DFO Atlantic Fisheries
Research Document 95/46

MPO Pêches de l'Atlantique
Document de recherche 95/46

The Midshore Lobster Fishery Off Southwestern Nova Scotia: Inception, Development And Current Status

By

D.R. Duggan and D.S. Pezzack
Benthic Fisheries and Aquaculture Division
Biological Sciences Branch
Halifax Fisheries Research Laboratory
Department of Fisheries and Oceans
Scotia-Fundy Region
P. O. Box 550
Halifax, N. S.
B3J 2S7

Abstract

The area in Lobster Fishing Area (LFA) 34 between the traditional inshore fishing area (less than 55m or approximately 20 km from shore) and the Offshore Lobster Fishing Area (LFA 41) is referred to as the midshore. Expansion of fishing effort by inshore fishers into the midshore area caused concern amongst many fishers and biologists. The previously un-fished midshore area was seen as a possible refugium that could contain a population of larger mature animals important for maintaining the areas' egg production. The number of fishers in the midshore increased from 18-20 in the early 1980's to 100 in the mid 1980's, and has remained relatively constant since. Midshore landings increased from less than 100t in 1979-80 to 900t in 1992-93. At the same time the overall LFA 34 landings increased by almost 6000t. The expansion of the midshore fishery accounted for less than 15% of the overall increase. Midshore fishers represented 10% of the total licences, and 10-12% (900t) of LFA 34 landings in 1992-93. The midshore fishery is fished on an opportunistic basis. When catch rates are low in the nearshore effort moves to the midshore and the reverse when nearshore catch rates are high. The trend towards larger and faster vessels in LFA 34 will allow more fishers to do this than in the past. Midshore is not a distinct stock but extensions of the nearshore and offshore stocks. The midshore grounds near Browns Bank and the area between the Browns Closed Area, offshore line and Truxton Swell appears to be part of the offshore Browns Bank concentration. Four to six vessels fished this area in 1992-93 (estimate landings <100 t). Landings from this area should be considered when assessing the impact of the offshore fishery on potential brood stock. The midshore grounds inside of this area are an extension of the nearshore lobster concentration and are currently exploited by an estimated 90-95 vessels (estimate landings 800-850 t). At-sea samples from the midshore area have lobster sizes moderately larger than in the nearshore grounds but smaller than the offshore areas. The data shows that the size structure has not changed significantly since 1986. Available data shows that while there is a higher proportion of mature sizes in the midshore, the fishery only lands 12% of all the mature sized lobsters landed in the LFA 34 - Offshore 4X region. The larger nearshore fishery lands 78% and the offshore 10% of the mature sized animals. American NMFS groundfish trawl surveys suggest that lobster abundance has increased on the midshore grounds since the late 1960s and information from fishers suggest the present large midshore population is a recent development that has occurred during the wide spread increase in lobster abundance during the 1980s. This would suggest that the midshore is less important than previously believed and that greater emphasis must be placed on protecting the egg production of in the nearshore area.

Résumé

La partie de la zone de pêche du homard (ZPH) 34 située entre les lieux de pêche traditionnels des pêcheurs côtiers (se trouvant à moins de 55 milles, soit environ 20 km des côtes) et la zone de pêche hauturière du homard (ZPH 41) est désignée secteur de pêche semi-hauturière. L'expansion de l'effort de pêche côtière dans le secteur semi-hauturier a suscité des inquiétudes parmi de nombreux pêcheurs et biologistes. On considérait ce secteur auparavant inexploité comme un refuge possible d'une population de plus gros homards adultes jouant un rôle important dans le maintien de la production d'oeufs pour la zone. Le nombre de pêcheurs dans le secteur semi-hauturier est passé de 18-20 au début des années 1980 à 100 au milieu de cette période. Il est depuis demeuré relativement constant. Les débarquements en provenance du secteur semi-hauturier sont, quant à eux, passés de moins de 100 t en 1979-1980 à 900 t en 1992-1993. En même temps, les débarquements totaux de la ZPH 34 se sont accrus de près de 6 000 t. L'expansion de la pêche semi-hauturière comptait pour moins de 15 % dans la hausse générale des débarquements. Le nombre de pêcheurs exerçant leur activité dans ce secteur équivalait à 10 % du nombre total de détenteurs de permis et leurs débarquements représentaient de 10 à 12 % (900 t) de ceux de la ZPH 34 en 1992-1993. La pêche semi-hauturière est pratiquée de façon opportune. Quand les taux de prises sont faibles dans la zone côtière, l'effort se déplace dans ce secteur, l'inverse se produisant quand les taux de prises dans les eaux côtières sont élevés. En raison de la tendance à acquérir des bateaux plus gros et plus rapides, les pêcheurs de la ZPH 34 seront désormais plus nombreux à agir ainsi. Le stock semi-hauturier n'est pas un stock distinct, mais plutôt une extension des stocks des zones de pêche côtière et hauturière. Le homard pêché à proximité du banc de Browns et dans les eaux situées entre la zone de fermeture du banc de Browns, la limite de la zone de pêche hauturière et Truxton Swell semble faire partie de la concentration hauturière du banc de Browns. De quatre à six bateaux pêchaient dans ce secteur en 1992-1993 (débarquements estimés : < 100 t). Il convient de tenir compte de leurs débarquements lorsqu'on évalue l'effet de la pêche hauturière sur le stock de reproducteurs éventuels. Quant aux lieux de pêche semi-hauturière situés en deçà de ce secteur, ils constituent un prolongement de la zone de pêche côtière et sont actuellement exploités par une flottille composée d'environ 90 à 95 bateaux (débarquements estimés : 800-850 t). Les échantillons prélevés en mer dans le secteur de pêche semi-hauturière révèlent que les homards y sont un peu plus gros que ceux des eaux côtières, mais plus petits que ceux de la zone de pêche hauturière. Les données révèlent que la composition selon la taille n'a pas beaucoup changé depuis 1986. S'il existe apparemment une plus forte proportion de homards de taille adulte dans le secteur de pêche semi-hauturière, les pêcheurs ne capturent que 12 % de tous les homards de taille adulte provenant de la zone de pêche hauturière de 4X et de la ZPH 34. La pêche côtière, plus importante, et la pêche hauturière produisent respectivement 78 % et 10 % des prises de homard de taille adulte. Le relevé au chalut sur le poisson de fond réalisé par le NMFS des États-Unis révèle que l'abondance du homard a augmenté dans le secteur de pêche semi-hauturière depuis la fin des années 1960 et les renseignements obtenus des pêcheurs donnent à croire que ce phénomène est récent et qu'il est associé à la hausse générale de l'abondance du homard survenue dans des années 1980. Cela signifierait que la pêche semi-hauturière revêt moins d'importance qu'on le croyait et qu'il importe de se concentrer davantage sur la protection de la ponte dans la zone côtière.

I INTRODUCTION

The Southwestern Nova Scotia lobster fishery, in Lobster Fishing Area 34 (LFA 34; Fig. 1) has historically been one of the largest and most stable lobster fisheries in Canada (Fig. 2). LFA 34 landings for the 1990-91 season exceeded 10,000 metric tons (t), representing 57 % of the reported landings in the Scotia Fundy Region (Fig. 2) and 25% of Canadian landings. LFA 34 extends 92-120 km from the coast to the Offshore Boundary Line in the west and to the Browns Bank Closed Area (56 km) in the south (Fig. 1). The 975 licensed inshore fishers can fish anywhere inside this area, but until the early 1970's little effort was directed outside the 55 m (30 fathom) contour (Fig. 3) or approximately 20 km from shore.

The Canadian offshore lobster fishery began in 1971, and soon found commercial quantities of lobster along the continental slope, on Browns Bank, and in the basins of the Gulf of Maine. During the early to mid 1970's the inshore lobster fleet began to expand effort from the traditional fishing areas (<20 km from shore) to German Bank and the shoal water of western Browns Bank. The area between 20 km and the offshore line became known as the midshore (Fig. 3).

Expansion into the midshore area caused concern amongst many fishers (D.E. Graham, Lobster Field Technician to 1988, Biological Station, St. Andrews, N.B., unpub. data.) and biologists (Pezzack, *et al.* 1992). The previously unfished midshore area was seen as a possible refugium that could contain a population of larger mature animals important for maintaining the areas egg production. It was speculated that the long term stability of the southwestern Nova Scotia lobster landings was due to the presence of this previously unfished portion of the population.

Since the early 1980's landings in LFA 34 have increased steadily (Fig. 2; Pezzack 1993) with 1990-91 landings the highest this century. The increase was the result of increased recruitment and a subsequent increase in effort. There is no direct measure of total effort, however indications from interviews with fishers, conversations with Fisheries Officers, DFO surveys (Sharp and Duggan 1985) and DFO over-flights are that effort (trap hauls and days fished) has both expanded and increased in the midshore since the early 1980's.

The unprecedented increase in landings during the 1980s resulted in concern again being expressed over the midshore fishery. Some fishers contend that increased landings in LFA 34 were due more to the expansion of the fishery into the midshore area and less to an overall increase in abundance.

This report examines these and other questions about the midshore fishery using information derived from a 1993 survey of fishers that fished the midshore area, lobster size frequency information from at-sea sampling data (1981-1994), and commercial landings records.

II BIOLOGICAL BASIS AND FISHERY CONTEXT OF THE MIDSHORE AREA

Lobster Distribution

Over most of the Canadian portion of the lobsters range (Fig. 4), fishing is a nearshore activity as lobsters are restricted by temperature to the coastal regions. Off Newfoundland, Quebec and in the Southern Gulf of St. Lawrence the deeper waters away from the coast remain cold year round. Along the Atlantic coast of Nova Scotia a cold water band limits the distribution of lobsters to a narrow coastal zone (Pezzack 1993). The Gulf of Maine area (including the Bay of Fundy) is unique in Canadian lobster fishing areas because lobsters are found from the coast to the upper continental slope and in the deep water basins of the shelf. Warm slope water, found along the upper continental slope and in the deep basins of the Gulf of Maine, provides year-round temperatures of 6-10°C (Mountain and Holzwarth 1989; Mountain, *et al.* 1989) and the shallow offshore banks (Browns and Georges Banks) warm to 10-12°C in summer (Hachey 1953; Mountain and Holzwarth 1989; Benway, *et al.* 1993) providing a suitable offshore habitat for lobsters. These allow a breeding population of lobsters to exist on the Banks and outer continental slope, and in the wide expanse of shallow water off SW Nova Scotia .

The management division between the inshore and offshore fishing areas is a line established in 1971, approximately 92 km (50 miles) from shore (Pezzack et. al., 1992). In the eastern Gulf of Maine there is a large coastal lobster population that may extend out to the deep basins and an offshore component centred on the outer slope and on Browns and Georges Banks. The relationship between nearshore and midshore lobsters and the even more distant offshore lobsters has been questioned since the respective fisheries began (Pezzack, et. al., 1992). The original line did not correspond to lobster distribution and split the Browns Bank concentration (Fig. 3).

Achieving a definition of the midshore as a biological unit is problematic as it includes components of both inshore and offshore lobsters. Seasonal movements of mature lobsters from Browns Bank into the basins of the Northeast Channel (Pezzack and Duggan 1985; Pezzack and Duggan 1986) and of mature lobsters from the coastal area (Campbell and Stasko 1985; Campbell 1989a; Campbell 1989b) into the basins further complicates the picture. The seasonal movements of coastal lobsters are not well understood. While they appear to make seasonal migrations, it is not known if the movement of lobsters from deep water in the midshore takes them to the coastal area or to shallow areas around German Bank, Seal Island and Lurcher Shoal. While the midshore is not a biological unit, we may define it as a logical fishing area extending from the 55m contour to the offshore line, based on fleet characteristics.

For the purpose of this survey, the midshore fishery was defined as that area lying between the 30 fathom (55 m) contour line and the Offshore Boundary Line (excluding the Browns Bank Closed Area-LFA 40) running from a point off Baccaro Point to a point off Trinity Ledge (Fig. 5), an area of approximately 21,000 km^2

Historical Development of the Midshore Fishery

Pre-1971

The lobster fishery off southwestern Nova Scotia was traditionally prosecuted between the coast and approximately 20 km offshore (Fig. 3). Intermittent fishing took place outside these traditional nearshore grounds but effort was limited because of the difficulties encountered in fishing operations. The midshore was hard to fish because of the transit distance and the strong currents that would pull buoys under water. It was only possible to fish 30-40 traps at slack tide making it not worth the long steam from ports on the mainland. Fishers that lived on the outer islands (Seal and Tusket Islands) during the fishing season were better able to fish these outside grounds, however German Bank remained the outer limit of fishing effort. Traps were not usually left in the water during the winter months as cooler water temperatures resulted in decreased catch rates, winter weather could damage the gear, and gear was difficult to tend from small boats.

1971-1980

In late 1971 offshore lobster licenses were made available to vessels displaced by the closure of the swordfish fishery (Stasko 1978). The offshore fishery (LFA 41) was restricted to the area outside a line drawn approximately 92 km from shore (Fig. 3). One of the most productive offshore areas was on the south and southwest edge of Browns Bank, in depths of 92-183m (50-100 fathoms). Lobster catch rates (kg/TH) offshore averaged 1.5 and 1.0 kg on Georges and Browns Banks respectively, compared to the nearshore average of 0.5-0.7 kg, and included more mature lobsters and a larger proportion of berried females (Stasko 1978; Stasko and Pye 1980; Pezzack and Duggan 1985; Pezzack and Duggan 1987)

Inshore vessels from the Yarmouth-Wedgeport area began to venture farther from shore in the early 1970s. Effort was extended to German Bank and the area around it. In 1975, before the closure of Browns Bank, two boats from Cape Sable Island set traps on Browns Bank inside the offshore lobster limit (Fig. 3) and obtained larger lobsters and greater catch rates compared to those of the nearshore fishery (D. E. Graham, unpub. data). This fishing activity represents the origin of the midshore fishery.

By May 1976 eight vessels were fishing Browns Bank from various ports in LFA 34 (D.E. Graham, unpub. data). During the fall of 1976 a number of inshore fishers transferred their inshore

lobster licenses from their regular lobster boats to 70 foot herring seiners to permit fishing farther from shore in harsh weather conditions. This was considered by DFO management to be contrary to good conservation practices and a vessel size restriction of 45 feet length over all (LOA) was imposed in 1977.

During 1975-76 inshore fishers expressed greater concern over the increased effort and landings by the offshore fleet. In response effort and catch controls were introduced that froze the number of offshore licenses at eight, and imposed a nine month season, a limit of 1000 traps and a 408 t quota in NAFO area 4x (Pezzack and Duggan 1985).

Stasko (1978) hypothesized that the shoal water of Browns Bank was an important spawning area for lobsters and that larvae produced there were transported to the nearshore area. The hypothesis was based on the presence of large numbers of berried females and lobster larvae (Stasko and Gordon 1983) in the Browns Bank area and a general circulation pattern that could transport larvae towards the coast. In 1979 Browns Bank was closed to all lobster fishing (Fig. 3), displacing two offshore and 8-10 inshore vessels that had fished the Bank. Some of the displaced inshore vessels began to look elsewhere inside the offshore limit for commercial concentrations of lobster.

In 1979-80 interviews with fishers were conducted to determine the extent of the midshore fishery (A. Campbell, Lobster Research Scientist to 1988, Biological Station, St. Andrews, N.B and D.E. Graham, unpub. data). By the spring of 1980, 18 vessels were reportedly fishing the midshore area from south of Cape Sable Island to German Bank with one vessel operating just inside the offshore limit above Crowell and Tusket Basins (Fig. 6).

1981-1984

The introduction of the wire lobster trap and fishing trawls of 15-20 traps each, allowed the midshore fishery to expand rapidly in the early 1980's. Larger fiberglass boats equipped with diesel engines, modern electronics, Loran C navigation, hydraulic haulers and improved depth sounders, enabled fishers to go farther, carry more traps, and fish in harsh weather or at night. This all added to the increased effort in the midshore area. As knowledge of the better catch rates was disseminated more inshore fishers began to expand into the midshore.

The distribution of fishing effort was more explicitly defined in the fall (December 9-18) of 1983 and spring of 1984 (May 11-16) using an aerial survey of lobster buoy distribution (Sharp and Duggan 1985). This survey showed that the midshore fishery had expanded since the late 1970's and that much of the effort was directed to the German Bank area in depths of 50 to 90 m (Fig. 7). It should be noted that all of the effort distribution may not have been included in this survey as some fishers only fish the midshore from January to March.

