Northwest Atlantic Fisheries Organization

Serial No. N2104

NAFO SCR Doc. 92/52

SCIENTIFIC COUNCIL MEETING - JUNE 1992

Fishing Grounds Exploited in 1990 by Longliners Based in Canada's Scotia-Fundy Region

by

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Abstract

Maps are presented of the grounds fished by the longline fleet of Canada's Scotia-Fundy Region, based on reports gathered during an interview survey of a large sample of boat captains. Overall, this fleet works from the coast out to the 500 fathom contour and from the Canada/U.S.A. boundary to Flemish Cap. No one boat exploits more than a small part of this area and most are confined to the waters off their home ports. The grounds fished can be divided into the "inside grounds", within 60 km of the coast which are typically fished by boats of less than 30 ft in length, the "offshore banks" of Divisions 4VWX+5Ze that are mostly fished by boats of between 35 and 65 ft, and the "distant grounds" of Subarea 3 that are mostly fished by large longliners more than 65 ft long. Some reasons for the distinctions among these three units and for the fishermen's choices of grounds within each unit are discussed, as is the evidence for inter-annual changes in the grounds fished.

Introduction

An increasing sensitivity to marine environmental concerns and a developing doubt over the sustainability of past fishing practices, amongst both the fishing industry and fishery managers in Atlantic Canada, have recently focussed attention on the supposed advantages of hook-and-line methods for groundfish fishing (e.g. Haché 1989). In the past, those methods have been ignored by many research programs, in favour of studies of bottom trawling and its effects. Thus, much of the information on which scientific advice to the managers of hook-and-line fisheries should be based is lacking. In particular, the areas and seasons fished by the longline fleet are largely undocumented.

As part of a broad effort to overcome the general deficiency in knowledge of hook-and-line fishing, during 1990-91 an interview

survey of the groundfish longline fishermen based in Canada's Scotia-Fundy Region (the coastline of which comprises the shores of Sydney Bight, the Atlantic coast of Nova Scotia and the shores of the Bay of Fundy: Figure 1) was carried out. While the questionnaire administered during the interviews was primarily concerned with longline fishing gear and the ways in which it was used, the opportunity was taken to record details of the grounds fished by the interviewees and to gather assorted ancillary information from them.

Although the larger longline boats (those over 25.5 grt) are required to maintain detailed logbooks and some maps of the reported fishing locations in the 1960s and 1970s have been prepared (Halliday et al. 1986), the logbook data set is fragmentary and is not available in an electronic format other than in a highly aggregated form. Since 1988 some of these boats have carried observers from Canada's International Observer Program but only a few longline trips each year have been observed and almost all of those have been on the largest boats in the Regional fleet. Halliday and Sinclair (1987) presented maps of longline grounds, based on a survey of a self-selected sample of the fishermen in one part of the Scotia-Fundy Region. The interview data gathered in 1990-91, however, include the first comprehensive account of the grounds fished by all sizes and types of groundfish longline boats based in all parts of the Scotia-Fundy Region.

In this paper, we present summary maps of the grounds fished in 1990 by various sub-groups of these longliners, as they were reported during the interviews. The fishermen's choices of grounds are discussed in relation to several potential controlling factors and the evidence for inter-annual changes in the areas fished is examined. We do not illustrate the areas fished by any one interviewee since, for many of them, that level of detail would compromise valuable commercial secrets. A general report on the interview survey, including examination of the data gathered on topics other than the grounds fished, is in preparation.

An Overview of the Scotia-Fundy Longline Fisheries

The Scotia-Fundy longline fishermen work a diversity of fisheries, united only by the regulatory requirement for them to have a groundfish longline licence (strictly: a longline designation on a groundfish licence). The great majority of the boats used are under 45 feet in overall length (2565 such are licensed, of which nearly 1000 fished longline gear during 1990). Many of these are open boats of about 30 to 40 ft length, primarily designed for the lobster fisheries. The remainder of the fleet comprises 45 to 65 ft boats (127 licensed; about 40 active in 1990) and a small number of larger vessels, up to nearly 150 ft overall (11 licensed and active in 1990). Their gear is usually traditional, bottom-set longline, hand-baited

and worked from tubs. Some, however, work their groundline from a reel (the hooks and gangions then being snapped on as required) and others use autobaiters. Some specialized hake fishermen employ complex float systems to keep their hooks above the scavengers that inhabit the muddy hake grounds.

The primary species landed (Table 1) are Atlantic cod (Gadus morhua), haddock (Melanogrammus aeglefinus), Atlantic halibut (Hippoglossus hippoglossus) and white hake (Urophycis tenuis). About a dozen other species are landed as bycatch or as secondary directed species by at least some of the boats. Of these, only cusk (Brosme brosme: 3300 tons landed in 1990) and pollock (Pollachius virens: 1000 tons landed in 1990) are individually important overall.

The longline boats are subject to a typical complex of regulations but few of those directly restrict their areas of operations. They are limited in the west by the international boundary with the United States' waters (usually known, following its determination by the International Court of Justice, as the "ICJ line"). Since 1982, Canada's inter-Regional boundaries and sector management policy have barred Scotia-Fundy boats under 65 ft in length (except for some that have "grandfather" rights) from NAFO Divisions 3P+4RST. The over 65 ft boats are managed by Enterprise Allocations, a form of Individual Quota. These are given for particular Divisions or groups of Divisions only. All sizes of boats are subject to the seasonal closures of Browns and Georges Banks from March to May (except that boats fishing with large hooks are exempted from this closure in respect of Georges Bank only: Halliday 1988) but are free to fish in those areas for the rest of the year. Finally, an area that includes both Western and Emerald Banks (the 4TVW Haddock Nursery Area, more commonly known as the "Haddock Box") has been closed to mobile gear fishing since 1987 and is thus, in effect, reserved for longlining.

Scotia-Fundy longlining is not a single, homogeneous fishery. Rather, in all aspects of fishing gear and fishing practices, the over-riding feature of the interview data is not any overall pattern but rather the extreme among-boats variability. In only the rarest cases, such as two brothers who work their boats side by side, did the fishermen report using gear identical to that of their neighbours or fishing it in the same way. Indeed, some interviewees specifically mentioned that, in the longlining season, "you do your own thing . . . everyone does something different".

Methods

The population sampled for the survey was all groundfish longline designations on boats less than 65 ft length based in the Scotia-Fundy Region, plus the over 65 ft boats that had fished under Enterprise Allocations in 1990. The licences were divided into four

classes based on the overall length of boat that can be operated under each, viz.: under 35 ft, 35 to under 45 ft, 45 to under 65 ft and over 65 ft, those being the size groups used by the Department of Fisheries and Oceans (DFO) to categorize boats for vessel replacement and/or quota allocation purposes. A list of the licensees holding the licences in each such class was extracted from DFO's files. The under 35 ft and 35-45 ft classes were then further subdivided by the area of residence of the licensee [defined by groups of counties, the groups being developed from previous social and economic surveys of the fishing communities (DFO 1990)]. A separate list was extracted from the Department's catch and effort database showing which longline licences had had a landing recorded against them in 1989, the most recent year for which data were available during the period of survey design. A comparison of the two lists served to divide the licences into those deemed "active" (landing recorded) and "inactive" (no landing recorded). Because of the initial definition of the population, there were no inactive over 65 ft boats.

A sample of licences was then selected randomly (without replacement) from each boat-size/county-group/activity-level stratum such that: all over 65 ft licences were selected, "active" licences in other classes were four times as likely to be selected as the corresponding "inactive" licences, and the 45-65 ft class was over-sampled, relative to the under 35 ft and 35-45 ft classes, to compensate for its smaller total number in the population. A total of 421 licences were included in this primary sample (Table 2). A matching alternative sample (410 licences) was then similarly selected, covering all segments of the total population except for the over 65 ft class. In a few cases, when licensees selected in the primary sample refused to be interviewed, a substitute was chosen at random from those in the same stratum of the alternative sample. Because of the small number of refusals and a lack of time to cover the entire primary sample, only two fishermen from the alternative sample who declared themselves to have been active in 1990 were interviewed. In a few cases, a selected licence for an under 45 ft boat had moved across a county-group boundary between 1989 and 1990, when bought by a new licensee. Those few licences were deleted from the sample.

A questionnaire was administered to the selected licensees by the senior author in October 1990 to March 1991, following one of two interview formats. Licensees who had been longline-inactive in 1990 (by the licensee's declaration) were interviewed only briefly and contributed no data to the present study of fishing grounds. Licensees who declared that there had been some longlining under their licence in 1990 (together with their captains, if the licensee was not also the captain) were interviewed face-to-face. These interviews gathered a wide variety of data and concluded with each interviewee being asked to identify his 1990 longlining grounds on a

set of medium-scale navigational charts. The interviewer transferred this information to a smaller-scale, contoured chart, with the assistance of the interviewee.

This process involved a number of potential errors. Firstly, the interviews usually took between one and two hours before the charts were considered, so that the interviewees were sometimes too tired to concentrate on this final question. Next, the fishermen were sometimes unable or unwilling to identify their grounds on the navigational charts. There was also some error involved in transferring the information to the contoured chart, particularly in areas of broken bathymetry where the depth indications on the navigational charts (in fathoms) corresponded poorly to the metric contours. Most importantly, there was considerable scope for simple memory failure on the interviewee's part and for his either simplifying the report (by omitting rarely fished grounds or reporting broad areas within which he only fished a few choice spots), or including areas fished in earlier years but not in 1990, or reporting areas fished with other gears, along with those where he longlined. Despite these problems, the charted data probably captured a reasonable summary of the grounds longlined in 1990 by most interviewees, with the following limitations: (1) no distinction was made between those grounds only fished once, or a few times, in the year and those fished frequently, (2) conversely, some men only reported commonly fished grounds, (3) data on the seasons at which particular grounds were fished, the species caught on each ground and on the depths fished were not often received, (4) the borders of reported grounds were often not recorded with a precision better than about 10 km and were sometimes much less precise and (5) within each reported ground, only some parts of the bottom were fished. In a few cases, the data were of much worse quality, particularly when the captain of the boat carrying a selected licence could not be interviewed and the interview was conducted with the licensee, owner or company fleet manager only.

On completion of the interviews, the charts were edited by the interviewer and five exceptionally imprecise ones were removed from the collection. Where the interviewee gave no specific landward limit for an inshore ground, an arbitrary boundary was placed just seaward of the outermost rocks and islands of the adjacent coast. The areas outlined on these edited charts were then traced onto summary sheets (usually one per boat size class for each county). The maps presented here were prepared from these sheets using a suite of computer drafting techniques, involving the tracing of scanned images of the sheets onto base maps.

