

Not to be cited without
permission of the author(s)¹

Canadian Atlantic Fisheries
Scientific Advisory Committee

CAFSAC Research Document 87/78

Ne pas citer sans
autorisation des auteur(s)¹

Comité scientifique consultatif des
pêches canadiennes dans l'Atlantique

CSCPCA Document de recherche 87/78

Offshore Lobster Stocks in NAFO Subarea 4W:
Potential for a New Fishery

By

D.S. Pezzack
Invertebrates, Plants, and Environmental Ecology 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

¹This series documents the scientific basis for fisheries management advice in Atlantic Canada. As such, it addresses the issues of the day in the time frames required and the Research Documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

Research Documents are produced in the official language in which they are provided to the Secretariat by the author(s).

¹Cette série documente les bases scientifiques des conseils de gestion des pêches sur la côte atlantique du Canada. Comme telle elle couvre les problèmes actuels selon les échéanciers voulus et les Documents de recherche qu'elle contient ne doivent pas être considérés comme des énoncés finals sur les sujets traités mais plutôt comme des rapports d'étape sur les études en cours.

Les Documents de recherche sont publiés dans la langue officielle utilisée par les auteur(s) dans le manuscrit envoyé au secrétariat.

ABSTRACT

The potential for commercial lobster concentrations on the outer shelf in NAFO Div. 4W is indicated from a review of lobster surveys, lobster bycatch in both groundfish surveys and the red crab fishery, and the similarity in physical and oceanographic conditions on the slope area from Georges Bank to Sable Island Bank. The lack of an active trap fishery in the area makes it impossible to estimate the size or extent of the commercial concentrations. The relationship of lobster in 4W to 4X and inshore fisheries is unknown. There is little evidence available to suggest a direct connection between the outer shelf and coastal areas in 4W. An experimental fishery, which could be combined with red crab, is suggested as a means of determining stock size, the relationships to other grounds, and economic viability. A separate lobster fishing district is suggested to assure additional effort is not applied to the existing 4X/5Ze fishing areas.

RÉSUMÉ

Une étude des relevés sur les homards, les prises incidentes de homards réalisées au cours des relevés portant sur le poisson de fond et dans le cadre de la pêche au crabe rouge, ainsi que la similitude dans les caractéristiques physiques et océanographiques de la zone de talus qui s'étend du banc Georges au banc de l'île de Sable indiquent la possibilité qu'il y ait des concentrations commercialement exploitables de homards sur la plate-forme extérieure de la division 4W de l'OPANO. L'absence d'une pêche active au moyen de casiers dans cette région fait qu'il est impossible d'évaluer la taille et l'étendue des concentrations commercialement exploitables. La relation entre les homards dans les zones 4W à 4X et les homards présents dans les pêcheries côtières est inconnue. Très peu de données laissent entendre qu'il y aurait une relation directe entre la plate-forme extérieure et la zone côtière de la division 4W. Une pêche expérimentale, qui pourrait être combinée à la pêche au crabe rouge, pourrait fournir un moyen de déterminer la taille du stock, les relations avec les autres lieux de pêche ainsi que la viabilité de cette pêche. Un district distinct de pêche au homard est proposé pour garantir que l'on n'appliquera pas un effort additionnel dans les zones de pêche existantes (4X/5Ze).

INTRODUCTION

The presence of lobsters (Homarus americanus) along the outer Scotian Shelf (Fig. 1), east of the present commercial lobster fishery in the Browns Bank area, has been known since at least the mid 1960's (McKenzie 1966a and b); but due to distance from existing ports used by the offshore fleet (Shelburne, Lockeport, and Port Mouton), potential gear conflicts with foreign fleets, and the abundance of lobsters on the known grounds of Georges and Browns Banks, the 4W area has never been fished. The absence of a direct fishery limits the data available to assess lobster abundance and distribution. Here, these data have been collated for the resource manager in an attempt to enhance further management decisions.

GENERAL DESCRIPTION OF THE 4W REGION

The offshore sector of 4W includes Emerald, Sable Island, and Banquereau Banks and their adjacent slope areas (Fig. 1). The slope between Western Bank and the Laurentian Channel is dissected by large submarine canyon systems. The major canyons are similar in size to Corsair and Oceanographer Canyons on Georges Bank. The slope between LaHave and Western Banks has a gentler slope and only a single large canyon below Emerald Bank.

The Shelf is shallow, with most of the area less than 100 m. The deeper areas of the Shelf are found to the west between Emerald and LaHave Banks, where the Shelf ranges between 100-160 m. To the north of this area are the deep basins of the Scotian Shelf - Emerald and LaHave Basins - which are up to 280 m deep.

The slope areas have waters with year-round temperatures 7-10°C (McLellan 1954) warmer than those of inshore waters in the winter. This warmer slope water fills the deep basins of the Shelf. It is believed to cross the Shelf through the deeper areas of the Shelf between LaHave and Emerald Banks (Smith et al. 1978). The eastern Scotian Shelf banks are shallower than Browns Bank, and therefore less influenced by the slope water and more affected by the cool intermediate water layers (Mahon et al. 1984). For example, Banquereau is cold year-round, with summer bottom temperatures of 0-5°C (McLellan 1954). Late-summer (July-September) surface-water temperatures over the outer Shelf, west of the Gully, are >15°C (McLellan 1954).