The 1993 fisher survey indicated that by 1985 approximately 100 vessels from ports between Cape Sable Island and Yarmouth were fishing the midshore area (Fig. 8) on a full time (6 month) basis or as a winter fishery (Jan.-April) and that this number has remained relatively stable since that time.

III BIOLOGICAL SAMPLING OF THE MIDSHORE FISHERY

Material and Methods

Size Frequency of the Midshore Catch

The size frequency of the catch was obtained through at-sea sampling in the first month (early Dec.) and the last month (May) of the fishing season. During 1981, 1992 and 1994 samples were also taken during the winter (Jan.-March; Fig. 9). Depending upon conditions the catch was either completely sampled or subsampled by sampling every second trap hauled. Lobster carapace length (CL) was measured to the nearest mm, and sex (egg condition if ovigerous), was recorded for all lobsters in a trap. Location (Loran C) and depth were recorded for each string of traps. Water temperature was recorded at a number of locations and depths throughout the sampling period.

Size frequencies were described for the total trap sample, while median sizes were calculated for both the total catch and for the legal catch (carapace length > 81 mm CL). Escape vents designed to prevent the retention of sublegal sized lobsters can affect catch rates of sublegal sizes and were made mandatory in the fishery in 1993 (some fishers used them on a voluntary basis prior to 1993). Comparison of total catches between years is not valid since the escape vents reduce the numbers of sublegals in the catch. Comparisons between years and areas were thus made using the legal portion of the catch.

Long term monitoring of lobster population size structure in a specific area is made difficult by the spatial and seasonal differences in size frequencies due to lobster movement and the mobility of the midshore vessels that change fishing grounds during the season and from year to year. For the present analysis midshore at-sea samples were subdivided into three groups of similar depth and locations (Fig. 9): Outside of German Bank (>100 m), German Bank (100 m) and Inside of German Bank (70-100 m). No at-sea sample data are available from the few vessels that fish along the Offshore Boundary Line, but it can be assumed that their catches are the same as the offshore vessels they fish beside.

Lobster By-catch in NMFS Groundfish Trawl Survey

Estimates of overall abundance are not possible from the available fishery data. Long term trends in relative abundance can be obtained from the lobster by-catch in National Marine Fishery Service, Woods Hole, Mass.(NMFS) autumn (Sept.) and spring (March) groundfish trawl surveys (1968-1994; (Anonymous 1988)). The American groundfish trawl survey has been used by American biologists in recent lobster assessments (SARC 16, 1993). From the beginning lobster by-catch was an integral part of the data collected with length, weight and sex recorded.

Mean catch per tow data (Delta Mean;Pennington 1983) data obtained for sampling strata 33,34 and 36 in Fig. 10.

RESULTS AND DISCUSSION

Size Frequency of the Midshore Catch

The size frequency distribution of lobster in trap samples provides information which can help biologists understand the relationship between midshore and adjacent nearshore and offshore areas, for assessing the effects of fishing on the population and for estimation of an areas importance to overall egg production.

Comparison of nearshore, Midshore and Offshore Trap Samples

The median lobster size in the legal portion of the catch from spring samples in midshore areas were compared with those from two spring nearshore samples (Lobster Bay and Seal Island) and two offshore areas (Crowell Basin and Southwest Browns Bank) (Fig. 11). The box plots show the median, 25th and 75th percentile and allows easy comparison of size frequencies.

The median size from the inside and German bank portion of the midshore were similar to those from the nearshore with a median size less than the size of 50% maturity. Samples from the deeper water area outside of German Bank in 1986 and 1992 were greater than German Bank and the nearshore but smaller than the offshore area. The median size in the deeper water areas is slightly higher than the size at 50% maturity.

Proportion mature and proportion of females berried

On average 43% of the legal sized females in the midshore at-sea samples were >95 mm CL, the size at which 50% are mature (Pezzack unpublished data), compared to 31% in nearshore samples. The higher proportion of mature sizes in the midshore area may be due to a lower exploitation rate in the midshore and migration of mature lobsters from the nearshore to the midshore area. In offshore samples from Browns Bank and the Gulf of Maine area, 69% of the catch is > 95 mm CL.

Concern that the midshore has been taking large numbers of mature lobsters and that this could have a long term impact on the population is based in part on the higher proportions of mature animals in the midshore. The proportion of berried females among mature females in the midshore at-sea samples varied from 0-8 % . Given the high proportion of animals >95 mm CL, the low proportion berried females suggest that there are behavioural and distribution differences between berried and non-berried females that affect their relative catch rates. The lower catchability of berried females makes the proportion berried in trap samples of little use in assessing reproductive potential of a stock or area. The proportion of mature sizes in the catch can be used to compare the relative reproductive potential of different areas, but it is also affected by the lower catchability of berried females and seasonal migration of mature animals.

Determining the contribution of the nearshore, midshore and offshore areas to overall egg production would require knowledge of relative population sizes as well as the proportion of animals that were mature. Alternatively, if the assumption is made that the nearshore, midshore and Browns Bank portion of the offshore represent a single unit, the proportion of the mature sized lobsters taken in each area would give an indication of the potential impact each fishing area has on the reproductive portion of the stock. The nearshore has a lower proportion of the catch in the mature size range but represents 86% of the total catch and therefore lands 78% of all mature animals. In contrast the offshore has a very high proportion of the catch in the mature sizes, but only accounts for 10% of the mature lobsters landed because it represents only 5% of the total catch (Table 1).

Table 1: Percentage of lobsters in the catch that are mature in the nearshore, midshore and offshore areas, and the percentage these represent of the mature lobsters landed in LFA 34 plus the 4X portion of LFA 41.

Fishing Area	% of LFA 34 and offshore Browns Bank landings	% Mature (>95 mm CL)	% of mature lobsters landed in LFA 34 and offshore Browns Bank
Near shore	86%	31%	78%
Midshore	9%	43%	12%
Offshore (Browns Bank)	5%	69%	10%

Area, seasonal and interannual differences in Midshore trap samples

The midshore is not an homogeneous area and the size structure and catch rates in the at-sea samples vary between areas, season and years (Fig. 12). The lack of samples at the inception of the midshore fishery makes it impossible to determine if there has been any long term shifts in the size structure and makes detailed analysis impossible. However, some general patterns can be seen.

Spring at-sea samples in 1991, 1992 and 1993 from the midshore area inside of German Bank and adjacent to the nearshore area had median sizes of 97, 93 and 93 mm CL respectively (Fig 12a). The single fall sample in 1990 had a median size of 99 mm CL. The fall sample had few animals <90 mm CL while the spring samples had animals down to 50 mm CL. The spring samples frequency suggest local recruitment with a moderate exploitation rate. The presence of larger sizes in the fall could be the result of an outward migration of mature sizes from the nearshore areas.

German Bank samples in January and March 1994 had the same median size (88 mm CL; Fig 12b), though the catch rate was much higher in January than in March. The January sample had a large number of prerecruits and a size structure similar to nearshore areas with high exploitation rates but seasonal distribution of mature animals would affect this sample.

The deep water (>100m) areas outside German Bank were sampled three times in early spring of 1981 (Figs 9; 12c). but samples were very small (two March samples were pooled). The area was sampled again in spring 1986. Fall samples were taken in December 1986, January 1987 and December 1992 (Fig 12d). Large differences in the median sizes between 1981 (123 and 128 mm CL) and 1986 (96 mm CL) may be biased by the small sample sizes in 1981 . The lack of sublegal

sizes, or animals less than 100 mm CL in the 1981 sample is inconsistent with all subsequent samples or samples from deep water sites in the offshore. The 1981 median sizes are greater than that of Corsair Canyon on Georges Bank, which has the largest median size in the region. The median size of the other fall samples was highly variable and suggests that the area is not homogenous. Large differences between samples taken in December 1986 (87 mm CL) and January 1987 (107 mm CL), illustrates the difficulty of comparing at-sea trap samples. The December sample had large numbers of immature sizes and a size structure suggesting high exploitation rates, while the January sample had few prerecruits.

The number of at-sea samples from the whole midshore fishery is limited and there is a lack of samples from the early period of the fishery. The data suggest that the size structure has not changed significantly since 1986, but the lack of a longer time series in any one area or season makes it impossible to determine if there has been a change over a longer period.

Lobster By-catch in NMFS Groundfish Trawl Survey

Trawl gear is not designed to sample lobsters and the catch rates are highly variable. For this reason long term trends and not year to year changes should be looked at. The data was smoothed using the Lowess method (Cleveland 1979) to indicate the general trends in catch rates.

Lobster by-catch data suggest an increase in the lobster population in the midshore area off SW Nova Scotia and in Jordan Basin since the early 1970s (Fig 13). The increase in abundance during the 1980s corresponds with the widespread increase in lobster abundance seen along the coast of eastern North America (Fig. 2; Pezzack 1993).

Data suggests that during the 1960s and 70s the midshore represented a very small stock of very large animals. The absence of large sizes in the present catch may be the result of a fishing out of large animals early in the midshore fishery or that the larger animals have been overwhelmed by the recruitment pulse of the 1980s and now represent a small proportion of the stock. The size frequencies from the at-sea samples support the suggestion of a recent increase in midshore abundance, showing an absence of very large sizes and a predominance of pre-recruits and newly recruited animals.

IV FISHERY PARTICIPANT SURVEYS OF THE MIDSHORE FISHERY

Material and Methods

An interview guide (Appendix 1) was prepared during the winter of 1992-93 and formed the basis of the survey. It included questions on areas fished, changes in fishing areas over time, fishing effort, fishing vessel description, fishing practices and a fisher profile. This guide allowed fishers being interviewed to express concerns or make comments about the midshore fishery. The questions were tested with a number of fishers and their suggestions and comments were used to modify some of the questions.

Aerial surveys carried out using a DFO helicopter during the 1990 and 1991 seasons and a fixed wing aircraft during the 1992-93 season helped delineate the current midshore fishing area and identify vessels fishing it. Fishers believed to be fishing the midshore area currently or who had fished the area in the past, were obtained from fishers, personal contacts, Lobster Advisory Committee members, and local fishery officers. A letter of introduction was sent to each fisher identified as fishing the midshore (Appendix 2). The letter informed them of the survey to be conducted during the summer and fall of 1993, outlined the purpose of the survey, the area of interest (a detailed map) and the information requested. A copy was also sent to all LFA 34 Lobster Advisory Committee members.

Appointments were arranged and each fisher was interviewed individually following the end of the 1992-92 lobster fishing season. Following the formal survey questions fishers were encouraged to discuss any concerns or comments they had about the lobster fishery or how the fishery could be better managed or policed.

Results and Discussion

Number Of Fishers Fishing The Midshore

It was determined from contacts in the S.W. Nova Scotia lobster fishery that approximately 100 fishers (10 % of LFA 34 licenses) now fish the midshore area during some part of the fishing season. Seventy-one fishers were contacted and from these contacts the fishing locations and fishing methods were obtained for an additional 25 fishers. Sixty-four of the 71 contacts completed the survey with detailed information. In addition one fisher who no longer fishes lobster had information to offer as he was one of the original midshore fishers; two had only begun to fish the area in the 1992-93 season and felt they did not have much information to offer; two of the fishers named had not fished the midshore. Only two of the fishers contacted refused to participate in the survey citing a mistrust for DFO. They thought the information would somehow be used against them, through imposition of new regulations.

Fishery Profile

From the survey a profile of the midshore fishery and those who participate in it was obtained (Figs. 14-16). Of the midshore fishers interviewed, 28 (44%) of those who currently fish the midshore are between 41-50 years of age (78% between 31-50 years; Fig 14a). Most (66%) have more than 15 years lobster fishing experience (Fig 14b) and have been fishing the midshore area for 10 years or less (Fig 14c). Seventy per cent of the lobster vessels currently active in the fishery are no more that 10 years old (39 % less than 6 years; Fig 15a); forty-five of the vessels are 44-45 feet in length (75% > 42 feet; Fig 15b); 81 % are constructed of fiberglass (Fig 15c); 78 % are capable of carrying 200 or more wire lobster traps (Fig 15d); 58 % are > 25 tons; (Fig 15e).and 78 % have 250 -300 brake horse power (Fig 15f).

The fishery is concentrated mostly along the 30 fathom edge of the LFA 34 as well as on and around German Bank (Fig. 8). The most common fishing strategy is to fish the nearshore area at the beginning of the season when nearshore catch rates are highest, and to move to the midshore as the nearshore catch and water temperatures drop. Most vessels carry a crew of 3 both in the fall and spring with an additional crew member for the first two weeks of the season (Fig 16 a & b). After the first two weeks of the season most fishers haul their traps every second or third day rather than every day. Of the 64 fishers who completed the survey 40 (63 %) concentrate greater than 85 % of their effort in the midshore areas (Fig 16c). Most fishing is done with trawls averaging 20 wire traps each (Fig 16 d & e). Along the 30 fathom edge the number of fishing days is estimated to be between 40 and 50 depending on weather. Near shore fishers average between 50-90 days fishing.

During the survey 10 per cent of the fishers indicated the number of traps they were fishing and an additional 25-30 per cent estimated the average number of traps being fished per vessel. Based on the information obtained, the trap limit of 375 fall/400 spring is being exceeded.

Fishing occurs to a lesser degree outside German Bank in Tusket Basin, inside Crowell Basin, and outside Lurcher Shoal (Fig. 8). These grounds are considered to be part of the offshore Browns Bank concentration and the lobsters are from the same stock as those fished by the offshore boats, but outside the offshore TAC established to prevent excessive fishing of a potential brood stock. The fishery in this area must be taken into account in offshore assessments and should be managed in a manner consistent with the objectives of the offshore lobster management plan.

The fishing strategy in these areas is more typical of the offshore than the inshore lobster fishery. Fishers haul the traps every 3 to 7 days; use up to 5 crew members; use large wire and wood-wire 4 foot offshore traps set in trawls of 30 - 80 each and indications are that the trap limit of 375 fall/400 spring is also being exceeded in this area.

The average days fished per season is estimated to be 30, which is less than the average of 85-100 and 50-90 days for the offshore and nearshore respectively.

The May 1993 survey suggested that the number of vessels fishing the midshore has remained relatively stable since 1985 with some fishers shifting seasonally between the inshore and midshore grounds depending on catch rates. Nearshore catch rates have increased dramatically over the past

number of years and a number of midshore fishers felt that if landings did not improve on the midshore grounds, they may move back to the nearshore where fishing is easier and current catch rates are better.

V FISHERS' ASSESSMENT OF THE MIDSHORE FISHERY

The following comments from the interviewed fishers represent their general assessment of the state of the midshore fishery and the problems facing them.

State Of The Stock

Most fishers feel that the number of vessels fishing the midshore, and midshore landings, have stabilized since 1985. During years when midshore catch rates are higher than the nearshore, more boats move from the nearshore after the first few weeks of the fishing season, but return when midshore catch rates drop in the late spring and the nearshore catch rates increase.

The fishers indicated that large lobsters are no longer as plentiful in the midshore and that there are more small lobsters in the catch. They feel that the average size of lobsters in the midshore is still larger than in the nearshore (the authors feel that the size change observed by the fishers may be due to a combination of the recruitment pulse, that would increase the numbers of smaller sizes, and the removal of the very large sizes by the fishery)

Gear Conflicts

While most fishers suggest that the fishery appears to be in good shape they are concerned about an observed increase in fish and scallop dragger activity in the German Bank area (Fig. 17). In past years fish draggers did not fish until April 1, but are now allegedly on or near German Bank in December. Lobster fishers report that they are now more restricted as to the type of bottom they can fish. Draggers are more active on the smoother bottom areas and lobster fishers are sometimes restricted to the hard bottom areas that draggers cannot fish. (Historically scallop fishing has taken place on German Bank and the Lurcher Shoal area by both the inshore and offshore fleets (Robert, *et al.* 1989). In 1986 the two sectors of the scallop fishery reached agreement whereby a line established at 43° 40' N became the division between inshore and offshore. Recent information shows fishing by the inshore scallop fleet has increased above this line (M. Lundy, Scallop Technician, Hfx. Res. Lab., Halifax, N.S., pers. com.) and that scallop-lobster gear conflicts have been reported.)

