. As in the past with cod, if the inshore sector cannot harvest the resources, significant amounts of the Total Allowable Catch (TAC) for a particular specie may be redirected to other fleet sectors, other regions of Canada or to other countries at the expense of the local economy.

From the standpoint of the individual fisherman, this raises the fundamental problem of determining the minimum efficient vessel size for participating in the new, diversified fishery. It is not the aim of this paper to solve this technical problem. What this report seeks to accomplish is to set out the safety and economic aspects that bear specifically on the issue of vessel replacement in the modernization of the Newfoundland fishery.

The study is organized as follows: Section 2 reviews the literature pertaining to the management of capacity and vessel size in the Newfoundland fishery. Section 3 briefly describes the fishery of the past (cod), and the origins of the present day maximum vessel size restriction of 64'11". Section 4 outlines the change over time in the species harvested by this key vessel class. Section 5 discusses safety at sea, methods used to increase stabilization and safety at sea as well as fuel and quality comparisons for various fleet sectors. In addition, Section 5 draws a comparison between the existing

Newfoundland fishing fleet with the other Eastern Provinces[2] in terms of fleet structure and economic returns to the fishing industry. Section 6 places vessel regulation in the context of other resource management methods employed to control capacity in the 'race for the fish'. Section 7 sums up the discussion and presents some conclusions and recommendations.

1.3 Approach

Previous studies have not examined the rationale for using 64'11" as the maximum vessel length for the inshore sector, although a considerable number have dealt with the ramifications of overcapacity problems in the groundfish industry. This study will therefore begin by reviewing the relevant aspects of this literature. Literature relating to snow crab, northern shrimp, turbot, Icelandic scallops, and seals will also be examined in order to highlight the conditions under which these fishery resources are prosecuted by the 45'-65' class of fishing vessel. The purpose here is to illustrate the location and abundance of the resources, harvesting techniques and processing requirements needed to achieve the product quality demanded by discerning consumers.

The information for this report was obtained from library research at Memorial University of Newfoundland, and the Department of Fisheries and Oceans (DFO) Newfoundland

[2] Nova Scotia, Prince Edward Island, New Brunswick and Quebec.

Region, and by personal, unstructured interviews with fisheries managers, fishermen, processors, and other stakeholders.

Section 2.0: Literature Review

One of the primary messages of the *Report on Income and Adjustments in the Atlantic Fishery* (Cashin, 1993) was that available capacity in most Canadian Atlantic groundfisheries far exceeds that required to harvest the resource, and that a 40 to 50 percent reduction in both harvesting and processing is required for the future viability of the groundfish fishery. In the context of this paper the challenge for managers can be put: how can a vessel ‘replacement’ program be implemented that at once reduces capacity in the groundfish fishery, and promotes a vessel design capable of harvesting new, non-traditional resources out to and beyond Canada’s 200 mile limit?

In 1996, the Fishing Industry Renewal Board addressed the problem of capacity adjustment by stating that it was ironic that groundfish based rules inhibited the prosecution of non-groundfish activities. The Board recommended a longer term approach to vessel replacement policy that would allow today’s fisheries to be prosecuted more safely and efficiently, and provide the basis for less competitive fishing arrangements based instead on output controls. These arrangements would take the form of individual quotas and trip/weekly limits. When the cod fisheries re-opened, inshore fishermen would be given more flexibility to adjust their vessel size to their overall enterprise shares. The result would be a shift from input control (vessel length) to output controls (harvesting restrictions).

The need to control fishing effort has long been seen as fundamental to conservation, and the collapse of groundfish stocks on the Atlantic coast is a tragic example of failure to effectively implement this principle. The Fisheries Resource Conservation Council (1996:5) recommended that "special measures be taken to ensure that the available capacity is managed so that the excess effort does not compromise conservation objectives at this critical juncture." One of these measures outlined in its report was the use of Conservation Harvesting Plans (CHPs). These comprehensive plans address components of fishing effort in terms of closed seasons, closed areas, selectivity for species and size of groundfish, and monitoring and control of activities. The Council noted that the introduction of the CHPs has improved the quality of management in the groundfish fishery.

Regarding vessels 45'-65', the Fishing Industry Renewal Board (1996:44) recommended that all vessels in this class be allowed to expand up to 21,192 cubic feet[3], the maximum for 64'11" vessels, provided they are currently engaged in a fishery in which individual quotas or smaller group arrangements have been made or are in the process of being implemented. This begs the question how this recommendation on the vessel size better promotes the safety and product quality issues of fishermen fishing far offshore, especially since the Board noted that vessels built to maximum cubic numbers tend to be slow and fuel inefficient? The Board further considered (but did not recommend) that

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[3] Derived from Length, width and depth of vessel.

vessels with a high cubic number be allowed to expand beyond 65’ with unchanged cubic number. While this may allow for a more streamlined vessel and therefore promote fuel efficiency and better stability, it is unclear how maintaining the same volumetric dimensions will allow for increased accommodation space and better crew comfort, or allow for the addition of refrigeration and ice-making equipment to further enhance the quality of the resource once brought onboard.

Almost three decades ago, Copes (1971) stated that if smaller longliners[4] are used that are suitable only for a close-to-shore role, then there are inherent limitations in the extent of the resource available. Relief from the resource constraint will be obtained only by the acquisition and effective utilization of vessels capable of “at least” middle distance fishing. In addition, fishermen would have to spend much more time at fishing than before, i.e. extending the season. The extent to which the season can be thus extended is limited by the fishing vessel design and the environmental conditions encountered. In a later paper, Copes (1972) noted that a large part of the Newfoundland longliner fleet consists of boats at the lower level of their size classification. They have a limited operating range from port and are thus often prevented from fishing by poor weather conditions. It is the larger vessel with greater operating range and seaworthiness that can achieve net returns substantially beyond those of the small boat inshore fishery. Mitchell and Frick (1970) also noted that the larger vessels are capable of more sustained fishing effort than smaller ones by being able to operate in rougher weather, while vessels under 60 feet on the Atlantic Coast must operate nearer to shore or in sheltered waters. An important point to establish here is that at the time of these reports, the recognized length categorization for intermediate type vessels was 50 to 75 feet[5] compared with the 45 to 65 feet categorization used today.

2.1 Previous Studies of Vessel Requirements

The importance of developing more efficient, economical and safer fishing vessels for the Newfoundland fisheries has been suggested on a number of occasions over the past three decades. The purpose of this section is to highlight some of the most important recommendations made in various government reports.

- Proskie (1965:9) recommended that "further emphasis may be on the development of larger boats, up to about '100 feet in length' for fishermen-owners and on trawler and other craft 100 feet and over for vertically integrated operations."

- In 1970 the Industrial Development Branch provided a specification for a 97' combination fishing vessel, designed for seining, bottom and mid-water trawling in North Atlantic conditions (Department of Fisheries and Forestry, 1970).

[4] The classification used by the Dominion Beareau of Statistics, Fisheries Statistics of Canada (1970) recognizes vessels 100 gross tons or more are over 75 feet in length, while vessels of 50-99.9 tons category range from 50 to 75 feet and vessels 25-49.9 tons are less than 50 feet.

- In 1973 the provincial government began to participate in a vessel conversion program involving a number of equipment modifications to convert two Faeroe longliners. These conversions envisaged vessels 80 to 130 feet with modern longlining and gillnetting gear and proper refrigeration facilities intended to permit these vessels to fish safely at greater distances from port (Department of Fisheries, 1974).[6]

- In 1975 the Industrial Development Branch, in determining the commercial distribution of shellfish and groundfish in the North, recommended the use of vessels no less than 80 feet in length and equipped with shrimp cookers or mechanical refrigeration, or a combination of both. This was because encouraging catches of shrimp and crab in the Hawke Channel were 150 to 200 miles from the nearest processing plants. This fishery would require weekly trips because shrimp deteriorate rapidly after three to four days if only held on ice (Brothers, 1976).

- In 1976 the Industrial Development Branch chartered a 65' wooden multipurpose stern dragger to carry out exploratory fishing for shrimp and crab in Labrador waters. The inadequacies of this vessel class for offshore use was noted in the first recommendation which stated:

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[5] See Footnote #4.
[6] See also Rendall (1974).

> "To carry out a shrimp and/or crab exploration in the Hawke Channel or southeast of Labrador, it is recommend that a vessel of 80 feet in length or over be chartered. The 65 foot vessel, "Robin and Gail" used during this charter was too small to fish in the rough weather conditions usually encountered in the areas explored (Brothers, 1977:3).

- A major fisheries planning initiative by the Government of Newfoundland and Labrador (1978:26) entitled *Setting a Course* concluded that "there was scope for development of a middle distance fleet".

- In 1979 the Industrial development Branch conducted a commercial shrimp survey in the Gulf of St. Lawrence. Two 58 feet vessels were chartered. Bad weather conditions showed up the "inadequacies of vessels in a size range of 55 to 58 feet when operating 40 to 60 miles from shore." After only 15 days, these vessels charters were discontinued and the remaining 25 days of the charter were completed by an 80' vessel. (Way and Hickey, 1979:5).

- In 1981 a Provincial Royal Commission (p242) recommended that "Government conduct, in short-season inshore fishery regions of the province, the projects necessary to demonstrate the economics of operating medium range longliners."

- The 1982 *Task Force on Atlantic Fisheries* (p91) recommended that 40,000 tons of the Northern Cod be allocated to middle distance class vessels in 1987, particularly large Scandinavian-type longliners (65 feet to 120 feet).

- In 1983, in response to the Kirby Task Force recommendation on the need for larger vessels, the DFO leased a 115’ Norwegian vessel, and the Province of Newfoundland acquisitioned a 90’ vessel from the United Kingdom (O’Rielly, 1988).

- In 1985 two 60’ inshore draggers were chartered to carry out a redfish harvesting experiment off the Northeast coast of Newfoundland (3K) and in Fortune Bay (3Ps). The object of this project was to determine the capability of inshore draggers to land redfish which met the specifications of the Japanese market and, more generally, determine the potential of a viable redfish fishery using these vessels. The fishing area in 3K was 120 nautical miles north off St. Anthony. Due to longer steaming time and adverse weather conditions it was decided that further fishing effort in Division 3K was not warranted. The vessels spent the remaining charter days in NAFO Division 3Ps in an area approximately 10 nautical miles from land (O’Leary and Clarke, 1987).

- In 1986 the Provincial Department of Fisheries acquired a 106’ Norwegian longliner, with a refrigerated hold, again in response to a recommendation of the Kirby Task Force (O’Rielly, 1988).

- In 1987 the first domestic Middle Distance vessels, were constructed with the following features for Newfoundland conditions:

1. good seakeeping capability,
2. a cooled fish hold and associated blast freezer room for by-catch,
3. endurance capability for 30 days and certified for a maximum crew of 14,
4. enclosed processing deck and space for handling fishing gear (O'Rielly, 1988).

Newfoundland has the largest proportion of coastline of any of the Eastern Provinces, and direct adjacency to fishery resources within the 200 mile limit. Yet, despite the recognition in the literature of the need for a larger vessel class there were only eight registered vessels in the 65'-100' class in Newfoundland in 1996, while other Eastern Provinces together had 76. Nova Scotia had 25, New Brunswick 39, and the province of Quebec twelve (DFO, 1998a). As discussed below, the size aspect is likely to affect the economic return in the fishing industry in the respective regions.

Section 3.0: Origins of the 64’11” Vessel Length Restriction in the Fishery of the Past

The purpose of this section is to establish the background of the existing vessel length restriction.

Marine resources in Canada have been determined constitutionally to be a common property resource. Northern Cod with its seasonal migration behavior, which for generations shaped the fishery and society of Newfoundland is a classic example of the exploitation of a common property resource in the context of Hardin (1968) ‘Tragedy of the Commons’.

It is well known that the settlement pattern of Newfoundland and Labrador is historically linked to the harvest of marine resources that occurred in abundance in the coastal and offshore waters. Northern Cod was, of course, the *raison d’être* of most settlement along the coast of northeastern Newfoundland and Labrador. The Island portion of the province has been described as a “great ship moored near the fishing banks” (Harris *et al.*, 1990:18). This description held for hundreds of years as the inshore fishery centered on the annual cod migration to the coast in early summer. From the sixteenth century to the nineteenth century, there were virtually no management or conservation policies in place in a modern sense. The constraints on fishing were the circumstances of nature; the geographic, physical and seasonal limitations. This early absence of a management regime did not jeopardize the health of the groundfish stocks. Arguably, the Northern Cod fishery from 1850 to 1950 can be viewed as a model of stability and sustainable usage (Harris *et al.*, 1990).

It is interesting to note that the origins of today's vessel length categorizations and the resulting restrictions dates back to pre-confederation days. In the period 1942 to 1968, the federal and provincial governments sought to modernize and expand Canadian fishing fleets by means of extensive subsidy programs. Significant in promoting these changes was Stewart Bates, Deputy Minister of Fisheries from 1947 to 1954. His report on the Canadian Atlantic Fisheries (the "Bates Report") has been described as a blueprint for fisheries development in the post-war period. Bates concluded that the Atlantic fishery, in all its branches, was undercapitalized, inefficient, and lacking in technology that could raise productivity. He argued that a modernized Atlantic fishery was a means to increase the productivity and incomes of fishermen in the Atlantic Provinces (Wright, 1997).

3.1 Early Canadian (Federal) Government Programs

The general objective of the subsidy programs resulting from the Bates Report was to increase output and returns to fishermen. The federal government implemented two programs during this time period. The first was the Department of Fisheries Program designed to assist fishermen with the construction of medium-sized vessels of approximately 25 to 100 tons, and wooden vessels exceeding 100 tons.[7] The second program was the Department of Industry Program of assistance to shipyards for vessels, including steel fishing trawlers over 75 feet in length or over 100 gross tons (Mitchell and Frick, 1970).

In an analysis of the government programs of assistance, Mitchell and Frick (1970) report that the first measure to encourage private investment in increasing the efficiency and capacity of the Canadian Atlantic fishing fleet came in 1942. The federal government wartime vessel construction assistance measure established a $165/gross ton subsidy for the construction of draggers, and conversion of schooners to draggers. Owners of the new or converted vessels were also given special or accelerated depreciation privileges through the Income War Tax Act and the Excess Profits Tax Act of 1940.

In 1944 the policy of assisting fishermen to build larger and more efficient fishing vessels began to emerge more clearly with an order-in-council[8] under the War Measures Act. This Act provided for the $165/gross ton subsidy to be paid to groups of not less than four fishermen. It was intended for the construction of draggers or long-line vessels of no less than 55 feet in overall length to a maximum to be determined by the Minister of Fisheries.

[7] See Footnote #4.
[8] P.C. 3978, June 1st., 1944. Mitchell and Frick (1970).

Mitchell and Frick (1970) report that the fishing vessel construction assistance was continued by the Department of Fisheries Program under the relevant Appropriations Act in 1947.

As vessel construction costs continued to rise, the incentive effect of the subsidy decreased. In 1961, the subsidy was therefore raised to $250/gross ton.[9] However, because building costs per ton increased with the size of the vessel, a flat-rate subsidy based on gross tonnage came to be seen as inappropriate for vessels of widely varying sizes. As a result, payment of subsidy as a percentage of approved cost was therefore substituted in 1964 for the flat rate basis.[10] Under this arrangement, vessels 35-55 feet received a subsidy of 25 per cent of approved costs. Vessels 55 feet to less than 100 gross tons (75 feet.)[11], received a 30 per cent subsidy. The minimum length to qualify for the subsidy was raised to 45 feet in 1968,[12] with a subsidy of 30 per cent on wooden vessels 45 feet to 100 gross tons (75 feet.). Yet another size category was established in 1965[13] when wooden fishing vessels in excess of 100 gross tons became eligible for a subsidy of 40 per cent of approved cost.

The primary objective of the Department of Industry Program was to provide work in

[9] (P.C. 1333). Mitchell and Frick (1970).
[10] (P.C. 855). Mitchell and Frick (1970).
[11] See Footnote #4.
[12] (P.C. 198). Mitchell and Frick (1970).
[13] (P.C. 1199). Mitchell and Frick (1970).

Canadian shipyards, while at the same time help modernize the Canadian commercial fishing fleet. Under Appropriations Act. No. 4, 1961,[14] *Ship Construction Assistance Regulations* were established, which provided for a construction subsidy to any eligible ship of 40 per cent of the approved cost incurred for work performed before 1963, and 35 per cent thereafter. It is noteworthy that this subsidy was to be paid only when a trawler replaced an existing trawler of steel or wooden construction that had been permanently withdrawn from fishing. (Interestingly this requirement was later dropped). These policies[15] therefore allowed capacity expansion. By contrast, this paper will argue for change in the existing replacement policies that do not promote capacity expansion. The importance of this distinction cannot be overstated.

3.2 Related Provincial Subsidy Programs

Turning to provincial initiatives, the Newfoundland Fisheries Development Authority administered the first inshore fisheries development program under the Bounties Act of 1955. A subsidy of $160/gross ton was paid on vessels built and equipped in Canada in the size range of 12 to 150 gross tons although grants could be paid on vessels outside this size range.[16] It is interesting to note that the maximum fishing vessel limit under the Bounties Act was set at 150 tons, (which is greater than 75 feet).[17] Yet the Division of

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[14] (P.C. 1290). Mitchell and Frick (1970).
[15] A summary of the legislation and the principal regulations from 1942 to 1968 can be found in Appendix A of Mitchell and Frick (1970).
[16] Mitchell and Frick (1970).
[17] See Footnote #4.

Vessel Construction and Inspection supplied blueprints only for 36' to 66' longliners for a fee of five dollars. Curiously, no blueprint plans for vessels larger than 66 feet were available.[18]

In 1962 a direct subsidy was also paid for the construction of small engine power boats that had been certified by a provincial authority as suitable for the traditional Newfoundland fisheries. This grant amounted to $8 per foot for boats 24 to 30 feet in length, and $10 per foot for those 31 to 35 feet long. These provincial initiatives therefore favoured smaller boats suitable for the traditional inshore trap fishery.

3.3 Implications of Subsidy Legislation for Future Fisheries Development

The result of changing the size limitations of the federal subsidy program (to 45 feet in 1951[19] and 35 feet in 1964)[20] and the direct subsidies of the Newfoundland Fisheries Development Authority combined to produce a fleet of small, less productive vessels. As the fleet increased in numbers, the subsidy program came to contribute increasingly to yet further expansion of the inshore fleet in these size categories. In effect, it became a program of assistance for small vessels although this was not the original objective of the

[18] Department of Fisheries (1955). The Fishing Vessel (Bounties) Act,. In addition to this Bounties Act, assistance in rebuilding or repairing vessels was available under the Fishing and Coastal Vessels Rebuilding and Repairs (Bounties Act of 1958). The bounty for rebuilding fishing vessels was from $100 to $250/ton, depending on the size of the vessel, or 50 percent of the approved cost, whichever was less (Mitchell and Frick, 1970).
[19] (P.C. 2490). Mitchell and Frick (1970).
[20] (P.C. 855). Mitchell and Frick (1970).

program. During the period 1957-66 the number of fishermen in Newfoundland increased from 16,469 to 20,286. The number of vessels increased from 12,866 to 17,237.[21] in the same time period. The resulting low incomes and increased dependance on unemployment insurance by Newfoundland fishermen and plant workers has been well documented[22] and will not be discussed further here.

