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Abstract

Regional assessments of three invertebrate species (northern shrimp (*Pandalus borealis*), snow crab (*Chionoecetes opilio*) and Iceland scallops (*Chlamys islandica*)) were conducted in February, April and May, 1996. These proceedings contain summaries of the working papers presented at the meeting, as well as summaries of the discussions of these papers. A list of working papers available to the meeting and a list of meeting participants are given. The committee concluded that the shrimp fishery continued to do well in most areas and that there was no reason to advise a change in the current management plan. The snowcrab fishery is expected to continue to perform well in 1996 but prerecruit indices continue to decline and the proportion of old shell crab seems to be increasing. The depletion noted for Iceland scallops in 4R in the 1995 assessment seemed to continue during the 1995 fishery. Recruitment is almost non existent and even at a low exploitation rate the stock will continue to decline. For 3LN Iceland scallops, for the Canyons area a TAC of 3000 t was recommended, as well as 1000 t for 3L and a further 3000 t for a new area.

Introduction

Regional assessments of invertebrate species were conducted during a number of meetings held between February 22 and May 28, 1996. Three species, northern shrimp (*Pandalus borealis*), snow crab (*Chionoecetes opilio*) and Iceland scallops (*Chlamys islandica*) were assessed. Northern shrimp are assessed as four management areas, NAFO Div. 0B, NAFO Div. 2G, Hopedale and Cartwright Channels, and Hawke Channel + NAFO Div. 3K. Developments in the *P. montagui* shrimp fishery in Hudson Strait and Ungava Bay were also examined. There is thought to be one stock of snow crab throughout the Newfoundland - Labrador area, although there are numerous management areas. Two stocks of Iceland scallop, Grand Banks (3LN) and 4R were also assessed.

The introduction of the collection of quantitative data on shellfish from the annual fall survey was considered to be extremely valuable by the committee. This information played an important role in the assessment of shrimp and crabs. For crab the survey information showed that crab are extremely widespread and indicated that there is potentially a very large biomass in the area. This information also supported some trends that were seen in the trap surveys, which have much more limited areal coverage. For shrimp, a preliminary biomass estimate was produced from the survey which also indicated a very large biomass and distribution maps clearly showed extensive distribution of shrimp throughout Div. 2J and 3K. The continuation of the collection of this data is considered to be very important but will require effort to be dedicated from the shellfish section to the staffing of these cruises.

Information from ROXANN formed an important part of the Iceland Scallop assessment. This seabed classification system was used in combination with dredge catch rates to post stratify the survey area and resulted in a more accurate estimate of biomass.

These proceedings contain summaries of the working papers presented at the meeting, as well as summaries of the discussions of these papers. As well, summaries by lead researchers of views of fishers on the stock status, gathered at meetings and from individual contacts, are presented. The summaries of the working papers and discussions are grouped by species. The reader is directed to the stock status reports and research documents for further information on these stocks.

NEWFOUNDLAND SNOW CRAB

Views of Fishermen

by

D.M. Taylor

Generally, fishers that participated in the 1995 snow crab fishery were quite pleased with the returns they received. Record high prices ($2.50/lb), high catch rates, increased quotas and good quality crab combined to make the 1995 snow crab fishery the most successful ever.

2J

Fishers in Northern Labrador reported lower catch rates than in 1994, primarily due to a high incidence of soft-shelled crabs on grounds that had been previously fished. In order to provide fishers the opportunity to fish without encountering soft-shelled crabs the northern boundary of this area was extended.

Fishers complained that catch rates in Southern Labrador were reduced in comparison with 1994 levels but agreed that CPUE remained high in comparison to most years. Again, the combination of reasonable catch rates and high prices resulted in a extremely successful season.

3K

Despite the fact that CPUE declined in several inshore management areas, fishers reported excellent catches of good quality crab. The incidence of undersized and soft-shelled crabs was lower than in previous years. Catch rates in experimental offshore area 3Kg-x were disappointingly low but fishers confirmed that only the extreme southwest corner of this area was fished.

3L

CPUE in almost all management areas was higher than those experienced in 1994. In Outer Bonavista Bay and Offshore Trepassey (areas 5B and 8B) there was a high incidence of both soft-shelled and undersized discards. Despite these two areas where problems were encountered, fishers reported highly successful seasons.

3Ps

Catch rates in the Placentia Bay areas of this NAFO division (areas 10 and 10-x) were comparable to those of 1994. However, fishers virtually abandoned Fortune Bay due to low catch rates. An experimental area in Fortune Bay (fishing grounds west of Pass Island) provided disappointing returns to fishers. In Placentia Bay, fishers reported that crabs were very large and that there were few problems with undersized and soft-shelled discards.

4R

CPUE in all management areas of this NAFO division are considerably lower than those on the east coast of Newfoundland and Labrador. However, fishers prosecuting the fishery in these areas reported catch rates comparable to those experienced in 1994. Soft-shelled and undersized crabs were not significant problems in 4R management areas.

Summary of performance of the 1995 Newfoundland and Labrador snow crab fishery - WP SF 96/2

by

D.M. Taylor and P.G. O'Keefe

Newfoundland Snow crab (*Chionoecetes opilio*) landings reached approximately 32,000 t in 1995, an increase of 15% over the previous year. The fishery is concentrated along the northeast and southeast coasts of Newfoundland and Labrador with a small, newly inaugurated inshore fishery operating in nearshore areas of the island. The fishery is prosecuted

by several fleet sectors; these include large full-time, large supplementary, small supplementary vessels <40 gross tons, and vessels under 35 ft. Vessels are licensed by NAFO division boundaries and are restricted to fishing snow crab management areas (Fig.1) within their division. Each year, before fishing activity commences, Resource Management Branch issues a Snow Crab Management Plan which outlines quotas per fleet sector by management area, trap limits, seasons etc.