Why They Moved To The Midshore

Most of the older fishers now fishing the midshore area moved there because nearshore grounds were becoming too congested as many of the nearshore vessels had been fishing over the trap limit. Expansion to the midshore enabled fishers to fish a larger area where effort had been relatively low and where greater water depths and higher water temperatures allowed for continued fishing during the winter. It is alleged by some fishers that the expansion also allowed for an increased opportunity to set traps over the limit by having one set of traps nearshore and one set in the midshore. The recent pattern is to set gear near the 30 fathom edge during the first few weeks of the fishing season and follow the lobsters out to deep water as the catch rates decrease inshore. In the past the midshore fishery continued through Jan.-May, with the fishers following the lobsters as they moved back to shallower water in late April -May. However, during recent seasons the midshore fishery in the German Bank area has been limited to Jan.-mid March (increased dragger activity earlier in the year near German Bank and decreased catch rates due to apparent cooler water temperatures). By mid March traps were moved back to the nearshore or in some cases landed.

Fishers' Concerns

Changing Trap Design

There was some concern over changes in entrance ring sizes on lobster traps. In the past 130-150 mm rings were used, but some fishers have recently been using 150-200 mm rings designed to catch larger lobsters. Some fishers have expressed concern over this as they suggest that larger lobsters,

especially mature females, may be targeted and therefore not getting a chance to reproduce. Fishers contend that there are more large female lobsters in the catch during the spring when lobsters are moving inshore and that they are now being caught at a higher rate due to the expansion into the midshore.

Manipulation of Trap Limit

Some fishers allege that in an attempt to circumvent the trap limit, especially in the midshore area, fishers are leasing other lobster licenses as a method to increase the number of "legally" tagged traps in the water. For example, two fishers (400 tags each) may pay a third for his trap tags. The two fishers would then fish the additional 200 traps each for a total of 600 "legally" tagged traps. This method may not increase the total allowable number of traps for the LFA, however it is illegal for one fisher to fish traps issued to another. It is contended that this regulation may also be circumvented by the third fisher being a crew member of one the first two fishers. (During the past year there has been increased effort by DFO to control vessels exceeding the trap limit in LFA 34. A number of fishers have had license suspensions imposed and a large number of untagged traps have been landed by fishery officers).

Enforcement

Fishers have indicated that the efforts by DFO to curtail illegal traps and the imposition of suspensions as opposed to monitory fines have had an effect. The number of illegal traps appears to have decreased and more fishers are adhering to the trap limit for fear of license suspensions if caught. (This trend was also observed by one of the authors who completed at-sea samples in LFA 34, onboard commercial inshore lobster vessels, in 1993 and 1994)

VI CURRENT STATUS OF THE MIDSHORE FISHERY

Fishery

Midshore fishers have sometimes found it profitable to exceed the trap limit. This was done because the longer soak time needed and greater travel distance travel meant fewer hauls per trap over the season. The recent introduction of administrative sanctions as well as peer pressure from other fishers has resulted in a noticeable reduction of the number of traps being fished.

The midshore fishery appears to have stabilized between 1985 and 1993. Existing controls on license numbers, season and the strict enforcement of trap limits may help to control further growth, however fishing effort and landings will continue to fluctuate with variations in the relative catch rates between the nearshore and midshore. Should nearshore catch rates decrease the potential exists for an increase in midshore effort by the nearshore fleet. If overall midshore abundance decreases there may be a trend for vessels to move back to the nearshore to maintain high catch rates. Any restrictions on the midshore would result in increased nearshore effort. The trend towards newer, larger and faster vessels in LFA 34 will allow more fishermen to use the option of fishing the midshore than in the past.

Midshore Landings

Total reported landings from LFA 34 (June 1994, Statistics Branch of Fisheries and Oceans) for the 1992-93 season were 8886 t. (Fig. 2). Total reported landings (June 1994, Statistics Branch of Fisheries and Oceans) and an estimate of these landings from the midshore (this survey) was obtained for 58 fishers of the 64 fishers that completed the survey (Fig. 18a). The average catch for the 58 fishers was 12683 kg of which 71% or 8957 kg came from the midshore area (Fig. 18b), with the remaining 29% caught in the nearshore. Survey information suggests that the fishing and landing patterns are similar for the remaining fishers that makeup the 100 fishers believed to fish the midshore and an estimate of the total midshore catch can be obtained by extrapolation. Landings by the 100 midshore fishers is estimated to be 1268 t with 896 t of it caught in the midshore area. The midshore fishers represent 10% of the licences in LFA 34 and in 1992-93 landed 14.3% of the districts catch (15% 1990-91 and 13% 1991-92). The midshore portion of their landings represented 10.1% of LFA 34 landings in 1992-93.

Table 2. Estimated midshore landings and percentage of LFA landings based on landings from surveyed fishers in 1992-93.

	LFA 34	Midshore Fishers	Midshore only
Landings (t)	8886	1268	896
Number of licenses	963	100	100
Average landings/License (t)	9.2	12.7	9.0
Percentage of total landings		14.3%	10.1%

Overall LFA 34 landings increased by approximately 6000t between 1979-80 and 1992-93 while midshore landings increased from less than 100t to 900t during the same period. Thus the expansion of the midshore fishery accounted for less than 15% of the overall increase.

LFA 34 Recruitment Index and Exploitation Rate Estimates

The recruitment index (Fig. 19) based on the abundance of prerecruits the previous spring (catch rate of lobsters just below legal size in spring at-sea sampling in Lobster Bay) shows continued high recruitment in nearshore areas. This suggests that the development of the midshore fishery in the early to mid 1980s has not had a detectable effect on nearshore recruitment.

Nearshore exploitation rates (Fig. 18), estimated by comparing the relative abundance of lobsters just below legal size with the numbers remaining the next spring after they have grown and been fished for one year (natural mortality assumed to be 10%), increased from 55% in 1982 to 75% in 1986 and have since remained between 70-85%.

VII CONCLUSIONS:

1. Midshore is not a distinct stock but extensions of the nearshore and offshore stocks. The midshore grounds near Browns Bank and the area between the Browns Closed Area, offshore line and Truxton Swell appears to be part of the offshore Browns Bank concentration. Four to six vessels fished this area in 1992-93 (estimate < 100t). The midshore grounds inside of this are an extension of the nearshore lobster concentration and are currently exploited by an estimated 90-95 vessels (estimate 800-850t).

2. In 1992-93 the midshore fishery accounted for less than 15% of the overall landings. Midshore fishers represented 10% of the total licenses, 10% (900t) of the landings and 12% of the mature lobsters landed in LFA 34.

3. The midshore fishery is fished on an opportunistic basis. When catch rates are low in the nearshore effort moves to the midshore and the reverse when nearshore catch rates are high. The trend towards newer, larger and faster vessels in LFA 34 will allow more fishermen to do this than in the past.

4. At-sea samples from the midshore area have median sizes moderately larger than in the nearshore grounds but smaller than the offshore areas. Size frequencies are highly variable with location and month and the limited sampling (12 at-sea samples 1986-1994) makes it difficult to accurately determine the overall population structure.

5. Available data shows that while there is a higher proportion of mature sizes in the midshore, this fishery only lands 12% of all the mature lobsters landed in the LFA 34 - offshore 4X region. The larger nearshore and offshore fisheries land 78% and 10% of the mature animals, respectively.

6. Available data shows that the size structure has not changed significantly since 1986, but the lack of a longer time series in any one area or season makes it impossible to determine if there has been a change over a longer period.

7. NMFS groundfish trawl surveys suggests that lobster abundance has increased on the midshore grounds since the late 1960s and information from fishers suggest the present large midshore population is a recent development. If so the hypothesis that the midshore served as a refugia for a brood stock, which helped maintain the stable fishery of LFA 34, may be incorrect.

VIII RECOMMENDATIONS

1. No management changes are recommended at this time.

2. That the landings of the 4-6 vessels (and any additional vessels) fishing near the offshore line, to the north-west of the Browns Bank Closed Area, be considered in future offshore assessments of this area.

REFERENCES

Anonymous. 1988. An evaluation of the bottom trawl survey program of the Northeast Fisheries Centre. NOAA Tech. Mem. NMFS-F/NEC-52:

Benway, R.L., K.P. Thomas and J.W. Jossi. 1993. Water-column thermal structure in the Middle Atlantic Bight and Gulf of Maine during 1978-92. NOAA Tech.Rep.NMFS-F/NEC. 97 154 p.

Campbell, A. 1989a. Dispersal of American lobsters, *Homarus americanus*, tagged off southern Nova Scotia. Can. J. Fish. Aquat. Sci. 46: 1842-1844.

Campbell, A. 1989b. Interim report on dispersal of lobsters (*Homarus americanus*) tagged off southern Nova Scotia. Can. Ms. Rep. Fish. Aquat. Sci. 2022: 29p.

Campbell, A. and A.B. Stasko. 1985. Movements of tagged American lobsters, *Homarus americanus*, off southwestern Nova Scotia. Can. J. Fish. Aquat. Sci. 42: 229-238.

Cleveland, W.S. 1979. Robust locally weighted regression and smoothing scatterplots. JASA 74: 829-836.

Hachey, H.B. 1953. A winter incursion of slope water on the Scotian shelf. J. Fish. Res. Bd Can. 10: 148-153.

Mountain, D.G. and T.J. Holzwarth. 1989. Surface and bottom temperature distribution for the northeast continental shelf. NOAA Tech. Mem. NMFS-F/NEC-73 : 32p.

Mountain, D.G., M. Pastuszak and D.A. Busch. 1989. Slope water intrusion to the Great South Channel during autumn, 1977-1985. J. Northw. Atl. Fish. Sci 9: 97-102.

Pennington, M. 1983. Efficient estimators of abundance, for fish and plankton surveys. Biometrics 39: 281-289.

Pezzack, D.S. 1993. A review of lobster (*Homarus americanus*) landing trends in the Northwest Atlantic, 1947-86. J. Northw. Atl. Fish. Sci. 14: 1115-127.

Pezzack, D.S. and D.R. Duggan. 1985. The Canadian offshore lobster fishery 1971-1984, catch history, stock condition and management options. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 85/89:

Pezzack, D.S. and D.R. Duggan. 1986. Evidence of migration and homing of lobsters (*Homarus americanus*) on the Scotian Shelf. Can. J. Fish. Aquat. Sci. 43: 2206-2211.

Pezzack, D.S. and D.R. Duggan. 1987. Canadian Offshore Lobster Fishery, 1985-86, and assessment of the potential for future increases in catch. Can. Atl. Fish. Adv. Comm. Res. Doc. 87/79: 25.

Pezzack, D.S., M.J. Tremblay, C. Hudon and R.J. Miller. 1992. The inshore-offshore lobster issue in Southwestern Nova Scotia. Can. Manuscr. Rep. Fish. Aquat. Sci. 2165 23 p.

Robert, G., M.A.E. Butler-Connolly and M.J. Lundy. 1989. Bay of Fundy scallop stock assessment for 1989. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 89/18: 38p.

Sharp, G.J. and R.E. Duggan. 1985. An aerial survey of near-shore and mid-shore lobster fishing distribution off southwestern Nova Scotia, spring and fall 1983-84. Can. MS Rep. Fish. Aquat. Sci. 1847: 37.

Stasko, A.B. 1978. Inshore-offshore S.W. Nova Scotia lobster stock interaction: A hypothesis. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 78/37: 10.

Stasko, A.B. and J. Gordon. 1983. Distribution and relative abundance of lobster larvae off southwestern Nova Scotia 1977-1978. Can. Tech. Rep. Fish. Aquat. Sci. 1175: 1-23.

Stasko, A.B. and R.W. Pye. 1980. Geographic differences in Canadian offshore lobster. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc 80/57: 12.

APPENDIX 1
Survey Questionnaire:

PORT : **YEARS LICENSED LOBSTER FISHER**

F'MEN AGE : **20-30** **30-40** **40-50** **50-60** **60+**

VESSEL : **Age** **Length** **Construction**
Carrying capacity

FISHING METHODS : **Full Time** **Part time**
No. Crew : **Fall**
Spring
Area(s) Fished (5' sqs) :
Traps : **Wire (%)** **Wood(%)**
Trawl **Pairs** **Singles**
Traps per trawl **Buoys/Trawl**
When do you double set gear?

HISTORY:
How long have you fished this ground?
Where did you fish previously?
Why did you move? (*if he moved a lot try to get history)

PRESENT GROUNDS:
Do you fish this area both fall and spring?
If not where do you fish?
On average how many fishing days do you have in the Fall? Spring?
Is all your gear in the mid shore?
If not what %?
How many other vessels fish in the same area?
What ports
Has the number of fishermen on the grounds changed in the last 5 years?
If so How?
If fished >5 years get older history also

CATCH : Over the past five years up down
More/less lobsters more/less traps more/less boats
Average size of lobsters: same up down
More shorts More seed
Areas/Times of higher concentrations of above:

REGULATIONS: Agree Disagree
Season
District
Trap Limit
License limit
Closed Area

GENERAL COMMENTS:

What do you feel is the most important concern of the "midshore" fishery at this time?
What do you feel is the state of the fishery? Where is it going?

APPENDIX 2
Letter Of Introduction:

Dear :

Lobster biologists from the Halifax Fisheries Lab of DFO will be talking with fishers in Lobster Fishing Area 34 this spring and summer to obtain more information on the history and development of the so-called "Midshore Fishery". This information will help us better understand the movements and distribution of lobsters off SW Nova Scotia. There is no obligation to participate, however your cooperation in this study would be appreciated.

From conversations with other fishers and members of the Lobster Advisory Committee we have put together a list of fishers believed to have fished or are now fishing beyond the 30 fathom contour, the line we have chosen to separate the inshore and midshore grounds for this study.

We are looking for information on when the fishery began, how it has expanded, what changes there have been in the catch rates or sizes of lobsters, and what are your feelings on the present state of the fishery and it's future.

A field technician will be contacting you in the next few months to set up a convenient time to meet informally to discuss these and any other issues you feel are important to the lobster fishery. Because of the potential large number and the busy time schedule of most fishers involved, meeting times need not be long.

The list we have may contain names of fishers who do not fish the area and have omitted some that do. We will continually update this list and attempt to contact any additional fishers.

Your cooperation will be much appreciated and if you have any questions or concerns please feel free to contact myself or the field technician at (902) 426-2099 (collect).

Thank you,
Douglas S. Pezzack
Lobster Biologist and
Assessment Coordinator

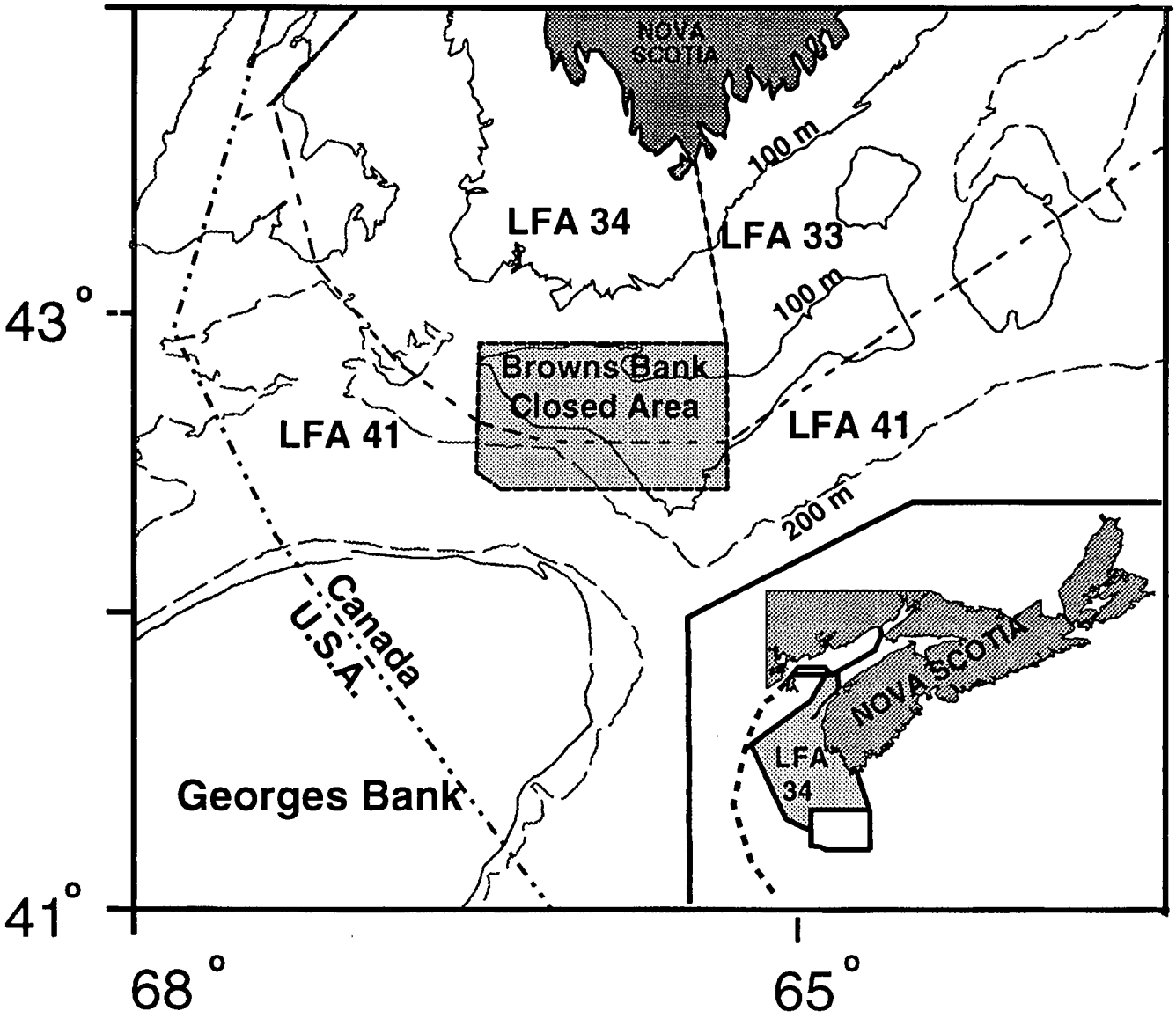


Figure 1 . Southwestern Nova Scotia lobster fishing areas.