No attempt was made to expand the reported data by the inverse of the appropriate sampling fraction. Given the tendency for small-boat fishermen to exploit unique grounds (see below), such expansion

would have given the impression of dense fishing where a selected licensee fished and of no fishing at all off shores where no interview chanced to be conducted. Instead, the maps presented here are confined to being plots of the data reported.

In an earlier part of each interview, the interviewee was asked how he chose exactly where to fish (on scales of metres to hundreds of metres) within his grounds. While no consistent attempt is made to report or analyze the answers to this question here, they and many other currently-unpublished comments recorded during the interviews were used in drawing conclusions from the charted data.

Results

Under 35 ft Boats

The smallest class of boats was primarily confined to what the fishermen know as the "inside grounds", within 10, 20 or sometimes 60 km of the coast and extending from off Cape North to off Cape Sable (Figure 2). These grounds are on the coastal slope, landward of the deep basins that form the central bathymetric features of the Scotian Shelf. Where shoal water extends further seaward, as on Scaterie Bank, the edges south of Sambro and off Cape Sable, so too did the inside longline grounds.

Further seaward, there are a few shallow areas between the basins that are within the range of under 35 ft boats. Some of these, such as Bickerton Ridge (on French Bank), Sambro Bank and Roseway Bank were fished by a few men. The only mid-range grounds that received much attention, however, were the hake grounds known as The Hake Ridge and The Dump (a former ammunition dumping ground). These were fished at depths of about 70-85 fathoms, on the lower slopes of Emerald Basin.

A very few under 35 ft boats went further still and fished the offshore banks, including St. Pierre, Banquereau, Western, Emerald, LaHave, Baccaro, Browns and even Georges banks. These grounds were much less important to this boat class than their prominence in Figure 2 might suggest, however. Only nine interviewees reported fishing on any offshore bank in an under 35 ft boat, seven of whom worked boats of 34 ft 11 inches length (the maximum permitted under their licences) while an eighth boat was only one inch shorter (the last was 32 ft overall) and most of them fished offshore only in good weather, working the inside grounds under other conditions. One of these interviewees, however, reported that his sole longline grounds were in the "Haddock Box".

West and north of a line from Cape Sable to Georges Bank, Figure 2 shows only isolated fishing areas in the Bay of Fundy. There certainly seem to be limited opportunities for longlining in the Gulf of Maine and the Bay of Fundy but this near-absence of fishing by under 35 ft boats appears to be a consequence of factors in the

lobster fishery. East of Baccaro Point (just east of Cape Sable), many lobster boats are less than 35 ft in length (though some are larger), whereas to the westward they tend to be between 35 and 40 ft long. Since most of the small longline boats are used for lobster fishing in the appropriate season, west of Cape Sable there are few under 35 ft boats available for longlining. Such longline effort as there is by this boat class in that area is sparsely distributed which, interacting with the sampling design of the interview survey, leads to the apparent scatter of grounds in the Bay of Fundy seen in Figure 2.

The shoreward margin of the inside grounds is not known with any certainty since many reports only specified the outer limits of the grounds. In general, however, it seems that very little longlining was done landward of the outermost rocks and islands, themselves usually a few kilometres seaward of the mainland along much of the Nova Scotian coast. Indeed, with the exceptions of Sydney Bight and the Bay of Fundy, embayments were generally avoided; almost no longlining was reported in Chedabucto Bay and none at *all in* St. Margaret's or Mahone Bays nor in any of the smaller bays and harbours along the coast. The sole exceptions to this avoidance of medium and small embayments concerned the Bras D'Or Lakes, where a few interviewees occasionally longlined for cod, and the channels between the Passamaquoddy islands, where there was some halibut fishing. Neither area saw more than a little longline effort in 1990.

Although the total area exploited by under 35 ft longliners is quite large, individual small-boat fishermen are much more restricted in their choice of grounds than Figure 2 might suggest. Figure 3, illustrating the grounds reported by men from each county, shows that they made only limited alongshore movements. The boats out of Victoria County and Cape Breton County ports shared some grounds while some Halifax County fishermen worked well to the westward but otherwise there was limited overlap of the grounds chosen by the fishermen of the various counties. Inspection of the raw data showed a *still more localized pattern, with* individual interviewees usually fishing off their own home port only.

Each fisherman's grounds were also restricted in area. Some reported fishing areas as small as 100 km^2 and the median individually-reported area appears to be less than 400 km^2, though some reports reached perhaps 2000 km^2 and one under 35 ft boat that went to the offshore banks exploited about 12000 km^2. Within these areas of course, only certain spots were fishable, though some of the offshore banks evidently offered extensive tracts of fishable bottom.

The individually-reported fishing grounds overlapped in many cases but no two fishermen with under 35 ft boats reported fishing exactly the same areas, even when the interview sample included

several fishing from the same wharf. Some of these differences may result from inaccuracies in the reporting and recording of the grounds but from the interviewees' verbal reports it seems that the inside fishermen sometimes have their own preferred fishing spots, which differ from those of their neighbours, or at least that they place more emphasis on some particular spots than their neighbours do. This dispersion of longline gear and effort was said by some to be deliberate and designed to share out the fish (while presumably reducing inter-boat conflicts; cf. Martin 1979). This practice probably does not apply when fishing the offshore banks, however, where the boats often compete for the same bottom and where the differences in the individually-reported grounds may relate more to differences in the steaming distances from particular ports to the various banks.

Except for the specialized hake grounds on the edge of Emerald Basin, cod were caught on almost all of the grounds where the under 35 ft boats fished. Haddock were scarce in Sydney Bight in 1990 but they were a minor supplement to the cod fisheries south of Cape Breton and generally increased in relative importance to the southward and westward until they were of primary interest off Cape Sable and in the "Haddock Box". Halibut were taken in many small, select spots throughout the Region, of which places on the edge of the Laurentian Channel, some holes south of Louisbourg and Canso and spots on the inside grounds off Halifax County were of particular note to this boat class. Apart from when fishing for hake, these boats usually longlined in depths of 20 to 65 fathoms, though a few interviewees reported grounds that extended to below 150 fathoms. With very few exceptions, their longlining was confined to the summer and fall, between the seasons of bad weather, and avoided the local lobster season. In general, the season of active longlining on any one part of the inside grounds was quite short and was apparently linked to the period of high fish availability.

35-45 ft Boats

The 35-45 ft boats fished much the same grounds as did the under 35 ft class (Figures 4 and 5) but there was a major quantitative difference, with the bigger boats placing much more emphasis on the offshore banks and much less on the inside grounds. As a result of the sampling protocols used in the survey and the marked individual variation in the grounds reported by each interviewee, this quantitative difference appears in the figures as both an increase in the density of reports of offshore fishing and also an increase in the total offshore area included in the reports. Some of the areas shaded in Figure 4 but not in Figure 2, however, particularly those between Cape Breton and Banquereau and between LaHave, Browns and Georges banks, may genuinely not have been fished by under 35 ft boats. Besides these grounds, the 35-45 ft class also exploited other areas that the smaller boats did not, notably the upper continental

slope and the deep water east and north of Sable Island (both fished for halibut with a secondary fishery for hake) and various grounds in the Gulf of Maine and Bay of Fundy. The latter areas are those in which the local lobster boats are mostly over 35 ft in length.

On the inside grounds, the 35-45 ft boats fished essentially the same areas, species and seasons as the smaller boats did. Offshore, particularly favoured grounds included The Stone Fence and some of the deep holes around Misaine Bank (for cod and halibut), Western, Emerald, LaHave and Browns banks (haddock and cod), the Northeast Channel (cod and halibut), the northern edge of Georges Bank (cod and haddock) and The Inside Gully (winter haddock fishery). The Gulf of Maine grounds from German Bank to the slopes of Jordan Basin supported some hake fishing, besides some for cod and haddock, while Grand Manan Basin was fished for hake. The 35-45 ft boats fished much the same depths as did those in the smaller class, except that the halibut fishery on the continental slope extended into much deeper water, sometimes reaching 500 fathoms.

A few of these boats longlined all year but, to the westward of Halifax, most carried lobster licences and, in 1990, were busy in that fishery during the appropriate season. To the eastward, most boats of this size were laid up during the winter months. Within their longlining seasons, many fishermen changed their gear and target species to suit seasonal changes in resource availability (or the large hook exemption to the March to May closure of Georges Bank) and these shifts necessarily involved seasonal changes in the grounds fished. Specific comments on seasonal shifts included some reports of fishing close in to land in the winter, fishing the southern ends of Western and Emerald banks in the winter but the northern ends in the summer, and fishing The Inside Gully in the winter. While Browns Bank was closed, some boats moved to neighbouring banks (LaHave, German, Lurcher etc.) and others changed to large-hook gear and went to Georges Bank but, in 1990, most that might have been affected by the closure were lobster fishing.

Some of the offshore banks were ignored by the 35-45 ft fleet, in particular parts of Banquereau and all of Canso, Middle, Sable Island (excluding Western) and Sambro banks. As with the smaller boats, this class also noticeably avoided fishing in the deep basins between the inside grounds and the offshore banks. Some fished in small, scattered halibut holes, a few boats joined the under 35 ft fleet on The Hake Ridge, a larger number took hake in the Grand Manan Basin and a few fished the floor of the Northeast Channel but otherwise their longlining was confined to the coastal slope, the banks and the upper continental slope.

In some areas, these 35-45 ft boats can be divided into those that only fished the inside grounds and those that only went to the offshore banks. Thus, of 31 reports relating to boats based in or

between Cape Breton and Queens Counties, 10 worked only the same inside grounds as the under 35 ft class and 12 worked only outside those grounds, leaving only nine fishing a mixture of inside and offshore areas. This pattern broke down off Shelburne County, perhaps because Browns Bank is accessible to quite small boats in the summer while the deeper water of The Inside Gully, between that bank and the land, is a prime winter haddock ground for some larger boats. Thus, there is a spatial (though perhaps not a spatio-temporal) overlap in this area between the grounds fished by boats of different sizes. There is a further spatial separation off that county, however, between the boats that went as far as Georges Bank and those that did not. The raw data shows that very few boats of less than 39 ft 11 inches length go to Georges Bank whereas most locally-based larger ones do. That this separation does not appear in the figures is an artifact of the boat size ranges used here.