However, a second less well-documented implication of the subsidy program is the legacy of a vessel class unsuitable to the pursuit of resources in the new diversified fishing industry. According to Mitchell and Frick (1970), Copes (1973) and others, the intermediate-sized vessel class (originally 50 to 75 feet) ranked as the most efficient for the Atlantic coast with the larger vessels within this category being better suited for offshore operations than the smaller ones because they were considered more seaworthy and therefore able to extend the effective fishing season by logging more time at sea per year.

Given the opportunity to expand vessel size provided by the various subsidy programs, why did this downward trend in vessel size occur? With a three mile coastal fishing limit prior to 1964, and a twelve mile limit from 1964 until January 1977 it was thought that in the exposed fisheries off Newfoundland, vessels exceeding 60’ were required if they were to be as safe and efficient as vessels 50’ long in the more sheltered fisheries in the other

[21] Mitchell and Frick (1970).
[22] Copes (1964), (1971), (1972), (1973) and others.

Atlantic waters (Mitchell and Frick, 1970). However, the amendments to the subsidy program during the 1942-68[23] had the eventual effect of subsidizing smaller vessel sizes. In addition, fishermen who were building their own boats could contribute their own labour "in lieu" of a down payment (Proskie, 1964). When one considers that at the time over 70 percent of fishermen had not attended high school (Proskie, 1967), it may be deduced that with the greater skill and knowledge needed in order to build and operate a 75' vessel, fishermen who were contributing their own labour would more readily accept the smaller size categories offered under the subsidized programs which were better suited for a trap and inshore gillnetting operation. The result according to Mitchell and Frick (1970:45) was that "the subsidy program contributed to the construction of relatively inefficient vessels in the intermediate-sized fleet."

The real effect of this shift in vessel size from 75' to a maximum of 64'11" came in the 1970's with what Parsons (1993) terms the 'evolution of limited entry controls'. By 1973 fishermen and resource managers had become increasingly concerned about the expansion in both the size and catching capacity of the Atlantic fleet. However, while subsidy programs had promoted small vessels in Newfoundland, they had not done so in other Eastern Provinces. For example, under the same federal subsidy programs, New Brunswick built the first 84' and 92' steel stern draggers and 86' wooden draggers. The first 78' conventional steel draggers were built in Quebec. In Nova Scotia, 85' to 92'

[23] See Footnote #15.

wooden longliners and a large number of 97' wooden scallop draggers were built. Two 92' steel seiners were built in New Brunswick.[24]

With the prospects of an expanded Canadian share of the North Atlantic catch, a serious short-term imbalance between catching capacity and available resources appeared imminent in the early 1970's. The federal government therefore established a Licensing Policy Review Committee to review existing licensing arrangements and to develop new policies. In 1973, it was recognized that "there was no government policy on licensing for the Atlantic fisheries...that there had been a real upsurge in interest in the Atlantic coast fisheries..., and that there were a lot of people talking about expanding their investments, expanding their fishing fleets."[25] Two reasons were identified for this increased interest. One was the growing imbalance between demand and supply. The other was the Law of the Sea discussions, and the expectation that coastal states would be extending their jurisdictions with attendent prospects of an increase in supply of Canadian fish. It was against this background that in 1973 the Ministry of Environment introduced for the first time a fishing fleet development policy for Canada's Atlantic Coast. The aim of this policy was to match fleet size to fish stocks by instituting a more selective subsidy program for vessel construction, and by establishing for the first time a licensing control program. This policy saw the number of offshore trawlers frozen and entry into the offshore restricted. Licenses were introduced for fixed gear fisheries in 1974. However,

[24] Proskie (1965: 11).

the new entry controls were not rigorously enforced.[26] Two years later, licenses for otter trawling by vessels under 65' were limited. The replacement rules for these vessels were as follows:[27]

1. vessels 45 feet and less - open access to all gear types,
2. vessels between 45 feet and 65 feet were placed under limited entry, with licenses issued only to a vessel which had been licensed in the previous two calendar years (1974 and 1975), and
3. a replacement vessel in the 45 feet to 65 feet class could not exceed 125% of the length of the vessel being replaced up to a maximum of 64 feet 11 inches.

3.4 The 200 Mile Limit

On January 1, 1977 Canada declared a 200 nautical mile fishing zone on the Atlantic coast encompassing 503,000 square miles. Canada agreed to the national allocation approach of the International Commission for the Northwest Atlantic Fisheries (ICNAF) of managing fisheries by Total Allowable Catch (TAC) and applied it to the domestic fleet.

In announcing the first Groundfish Management Plan (1977) involving this vast new fishing zone, the government noted that "the intermediate and small boats, more than 10,000 of them, had only limited range. Hence the large trawler fleet had a duty and opportunity of going farther afield."[28] Large foreign vessels were also allowed to take

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[25] Observed by the Senior Assistant Deputy Minister of the Fisheries and Marine Services, as reported by Parsons (1993:176).

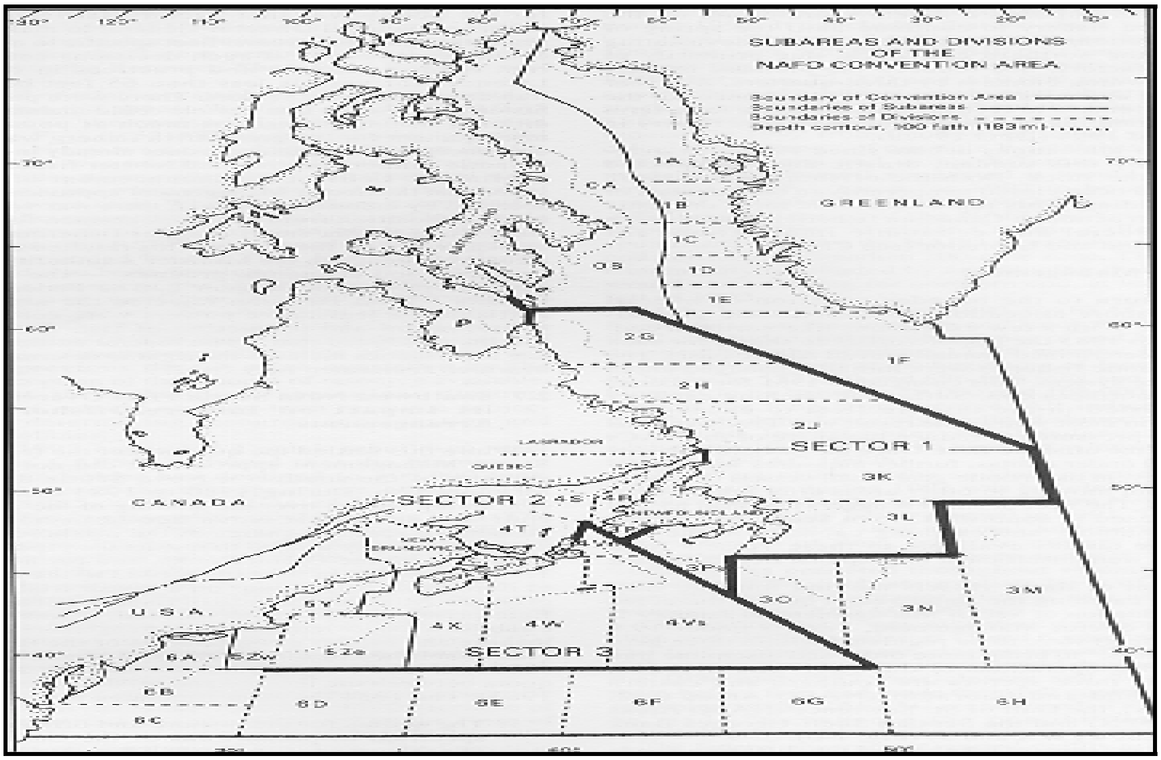
[26] Parsons (1993).
[27] Parsons (1993:177).
[28] Romeo Leblanc, as quoted in Parsons (1993:122).

fish surplus to Canadian requirements and reserves (Jackson, 1981). The larger trawler fleet was defined to comprise vessels larger than 100 feet. Then in 1977-78 a debate arose over the inshore/offshore allocation of the TAC for Northern Cod. The DFO gave priority to the inshore in 1979. In its discussion paper entitled *Toward a Policy for the utilization of Northern Cod,* one of the main policy directions was that two-thirds of the TAC of Northern Cod be set aside for the inshore sector (Parsons and Lear, 1993). With reference to Northern Cod, the Minister stated that:

> "Who gets first crack at these fish? Here I must say...that I have a clear bias for the inshore fisherman. Not because of some romantic regard, not because of his picture on the calendars, but because he cannot travel far after fish, because he depends on fishing for his income, because his community in turn depends on his fishery being protected" (quoted in Parsons, 1993:123).

In order to distinguish between inshore and offshore, operators of the large trawler fleet preferred to use a 100' cut-off length to identify vessels that could fish anywhere along the Atlantic coast and those which were to fish close to home port. Parsons (1993) reports that the terms 'inshore' and 'offshore' were in fact misleading because 65' draggers from southwest Nova Scotia were quite capable of fishing the Scotian Shelf most of the year. However, the 100' cut-off was gradually accepted as the basis for determining the inshore/offshore allocations of harvests.

Nevertheless, the recognition of the mobility of the 65' draggers from Nova Scotia resulted in the introduction of 'Sector Management' in January 1982. This was to prevent this fleet of small draggers from moving into the Gulf of St. Lawrence and catching the small vessel quotas there (Parsons, 1993). The policy was applied to all vessels less than 65' that fished groundfish, and regulated them within three geographic sectors (Figure 3.1).



Source: Parsons, (1993:138).

FIGURE 3.1: THE THREE SECTOR MANAGEMENT AREAS OF THE ATLANTIC COAST.

This three sector approach was introduced in order to make decisions affecting capacity specific to a geographic sector. Under Sector Management licenses for vessels less than 65' became non-transferable between sectors. This was to allow decentralized management of the inshore fishery with a regional headquarters, thus allowing each region to respond quickly to local fisheries problems and align fishing effort to resource availability (DFO, 1985).

Since the inshore fishery traditionally takes place in Summer and early Fall, and the offshore fleet capable of fishing in late Fall and Winter, it was suggested by the Kirby Task Force (1982) that the inshore and offshore be divided "so that the maximum employment model applies inshore and the maximum economic rent offshore."[29] With two-thirds of the fish were allocated to the inshore (<65') and the remainder to the offshore (>100'), there were virtually no allocations to vessels between these two size classes (Parsons and Lear, 1993). A review of vessel classes (to be discussed in a later section) reveals that the 65'-100' vessel class comprise less than 0.1 percent of fishing vessels in Newfoundland.

Recall that the subsidy programs 1942-68 had led to a size of vessel operated by inshore fishermen ill suited to the harsh environmental conditions in the offshore fishery. This inaccessibility of offshore resources was recognized by the Kirby Task Force (1982). One of the two mandates of the Task Force according to Parsons and Lear (1993:73), was "to advise the government on the long-term policies it should implement to promote a healthy fishery in the future." The Task Force recommended that the harvest allowance for existing inshore vessels (<65') not be increased in proportion to the expected growth in the TAC due to the high seasonal catches already being landed. It was felt that any increases would only add to the seasonal 'glut' situation. Instead it was recommended

[29] See Schrank (1995:293).

that a significant amount be set aside for the Resource Short Plant Program (RSPP). This program was seen as a way to provide raw material to plant operators who complained of a critical shortage during the off-season. This required use of additional harvesting capacity from larger Canadian offshore vessels. Since this domestic effort did not materialize, large foreign offshore vessels were used to land cod until 1989. The Task Force also recognized that the extreme seasonality and the low annual production in the inshore fishery on the East Coast of Newfoundland was fundamentally a problem of technology. The Task Force therefore placed a high priority on the development of a fleet of large Scandinavian-type longliners that could fish most of the year. There appeared to be no other intermediate vessel already in existance between the smaller vessel (<65') and a large stern trawler (>100') that was capable of fishing Northern Cod (Parsons and Lear, 1993). The recommendations to develop the new fleet were accepted by the federal government and reflected in the 1983 Groundfish Plan. The plan included a 3000 ton quota for the new 65'-100' fixed gear vessels, which used traditional inshore fishing gear technology but were capable of fishing all areas accessed by the larger trawler fleet (O'Rielly, 1988).

3.5 Trends in Newfoundland Fishing Fleets

Table 3.1 suggests that the number of fishing vessels in all classes decreased by almost 29 percent in the period 1983-96. From the standpoint of overcapacity, it is interesting to note that vessels <35' made up 93.1 percent of the total fleet in 1983. By 1996 this share had dropped only slightly to 91.6 percent. The share of the 65’-99’11” remained unchanged at less than 0.1 percent over the same period. The 45’-64’11” class saw a slight increase from 2.6 percent to 3.6 percent over the same thirteen year time period as did the 35’-44’11” vessel class in going from 3.7 to 4.5 percent.

TABLE 3.1 NUMBER OF FISHING VESSELS BY SIZE CLASS, NEWFOUNDLAND AND LABRADOR, 1983-96.

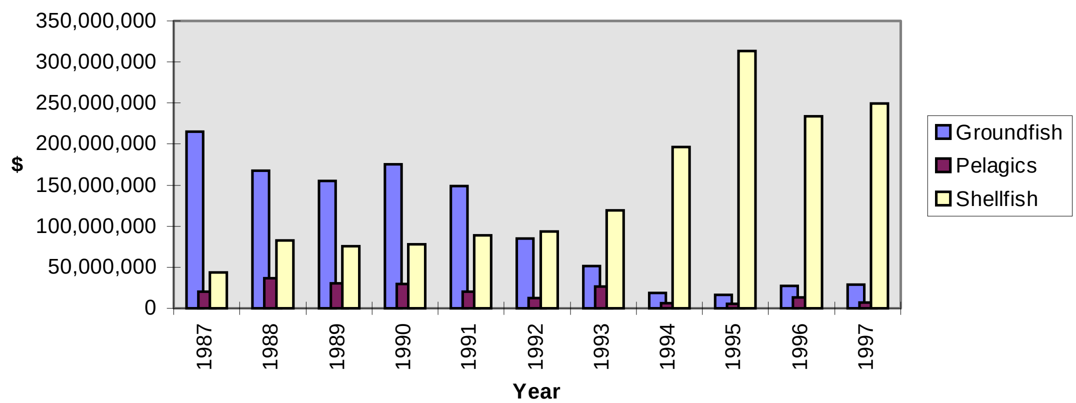
Year	<35'	35'-44'11"	45'-64'11"	65'-99'11"	>100'	Total
1983	15,207	597	430	12	89	16,335
1984	15,020	875	545	18	90	16,548
1985	14,184	740	502	9	89	15,524
1986	14,438	768	493	9	84	15,792
1987	15,326	770	481	8	78	16,663
1988	15,828	662	494	10	85	17,079
1989	15,730	715	488	9	85	17,027
1990	15,360	694	502	7	75	16,638
1991	13,678	646	497	8	76	14,905
1992	13,587	638	485	8	75	14,793
1993	12,848	601	470	8	74	14,001
1994	12,075	561	445	9	40	13,130
1995	11,403	536	438	8	13	12,398
1996	10,659	521	420	8	28	11,636

Source: Adapted from Department of Fisheries and Oceans, 1998a.

The issue is whether the present (1996) fleet structure of which the 45’-64’11” vessel class comprise 3.6 percent is suited to maximize the potential economic return from the new fishery involving underutilized resources. Is it desirable to keep the 65’-99’11” class at less than 0.1 percent of the total fleet and instead allow the offshore vessels of >100’ to expand? The effects of large offshore draggers capable of fishing twelve months of the year are in evidence, as is the struggle of the inshore fleet to keep up. This paper argues that the time has come to consider merging elements of the inshore and the offshore into a new intermediate design of vessel that is safe and efficient in harvesting sensitive ocean resources of high value and quality for a global market.

Section 4.0: Today's Resources, Harvesting Techniques and Product Market Requirements

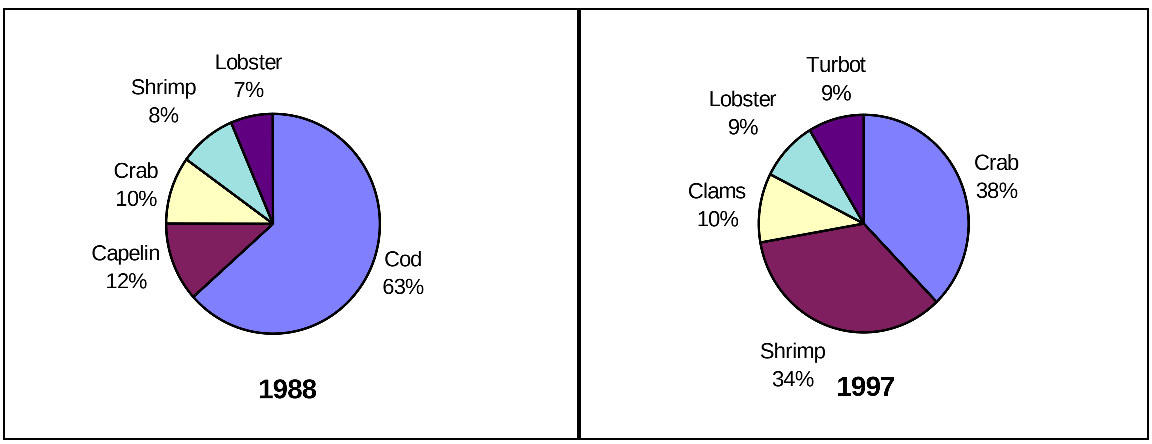
Several developments continue to alter the face of the Newfoundland fishing industry as we approach the next century. One is the value of shellfish landings, which generated more value from 1994-97 than did groundfish from 1987-93 (Figure 4.1).



Source: Department of Fisheries and Oceans, Newfoundland Region.

FIGURE 4.1: VALUE OF LANDINGS IN CURRENT DOLLARS, NEWFOUNDLAND AND LABRADOR, 1987-97.

This section describes the geographic location of these new resources. The purpose is to illustrate that the value of landings can be increased and safety issues addressed if these new fisheries are pursued with a more appropriately sized fishing vessel that matches both the environmental conditions encountered, and the product quality demands of the market. In his analysis of fisheries development in Newfoundland Copes (1973) suggested that the longliners acquired by Newfoundland fishermen were too small to achieve a really significant extension of the seasonal and geographical range of operations. Copes pointed out that the administrative management measure of restricting vessel length impacts upon not only volume, but size, quality, presentation and the overall image of Newfoundland as a seafood producer. Since the fishing enterprise is a business organization, it stands to reason that the type and size of vessel must bear a sound economic relationship to the resources exploited. Doll (1988) argues that the goal of the fishing enterprise is to maximize profits within the production period. It may therefore be argued that the shift in species diversity in the past decade (Figure 4.2) and its geographical location should allow flexibility in vessel design.