Assessment of fishery performance for each of the various management areas (Fig. 1) relies on analyses of fishers logbook entries (mandatory for all fleet sectors) as the principle means of comparing a given years fishery performance to that of the previous fishing season. The standard used in this comparison is catch per unit of effort (CPUE) calculated by dividing the landings for a trip by the number of traps hauled as reported in the log books. While it is felt that information obtained from most logbooks during the course of a fishery is reasonably accurate, providing reliable data on catch and effort, some management areas are problematical in terms of interpreting the information provided. A summary of 1995 fishery performance for all Newfoundland snow crab management areas with comparisons to 1994 fishery performance is presented in Table 1.

In most management areas both landings and effort increased over 1994 levels while CPUE increased in 10 management areas and decreased in 8. Where data were considered acceptable for comparison between years, CPUE'S calculated for the 1995 fishery were the same in 8 areas, higher in 2 areas and lower in 1 area. It should be noted that changes in CPUE from one year to the next may not accurately reflect abundance due to the influences of such things as environmental effects (water temperature), changing fishing patterns, changes in fishing season etc..

Logbooks have also been utilized to determine fishing positions of crab fishers with the aim of summarizing fleet fishing patterns, identifying portions of the fishing grounds that are the most heavily fished, delineating the boundaries of new fishing grounds and illustrating the expansion of the fishery in recent years both in terms of effort and area. A large sub-sample of the log book entries of full-time and supplementary fishers are entered into a computer data bank and a computer-generated map of Newfoundland and Labrador indicating these fishing positions is produced. To date, the only charts produced have been for the 1994 and 1995 fishery (Fig. 2). We are continuing with plans to produce a full retrospective set for the period 1979-95 inclusive. Currently data are available for the period 1990-95.

Research vessel surveys are conducted annually in 3 snow crab management areas in NAFO Division 3L; Northeast Avalon (6C), Bonavista Bay (5A) and Conception Bay (6B). The surveys are carried out using both commercial crab traps (in order to emulate those used in the commercial fishery), and small-meshed traps. Traps were set at randomly selected stations stratified by depth. Weather permitting, traps were hauled after a 24h soak and sampled in order to determine catch per trap, size frequency, shell condition, and proportion small-clawed (potential pre-recruits). In recent years, it has been observed that there has been a steady decline in the proportion of small-clawed crabs in all areas (Tables 2A, 2B and 2C) which may indicate a downward trend in recruitment. Also apparent is a steady increase in the proportion

of old-shelled crabs in research vessel commercial trap catches from 1992-95 (Table 3). While this phenomenon is discernable within the commercial size range for all 3 management areas surveyed, particularly Bonavista Bay, it is most apparent for those crabs in the immediate pre-recruit size range. There has been a steady increase in the percentage of old-shelled crabs in all areas since 1992. This may be a further indication of potential problems in terms of future recruitment into the commercial biomass in that many animals are entering a terminal molt phase in their life cycle. Both these phenomena will be monitored closely during future research surveys.

WP SF 96/2 Discussion - D.G. Parsons

Spatial analysis of the commercial fishery data showed an expansion of the fishing grounds in 1995 compared to 1994. Discussion revealed that this expansion was due, in part, to exploratory fishing in new areas as well as to efforts to maximise catch rates. It was suggested that areas of very low catches be mapped to aid in the interpretation of the catch per unit effort.

Review of fishery performance in each of the major fishing areas led to the general conclusion that exploitation of crab resources has been low in recent years and, although recruitment appears to be declining, catches have been maintained by the high abundance of commercial-sized animals. Much of the discussion focused on the utility of the shell condition data for making inferences about exploitation rate. It was noted that there is a high degree of subjectivity in determining shell condition and that catchability is different for the various stages. It was agreed, however, that the monitoring of shell condition should continue and a research recommendation was formulated to re-evaluate, and possibly improve, the current methods.

Assessment of Newfoundland and Labrador snow crab for 1996 - WP SF 96/3
by
E.G. Dawe et. al.

Data on catch rate, size (carapace width, CW) and molt status (chela allometry) from various sources were presented and used to infer resource status. Trap survey data from commercial grounds in each of three management areas in NAFO Div. 3L were available since the early 1980's, based on sampling with both large-meshed (commercial) traps and small-meshed traps. A model was developed for each area which uses the survey catch rate of legal-sized crabs (including 'soft' crabs) to provide an indication of the commercial catch rate in the following year. The commercial catch rates in all three areas remained high in 1995, as had been predicted from the 1994 surveys (Fig. 3 and 4). For both trap types, the 1995 survey catch rates indicated that commercial catch rates should generally remain high in Div. 3L in 1996.

The survey catch rates of two size groups of prerecruit crabs (Fig. 5 and 6) have been declining over the past 3-4 years especially for small-clawed crabs (which will continue to molt and may begin to recruit in 2-3 years). This suggests that recruitment is declining in Div. 3L. Data from Div. 3K trap surveys, in area 3B (White Bay) in 1994 and 1995 showed no clear difference between years in the catch rates of legal-sized or prerecruit crabs.

With the introduction of the Campellen trawl, data were acquired from the fall NAFO Div. 2J3KLNO bottom trawl survey for the first time in 1995. Div. 3L catch rates by size agreed with those from the 3L trap surveys in suggesting that abundance of prerecruits, relative to that of legal-sized crabs, was low in that division (Fig. 7). The trawl data also suggested that crab abundance was low in Div. 2J and 3K. Abundance of prerecruits appeared to be particularly high in virtually unexploited Div. 3N. First estimates of minimum trawlable biomass were generated using STRAP, although it was recognised that the catchability of the survey trawl for snow crab is unknown. Plots of spatial distribution showed that legal-sized crabs were not caught in deepest sets on the Div. 3KL slope or in shallow areas near the Labrador coast (Div. 2J) and on the Grand Bank (Div. 3LNO) (Fig. 8). Prerecruit and female crabs extended into shallower areas than did commercial crabs.

