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# Compilation of available information regarding the Scotian Shelf herring spawning component

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**Abstract**

This paper is a compilation of information from commercial fishing and scientific research on the herring spawning component on the offshore Scotian Shelf banks. An analysis of ichthyoplankton data and records of spawning herring indicates that spawning takes place on central Sable Island Bank during the second half of October.

Fall ichthyoplankton surveys in 1997 and 1998 showed a high concentration of recently hatched larvae in the Western/Sable Island bank area. Larval herring densities in 1998 (maximum = 713 larvae/100 m3) were an order of magnitude greater than those in 1997 (maximum = 69 larvae/100 m3). Offshore adult herring catches during the 1998 July bottom-trawl survey were second highest in 16 years at an average of 96 fish per set. Herring were widely distributed on banks west of Sable Island. The age distribution from the 1998 survey was dominated by the 1992-93 year classes. The 1998 fishery for herring on the Scotian Shelf landed 5 579t, substantially less than the two previous years (11 745 t in 1996 and 20 261 t in 1997). The reduction in catch is attributed to changes in herring behaviour and distribution.

**Résumé**

Le présent document est une compilation de renseignements tirés de la pêche commerciale et de la recherche scientifique ayant trait à la composante de frai du hareng sur les bancs hauturiers du plateau néo-écossais. Une analyse des données sur l'ichthyoplancton et de la documentation sur le frai du hareng montre que le frai a lieu sur le banc central de File de Sable pendant la deuxième demie d'octobre.

Des relevés d'automne d'ichthyoplancton réalisés en 1997 et 1998 indiquent une forte concentration de larves écloses depuis peu dans la région du banc Western et île de Sable. La densité des larves de hareng de 1998 (maximum = 713 larves/100 m3) était d'un ordre de grandeur supérieure à celle notée en 1997 (maximum = 69 larves/100 m3). Les captures de harengs adultes réalisées en zone hauturière pendant le relevé au chalut de fond de juillet 1998 étaient les deuxièmes plus importantes en 16 ans, la moyenne atteignant 96 poissons par trait. Les harengs étaient largement présents sur les bancs à l'ouest de l'île de Sable. La répartition par âge des individus des relevés de 1998 était dominée par les classes d'âges de 1992 et 1993. La pêche du hareng effectuée en 1998 sur le plateau néo-écossais a donné lieu à des captures de 5 579 t, soit beaucoup moins que celles des deux années antérieures (11 745 t en 1996 et 20 261 t en 1997). La diminution des prises est attribuée à des modifications du comportement et de la répartition des harengs.

## Introduction

The herring fishery on the offshore Scotian Shelf banks was reinitiated in 1996 after a period of 20 years and therefore lacks the historical data commonly used in stock status evaluation. This paper attempts to synthesise historical and current information regarding herring on the Scotian Shelf in an effort to test assumptions regarding stock structure, evaluate status, and improve management.

## History of the Fishery

A foreign (mostly the former Soviet Union) herring fishery took place on the offshore Scotian Shelf banks between 1963 and 1974. The domestic fleet showed little interest in the offshore herring at the time and fished, primarily, closer to shore. Offshore catches ranged from 600 tons to as much as 60 000 tons in a single year and were focused on Emerald and Sable Island/Western banks (Miller 1973). Reliable catch estimates are difficult to assign to a specific area due to changes in the management units and the lack of a rigorous documentation system. The fishery ended with the extension of Canadian jurisdiction in 1977, which excluded the foreign fleet.

During the 1970's and early 1980's few herring were observed on the Scotian Shelf banks (as indicated by the few caught on the July bottom-trawl research surveys) thus there was little incentive to explore the area for herring. However, interest in this stock increased during the late 1980's with larger herring catches in the bottom-trawl surveys and with observations from the groundfish industry of large herring offshore. These observations prompted a joint Fisheries and Oceans-industry survey of the offshore banks to find and tag herring. Three purse seiners searched Emerald, Sable, Western, Middle, and Banquereau banks in April of 1985 but few fish were found and none were tagged. A second survey was conducted in the fall of 1986 after additional reports of herring from members of the groundfish trawler fleet. On October 2 and 3, four seiners made several successful sets catching large roe fish on Western Bank (Stephenson *et al.* 1987). Herring were also caught in this area during the fall bottom-trawl surveys (1978-1985). There was little additional activity offshore of the purse-seine fleet until 1996 (Stephenson *et al.* 1997).

Historically, herring on the Scotian Shelf were considered to be overwintering members of the fall-spawning stock complex from southwestern Nova Scotia (ICNAF 1972). This belief was based, in part, on data from the former Soviet Union (ICNAF 1972). Stock structure work in the 1970's (including tagging, Stobo *et al.* 1975) suggested that the fish on the offshore banks were not part of the southwest Nova Scotia component, as did the presence of roe fish on Western Bank in the fall of 1986.

The persistence of herring on the Scotian Shelf during the late 1980's and early 1990's, further indications of Scotian Shelf spawning, and increased recognition of the importance of maintaining spawning components led to the consideration of the Scotian Shelf banks as a separate management unit when the fishery was re-established in 1996 (Stephenson *et al.* 1997).

## Biological Requirements for Management

The offshore Scotian Shelf spawning herring component is poorly documented. The absence of historical fishery information and the general lack of biological documentation make it difficult to evaluate stock status. As has been previously recommended, the recent fishery has been aimed at increasing biological knowledge and exploring fishery potential.

A number of biological requirements have been set out for this area. The 1997 Maritimes Region Herring Workshop (Sinclair 1997) recommended:

> "that management/science/industry prepare a strategy for the management of the offshore Scotian Shelf banks spawning component in 4VWX that takes into account forage issues"

During the Atlantic Zonal Herring Workshop (Rice 1997) it was recommended for the new fisheries on the Scotian Shelf that:

> "The offshore purse seine fishery could continue to conduct exploratory fishing within the Guidelines for Emerging Fisheries. These guidelines provide for:
> - a slow and controlled increase in effort
> - the developing fishery must operate in ways which maximise the acquisition of biological information needed to manage the fishery
> - industry contributes significantly to the cost of collection of information and management of the developing fishery"

This requires further documentation of stock structure including the spawning location and movements of herring, the quantification of the biomass of herring, and consideration of the role of herring in the ecosystem as it may be relevant to management of the Scotian Shelf banks.

## Determination of Timing and Location of Spawning Areas

- *An analysis of ichthyoplankton data and records of spawning herring indicates that spawning takes place on central Sable Island Bank during the second half of October.*

In an attempt to improve knowledge of stock structure and guide the 1998 industry acoustic survey on the offshore Scotian Shelf banks, evidence of previous spawning activity was synthesised. Evidence of spawning included observations of ripe or spawning herring and herring eggs or larvae.

The most detailed sources of information on the Scotia-Fundy herring stock complex are the Fisheries and Oceans Pelagic Samples and Ichthyoplankton databases. Herring samples have been routinely collected from a variety of sources including the commercial

fishery, groundfish surveys, and herring surveys. These samples have been processed and the information added to the Pelagic Samples database (juveniles and adults) or in the Ichthyoplankton database (larvae). The Pelagic Samples database contains little information on spawning herring on the offshore banks because sampling of that area was minimal until recently. Data on larval herring are also scarce since 1997 was the first year that the fall ichthyoplankton survey aimed at herring covered this area. Because there are few data available in the Pelagic Samples and Ichthyoplankton databases, other sources were also examined to increase our knowledge of herring spawning offshore. The following is a list of data sources that have been investigated.

Spawning Herring:

*1- Pelagic Samples database*

The Pelagic Samples database contains biological information on herring (including length frequencies, maturities, weights, and age composition) derived from various sources including industry, research, and observer sampling. The only records of spawning herring on the offshore banks in this database occur in October 1997. There were 3 samples of spawning herring from the annual silver hake survey in late October 1997 (Figure 1). In a sample of 13 fish caught on October 25, 3 were ripe and 8 were spawning, of 14 fish caught October 19, 2 were ripe and 12 were spawning and of 39 fish caught on October 22, 5 were ripe and 22 were spawning. Three additional samples of ripe herring (12 of 17, 2 of 2, and 1 of 1) were also caught during the 1997 silver hake survey. There were also three samples with ripe herring caught in July during the bottom trawl surveys: 11 of 17 herring in 1996 and 3 of 11, and 1 of 25 in 1997.

*2-July bottom-trawl surveys*

The July bottom-trawl surveys have collected information on marine fish, primarily groundfish, in the Scotia-Fundy region since 1970. Data are also available on by-catch of herring. Offshore catches of herring (strata 55-78, Figure 2) were low from the early 1970's to the mid-1980's and increased during the late 1980's and 1990's. There were both vessel and gear changes since 1970 but both have been constant since 1983. 1994, 1995, and 1998 had the highest catches in the past 16 years (Figure 3).

In addition to records of weight and numbers of herring in the survey database, samples were frozen and later processed for detailed biological information. The data from these samples have been included in the Pelagic Samples database. Although there are records of ripe or spawning herring from this survey, none of these were from the offshore Scotian Shelf banks area.

*3-Observer Data*

The International Observer Program has monitored a percentage of trips made by the herring purse-seine fleet between 1989 and 1998. Length frequencies were recorded and a detail sample kept frozen for later processing. Biological information such as maturity has been recorded in the Pelagic Samples database.

Observers also note herring as by-catch in other fisheries. The highest incidence of herring as by-catch is in the silver hake fishery. In response to this high incidence of herring, samples are being collected from the silver hake fishery in 1999.

In August 1998 observers on scallop and groundfish vessels on German Bank were requested by the observer program officer in Yarmouth to make a note of spawning herring or spawn on gear. No reports of spawning herring on the Scotian Shelf were made.

*4-Silver hake survey*

Historically, silver hake were fished by foreign (Russian and Cuban) vessels, but the fishery is now shared between the domestic and foreign fleets. In 1981, and 1983 to 1991 6-week Russian surveys were conducted from Browns Bank to Banquereau Bank. Since 1993, Fisheries and Oceans has conducted 3-week fall surveys of silver hake with sampling of the 'core' groundfish strata in 4X and 4W. The survey was cancelled for 1998.

There is no information on herring available in this survey's database. Some spawning herring were collected in 1997 and the data from this sample are on the Pelagic Samples database (Figures 1 and 4). If this survey is reinstated, a request should be made that observations of herring spawn or aggregations of herring be noted.