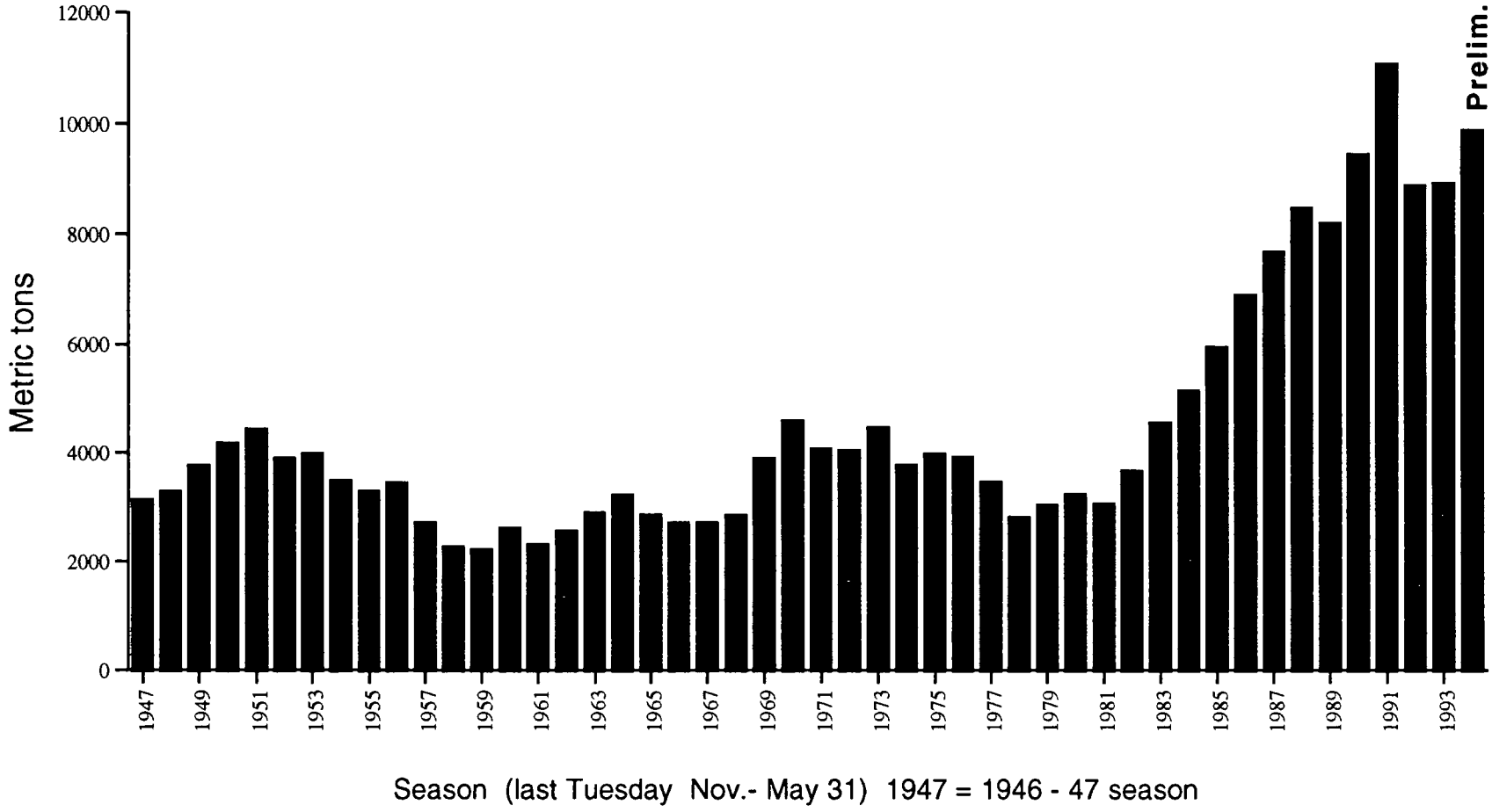


Figure 2. Seasonal lobster landings - LFA 34

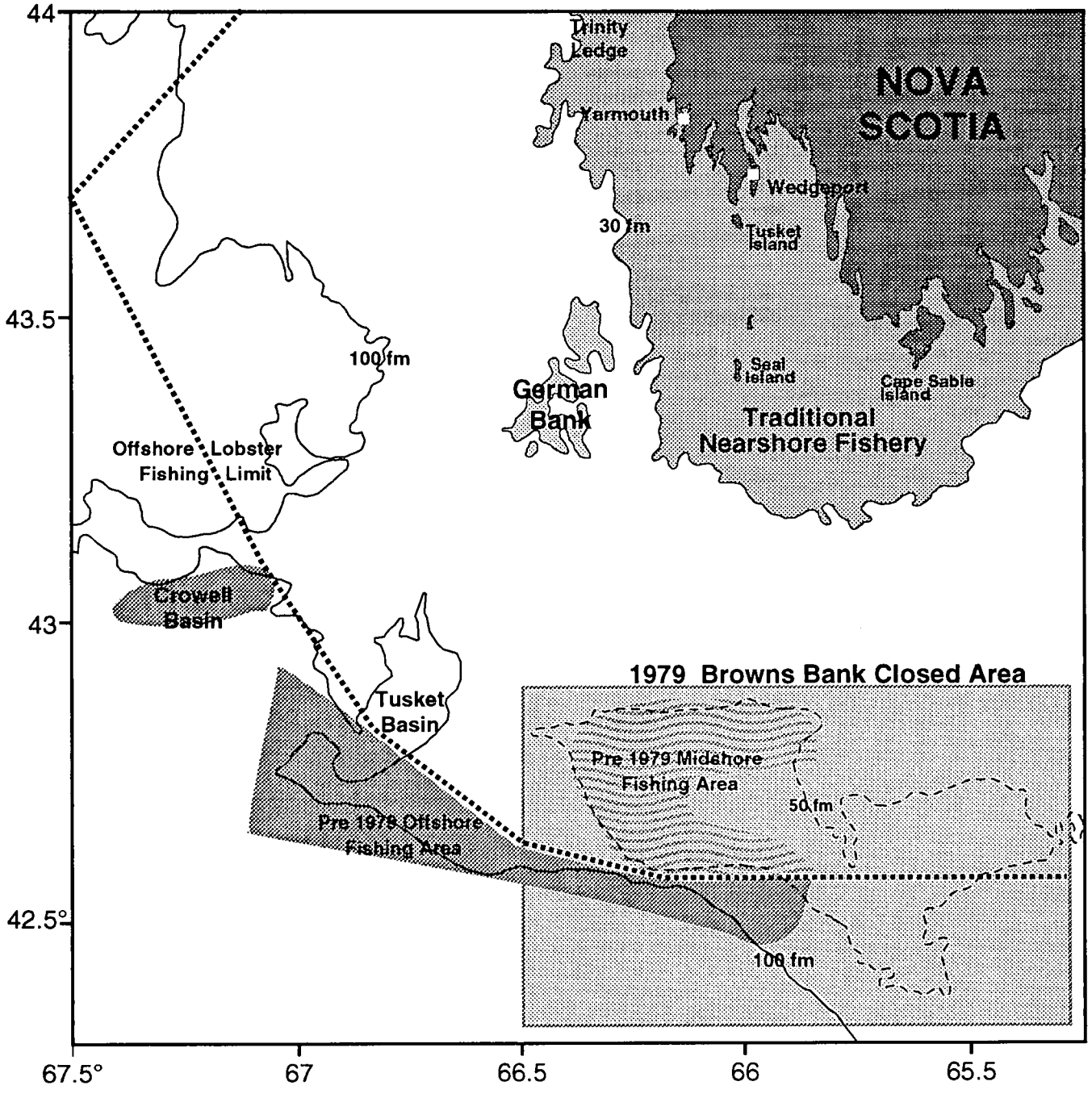


Figure 3. Lobster fishing areas in S.W. Nova Scotia - LFA 34

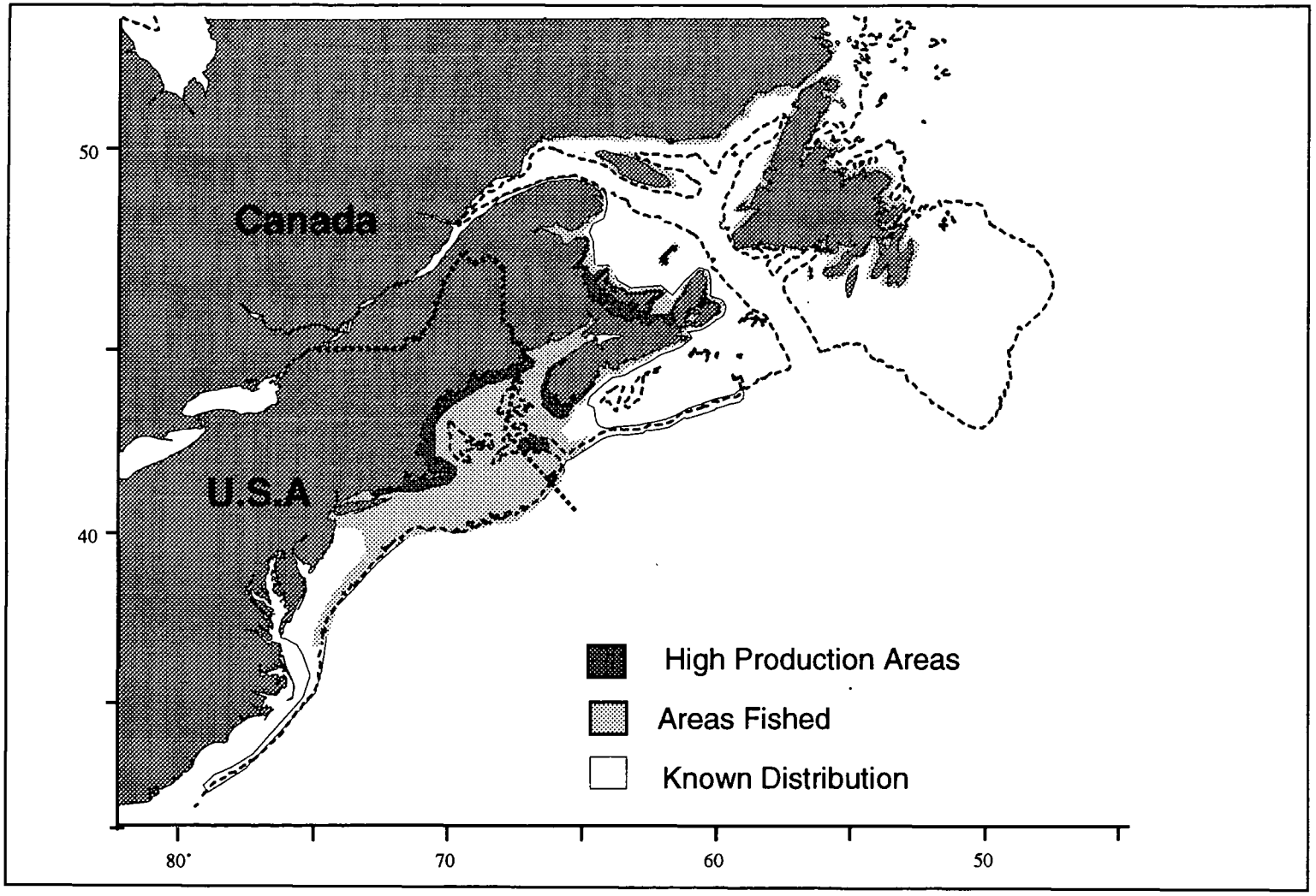


Figure 4. Lobster range and fishing areas.