Data from sampling by observers aboard commercial vessels were presented for 1994 and 1995. Comparison between years was hampered by yearly differences in distribution of sampling effort by trap type among management areas. However it appeared that catch rates were lowest in Labrador and on the West Coast of the Island.

WP SF 96/3 Discussion - G. P. Ennis

Higher values for correlations between year y-1 survey catch rates from small-meshed traps and year y commercial catch rates than for survey catch rates from large-meshed traps appeared incongruous.

A possible method of estimating natural mortality from trap survey data was identified. It involved a comparison of the numbers of prerecruit, old and new-shelled pygmy crabs in one year with the number of old shelled only the next year.

The trap survey targets commercial crab grounds. This may be a factor in the low proportion of small-clawed prerecruits in recent trap surveys compared with the new trawl survey. Alternatively small-clawed (intermolt) crabs may not trap readily. They don't enter traps for a period from before the molt until they have molted and hardened to some extent.

At low levels of crab abundance yearly trends seemed similar between commercial and Prerecruit 1 crabs. This may be explained by yearly changes in catchability and the fact that these groups don't necessarily represent distinct cohorts. The increasing abundance of commercial crab may be causing the decline in prerecruits in trap surveys in recent years. An alternate interpretation suggests that commercial crab are accumulating because quota increases have not been proportional to increases in abundance and as a result exploitation rate has been declining.

The relative abundance of small-clawed crab at size fluctuates as a wave of strong recruitment moves through the population size structure whereas large-clawed crab tend to accumulate at size.

The MTB estimates from the trawl survey data were generated by STRAP. It was suggested that another method incorporating spatial analysis should be investigated.

Direct estimates of trap selectivity from crab tagging experiments - WP SF 96/1
by
N.J. Barrowman et. al.

Direct estimates of trap selectivity are obtained from crab tagging experiments conducted from 1979-1982 in Bonavista Bay, off the Avalon peninsula, and in Notre Dame Bay. Numbers of crabs tagged and recaptured in the same year are tabulated by grouping carapace widths (cw) into 5 mm groups from 95 mm to 129 mm (Table 4). For all three areas, the selectivity appears to increase monotonically from 97 to 112 mm cw (Fig. 9-14). For Bonavista Bay, the selectivity curve appears dome-shaped with the peak at 112 mm cw while for the Avalon, the curve continues to increase up to 127 mm cw. Results for Notre Dame Bay are inconclusive because there is only one year of tagging.

WP SF 96/1 Discussion - J. Morgan

There was some question as to the consistency of the patterns across years and areas. However, this was only a preliminary look at the data and further analyses should investigate this question. Selectivity as determined here should not be dependent on effort but rather changes in effort should have only a scaling effect on the selectivity curves. Different molting rates over the different size classes used in the model is a potential problem but in the analyses presented the fishing was completed before molting began so that there should have been no bias introduced by this.

ICELAND SCALLOPS

4R Strait of Belle Isle

Views of Fishermen
by
K.S. Naidu

Views of fishermen as reported in the media are concordant with our assessment of scallop and corroborated by a number of active fishermen during consultations (April 26, 1996) to address management issues for the 1996 fishery. Scallop fishermen are worried about the scallop stock in the Strait of Belle Isle. They have been forced to go further than ever for

catches that are significantly smaller than in the past. As a result of this scarcity, the number of active vessels has dropped by more than half. Even then, many participants were not reaching the 1000 lb weekly limit. One processor said "The fishermen are worried about the stocks and so am I. Last year you could go out almost anywhere and get scallops. It looks like there have been too many boats fishing for too few scallops."

Abundance of Iceland scallops in NAFO Div. 4R (Strait of Belle Isle) declines further in 1995 - WP SF 96/4

by

K.S. Naidu et. al.

From its inception the Strait of Belle Isle Iceland scallop fishery has been characterised by four strong peaks in landings (1972-73, 1980-81, 1984-86 and 1992 to present). In the past, each pulse was followed by several consecutive years of poor catches. Nearly one quarter (5,383 t round or 24%) of all removals (22,581 t) from this fishery came from the past three years (1993-95). Nominal catch in each of the last four years has exceeded the overall 27-year average of 836 t. In 1993 and 1994, removals were well over twice the annual mean.

Using a better estimate of landings per unit effort (lb/tow) we now estimate a further 32% decline in 1995 from the 30% reduction already noted for between 1993 and 1994.

A research vessel survey in 1995, the first in eight years, showed that catch rates were low throughout. The stock now appears to be mostly composed of pockets of residual cohorts consisting primarily of large scallops. Scarcity of juveniles throughout the area (847 mi^2) surveyed suggests that prospects for significant and extensive recruitment events in the short to medium term are poor.

Six scallop aggregations were identified. Cumulative minimum dredgeable biomass within these patches is estimated to be between 2000-2800 t (x=2,400 t). However, scallop densities are low throughout. The stock has probably reached a level of abundance so low as to now require a rebuilding strategy.

WP SF 96/4 Discussion - J. Morgan

Peaks and troughs in landings and CPUE time series are very similar. These patterns are likely the result of a combination of availability of scallops as well as markets for scallops and opportunities to fish other species.

There are difficulties with ageing scallops and so year classes can not be readily identified. However, the almost complete lack of very small scallops in the area would indicate that recruitment is very low. There does not appear to be much of a stock/recruit relationship for scallops or any other molluscan species.

The use of ROXANN during the survey appeared to improve the estimate of biomass substantially. The heterogeneity of the bottom caused some difficulty in identifying 'scallop bottom' but the combination of ROXANN information as well as dredge catch rates to post stratify the area seemed to be a success.