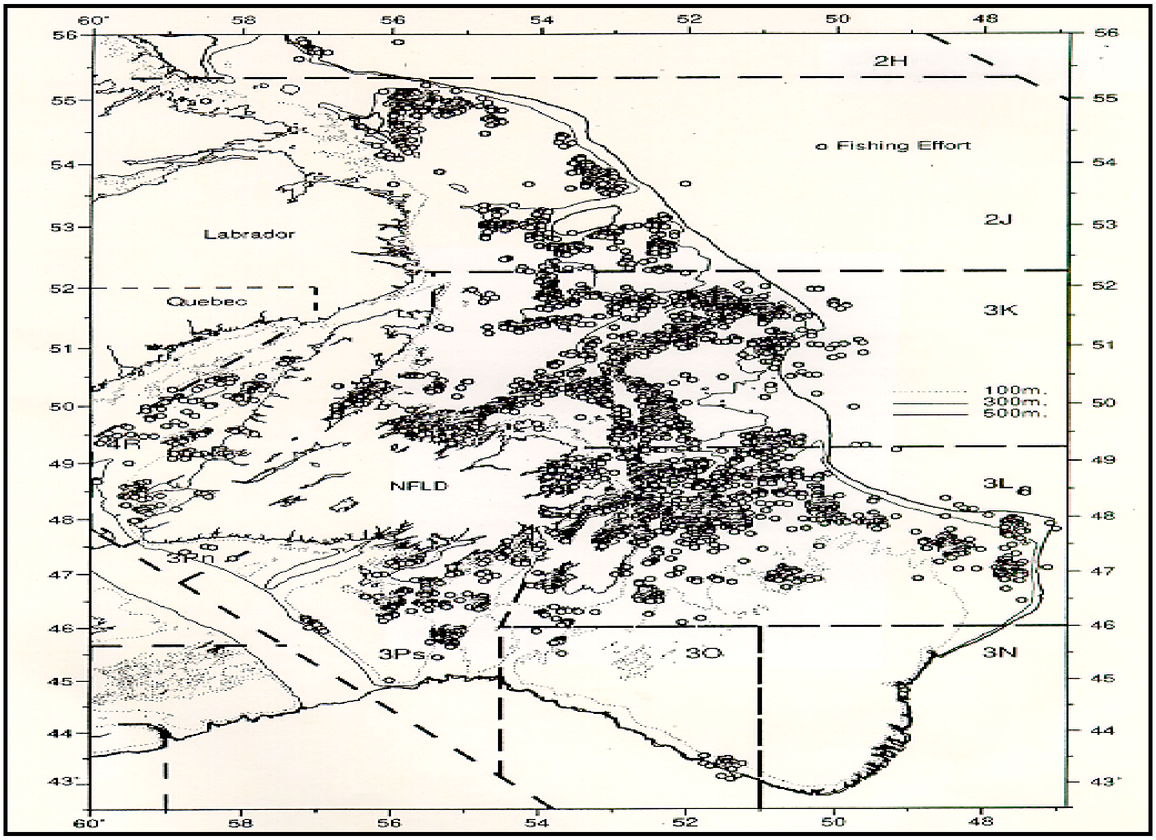
Source: Department of Fisheries and Aquaculture, Newfoundland.

FIGURE 4.2: SPECIES DIVERSITY, PERCENTAGE OF LANDINGS 1988 AND 1997.

It is instructive to examine how restrictions on design relate to the requirements of the market, and to attempt to draw out the implications of these administrative measures on the resource management, harvesting, processing and marketing of particular species. A case for modified vessel length restrictions can be made in respect of each of the species considered below.

4.1 Snow crab

The Newfoundland and Labrador snow crab fishery has grown primarily as a result of the post moratorium expansion of the exploratory fishing grounds in all NAFO Divisions to the offshore as far as 200 nautical miles and beyond (Figure 4.3).



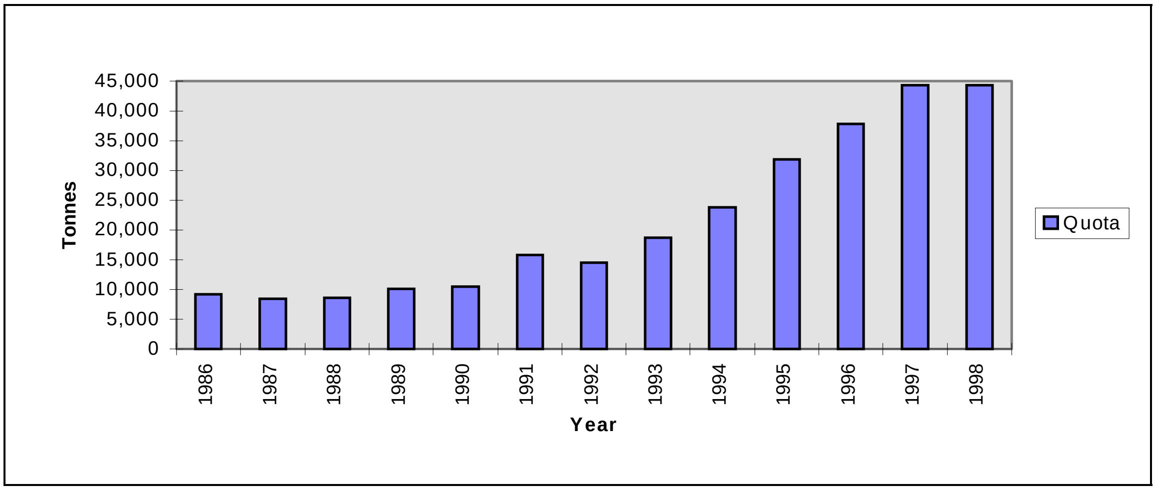
Source: Taylor and O'Keefe, 1997.

FIGURE 4.3: DISTRIBUTION AND LOCATION OF CRAB FISHING EFFORT, 1996.

The snow crab quota outside 200 miles in 1997 and 1998 was set at 2500 tonnes compared to 1500 tonnes in 1996 for a total snow crab quota of 44,300 tonnes in 1997 and 1998[30] (Figure 4.4). However, it is doubtful that the full economic value of this

[30] Department of Fisheries and Oceans (1997a).

resource can be realized by using the existing fleet of 45' to 65' vessels to harvest the resources now found as far offshore as the 200 mile limit and beyond.



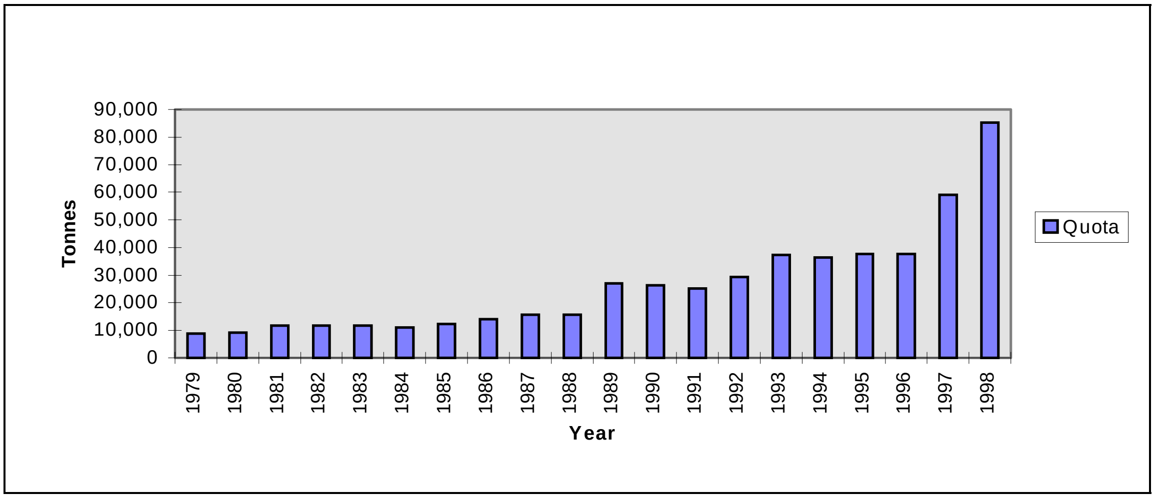
Source: Department of Fisheries and Oceans, 1997a.

FIGURE 4.4: SNOW CRAB QUOTAS, NEWFOUNDLAND AND LABRADOR, 1988-98.

Snow crab sections from Newfoundland, where more than half of the Canadian snow crab quota is now caught, sell at a discount of as much as $2.20 per kilogram compared with crab product from Alaska and New Brunswick. Two reasons have been given for this. The first is the higher percentage of barnacles and dark shell discolouration of older crab from Newfoundland. This is an unfortunate circumstance of nature. The second reason is that because the snow crab fishery is a high volume fishery conducted by many small boats without live tanks, Newfoundland processors inevitably process some crab that is almost dead, which results in lower-quality meat (Anon., 1997). This contention is further supported in the *Report on the Provincial Mission to Japan* (Vardy, 1997), which states that mission members were told by Japanese importers that Newfoundland ranked at the bottom of the list of preferred suppliers. Ahead of Newfoundland, in order of preference were Japan, Gulf of St. Lawrence, Alaska, and Russia. The reason is the Japanese importers insistence that crab should be treated like eggs. This means that they should be properly boxed and iced at sea, and placed in refrigerated sea water systems onboard harvesting vessels. This is the industry standard in high-end markets. The intrinsic quality of the crab stock is given by nature. However, the means by which it is harvested can be improved. It is paramount that Newfoundland vessels and practices are up to this standard.

4.2 Shrimp

The East Coast shrimp fishery off Newfoundland has both offshore and inshore processing capability. The offshore harvesting and processing is conducted onboard approximately twelve offshore trawlers (164'-223') capable of cooking, peeling, freezing and packaging shrimp within minutes of the harvest. This fleet harvests shrimp quota from 17 offshore licenses which are currently held by 14 companies and received about 61 percent of the TAC in 1998 with the remainder going to the inshore sector (DFO, 1997b). Quotas for northern shrimp have increased from 5,000 tonnes in 1979 to 85,020 tonnes in 1998 (Figure 4.5).



Source: Department of Fisheries and Oceans, 1997b.

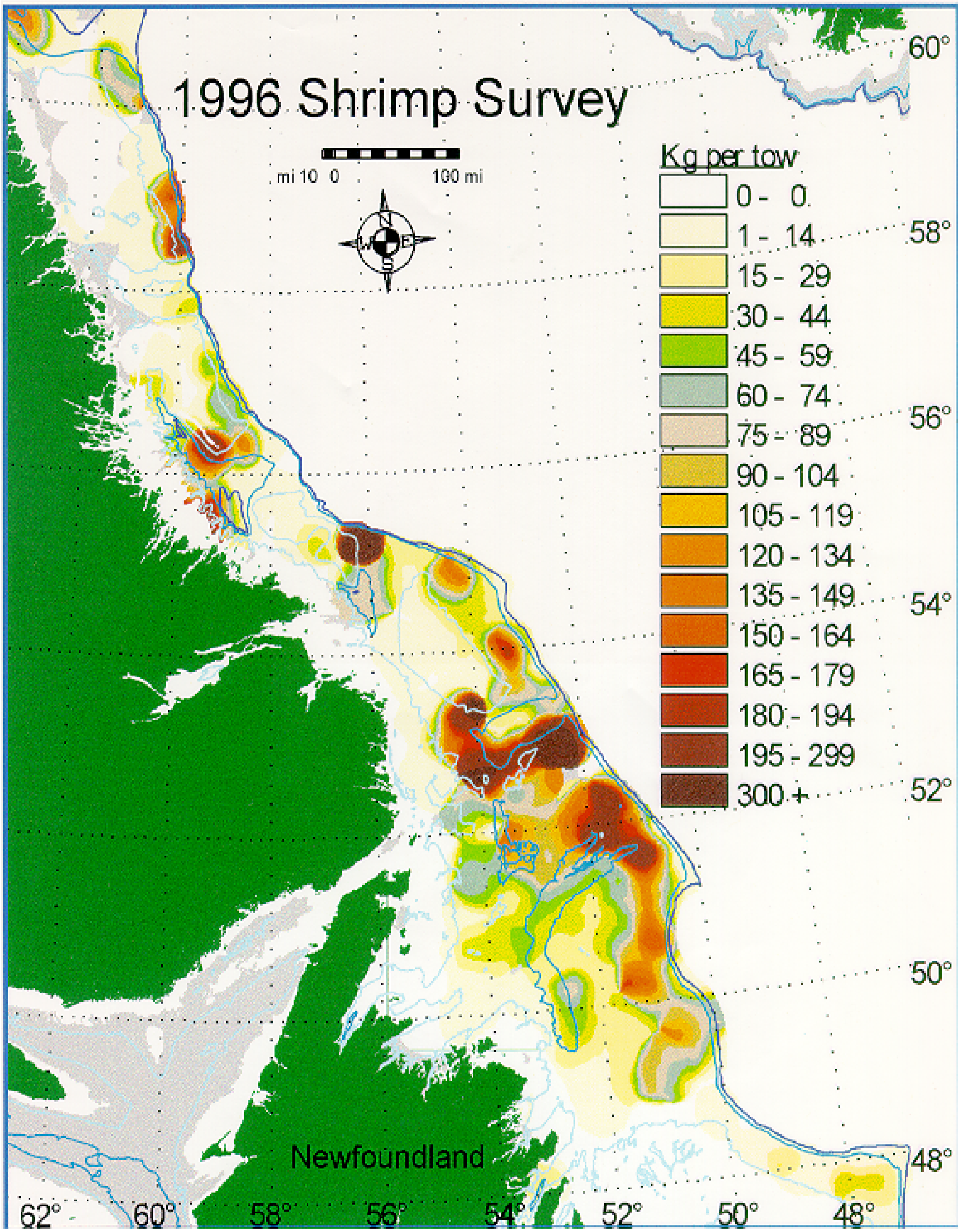
FIGURE 4.5: NORTHERN SHRIMP QUOTAS, NEWFOUNDLAND AND LABRADOR, 1979-98.

The inshore (<65') sector fishing off Newfoundland is a wetfish shrimp fishery in which the shrimp are iced onboard and usually landed to processing plants onshore within two to three days of harvest. Longer periods can result in serious quality deterioration (Walsh, 1994). This wetfish shrimp is then processed as 'industrial grade' and sold to restaurants and processing plants. While prices for this grade of cooked shrimp can be fairly high depending on the count per kilogram, it is comparable with the lower quality Northern Cod, traditionally suited only for 'codblock'. Europe and the United States are the primary markets for industrial grade shrimp from Newfoundland.

Raw seafood is a primary staple in Japan. To meet the high quality standards established by Japanese buyers, only product processed at sea will meet colour and texture requirements. As such, northern shrimp is an excellent example of how the market sets standards regarding presentation and quality. It is important therefore to understand how the vessel length restrictions affect the product standards achievable at the supply end.

Prices for product frozen raw at sea have been considerably higher than the cooked product, approximately 40 percent for shrimp of 70-90 count. For example, in 1993 Fishery Products International sold cooked shrimp of 70-90 count cooked for $3.90 per kilogram. Raw shrimp frozen at sea, same count, sold for $6.99 per kilogram (Walsh, 1994). A second factor influencing the value of shrimp frozen raw at sea and cooked product is weight loss. A study by Botta and Kulka (1995) reveals that the cooked product can lose up to six percent in weight, while the raw product frozen at sea for the Japanese market showed no change in weight.

Having discovered considerable shrimp abundance in the 1996 surveys (Figure 4.6), the DFO under pressure from fishermen wanting to exploit this fishery, implemented new supplementary vessel replacement rules in the interest of improved safety and comfort (Warren, 1997). These new rules replaced the five foot intervals in vessel categories implemented under the groundfish replacement policy in June, 1981 (DFO, 1981) and allowed fishing vessels to be replaced by a vessel 33 1/3 percent longer up to its original size classification of 35', 45' or 65' respectively. However, this was allowed only in conjunction with an Individual Harvesting Restriction (IHR). The IHR requires that all



Source: Department of Fisheries and Oceans, Newfoundland Region.

FIGURE 4.6: NORTHERN SHRIMP LOCATION AND ABUNDANCE, 1996.

catches be monitored at dockside at the fishermen's expense, and provides for a specific level of at-sea monitoring coverage. In addition, a letter of acknowledgment concerning capacity potential must be signed by each fishermen availing of vessel replacement under this policy.[31] While these new supplementary replacement rules modified the 45'-65' vessel class in terms of length and engine horsepower, there have been no requirements at all stipulated regarding refrigeration equipment or improved handling designs.

4.3 Turbot

This species has risen to new economic prominence in the Northwest Atlantic as a result of the cod moratoria. Its vast spatial distribution (Figure 4.7) does not match very well the geographical Divisions (Figure 1.1) devised by fisheries managers for administrative purposes. The turbot fishery is therefore subject to regional, national, and international considerations that create a wide variety of pressures which complicate the management of this resource. For example, the arrest of the *Estai* fishing for turbot in alleged contravention of international agreements in 1995, remains an unresolved international dispute at the present time.

There are three separate fleet sectors presently pursuing the turbot fishery; the large Canadian offshore fleet, the Canadian 45'-65' fleet, and the foreign-owned Scandinavian-

[31] Curran, Tom. Staff Officer, Fishery and Policy Innovations. Department of Fisheries and Oceans, Newfoundland Region. Personal Communication, May 12, 1998.