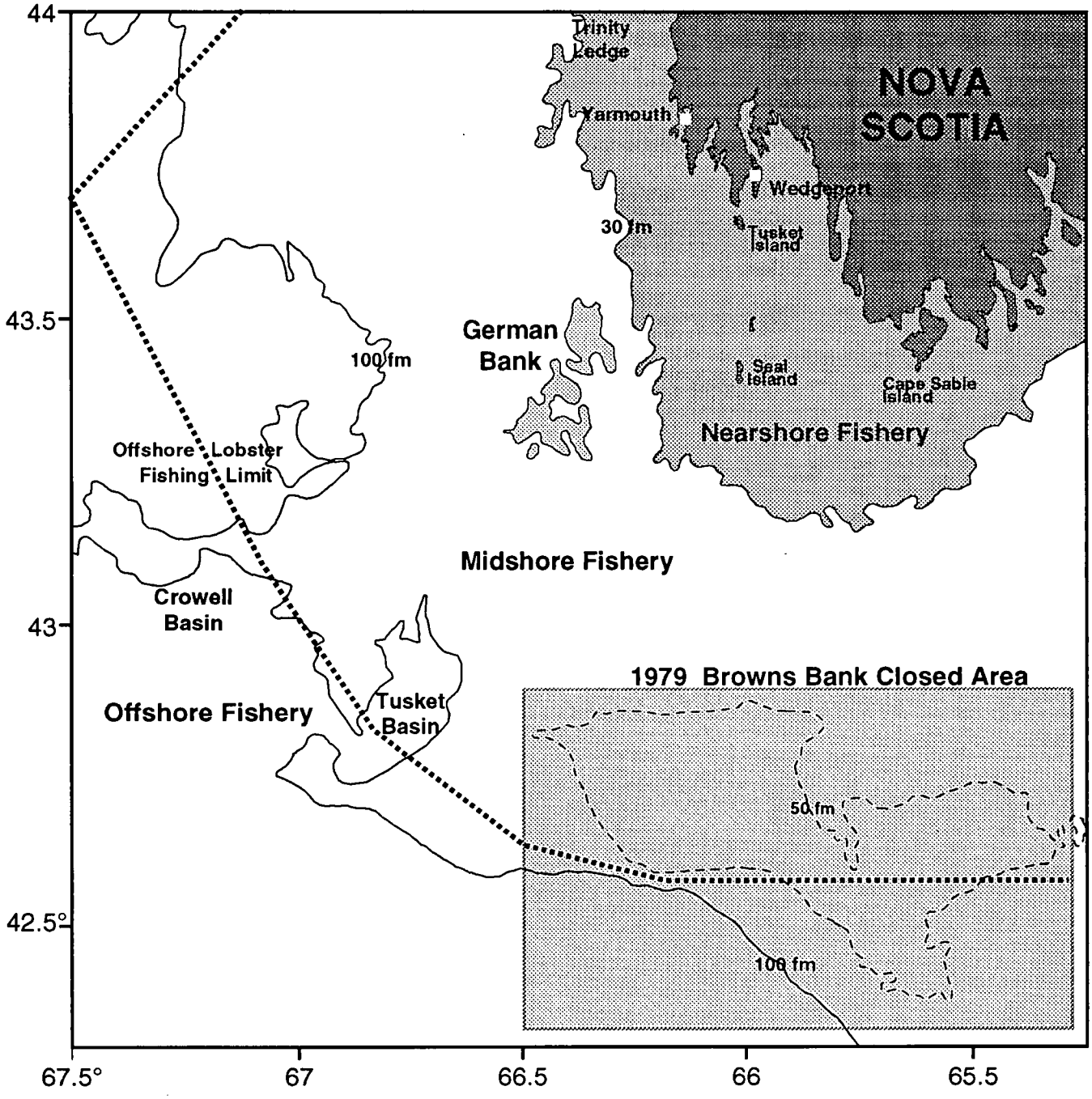


Figure 5. LFA 34 showing the "midshore" lobster fishing area

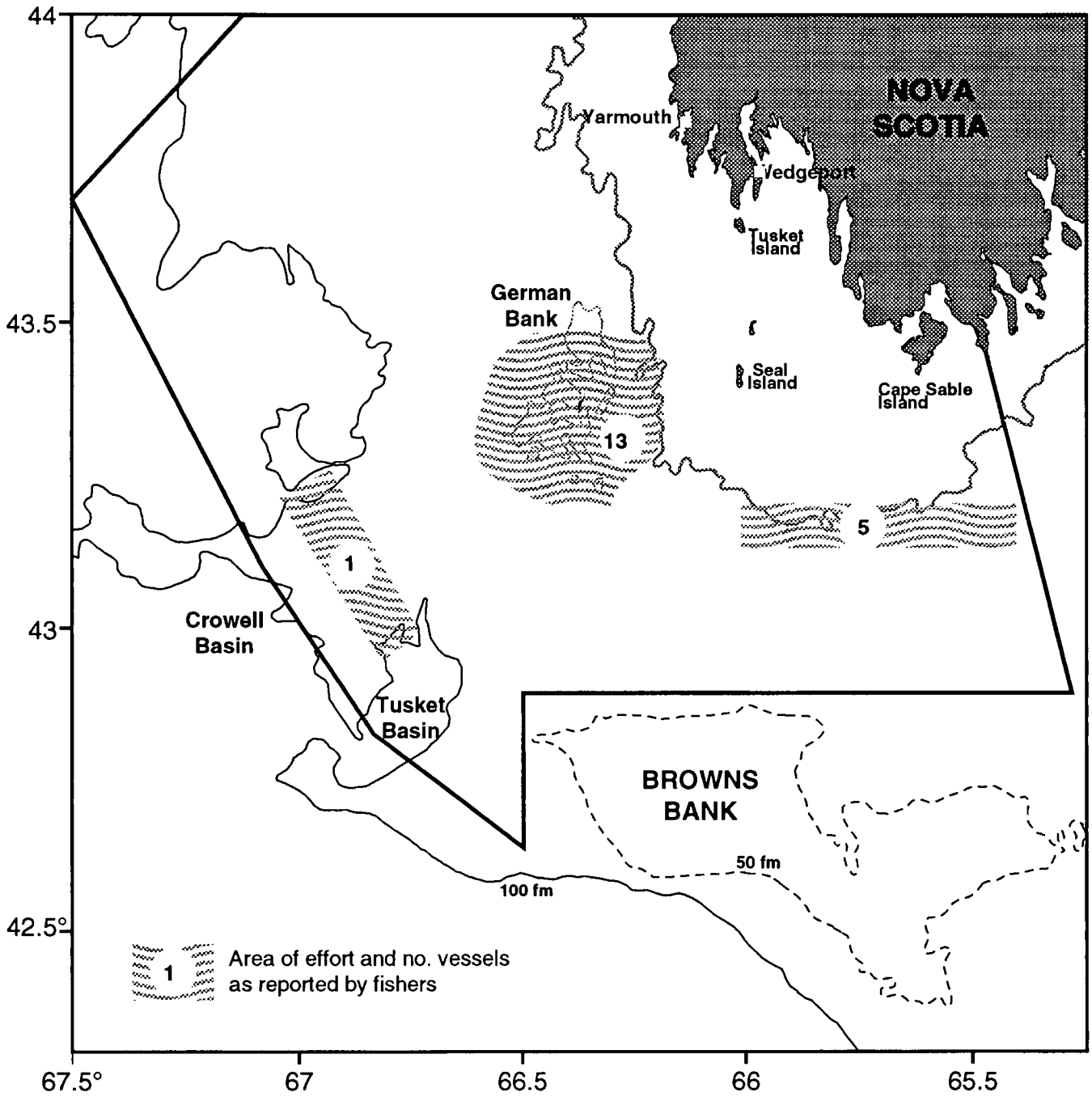


Figure 6. LFA 34 showing effort distribution in the midshore -1979-80 as reported by A. Campbell and D.E. Graham.

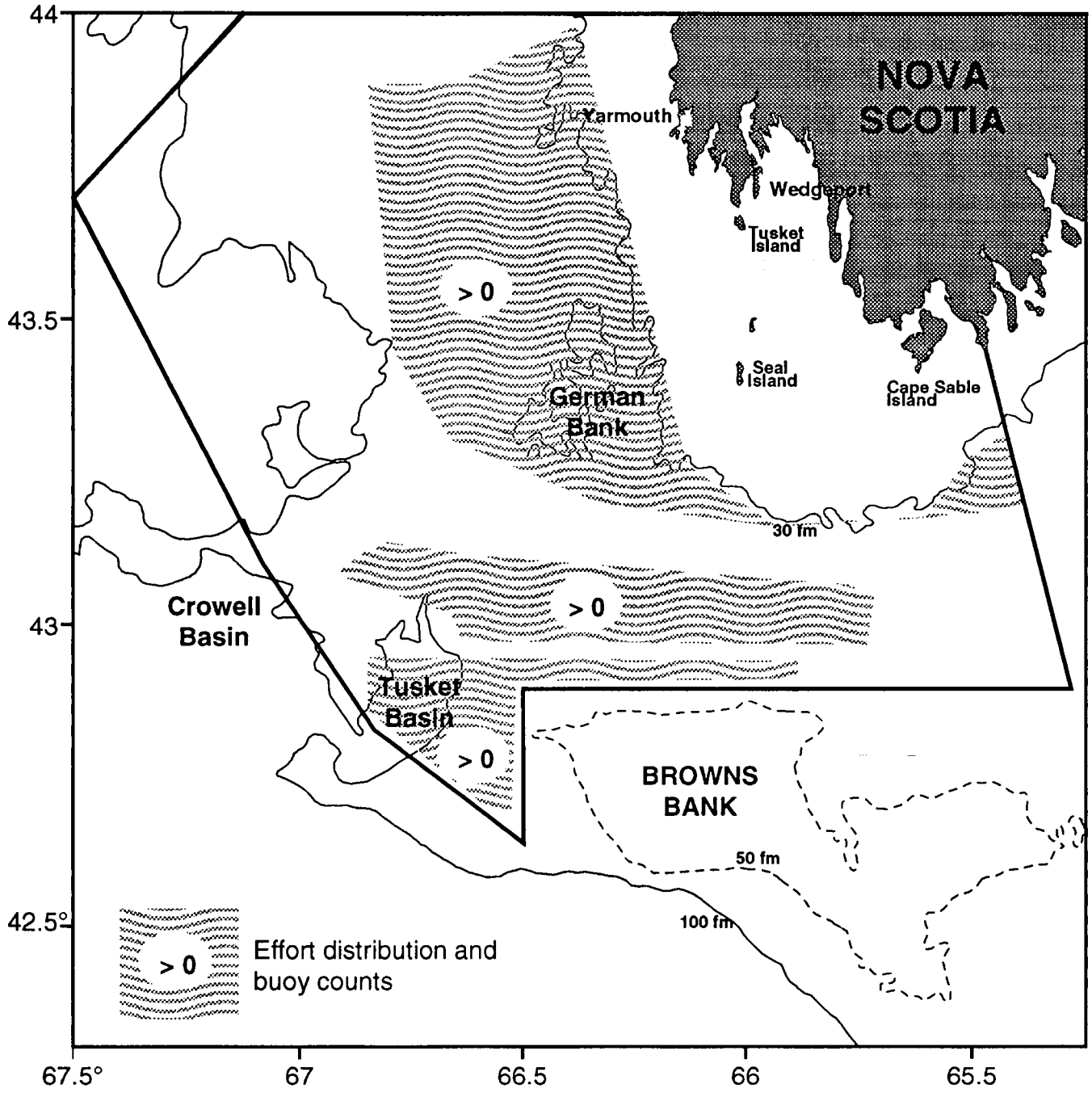


Figure 7. Contours of lobster trap buoy counts - spring 1984 from Sharp and Duggan

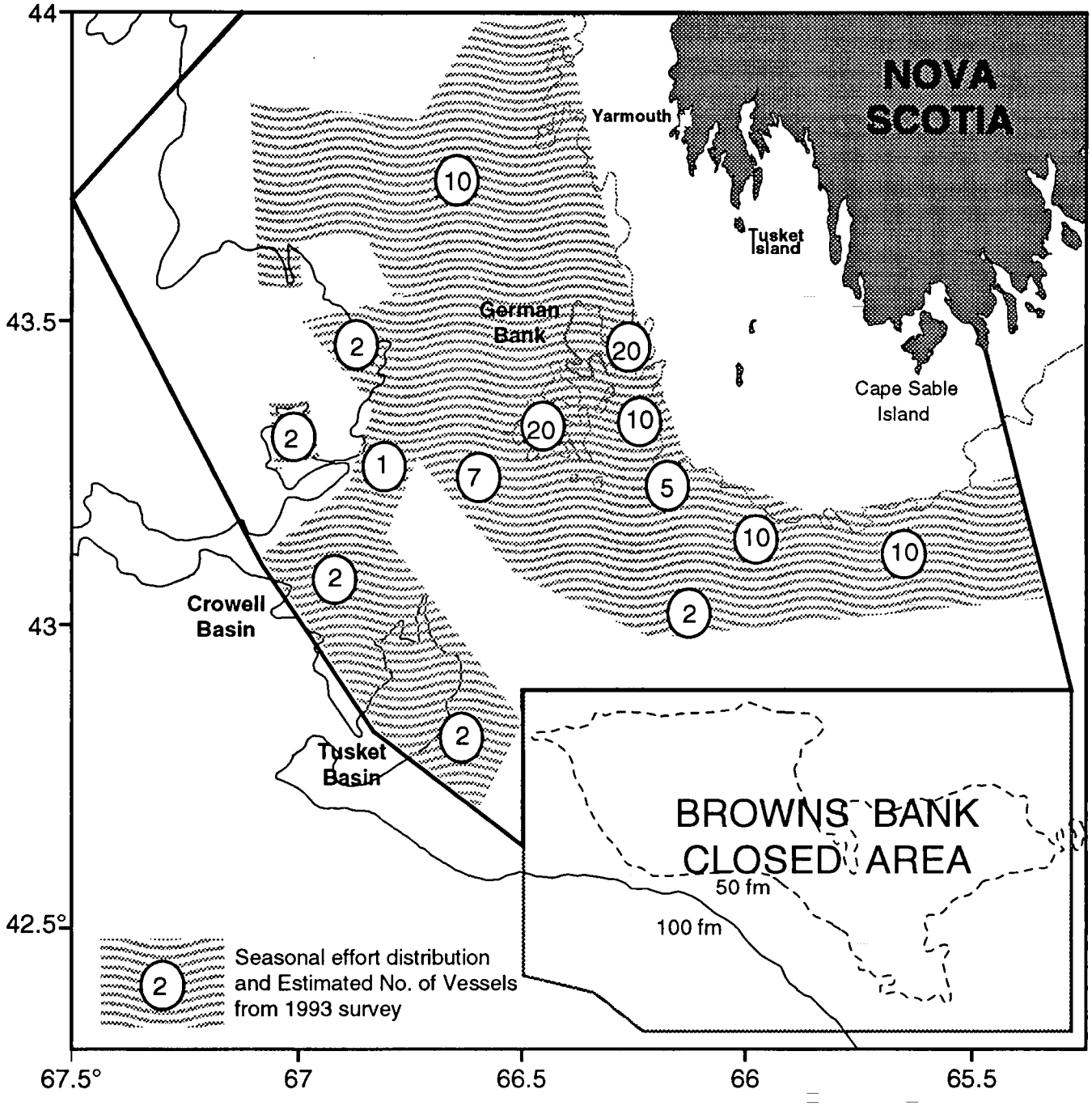


Figure 8. Midshore effort distribution from the 1993 fisher survey.

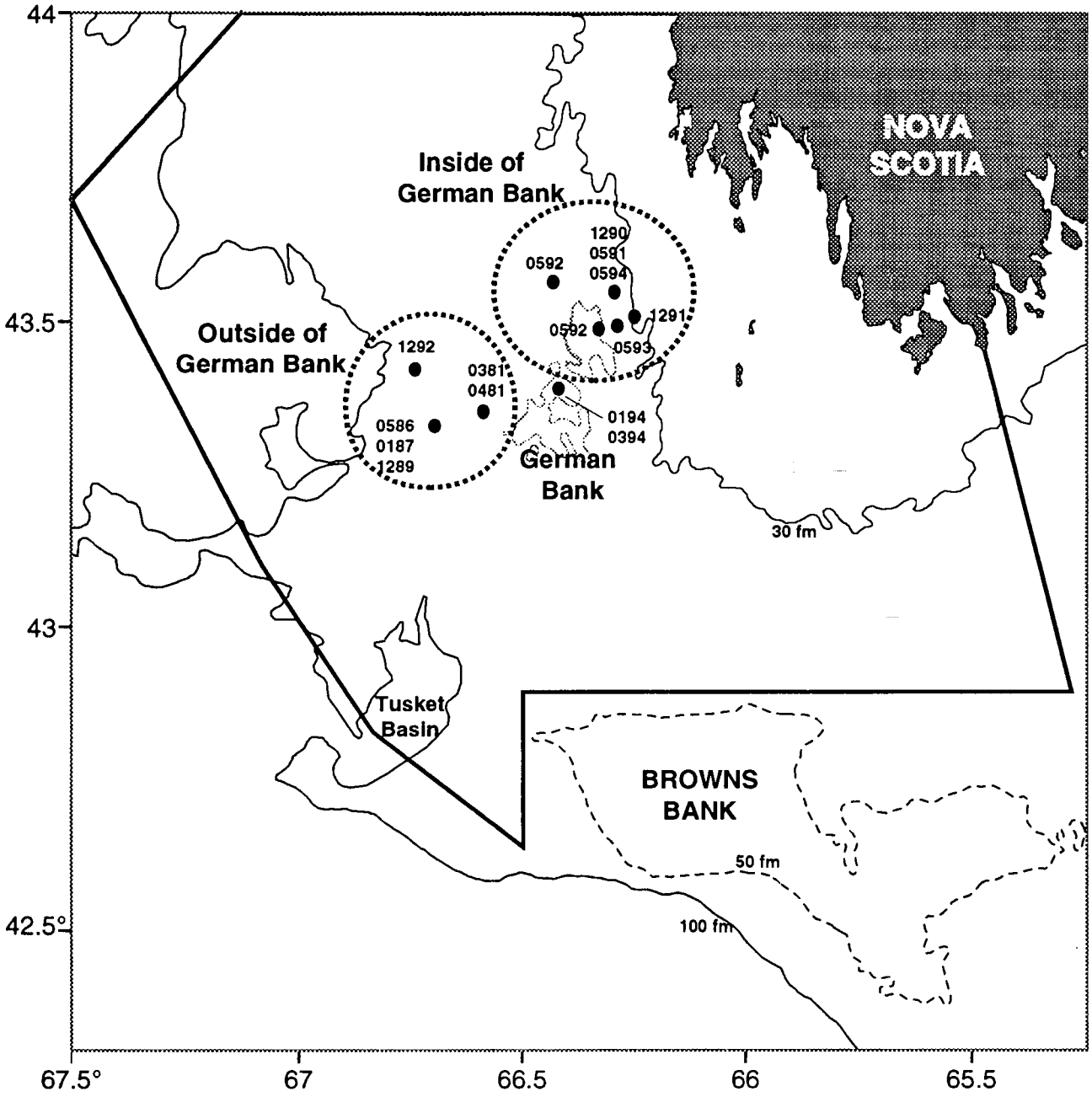


Figure 9. LFA 34 showing midshore at-sea sample locations and subareas used to group the samples.