The distributions of fishing by 35-45 ft boats from various counties (Figure 5) generally reflected those shown by the under 35 ft boats, with fishermen usually working off their own shores and making relatively limited along-shore movements. The principal exceptions were those of Cape Breton County who fished off Victoria County and even in the Gulf of St.Lawrence, in addition to working off their own shores as far out as Banquereau, and across to St. Pierre Bank. Similarly, one Kings County interviewee moved down the Bay of Fundy to join the hake fishery in Grand Manan Basin in the appropriate season. Otherwise, there was only slight inter-county overlap, even on the offshore banks.

On a finer scale, individual 35-45 ft boats worked much the same amounts of bottom as did those under 35 ft boats that worked similar grounds. Thus, those that remained inside typically exploited about 400 km^2 whereas those who went offshore typically exploited areas of about 4000 km^2. Such "typical" figures conceal extreme variation, however. One interviewee reported fishing just two spots, one on Browns Bank and the other in the Northeast Channel, neither of which exceeded 100 km^2 in area, whereas some others reported grounds exceeding 12000 km^2.

As with the smaller boats, these individual areas overlapped broadly but were only identical when a single interviewee gave information on two or more selected licences (a situation that did not arise with the under 35 ft class).

45-65 ft Boats

The survey interviews covered 14 licences for 45-65 ft boats that were declared active in 1990 but only nine of these interviews produced useable chart data, including two relating to boats that had not been fully active. The nine fished a variety of grounds from the Bay of Fundy and Georges Bank to Sydney Bight and the southwest edge of Grand Bank (Figure 6: areas fished on Grand Bank not mapped) but this is unlikely to be a complete record of the grounds exploited

by the approximately 35 45-65 ft longliners that were active in 1990. Many of the blank spaces on the map might have shown fishing activity had more data been collected.

In so far as conclusions can be drawn from the reports received, it seems that the 45-65 ft boats fished much the same grounds as those exploited by the 35-45 ft class, though with more emphasis on the deepwater halibut grounds along the continental slope (including their extension onto Grand Bank) and less on the inside grounds. Some of the bigger boats had considerably more tendency to move alongshore than the smaller ones did: two Cape Breton County boats (not included in the figure) were reported as fishing extensively in the Gulf of St. Lawrence and off Newfoundland and two Shelburne County boats fished both Banquereau and the continental slope between there and Browns Bank; one of those latter and one out of Halifax County being the two for which the *reported* grounds extended onto Grand Bank.

Apart from some gillnetting for pollock and some pelagic longlining for swordfish, these boats were dedicated groundfish longliners. Those based in Cape Breton were laid up during the winter ice season but the rest worked almost 12 months in 1990. Within their groundfish longlining season, they made much the same within- and between-grounds movements as the larger 35-45 ft boats did.

Over 65 ft Boats

The over 65 ft boats fished very different grounds from all but the furthest-ranging smaller boats (Figure 7). Apart from pelagic longlining for swordfish in the summer, *these boats only* pursued one or more of three specialized longline fisheries: for big cod on Grand Bank and some neighbouring banks, for deepwater halibut and for hake on the continental slope. Their reported grounds reflected this specialization, with cod fishing from Banquereau to Grand Bank (mostly at 20 to 35 fathoms but some down to 100 fathoms), halibut fishing along the continental slope from Georges Bank to Flemish Cap (plus some in the mouth of the Laurentian Channel: all at 80 to 500 fathoms, depending on location and season) and directed hake fishing on the southwest edge of Grand Bank (at about 200 fathoms).

In another contrast to the smaller classes, the 11 over 65 ft boats tended to fish much the same grounds as one another. Only two fished west of Sable Island, however, while the *two largest were* excluded from cod fishing in Subdivision 3Ps (through lack of quota for over 100 ft boats in that area) and the smaller and older boats in the class did not go as far to the eastward as the larger and more modern ones; various captains setting their limits at the Virgin Rocks, South East Shoal, Tail of the Bank, the 200 mile limit or some other such point. One captain specifically stated that his boat was too old to risk going further.

The big boats did have one feature in common with the smaller ones, in that they generally avoided fishing the channels between the banks and none reported working in the Avalon or Halibut Channels. The sole exception to this (other than some probably overly-inclusive reporting between Green and Grand Banks) was a single captain who gave, and under questioning confirmed, a report of fishing on the flat bottom of the Laurentian Channel.

Discussion

Reliability of the Maps

Throughout this paper, the longline fishermen's reports of their grounds have been accepted as accurate, subject only to the caveats outlined above. Those address the uncertainties in the reports but not the chance of deliberate deception by the interviewees. Such deception almost certainly occurred but its effect on the present data was probably small. Of the 214 longline-active interviewees, only one seemed to the interviewer to have concocted his entire report. His information had no material effect on the maps presented here since his reported grounds lay in a heavily fished area. Some other interviewees may have claimed to have set longline gear in 1990 where or when they did not but the congruence of the grounds reported by different men is so strong that a few such errors will have had no noticeable effects on the maps presented here. A possibly more significant deception would be the failure to report fishing that had occurred in illegal areas. Other than seasonal closures of areas fished in other seasons (and thus already correctly shaded in the maps), the only grounds closed to most of these men that some might have wished to fish are the waters of Division 3P. It is likely that there was more fishing there than was reported. Some over 65 ft boats lack Enterprise Allocations for particular Divisions and it is possible that individual boats fished more widely than was reported. The nature of their specialized fisheries suggests that any such error would be minor. Otherwise, the maps are probably accurate at the limited levels of spatial and temporal precision that they convey.

The only directly comparable, independent data that can provide some confirmation of these maps are those gathered on groundfish longliners during 1990 by the observer program. Data were collected on only ten trips on six boats, all six being in the over 65 ft class. Position data are available for a total of 258 sets made on these trips (perhaps 10% of the total for this class during the year). The close similarity between the distribution of the observed sets (Figure 8) and the grounds reported by the captains of over 65 ft boats (Figure 7) supports the general validity of the survey data, for this class at least. The observers did, however, record some fishing from parts of St.Pierre Bank for which there was no interview report.

Large-Scale Spatial Patterns

The maps presented here indicate that, as a whole, the Scotia-Fundy longline fleet exploits a very wide area, extending from the upper Bay of Fundy, down the ICJ line to the southeastern side of Georges Bank and thence eastwards as far as Flemish Cap, in a broad swath reaching from the coast out to the 500 fathom contour, and including some grounds in the Gulf of St. Lawrence. Thus, some of these boats fish as far to the southward, as far to the eastward or as deep as any out of Atlantic Canadian ports. No individual boat works more than a fraction of this area, however.

Within the overall area fished, the grounds can be conveniently divided into three units: the "inside grounds", accessible to small boats day fishing from shore, the "offshore banks", including the Scotian Shelf banks, Georges Bank and the continental slope in Divisions 4VWX+5Ze, and the "distant grounds" in Subarea 3. The distant grounds were primarily fished by the over 65 ft boats, while the offshore banks were fished mostly by the 35-45 ft and 45-65 ft classes and the inside grounds were largely left to the under 35 ft boats. These units are not perfectly discrete since there are some mid-range grounds, such as The Hake Ridge, while the inside and offshore units merge between Cape Sable and Browns Bank, and all boat classes fish Banquereau and St.Pierre Bank. Furthermore, the Gulf of Maine and Bay of Fundy grounds do not fit the pattern and there were a few exceptional boats that fished grounds more commonly exploited by other size classes. Nevertheless, the three units are generally well separated geographically and there is a strong tendency for each one to be fished by particular sizes of boats.

This division of the longline fisheries seems to be caused by an interplay of several factors. Most clearly, the separation between the inside and offshore units is founded on the lack of longlining in the deep basins of the Scotian Shelf, which provides the strong geographic break between the two sets of grounds. Based on the comments of many interviewees, it is certain that this lack of effort results from the poor catch rates that would be achieved by longlining on the soft sediments that are found in the basins (King 1970; MacLean and King 1971; Drapeau and King 1972). The fishermen are not able, however, to distinguish fully between a lack of resource in those areas, the low availability to longline gear of such fish as are present and the consequences of the high densities on mud bottom of scavengers (mainly hagfishes and amphipods), which eat the bait, and even the catch, off the hooks.

The simple absence of longlining in the basins cannot alone explain more than a geographic distinction between the inside and offshore grounds, however. Other factors of importance to the observed division of the fisheries include the safe operating range of small boats and the fishermen's expectations of low catch rates on the

inside grounds. There is no exact size of boat that distinguishes one that can safely go to the banks from one that cannot; a new glassfibre boat with a diesel engine and large fuel tanks was considered by the interviewees to be much safer offshore than a larger but older wooden boat with a gasoline engine. Nevertheless, it is certain that bigger boats tend to have a greater effective range and that many small boat fishermen who fish the offshore banks believe that they are working at or beyond the safe limits of their boats in doing so, while some of those who do not go off stated during the interviews that their boats were not adequate for the trip. Meanwhile, there is a clear perception among the fishermen that longlining catch rates on the inside grounds have become severely depressed in recent years. Although the causes of this remain unclear, it undoubtedly influences longline fishermen's choice of grounds.

The intersection of these three factors may explain the observed distinction between the inside and offshore grounds. Fishermen whose boats are not capable of going off to the banks must choose between doing what fishing they can on the inside grounds and quitting longlining altogether (unless they have one of the few mid-range grounds within reach of their home port). Men whose boats can go to the offshore banks usually choose to do so, presumably because offshore fishing promises better earnings.

The distinction between the offshore and distant fishing areas is partly a matter of fishery regulations, since most under 65 ft boats are barred from Division 3P whereas the over 65 ft class has very limited Enterprise Allocations for Divisions 4VWX+5Ze. The same factors that separate the inside and offshore units seem also to have an effect, however. Thus, the concerns over seaworthiness that prevent the small boats going to the offshore banks also constrain the grounds fished by some 65 to 95 ft boats (relative to those worked by the largest boats) and those same concerns presumably prevent most under 65 ft Scotia-Fundy Region longliners from bypassing Division 3P to fish Divisions 3NO. Meanwhile, the very large longliners have to operate within narrow limits of financial viability. They cannot haul more than one longline at a time and cannot haul it any faster than a typical 30 ft boat would, since faster hauling loses fish off the hooks. Thus, although the big boats may be able to haul for more hours per day and fish for more days per year, because of their larger crews and the more stable working conditions on a bigger hull, they cannot haul enough extra hooks to compensate for the much higher costs of operating a large vessel. They can only fish profitably, therefore, if they can achieve high average catches (in dollar terms) per hook set. Large Grand Banks cod and big, deepwater halibut, each of which currently attracts a high landed price per unit weight, are viable resources for these boats whereas smaller fish from the Scotian Shelf banks might not be.