Grand Banks

Views of Fishermen

by

K.S. Naidu

During industry consultations (June 20, 1996), a couple of fishermen and one processor indicated that DFO may have overestimated declines in CPUE in the Lilly Canyon and Carson Canyon area and that it can withstand a TAC in excess of the 1995 TAC of 3,000 t round. Criticism was levied against our drawing conclusions on the proportions of large meats to smaller ones based on relatively small sample sizes. We explained the difference between industry standard based on a blended count versus our estimation based on the weights of individual meats.

We have taken up an offer from one processor to assist us in improving sample sizes to better reflect composition of meat weights.

The burgeoning fishery for Iceland scallops on the Grand Banks of Newfoundland- WP SF 96/8

by

K.S. Naidu, F.M. Cahill, E.M. Seward, and P.J. Veitch

The directed fishery for Iceland scallops on the Grand Banks of Newfoundland is relatively recent (1993) and driven largely by the lack of opportunities in the groundfish sector. The high economic return from the scallop fishery has quickly resulted in a disproportionately large shift in fishing effort into this sector. In just three years total catch from the Grand Banks of Newfoundland has surpassed 11,000 t round. Over half (55.5%) of this was taken in 1995. The majority (93%) of removals during the period was from NAFO Div. 3N, particularly from the highly productive grounds near the Lilly Canyon and Carson Canyon. Scallops here tend to be larger than elsewhere on the bank and consequently attract most of the effort. Overall mean daily catch/tow had declined in 1994; a similar decline is not evident in 1995. The proportion in the catch of small meats to large ones from the Canyons continues to increase. Much of the remaining removals came from aggregations trending northeast just outside of the box but within Div. 3N.

Only sporadic effort was directed outside (77 days) of these two areas resulting in a further removal of 170 t (or 3% of 1995 total).

WP SF 96/7 Discussion - G. P. Ennis

The 1995 survey to the north of the Lilly/Carson Canyons, where the Grand Bank scallop fishery has been concentrated so far, identified two major scallop beds whose distribution overlaps the NAFO Divisions 3L/3N boundary. It was felt that this should not preclude managing this area of high scallop concentration as a unit.

The starfish predation problem that has developed on St. Pierre Bank may have been triggered by the fishery in that the initial increase in starfish abundance may have been associated with non-catch mortality. A similar problem may also arise on the Grand Banks. It is not known how the practice on the Grand Banks of shucking at sea, in contrast to on-shore in the St. Pierre Bank fishery, will affect proliferation of their numbers in this area. Efforts should be made to monitor starfish abundance in the area.

NORTHERN SHRIMP

Views of Fishermen
by
D.G. Parsons

Meetings with industry, through the Northern Shrimp Advisory Committee (Jan. 26/96), and informal and opportunistic discussions with vessel captains and fisheries observers during the fishing season revealed that no problems had been encountered regarding resource availability in any of the northern shrimp management areas.

Regional, interim review of the status of northern shrimp (*Pandalus borealis*) resources in areas off Newfoundland and Labrador (Divisions 0B to 3K) - WP SF 96/5
by
D.G. Parsons and P.J. Veitch

Data from the commercial fishery for northern shrimp were presented for four assessment/management areas: Division 0B, Division 2G, Hopedale + Cartwright Channels and Hawke Channel + Division 3K. Within each area, fishing pattern, catch, effort, catch per unit effort and size/sex composition were reviewed to infer the status of the resource. For Hawke Channel + 3K, results of the 1995/96 multispecies survey pertaining to shrimp also were presented.

With the exception of Division 0B, where the status remains uncertain, the shrimp fisheries performed well in 1995 with catch rates as high as or higher than observed since the fisheries began. Large, female shrimp were well-represented in catches from all areas, indicating a healthy spawning biomass, and high catch rates of smaller, male shrimp indicate good recruitment to the fishery in the short term. Significant catches of *Pandalus montagui* were reported from Division 2G and, more frequently, from Division 0B.

Based on the favourable review of the 1995 fishery data in comparison to previous years and the extensive area of shrimp abundance evident in the research survey, it was concluded that no decreases in TAC's were required in 1996, the third year of the 1994 - 1996 northern shrimp Management Plan.

WP SF 96/5 Discussion - E. Dawe

Commercial CPUE increased or remained high in 1995 in all areas, suggesting continued high abundance. However a need for fishery-independent abundance data was apparent. CPUE levels reflect the degree of success of the fleet in locating exploitable concentrations of large shrimp, and so they may not reliably reflect abundance. This is particularly true for Area 0B. Other developments have affected fishing patterns, and CPUE, in recent years. *Pandalus montagui* was prevalent in northern areas in 1995 and the fishery in Area 2G avoided shallow-water areas so as to minimize bycatch of this less desirable species. The observed decline in prevalance of males from observer samples in that area may be an artefact related to this fishing pattern. The change of fishing season from summer-autumn to year-round in recent years has resulted in shifting much of the fishing effort toward the slope to avoid ice.

A first estimate of shrimp biomass for Hawke Channel and Div. 3K was generated by applying the STRAP analysis to data from the 1995 fall bottom trawl survey. The resultant large shrimp biomass estimate suggested that exploitation rate was quite low in this area. It was noted that females, approximating the exploitable biomass, comprised about 44% of the total. Suggestions for future analyses included estimating the exploited biomass by selecting only those strata commercially fished. The harvestable biomass may be estimated if data could be selected for those stations where the minimum catch per tow exceeded some minimum level deemed to be commercially viable. It was also noted that STRAP may not be the most appropriate analysis for shrimp and STRAP estimates should be compared with results from other analyses.