*5-Groundfish ITQ survey*

The groundfish ITQ survey is an annual survey conducted by members of industry for Fisheries and Oceans. It is performed in July by bottom trawlers targeting groundfish in NAFO division 4X who are members of the ITQ fleet. There were few reports of herring caught during the 1995 to 1997 surveys, particularly offshore. In 1998 all captains were requested to note location of spawning herring or large aggregations of herring offshore. Captains are unable to collect herring samples due to time constraints.

The 1998 ITQ survey ran from June 29 to July 10. On July 13, 1998, one captain saw a lot of herring on the Western Scotian Shelf but none were close to spawning. The only quantity of near ripe herring was caught by another captain near Hampton, Nova Scotia, in the Bay of Fundy.

*6-Sentinel Survey*

The sentinel survey is an annual survey conducted in the fall by the industry for Fisheries and Oceans. It is performed by vessels in the fixed gear sector targeting groundfish in 4VsW. In 1996, 1997, and 1998 cod stomachs were collected for analysis where, generally, only fish and not eggs were routinely identified to species. However, the records show that the stomachs of two cod caught in September 1996 contained herring eggs. Another stomach, also from September 1996, contained a ripe herring (Figure 1). Eggs were present in other stomachs however these were not identified to species. A number of other cod stomachs contained herring but maturity was not specified. These records of herring or herring roe could provide useful information on the timing of spawning. The location of spawning based on these data is less reliable because of the possibility that cod moved after consuming the eggs or herring.

It was requested that occurrence of herring eggs be noted during cod stomach content analysis from the 1998 survey.

*7- IMFGBH (Impact of Mobile Fishing Gear on Benthic Habitat)*

This project examines the effects of bottom trawling on benthos. Trawls were conducted on Western Bank in the haddock nursery box in May 1997, September 1997, and May 1998 and will continue in May 1999. 250 kg. of mature herring were caught during the September 1997 sampling period and 4 kg of herring (maturity was not noted) were caught in May 1998 (Figure 4). Length frequencies were recorded but no further sampling was done.

Herring Eggs and Larvae:

*1- Ichthyoplankton survey*

For 25 years annual fall surveys of ichthyoplankton have been aimed at herring in the Scotia-Fundy region. These surveys covered the Bay of Fundy but in 1997 the first survey of the Scotian Shelf was conducted in conjunction with Dr. Christopher Taggart's group at Dalhousie University. Samples from the 1997 survey were processed at Dalhousie University. The Scotian Shelf data were used to back-calculate the time and location of spawning activity. Hatch dates were back-calculated based on the length of the herring and the date of capture (Figure 5).

*2- Other Dalhousie larval surveys*

Researchers at Dalhousie University conducted several larval surveys during summer and fall of 1997 and 1998 on Western Bank and Sable Island Bank. These surveys were in July/August, September, and October (as well as the joint Fisheries and Oceans-Dalhousie University ichthyoplankton survey in November). No larval herring were caught until the November survey suggesting that spawning does not occur until the fall. The captain was requested to monitor acoustic equipment for aggregations of herring during all the 1998 surveys but none were reported.

*3-OPEN (Ocean Production Enhancement Network)*

As part of the OPEN project, ichthyoplankton was collected every month from March 1991 to May 1993 on and around Western Bank. Dr. Louis Fortier of Unversité Laval provided the numbers and lengths of larval herring caught during the surveys. Small, recently hatched larvae were only caught in October (2 larvae in 1991 only), November, and December. Spawning date was back-calculated and peak spawning activity occurred from October 24 to November 11, 1991 (Figure 6). The 1991 data suggested the same peak spawning time and location as demonstrated by the 1997 larval research survey data (Figure 5).

In 1992 spawning activity was bimodal: there was a small peak in estimated spawning time from the end of September to mid-October and then a larger peak from November 23 to December 6. The 1992 data indicated peak spawning later and closer to shore (Figures 6 and 7) than suggested by other data sources. A severe offshore storm

December 3 to 6, 1992 may have affected the distribution of the herring larvae causing them to be caught closer to shore.

*4-Larval Lobster Survey Summer1998*

This was joint Fisheries and Oceans-Dalhousie University survey of Western Bank and also the Halifax, LaHave, Cape Sable, and NE Channel lines. No herring larvae were caught.

*5-S.S.I.P. (Scotian Shelf Ichthyoplankton Program)*

The S.S.I.P. was a series of ichthyoplankton surveys on the Scotian Shelf from 1976 to 1982 using a variety of sampling gear. This was a collaborative project undertaken by various agencies including the Fisheries and Oceans, University of Guelph, AtlantNIRO (USSR), and the Canadian Wildlife Service. Very few herring larvae were caught in the fall on the offshore banks during S.S.I.P. despite repeated sampling of the area (Figure 8).

*6-FEP (Fisheries Ecology Program)*

Surveys were conducted from 1982-1985 in 4X and some of 5Z (Browns Bank area) mostly in spring with some sampling in the summer and winter. Larval herring were caught during this program but since these surveys were limited to southwestern Nova Scotia there is no information from the offshore banks of the eastern Scotian Shelf.

## Estimation of Spawning Time and Location

The data from the 1997 fall survey of ichthyoplankton aimed at herring were used to back-calculate spawning time according to the method in Chenoweth *et al.* (1989). The formula used to calculate age was:

Age = (length - size at hatching) /growth rate

where length is the standard length of the larvae (mm.), size at hatching is assumed to be 5 mm., and growth rate 0.24 mm/day. Incubation time was assumed to be 11 days (Jean 1956).

The capture location of fish less than 2 weeks of age were plotted (Figure 4). Only the locations of young larvae were plotted to minimise the effects of movement from the original spawning location. The larval survey data were also used to identify the location of the highest density of herring (which is outlined in Figure 4). In the same area of Western and Sable Island Banks as these larvae were captured, a total of 245 tons of roe fish were harvested by three vessels in 1986 and spawning herring were collected in the 1997 silver hake survey.

The larval survey data indicated that the peak offshore spawning period in 1997 (Figure 5) was from October 25 to November 11, however some spawning in this area occurred as early as the first week of October. In 1986, catches of roe fish were made October 2 and 3. Although these fish were described as having good roe, they were not described as ripe and running and may have been pre-spawning fish. The samples from the silver hake survey also suggested October spawning since the ripe and spawning herring were caught on the 19th, 22nd, and 25th of that month.

The combined information from all available data on herring spawning and larval herring distribution suggest that herring spawning occurs on the Scotian Shelf in mid to late October and early November, in the Sable Island Bank and Western Bank area. On this basis, the recommended time and location for the 1998 fall industry survey of the Scotian Shelf spawning component was from the middle of October to the first week of November in the area enclosed by the straight lines joining the following points (in the order in which they are listed, Figure 4):

| Point | Latitude (N) | Longitude (W) |
|---|---|---|
| 1) | 44°00 | 61°70 |
| 2) | 44°00 | 60°50 |
| 3) | 43°68 | 60°32 |
| 4) | 43°42 | 60°60 |
| 5) | 43°27 | 61°70 |
| 6) | 44°00 | 61°70 |

**1996 - 1998 Fishery and Research**

- *Fall ichthyoplankton surveys in 1997 and 1998 showed a high concentration of recently hatched larvae in the Western/Sable Island bank area. 1998 densities (max= 713 larvae/100 $m^3$) were an order of magnitude greater than those in 1997 (max=69 larvae/100 $m^3$).*

- *Offshore herring catches during the 1998 July bottom-trawl survey were second highest in the series at an average of 96 fish per set. Herring were widely distributed on banks west of Sable Island.*

- *Although the catches in the bottom-trawl survey and the ichthyoplankton survey were very high, commercial catches were low. The increase in herring by-catch in the bottom-trawl survey may be due, in part, to changes in behaviour as well as in actual abundance.*

- *The age distribution from the 1998 July bottom-trawl survey was dominated by the 1992-94 year classes.*

- *The 1998 fishery for herring on the Scotian Shelf landed 5 579 t, substantially less than the two previous years (11 745t in 1996 and 20 261t in 1997). The reduction in catch is attributed to changes in herring behaviour and distribution.*

Acoustic Survey

An industry acoustic survey of the Western and Sable Island banks (the recommended survey area) was conducted from the 19th to the 22nd of October, 1998 to locate, quantify, and tag spawning herring (see Melvin *et al.* 1999). The four vessels that participated in the survey were the Island Pride no. I, the Leroy and Barry II, the Lady Melissa, and the Mari-Lynne Anita. Both the Leroy and Barry II and the Island Pride no. 1 recorded the acoustic data for analysis. Water temperature and depth data were also collected on the Leroy and Barry II using a mini-logger recorder.

Most of the recommended survey area was covered however only small amounts of fish were detected on the sonar and sounder (Figure 9). There were some observations of 'small bunches' or a 'thin layer' of fish. A total of 3086 km$^2$ were surveyed and an estimated 17 445 tons of fish were recorded. No sets were made and so no fish were tagged.

In June of 1996 members of the industry and Fisheries and Oceans had also conducted an acoustic survey of the offshore banks. This survey covered a large area but only documented a moderate amount of herring, mostly Emerald and Western banks and on French bank (see Figure 10 for locations).

Larval Survey

A joint Fisheries and Oceans-Dalhousie University ichthyoplankton survey to document distribution and abundance of recently hatched larvae on the Scotian Shelf was undertaken aboard the CCGS Alfred Needler at the end of November in 1997 and 1998 (see Appendix A). The 1997 survey had high catches of herring on Western/Sable Island Bank and along the coast of Nova Scotia (Figure 11). The larvae offshore were small and so were presumed to have been recently hatched.

The 1998 survey also documented high density of larval herring on Sable Island Bank (Figure 11). Maximum density in 1998 was an order of magnitude higher than that in 1997. Although a back-flushing problem may have reduced the abundance in some earlier sets in 1997 (Stephenson *et al.* 1998), this problem was believed to have been overcome during the 1997 sampling of the Western Bank area, and the higher larvae abundance in 1998 is considered to be real.

July Bottom-Trawl Surveys

The bottom-trawl survey catches of herring offshore were very high in 1994 and 1995, and 1998. Catches in 1998 were second highest in the 16-year series where the same vessel and gear were used. The average catches of herring on the offshore banks (groundfish strata 55-78, Figure 2) in 1996 and 1997 were 33 fish per set and 21 fish per set respectively (Figure 3). The 1996 catches were dominated by age 4 fish (47%) and the 1997 catches were dominated by age 4 (27%) and age 5 fish (43%) (Figure 12).