Medium-Scale Spatial Patterns

Within each of the three units, inside, offshore and distant, most areas were fished by at least some boats but a few were not. The absence of longlining in the deep basins and channels, while not universal, was particularly notable, as was its absence from medium- and small embayments. In addition, some shallow offshore areas, which appear little different to the prime grounds, were not fished with longline gear during 1990 by any of the interviewees. In general, their reports suggested that these choices were controlled by their expectations of catch rates; Sambro, Sable Island, Middle and Canso banks, the bays and the deep basins were largely or completely ignored because they were not thought to have enough longline-available fish for profitable fishing. There is no reason to doubt the general validity of these expectations but the reasons for the low biomass densities or low fish availabilities are unsure.

It might be expected that these densities and availabilities would be strongly influenced by the benthic habitat. Certainly, the fishermen regarded the type and condition of the "bottom" as being important to their fishing success. Their descriptions of the ideal sediment type for each species were not fully consistent but; on most grounds, the best "bottom" for cod fishing was said to be "hard", "rocky" or composed of small stones. Haddock, in contrast, were most available to longline gear on gravel, sand or shell sediments while hake were best taken on muddy sand or mud with small stones. Halibut were caught on any sediment type from mud to rock, depending on the area, season and depth being fished.

The surficial sediments of the areas of present interest have been mapped in detail (King 1970; MacLean and King 1971; Drapeau and King 1972; Fader et al. 1977, 1982; MacLean et al. 1977; Fader and Miller 1986; Geological Survey of Canada Open File #1692) and attempts have been made to relate this geological information to the distribution of the fish resources (Scott 1982a; Mahon et al. 1984). None of the longline fishermen's descriptions of good gadid "bottom" types accord closely with the geological classifications, however. This disagreement may arise, in part, because King's (1970) classification scheme was primarily concerned with the origin and development of the sediments and has been applied to strata with thicknesses of the order of metres and spatial extents of (usually) a kilometre or more. The benthos, the fish and the fishermen, in contrast, probably respond to the present nature of the uppermost few centimetres of the sediment and over spatial scales of metres to hundreds of metres. The map units "Scotian Shelf Drift", "Laurentian Drift" and "Grand Banks Drift", for example, are all poorly-sorted glacial tills that were distinguished geologically largely on the basis of the different parent rocks that contributed to them (King 1970; MacLean and King 1971; Fader et al. 1982; Fader and Miller 1986). This difference is unlikely to be of much biological relevance. Equally, the term "Emerald Silt" is applied to sediments that can be silty clays, clayey or sandy silts, silty or clayey sands

or even silty sands with gravel, each of which is likely to provide a quite different fish habitat but which were all formed as proglacial submarine deposits (King 1970, MacLean and King 1971; Drapeau and King 1972; MacLean et al. 1977; Fader et al. 1977). Above the late glacial palaeo-shoreline that can be found at 63 fathoms depth throughout the Scotian Shelf area, King's (1970) scheme classifies almost all surficial sediments in Divisions 4VWX+5Ze as "Sable Island Sand and Gravel", on the basis of their having been re-worked during the marine transgression (King 1970, MacLean and King 1971; Drapeau and King 1972; MacLean et al. 1977; Fader et al. 1977). As mapped, Georges Bank is covered with a more-or-less homogeneous deposit of this sediment, some areas having more and some less than 50% gravel mixed with sand (Geological Survey of Canada Open File #1692). In contrast, a recent detailed study of the biologically-active layer on the northern part of that bank has shown it to be composed of gravel pavements (probably the fishermen's "rocky bottom") interspersed with mobile sand ridges, both of which grade southwards into large areas of sand and gravelly sand (Valentine and Lough 1991). The pavements and mobile sand support quite different benthic communities. Thus, even if the distribution of the longline grounds was determined by benthic habitat characteristics and even if those characteristics were highly correlated with substrate type, given these differences between the objectives of the geological classification and the issues and scales of importance to the fish and fishermen, exact correspondence between the maps of surficial sediments and those of the longline grounds would not be expected.

Despite these problems, however, there is some congruence between the two sets of maps as they relate to cod and haddock longlining. These species were mostly caught on grounds shallower than 65 fathoms, which correspond to their preferred depth range on the Scotian Shelf as measured by summer research vessel bottom trawl surveys from 1970 to 1979 (Scott 1982b). As noted above, the seabed above the 65 fathom contour is almost exclusively floored by "Sable Island Sand and Gravel" or its differently-named equivalents (King 1970; MacLean and King 1971; Drapeau and King 1972; Fader et al. 1977, 1982; MacLean et al. 1977; Fader and Miller 1986; Geological Survey of Canada Open File #1692). Whether it is the depth, the sediment type or some other factor that influences this distribution of cod and haddock longlining and whether they act via the habitat preferences of the resources or directly on the efficiency of the gear are, however, impossible to determine, given the close correlation between these factors. Certainly, neither depth nor sediment type, as it is mapped, can explain why some banks are ignored while others nearby are fished intensively, nor why certain parts of some banks are preferred to other parts. Nor is either factor an absolute and invariant control on longlining. The prominent haddock ground in The Inside Gully, for example, is about 70 fathoms deep and is floored with a gravel-rich variant of "Sambro Sand", a sublittoral sediment that is more commonly a complex of silty and

clayey sands (King 1970; MacLean and King 1971; Drapeau and King 1972; Fader et al. 1977, 1982; MacLean et al. 1977; Geological Survey of Canada Open File #1692). Moreover, there is at least some longlining for cod or haddock on each of the other sediment types recognized by King (1970), though perhaps only where either the sediment is unusually modified or the fish show aberrant behaviour. Thus, while there is probably some link between benthic habitat factors and the distribution of cod and haddock longlining, it is not a simple one. It is possible that more biologically-relevant classifications of the sediments, supplemented with data on the benthos, would lead to habitat maps that more closely reflect those of the fishing grounds.

The distribution of hake fisheries bears quite different relations to the maps of sediments and resource biomass. Scott (1976, 1981, 1982a,b) found that white hake on the Scotian Shelf had a preferred depth range, as recorded in the summer surveys, of 100 to 150 fathoms and were caught in greatest numbers in areas of "LaHave Clay" sediments (the softest class of mud in this area: King 1970). Notable quantities of hake have been taken by the surveys on the floors of Emerald, Georges, Jordan and Grand Manan basins, as well as along the upper continental slope. In contrast to this distribution of the resource, the specialized hake fishery on the Scotian Shelf was located on deposits of "Emerald Silt" at 70 to 85 fathoms along the edge of the Emerald Basin, the fishermen specifically avoiding the hake-rich "LaHave Clay" floor of that basin. The Grand Manan Basin hake fishery did lie in an area which has seen high research vessel catch rates but it was on a deposit of "Scotian Shelf Drift" (Fader et al. 1977) and was not matched by similar fishing on the "LaHave Clay" of Jordan Basin. These observations may be explained by the hake fisheries being in areas where the distributions of the clay-preferring hake overlap with those of rather coarser sediments, which permit relatively-high hake availability to baited hooks. (On finer sediments, the bait would be eaten off the hooks by scavengers.) If this hypothesis is correct, the benthic habitat that fulfils the requirements of both the hake and the fishermen is found on "Emerald Silt" around the Emerald Basin but on "Scotian Shelf Drift" in the Bay of Fundy, where substrate modification by tidal winnowing is pronounced.

The halibut fishermen appeared to work every habitat type that was accessible to them. This may reflect the diverse preferences of the fish but could equally be an artifact resulting from the very fine scale targeting practices of these men, who may have found small spots of prime halibut "bottom" amidst areas of quite different habitat. Halibut are too rarely taken by the research vessel surveys (Scott 1976) for analysis of those catches to provide a useful comparison. In any event, the continental slope fishery for this species, as that for hake, exploits depths for which no sediment data are yet available.

If this overview of environmental factors cannot show simple links between the distributions of benthic habitats and of longlining, it is at least consistent with the fishermen's belief that they cannot fish most deep basins and channels because those areas are too muddy. There were, however, some places where a few fishermen did report longlining on the flat bottoms of such depressions. The special cases of the Grand Manan Basin and The Inside Gully have already been noted. The floor of the Northwest Channel, which was intensively fished, is nominally composed of "Sambro Sand" and "Emerald Silt" with patches of "Scotian Shelf Drift". As a result of tidal winnowing, however, the seabed is made of much coarser particles than these classifications suggest (Geological Survey of Canada Open File #1692; Dr. G.B.J. Fader, Atlantic Geosciences Centre, Bedford Institute of Oceanography, pers.comm.) and much of it would probably be regarded as "rocky" by the fishermen and hence as prime "bottom", despite its depth. Where this coarse material gives way to the finer "LaHave Clay", in the northwestern quadrant of Georges Basin, no interviewees reported fishing. Similarly, the one interviewee who reported halibut fishing on the floor of the Laurentian Channel named an area near its mouth where "Emerald Silt" crops out through the "LaHave Clay" that otherwise covers the area (Fader et al. 1982). Thus, the sediments in these two particular deep areas are not inconsistent with those fished at lesser depths elsewhere and the mapped distributions of longlining support the conclusion that the fishermen avoid areas of soft mud rather than basins and channels per se.

The principal feature of the distributions of longlining grounds that does not seem to be explained by the distribution of habitat characteristics is the lack of longlining on some offshore banks and, within the areas that are fished, its greater concentration on some banks than on others. In several areas, according to the interview reports, the absence or limited extent of longlining in 1990 was a recent development. Banquereau, Sable Island Bank and Sambro Bank, in particular, were all said to have been fished in the 1980s and subsequently abandoned because they no longer provide adequate catch rates. The longline fishermen generally attribute these changes to habitat destruction and resource depletion resulting from mobile gear fishing. Their claims cannot be examined here (but see Kenchington 1991) but the short period over which these changes in grounds were said to have occurred is consistent with their having an anthropogenic cause.

It is also notable that the closure of the "Haddock Box" to mobile gear has led to a substantial longline fishery on Emerald and Western banks. The eastern and southern borders of the longline grounds reported in that area closely followed the boundaries of the "Box" (its northern and western limits lie over deep water) and it is likely that the location of those borders was defined by the regulated absence of trawler fishing, although there is nothing in

the regulations to prevent the longline boats fishing outside the closed zone. The mechanisms by which the closure has had this effect are not certain, however, but might involve the avoidance of direct gear conflicts and differences in resource density inside and outside the closed area.