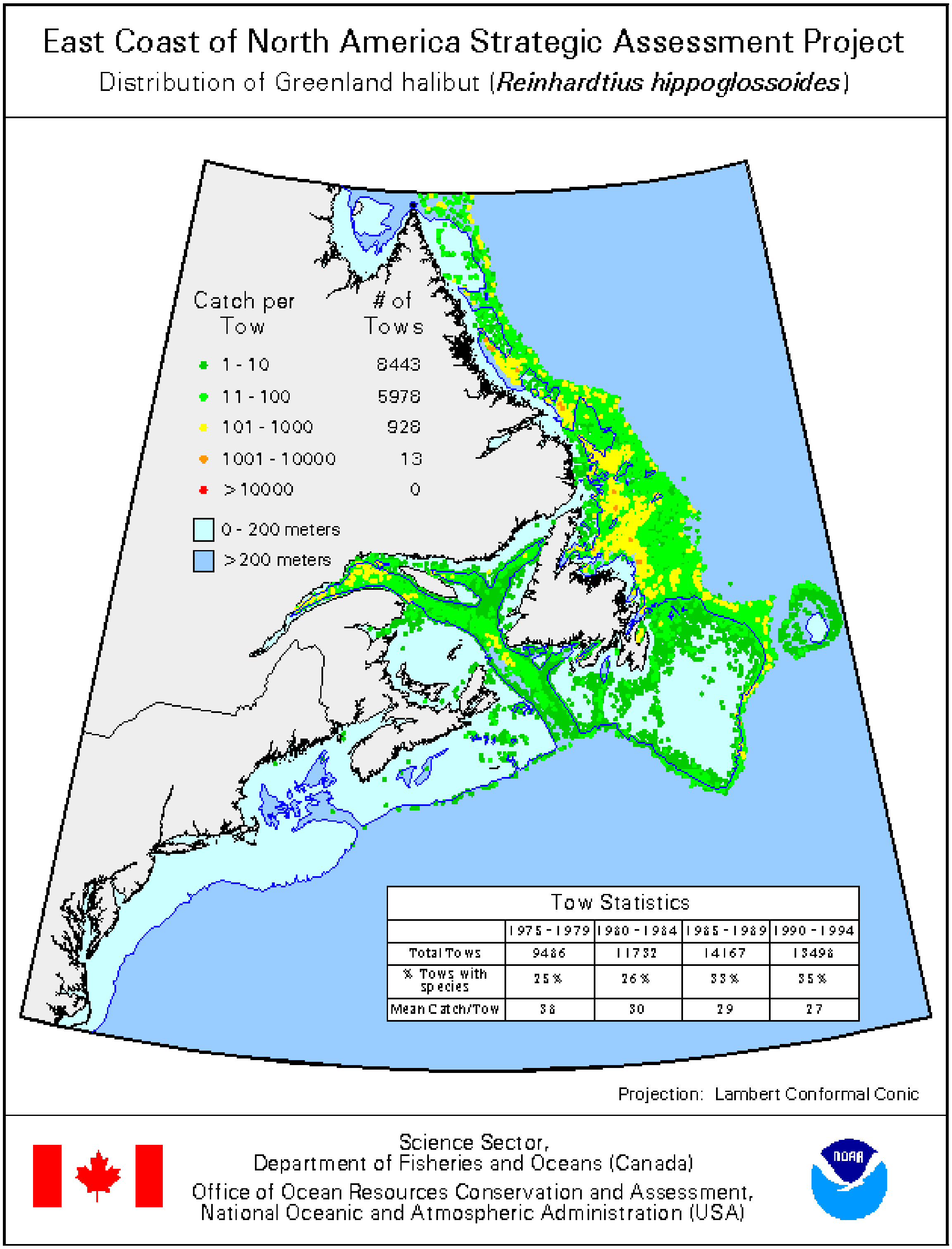


FIGURE 4.7: TURBOT DISTRIBUTION AND ABUNDANCE AROUND NEWFOUNDLAND AND LABRADOR.

type vessels of the 65'-120' class usually operated as charter vessels by Canadian companies. Outside Canada's 200 mile zone, the fishery is prosecuted by European Union (EU) countries and other North Atlantic Fisheries Organization (NAFO) members using large factory freezer trawlers.

The 45'-65' fleet delivers its catch iced either directly to production facilities, or via collector vessel from the Labrador coast. Production begins at dockside with an inspection process. Prices paid to fishermen currently vary from $1.54 per kilogram to $1.76 per kilogram depending on size and quality. Notably, only four vessels of 45'-65' in length are equipped with freezing capacity and can land the quality that command prices up to $3.75 per kilogram.[32] However, freezing at sea is a controversial issue with processors since there is a trade-off between the above considerations and unofficial government policy to maximize employment in onshore processing facilities.[33] Considerations of this trade-off is beyond the scope of this present paper. As previously stated, this report is primarily concerned with the safety, efficiency and product quality issues of the harvesting operation.

In regard to the 65'-120' foreign vessels used in the northern turbot developmental fishery, it has been argued that:

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[32] Simmons, Rex. President, A.M. P. Fisheries, St. John's, NF. Personal Communication, June 4, 1998.
[33] Warren, M. Director, Planning Services, Department of Fisheries and Aquaculture, Provincial Government of Newfoundland and Labrador. Personal Communication, May 29, 1998.

> "...under appropriate conditions, Canadian vessels have been able to harvest turbot profitability. In this context vessel and gear type are important considerations. Thus while large Canadian freezer trawlers, for example, may in current circumstances, incur harvesting costs that the processing sector cannot afford, gillnetters in the 65' to 120' class have been shown to be capable of delivering fish at a cost permitting profitable processing operations..." (Harris, 1993:2).

In a 1997 news release on turbot quotas for the Davis Strait fishery, the Minister of Fisheries and Oceans, announced that a total of 2,500 tonnes of the Canadian quota would be available to Canadian companies wishing to charter foreign owned Scandinavian-type vessels. In addition, the Nunavut could charter the foreign vessels to harvest the 600 tonne offshore portion and an exploratory quota of 300 tonnes in area 0A (Figure 1.1). It was noted that since the foreign charter fishery generated a significant amount of employment in several areas in Atlantic Canada, it was important that the use of foreign charters be phased out only gradually (Mifflin, 1997a).

4.4 Scallops

The scallop fishery in NAFO Division 3LNO (Grand Banks) is a so called limited-entry fishery with licenses restricted to residents of 2J3KLPs using 35'-65' vessels. Until 1993 there was little interest in the Icelandic scallop *(Chlamys islandica)* on the Grand Banks of Newfoundland. Earlier explorations for scallops were aimed at the larger scallop *Placopecten magellanicus*. However, declining opportunities in the groundfish sector, particularly for vessels in the 55'-65' class has rekindled interest in this mollusc. By

1994 a directed fishery for Icelandic scallop included 57 vessels, up from ten vessels in 1993 and only one in 1992 (DFO, 1997c). The actual catch is seen in Table 4.1.

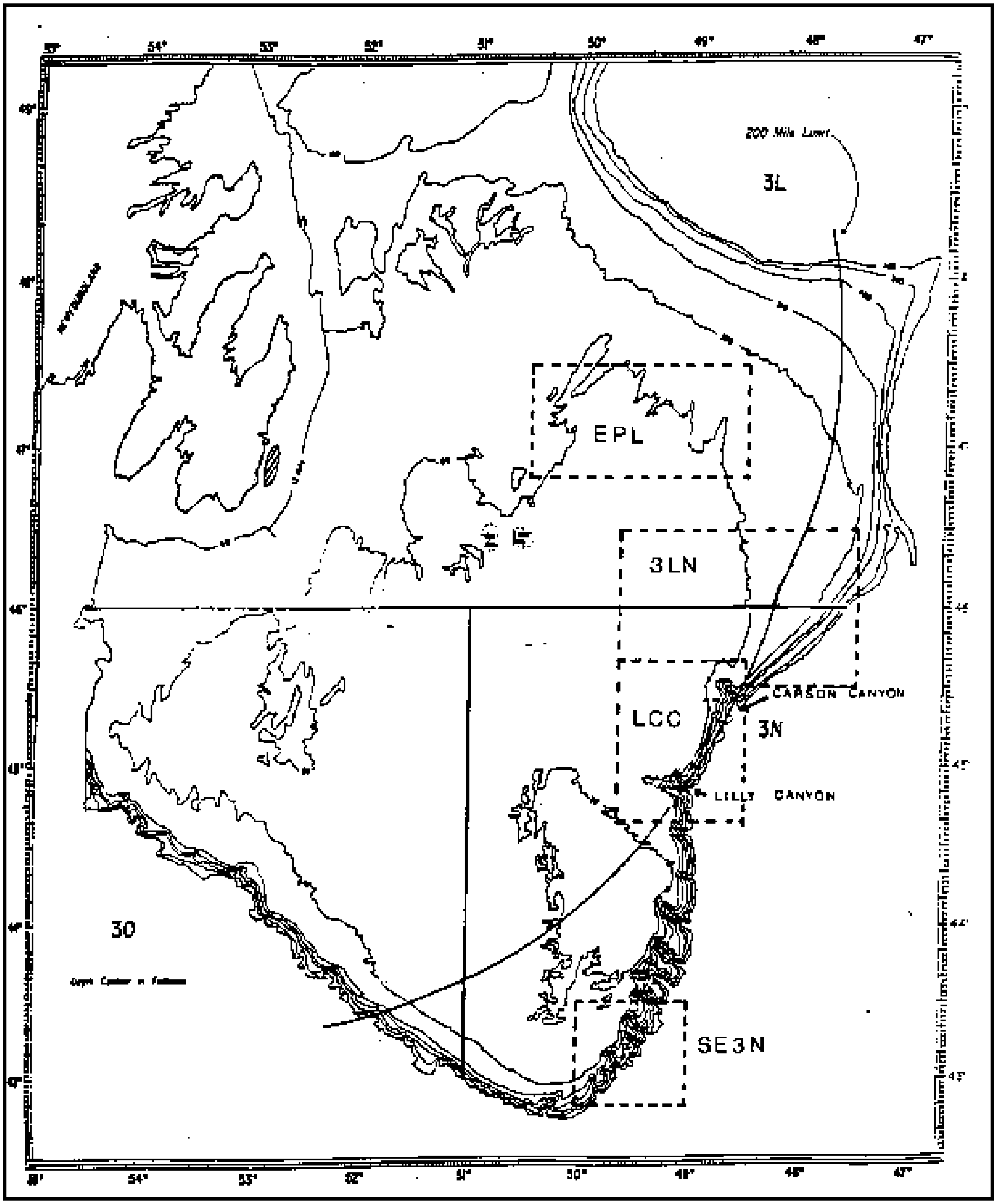
TABLE 4.1: NEWFOUNDLAND REGION 3LNO SCALLOP FISHERY BY YEAR.

Year	Number of vessels	Catch (RwKgm)	Value ($)	Avg. $/vessel	Avg. $/RwKgm
1994	57	3,555,168	6,268,673	109,976.71	1.76
1995	48	6,067,347	8,334,342	173,632.12	1.37
1996	55	9,325,678	13,952,472	253,681.30	1.50

Source: Adapted from Department of Fisheries and Oceans, 1997c.

Note that in the period 1994-96, a three-fold increase in the catch produced a slightly more than two-fold increase in the average dollar return per vessel, although the average price per kilogram fell. Over 90 percent of this catch came from NAFO Division 3N (Lilly Canyon and Carson Canyon areas) (in Figure 4.8**,** note location of 200 mile limit).

The fishery for Icelandic scallops on the Grand Banks commences in early April and continues to late October with some landings in November. The vessels used are the displaced longliners from the groundfish sector that would carry five to six crew members. However, for this scallop fishery, the harvesting and processing techniques involved require twelve to 14 men for up to a period of two weeks at a time with the vessels operating on a shift basis 24 hours a day. This fishery is located approximately 180-200 nautical miles offshore. This raises very serious concerns about safety and working conditions at sea. Hodder (1998) argues that the reason no alarm bells are being sounded



Source: Department of Fisheries and Oceans, 1997c.

FIGURE 4.8: LOCATION OF TAC ZONES FOR THE ICELANDIC SCALLOP FISHERY ON THE GRAND BANKS OFF NEWFOUNDLAND.

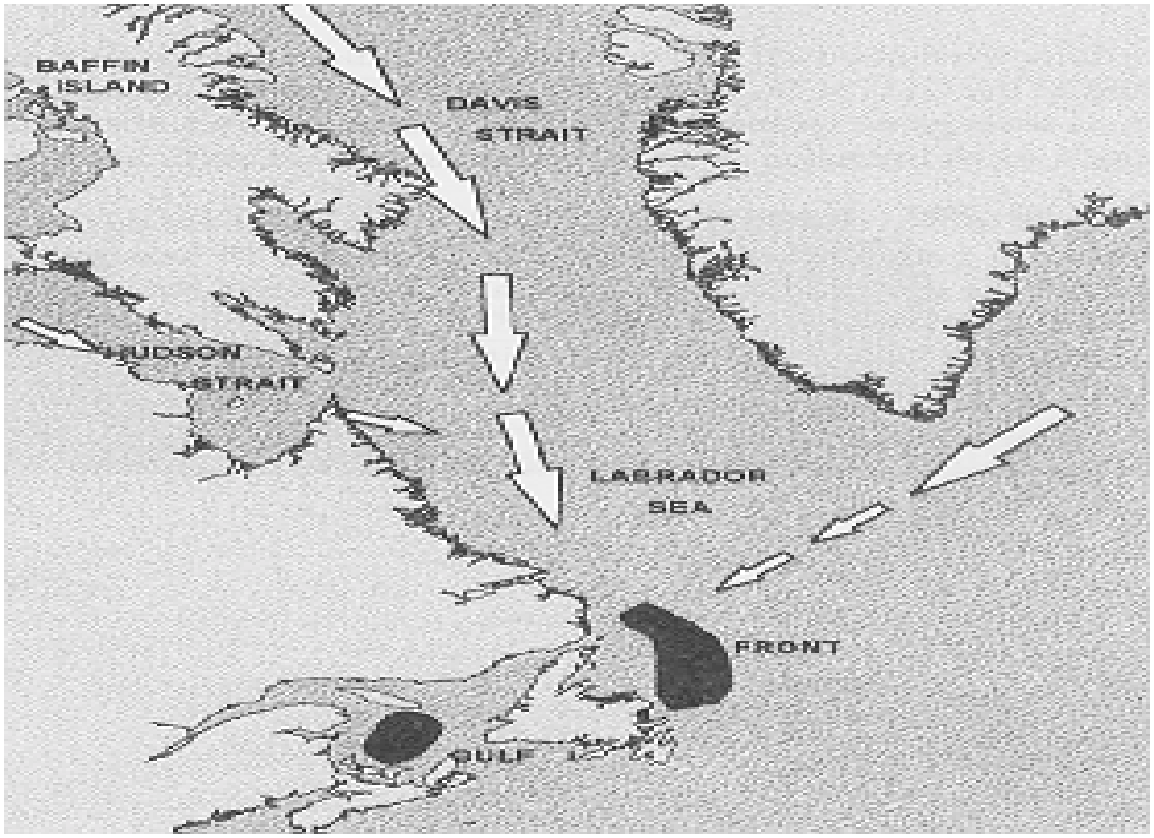
by crew members is concern about the widespread unemployment created by the collapse of the Northern Cod stock. With a limited number of berths, crew members realize their vulnerability and at present there is no code of standards for working or living conditions onboard these types of fishing vessels.

The price paid to scallop fishermen in 1995 and 1996 ranged from $8.81 to $15.43 per kilogram of cleaned meat. This is to be compared with the price per round weight kilogram (Table 4.1). The very considerable value added in processing speaks to the importance of ensuring that the quality of the landed product be as high as possible. The fishery is controlled by area specific quotas and additional exploratory areas are opened to fishing only with a preemptive quota which is subject to changes pending scientific advice (DFO, 1997c).

4.5 Seals

The collapse of the large vessel hunt for whitecoat pelts in the late 1980's, and findings of the *Royal Commission on Seals and Sealing* led to the prohibition in 1987 of the use of vessels over 65' in length.

In 1997, over 75 percent of the commercial harvest occurred on the 'Front' off the north and east coast of Newfoundland (Figure 4.9).



Source: 1998 Seal Harvest Management Plan, DFO.

FIGURE 4.9: MIGRATION AND LOCATION OF HARVEST AREA FOR SEALS OFF NEWFOUNDLAND.

The commercial harvest is now typically carried out by longliners or small boats. The commercial seal hunt involves harp and hooded seals, with some grey seals and ringed seals taken under special commercial licenses. The harp seal harvest ranged from a low of 20,000 animals in 1988 to 264,204 landed in 1997 (DFO, 1998b). The harvesting of seals today is aimed at the whole-animal utilization. This includes the seal pelts for fur and leather, and the seal meat with product and market development taking place in Asia. Seal oil, high in the Omega 3 fatty acid, has been said to have potential for human consumption and pharmaceutical/cosmetic purposes. Selected seal products can command high prices in Asian markets.

The ice conditions typically determine the harvesting success of the vessels less than 65’. One of the issues identified in the Atlantic Seal Harvest 1998 Management Plan (p19) was the desirability of using vessels over 65’ in length:

> “There has been some interest in the possible use of large vessels, as platforms to assist the existing small vessel harvest. While current government policy does not permit sealing from a large vessel, there is no policy against the use of a large vessel to collect, transport and process seals harvested by small vessels and as a possible safe haven during bad weather conditions. Industry proposals for large vessels may be given serious consideration, on a case-by-case basis, if additional sealing activity is required to meet market demands or if environmental conditions require assistance of this nature.”

Section 5.0: Newfoundland's Existing Fleets, Fishing Vessel Design and Global Competition

This section highlights some of the characteristics, in terms of size and technology, of other fishing fleets that fish for some of the same or similar species, and target the same markets as the Newfoundland industry.

In a report submitted to the Fisheries Council of Canada (Tavel, 1997:12) entitled *Responsible Fishing in Canada,* the authors had this to say about remaining competitive in a global marketplace:

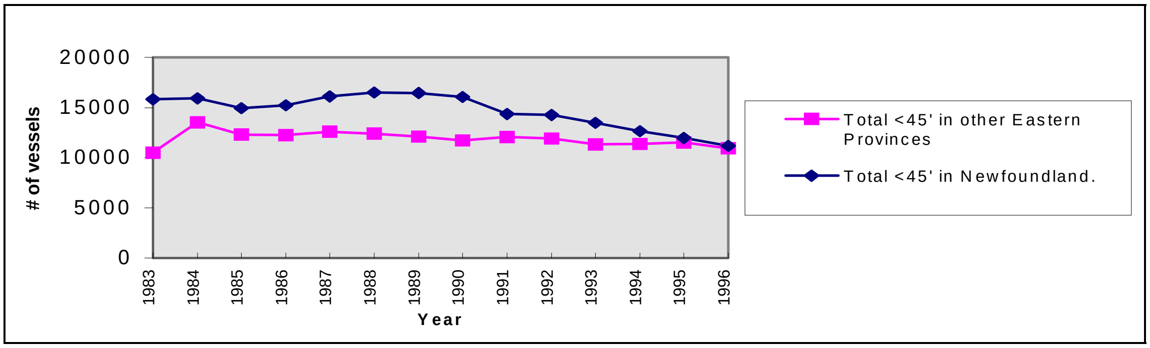
> "The increasing 'Globalization' of the international marketplace for seafood products may also place constraints on the type of fleet and fishing gear which is required. For example, if our competitors are using advanced fishing technology, we will probably be forced to do the same."

Presently the Atlantic fishing fleet, has three main fleet sectors. These fleet sectors and their development over time can be described as follows:

1. Vessels less than 45 feet operating mainly fixed gear, they usually have no covered deck and are suited only to operations close to land and day trips (Figure 5.1).

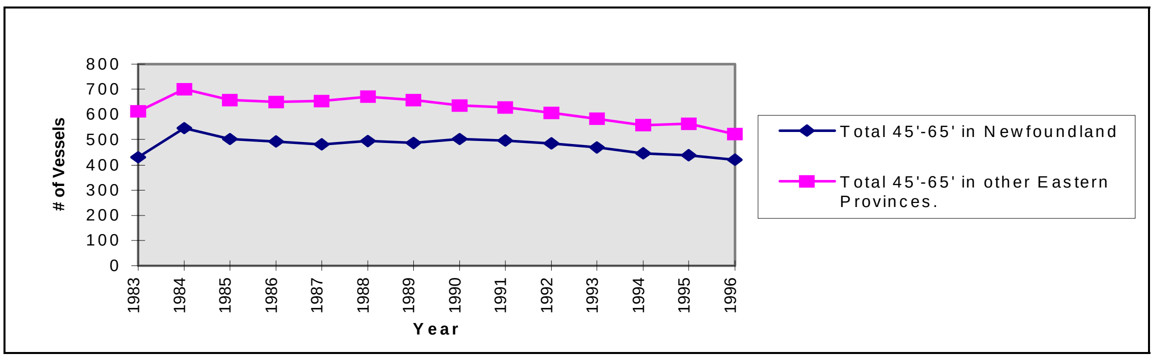
2. Vessels between 45 and 65 feet operating either fixed gear, mobile gear or both and can operate far from land during good weather, but have limited capability to fish in deep water. These vessels are owner operated (Figure 5.2).