The surface currents in the region are believed to form a gyre around Sable Island Bank, with the Island at its center (O'Boyle et al. 1984). There is little evidence for shoreward transport of surface waters. Warm-core eddies periodically interact with Shelf waters along the slope and may draw large volumes of water off the Shelf (Smith 1979).

TRAWL SURVEYS, 1965-66

Two lobster and deep-sea red crab (Geryon quiquedens) trawl surveys were conducted along the outer Shelf from Lydonia Canyon on Georges Bank to Banquereau, in the summers of 1965 and 1966 (McKenzie 1966a and b). The surveys were designed to assess the potential for a Canadian offshore lobster trawl fishery (at the time, all American offshore lobster fishing was trawl based). No commercial concentrations were found (Fig. 2). The highest catch rates recorded were those of Browns Bank (1.6 and 0.8 lobsters per tow in

1965 and 1966 respectively) and the outer edge of Sable Island Bank (0.8 and 0.9 lobsters per tow in 1965 and 1966 respectively). The lobsters were most plentiful between 110 and 200 m (90% of catch), 66% of the catch taken at sites with bottom temperatures between 7-10°C.

Though few lobsters were captured in trawls on Browns Bank, a trap-based fishery developed in the early 1970's. The fishery landed 496 t in 1976. The similarities between the 1965 and 1966 catch rates on Browns and Sable Island Banks raises the possibility that commercial concentrations exist on the latter. It should be noted first, that the surveys were conducted in summer when lobsters were likely dispersed on the Shelf, and secondly, that trawls are inefficient sampling tools for lobsters (Uzmann et al. 1977).

TRAWL SURVEY, 1986

An exploratory trawl survey was undertaken during April and May 1986 to assess the distribution of lobsters in spring along the Scotian Shelf. Tows were made in both the Browns and Georges Banks areas, on known lobster concentrations, and between LaHave Bank and The Gully (31 tows). A Western 2A groundfish survey trawl was employed. Tows were of 30-min duration at depths between 35 and 475 m.

Catch rates along the slope, between LaHave Bank and The Gully, ranged from 0.25 to 0.8 lobsters per tow (Fig. 3). Lobsters were caught between 200 and 400 m depths. Here, bottom temperatures at the lobster capture sites ranged between 5.7 and 9.3°C (Fig. 3). No lobsters were caught in The Gully (six tows) or on top of Sable Island Bank (three tows). The rough and variable bottom of the canyons prevented adequate sampling with the gear available. The overall distribution of catch is similar to that of McKenzie (1966a and b).

Catch rates in the closed area of Browns Bank were 16 lobsters per tow. The area sampled was specifically chosen to test the trawl's ability to catch lobsters, because of its high lobster concentrations and ideal trawling bottom. The catch rates obtained on these tows do not reflect Browns Bank as a whole.

Catch rates on commercial lobster grounds are not available because of the concentration of fixed gear on the bottom. Seven tows were made east of Corsair Canyon on Georges Bank, just outside the commercial fishing gear, and catch rates of 0.7 lobsters per tow were obtained.

CANADIAN GROUND FISH SURVEYS, 1970-82 AND 1986

Lobster catches in the Canadian groundfish surveys were reported by Pezzack (1983). Aside from the catches on the known lobster grounds in the Browns Bank area, the most consistent lobster catches were south of Emerald Bank (Fig. 4). Lobsters were also caught during winter and summer along the slope south of Sable Island, and on Sable Island Bank during the summer. Lobsters were captured only once on the slope east of The Gully. None have been taken between Emerald and LaHave Banks.

Lobsters were also caught during an October 1986 groundfish cruise on Sable Island Bank and the adjacent slope using the same trawl. Six lobsters were taken in less than 50 m, two at 250 m, and one at 335 m. Four of the nine lobsters were berried females.

The results of these surveys must be interpreted cautiously. The groundfish trawl is not an efficient lobsters sampling tool. As well, early surveys frequently gave an incomplete report of lobsters caught. The large canyons on the Shelf edge were not well sampled due to their rough bottom and steep sides. In addition, the random survey design results in few sites being assigned to the canyons, which represent a small part of the total area. The canyons on Georges Bank represent a small percentage of the total area but a major part of the lobster fishing grounds.

RED CRAB SURVEYS, 1980 AND 1981

The late-summer (August-September) red crab trapping surveys along the Scotian Shelf from Browns Bank to The Gully caught no lobsters at any of the 25 (1980) and 85 (1981) sites (McElman and Elner 1982). This survey included samples from the slope of the southeastern Browns Bank lobster grounds. The fishing depths of 265-915 m (50% deeper than 400 m) were deeper than those in which lobsters are commercially fished in late summer (90-125 m). The 14-h set-over period, which was less than the 3- to 6-d period used in the commercial offshore lobster fishery, may have contributed to the absence of lobsters.

SIZE-FREQUENCY DATA ON 4W LOBSTERS

A single sample of 403 lobsters was measured during a March 1985 red crab sampling cruise along the Scotian Shelf slope. The lobsters were caught in traps set at 450-650 m (traps were modified offshore lobster traps). The mean male and female carapace lengths (CL) were 140 mm (2.4 kg) and 129 mm (1.8 kg) respectively (Fig. 5). These are larger than those presently caught on the southeastern Browns Bank, but are similar in size to those caught both in the deep Corsair Canyon grounds and the Browns Bank closed area (Pezzack and Duggan 1985). Similar as well was the male:female sex ratio (1:2.4) and the proportion of berried females.