Space Limitations

Within the large total area fished by the Scotia-Fundy longline fleet, during 1990 each boat was confined to a small or very small area, typically about 400 km^2 for an under 35 ft boat fishing the inside grounds though usually more for the larger ones working offshore. The area that could profitably be exploited by a given boat on a given day would usually be a small part of the grounds reported for the whole year, since the fish move seasonally within the grounds and the form of data recording used in the interviews often led to much barren and marginal "bottom" being included in the charted grounds. Indeed, with the present expected catch rates and costs of fishing, many small-boat fishermen may barely have access to enough productive bottom for them to set their gear.

Indeed, much of the longline fleet appeared to be constrained by the area available for fishing. This was confirmed for some particular fisheries by the anecdotal reports of interviewees who described, for example, fitting larger engines in their boats to give them an advantage over their neighbours when racing out to The Inside Gully after a period of bad weather; the first arrivals being those who reserve the ground for themselves by setting their gear on it. On Western Bank in the summer, when the grounds were more continuously occupied, the men set down LORAN "lanes" to keep their gear parallel to and clear of their neighbours'. By report, they often had to select an unoccupied "lane", rather than taking one where they expected the fish to be plentiful. In deepwater halibut fishing, where the usual strategy was to set on a number of privately-known spots that have proven good in the past, it was said not to be unusual to be displaced from a pre-chosen location when it proved to be already occupied by another boat's gear.

This space limitation is partly a result of the numbers of boats in the fishery and the area of the accessible grounds. It is greatly strengthened, however, by the tendency for fishermen in under 65 ft boats to confine themselves to particular parts of the grounds. The reasons for this behaviour are not certain. The boats that fish the offshore banks may be confined to those off their home ports by the costs of steaming further. The inside boats, however, not infrequently went 40 km offshore but rarely more than 10 or 20 km along the shore from their home ports, suggesting that steaming distances alone cannot explain their localization. This might instead be caused by the resource being generally richer further from shore, thus rewarding with higher catch rates the extra costs of steaming off but not those of steaming parallel to the land. It seems

improbable, however, that this differential distribution of catch rates would be so consistent around the coast as to produce the observed localization of inside fishing, with so few areas where an along-shore movement would pay. Nor does it seem likely that the men from one port are forcibly excluded from the grounds off other ports, as happens in the lobster fisheries (Acheson 1975, 1979; Davis 1984). There is little evidence of such exclusion being strongly applied in the groundfish fisheries (Martin 1979; Davis 1984; Acheson 1988) and none was mentioned during the present survey as being exercised between longline men. Rather, it is likely that the inside grounds can only be made to yield financially-viable catch rates by men who know the local "bottom" intimately, which in turn implies that they can only work the small areas that they have known for most of their lives (cf. Martin 1979). Even then, it is necessary to find a "bunch" of fish and follow them over a period of days. This requires cooperation, since no one boat can set enough gear to gather the required information. The fishermen, however, are loathe to pass any of their hard-won knowledge to their rivals and they have complex information-management behaviour patterns, designed to maximize their data acquisition while minimizing their provision of data to others (for discussions of such patterns in three Newfoundland groundfish fisheries, see: Andersen 1972, 1988; Stiles 1972). Only local fishermen can usually benefit from these information exchanges and it may be that the lack of data for grounds off other ports removes any incentive for the inside boats to steam along the shore.

There were only a few exceptions to this limited along-shore movement of small boats, the principal one being in the Sydney Bight area. Seasonal movements, by which small longline boats were operated out of ports other than their home ports, used to be normal there, with Cape Breton boats moving to Newfoundland to fish the Rose Blanche Bank cod as well as shifting between the west and south shores of the Bight. Some Newfoundland boats have moved seasonally to Sydney Bight since the 1940s (Stiles 1972). In 1990, the catch rates on each of the grounds were said by some interviewees to be too low to justify these movements, though some still occurred.

The extreme localization of small-boat, inside fishing did lead to an important behavioural difference between fishermen who work the inside grounds and most of those who fish the offshore banks. The former group were area-specialists, being confined to the small area off their home ports. In order to prolong their fishing seasons, they therefore had to be resource-generalists, taking a series of different species at appropriate times of the year (cf. Acheson 1988). These typically included lobster and often herring, mackerel, crabs or scallops, in addition to groundfish. The large boats, in contrast, were able to move to wherever groundfish were available at a particular season. The efficient use of large, high-cost boats required, however, that they be specialized for a particular kind of

fishing, such as longlining. Thus, most over 40 ft boats were area-generalists and resource-specialists. Some intermediate-sized boats were able to pursue an area-generalist, resource-generalist strategy. This was particularly seen in southwest Nova Scotia where, with the relative abundances of various resources in 1990, some fishermen were choosing to use fully-decked longline boats in the lobster fisheries during the appropriate season. Conversely, the Sydney Bight area may offer so few alternative resources that local longline fishermen have traditionally had to be cod-specialists, compelling them to develop their area-generalizing pattern of seasonal movements.

Changes in the Longline Grounds since 1960

There are very few published data on the distribution of Scotia-Fundy Region groundfish longlining with which these maps can be compared. Halliday et al. (1986) presented some small-scale maps of the distribution of Canadian fishing effort west of 64° W longitude, including two of the number of longline hooks set in each 10' by 10' rectangle (in 1960-72 and 1973-7 respectively), based on logbook data, but these maps were not thought to be fully reliable. No information on the sizes of boats that contributed to the logbook program nor on the proportion of total effort that was included is available. Within these limitations, the map for 1960-72 showed a relatively even density of effort along the northern edge of Georges Bank, in the mouth of the Northeast Channel, up the 50 fathom contour past German and Lurcher banks, on parts of LaHave and Roseway Banks and particularly from Baccaro Bank and the Tail of Browns in to the 50 fathom contour near the shore. The data for 1973-77 suggested much more extensive fishing, extending from the north around to the east side of Georges Bank (but not on the Northeast Peak itself), throughout the Northeast Channel, much more broadly up the coast, almost to Grand Manan, and in almost every rectangle eastward from the Northeast Channel to 64° W, including some of those inside the 50 fathom line. It is not possible to tell how much of this apparent increase in the extent of the grounds between 1960-72 and 1973-77 was simply a result of more comprehensive data collection, as logbooks became compulsory for boats over 25.5 grt in 1972.

In 1985, through the mediation of the Longliner Branch of the Nova Scotia Fisherman's Association, Halliday and Sinclair (1987) circulated a survey, designed to elucidate the grounds fished in 1982-84, to the longline fishermen of the Cape Sable Island-Woods Harbour area of Shelburne County. They received useful responses from 24 fishermen (representing about 20% of the licensed 40-65 ft longliner fleet in the area plus one man with a 36 ft boat). For this sector of the fleet and for this one home area, they were able to extract more information than is available from the present interviews because their survey gathered data on seasonal distributions of effort and on the species caught in each area. In

sum, they found that relatively high numbers of boats fished Browns Bank (principally around the Cove of Browns), the northern edge of Georges Bank and the mouth of the Northeast Channel. Less important areas included the rest of Browns, LaHave, Baccaro and Roseway banks, "The Bar", the continental slope eastward from LaHave Bank, all of the northern and eastern sides of Georges Bank, the deep water of the Northeast Channel, and the area around German Bank.

Halliday et al.'s (1986) 1973-77 effort distribution was rather similar to that reported for the 35-45 ft class west of 64°W in the present study. There seems to have been a marked decrease in fishing from German Bank northwards [except in the Grand Manan Basin and other parts of the Bay of Fundy where Halliday et al.'s (1986) logbook data showed no activity] and there may have been a reduction in effort on Roseway Bank and in the surrounding waters. Otherwise no changes between 1977 and 1990 can be reliably perceived, given the resolutions of the two data sets. Even the change north of German Bank may be an artifact: fishing in this area was reported by some 45-65 ft boats in the present survey, which size class would probably be relatively more intensively represented in the logbook data than it is in the interview data.

The reported distribution of grounds in 1982-84 (Halliday and Sinclair 1987) suggests a choice of grounds intermediate between that for 1973-77 and that for 1990. The greater resolution of the data permits further interpretation, however. The concentration of boats on the Cove of Browns in the winters of the mid-1980s that was recorded by Halliday and Sinclair (1987) was recalled by some interviewees during the present survey. Most of the boats, however, now fish The Inside Gully in that season while the Cove of Browns was said to no longer have desirable concentrations of fish. There has also been some retreat, between 1982-84 and 1990, from the westernmost areas fished along the north side of Georges Bank; presumably because the final settlement of the ICJ line drove back the limit of Canadian fishing. These differences are minor, however, and there seems to have been relatively little change in the areas fished by boats out of western Shelburne County ports between 1982-4 and 1990, on the spatial scales seen in the two sets of charts.

In the only other published mention of the Scotia-Fundy longline grounds Davis (1984), using data for 1974-77 gathered during an anthropological field study, divided the boats of the Port LaTour-area of Shelburne County into two classes: open boats 11 metres in length or less (his "inshore") and 12-18 metre boats with fish holds (his "offshore"). The "offshore" boats, which would be classed as 35-45 and 45-65 ft boats in the present study, fished the northern edge of Browns Bank (possibly the Cove of Browns) with "fine gear", suitable for haddock and cod, in the early winter, moving still closer to the land when the bank was closed in late February. When it was re-opened in June and with the coming of summer weather, these

boats mostly took "big gear", for halibut and cod, and worked the outer edge of Browns Bank, Georges Bank and the Sable Island grounds. With the change in the weather in about September, they returned to the inside edge of Browns Bank. This distribution is fully in accord with those mapped by Halliday et al. (1986) and by Halliday and Sinclair (1987), except for the record of fishing off Sable Island which lay outside of the former study's area of concern. The Shelburne County fishermen seem largely to have abandoned trips to the eastward for gadid fishing by 1990, with only a few 45-65 ft boats still going to Banquereau for such longlining.

Davis' (1984) "inshore", or under 35 ft, boats did not go more than a few kilometres beyond the Brazil Rocks, themselves about 10 km off the mouth of the Port LaTour inlet. Within this zone, they worked longlines seaward of the Brazils and in a broad band between those rocks and the fairway buoy (about 2 km off the mouth of the inlet). This is a very different area from that worked by similar boats in 1990. Of nine Port LaTour-area small-boat fishermen interviewed for the present study, none longlined inside the Brazil Rocks and all but two went more than 10 km from land; four of them going to middle-distance and offshore grounds, from The Bar to Georges Bank. This marked change is fully in accord with comments made by many interviewees who worked small boats, based everywhere from Cape Breton to the Bay of Fundy, to the effect that they went much further off in 1990 than they did even a few years before.