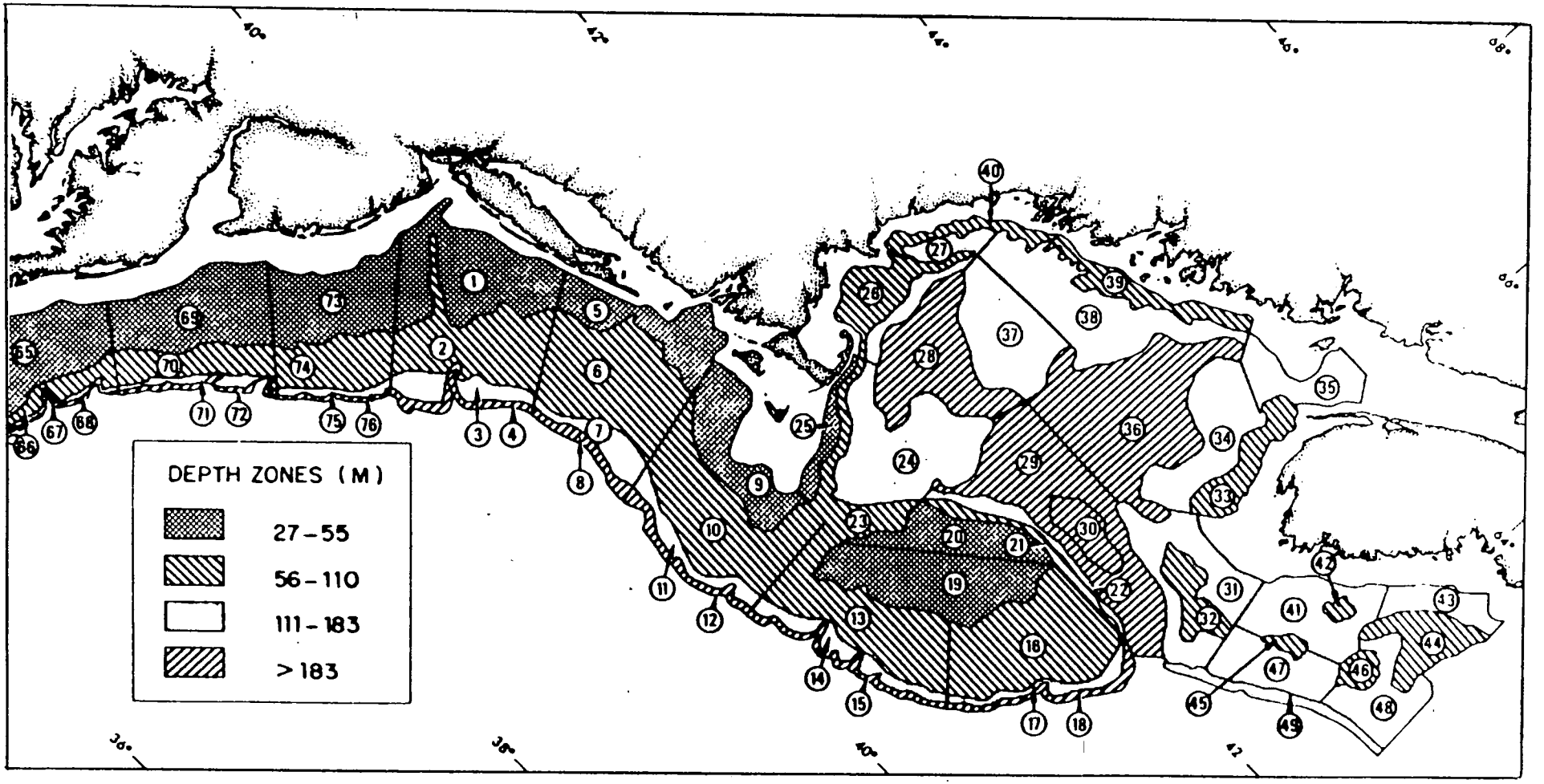


Figure 10. Northeast Fisheries Center bottom trawl survey strata from NOAA Technical Memorandum NMFS-F/NEC-52

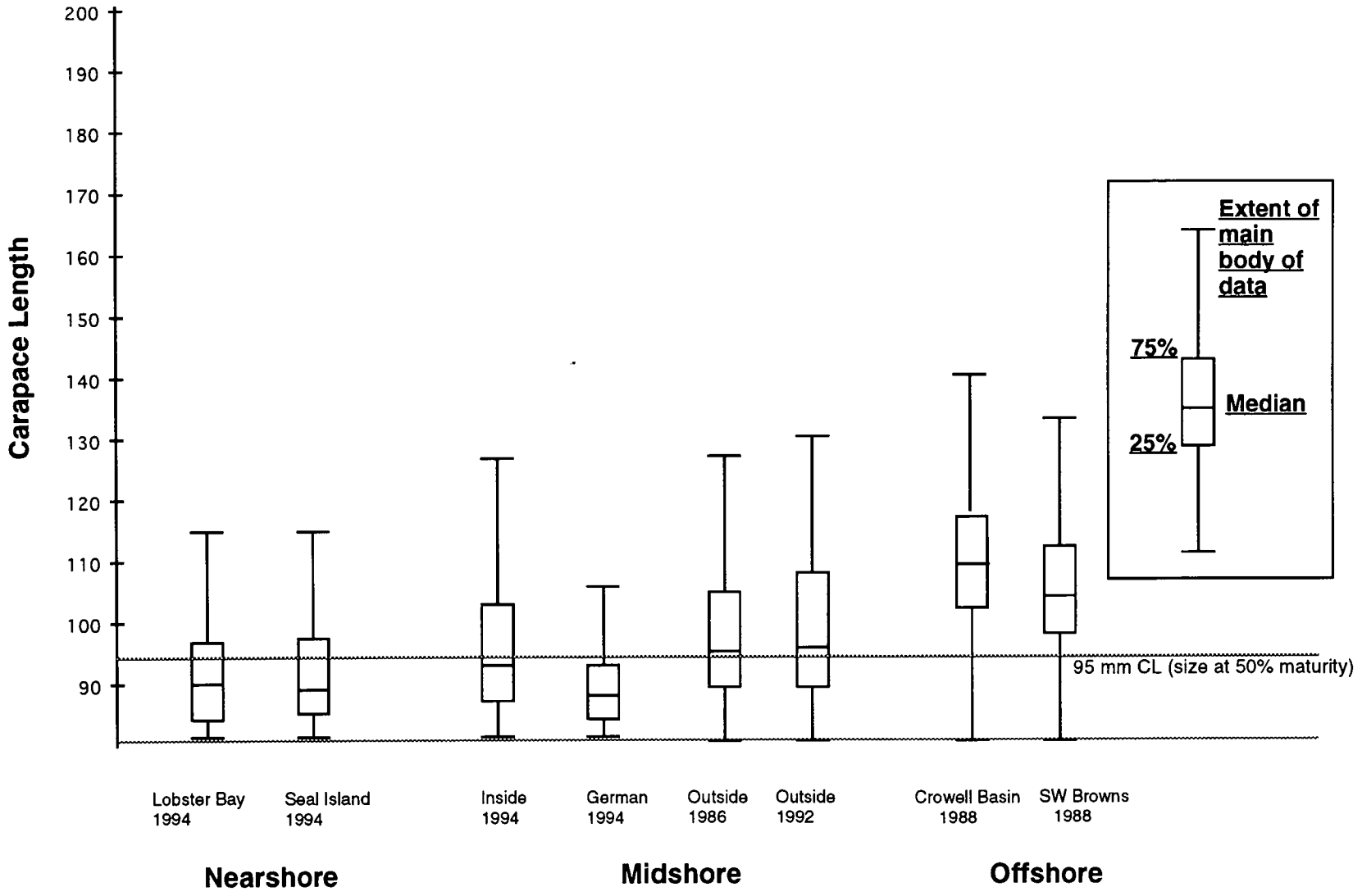


Figure 11: Box plot of legal portion (>81 mm CL) of spring at-sea trap caught samples from nearshore and midshore, and summer at-sea samples from the offshore.

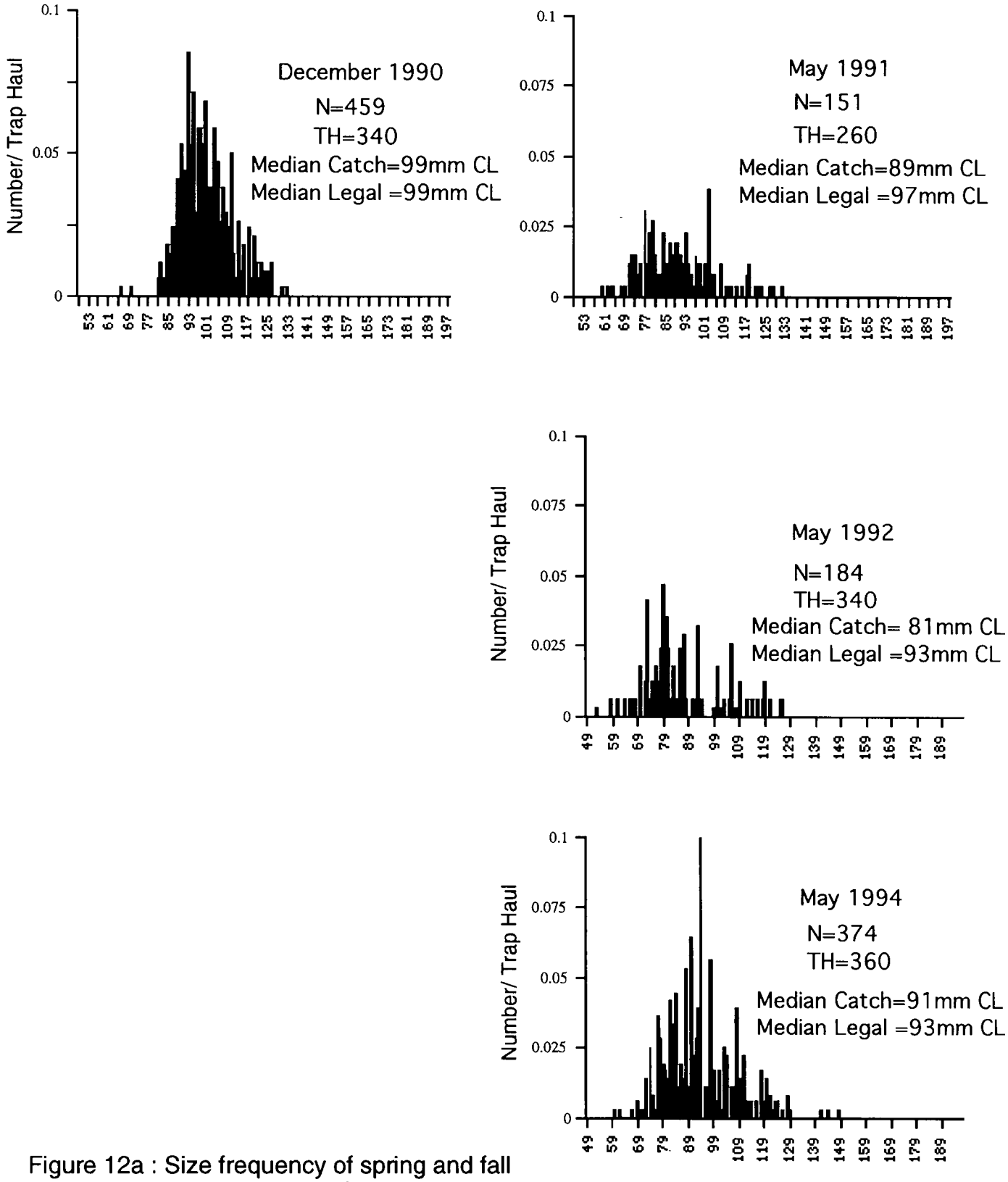


Figure 12a : Size frequency of spring and fall at-sea samples from the area inside of German Bank

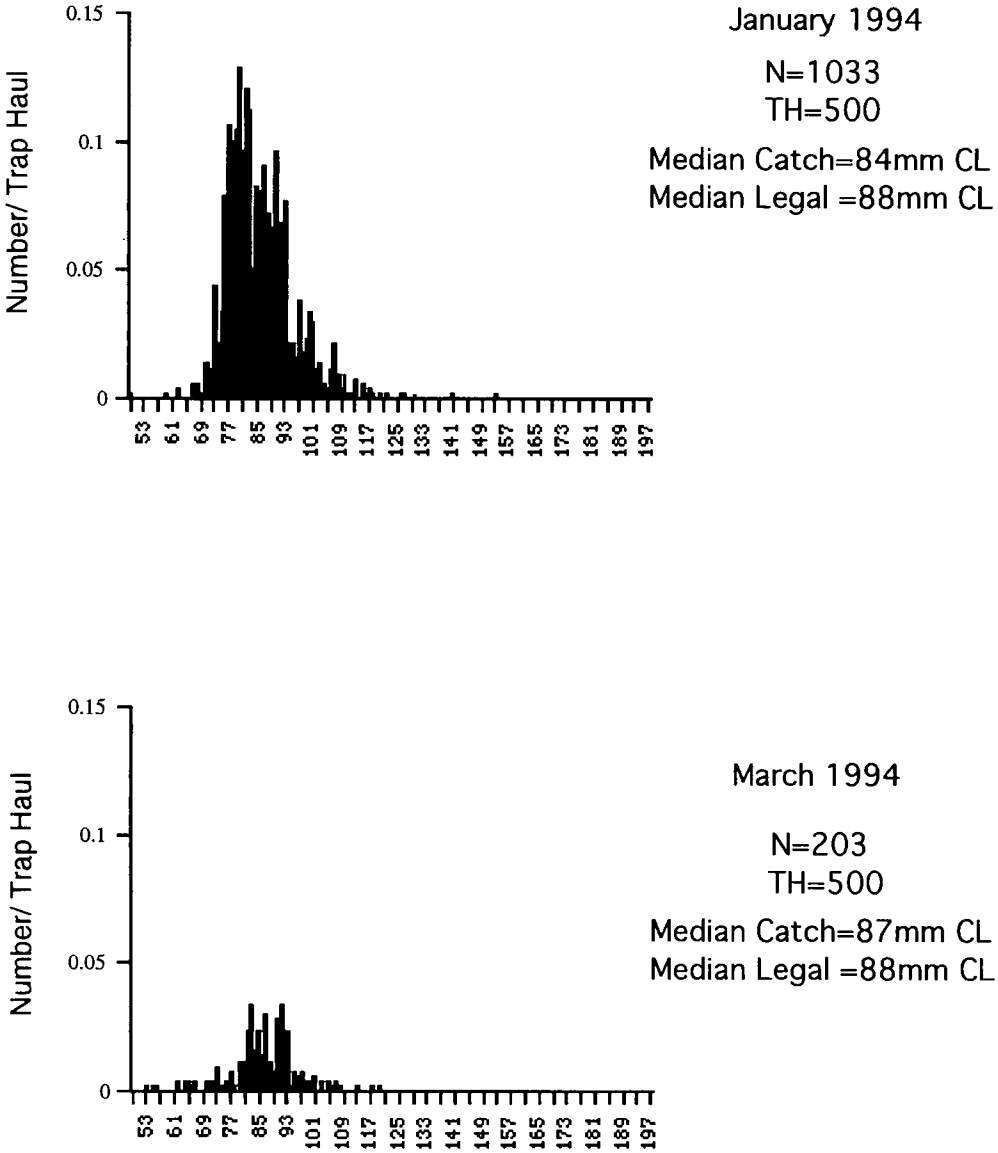
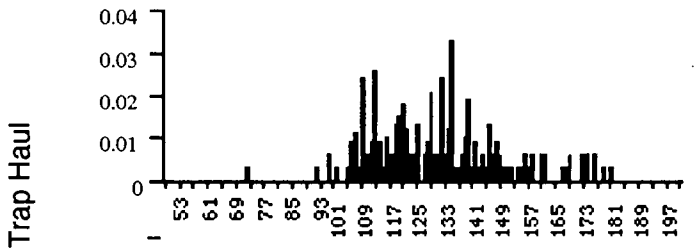
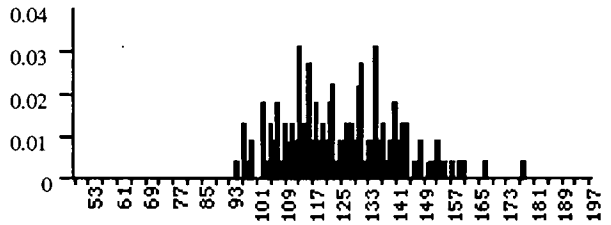