The chief scientist for each leg of the 1998 survey was contacted and was requested to take note of any spawning herring or large aggregations of herring seen on the acoustic

equipment. None were reported although catches were high; in 82 sets, 7874 herring were caught (96 per set on average). Some of the larger catches of herring were near the south of Emerald Bank, around 'The Patch', and in the northwestern portion of Sable Island Bank (Figure 13). Subsamples were processed for biological information and no herring were ripe or in spawning condition. The 1993 year class (age 5) dominated the age distribution followed in abundance by 1992 and 1994 (Figure 12).

Commercial Fishery:

The first season of the domestic herring fishery on offshore banks was conducted by purse seiners from late May to late June 1996 with landings of 11 745t. Catches were primarily near 'The Patch' (Anon. 1997) (Figures 10 and 14). In 1997 the fishing season was longer, late May to mid-July, and landings nearly doubled to 20 261t. Catches were widely distributed on several banks. The fat content of the herring was very high.

The 1998 fishing activities offshore occurred from May 7 to June 3. There were many reports of unusual herring behaviour making the fish difficult or impossible to catch (Page *et al.* 1999, unpublished data). Several commercial fishers found that, in certain areas, herring were staying very close to bottom and not exhibiting the characteristic vertical movement toward the surface. Others stated that herring were rising to the surface very quickly then dispersing making them impossible to catch by purse-seine. Low fat content and absence of fish on traditional fishing grounds were also cause for concern. Many of the fishers felt that these changes in behaviour were due to changes in the environment, particularly ocean temperatures. Catches were focused on and around Emerald Basin, 'The Patch', and 'Mackenzie Spot' (Figures 10 and 14). Total catches for the year were low at 5 579 tons.

## Acknowledgements

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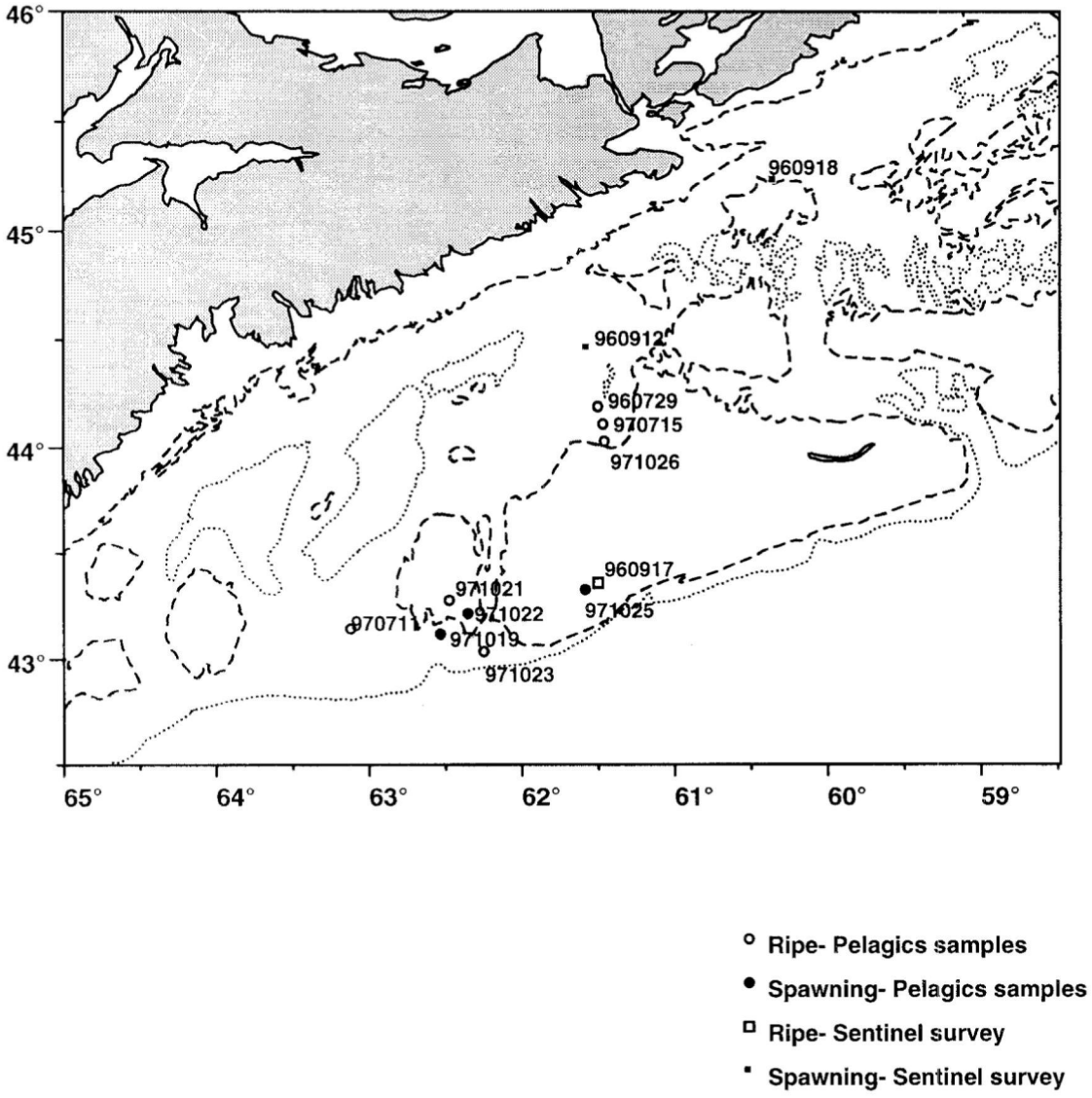


Figure 1. Location of ripe or spawning herring offshore in recent records.

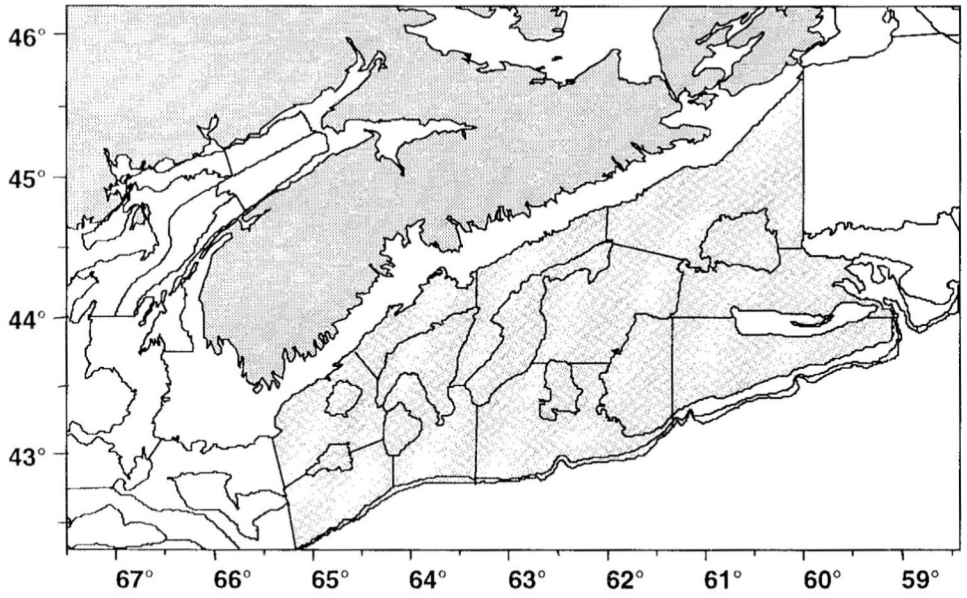


Figure 2. Strata used in bottom trawl surveys. The term 'offshore' in this paper refers to the strata in the shaded area (55 to 78).

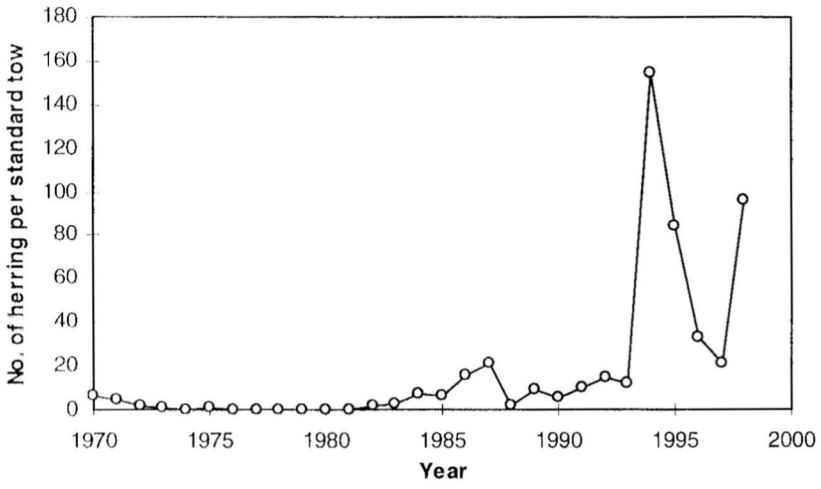


Figure 3. Abundance indices for herring from July bottom-trawl surveys of the Scotian Shelf (strata 55-78).