As noted above, other interviewees' reports suggested that their choices of which particular grounds to fish on the banks changed from year to year, even if their general pattern of offshore fishing does not. The Cove of Browns and Roseway, Sambro, Sable Island, Banquereau and Rose Blanche banks were all said to have seen more longlining by some interviewees in the 1980s than they did in 1990. Western and Emerald banks and The Inside Gully may have seen the reverse trend. The longline fishery on the Grand Banks is an even more prominent development. After the dory schooner fishery for salt cod ended in 1962, there was very little Nova Scotian longlining in those waters until the 1980s, except for a short-lived hake fishery (Figure 9). The growth, since 1984, of a specialized fishery for large cod in Divisions 3NO is the principal recent change in the Scotia-Fundy longline fisheries.

Acknowledgements

This study would have been impossible without the willing cooperation of the many longline fishermen who were interviewed. We also thank Marc Showell, Marine Fish Division, for extracting data from the International Observer Program database, and Dr. Gordon Fader, Atlantic Geoscience Centre, for the provision of unpublished information on the sediments of the Georges bank area.

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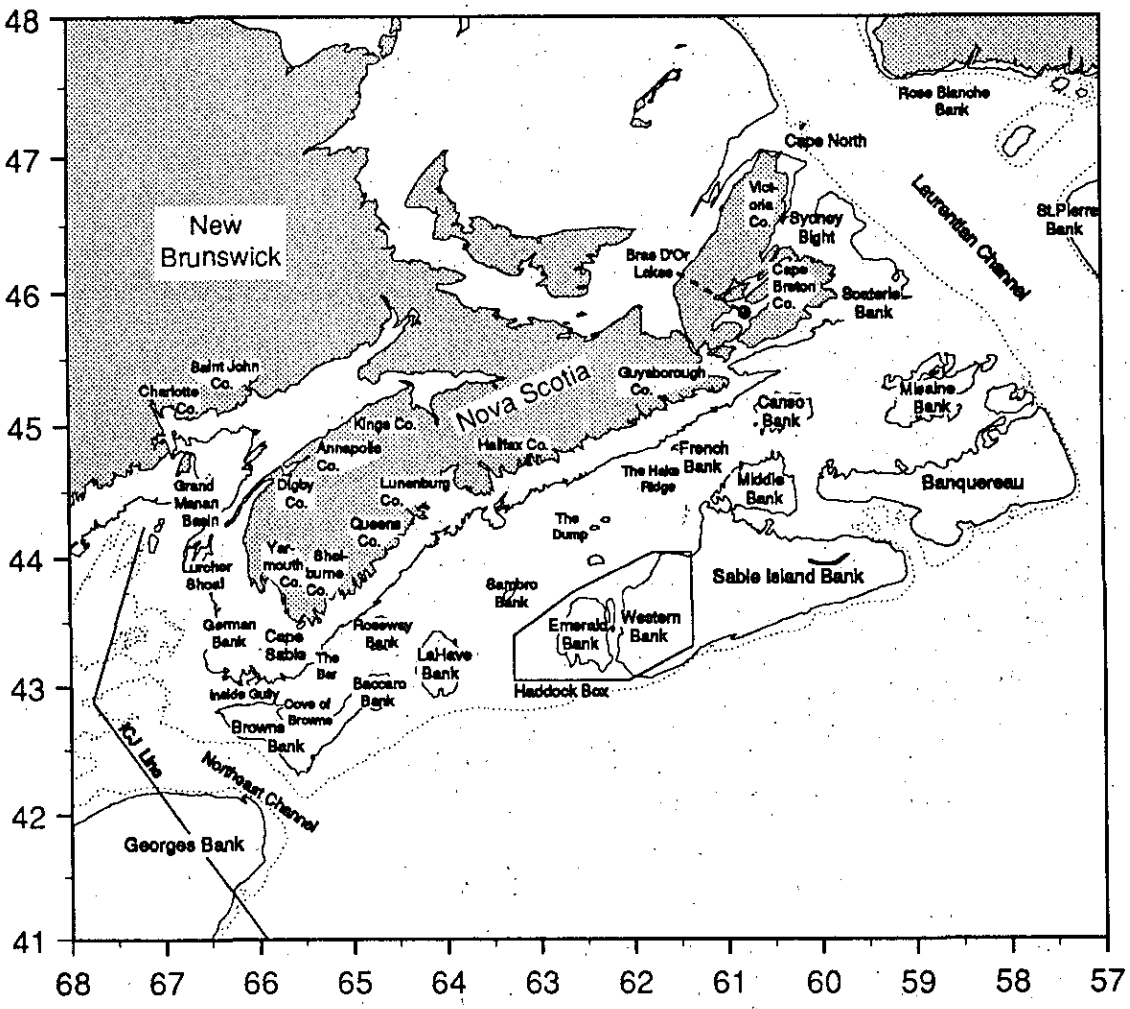
Table 1: Landings in Scotia-Fundy Region in 1990 by Longliners, excluding landings of pelagic species (in tons live weight)

	Boat Size Class			
Species:	**Under 45ft**	**45-65 ft**	**Over 65 ft**	**Total**
Cod	19106	3307	5579	27992
Haddock	6466	1018	71	7555
Hake	3569	1276	1754	6599
Halibut	741	335	508	1584
others	5025	707	160	5892
Total	34907	6643	8072	49622

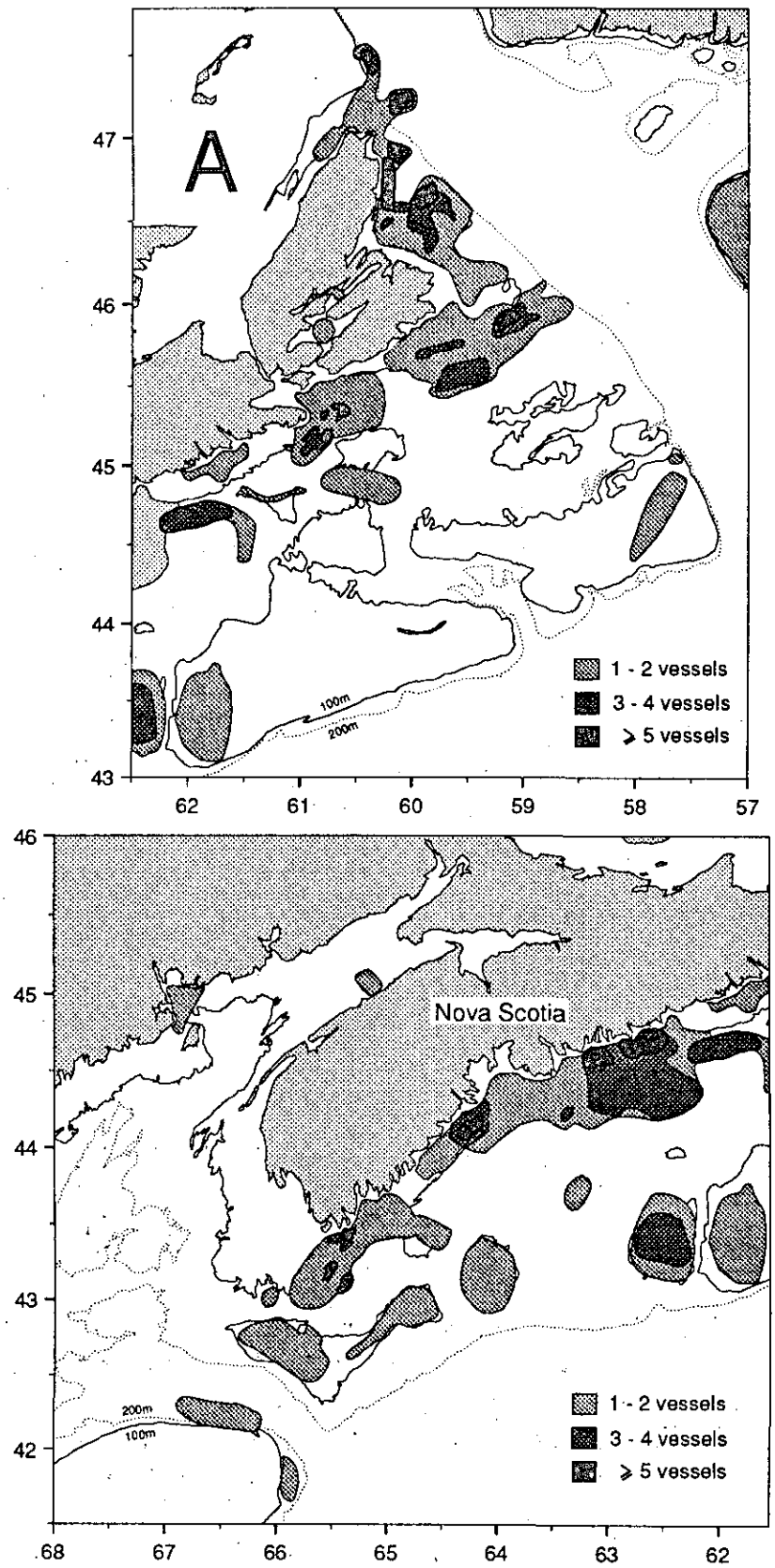
Data extracted from Department of Fisheries and Oceans landings records. These figures refer to landings in Scotia-Fundy Region rather than by boats licensed in that Region but out-of-Region landings by Canadian longliners are relatively minor. The "others" category includes 69 tons of sharks, some part of which were probably landed as a bycatch of the pelagic longline fisheries for swordfish and tuna.