3. Offshore vessels consisting largely of 150 to 170 feet trawlers using mobile fishing gear, are owned and operated by large vertically integrated fish companies and can operate year round at any distance from land (Cashin, 1993:3-4) (Figure 5.3).



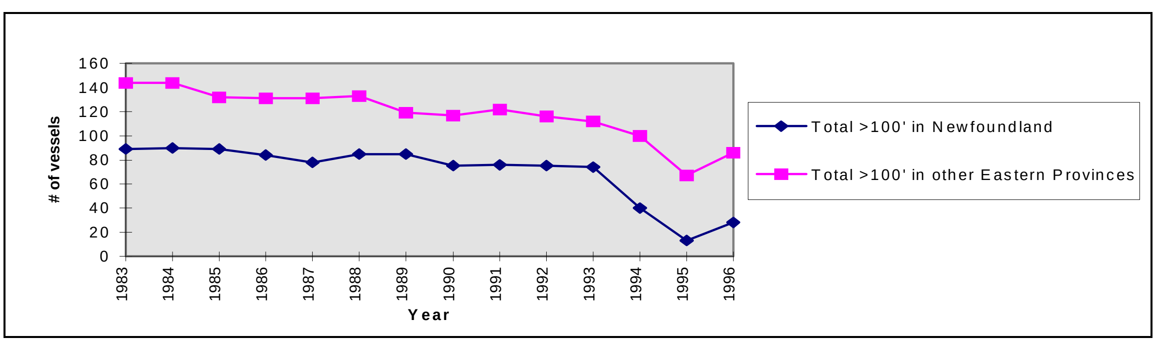
Source: Adapted from Department of Fisheries and Oceans, 1998a.

FIGURE 5.1: FISHING VESSELS <45' NEWFOUNDLAND AND OTHER EASTERN PROVINCES, 1983-96.



Source: Adapted from Department of Fisheries and Oceans, 1998a.

FIGURE 5.2: FISHING VESSELS 45-65' NEWFOUNDLAND AND OTHER EASTERN PROVINCES, 1983-96.

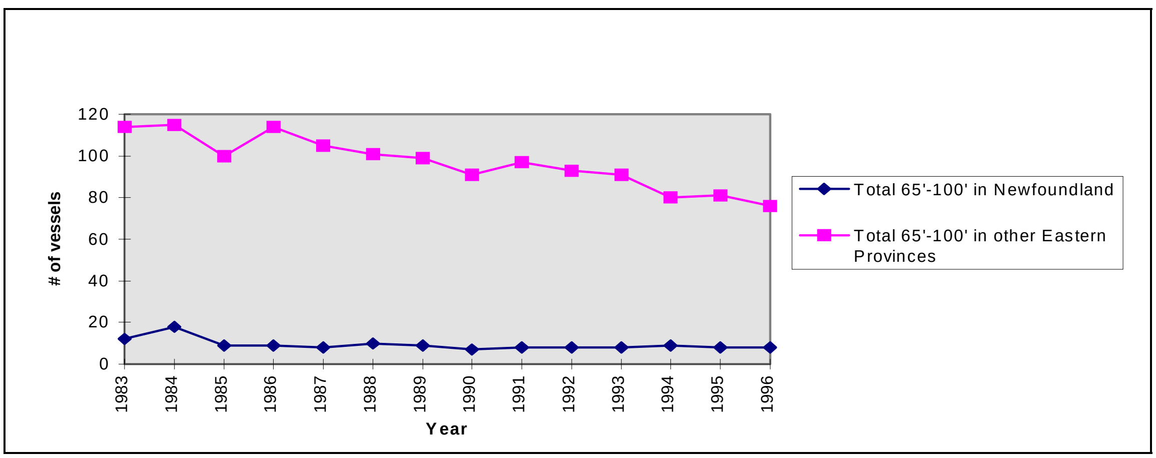


Source: Adapted from Department of Fisheries and Oceans, 1998a.

FIGURE 5.3: FISHING VESSELS >100' NEWFOUNDLAND AND OTHER EASTERN PROVINCES, 1983-96.

The rationale behind these size classes is not based on any economic or other type feasibility study. It is merely an arbitrary classification deemed convenient by the DFO when in 1976 the Department prepared for the implementation of the first (1977) groundfish management plan.[34]

In comparing the various fleet sectors it is interesting to note that there has been a general downward trend in all Eastern Provinces for the 45'-65' class and the <45' class vessel. In the 65'-100' class there has also been a downward trend in other Eastern Provinces other than Newfoundland. This size class remains relatively constant in Newfoundland with only eight vessels (Figure 5.4).



Source: Adapted from Department of Fisheries and Oceans, 1998a.

FIGURE 5.4: FISHING VESSELS 65'-100', NEWFOUNDLAND AND OTHER EASTERN PROVINCES, 1983-96.

[34] Curran, Tom. Staff Officer, Fishery and Policy Innovations. Department of Fisheries and Oceans, Newfoundland Region. Personal Communication, May 12, 1998.

However, in the over 100’ class there has been a significant increase from 1995 to 1996 with Newfoundland adding 15 vessels, while the Provinces of Nova Scotia and Quebec have added twelve and seven respectively since 1995 (Table 5.1).

TABLE 5.1: FISHING VESSELS >100’ BY PROVINCE, 1983-96.

Year	Nfld.	Nova Scotia	PEI	New Brunswick	Quebec	Total
1983	89	124	1	10	9	233
1984	90	124	1	10	9	234
1985	89	113	1	10	8	221
1986	84	111	1	9	10	215
1987	78	109	1	10	11	209
1988	85	106	1	11	15	218
1989	85	95	3	10	11	204
1990	75	92	4	10	11	192
1991	76	96	4	9	13	198
1992	75	92	4	9	11	191
1993	74	90	3	9	10	186
1994	40	79	3	9	9	140
1995	13	50	3	9	5	80
1996	28	62	3	9	12	114

Source: Adapted from Department of Fisheries and Oceans, 1998a.

This increase may best be explained by the increased abundance of northern shrimp realized in the 1996 DFO shrimp surveys (see Figure 4.6 above).

5.1: Vessel Design Efficiency and Safety at Sea.

Piche (1984:9) put legislation on fishing capacity and vessel safety into this perspective:

> “Fishing boat safety will only improve if the right climate is created for fisheries. The fisherman is attacked on all sides by legislation, governing where he can fish, how he can fish, what he can fish, and the type of boat he can use. This is not the right climate for safety.”

All vessels must meet safety standards, minimum stability requirements, and provide adequate accommodation for the crew. Efficient, economical and safe fishing vessels are required in any fishery, but vessel designs need to be particularly concerned with the end use and the environment in which the vessel is to be operated (Fitzpatrick, 1987). This section highlights the vessel requirements created by the dangers of pursuing resources as far as 200 miles from shore in 45'-65' fishing vessels. Some of the cost considerations of utilizing a larger vessel such as 65'-100' are also discussed.

According to the Transportation Safety Board of Canada, 618 fishing vessels 45'-100' in length have been involved in shipping accidents in the Newfoundland Region since 1975.[35] Twenty seven lives were lost as a result. More than 90 per cent of the boats were of the 45'-65' vessel class (Figure 5.5). Accident numbers are aleatory, but they decrease after the 1992 cod moratorium to their lowest numbers since 1983 for the 45'-65' vessels during 1993-95, but increase again in 1996. While more study is needed to determine the actual causes of these accidents, the trend seems to parallel the changes in the Northern Cod stock abundance. It is useful to adjust the raw accident numbers[36] for changes in the fleet size over time. The highest accident rate since 1983 occurred in 1997 (Figure 5.6).

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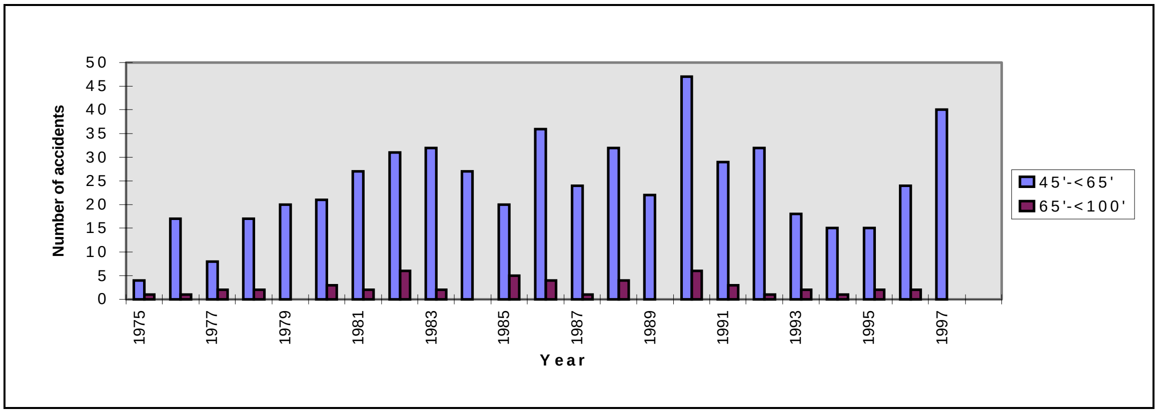
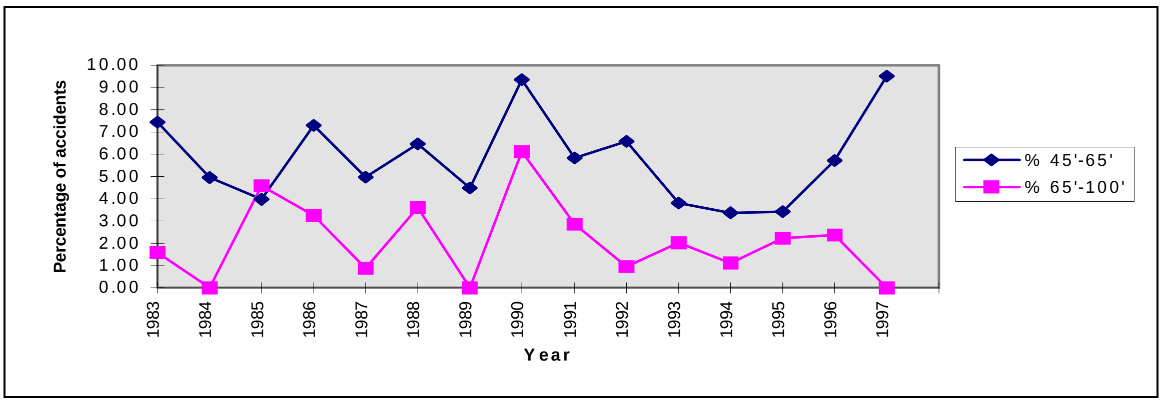
[35] Lavoie, Serge. Senior Data Analyst, Marine Safety Deficiency Analysis. Transportation Safety Board of Canada. Personal Communication, August 10, 1998.

[36] Accident rate for the 45'-65' vessels class was calculated by dividing the number of accidents by the number of vessels of that class registered in Newfoundland for that particular year. The 65'-100' rate was calculated by using the total number of 65'-100' registered vessels in the Atlantic Region.



Source: Transportation Safety Board of Canada.

FIGURE 5.5: NUMBER OF ACCIDENTS OF FISHING VESSELS BY SIZE CLASS OFF NEWFOUNDLAND, 1975-97.



Source: Adapted from Transportation Safety Board and DFO, 1998a.

FIGURE 5.6: ACCIDENT RATE BY SIZE CLASS IN NEWFOUNDLAND REGION FOR 45'-100' VESSELS, 1983-98.

This is likely associated with the increased fishing activity as these vessels headed further out to sea to harvest at new locations under riskier conditions. Similarly, the peak in 1990 may be associated with the movement of the 45'-65' fishing vessels offshore to the Virgin Rock fishery which was located some 80 to 90 nautical miles off St. John's. It may be assumed that as the 45'-65' vessels move further out to sea they will experience more severe weather, more equipment wear, more exposure to risk, and be further away from help if an emergency develops.

Further research into the actual causes of the increase in accidents in the years 1990 and 1996-97 may reveal that certain types or sizes of fishing vessels are unsuitable for the environment in which they now operate. If indeed there is a positive correlation between the design or size of vessel and the cause of the accident, the number of accidents may increase as fishermen seek to harvest more remote high-valued species.

5.2 Stabilization Systems for Fishing Vessels

It is well known that fishermen have circumvented the length ceilings implemented in 1976 by building wider vessels (Plate 5.1).

Photo by: C. Parsons courtesy vessel owner/operators, Port-de-Grave, 17/05/98.

PLATE 5.1: THE 65' VESSELS "EASTERN PRINCESS" ON RIGHT BUILT IN 1980 AND "ATLANTIC SEA CLIPPER" ON LEFT BUILT IN 1990. NOTE PARAVANES IN UPRIGHT POSITION ON BOTH VESSELS.

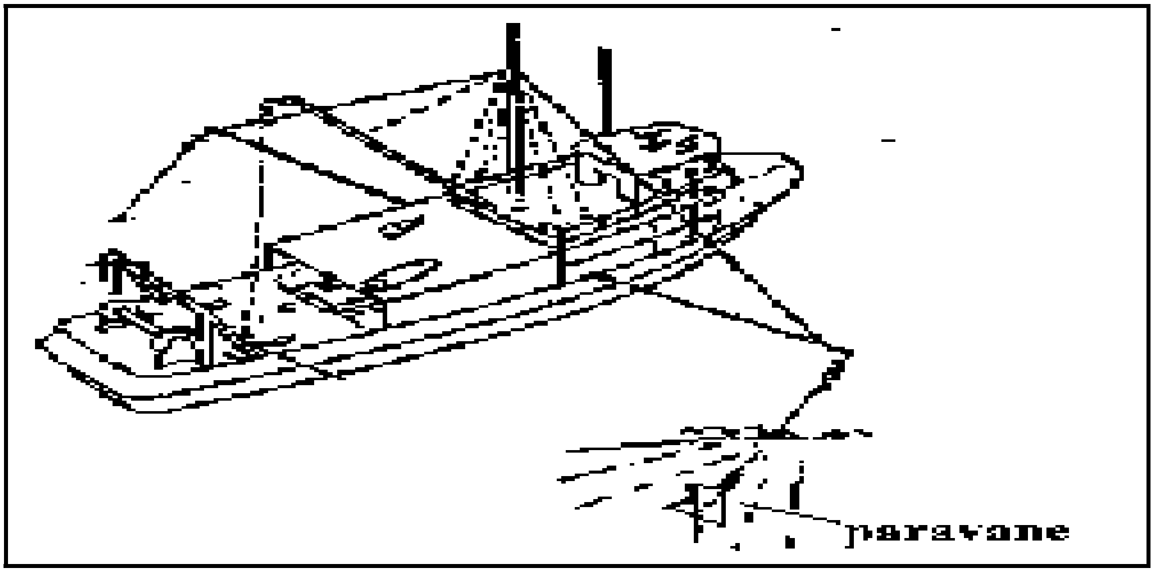
One result of this circumvention was overly wide beams and low centres of gravity in the 45’ to 65’ vessel class. This causes short roll periods from side to side with attendent sharp lateral accelerations when exposed to wave action (Bass *et al*., 1995). The degree of roll is generally dependent upon the type of vessel and the wave motion encountered. The rolling motion of the vessel is what commonly causes seasickness, and makes it more difficult to walk or work on the deck of the vessel. In extreme cases, excessive roll can cause the vessel to capsize (Way, 1995). In the Newfoundland fishery, there are currently two systems used on 45’-65’ vessels for roll stabilization. They are paravane stabilizers (or outriggers), and anti-roll tanks.

5.1.1 Paravane Stabilization System

The paravane system consists of two retractable booms (Figure 5.7), one located on either side of the vessel, which supports a cable connected to a paravane stabilizer, also known as a fish, that is immersed in the water. The paravane depends on a lift effect to operate efficiently in counteracting vessel roll. It is more effective when the vessel is moving rather than stationary. Several problems with this type of system have been identified by Bass *et al*. (1995).

1. Gear and paravane entanglement which often result in one or both paravanes being withdrawn when nets or pots are hauled or deployed.
2. When towed at steaming speed the drag of the stabilizers leads to increase fuel consumption.
3. Concern related to the dangerous situations arising from the loss of a paravane.

The loss of the M.V. Straits Pride II and three of the six crewmembers can be attributed to the loss of a paravane during a storm (Wellman, 1998).



Source: Bass *et al*. 1995.

FIGURE 5.7: PARAVANE STABILIZER IN DEPLOYED POSITION.

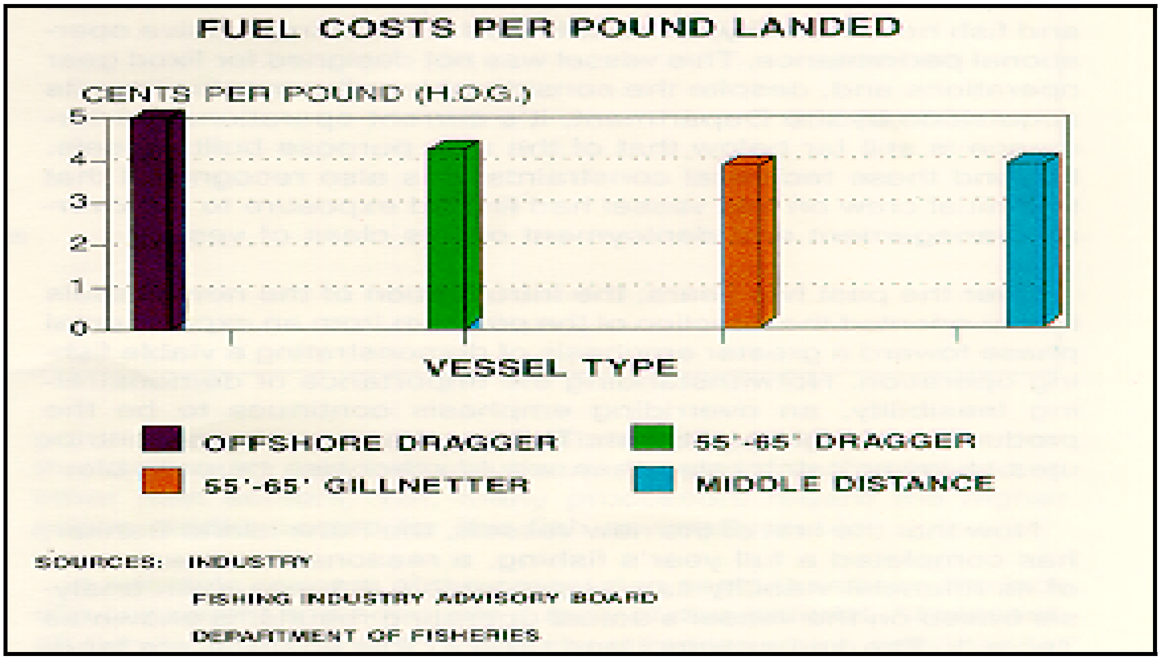
5.1.2 Anti-roll Tanks

Increased stabilization on small fishing vessels can also be achieved alternatively by installing the so-called passive or anti-roll tank system. This system involves a baffled tank on the deck of the vessel partially filled with water. As the vessel rolls in one direction, the water in the tank moves in the opposite direction. The side to side movement of the water lags the vessels roll motion just long enough to counteract it. While this system has been found to reduce vessel roll by 50 per cent in 50 knot winds, the system cannot be safely adapted to all vessel designs. Each vessel must be assessed for suitability by qualified personnel in order to properly design and locate an effective and safe anti-roll tank. The deck must also be able to support the added weight of the system (Way, 1995).