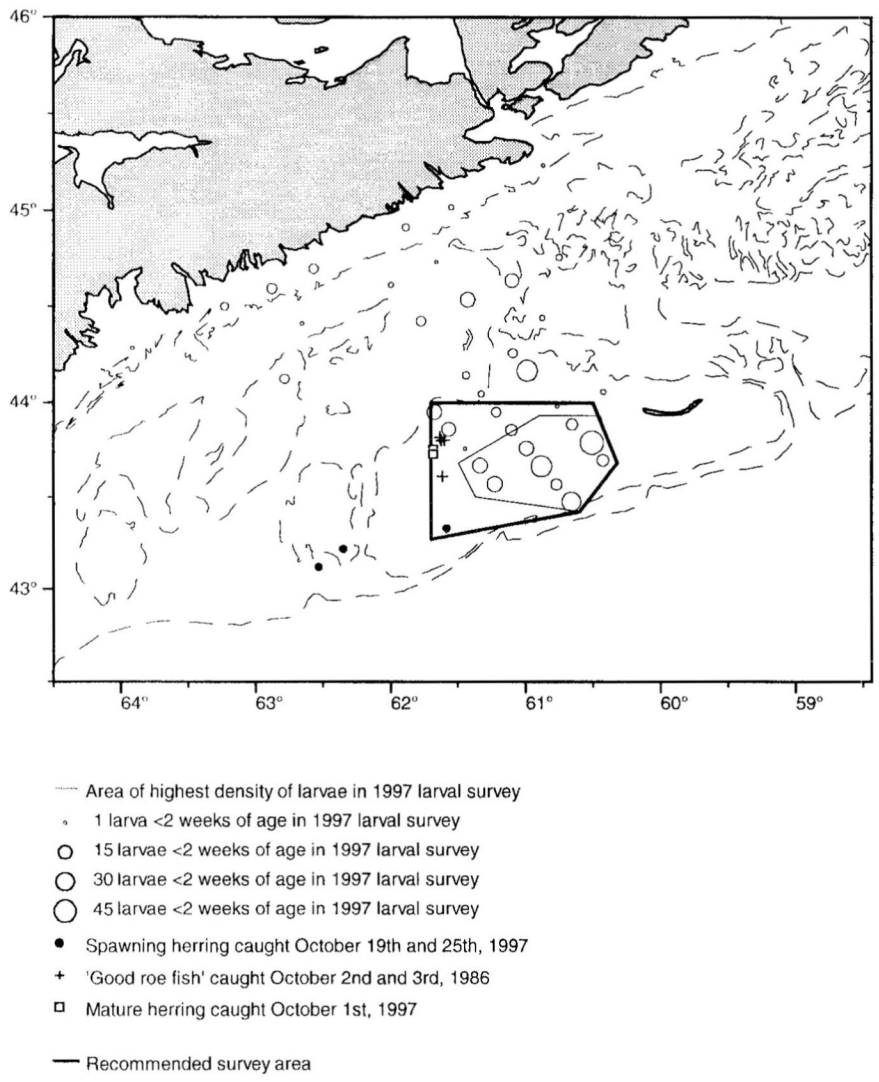


Figure 4. Location of recommended survey area based on evidence of past spawning activity.

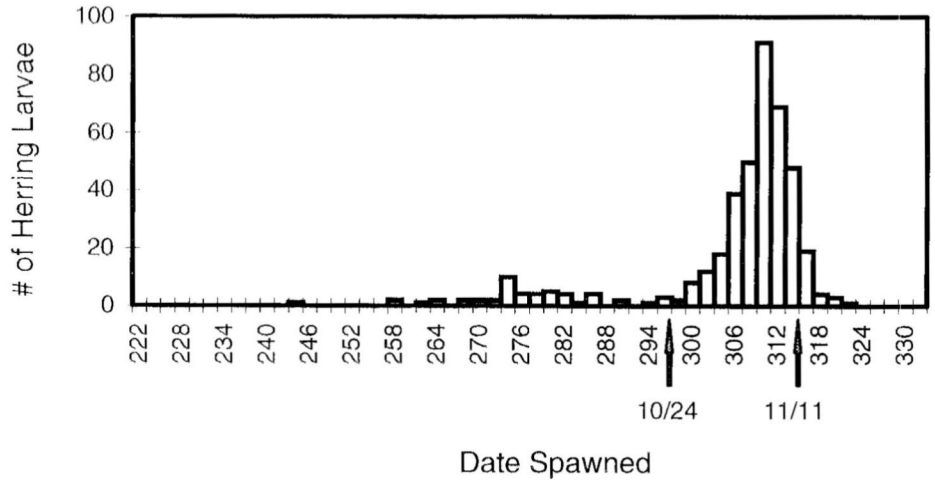


Figure 5. Frequency of larvae by spawning date. Spawning date was back-calculated based on data collected during the offshore component of the 1997 larval survey. Arrows indicate beginning and end of peak spawning activity.

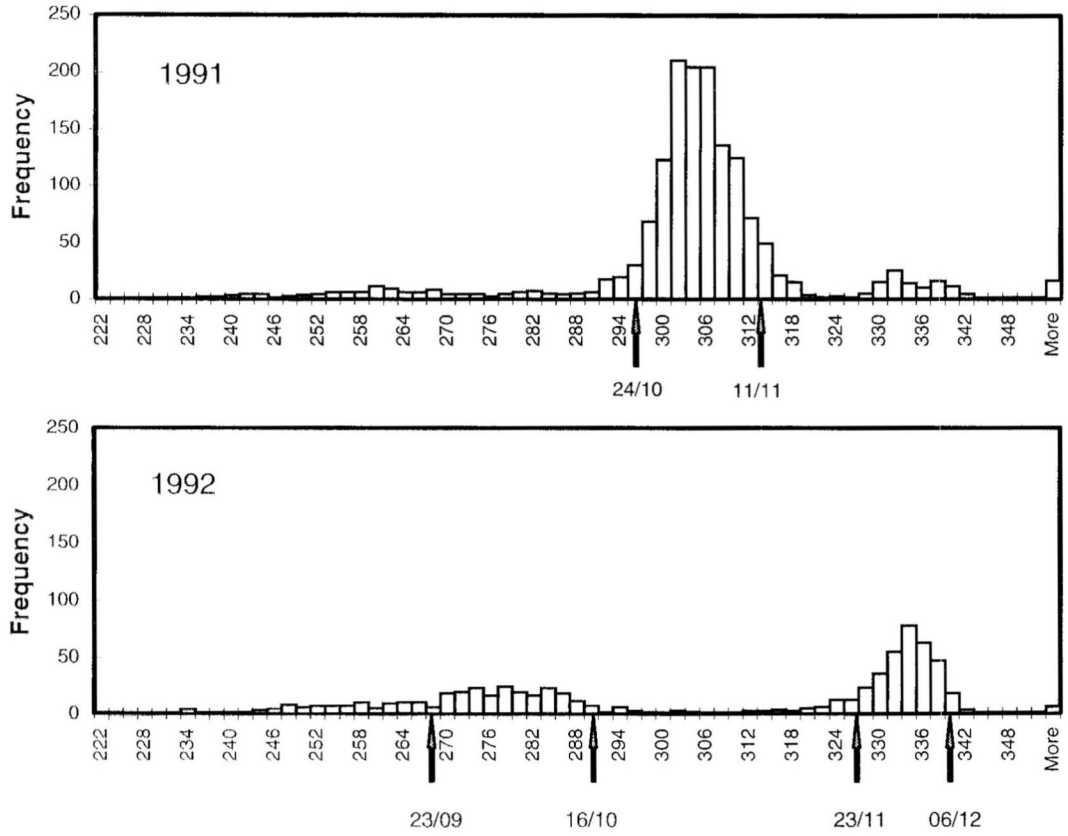


Figure 6. Abundance of larval herring caught during the OPEN surveys, grouped by back-calculated spawning date. Arrows indicate beginning and end of peak spawning activity.

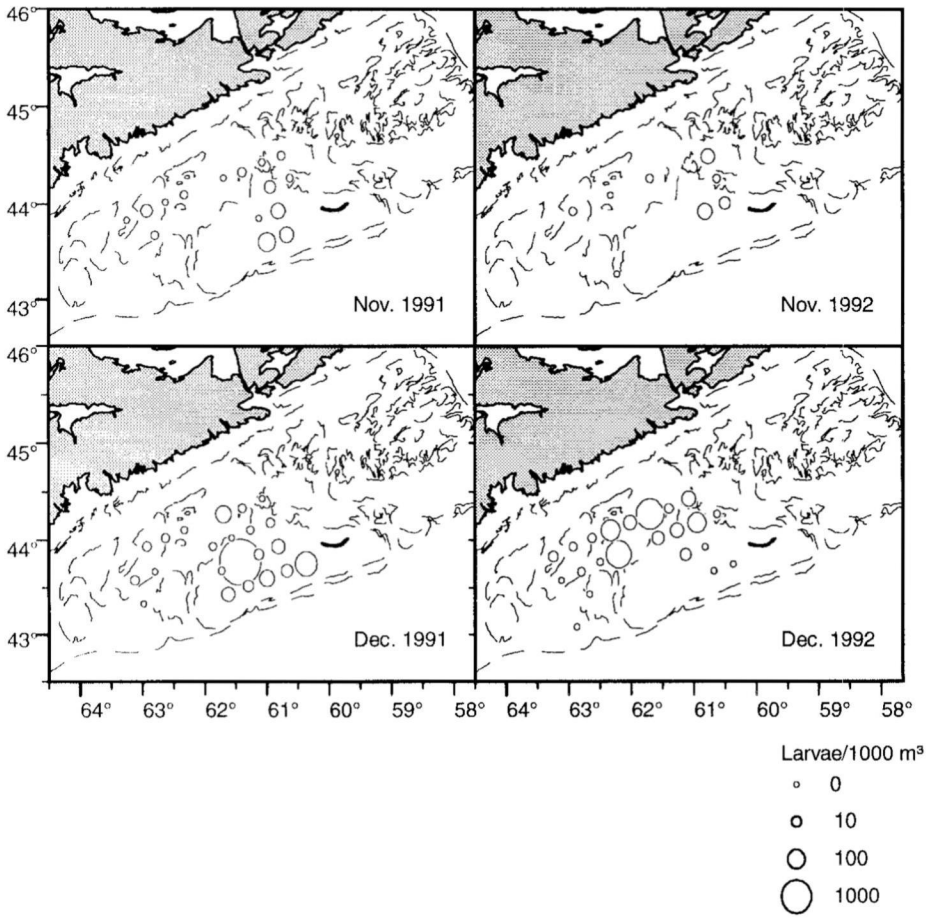


Figure 7. Number and distribution of herring larvae caught during OPEN surveys.