Acoustics studies on shrimp - WP SF 96/6
by
D. Miller

Acoustic data were collected on shrimp concentrations during a trip on the TELEOST from Feb. 6-16, 1996. Data were collected at 38 kHz using the stern deployed deep towing body with the transducer at a depth of about 200 m. Figures 15 to 18 show ehcograms with a clearly defined scattering layer in the near bottom zone at a range of 45 to 130 m. Catches from Campelen trawl sets made in the same area were 94-99% *Pandalus borealis* which indicated a relatively species pure scattering layer.

Acoustic signals from the scattering layer were low in amplitude and near the threshold setting (50 millivolt) of the data acquisition system. If signals from low density concentrations

or single targets are below threshold, this will negatively bias estimates of biomass by acoustic echo integration. In addition, target strength data collected at 40 log R at the same time gave target strengths of approximately -56 dB which is greater than expected values in the -60 to -65 dB range (George Rose, pers. com.). The higher than expected target strength values may also have resulted from smaller targets being excluded due to the problem of thresholding.

Further studies are required to determine the extent of the threshold problem for both target strength determination and biomass estimation by echo integration.

WP SF 96/6 Discussion - J. Morgan

It was agreed that the acoustic work shows promise and should be pursued further. The ability to distinguish shrimp from other species needs more work before this becomes a routine tool. There may be problems with detecting shrimp when densities are low and as with other animals, when the shrimp are close to the bottom. There should be better separation from the bottom at night and one approach could be to use acoustics at night to define strata in an area and then use an optimal allocation scheme to fish these areas during the day to produce the actual biomass estimates. Another approach would be determine the proportion of shrimp in the signal through trawling and apply this to the biomass estimate from the acoustics. If the acoustic signal of shrimp can be better defined this tool may be particularly useful in areas that are thought to be shrimp habitat but which are untrawlable.

The fishery for *Pandalus montagui* in the Hudson Strait/Ungava Bay area. - WP SF 96/7
by
D.G. Parsons, P.J. Veitch and D.W. Kulka

The occurrence of *Pandalus montagui* in the shrimp catches from Division 0B in 1995 required a review of the fishery for this species in the Hudson Strait - Ungava Bay area. Historically, the fishery occurred within shrimp fishing area three (SFA 3), primarily west of Resolution Island. In 1995, large catches were taken in Division 0B (SFA 2), close to the island, where the TAC applied only to *P. borealis*. The data indicated that the resource fished in 1995 was the same as previously fished within the SFA 3 boundary and that a change would be required to the Management Plan in 1996 to insure control over the level of harvest. This can be accomplished by setting a TAC for *P. montagui* in SFA's 2, 3 and 4, west of 63^0 W. There was no basis to advise a change in the TAC of 1200 tons previously set for this species in SFA 3.

WP SF 96/7 Discussion - J. Morgan

It was agreed that the information for this species was insufficient for a stock status report or update but that the working paper should be upgraded to a research document. It was recommended that the Regional Director of Science should communicate the working paper and conclusions for *P. montagui* to Fisheries Management.

Progress on Recommendations from 1995

Shrimp

1. A priori decision making rules should be established for determining changes in abundance from the set of indices used in the assessment.

It has been decided to explore a Bayesian decision making approach but no work has been started on this method yet. Work on this is expected before the 1997 assessment.

2. Fishery independent indices of abundance must be developed. In future 'multispecies groundfish' surveys should be modified to collect useful information on shrimp. This should now be possible with the introduction of the Campelen 1800 shrimp trawl as the standard survey gear. However, surveys would have to be extended into NAFO Div. 2GH, at least on a biennial basis.

Data were collected on shrimp in the fall surveys. These data were considered to be extremely valuable, however, much of the shrimp distribution is not covered during the annual fall survey. A survey to 2GH is planned for 96/97 and shrimp data will be collected on that trip.

3. The feasibility of involving industry in a program to provide standardized CPUE data in specific areas should be explored.

This was pursued with industry. W. Warren began looking into a survey design using the commercial fleet in a standardized CPUE / survey by industry. However, industry interest declined with the introduction of user fees by government.

4. There should be a working group to explore the relationships between shrimp CPUE and groundfish biomass and between shrimp CPUE and temperature. This should be part of the work undertaken by the working group recommended in the Assessment Environment Ecosystem meeting.

This working group has not been established but has been once again recommended by the Assessment Environment Ecosystem committee.

5. The consistency of length frequency trends from the commercial fishery, cod stomach information and previous shrimp RV surveys should be examined to determine if they all show the same trends in year class strength.

No progress.

6. The annual consumption of shrimp by cod should be estimated. This should also be examined in light of the timing of the apparent increase in shrimp abundance.

Progress has been made on the analytical techniques but they have not yet been applied to the consumption of shrimp.

Crab

7. The amount of time devoted to the processing of vessel logbooks in the shellfish section is unmanageable. Subsampling of the logbooks should be explored. However, this work should not be the responsibility of Science Branch in the first place. Logbook information including latitude and longitude for each haul of pots, effort, soak time, landings, discards by weight and type should be provided by Statistics in a computerised format.

Most of the log book data has now been punched within the Shellfish section under contract. No progress has been made on an appropriate design for subsampling the logbooks. The adoption of a simpler log is being explored with Statistics.

8. The commercial CPUE data should be examined in additional ways. The CPUE should be standardized either using a multiplicative model with month as an effect and/or by using the CPUE only from the beginning or end of the fishing season. Standardisation needs to be done over the entire time series. This requires computerisation of the data both current and historical (see recommendation 13).

Some work was done to look at early season records separately. However, completion of this recommendation awaits the completion of the computerisation of the historic log book information.

9. Relationships between survey CPUE and commercial CPUE need to be explored further. The data from large mesh pots in the survey should be examined relative to the commercial CPUE. Also, the relationship between the prerecruit index + commercial CPUE in year y+1 and commercial CPUE in year y+2 must be explored further combining the two indices in different ways (prerecruit as CPUE from survey, legal catch converted to weight) and determining whether the addition of the prerecruit information in fact adds anything to the model of commercial CPUE in year y+1 alone.