5.3 Fuel Efficiency

It is generally recognized that larger vessels require more fuel per hour of operation than a smaller vessel utilizing similar fishing methods. Deploying small vessels may therefore produce marginal results in some fisheries. In an industrial fishery this is typically not a viable operational strategy. Dopplinger (1981) states that it is instead necessary to develop more efficient vessels and more efficient fishing gear, and to use them in the most efficient combinations. Dopplinger uses a specific cost index for fuel and price of the catch, and shows that high fuel use may be profitable combined with a relatively low catch of a high valued species. For example, shrimp trawling by offshore trawlers appears to give a better use of fuel on a cost basis than does otter trawling for groundfish, even though the yield in weight for shrimp is lower.

O'Rielly (1988:9), using fuel and harvesting cost data from industry, shows that the fuel costs of the Middle Distance vessels were somewhat lower than that of the trawler fleet, and comparable to the fuel costs incurred by inshore gillnetter operations (Figure 5.8).



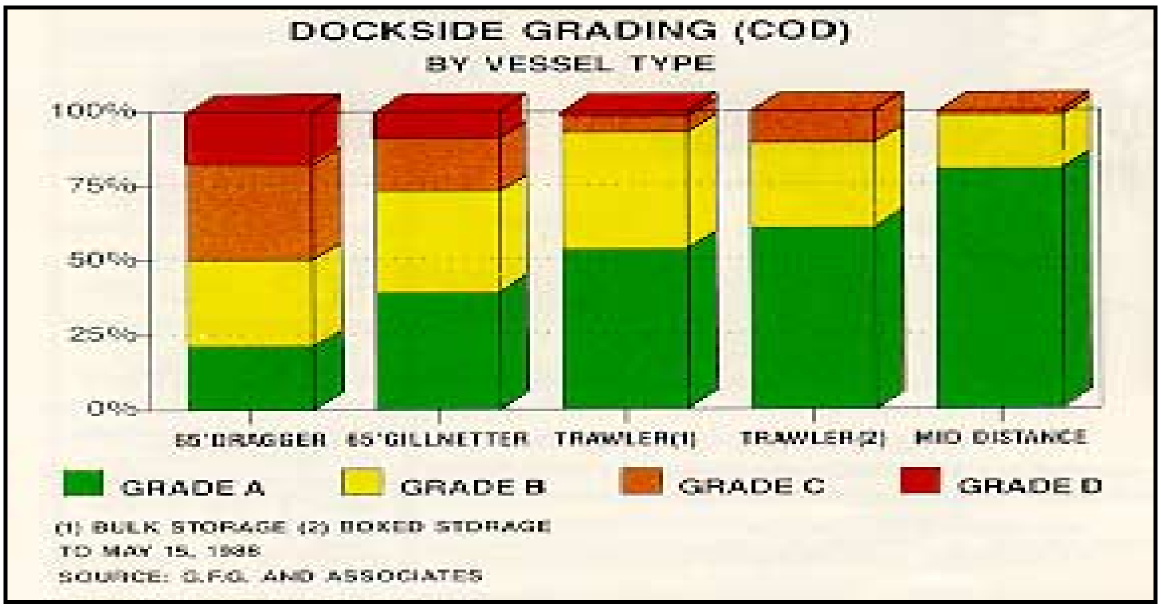
Source: O'Rielly, 1988.

FIGURE 5.8: FUEL COSTS BY FLEET SECTOR.

Another means of reducing fuel cost is sail assisted fishing. This has been practiced in Newfoundland fisheries since the days of steam powered schooners. It is still used today by modern longliners. Morey (1981) suggests that a new vessel design for a 96' longliner could give up to 40 percent savings in fuel used. This is higher than for a retrofit vessel because in the new design the sails are taken into consideration as well as the hull shape, and better coordination of engine gear and propeller ratios. At present, the design of the 45'-65' vessel is not considered energy efficient because fishermen have circumvented the length restrictions by building wider vessels to meet the maximum cubic numbers allowed for the size class. This has resulted in large volume holds, but slow and fuel-inefficient vessels (Fishing Industry Renewal Board, 1996).

5.4 Product Handling and Price Differences

Recall that the original design of the 45'-65' vessel class of fishing vessel was primarily intended for groundfish operations. These fishing vessels were designed, and in practice limited to the traditional groundfish species, i.e., cod, pollock, haddock, and flatfish. These species kept well in ice. Provided vessel trips were not of excessive duration, fish of an 'acceptable' quality could be landed (Murphy, 1979). A comparison of groundfish (cod) landed from the larger mid-distance vessels with other fleet sectors reveals the advantage larger vessels have in landing a higher quality product. The superior quality performance of the Middle Distance fleet is apparent from Figure 5.9 indicating the highest content of Grade A amongst the five vessel categories studied.



Source: O'Rielly, 1988.

FIGURE 5.9: COMPARISON OF THE QUALITY OF GROUNDFISH LANDED BY VARIOUS FLEET SECTORS, JANUARY-MAY, 1988.

More research is needed on species-specific relationship between vessel size (type) and the quality grade of landed product in today's fishery. Such research should take the following factors into consideration.

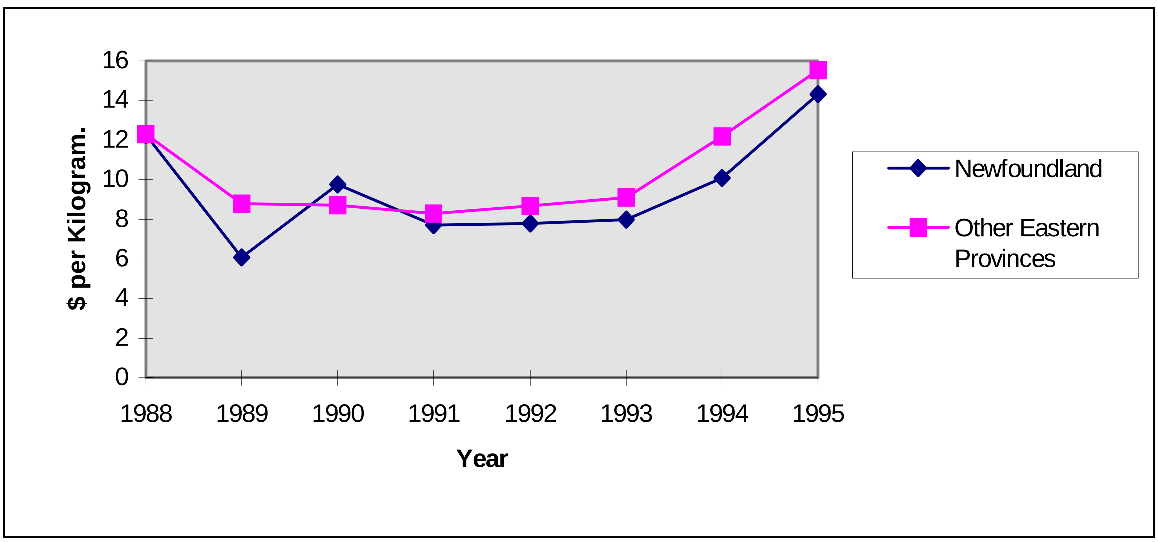
Snow crab

Snow crab are extremely vulnerable to environmental change. Crab suffer from thermo-shock in leaving very cold waters at the ocean floor for the much warmer conditions at the surface and onboard the vessel. As a result, the quality of crab landed can be drastically affected. Since it is illegal to process dead crab, the mortality rate of crab is an important determinant of profitability (O'Leary, 1986). The present practice in Newfoundland is to keep crab in cool, moist conditions onboard by taking adequate ice from a processing facility onshore and then ice each individual box of crab at sea. The trend for new fishing vessels in competing countries is to have salt water flake ice making equipment incorporated into the original design of the vessel. The new orientation in world fishing practices according to Jeffs (1997a) is not to increase catch in order to maximize income. Increases in income will instead come from the higher unit price fetched by landed products of higher quality. This requires the promotion of quality awareness in the Newfoundland fishery.

Two reasons for price differences between Newfoundland and Labrador crab and crab from Alaska have been identified: (i) intrinsic characteristics (barnacles and colour), and

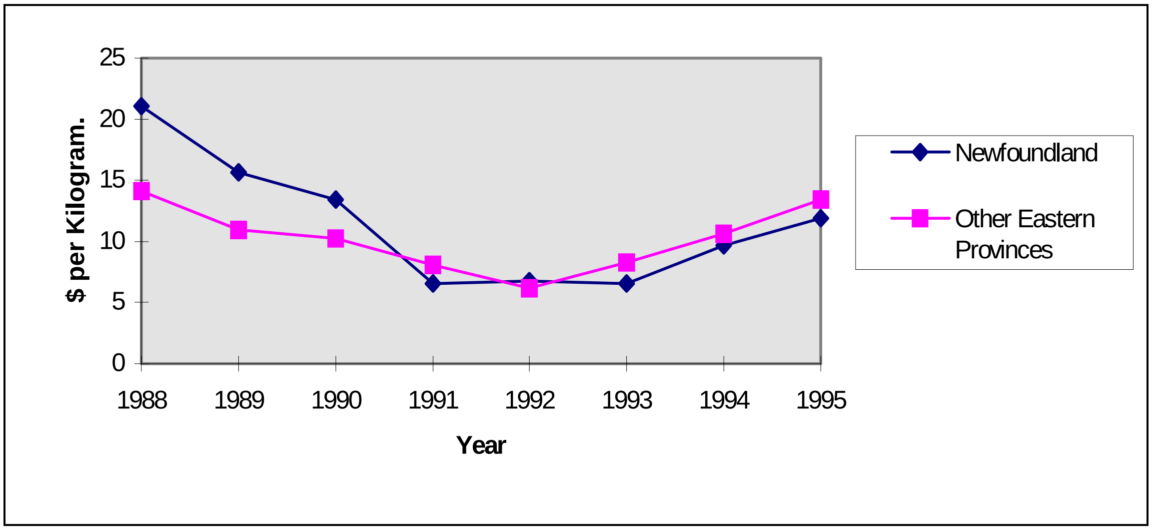
(ii) differences in the quality arising from differences in timing, speed and condition under which crab is harvested (Vardy *et al.*, 1998:10). Snow crab, unlike groundfish, must be brought to shore in a live condition, sometimes from beyond the 200 mile limit. It has been suggested that one way of improving snow crab products is to use refrigerated sea water systems onboard existing vessels. Further research is needed to determine a correlation between the size of vessels, distance harvested from the landing port and the economic return.

After the cod moratorium in 1992 and the movement of vessels further offshore, it is interesting to note that in the snow crab industry the export price of product from Newfoundland has been persistently lower than that of the other Eastern Provinces. This holds for both the Japanese (Figure 5.10) and the United States (Figure 5.11) markets.



Source: Statistics Canada, 1998.

FIGURE 5.10: PRICE OF CRAB EXPORTS IN CURRENT DOLLARS TO JAPAN FROM NEWFOUNDLAND AND OTHER EASTERN PROVINCES, 1988-95.



Source: Statistics Canada, 1998.

FIGURE 5.11: PRICE OF CRAB EXPORTS IN CURRENT DOLLARS TO THE UNITED STATES FROM NEWFOUNDLAND AND OTHER EASTERN PROVINCES, 1988-95.

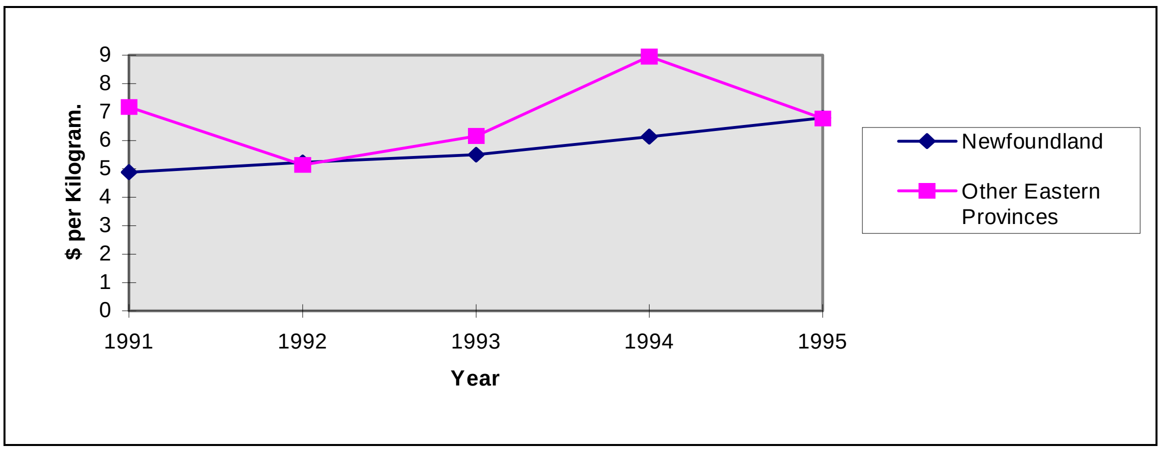
Shrimp

When shrimp is landed for processing, quality is determined by smell, texture, broken shrimp and discolouration. The discolouration of the shell (*melonosis* or blackspot) is natural and occurs as the shell and meat are removed from the water. In order to avoid *melonosis* shrimp must be processed as soon as possible (Anon., 1998). By freezing within hours of harvesting, shrimp can in effect be frozen raw and therefore command a premium price in the Japanese Sushi market.[37] Large offshore shrimp vessels already employ this processing technology off the coast of Newfoundland and Labrador. In British Columbia, where distance and weather conditions are not the same as the North

[37] Hann, Sid. Seafood Instructor, School of Fisheries, Marine Institute, Memorial University of Newfoundland and Labrador. Personal Communication, May 22, 1998.

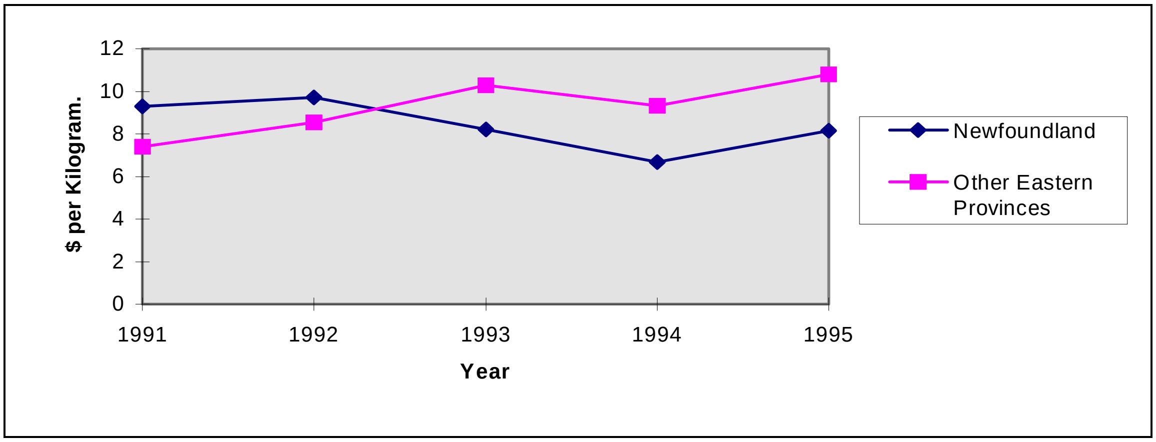
Atlantic, fishermen are also increasing their return by installing refrigeration systems with a freezing capacity of 365 kilograms a day onboard their 24 foot prawn boats (Anon., 1990). By contrast, onboard the 45'-65' fishing vessel from Newfoundland the shrimp is stored in 15 kilogram onion bags, iced in bulkform and delivered to the closest landing site from where it is trucked to fish plants located throughout Newfoundland for further processing.

As with snow crab, Newfoundland again receives less per unit comparable product than the other Eastern Provinces in both the Japanese (Figure 5.12) and the United States (Figure 5.13) markets.



Source: Statistics Canada, 1998.

FIGURE 5.12: PRICE OF SHRIMP EXPORTS IN CURRENT DOLLARS TO JAPAN FROM NEWFOUNDLAND AND OTHER EASTERN PROVINCES, 1991-95.



Source: Statistics Canada, 1998.

FIGURE 5.13: PRICE OF SHRIMP EXPORTS IN CURRENT DOLLARS TO THE UNITED STATES FROM NEWFOUNDLAND AND OTHER EASTERN PROVINCES, 1991-95.

Turbot

It is widely recognized in the industry that there are quality problems associated with turbot landed by 45'-65' vessels. Canadian turbot processors cite 'bruising' and 'sourness' as the main problems. Bruising results from extended soak times due to the limited ability of these vessels to operate in inclement weather, and onboard handling techniques. Sourness is a result of excessive trip duration and distance from port. These problems result in lower prices paid to fishermen operating 45'-65' vessels compared with the large Canadian wetfish and foreign offshore factory freezer trawlers.[38] Again, as with crab and shrimp, Newfoundland harvesters are receiving less for turbot products than the other Eastern Provinces (Figures 5.14 and 5.15).