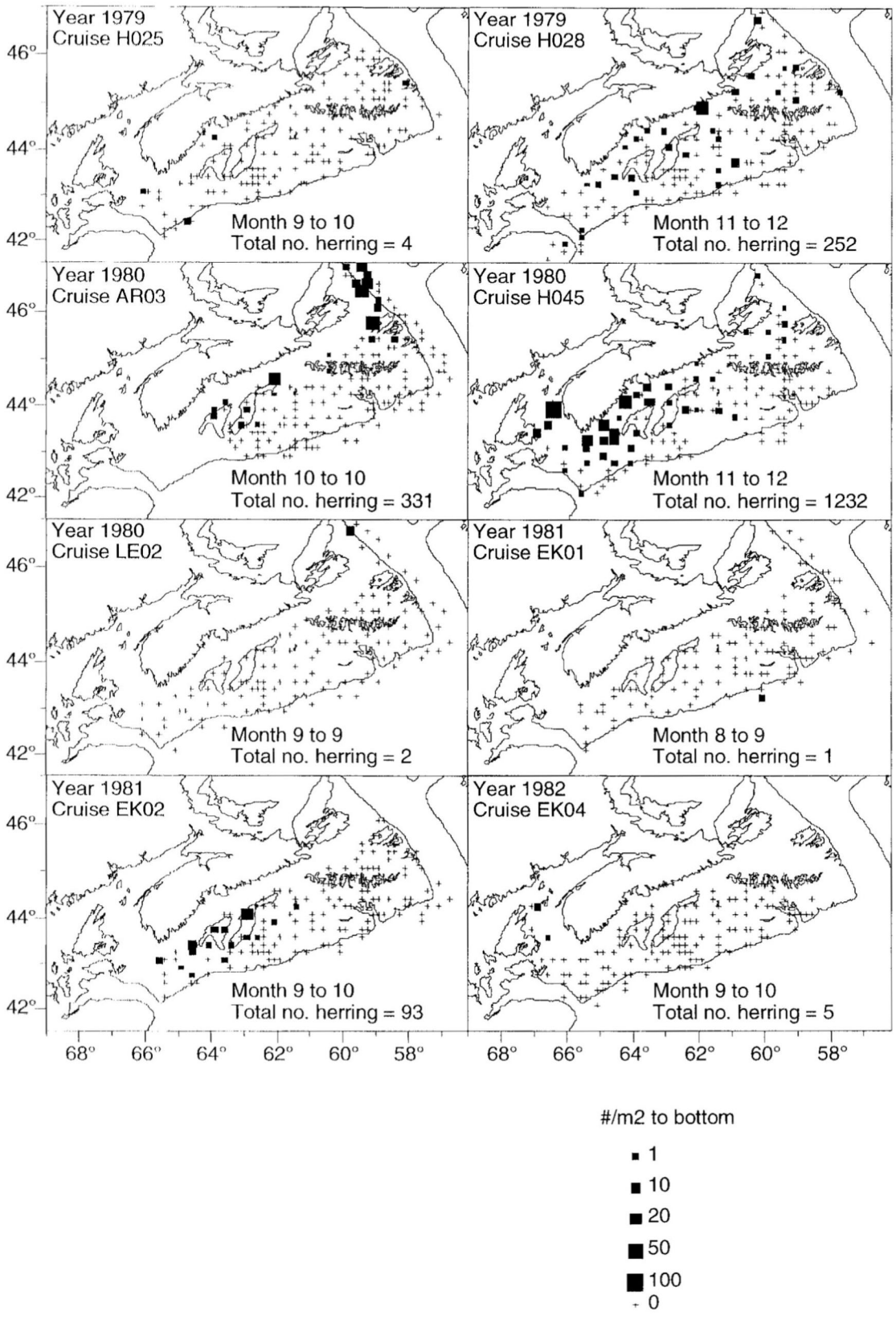


Figure 8. Larval herring catches from SSIP & FEP fall surveys (sum by 10 mile square for all gears)

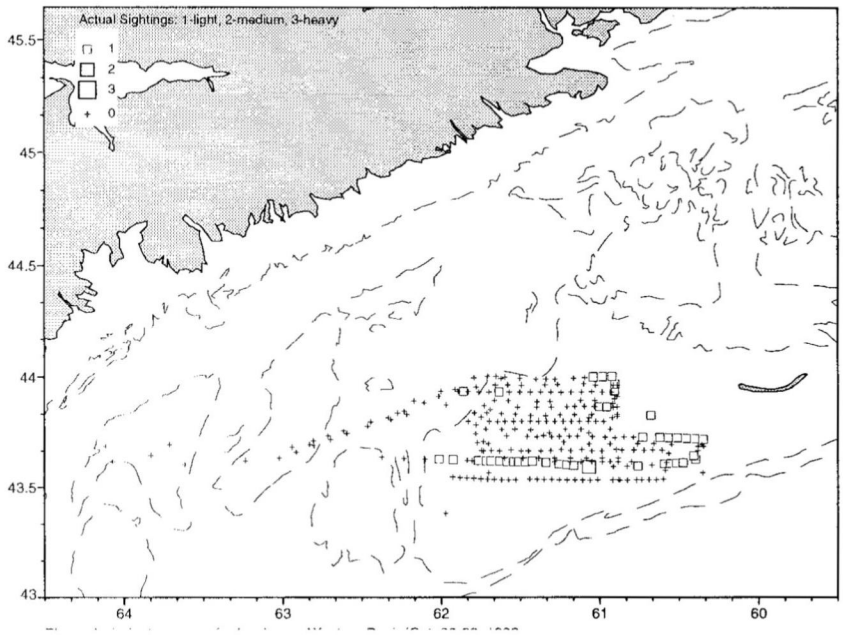


Figure 9. Industry survey for herring on Western Bank (October 19-22, 1998).

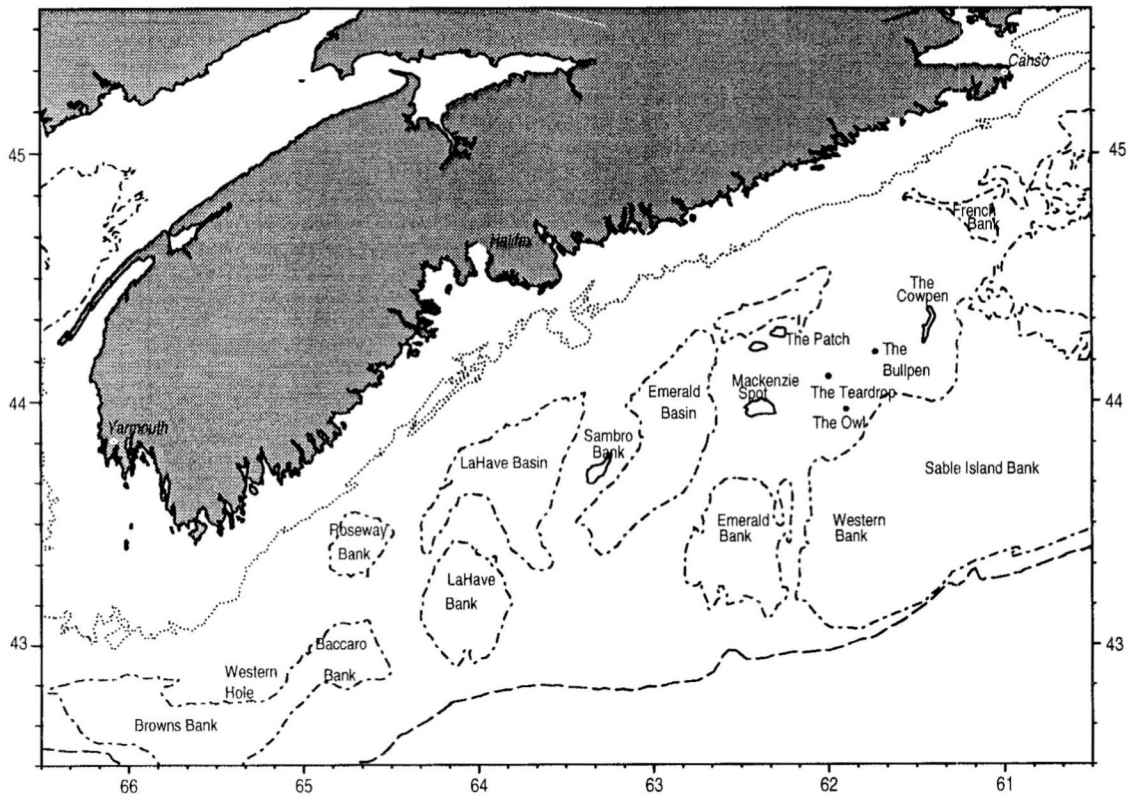


Figure 10. Offshore fishing locations for herring on the Scotian Shelf.

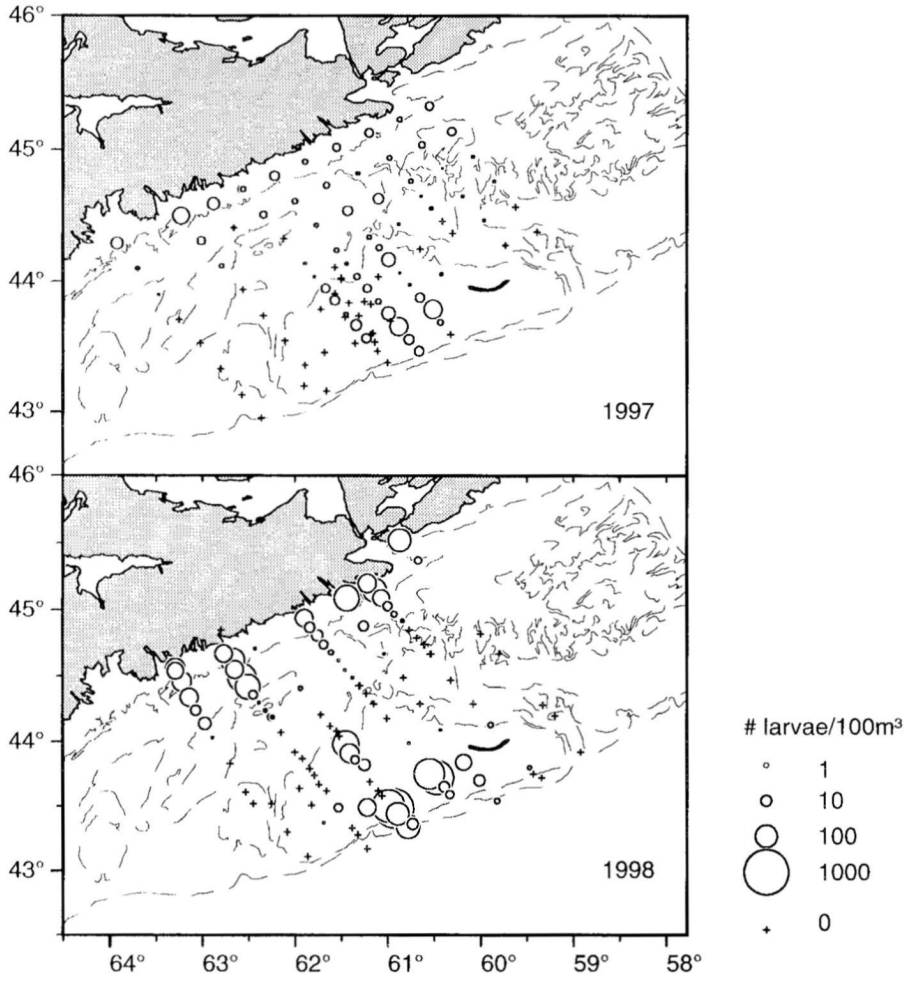


Figure 11. Larval herring abundances and distribution from fall ichthyoplankton research surveys.