Table 2: Numbers of Scotia-Fundy Region Groundfish Longline Licences and Survey Sample Sizes

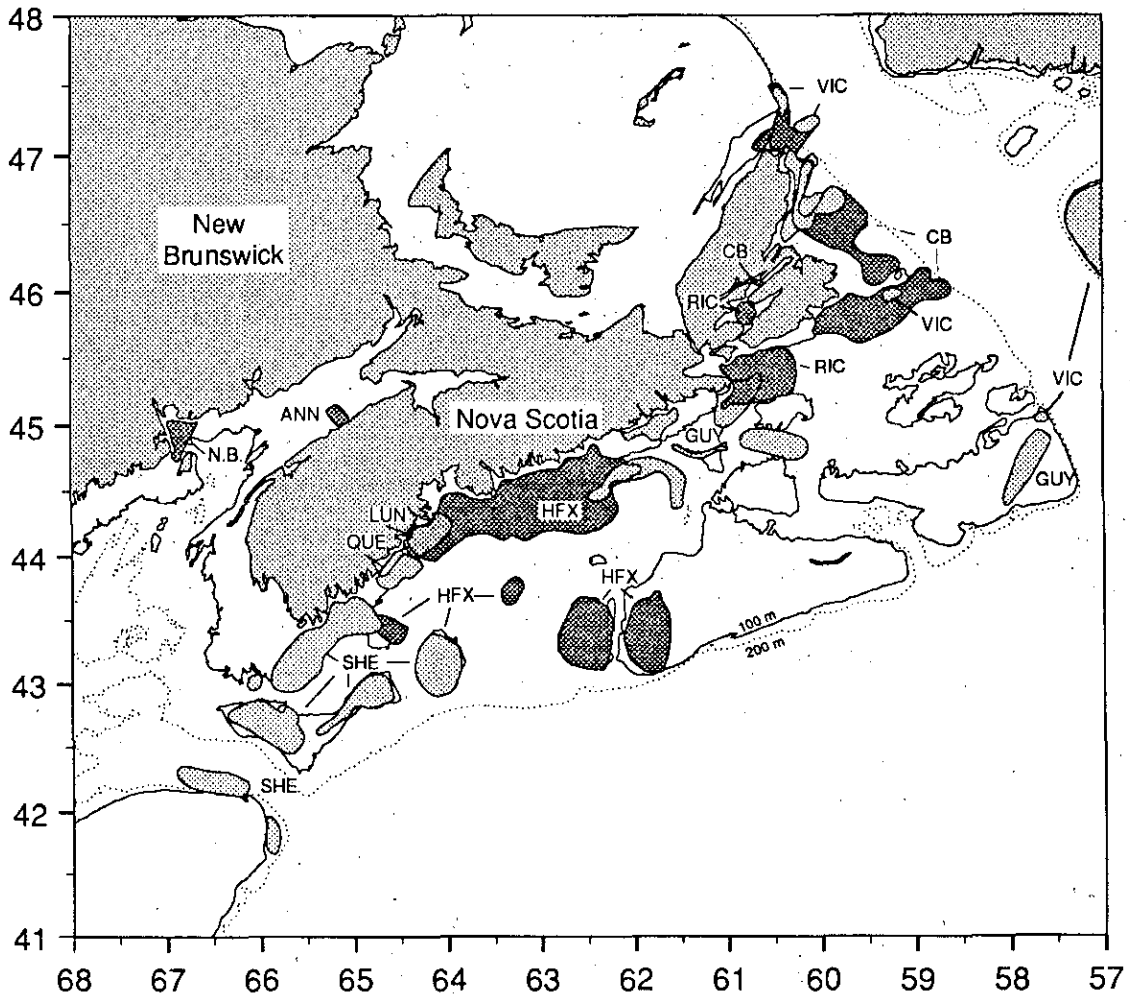
Group	Licences in Fleet	Licences in Primary Sample	Interviews Completed	
			Active 1990	Inactive 1990
Over 65 ft				
	11	11	11	0
45-65 ft				
Active 1989	49	19	14	3
Inactive 1989	78	6	0	5
35-45 ft				
Cape Breton Island and Guysborough & Halifax Counties				
Active 1989	156	44	30	6
Inactive 1989	148	12	1	7
Lunenburg, Queens & Shelburne Counties				
Active 1989	254	72	47	12
Inactive 1989	246	17	4	12
Yarmouth to western Kings & Saint John & Charlotte Counties				
Active 1989	64	19	7	9
Inactive 1989	399	26	4	17
eastern Kings to Albert Counties				
Active 1989	0	0	0	0
Inactive 1989	4	1	0	1
Under 35 ft				
Cape Breton Island				
Active 1989	109	47	31	7
Inactive 1989	201	15	5	8
Guysborough & Halifax Counties				
Active 1989	90	39	30	8
Inactive 1989	374	27	5	22
Lunenburg, Queens & Shelburne Counties				
Active 1989	63	27	15	9
Inactive 1989	309	23	5	17
Yarmouth to western Kings & Saint John & Charlotte Counties				
Active 1989	13	5	3	2
Inactive 1989	121	9	2	8
eastern Kings to Albert Counties				
Active 1989	0	0	0	0
Inactive 1989	14	2	0	2



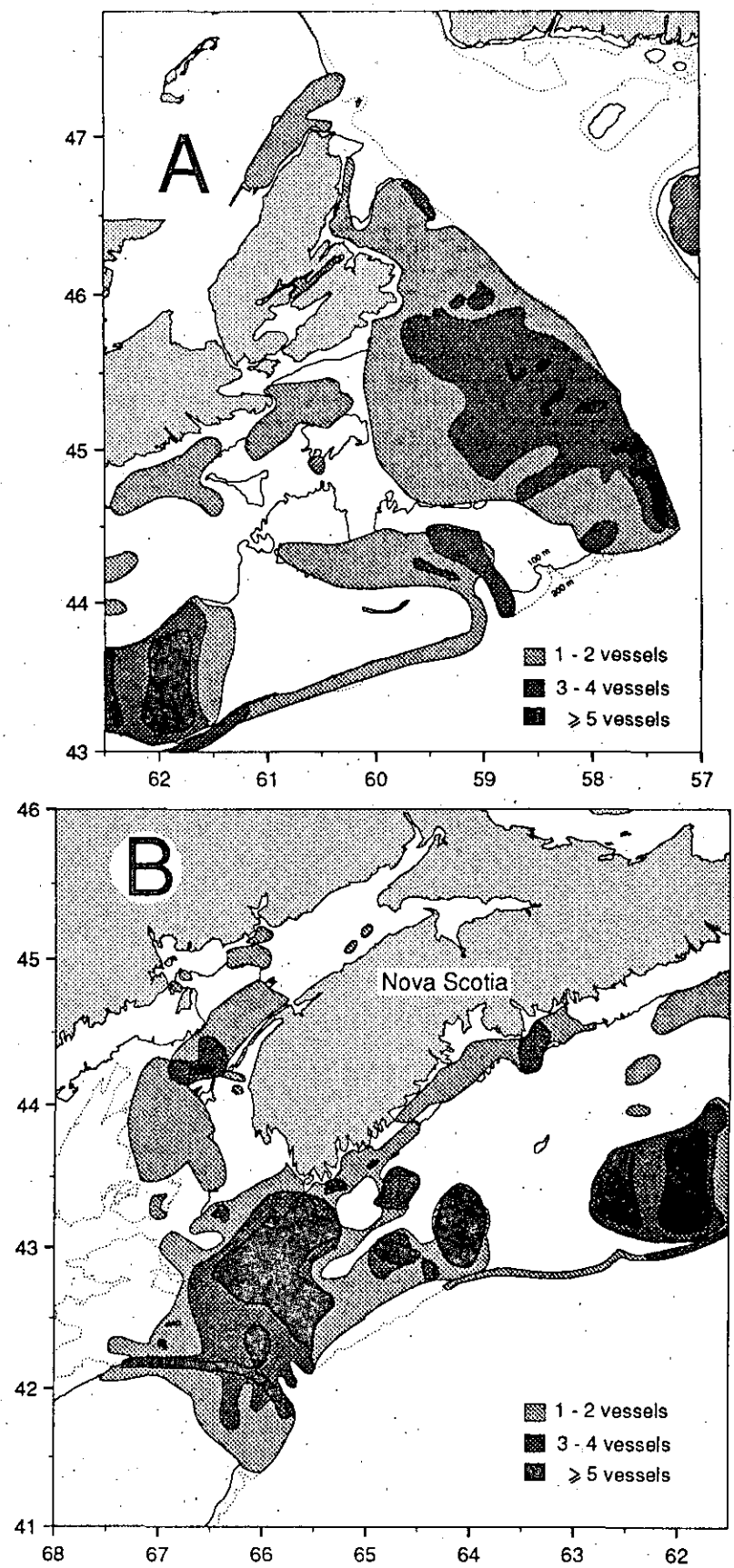
1: Chart of the fishing grounds, showing the locations of some bathymetric features and the boundaries of some administrative areas named in the text.



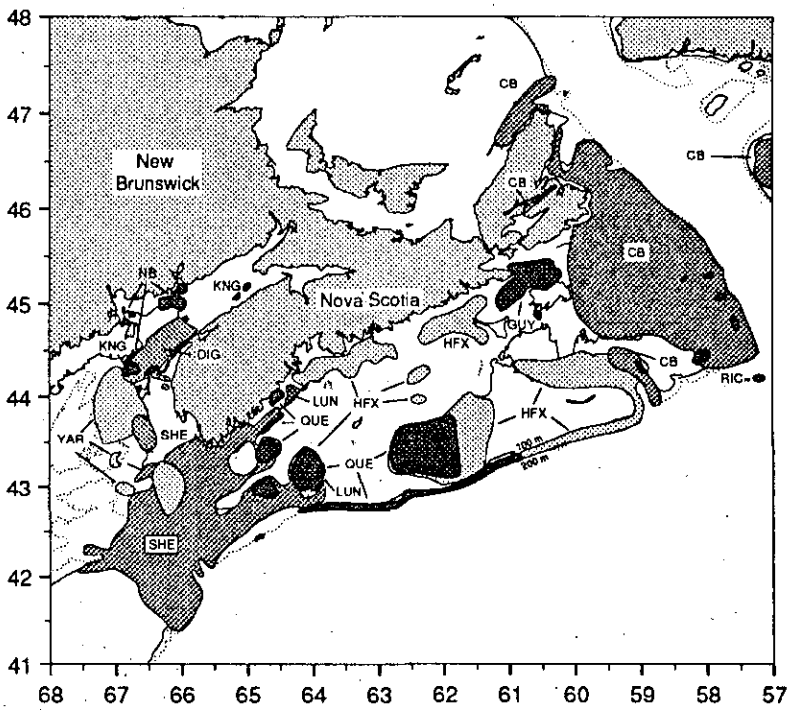
2: Map of the spatial distribution of longline fishing by under 35 ft boats in 1990.
(A) northeastern Scotian Shelf, St.Pierre Bank and Gulf of St.Lawrence. [Note areas fished in Bras D'Or Lakes. The area shaded on St.Pierre Bank is nominal, the report received being insufficient for more precise mapping.]
(B) southwestern Scotian Shelf, Georges Bank, Gulf of Maine and Bay of Fundy.