This sample cannot be taken to represent the entire region as size frequencies can vary between areas, depths, and seasons. The sample was from a deep slope region; and in general smaller lobster are more common on the shallows of the banks and in basins, rather than on the slope or in canyons (Pezzack and Duggan 1987).

The lobsters were caught in four strings of gear with an average CPUE [kg/trap haul (TH)] of 1.4 lobsters or 2.7 kg/TH. One string of 83 traps averaged 3.1 lobsters/TH or 6.1 kg/TH. CPUE's on prime offshore lobster grounds vary between 2.2 and 3.5 kg/TH (annual CPUE).

Fishermen target their effort on areas with smaller 0.5-1.4 kg (1-3 lb) lobsters, which generally earn \$1.30-\$1.85/kg more than the 1.4-3.6 kg (3-8 lb) lobsters and \$3.20/kg more than the >3.6 kg (>8 lb) lobsters. The mean size of lobsters in the single sample from 4W is within the 1.4-3.6 kg (3-8 lb) size group. Browns and Georges Banks data show areas with different size frequencies, each of which has remained stable over time. A similar situation may exist in 4W.

LARVAL SURVEYS

The only data on Shelf-wide larval distribution is from an August 1971 ichthyoplankton survey (Fig. 6) (Stasko 1977) which employed a small neuston net. Recent work has shown that the larvae are not concentrated in the upper metre of water, but distributed throughout the upper 50 m. Exact location varies with time of day and molt stage (Harding et al. 1987). As well, the larvae are rare in the water column; thus a large net is required with long tows. Nevertheless, the survey showed highest concentrations over Browns Bank and along the outer Shelf as far east as LaHave Bank. Two sites between Emerald and Western Banks yielded a total of five larvae. Given the techniques employed and the diurnal behavior of the larvae, it is not surprising that few larvae were captured. The absence of larvae should not be interpreted as an absence of spawning stock or settlement.

DISTANCE FROM PORTS

The maximum distance from port presently fished by an offshore vessel is 160 naut mi (Shelburne to Corsair Canyon), while most fishing occurs within 120 naut mi of port. The distance from Shelburne and Port Mouton to grounds below Emerald Bank would be approximately 140 and 120 naut mi, respectively. Grounds to the east on Sable Island Bank would be 180 to over 240 naut mi. Vessels based in Halifax and on Cape Breton Island would be closer to the more easterly grounds on Sable Island but more distant from those below Emerald Bank.

The continued fishing in Corsair Canyon indicates that given high catch rates and sound vessels, the distance from existing ports should not hinder development of a 4W fishery.

CONFLICTS WITH OTHER FISHERIES

Potential gear conflicts could develop with other fisheries interests already fishing the 4W slope area. Foreign trawlers fish silver hake in the small mesh gear box, concentrating in the canyons along the slope of Sable Island Bank. Domestic trawlers fish redfish and silver hake along the slope. Foreign and domestic longliners (tuna, swordfish, and halibut) fish the slope, but concentrate in the canyons. Canadian swordfish fishermen voiced concern at the 1986 Offshore Lobster Advisory Committee meeting over red crab traps set southwest of Emerald Bank on traditional longline grounds.

The concentration of existing effort in the canyon areas of the slope could lead to gear conflicts if lobsters are, as on Georges Bank, found to concentrate in the canyons. Co-existence of other fixed gear is possible, but mobile gear is unable to operate in the canyons if fixed gear is present.

RED CRAB FISHERY

A small, red crab (G. quinquegens) fishery operated along the slope between LaHave and Emerald Banks during 1984-85. Due to high operating cost and low landed value, the fishery was not active in 1986. A combined red crab/lobster fishery would improve the profitability of each and give flexibility during those months when catch rates of one of the species is low (i.e. lobster catch rates low during August to October). Both fisheries use

the same vessel type and gear, and bycatches of each species can be expected in any directed fishing activity.

FURTHER RESEARCH NEEDS

Information on the distribution and abundance of lobsters in 4W could be obtained through an experimental fishery. An experimental fishery would facilitate biological studies of size frequency, sex ratios, size of maturity, growth rate, and migration patterns. Attempts to conduct trap fishing surveys alone would be expensive and cover only a small area and period of the year. Trawl surveys would cover larger areas, but catch rates are low and the relationship between catch and abundance is unknown.

SCIENTIFIC DATA REQUIREMENTS FROM EXPERIMENTAL LICENCES

Given present fiscal resources, an active fishery is the best sampling tool available to supply the data needed on distribution, densities, and stock structure. Any exploratory licences should be required to submit detailed daily log records as is presently done in the existing offshore lobster fishery. Observers must be allowed on board to sample catches both at sea and in port. Fishermen would be expected to return lobster tags.

The experimental fishery would extend 3-5 yr, with annual reviews by CAFSAC. Finding the lobster concentrations, and their seasonal patterns, could take several years.

CONCLUSIONS

The information available indicates that lobsters exist on the Sable Island-Emerald Banks area. The similarity of the 1965 and 1966 catch rates on Sable Island and Browns Bank and the high catch rate observed in two red crab trap strings suggest that commercial concentrations exist in 4W. Large submarine canyons are present, similar to those which are the centres of lobster fishing on Georges Bank. No further information on distribution or commercial potential will be available until an exploratory fishery is established to fish the area.

The 4W grounds are isolated from coastal fisheries by cold-water, offshore currents and greater distance than the Browns Bank grounds. Unlike the Gulf of Maine area, lobsters on the eastern Scotian Shelf do not appear to be continuously distributed from the coast to the slope (Fig. 4 and 7). It appears unlikely that there is a connection between offshore and inshore lobsters in 4W. The few tags recovered on Sable Island Bank suggest that there is some connection with Browns Bank.