Figure 12b: Size frequency of spring and fall at-sea samples from German Bank



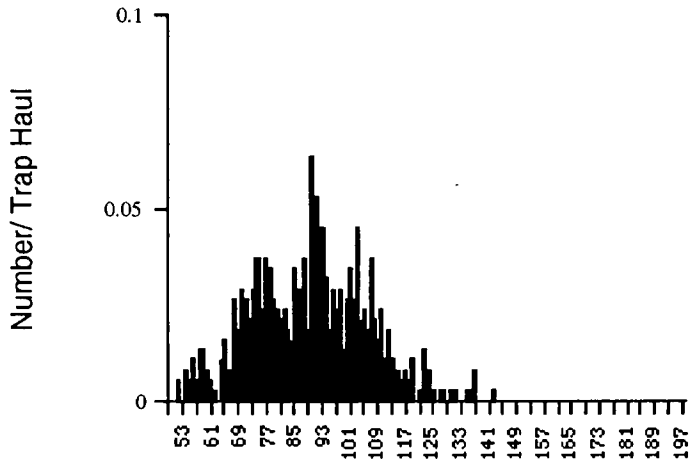
March 1981 (2 samples pooled)

N=137
TH= 241
Median Catch=128mm CL
Median Legal =128mm CL



April 1981

N=141
TH= 226
Median Catch=123mm CL
Median Legal =123mm CL



May 1986

N=566
TH=379
Median Catch=90mm CL
Median Legal=96mm CL

Figure 12c : Size frequency of spring at-sea samples from the area outside of German Bank

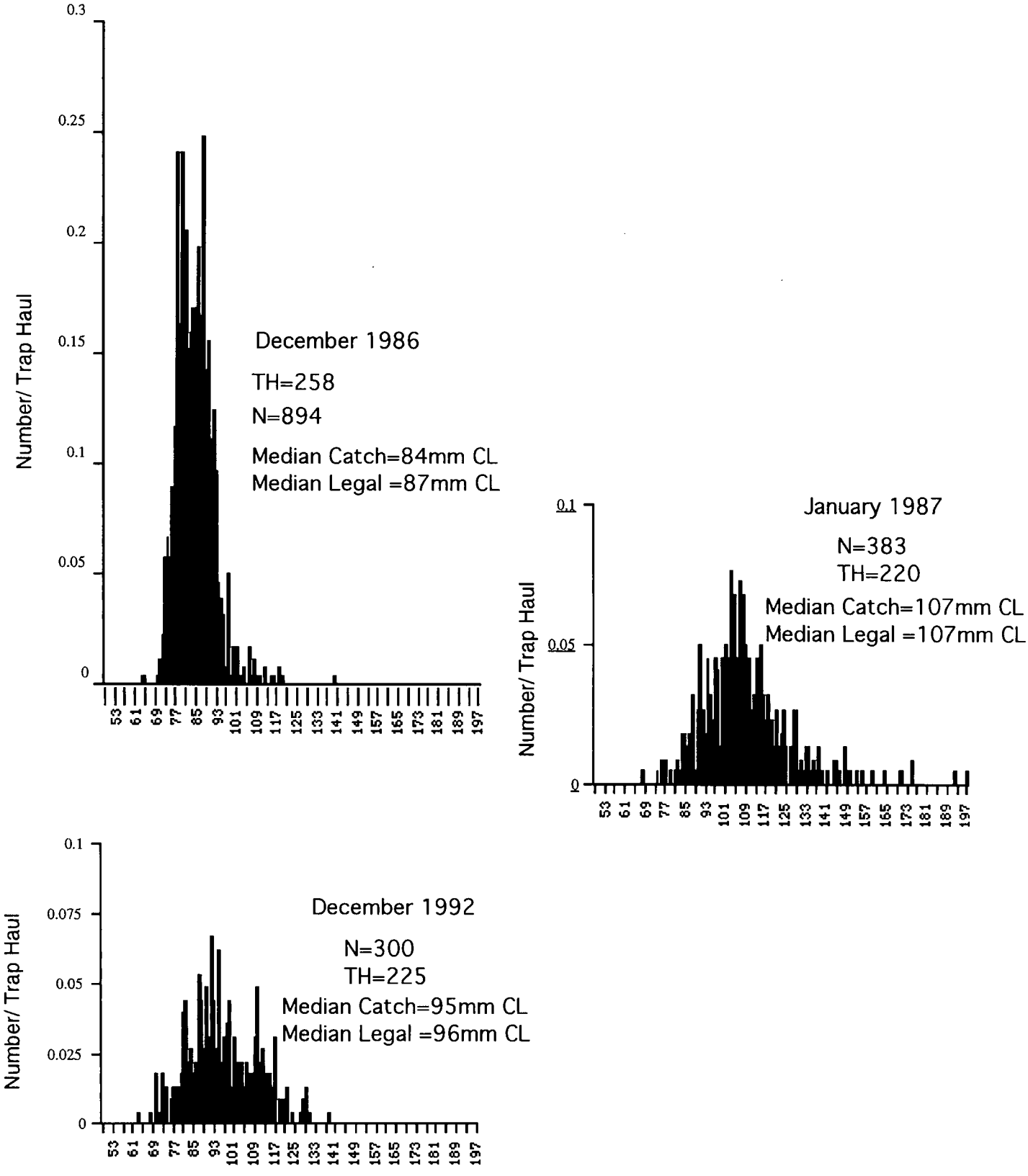


Figure 12d : Size frequency of Fall at-sea samples from the area outside of German Bank

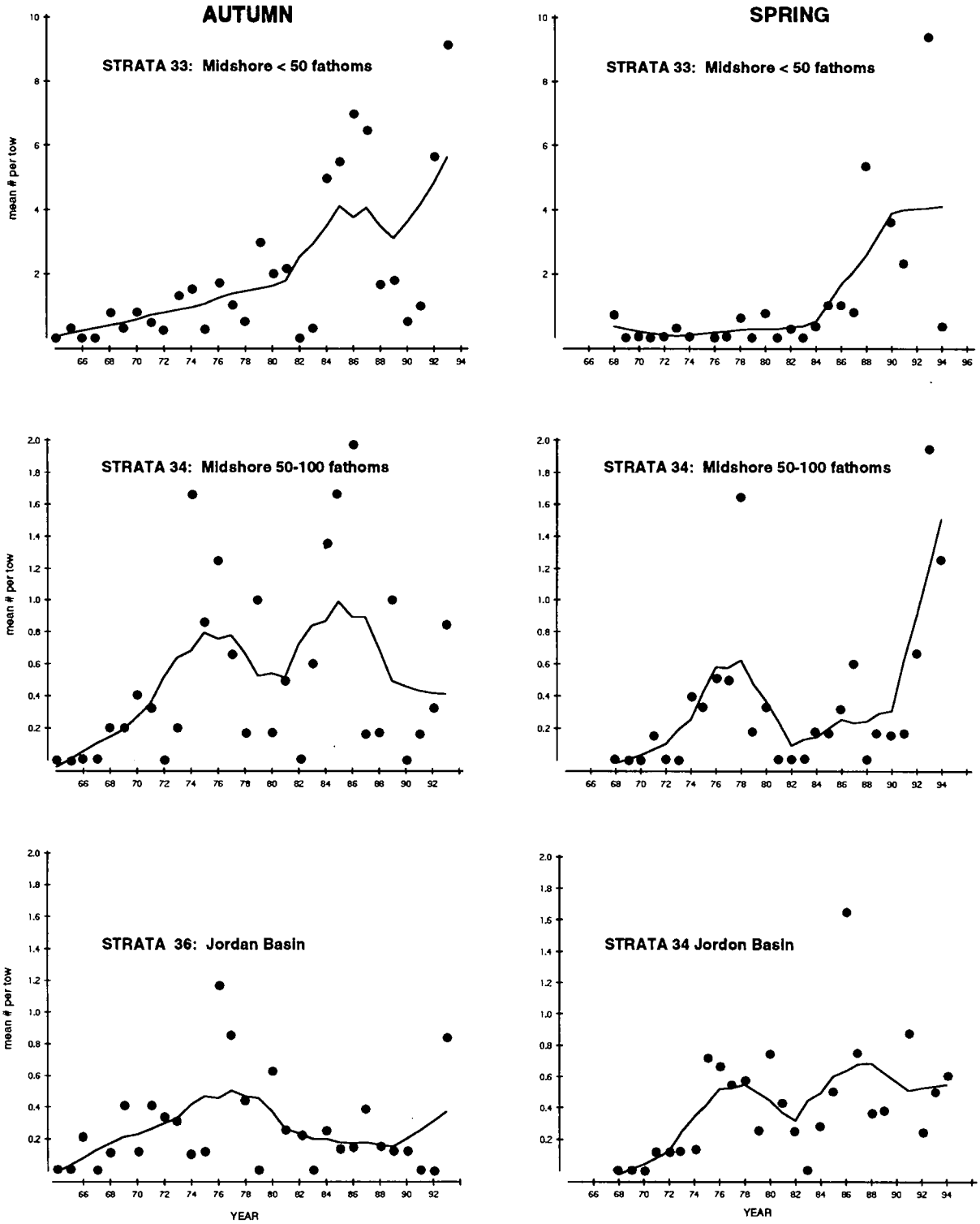


Figure 13 : Delta mean lobster number per tow from NMFS autumn and spring groundfish trawl surveys - 1968-94. Solid line indicates smoothed data using Lowess method (Cleveland 1979).

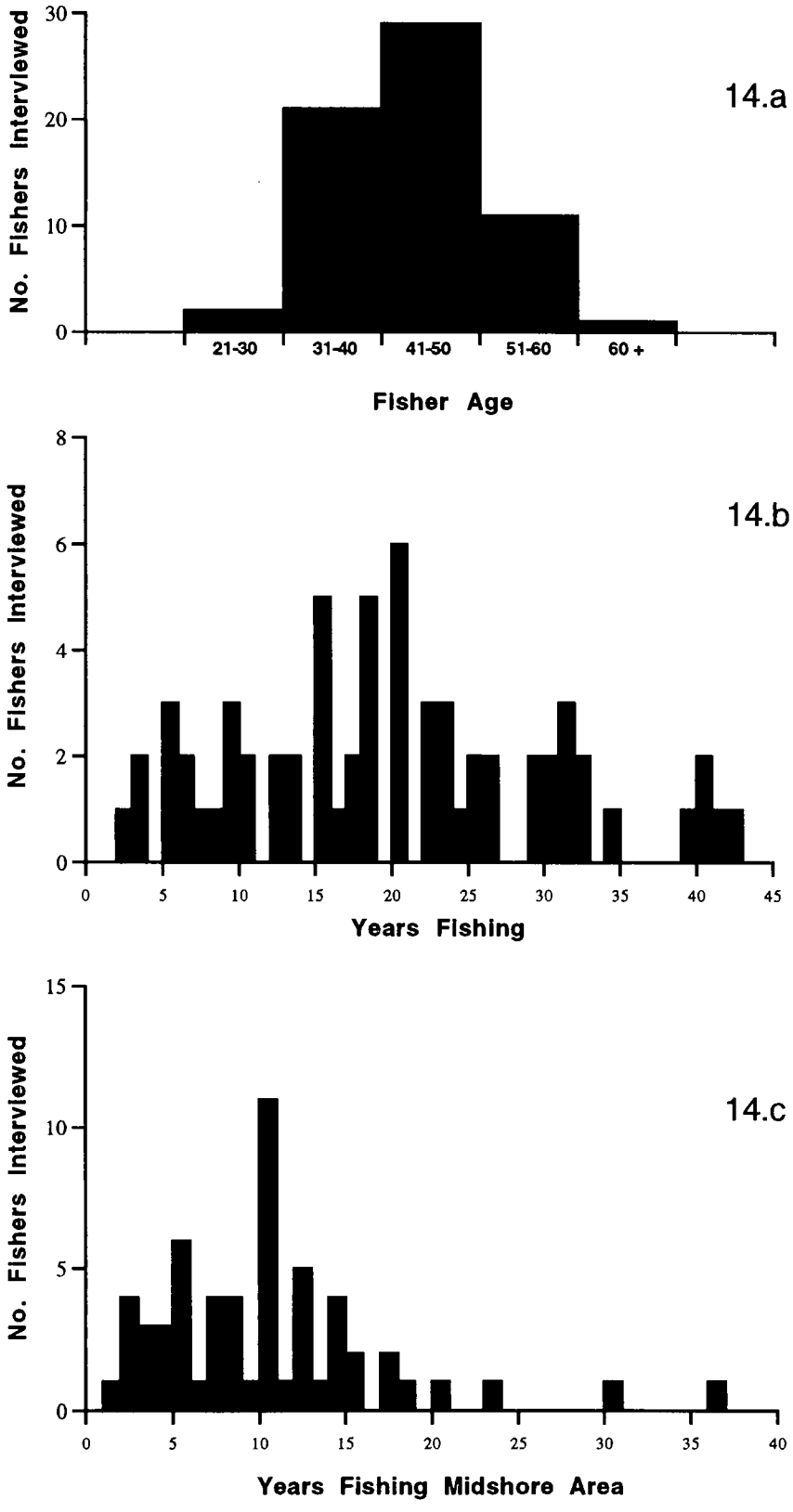


Figure 14. Fisher profile of age, years fishing and years fishing the midshore area of the 64 captains interviewed.

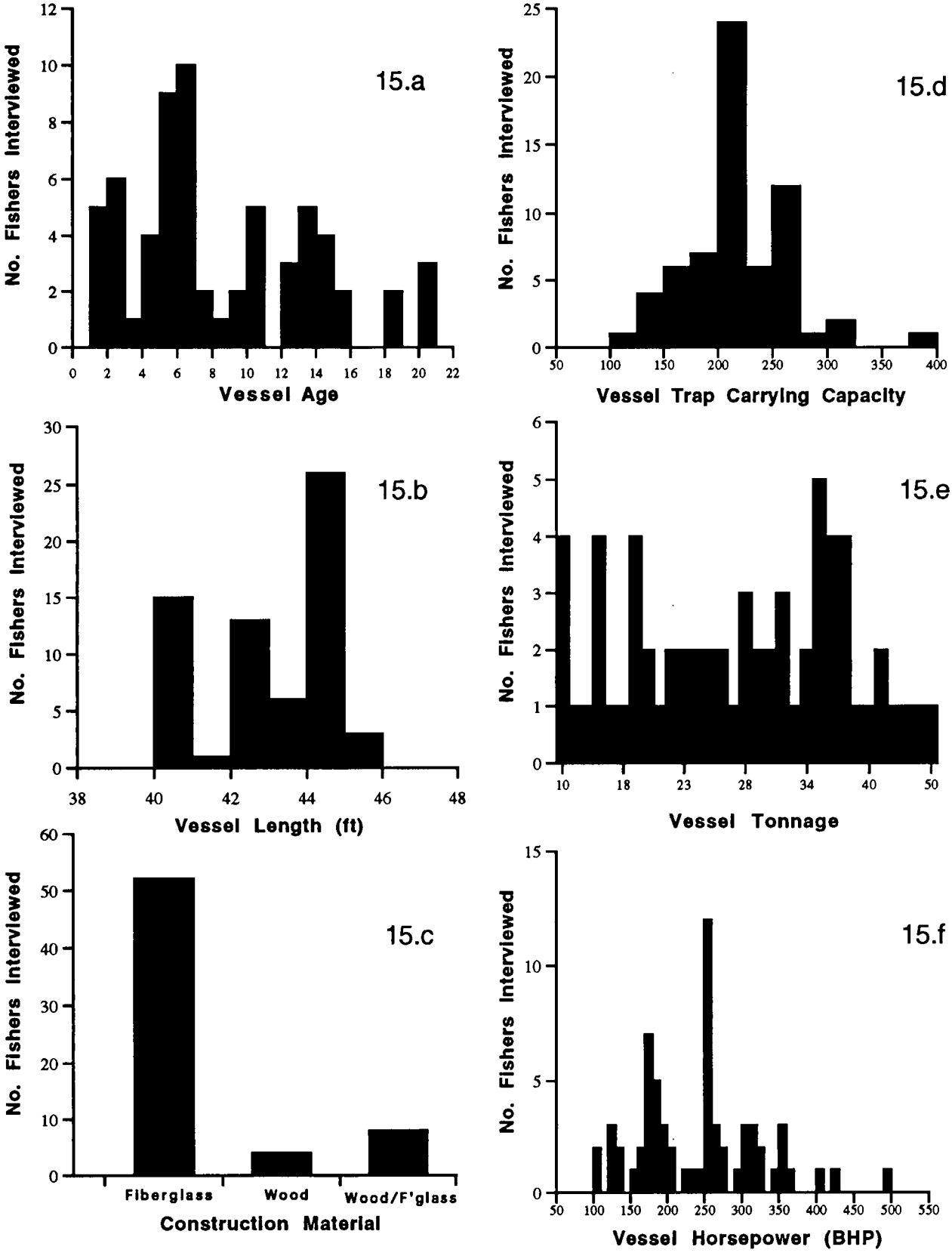


Figure 15: Vessel profile of age, length, construction, capacity, tonnage and horsepower of the vessels owned by the 64 captains interviewed