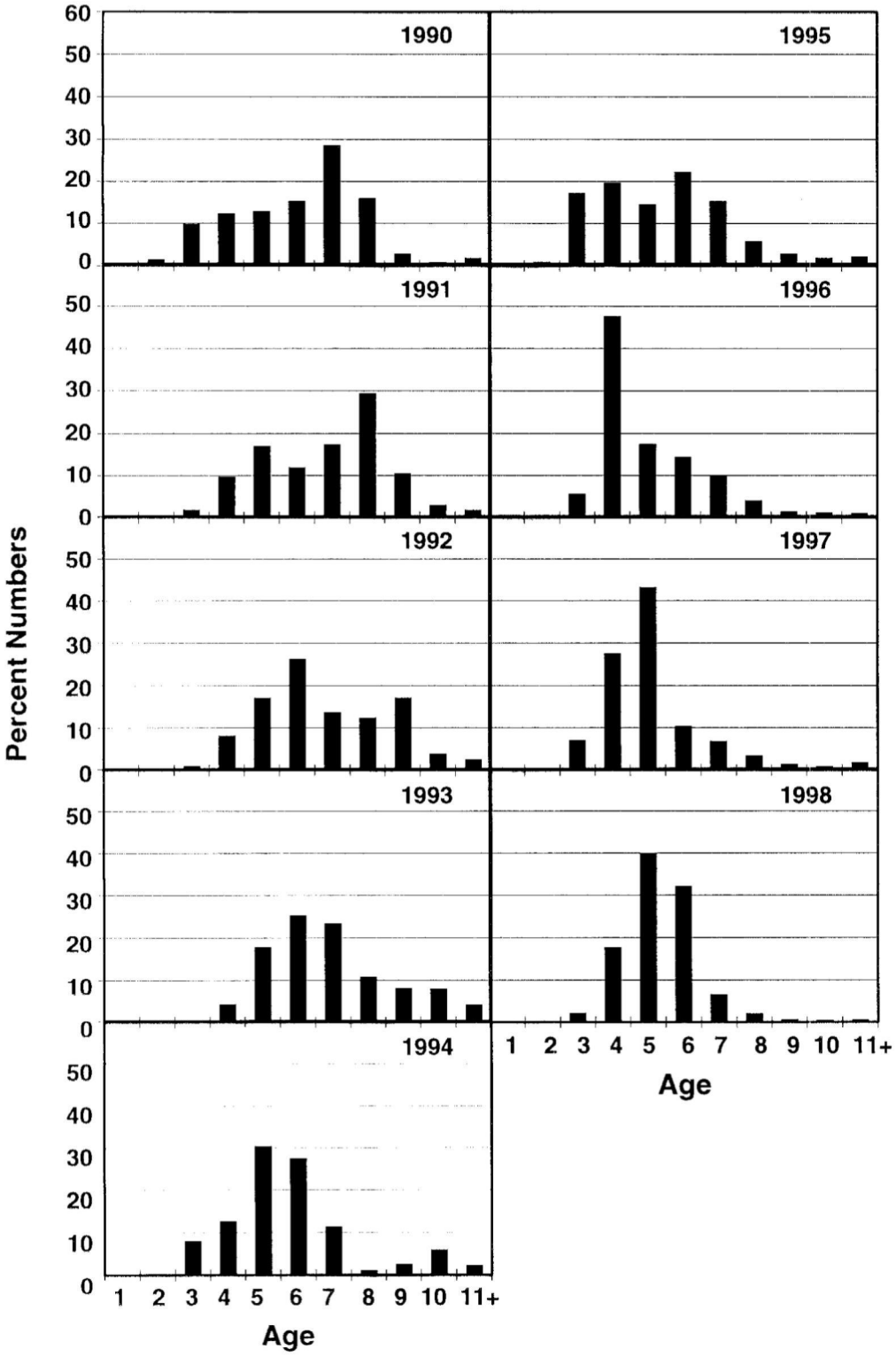


Figure 12. Herring catch at age from the July bottom-trawl survey on the Scotian Shelf (strata 55-78) for years 1990-1998.

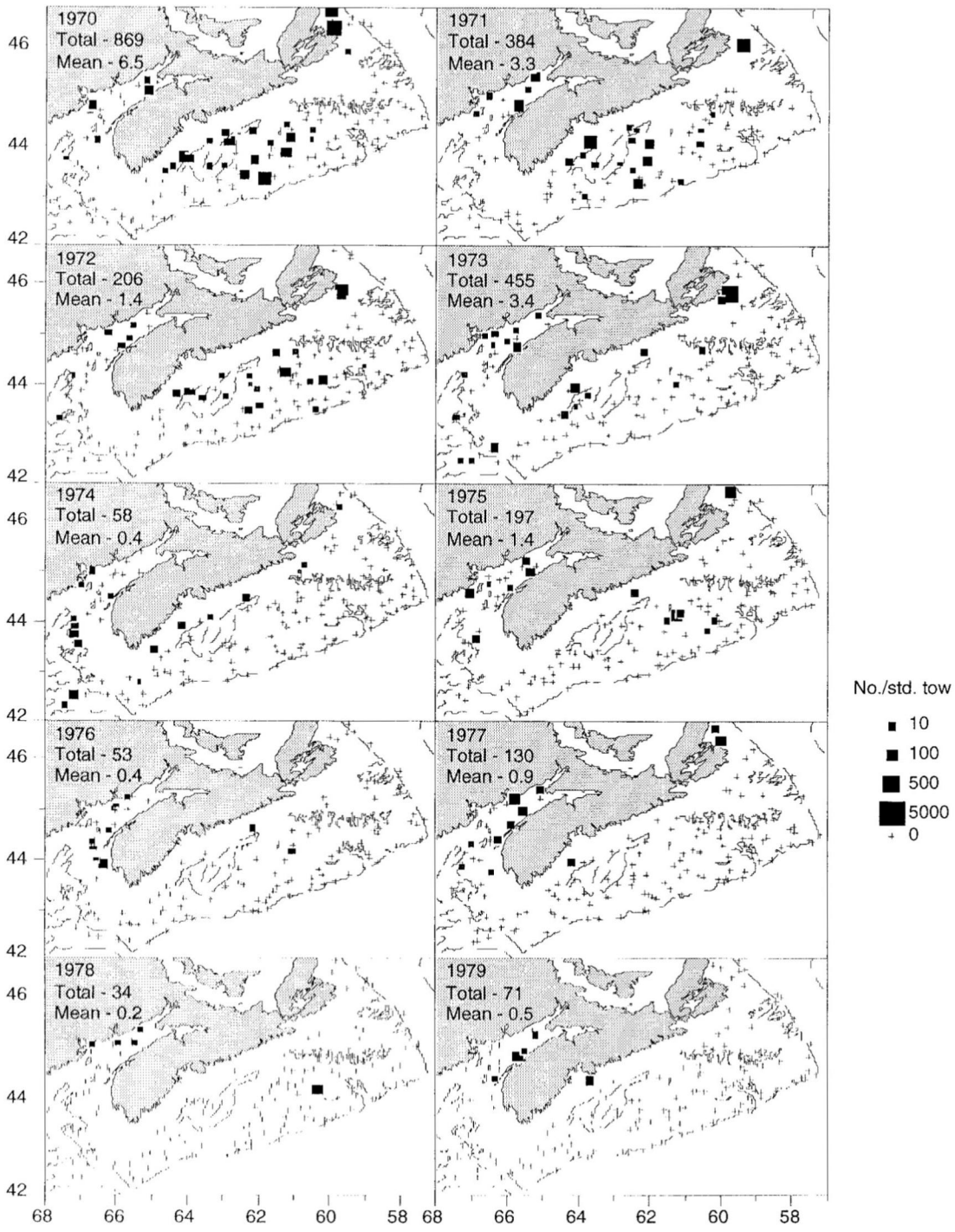


Figure 13. 1970-98 herring catches (numbers per standard tow) in summer ground trawl survey.

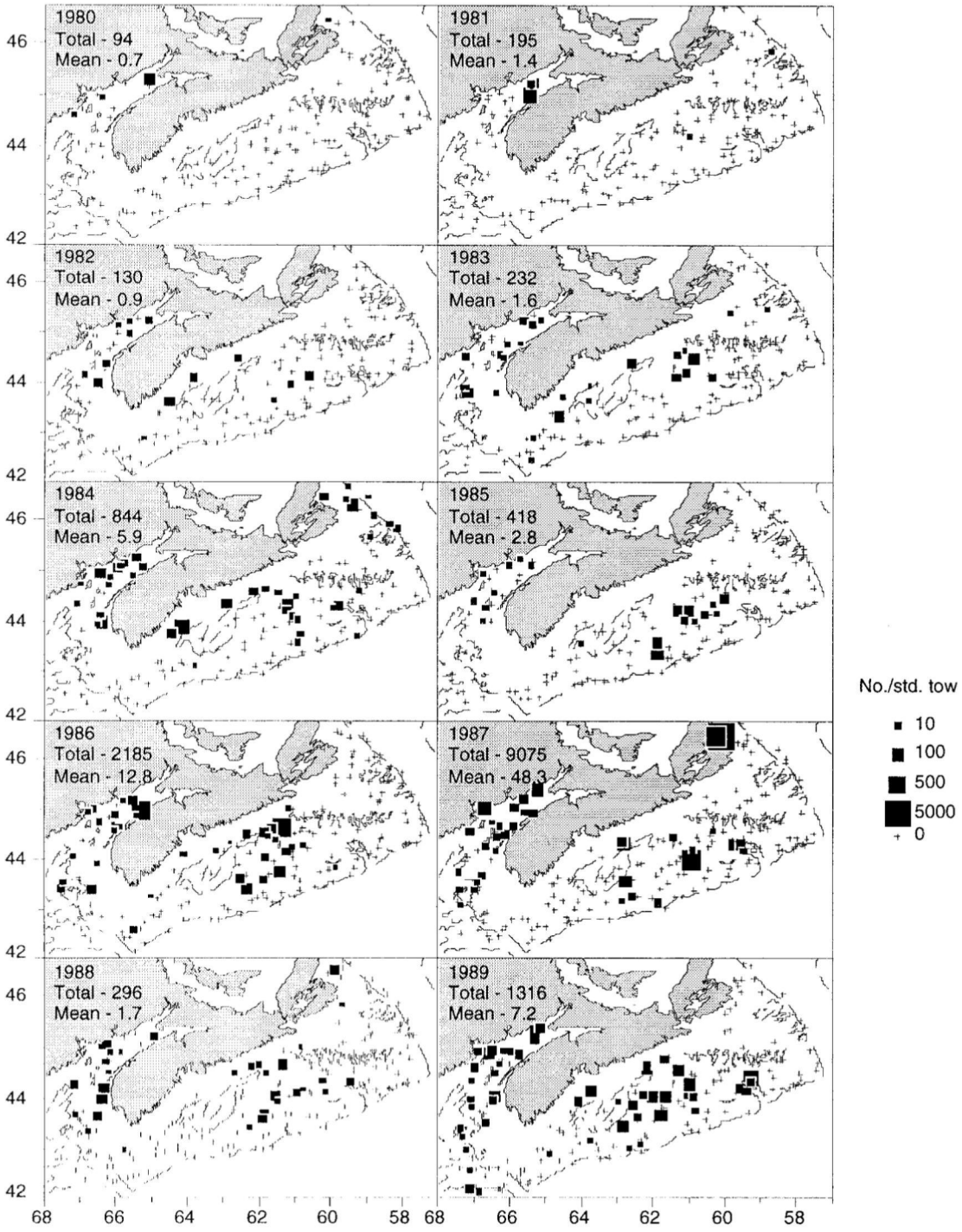


Figure 13. continued.