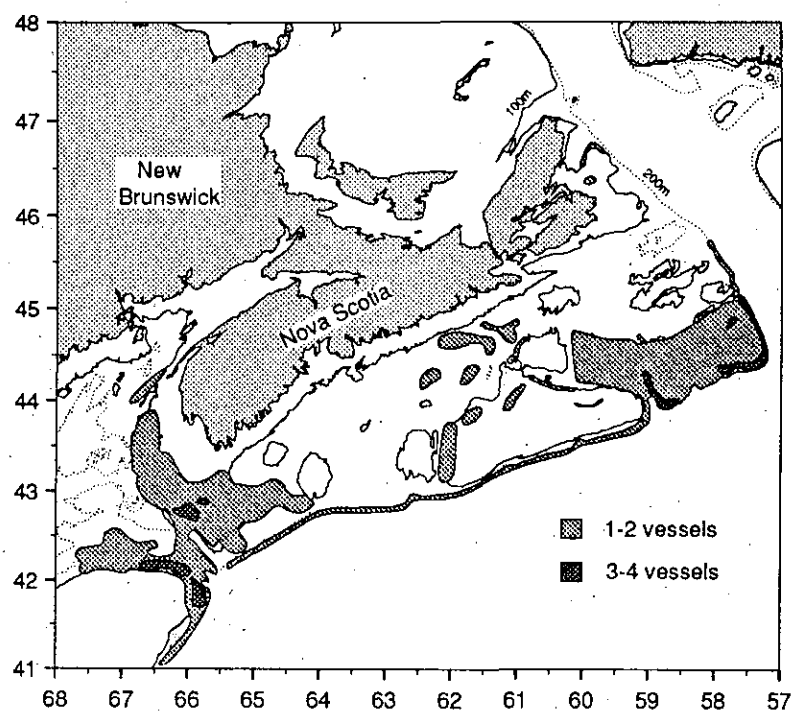
3: Map of the spatial distribution of longline fishing by under 35 ft boats in 1990, showing the counties in which the boats fishing each area are based. ANN: Annapolis Co.; CB: Cape Breton Co.; DIG: Digby Co.; GUY: Guysborough Co.; HFX: Halifax Co.; LUN: Lunenburg Co.; NB: Charlotte & St.John Cos., New Brunswick; QUE: Queens Co.; RIC: Richmond Co.; SHE: Shelburne Co.; VIC: Victoria Co.; YAR: Yarmouth Co.
(Fished areas shaded differently for clarity only. In some areas of overlap, the perimeter of one area is drawn over the shading of the other.)



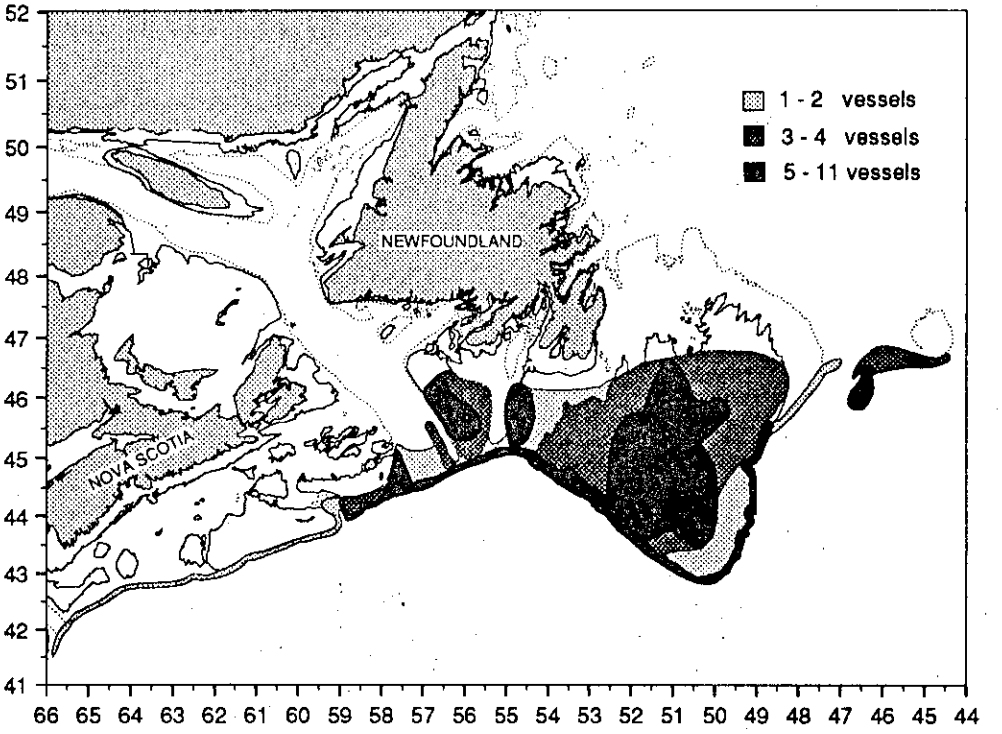
4: Map of the spatial distribution of longline fishing by 35-45 ft boats in 1990. (A) northeastern Scotian Shelf, St.Pierre Bank and Gulf of St.Lawrence. [Note areas fished in Bras D'Or Lakes. The area shaded on St.Pierre Bank is nominal, the reports received being insufficient for more precise mapping. One small reported area elsewhere on this map has been surpressed to maintain confidentiality.] (B) southwestern Scotian Shelf, Georges bank, Gulf of Maine and Bay of Fundy.



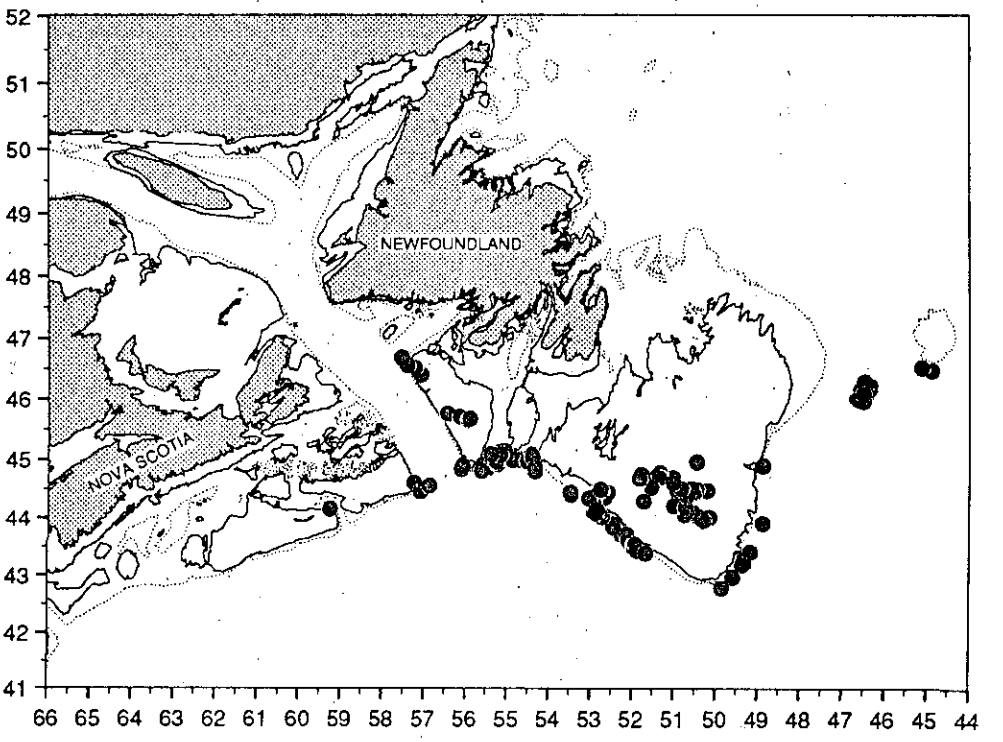
5: Map of the spatial distribution of longline fishing by 35 and 45 ft boats in 1990, showing the counties in which the boats fishing each area are based. CB: Cape Breton Co.; DIG: Digby Co.; GUY: Guysborough Co.; HFX: Halifax Co.; KNG: Kings Co.; LUN: Lunenburg Co.; NB: Charlotte & St.John Cos., New Brunswick); QUE: Queens Co.; RIC: Richmond Co.; SHE: Shelburne Co.; VIC: Victoria Co.; YAR: Yarmouth Co.
(Fished areas shaded differently for clarity only.)



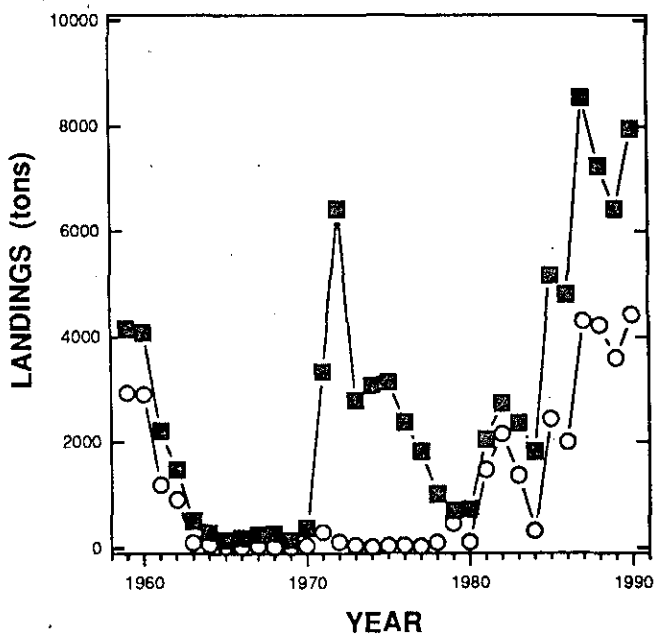
6: Map of the spatial distribution of longline fishing by 45-65 ft boats in 1990. [In addition to the areas shown, two boats fished the continental slope along the southwest side of the Grand banks.]



7: Map of the spatial distribution of longline fishing by over 65 ft boats in 1990



8: Map of the locations of groundfish longline sets by over 65 ft boats recorded by observers in 1990



9: Total landings (squares) and cod landings (circles) from 1959 to 1990 of fish caught in Subarea 3 by groundfish longliners (and, for 1959-62, dory vessels) of more than 50 gross tons, and landed in Canada (Maritimes and Quebec) [except 1989-90 data: in the Scotia-Fundy Region only]. Most, or all, of these landings were made in what is now the Scotia-Fundy Region. The larger 45-65 ft longliners exceed 50 grt, as do all of the over 65 ft class. The high catches of the 1970s were probably mostly hake.
(Data for 1959-88 extracted from ICNAF and NAFO Data Reports. 1989 and 1990 data taken from Canadian catch and effort database.)