The rugged and unknown nature of the new grounds may make fishing difficult and gear losses potentially high during the initial exploratory phase of the fishery. Present foreign and domestic fishermen could create a serious gear conflict situation; but if the lobster fishery proves to be sufficiently valuable, a compromise could no doubt be worked out.

Those interested in pursuing the fishery should bear in mind the large mean size of these lobsters. However, the data were from one sample only and may not be an accurate representation of this potential stock.

A new separate 4W offshore lobster fishing district is recommended which would allow exploratory licences to be introduced but prevent new effort in 4X. Without a separate lobster district, effort would quickly shift to the existing grounds of Browns and Georges Banks. It is not known what catch rates can be expected in 4W or how large an area has commercial concentrations. Temperature differences between 4W and 4X areas may mean different growth and recruitment rates which would dictate different exploitation rates. Separate management plans with different TAC's may be needed.

The new lobster district may encourage a renewal of the red crab fishery, which could be fished with the same gear during periods of low lobster catches. Joint lobster and red crab licences may increase the economic viability of the two fisheries.

The existing 4X/4W line is suggested, for convenience, as the boundary. It has no biological basis. A separation of the fisheries is needed, and one which does not dissect a concentration or natural unit is desirable. The trawl and larval data suggest that catches would be low between LaHave and Emerald Banks and that a line drawn at the 4X/4W boundary would not split a fishable concentration. The line, however, conflicts with the present red crab fishing district and fishing grounds. It would be advantageous to have the red crab and lobster districts correspond if joint crab-lobster licences are to be issued.

SUMMARY

1. The slope environment in 4W is similar to that in 4X. It has year-round warm slope water needed for growth and reproduction of offshore lobsters.
2. Early (1965-1966) trawl surveys found similar lobster catch rates on the Sable Island/Emerald Banks as those on Browns Bank, which now supports a major offshore fishery.
3. Groundfish surveys regularly catch lobsters in the Sable Island/Emerald Banks area, but not on Banquereau Bank or in the area between the coast and the offshore banks of 4W.
4. Commercial lobster catch rates were obtained in a series of traps set by red crab vessels in 4W. The size frequency showed the mean size to be similar to Corsair Canyon and southeastern Browns Bank areas.
5. The limited data available indicates the potential of commercial concentrations in 4W.
6. There is potential gear conflicts with trawlers and longliners and swordfish fisheries.
7. A separate lobster fishing district is recommended to prevent effort from shifting to present offshore grounds.

8. An exploratory fishery is the most efficient means of establishing lobster densities and distribution. Three to 5 yr of data from an experimental fishery will be required to permit an assessment of the potential stock. Vessels involved must supply detailed logbooks and cooperate in tagging and sampling programs.

ACKNOWLEDGEMENTS

David Robichaud provided lobster size-frequency data taken during his sampling of red crab catches.

REFERENCES

- Harding, G.C., J.D. Pringle, W.P. Vass, S. Pearre, Jr., and S.J. Smith. 1987. Vertical distribution and daily movements of larval lobsters Homarus americanus over Browns Bank, Nova Scotia. Mar. Ecol. Prog. Ser.: in press.
- McElman, J.F. and R.W. Elnor. 1982. Red crab (Geryon quinque-dens) trap survey along the edge of the Scotian Shelf, September 1980. Can. Tech. Rep. Fish. Aquat. Sci. 1084.
- McKenzie, R.A. 1966a. Offshore lobster investigations. Can. Fish. Rep. 6, Dept. Fish. of Can., Ottawa.
- 1966b. Canadian Atlantic offshore lobster and red crab investigation, 1966. Fish. Res. Board Can. MS Rep. 895: 35 p.
- McLellan, H.J. 1954. Bottom temperature on the Scotian Shelf. J. Fish. Res. Board Can. 11: 404-418.
- Mahon, R., R.W. Smith, B.B. Bernstein, and J.S. Scott. 1984. Spatial and temporal patterns of groundfish distribution on the Scotian Shelf and in the Bay of Fundy, 1970-1981. Can. Tech. Rep. Fish. Aquat. Sci. 1300.
- O'Boyle, R.N., M. Sinclair, R.J. Conover, K.H. Mann, and A.C. Kohler. 1984. Temporal and spatial distribution of ichthyoplankton communities of the Scotian Shelf in relation to biological, hydrological, and physiological features. Rapp. P.-v. Reun. Cons. int. Explor. Mer 183: 27-40.
- Pezzack, D.S. 1983. Distribution of American lobster (Homarus americanus) in the midshore and offshore regions of S.W. Nova Scotia during October 1980, July 1981 and October 1981 trap surveys. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 83/67.
- 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.
1987. Canadian offshore lobster fishery, 1985-86, and assessment of the potential for future increases in catch. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 87/79.
- Smith, P.C. 1979. A proposal to study the circulation off Cape Sable, Nova Scotia. Bedford Inst. Oceanogr. Rep. Series B1-R-79-5: 107 p.

- Smith, P.C., B. Petrie, and C.R. Mann. 1978. Circulation variability and dynamics of the Scotian Shelf and slope. J. Fish. Res. Board Can. 35: 1067-1083.
- Stasko, A.B. 1977. Lobster larvae on the Scotian Shelf. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 77/31.
- Uzmann, J.R., and R.A. Cooper, R. Theroux, and R.L. Wigley. 1977. Synoptic comparison of three sampling techniques for estimates abundance and distribution of selected megafauna: Submersible vs. camera sled vs. otter trawl. NOAA Mar. Fish. Rev. Paper 1273, 39(12): 11-19.