This recommendation was completed and the information presented at the assessment meeting.

10. The optimum sampling design for combining large and small mesh pots in the RV surveys should be examined.

No progress.

11. The survey area should be re-examined given that prerecruit habitat may not be adequately covered.

The survey area has not been re-examined but prerecruits will now be better sampled with the introduction of the Campelen 1800 shrimp trawl for use during the fall survey and with plans to survey the four inshore regions with a shrimp trawl as well as with pots.

12. In future 'multispecies groundfish' surveys should be modified to collect useful information on crab. This should now be possible with the introduction of the Campelen 1800 shrimp trawl as the standard survey gear.

Data was collected from the fall 2J3KLNO trawl survey for 1995. Considerable data from this survey was presented at the assessment meeting and analyses will continue. The information from this source was considered to be very valuable.

13. The historical vessel log book data should be examined. To do this the data must be computerised. This will probably require an outside contract to collate and enter the data because of the amount of work.

A contract was let and much (1990-95) of the log book data has been punched.

14. Shell condition data from the RV surveys should be examined. This may give an indication of the relative exploitation rate.

Information on shell condition was presented. The percentage of old shell crabs seems to be increasing.

15. The feasibility of developing estimates of exploitation rate through the use of catchability coefficients should continue to be explored.

This is dependent upon completion of the computerization of the data from the historical logbook data base.

16. A means of including the prerecruit estimates in predictions for the upcoming fishery in an appropriate functional way should be examined.

Time lags of correlations between prerecruit estimates and fishery performance were conducted but did not indicate an appropriate time frame for recruitment to the fishery.

Scallops

17. Surveys should continue so that a time series of fishery independent estimates of abundance can be developed. The surveys would have to be on the TELEOST because of the fishing gear used.

A survey was conducted in 4R for the first time in 8 years. A new dredge had to be constructed in order to allow the survey to be conducted on the WILFRED TEMPLEMAN.

18. Areas of 'commercial abundance' (20 Kg or greater) should be calculated accounting for the weight of fouling organisms on the scallops.

There was little fishery in the area where fouling is the greatest and so this was not incorporated this year but will be accounted for as necessary in the future.

Research Recommendations for 1996

Crab

1. Shell condition of crabs should continue to be monitored. The proportion of old shells among the prerecruits may be useful in developing an estimate of natural mortality while the proportion of old shell crab among the commercial sized individuals gives an indication of the rate of exploitation and the age of the standing stock. Along with the continued monitoring of shell condition the requirement for a more detailed staging system should be investigated.

2. With much of CPUE data now computerised, catch rates in specific areas such as historic fishing grounds, as well as specific fleet sectors, should be more closely examined. This may make the interpretation of CPUE in a rapidly changing fishery more meaningful.

3. Further spatial analyses of abundance, distribution by carapace width, claw size etc. from the RV bottom trawl surveys should be attempted.

4. There is still a requirement for the development of an optimum sampling design for combining large and small mesh pots in the RV trap surveys. A formal request for work in this area should be made to the CODE.

5. The appropriate level of subsampling of log book data should be determined. A formal request for work in this area should be made to the CODE.

6 Although great strides have been made in computerising the log book information this has not been completed. The remainder of the historical log books as well as all future log book information should be computerised.

7. The selectivity of the Campelen bottom trawl for small crabs should be investigated, perhaps by comparing the catch of the Campelen with the catch from a Nephrops trawl. Any experiments on this subject should be discussed first with the gear technologist.

8. The synchrony between year classes in different areas in Atlantic Canada should be examined as well as any possible relationship between year class strength and environmental factors.

Scallops

9. A formal request should be made to Statistics Branch to apply species specific conversion factors from meat weight to round weight for scallops. For Iceland scallops the proper conversion factor is 9.2 and for sea scallops it is 8.3. Statistics Branch currently uses the 8.3 conversion factor for Iceland scallops which results in an under estimation of the total catch.

10. There is no in house expertise in ROXANN, all the analyses to date has been done under contract or by term employees. Such in house expertise should be developed.

11. During research surveys and as part of fishery monitoring, data necessary to detect changes in starfish abundance in the main scallop fishing areas on the Grand Banks should be collected.

Shrimp

12. The current CPUE model should be investigated with respect to the weighting of the catch rate by area to ensure that areal weightings are incorporated.

13. Biomass estimates from the fall RV surveys should be produced in a number of ways, for example, including only areas that are commercially fished or only including areas with catch/tow equal to or greater than the minimum viable commercial catch rate.

14. The trawl acoustics committee should review the use of acoustics for shrimp assessments. They should specifically examine:

a) The need for dedicated vessel time in the spring of 1997 to examine in situ target strength. This will require the ability to collect acoustic data and conduct fishing.

b) The use of both 120kHz and 38kHz acoustic systems on the TELEOST stern deployed towed body at the same time.

c) Review and determine the status of the proposal submitted to the ADM priority funding to look at the identification of and optimisation of shrimp acoustic signals to better distinguish shrimp from other targets.

Working Papers Available to the Meeting

WP SF 96/1 Barrowman, N.J., J.M. Hoenig, D. Taylor, and R.A. Myers. Direct estimates of trap selectivity from crab tagging experiments. 8 pp.

WP SF 96/2 Taylor, D.M. and P.G. O'Keefe. Summary of performance of the 1995 Newfoundland and Labrador snow crab fishery. 50 pp.

WP SF 96/3 Dawe, E.G., D.M. Taylor, P.J. Veitch, H.J. Drew, P.C. Beck, and P.G. O'Keefe. Assessment of Newfoundland and Labrador snow crab for 1996. 35 pp.