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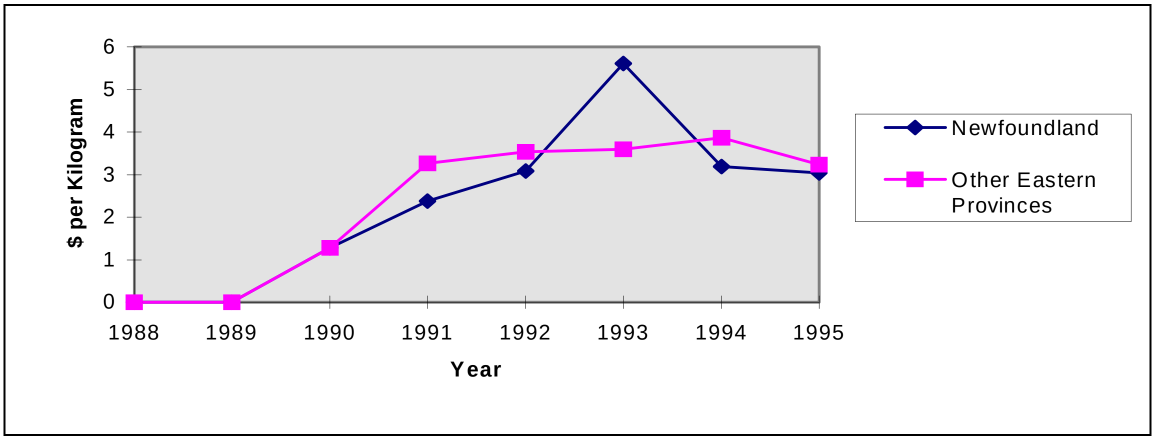
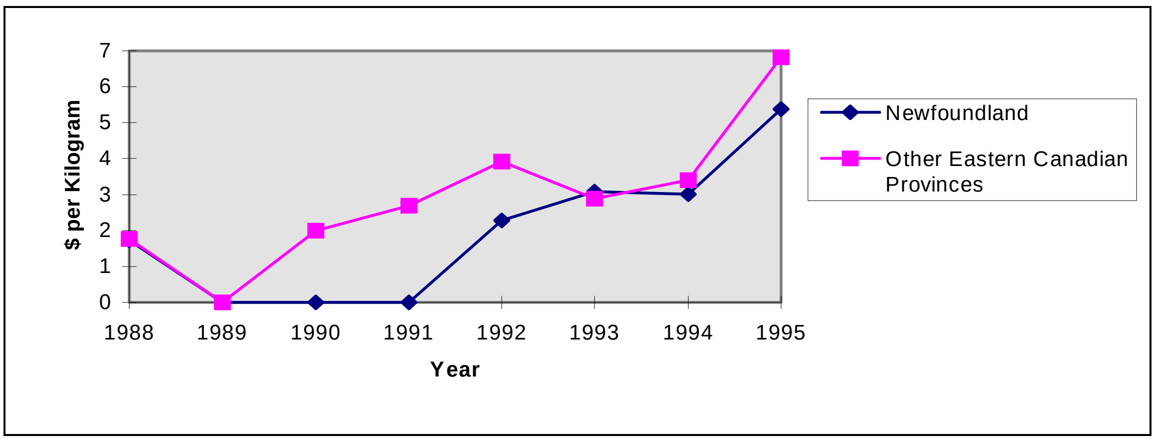
[38] Gibbons, Roy. Instructor, Fishing Technology Unit, Marine Institute, Memorial University of Newfoundland. Personal Communication, May 21, 1998.



Source: Statistics Canada, 1998.

FIGURE 5.14: PRICE OF TURBOT EXPORTS IN CURRENT DOLLARS TO TAIWAN FROM NEWFOUNDLAND AND OTHER EASTERN PROVINCES, 1988-95.



Source: Statistics Canada, 1998.

FIGURE 5.15: PRICE OF TURBOT EXPORTS IN CURRENT DOLLARS TO JAPAN FROM NEWFOUNDLAND AND OTHER EASTERN PROVINCES, 1988-95.

In summary, the greatest challenge facing the fishing industry in Newfoundland is the ability to safely harvest and market the landed catch at prices that cover the relatively high costs of harvesting, transportation, and processing. Further study involving this comparison of value returns to various vessel sizes is worth pursuing. Based on the preliminary analysis in this study, there may be a significant correlation in these returns based on the size of vessel utilized and the distance traveled to and from the fishing grounds. If so, the key element of the response to this challenge must be an emphasis on quality. Quality cannot be improved once the harvest has reached the wharf. High quality must be secured and maintained when the resource first comes onboard the fishing vessel. Consumers in Asia, Europe, and North America pay a premium for top quality product but reject outright product that does not meet their specifications of quality. Therefore, it is essential that fish harvesters be able to improve the quality of the landed catch if industry is to compete successfully on world markets. This calls for an appropriate, state-of-the art vessel designed to fish offshore areas. Crutchfield (1979:746) observes that “the vessel is after all, only a platform that carries harvesting equipment.” Kesteven (1995) noted that it is not the effort but the appropriate quantity and quality of the allowable catch that matters. These concepts have not been lost by our competitors.

5.5 Trends in World Fishing Vessel Design

Of the 82 fishing vessels on order around the world in 1994 approximately 28 percent were 65.6’ to 131.2’ in length (Baird, 1995). In 1997 this size class accounted for 41 percent (Jeffs, 1997b). A review of these vessel specifications reveals that the new international approach to vessel design focuses on efficient, economical, and safe vessels that can harvest and preserve catches of higher quality rather than quantity. Fishing vessels now being built for New Zealand, Scottish and Faeroe fleets are not ‘additions’ to the fleet, but instead ‘replacement’ vessels. Some of the specifications incorporated into the design of such vessels are:

- comfortable crew accommodations for 12 to 14,
- insulated chilled fish rooms,
- freezing tunnels capable of freezing 200 kilograms of shrimp every 8 hours,
- ice-making capability at sea, producing up to 6 tonnes/day.

For example, in Alaska where *opilio* crab is harvested for the Japanese market, there are vessels which are 98 feet in length and equipped with refrigerated sea water capabilities, brine freezers, bait freezers and fish holds that can freeze to minus 10 or 20 degrees centigrade (Chambers, 1998).

Section 6.0: Fleet Replacement and Resource Management

It should be clearly recognized and understood that there are many difficulties in introducing and enforcing management measures which would simultaneously meet the requirements of preserving the stock, making the fishing enterprise viable, and satisfying the requirements of the market. The purpose of this section is to outline various fishery management techniques now used in the multispecies fishery of Newfoundland. The aim is to draw attention to ways of controlling fishing effort other than restricting the length of a fishing vessel.

The principal reason for controlling fishing effort expended on any commercial marine species is to control the catch per unit effort (CPUE), which in turn determines the returns that a fishing enterprise can obtain from exploiting a particular species. According to Doucet (1983), the methods of controlling fishing effort can be divided into two categories: those that control inputs and those that control the output. The first category includes at least the following: (i) restrictions on the size and power of the vessel, (ii) the amount and type of fishing gear, (iii) the kind of technology to be used, and (iv) the number of days a vessel is permitted to fish. The second category includes the following at a minimum: (i) an allocation of a commercial species to each enterprise in the form of an annual quota, (ii) a limit of the amount of fish per trip, per week or per month, and (iii) a limit on the number of trips for a given time period. Both categories place limits on the number of vessels licensed to participate in a fishery.

This brings us back to the fundamental issue raised in this paper: will maintaining a maximum length restriction of 64’11” allow the degree of advancement required for efficient development in the light of clearly defined management objectives? The Fisheries Resource Conservation Council (1993:9), in addressing the overcapacity issue in the groundfish fishery, states that: “measures such as limited entry and vessel replacement guidelines generally have not been effective in curtailing or reducing capacity.” Bell (1978) argues that such measures ration effort on the basis of criteria established by law and not the market mechanism. Levelton (1981:58) states that

> “replacement guidelines should not be overly rigid and not the same for all fisheries, even on a relative basis. A balance must be struck between permitting technological increase but controlling it so that it does not get out of hand. The management objective for each fishery must take active account of the technological and associated economic and biological consequences of vessel replacement allowances.”

The following subsections highlight control measures that can help curb the overcapacity issue and at the same time bring sustainability to a fishery.

6.1 Professionalization and Certification of Fish Harvesters

The recent initiative to professionalize and certify Newfoundland and Labrador fish harvesters is intended to reduce capacity and help contribute to resource management.

Newfoundland fishermen realize that in a modern fishery, there must be controlled access to the resource and efficient management of that fishery. In 1988, fishermen themselves took the lead in implementing a professional status. Five years later the *Report of the Task Force on Incomes and Adjustment in the Atlantic Fishery* (Cashin, 1993:71-2) states that:

> "Professionalization will mean restricting access to the fishery: this must be explicitly acknowledged from the beginning...With strong professional organizations, it will be possible for fishermen to participate actively in conservation policies and programs that will reduce and remove excessive pressure on the resource. Also, it will be possible for them to be central players in any program to reduce excess capacity in the various fleets affected by the groundfish crisis."

More recently it has been estimated that between 1990 to 1996, 20,000 - 22,000 fishermen were registered as having either full-time, part-time or temporary fishing licenses. In 1997, 16,582 fishermen were registered under the Professional Fish Harvesters Certification Board's new criteria, a reduction of approximately 20 percent. In 1998 the number registered was 15,795. This certification by the board is a requirement for participation in a commercial fishery and for consideration of a license from the DFO.[39]

[39] Smith, Boyd. Executive Director, Newfoundland and Labrador Professionalization Fish Harvesters Certification Board. Personal Communication, August 7, 1998.

6.2 Enterprise Allocations

The term fishing enterprise refers to the sum of an individual fishermens investment in vessels, gear, shore facility and operating capital. Enterprise allocations (EAs) are the total level of allocations assigned to an individual enterprise for a particular stock(s) expressed in volume (and percentage) terms. Enterprise allocations were introduced on a voluntary basis for the offshore fleet in 1982 and for the middle-distance fleet in 1988 (Hache, 1989). The concept of EAs implies that vessel replacement restrictions are not needed. Each enterprise would seek to invest in the appropriate number and size of vessel necessary to harvest its enterprise allocation. In contrast to competitive fishing, there would be no tendency towards over-investment in the fleet (Atlantic Fisheries Service, 1986)

6.3 Individual Quotas

In the Newfoundland Region, the use of output control measures such as individual quotas (IQs) is increasing. In the snow crab fishery, all fleet sectors support the continuation of individual quota programs. Some sharing arrangements such as historical fishing performance and vessel mobility have been agreed upon and most fleets have agreed to share fleet sector quotas on an equal basis. However operators of smaller vessels are requesting increased shares in management zones close to shore or adjacent to their homeport. In order not to increase effort on these inshore stocks small boat operators are suggesting that the larger vessels be restricted to fish crab primarily in areas further offshore (DFO, 1997a).

For inshore vessels recently operating in Shrimp Fishing Area 6 of the Newfoundland Region the fishery will initially be conducted on a competitive basis. However, the concept of IQs are to be reassessed as the fishery progresses and if IQs are to be introduced, all licensees will participate on an equal basis (DFO, 1997b).

6.4 Individual Transferable Quotas.

Individual transferable quotas (ITQs) are important in rights-based management and offer the potential of meeting objectives of sustainability and economic viability. ITQs allocate a total allowable catch among fishermen in the form of individual harvesting rights. According to Grafton (1996) they can improve product quality, increase safety at sea, and reduce the race for the fish. In Atlantic Canada, ITQ programs for the Gulf Mobile-gear of the southern Gulf of St. Lawrence were established for 50' to 65' vessels in 1989 and for 45' to 49' vessels in 1992. As well, Gulf shrimp ITQs were established in the Gulf of St. Lawrence shrimp-fishery in 1991, which included 49 vessels from Quebec and 22 vessels from New Brunswick. The Scotia-Fundy mobile-gear <65' has had an ITQ program in place since 1991. An important feature of this program is dock-side catch monitoring paid for by fishermen. It monitors 100 percent of all landings and records individual catch and fishing-effort data for each vessel.

ITQ management may also reduce the need for certain types of regulations and input controls. Arnason (1990) proposes that by enabling fishermen to harvest year round, a higher quality product may be landed. Further to this, by enabling fishermen to spread their fishing effort over a longer period, ITQs can prevent sharp falls in prices brought about by a large increase in supply when fishing occurs on a competitive basis, which tends to shift effort toward the present.

6.5 Vessel Trip/Weekly Landing limits

Trip limits are presently used in the snow crab fishery. They are set in accordance with the overall TAC. For example, the large vessel supplementary fleet in 3L will have maximum landing limits of 11,340 kilograms per trip with a maximum of 22,680 kilograms per week (DFO, 1997a). Arnason (1996) and others have argued that individual vessel quotas constitute a private property right in total harvesting quantity because each fisherman's use of the fish stock is restricted by his/her quota holdings. The common property nature of the fishery is therefore greatly reduced.

6.6 Gear Limits

Fishing effort is a function of the amount of time the fishing gear is used. If only one type of gear (for example the Japanese conical crab pot) is used, all units of gear are assumed to be of equal efficiency and fishing practices are relatively standard, then fishing effort is equivalent to the total amount of time spent fishing (Sissenwine and Kirkley, 1982). In Newfoundland, for the full time crab fleet in areas 2J3KL the maximum number of traps assigned to any full time license is 800 (DFO 1997a). The size of the harvest is thus limited, independent of the vessel used in the fishery.

6.7 Gear Selectivity

Gear selectivity can prevent overfishing in a biological sense. Gear selectivity in terms of mesh regulations are among the most common tools of use in fisheries management. It can be used to reduce the fishing mortality of young or small fish, undesirable by-catch, and overall fishing mortality (Sissenwine and Kirkly, 1982). One of the major challenges for fisheries management in the future will be to design and implement harvesting policies that promote the use of more species-selective fishing practices. Wilen (1988) notes that certain gear characteristics offer few competitive options to pursue. Also, if vessels are designed to work during a longer period of the year, the investment must be larger and the boat must be made to use more efficient fishing methods (Traung, 1965).

6.8 Conservation Harvesting Plans

Beginning in 1996 the Department of Fisheries and Oceans included the requirement that fishing fleets establish a Conservation Harvesting Plan that is approved by the DFO before fishing begins (DFO, 1996). As noted in Section 2.0, these plans are drawn up for each species and include TACs, seasonal and area closures, small fish protocols, bycatch limits, as well as details on the technical specifications for each fishing method (Fisheries Resource Conservation Council, 1996).

6.9 Individual Harvesting Restrictions

Individual Harvesting Restrictions (IHR) were introduced to designated fisheries in 1997 and stipulate the maximum share of an assigned fleet quota for a specific stock that can be harvested by an individual fisherman. This catch limit per vessel allows all core fishermen[40] in the 35'-65' classes to increase their vessel size to their maximum limits of 44'11" and 64'11." All fishermen increasing vessel size under the IHR are required to sign a letter of acknowledgment outlining the terms and conditions under which the larger vessel is registered. In addition, all catches must be monitored at dockside and an agreed amount of at-sea observer coverage must be provided at the fishermen's expense (Mifflin, 1997b).

These types of controls outlined above can improve the viability and sustainability of a fishery while at the same time allowing the industry to choose replacement vessel designs that are more appropriate for the fishery in question. However, the maximum vessel length description dating back to 1976 applied mainly to an inshore groundfishery. In addition, an administrative plan of vessel classification was necessary in order to implement the new 200 mile EEZ in 1977. These length restrictions therefore are still underlying today's new diversified fishery.

[40] Must have Professional Level II status and usually owns several licenses, i.e. Groundfish, tuna, crab, shrimp, capelin etc...

Section 7.0: Discussion and Conclusions.

Summary

This study aimed to establish the rationale of using 64’11” as the maximum length restriction, and to draw out the implications of such restrictions for future development of the Newfoundland fishery.

The vessels in the Newfoundland fishing fleet are categorized in five different size classes; (i) <35’, (ii) 35’-44’11”, (iii) 45’-64’11”, (iv) 65-99’11”, and (v) >100’. This classification system has long served as a corner stone in the implementation of fisheries policy in the Province. This system, devised when groundfish was still the mainstay of the economy, has been subject to surprisingly little scrutiny in the literature. It would therefore appear that it has served the purpose for which it was intended. However the on-going restructuring, reorientation and diversification of the fishery in the wake of the 1992 moratorium on cod fishing raise serious concerns about the appropriateness of the existing vessel classification system. These concerns stem from the fact that the new fishery places new demands on the resource inputs used to catch species found further offshore.

This paper therefore argues that the vessel classification system, was essentially arbitrary in its design, and may hamper the required transformation of the fishery in several respects. In particular, the preliminary results of this study suggest that it may slow technological change, reduce economic efficiency, and compromise safety at sea. These results were derived in the context of a specific vessel class, namely the 45’-65’ class but the rationalization may be applied to the smaller vessel classes as well. A more complete analysis of the vessel classification system and its implications is thus called for.

The scope of this study was limited to the class of vessels 45-65 feet in length. The reason being that this fleet sector is maybe in the best position to adapt to access offshore resources previously deemed ‘underutilized,’ or inaccessible. These vessels are however already increasingly used to catch high-valued, quality-sensitive species far offshore. The problem is that the same vessels therefore often fish under conditions more demanding than those they were designed for.

The study begins by an attempt to identify the rationale for using 64’11’ as the maximum length for the size class in question. This led to an examination of the role of the various vessel subsidy programs of which the main objective was to modernize the fleet and resulted in the existing fleet structure. It is well known that fishermen have long attempted to circumvent maximum vessel length regulations in various ways such as building wider and deeper vessels. It is likely that the incentives to continue to do so will intensify as fishermen attempt to access lucrative offshore species. The implications of this effort are considered both in their historical context, and in terms of fisheries development. The analysis suggests a new vessel replacement policy to allow a safer, more economical prosecution of offshore fisheries, while at the same time preventing an expansion of fishing capacity in the fishery as a whole. The high product quality requirements and competition in today's international markets risk leaving Newfoundland fishermen behind, particularly where the intrinsic quality of the stocks fished by Newfoundlanders may be inferior to stocks of the same species found elsewhere.

Conclusions

An extensive review of the literature uncovered no apparent rationale for the 64'11" maximum length regulation. The lack of an explicit rationale was confirmed in interviews with key DFO officials in both the Newfoundland and Atlantic Region. In 1976 the DFO determined a new size classification in anticipation of the implementation of the 200 mile limit in 1977. An official who participated in the process indicated to the author that the maximum length regulations agreed upon by the DFO and the Coast Guard at the time were in fact arbitrary. This is noteworthy since an analysis of the fleet structure in 1976 revealed that the small boats used by Atlantic fishermen were too small and inefficient to be able to extend their fishing range and thus lengthen their fishing season. The Government had long since recognized this, and had as early as the 1940s put in place subsidy programs with the objective of assisting fishermen in upgrading or acquiring larger vessels. However, by reducing gradually the existing vessel size limit for eligibility to 45' and then later to 35', these subsidy programs came to favor small vessel owners. The Newfoundland fishermen who did avail of these programs built few vessels larger than 45'. There was simply little reason to build such a large technological vessel in an era where the principal component of the fishery was the inshore catch of groundfish, especially the annual inshore migration of Northern Cod in the early summer months. (Fishermen in Quebec and the other Atlantic Provinces, also took advantage of the subsidies, especially in the greater than 65' class).

With the advent of the 200 mile limit in 1977 the advantages of venturing beyond the old 12 mile limit started to become apparent. The number of vessels larger than 35' began to increase. However, the vessel replacement rules implemented in July 1976 made 64 feet 11 inches the maximum length for vessels in the 45'-65' class. This rule was easily circumvented however. The answer was to build wider and deeper vessels, although this resulted in a slow and fuel inefficient vessel design subject to stability problems. Data presented in this study indicates that the highest accident rates involving 45'-65' vessels since the early 1980's occurred in 1990 and 1997, coinciding with the movement of more vessels to new fishing locations much further offshore. It is possible that further research would reveal a correlation between distance from shore, vessel size and the number of accidents. It seems clear that a legacy of at least three decades of vessel subsidies has resulted in a fleet structure where vessels smaller than 35' now comprise approximately 92 percent of the total Newfoundland fishing fleet. Vessels greater than 65' make up a mere 0.1 percent and the present fleet structure (>45') presently fishing offshore, amounts to less than four percent. Moreover, Newfoundland has a higher proportion of vessels less than 35', and a lower proportion of vessels larger than 65' than any other province participating in the Atlantic fishery. Yet by contrast, Newfoundland has the highest proportion of coastline, and direct adjacency to the fisheries resources in question. These circumstances help explain the current predicament of the 45'-65' class, and they carry implications for the future prospects given vessel size regulations.