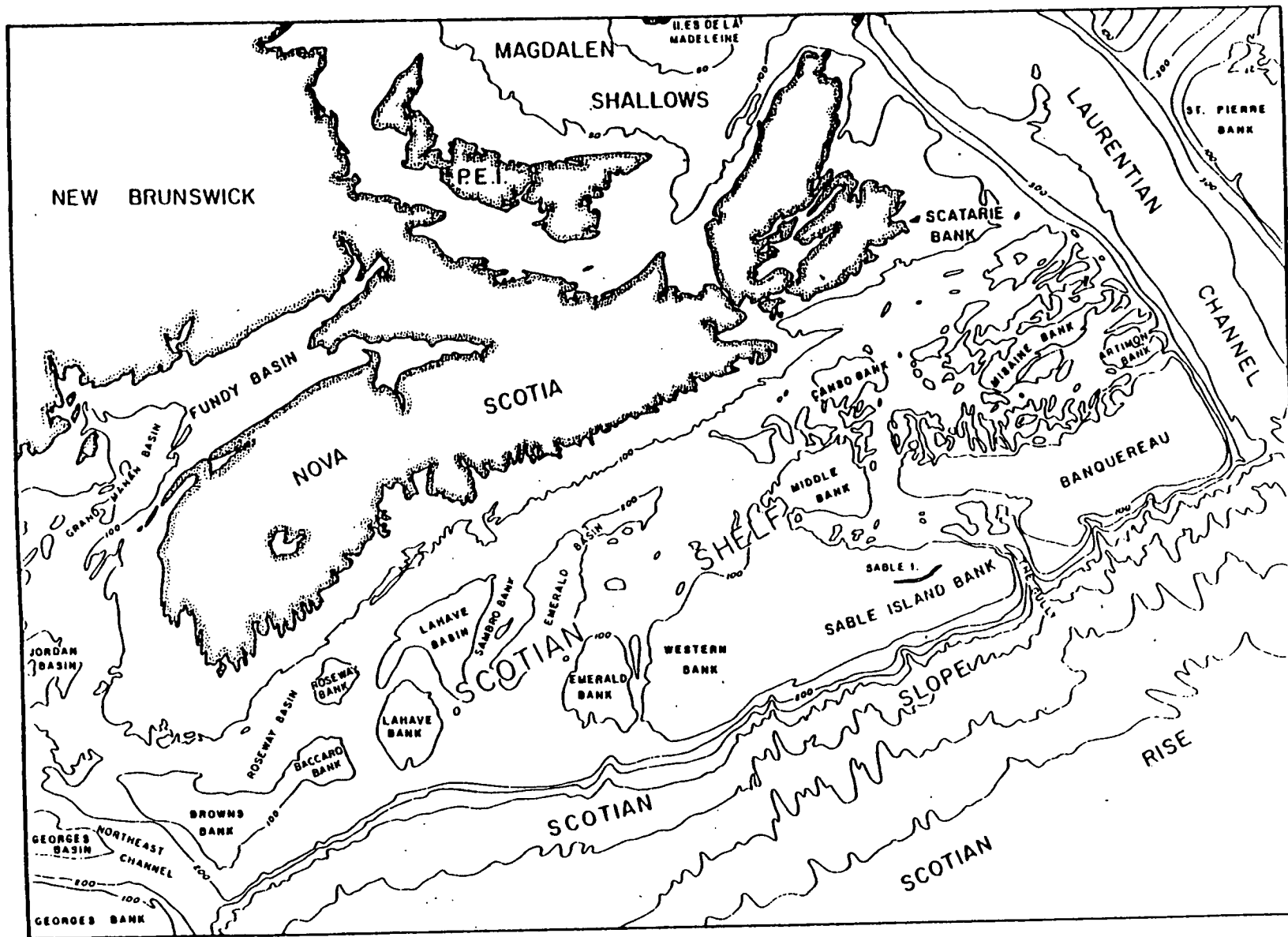


Fig. 1 Scotian Shelf

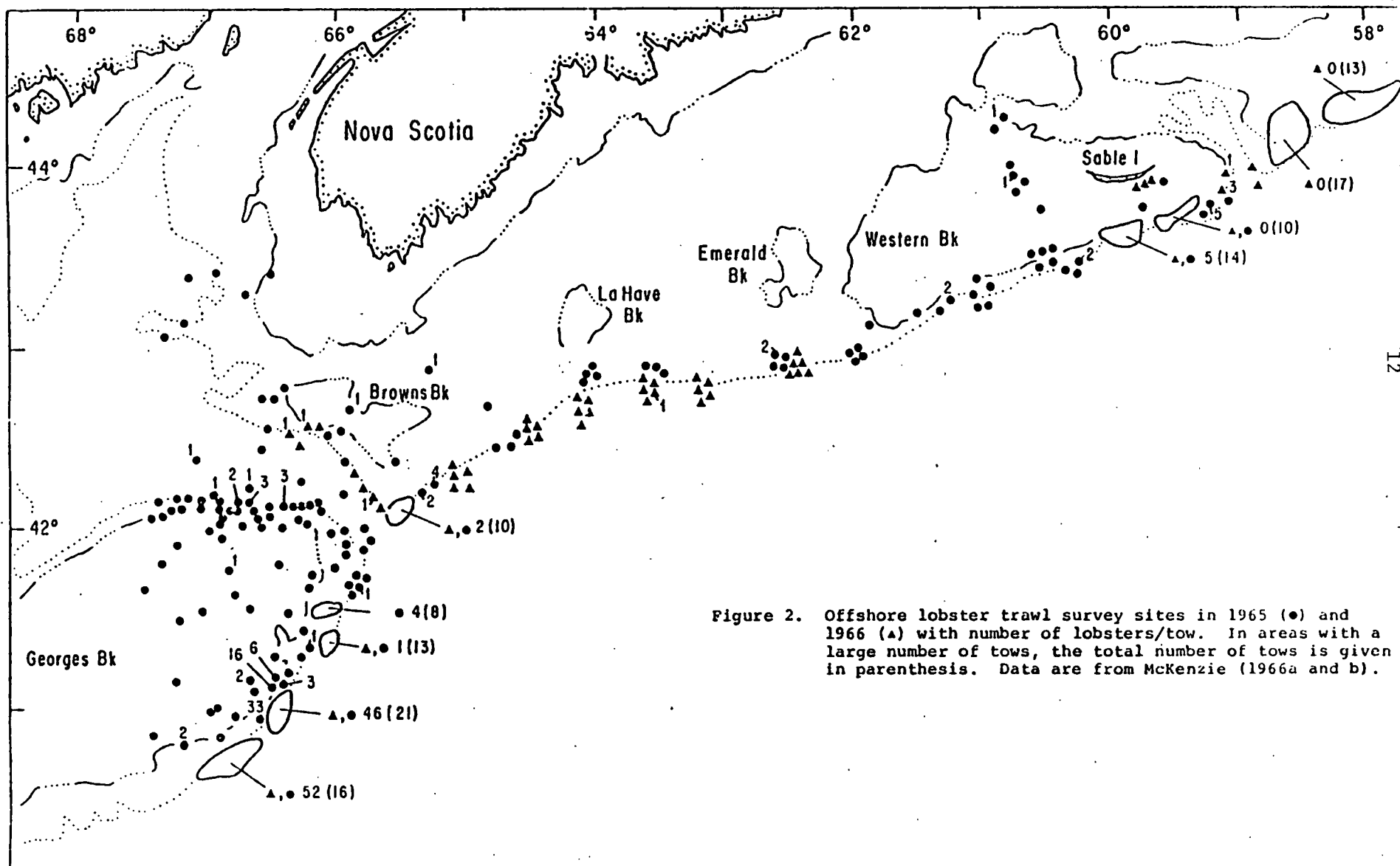


Figure 2. Offshore lobster trawl survey sites in 1965 (●) and 1966 (▲) with number of lobsters/tow. In areas with a large number of tows, the total number of tows is given in parenthesis. Data are from McKenzie (1966a and b).