WP SF 96/4 Naidu, K.S., F.M. Cahill, and E.M. Seward. Abundance of Iceland scallops in NAFO Div. 4R (Strait of Belle Isle) declines further in 1995. 36 pp.

WP SF 96/5 Parsons, D.G. and P.J. Veitch. Regional, interim review of the status of northern shrimp (*Pandalus borealis*) resources in areas off Newfoundland and Labrador (Divisions 0B to 3K). 19 pp.

WP SF 96/6 Miller, D Acoustic studies on shrimp. 3 pp.

WP SF 96/7 Parsons, D.G., P.J. Veitch, and D.W. Kulka. The fishery for *Pandalus montagui* in the Hudson Strait/Ungava Bay area. 6 pp.

WP SF 96/8 Naidu, K.S., F.M. Cahill, E.M. Seward, and P.J. Veitch. The burgeoning fishery for Iceland scallops on the Grand Banks of Newfoundland. 32 pp.

List of Participants

Name	Affiliation
Barrowman, Nick	CODE
Beck, Paul	Shellfish Section
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Coady, Larry	Regional Director, Science
Conan, Gerard	Shellfish Section
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Naidu, Sam	Shellfish Section
Parsons, Don	Shellfish Section
Perry, Geoff	Experimental Sciences
Sainte-Marie, Bernard	Laurentian Region
Seward, Elaine	Shellfish Section
Taylor, Dave	Shellfish Section
Veitch, Pat	Shellfish Section
Winters, George	Pelagics, Salmonids and Shellfish Division

Table 1: Summary by management area of the comparison of 1994/95 snow crab fishery data. Numbers represent the percentage change. Asterisks indicate areas where additional comments are necessary.

Area	Landings	Effort	CPUE	Acceptability of comparison	*Comments*
2J					
North	-21	-15	-7	poor	*
South	-4	+32	-27	fair	*
3K					
3A	+21	+73	-30	fair	*
3B	-14	+5	+5	excellent	
3C	+13	+9	+3	excellent	
3D	+21	+52	-21	good	
4	+3	+16	-14	good	
3Kb	-15	-15	0.00	excellent	
3Kc	+6	+13	-6	excellent	
3Kg	+46	+26	+16	good	
3L					
5A	-29	-23	-8	good	
5B	+31	-38	+11	fair	
5Bx	-15	-57	+96	poor	*
6A	+19	-9	+30	excellent	
6B	+24	+11	+12	excellent	
6C	+5	+9	-8	good	
7A	-1	+4	-4	good	
7B	+6	+9	-3	good	
7C	+15	-7	+23	good	
8	-31	-45	+11	fair	*
9	-14	+27	-10	excellent	
3Ps					
10	-22	-23	+2	fair	
10x	+108	+215	-10	fair	
11	-7	+117	-62	poor	

This table was constructed from fishery performance information collated from vessel logbooks in each of the management areas. The comparisons made based on CPUE may not accurately reflect abundance. Areas in the "Comments"column designated with an asterix are areas where direct comparison between two years is not straightforward and where additional discussion is provided on subsequent pages.

Key to categories describing acceptability of comparison:

Poor - Areas in which radical changes in fishing areas or severe misreporting affect the reliability of log data either for the current year under review or during the previous year.

Fair - Areas where fishing grounds and fishing fleet are relatively constant but minor misreporting of effort or changes in quota allocations negatively affect the reliability of the data.

Good - Areas between fishing seasons remain constant with little change in quota between years. Reliability of logbook data is high.

Excellent - Areas between fishing seasons remain constant with little change in quota between years. Reliability of logbooks is of an extremely high calibre.

Table 2A. Summary of data from snow crab morphometric measurements (chelae height versus carapace width) obtained during time-series research surveys in Northeast Avalon using 1" meshed Japanese conical traps.

		Small clawed		Large clawed	
Year	No. measured	No.	%	No.	%
1989	805	81	10.1	724	89.9
1990	1342	636	47.4	706	52.6
1991	1036	377	36.4	659	63.6
1992	1094	316	28.9	778	71.1
1993	281	57	20.3	224	79.7
1994	2659	260	9.8	2399	90.2
1995	2244	199	8.9	2045	91.1

Table 2B. Bonavista Bay.

		Small clawed		Large clawed	
Year	No. measured	No.	%	No.	%
1989	1408	466	33.1	942	66.9
1990	1077	508	47.2	569	52.8
1991	1553	636	41.0	917	59.0
1992	748	191	25.5	557	74.5
1993	857	103	12.0	754	88.0
1994	4116	257	6.2	3859	93.8
1995	2462	135	5.5	2327	94.5

Table 2C. Conception Bay.

		Small clawed		Large clawed	
Year	No. measured	No.	%	No.	%
1991	2094	517	24.7	1577	75.3
1992	630	178	28.3	452	71.7
1993	602	42	7.0	560	93.0
1994	3703	320	8.6	3383	91.4
1995	2909	58	2.0	2851	98.0

Table 3. . Summary of the proportion (%) of old-shelled male crabs by size group caught in commercial crab traps during 3L research surveys 1992-95.

	Northeast Avalon			
Size group	1992	1993	1994	1995
Immediate prerecruits (75-94 mm CW)	4.8	6.3	13.5	24.4
Legal size (≥95 mm CW)	1.9	1.7	2.1	6.6

	Bonavista Bay			
Size group	1992	1993	1994	1995
Immediate prerecruits (75-94 mm CW)	6.1	21.7	40.0	47.0
Legal size (≥95 mm CW)	3.9	7.1	11.9	14.0

	Conception Bay			
Size group	1992	1993	1994	1995
Immediate prerecruits (75-94 mm CW)	22.7	28.0	30.1	67.8
Legal size (≥95 mm CW)	1.5	0.9	2.8	15.4

TABLE 4. Numbers of crabs tagged and recaptured in the same year in Bonavista Bay, off the Avalon peninsula, and in Notre Dame Bay from 1979 – 1982. Data for sizes above 129 mm are not used in the graphs or analyses because the sample sizes are small.