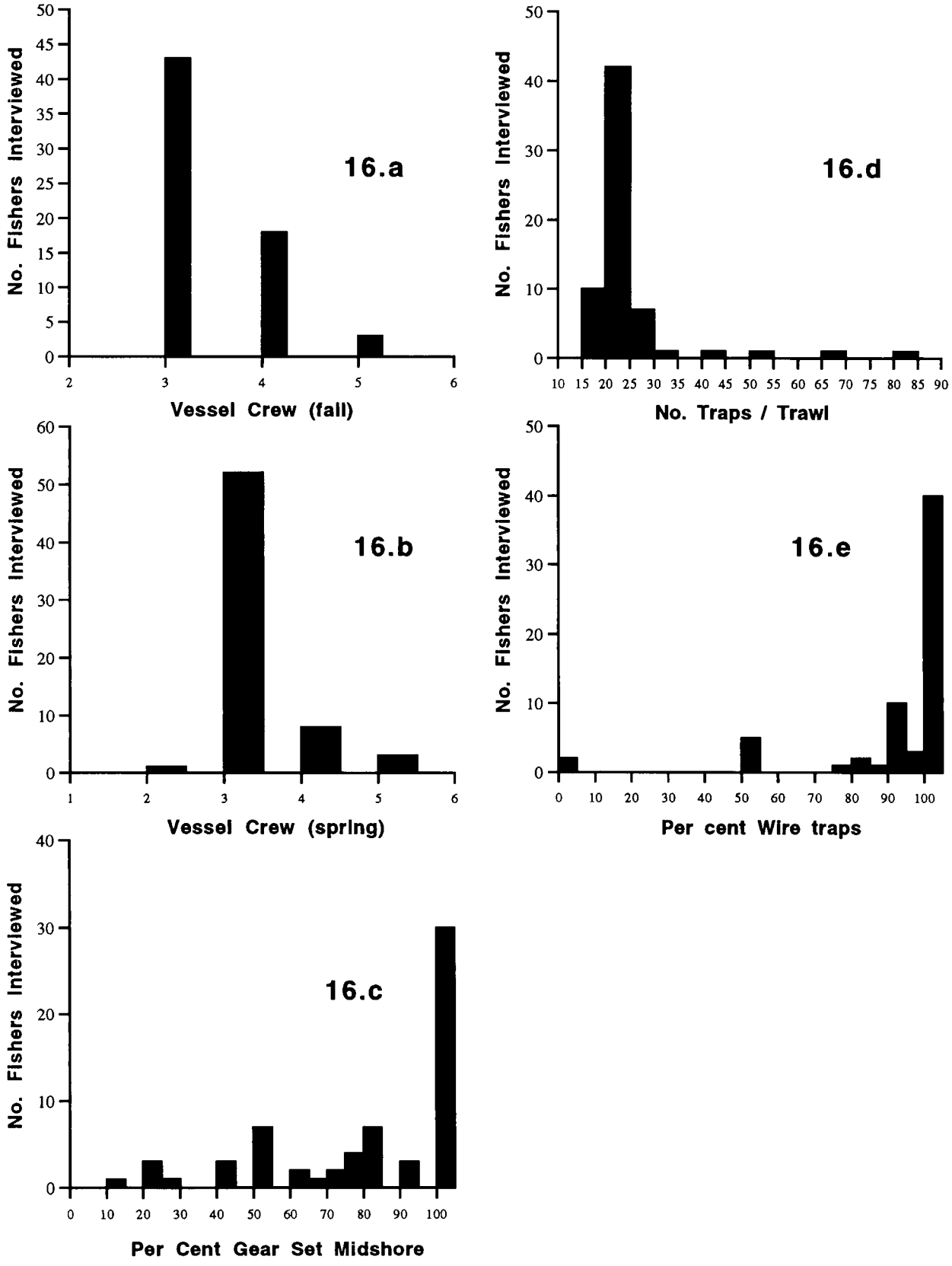


Figure 16: Profile of crew component (fall and spring), percentage of gear set in the midshore, number of traps per trawl and percentage of the traps constructed of wire .

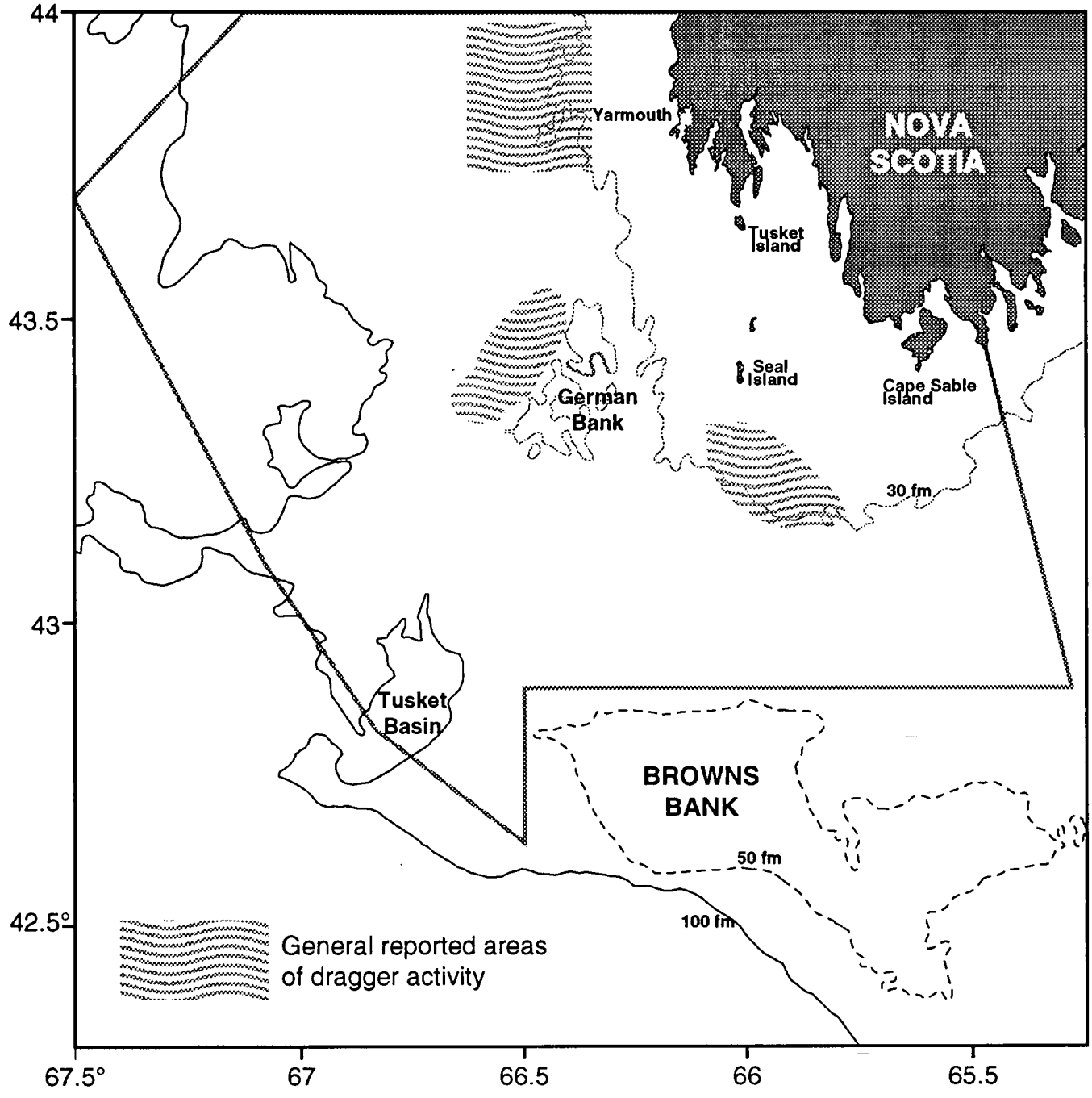


Figure 17. LFA 34 showing areas of dragger and long line fishing activity as reported in the 1993 fisher survey.

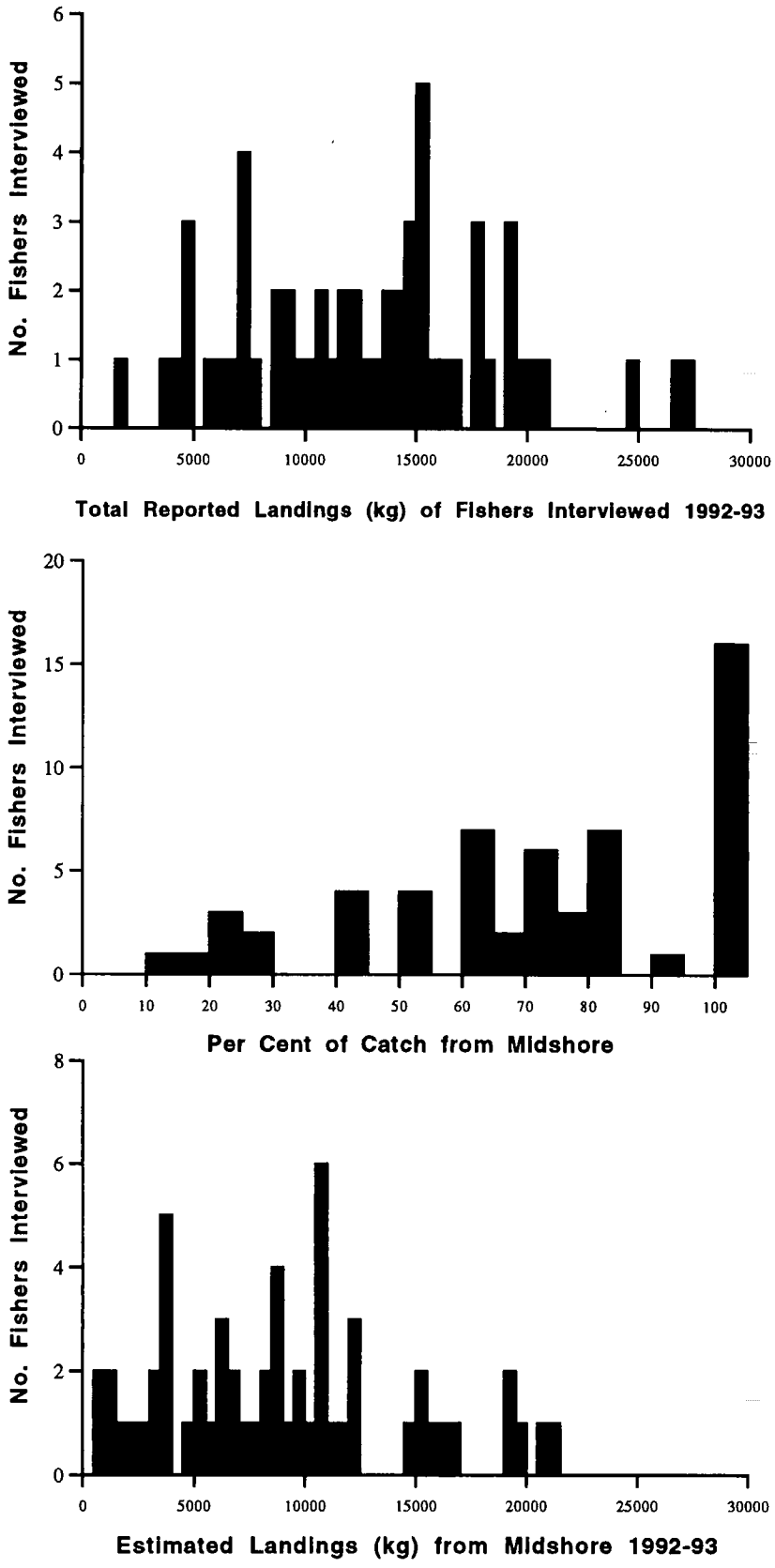


Figure 18. Reported Landings of 58 interviewed fishers, percentage of their catch from the midshore and estimated landings from the midshore area

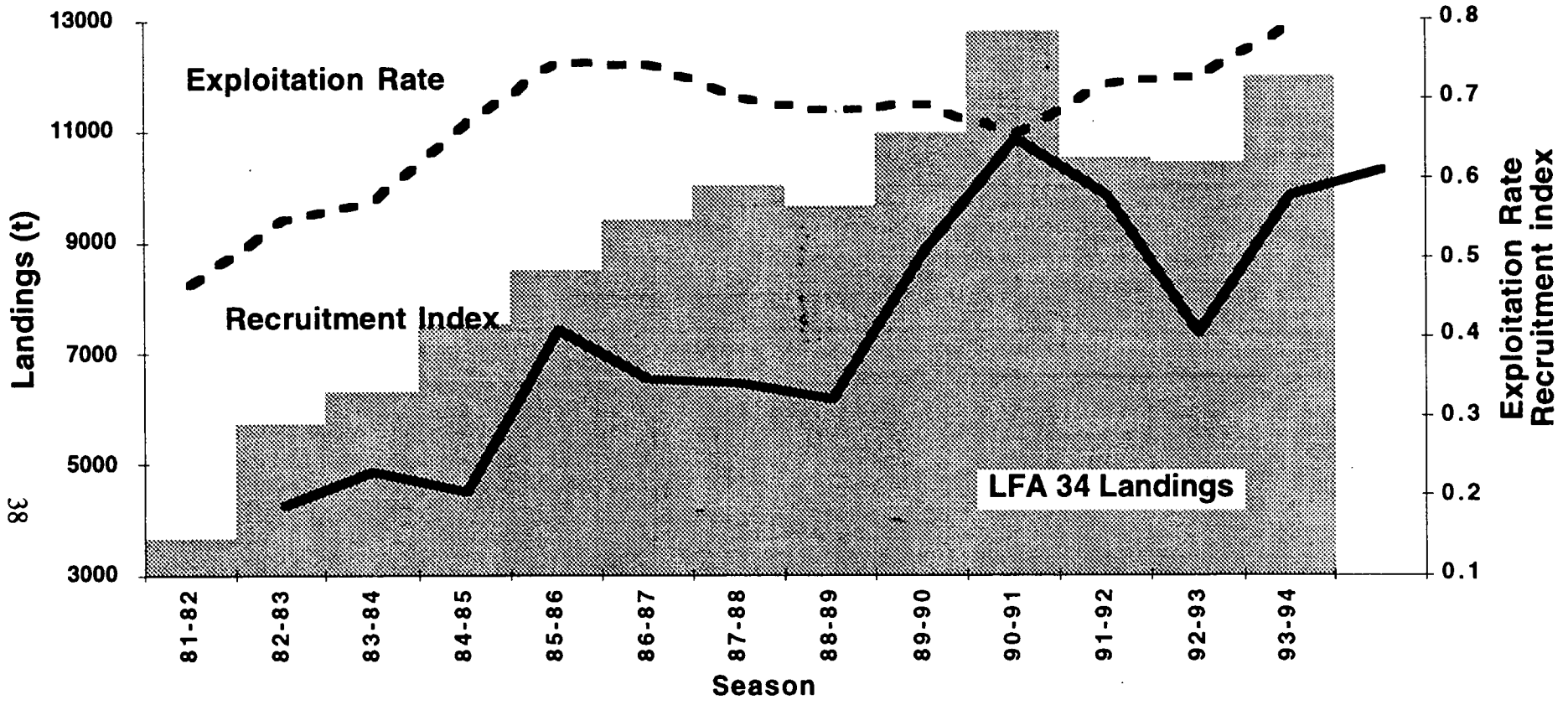


Figure 19: LFA 34 lobster landings; recrutment index and exploitation rates calculated from Lobster Bay spring at-sea samples of the commercial trap fishery.