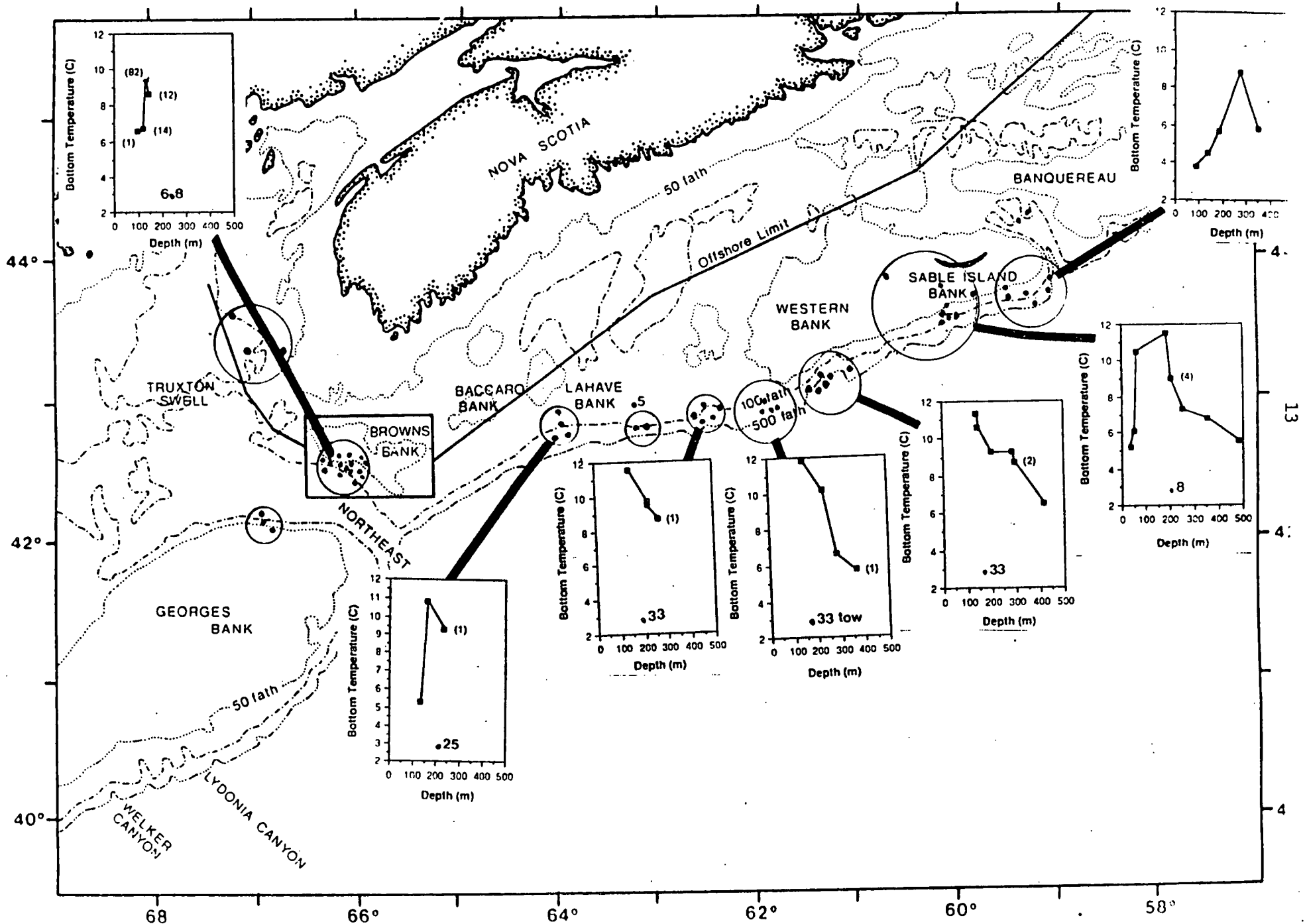
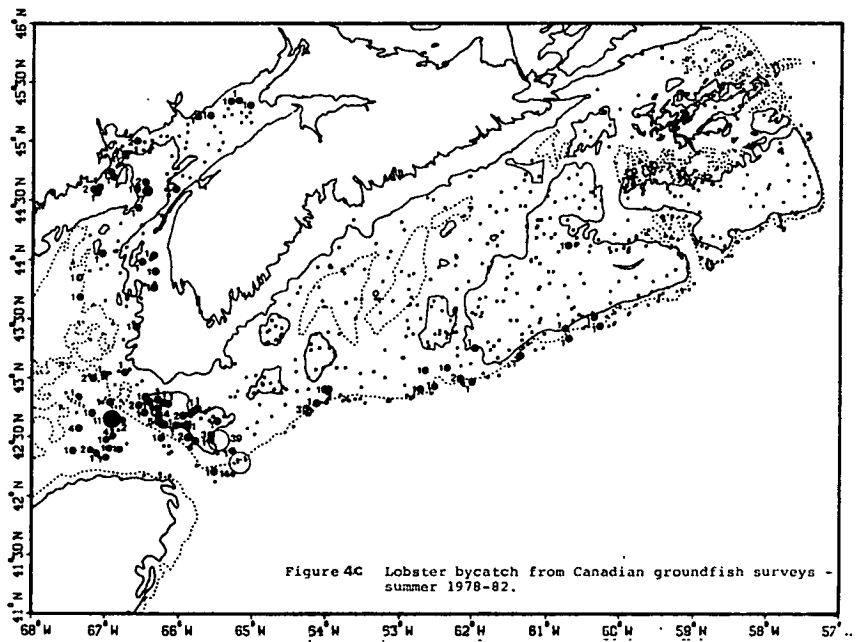