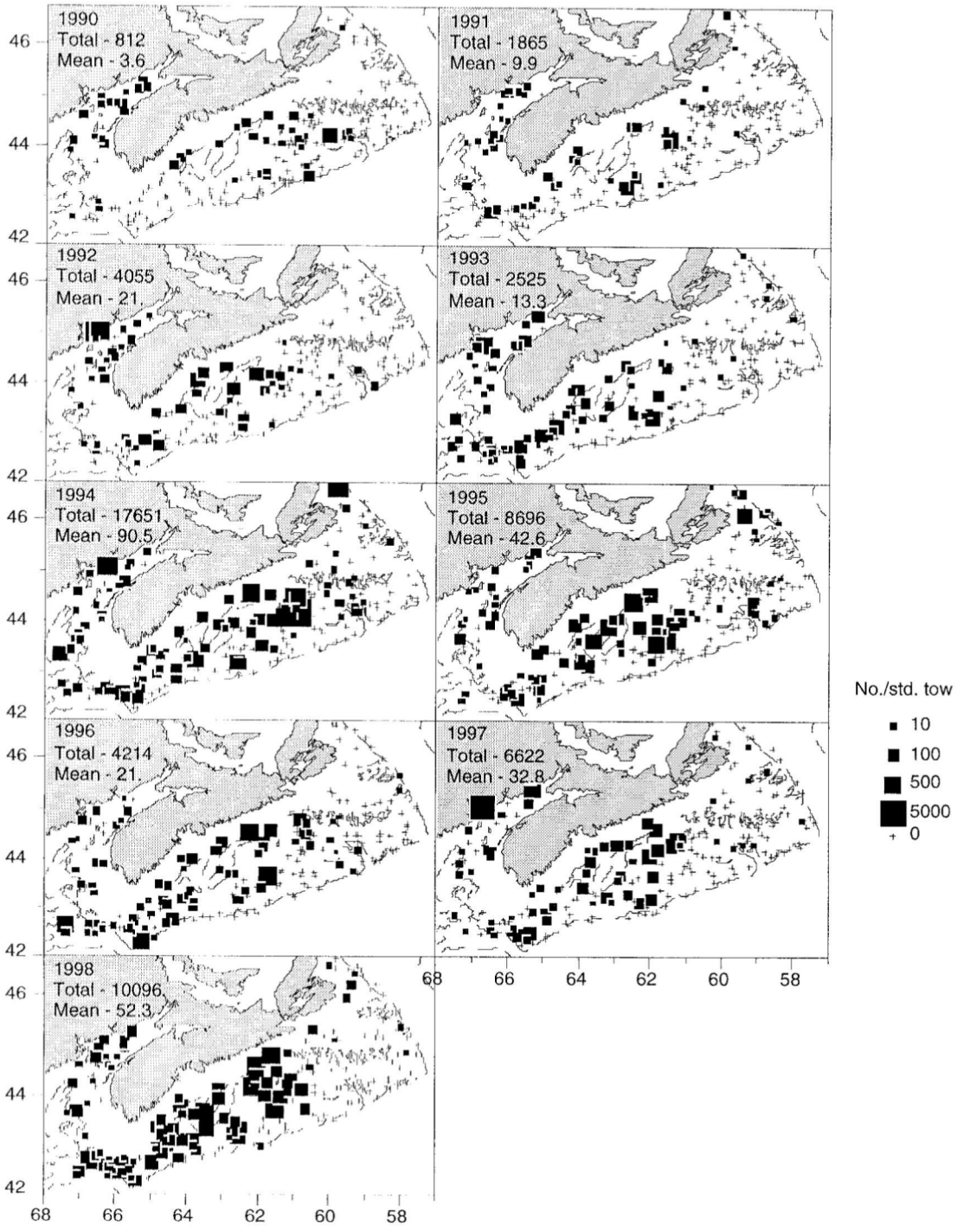


Figure 13. continued.

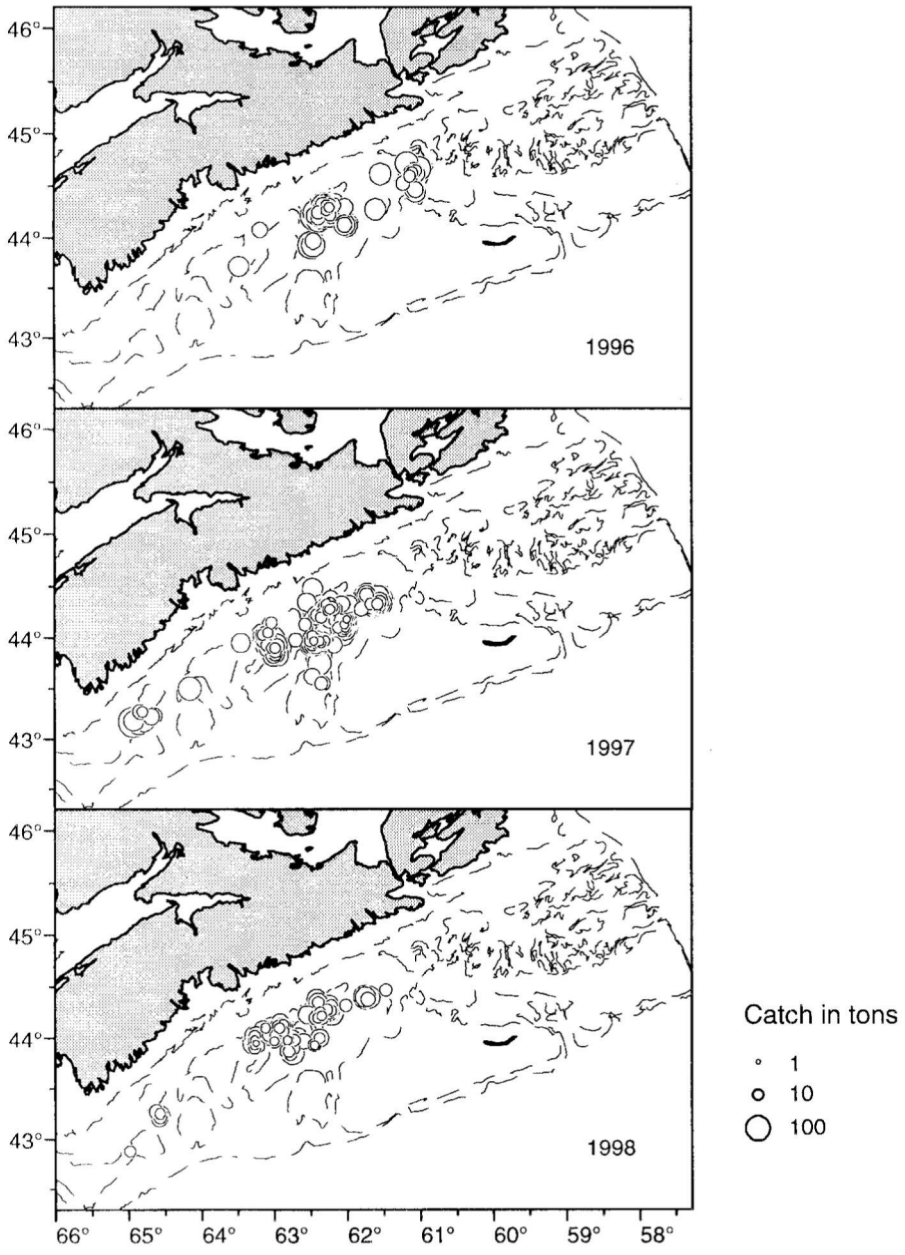


Figure 14. Distribution of offshore herring catches by the purse-seine fleet.

Appendix A

**Department of Fisheries and Oceans**
**Science Branch**
**Maritimes Region**

Bedford Institute of Oceanography
Station
P. O. Box 1006
N. B.
Dartmouth, N. S.
B2Y 4A2

Biological
St. Andrews,
E0G 2X0

Mission Report 98-068

VESSEL/MISSION: Alfred Needler (98-068)

DEPARTURE PORT: Dartmouth, N. S. DATE: November 12, 1998

ARRIVAL PORT: Dartmouth, N. S. DATE: December 1, 1998

AREA OF OPERATIONS: Eastern Scotian Shelf with special focus on the Western Bank area

PERSONNEL:

| | |
|---|---|
| Michael Power - | St. Andrews Biological Station (Scientist-in-charge) |
| Kirsten Clark - | St. Andrews Biological Station |
| Susan Boates - | St. Andrews Biological Station / Pelagics Research Council |
| Andrew Ing - | Pelagics Research Council |
| Lei Harris - | St. Andrews Biological Station / Pelagics Research Council |
| Travis Scheidl - | St. Andrews Biological Station / Pelagics Research Council |
| Alison Pickle - | Dalhousie University |

OBJECTIVES:

1. Survey of the eastern Scotian Shelf to determine the large-scale distribution and abundance of ichthyoplankton (especially larval herring and cod) and other zooplankton.

2. Conduct medium-scale and fine-scale physical/biological surveys in the vicinity of Western Bank and along the coastal zone to delimit larval herring distributions.

3. Conduct bottom trawling on suitable aggregations of herring where observed on the sounder.

4. Use bottom trawl to attempt recovery of Dalhousie University bottom current meter on Western Bank.

METHODS:

The spatial distribution of larvae (especially herring and cod) was sampled using bongo gear and a variable line grid station design. The initial emphasis was to complete the inshore fine-scale stations followed by more intensive sampling offshore and on Western Bank (Fig. 1).