From an economic perspective, the data reveal Newfoundland fishermen have consistently received a lower return than their domestic competitors from the export of snow crab, northern shrimp and turbot. In part this may be related to the intrinsic quality of the resources in the new diversified fishery. It is likely that a much more important factor is the technical ability of the Newfoundland fleet to land fish of prime quality. That is, the ability to handle fish out of the water in a way that prevents quality deterioration. The reason is that the size and design of most vessels pursuing shellfish and turbot are better suited for an inshore groundfish fishery. It may be argued that the industry has not reached its economic potential, and that it may not be able to do so unless the chiefly administrative vessel size regulations are updated to reflect the conditions in a fishery that is diversified rather than groundfish based as in the past. For those fortunate enough to participate in the new fishery, prosperity will not come from ever increasing quantities landed. Instead the economic potential will be reached by securing the highest possible quality (and hence value) of the product landed. This can only come from deployment of safer, more efficient and comfortable fishing vessels.

A proposal to revise, or remove, the current maximum length restriction raises at least two fundamental questions for policy. The first concerns the implications for the overall harvesting capacity of the fishing fleet of such a move. This is in the end an efficiency issue. The second issue concerns options for implementation. This is about the equity aspects of changing the status quo by implementing a particular alternative regulatory framework. Both issues warrant detailed analysis that falls beyond the scope of this present study. However, some tentative conclusions can be drawn on the basis of the research undertaken here. To begin, it is hard to overstate the point that boats built under a revised replacement policy must not add to net capacity. For every new vessel built an old one must be retired. To ensure that new boats with greater capacity do not add to effective net fleet capacity, output controls should be implemented simultaneously. Output controls such as IQs, ITQs, CHPs and IHRs can potentially, by themselves, render vessel size regulations obsolete from an efficiency perspective at least. Furthermore, while anecdotal evidence suggests that some fishermen would like to build larger vessels, fishermen as a group have themselves recognized the need to curb fishing effort. The Professionalization and Certification Board was established in 1997 on the initiative of fishermen. The number of fishermen in Newfoundland and Labrador has since dropped by 20 percent.

With regard to the equity aspects of revising the vessel replacement policy, three distinct options emerge from the analysis in this paper. The first option is that recommended by the Fisheries Renewal Board in 1996, which would allow vessels in each class to expand up to the maximum cubic number for that class. (It should be noted that this scheme has now been implemented.) This study does not favor this option because it may compromise the integrity of the original vessel design. Published research and anecdotal evidence from fishermen indicate that this could lead to stability problems, fuel inefficiency, and poor or unsafe vessel performance in rough weather. This option also amounts to preserving the existing fleet structure, which in itself may not be desirable for reasons discussed at greater length above. However, this option may be politically attractive since by retaining the fleet structure and the existing inshore/offshore allocations this option does not have significant ethical and political implications.

There are two other options offered here for further analysis. The first option would establish an inshore/offshore cut-off vessel length of 45 feet and would work in conjunction with output controls. Under this option all vessels <45' could be replaced by a vessel of up to 45'. A vessel >45' could be replaced by one up to 100'. The investment would be undertaken by the individual fisherman on the understanding that the output controls will typically vary from season to season depending on, for example, the state of the resource stock.

The second option envisioned here would retain a four category vessel classification, but supplemented by a fishing zone classification that would limit vessels to a specific zone on a seasonal basis. The fishing zones designated inshore, near shore, middle distance, and offshore would be accessible by vessels capable of safely operating in that particular environment. Fishermen would be allowed to replace the existing vessel with a larger one without restriction. Vessels <35' would be limited to the inshore zone, whereas larger vessels could fish more than one zone with only the largest vessels having access to the offshore. Although vessels >65' could, in principle, fish all four zones, only one predetermined zone could be fished in a particular season. Enforcement is key to successful implementation. Observer coverage and dock-side monitoring might usefully be supplemented by a satellite tracking device specific to the vessel's designated fishing zone.

The alternative options outlined above, are of course, only hypothetical examples of how a vessel replacement policy more conducive to economic efficiency may be implemented. However, before any further revisions to the existing replacement policy are contemplated, it is recommended that further research be undertaken in the following areas:

Recommendations

- the relationship between accidents, vessel size and distance from home port,
- the relationship between the quality of landed product and vessel size,
- the feasibility of installing ice-making and refrigeration equipment on vessels >65',
- the economic return for commodities frozen at sea for vessels >65',
- fuel consumption between existing (modified) vessel types and newly designed vessels >65'.

References

Anonymous. (1990). Congratulations to Milan Pesicka of Drury Inlet, BC, on the Completion of his 24’x10’ Freezer Prawn Boat. The Westcoast Fishermen. November 1990.

Anonymous. (1997). Buyer Beware: Not all Snow Crab is Created Equal. Seafood Leader, V. 17, No. 5, September/October 1997.

Anonymous. (1998). Not the year of “the Tiger”. White shrimp is likely to be more plentiful in 98. Seafood Business, Vol. 17, No. 1. Diversified Publications, Portland.

Arnason, R. (1990). Minimum Information Management in Fisheries. Canadian Journal of Economics, 23, 630-653.

Arnason, R. (1996). ITQ Experiences Around the World. Department of Economics, University of Iceland.

Atlantic Fisheries Service. (1986). Enterprise Allocations for the Atlantic Offshore Groundfish Fisheries. Department of Fisheries and Oceans, Newfoundland Region.

Baird, N. (1995). [ed.]. Fishing Vessels on Order. World Fishing Vessels 1995. Baird Publications Ltd. Hong Kong.

Bass, D., D. Friis & D. Greening. (1995). Roll Stabilization for Small Fishing Vessels: Report to the Canadian Centre for Fisheries Innovation. Faculty of Engineering, Memorial University of Newfoundland. St. John’s, Newfoundland.

Bell, F.W. (1978). Food from the Sea: The Economics and Politics of Ocean Fisheries. Westview Press. Inc. Colorado.

Botta, J.R. & D.W. Kulka. (1995). Relationships between the Weight of Processed and Completely Unprocessed Northern Shrimp *Pandalus borealis*. Can. Tech. Rep. Fish Aquat. Sci. #2048.

Brothers, G. (1976). Commercial Explorations for Shrimp and Turbot Labrador. Industrial Development Branch. Government of Canada. St. John’s, Newfoundland.

Brothers, G. (1977). Exploratory Fishing for Shrimp and Crab 1976. Industrial Development Branch. Government of Canada. St. John's, Newfoundland.

Cashin, R. (1993). Charting a New Course: Towards the Fishery of the Future. Task Force on Incomes and Adjustments in the Atlantic Fishery. Supply and Services Canada.

Chambers, S. (1998). Vixen Versality: Wahl's latest boat can crab, tender, and fish a string of species. Salmon Bay Communications, Washington DC. Pacific Fishing, Vol. 19, No. 5. May, 1998. 27-29.

Copes, P. (1964). Government Assistance, Productivity and Income in the Fisheries Industry of Newfoundland. Memorial University of Newfoundland. St. John's, Newfoundland.

Copes, P. (1971). Fisheries Development in Newfoundland. Department of Community and Social Development, Ottawa.

Copes, P. (1972). The resettlement of Fishing Communities in Newfoundland. Canadian Council on Rural Development. April.

Copes, P. (1973). Fisheries Development in Newfoundland. Department of Regional Economic Expansion, Ottawa.

Crutchfield, J.A. (1979). Economic and social implications of the main policy alternatives for controlling fishing effort. Journal of the Fishing Research Board of Canada 36:742-752.

Department of Fisheries, (1955). The Fishing Ships (Bounties) Act. Division of Vessel Construction and Inspection, St. John's Newfoundland.

Department of Fisheries. (1974). Annual Report of Department of Fisheries for the year ending March 31, 1974. Office of the Minister, Department of Fisheries. St. John's, Newfoundland.

Department of Fisheries and Forestry. (1970). Outline Specification for 97-foot LOA FRP Combination Fishing Vessel. Project Report No. 34, Department of Fisheries and Forestry, Ottawa, Canada.

Department of Fisheries and Oceans. (1981). New Guidelines for Fishing Vessel Assistance Program and Vessel Replacements. NR-HQ-081-032E, June 16, 1981.

Department of Fisheries and Oceans. (1985). Sector Management Policy for Canada's Atlantic Policy for Atlantic Groundfish Fishery. Department of Fisheries and Oceans, Canada.

Department of Fisheries and Oceans. (1996). Integrated Fisheries Management Plan, Atlantic Groundfish. Department of Fisheries and Oceans, Canada.

Department of Fisheries and Oceans. (1997a). 1997/1998 Multi-Year Snow Crab Integrated Management Plan Newfoundland Region. Department of Fisheries and Oceans, Fisheries Management Branch.

Department of Fisheries and Oceans. (1997b). 1997-1999 Northern Shrimp Interim Management Measures for Inshore Vessels Operating in SFA 6 Newfoundland Region. Department of Fisheries and Oceans, Fisheries Management Branch.

Department of Fisheries and Oceans. (1997c). 1997 3LNO Scallop Integrated Management Plan Newfoundland Region. Department of Fisheries and Oceans, Fisheries Management Branch.

Department of Fisheries and Oceans. (1998a). Http://www.dfo mpo.gc.ca/communic/statistics/LICENSES/VESS96.htm

Department of Fisheries and Oceans. (1998b). Atlantic Seal Harvest. 1998 Management Plan. Communications Directorate, Fisheries and Oceans, Canada.

Doll, J.P. (1988). Traditional Economic Models of Fishing Vessels: A Review with Discussion. Marine Resource Economics 5:99-123.

Dominion Bureau of Statistics. (1970). Fisheries Statistics of Canada, Ottawa, The Queen's Printer.

Dopplinger, F. (1981). An Assessment of the Fuel Efficiency/Gear Combination in use in the Newfoundland Fishery. Fishing Vessel Advisory Board. Government of Newfoundland and Labrador.

Doucet, F. J. (1983). Fishermen's Quotas: A method of Controlling Fishing Effort. Food and Agriculture Organization of the United Nations. Fishing Report No. 289, Suppl. 2:161-172.

Fishing Industry Renewal Board. (1996). Towards a Vessel Replacement Policy for the Next Millennium. Policy Support Document.

Fisheries Resource Conservation Council. (1993). 1994 Conservation Requirements for Atlantic Groundfish; Report to the Minister of Fisheries and Oceans. Minister of Public Works and Government Services Canada.

Fisheries Resource Conservation Council. (1996). Building the Bridge: 1997 Conservation Requirements for Atlantic Groundfish. Report to the Minister of Fisheries and Oceans. Minister of Public Works and Governmental Services Canada.

Fitzpatrick, J. (1987). Fishing Technology Fisheries Resources and Future Demand. Food and Agriculture Organization of the United Nations, Rome, Italy.

Government of Newfoundland and Labrador. (1978). Setting a Course: A Regional Strategy for Development of the Newfoundland Fishing Industry to 1985. St. John's, Newfoundland. Vol. 2:432-573.

Grafton, R. Q. (1996). Performance of and Prospects for Rights-based Fisheries Management in Atlantic Canada. (ED) Crowley, B. L. in Taking Ownership: Property Rights and Fishery Management on the Atlantic Coast. Atlantic Institute for Market Studies, Halifax, Canada.

Hache, J. (1989). Report of the Scotia-Fundy Groundfish Task Force. Department of Fisheries and Oceans, Minister of Supply and Services Canada.

Hardin, G. (1968). Tragedy of the Commons. Science 162:1243-1247.

Harris, L. (1990). Independent Review of the State of the Northern Cod Stock. Final Report, Department of Fisheries and Oceans Canada.

Harris, L. (1993). (Chairman): Report of the Panel on the use of Foreign Vessels in Canadian Waters; Northern Turbot Fishery. May, 1993.

Hodder, C. (1998). The Forgotten Fishermen. The Navigator. Vol. 1, No. 3. Robinson and Blackmore Publishers, St. John's, Newfoundland.

Jackson, R. (1981). Extended National Fisheries Jurisdiction. Pallitative or Panacea? University of Washington.

Jeffs, A. (1997a). [ed.]. World Fishing Vessel Review. World Fishing Vessel Yearbook 1997. Baird Publications Ltd. Melbourne, Australia.

Jeffs, A. (1997b). [ed.]. Fishing Vessels Under Construction. World Fishing Vessel Yearbook 1997. Baird Publications Ltd. Melborne, Australia.

Kesteven, G. L. (1995). Rejoinder: Chaos, Complexity and Community Management. Marine Policy, Vol. 19 No. 3:247-248.

Kirby, M. L. J. (1982). (Chairman). Task Force on Atlantic Fisheries: Navigating Troubled Waters. A New Policy for the Atlantic Fisheries. Department of Fisheries and Oceans, Ottawa, Canada.

Levelton C. R. (1981). Toward an Atlantic Coast Commercial Fisheries Licensing System: A report prepared for the Department of Fisheries and Oceans, Government of Canada.

MacSween, I. (1983). The Interaction Between Fisheries Management and the Marketing of Fish: Papers Presented at the Expert Consultation on the Regulations of Fishing Effort (Fishing Mortality). Food and Agriculture of the United Nations. Rome.

Mifflin, F. (1997a). News Release: Mifflin announces Turbot Quotas for Davis Strait Fishery. NR-HQ-97-20E. April 7, Fisheries and Oceans Canada.

Mifflin, F. (1997b). News Release: Mifflin Announces Vessel Replacement Rules. Nr-Hq-97- 25E. April 24, Fisheries and Oceans Canada.

Mitchell, C. L. & H.C. Frick. (1970). Government Programs of Assistance for Fishing Craft Construction in Canada: An Economic Appraisal. Economics Branch Fisheries Service, Department of fisheries and Forestry, Ottawa. Canadian Fisheries Reports No. 14.

Murphy, W.M. (1979). Freezing at Sea: A Canadian Opportunity. Nova Scotia Fish Packers Association.

Morey, F. J. (1981). Sail-assisted Fishing: Energy and Fish Harvesting. Conference Proceedings. Department of Fisheries and Oceans, Government of Canada.

O'Leary, T.J. (1986). Sea Water Spray/Fog Cooling System for Crab Vessels. Department of Fisheries and Oceans, Newfoundland Region.

O'Leary, T. & Clarke, K. (1987). Redfish Harvesting Experiment 1985. Canadian Technical Report of Fisheries and Aquatic Sciences. No 1530.

O'Rielly, A. (1988). Inshore Fishing Technology in Offshore Vessels: The results of Newfoundland's Middle Distance Program. World symposium on fishing gear and fishing vessel design, St. John's, Newfoundland.

Parsons, L. S. (1993). Management of Marine Fisheries in Canada. Canadian Bulletin of Fisheries and Aquatic Sciences. 225: 763p.

Parsons, L. S., & W. H. Lear [ed.]. (1993). Perspectives on Canadian Marine Fisheries Management. Canadian Bulletin of Fisheries and Aquatic Sciences. 226:446p.

Proskie, J. (1964). Cost and Earnings of Selected Enterprises, Atlantic Provinces, Vol. 14, Part 2.

Proskie, J. (1965). Economic Aspects of Small Boat Fishing: Conference on the Design, Construction and Operation of Small Fishing Vessels. V2 College of Fisheries, Navigation, Marine Engineering and Electronics. St. John's Newfoundland.

Proskie, J. (1967). Survey of the Labour Force in the Offshore Fisheries Fleet of the Atlantic Coast 1966-1967, Third Progress Report, Department of Fisheries of Canada, Ottawa.

Piche, G. (1984). US Coast Guard Fishing Vessel Initiatives: Fishing Vessel Safety Conference. Washington, DC.

Rendell, F. (1974). The Refit and Conversion of the 'Harmon' Vessels for Automated Longlining. Fisheries Development Report #14. Government of Newfoundland and Labrador. St. John's, Newfoundland.

Royal Commission on Newfoundland Inshore Fishery. (1981). Report of the Royal Commission to inquire into the Inshore Fishery of Newfoundland and Labrador. Government of Newfoundland and Labrador. St. John's, Newfoundland.

Schrank, W. E. (1995). Extended Fisheries Jurisdiction: Origins of the Current Crisis in Atlantic Canada's Fisheries. Marine Policy. V. 19, No. 4:285-299.

Sissenwine, M. P. & Kirkley, J.E. (1982). Fishery Management Techniques: Practical Aspects and Limitations. Marine Policy. V. 6, No. 1:43-57.

Statistics Canada. (1998). TIERS: Trade Information Enquiry Retrieval System. 1988-95.

Tavel Ltd. (1997). Responsible Fishing in Canada. Fisheries Council of Canada. Ottawa, Canada.

Talyor, D.M. & P.G. O'Keefe. (1996). Summary of Performance of the 1996 Newfoundland and Labrador Snow Crab Fishery. Department of Fisheries and Oceans, Canadian Stock Assessment Secretariat, Research Document 97/08.

Traung, J. O. (1965). Conference on the Design, Construction and Operation of Small Fishing Vessels. V1 College of Fisheries, Navigation, Marine Engineering and Electronics. St. John's NF.

Vardy, D. (1997). Report on Mission to Japan, November 10-16, 1997. Task Force on Fish/Crab Settlement Mechanisms in the Fishing Industry Collective Bargaining Act. Government of Newfoundland and Labrador.

Vardy, D., Delaney, B., Jones, D., & O'Neil, J. (1998). New Beginnings: Bringing Stability and Structure to Price Determination in the Fishing Industry. Report of the Task Force on Fish/Crab Price Settlement Mechanisms in the Fishing Industry Collective Bargaining Act. Government of Newfoundland and Labrador.

Walsh, I. J. (1994). The Northern Shrimp Fishery: A feasibility Study of an Inshore Fishery. Canadian Centre for Fisheries Innovation. Marine Institute, St. John's. Newfoundland.

Warren, T. (1997). Replacement Rules Revamped. The Navigator. Vol. 1, No. 3. Robinson and Blackmore Publishers, St. John's, Newfoundland.

Way, E. (1995). Project Summary: Installation of an Anti-roll Tank on a 65' Fishing Vessel. CAFID #1.

Way, E. & Hickey, W. (1979). Commercial Shrimp Survey, Gulf of St. Lawrence. Industrial Development Branch, Newfoundland Region. Government of Canada.

Wellman, J. (1998). The Loss of the Straits Pride II. The Navigator. Vol. 1, No. 3. Robinson and Blackmore Publishers, St. John's, Newfoundland.

Wilen, J. E. (1988). Limited Entry Licensing: A Retrospective Assessment. Marine Economics 5:313-324.

Wright, M. C. (1997). Fishing in Modern Times: Steward Bates and the Modernization of the Canadian Atlantic Fishery. In J. E. Candow and Corbin, eds., How Deep is the Ocean? Sydney, NS: University College of Cape Breton Press.