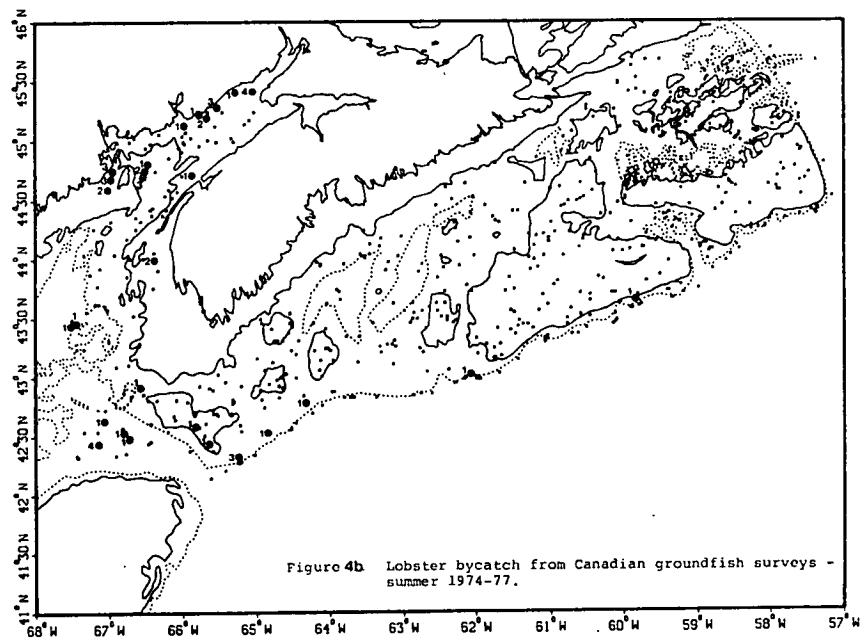
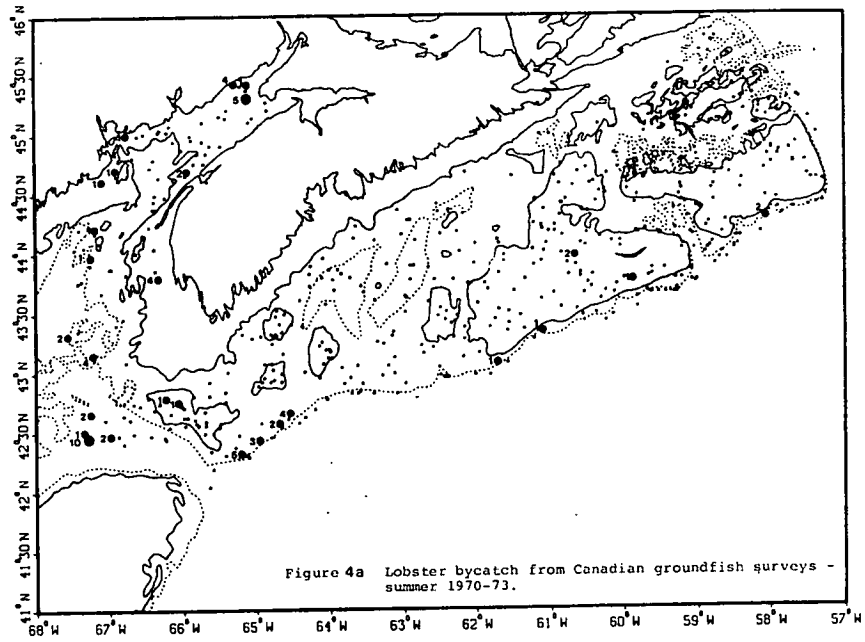