Bongo hauls - Bongo frames with 61 cm diameter openings were mounted with black 0.333 mm mesh nets equipped with PVC plastic cod-end buckets. Flowmeters (General Oceanics Model 2030 and TSK electronic types) were installed on steel brackets in the frame openings. At selected stations 20 cm (mini-bongos) were attached to the outside of the 61 cm bongo. These were mounted with 0.064mm mesh nets for collection of micro-zooplankton.

During the 1997 survey (N97-070) a problem was observed in the way the bongo gear fishes when deployed down the trawl ramp with the meter block in a fixed position above the net roller. On haulback the net may be 'flushed' out by backwash due to the ships pitching motion in some swell conditions with suspected substantial loss of plankton.

During the current 1998 survey, a HIAB crane was situated on the starboard stern catwalk, the plankton winch was placed on the trawl deck level and the meter block was suspended from the crane. From the stern catwalk position, the crane was able to pick the bongo off the trawl deck and then swing aft of the stern to deploy the gear without touching the ramp. During the tow, a bracket mounted between the 'gallows' provided support for the crane and 'sideload' protection. On retrieval the crane was swung slightly astern and the gear was pulled out the water without contact with the stern of the ship and thus no possibility of 'backwash' or loss of the net contents.

Standard oblique hauls with a ship speed of 3.0 knots through the water were made while deploying and retrieving the bongo gear at rates of 50 and 20 m/min respectively to within 5 m of bottom. A Swann slip-ring winch with 3/8" electro-mechanical cable and a digital meter block system was used to deploy the gear with hauls repeated until a minimum total tow time of 10 minutes was achieved. The Netminder II gear monitoring system was used to continuously monitor gear depth, net flow, temperature, pitch and roll with half second updates to computer. This system also included a Windows based software interface for displaying and recording tow data. Plots of the gear depth profile were also observed on a regular basis during the tow. Wire angles were calculated from gear depth and total wire out.

Plankton samples - All port side bongo plankton samples were gently washed down with seawater and preserved in 5% formaldehyde in seawater buffered with a few marble chips. If the port sample was lost or determined to be invalid, the starboard sample either replaced it or the entire tow was repeated. The starboard sample was also washed down with seawater but was then preserved (for most sets) in 95% ethyl alcohol after the raw plankton was first concentrated in a 0.253 mm mesh sieve.

Hydrographic sampling - Profiles of the water column were completed for all stations (except set 32) using a Seabird SBE-25 CTD equipped with conductivity, temperature, depth, and oxygen sensors. The CTD was first lowered to 10 m and allowed to equilibrate for 5 minutes. The unit was then raised to the surface before being deployed and retrieved to 3-5 m off bottom at a wire rate of 30 m/min. The CTD distance off bottom was determined using a

Datasonics Model PSA-900 Sonar Altimeter (pinger) which gave one second updates for distance from bottom. The amount of wire out and wire rates in/out were monitored with a MFD designed electronic meter block system using a Tattletale microprocessor on a modified General Oceanics block.

A six litre Niskin reversing water bottle equipped with electronic reversing thermometers was attached 1 m above the CTD unit to collect calibration water samples, either at 10 m depth or near bottom at alternating stations. Two water samples were taken from the Niskin bottle at each station for calibration of the oxygen data collected by the CTD. One water sample was taken for conductivity/salinity calibration. In addition, two water samples for nutrient analysis were collected and frozen in 30 ml. wide mouth Nalgene plastic bottles. The water samples for oxygen were processed before the next set using an on-board 'Automated Dissolved Oxygen Titration System' with all titration data logged to a controlling computer. Calibration oxygen samples using a standard concentrate of Potassium Iodate were also run daily in triplicate.

An electronic thermometer (VEMCO SEATEMP) was used to provide surface water temperature.

After retrieval, the CTD raw data was 'down-loaded' to a computer and archived on floppy disc. The validity of each cast was also verified by printing hardcopy graphs of temperature, salinity, conductivity and oxygen with depth.

OPERATIONS:

Scientific staff met the Alfred Needler at the Bedford Institute of Oceanography (BIO), Dartmouth on Nov. 12 for gear loading and setup. The Needler departed BIO at 2300 hours and survey work began at 0100 hours on Nov. 13 at station 2-1. The first part of the survey (set 1 to 35) concentrated on the inshore fine-scale lines 3, 5 and 7, which were completed before the scheduled crew change at BIO on Nov. 17. The 2$^{nd}$ leg began on Nov. 18 with effort directed at completing the remaining offshore lines and stations. These were completed (except for line 1) by Nov. 25 when engine problems forced the vessel to return to BIO for repairs. Forecast storm force winds through the following weekend resulted in termination of the survey on Nov. 26 with final gear off-loading.

A sounder observation log for concentrations of adult herring was maintained throughout the survey but only a few small areas of 'fish' were observed. No bottom trawling was undertaken as this survey objective was delayed until the end of the survey when weather and time precluded further work. The successful recovery of the bottom current meter on Western Bank was completed by the Hudson on Nov. 24$^{th}$ through the coordination efforts of Captain Abbott.

RESULTS:

This is the second consecutive year of broad scale larval surveys (for herring) on the Scotian Shelf since the SSIP surveys ending in 1982. Herring taken in research bottom trawl surveys in recent years show a consistent autumn group of herring on Western and Sable Island Banks. Recently, larval herring have also been documented on the offshore banks, particularly in the autumn months, during the 1991-1993 OPEN surveys and also by

GLOBEC studies in 1997-98 on Western Bank. The presence of a localized autumn group on Western Bank and the continued appearance of ripe and running fish in this area in the fall of the year has raised questions about stock structure on the offshore banks. The results of this survey will form an essential part of the offshore 4VWX herring assessment and may help answer some of these questions.

In total 122 sets (Fig. 1) were completed. Bongo tows were completed at all sets except for set #35 and 69 where only a CTD was done. Hydrographic casts (Seabird 25 CTD) were completed for all sets except #32 where the CTD batteries failed and the cast was not repeated. Duplicate bongo tows were made at set #94, 95, 96, 113, 114 and 115 with a 5 minute tow at-depth of 5 to 10m off bottom. Mini-bongos with 0.064 mm mesh nets were attached to the 61 cm bongo for collection of micro-zooplankton at sets 36-65, 75-96, 107-109 and 113-118 when sea conditions were suitable and the chance of gear damage was reduced. These mini-bongo samples were preserved in 5% formaldehyde in seawater buffered with a few marble chips.

The port-side plankton samples which were preserved in formalin will be sorted for all fish and fish-egg species as well as for general invertebrate taxonomic groups by Atlantic Reference Center staff. The starboard-side plankton samples (preserved in alcohol) will be processed by the Dalhousie University technical staff for fish species. The results should be available by May 1998. All data will be made available on the Oracle plankton database on the 'quoddy' HP-755 computer after quality checks and edits are completed.

The salinity samples and CTD salinity and temperature data will be processed in-house by MFD personnel at the St. Andrews Biological Station. Nutrient samples will be analyzed by Pierre Clement at BIO, Dartmouth, N.S. Oxygen calibration data and the Seabird CTD oxygen data will be analyzed separately by Jeff McRuer, also at BIO. All hydrographic data will be prepared in a computer format appropriate for transfer to MEDS in Ottawa and will also reside on the local Oracle database.

We would like to thank J. McRuer, J. Reid and D. Reimer for their time and assistance with the Netminder II gear monitoring system. The scientific staff would especially like to thank the Captain and crew of the Alfred Needler for their interest and help that made this a very smooth running and successful survey.

Responsible officer: Michael Power

Date: 2/23/99

Approved for release: Dr. John Neilson

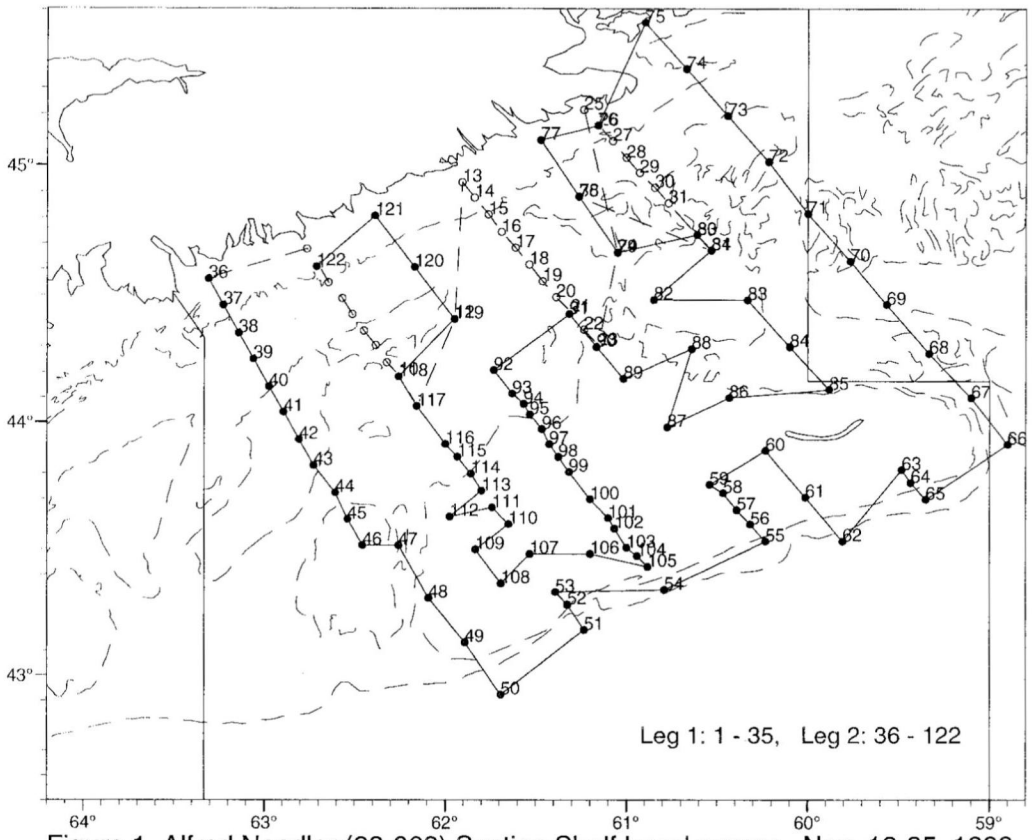


Figure 1. Alfred Needler (98-068) Scotian Shelf larval survey - Nov. 12-25, 1998.