Figure 3 April/May 1986 lobster trawling survey. Sample sites, number of lobsters/tow and bottom temperature plotted against depth and mean lobster/tow by area.



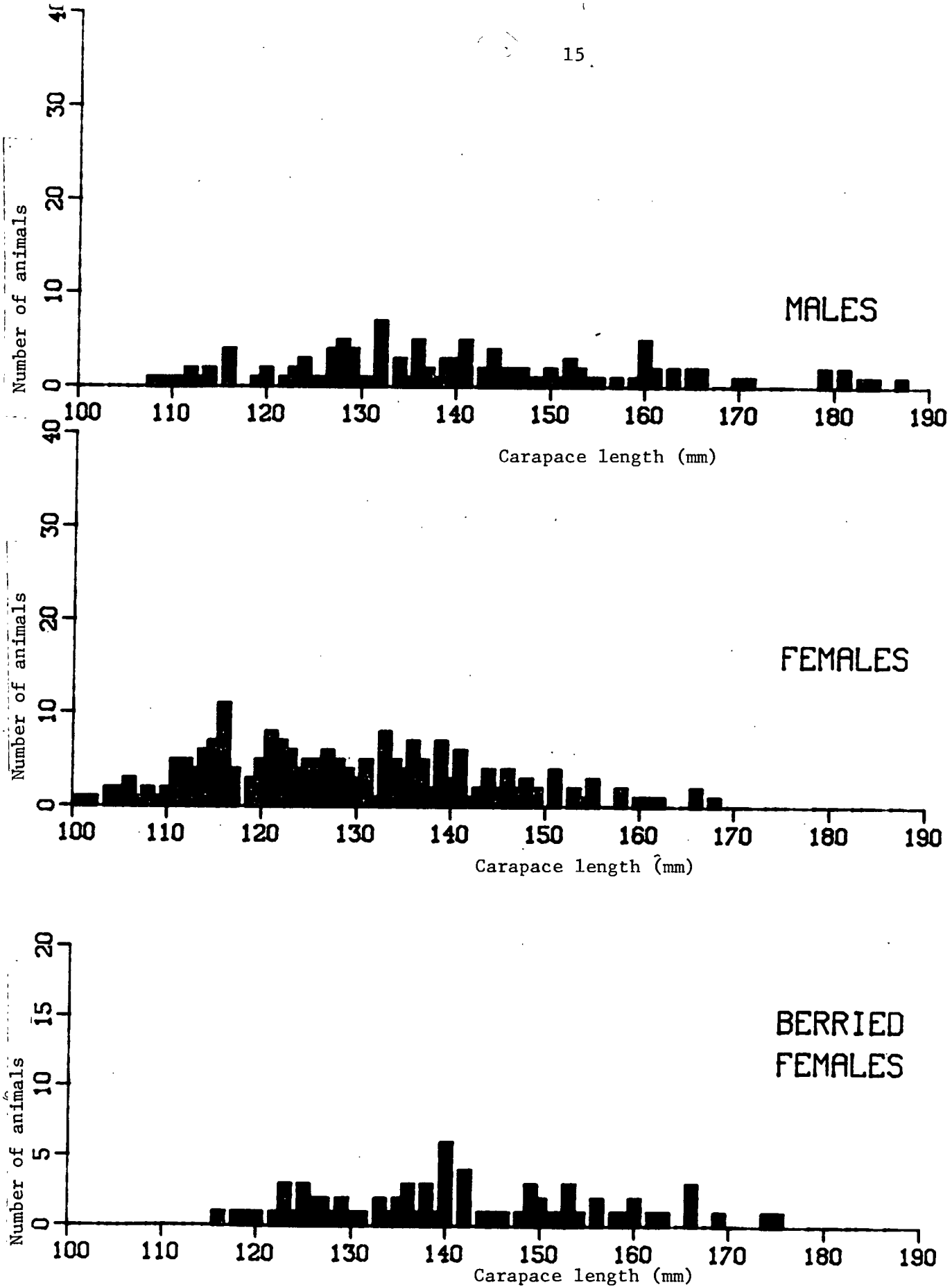


Figure 5 Lobster size frequency distribution from March 1985 Red Crab sea sample in NAFO Division 4W.