	Carapace width class	Bonavista Bay		Avalon		Notre Dame Bay	
Year	(mm)	Tagged	Recap	Tagged	Recap	Tagged	Recap
1979	95 – 99	543	249	1189	282		
	100 – 104	594	311	758	221		
	105 – 109	582	326	503	156		
	110 – 114	539	305	354	119		
	115 – 119	469	250	180	47		
	120 – 124	156	75	41	11		
	125 – 129	42	14	6	2		
	130 – 134	3	2	1	0		
1980	95 – 99	586	229	449	200		
	100 – 104	670	275	557	264		
	105 – 109	611	295	429	224		
	110 – 114	460	255	301	152		
	115 – 119	375	200	140	68		
	120 – 124	175	88	45	20		
	125 – 129	88	48	8	4		
	130 – 134	19	7	1	0		
1981	95 – 99	478	100	524	275		
	100 – 104	332	102	589	338		
	105 – 109	318	113	501	297		
	110 – 114	320	126	444	292		
	115 – 119	225	75	230	156		
	120 – 124	120	38	94	67		
	125 – 129	31	5	28	18		
	130 – 134	9	3	4	3		
1982	95 – 99	514	70	703	223	196	58
	100 – 104	367	108	647	255	237	86
	105 – 109	377	122	519	227	264	95
	110 – 114	339	138	448	227	260	106
	115 – 119	288	125	255	133	223	79
	120 – 124	162	72	99	51	149	61
	125 – 129	64	26	34	19	117	46
	130 – 134	19	6	2	2	41	13

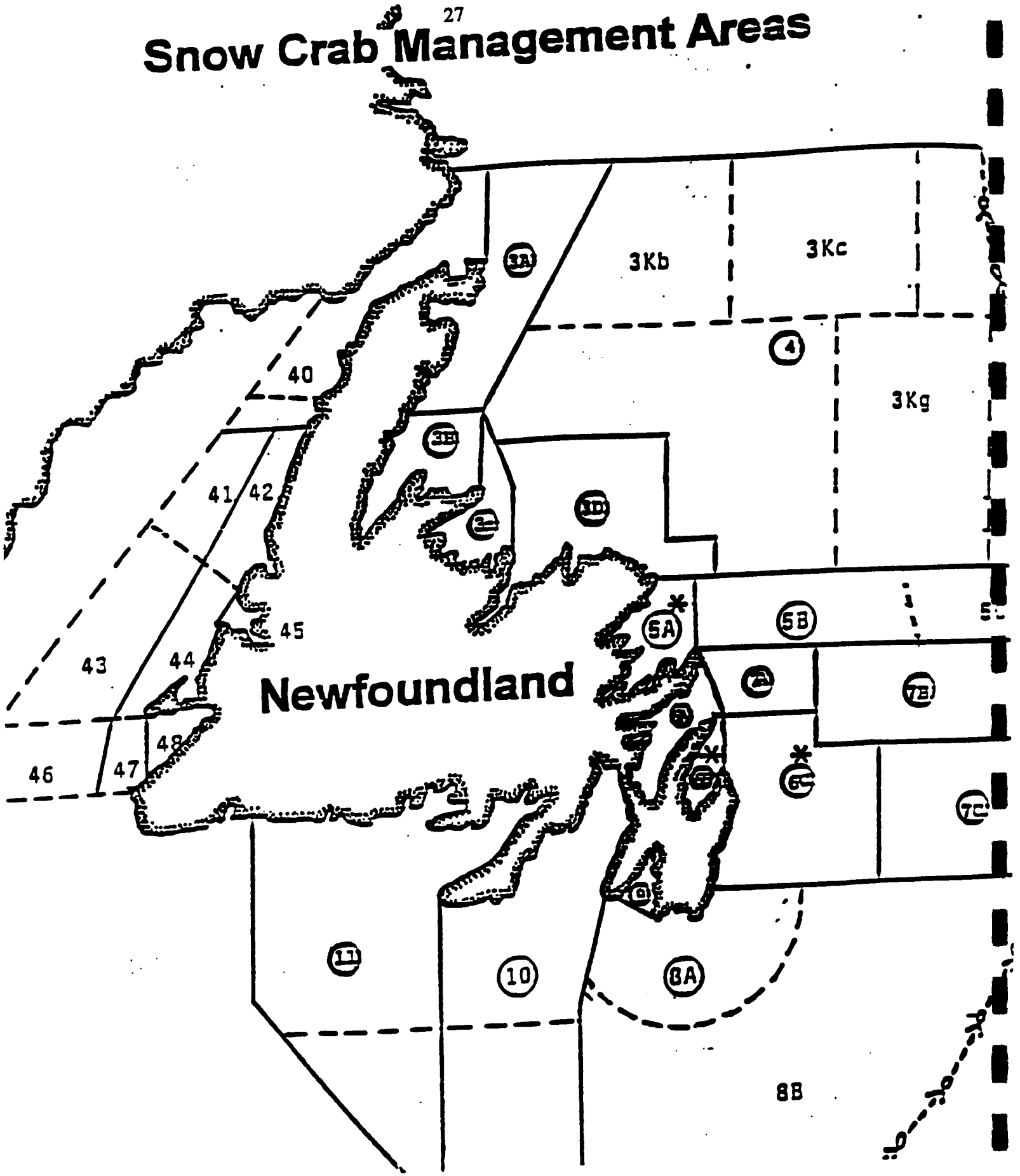

Figure 1. Snow crab management areas: those marked by an asterisk represent the survey areas Bonavista Bay (5A), Conception Bay (6B) and Northeast Avalon (6C).

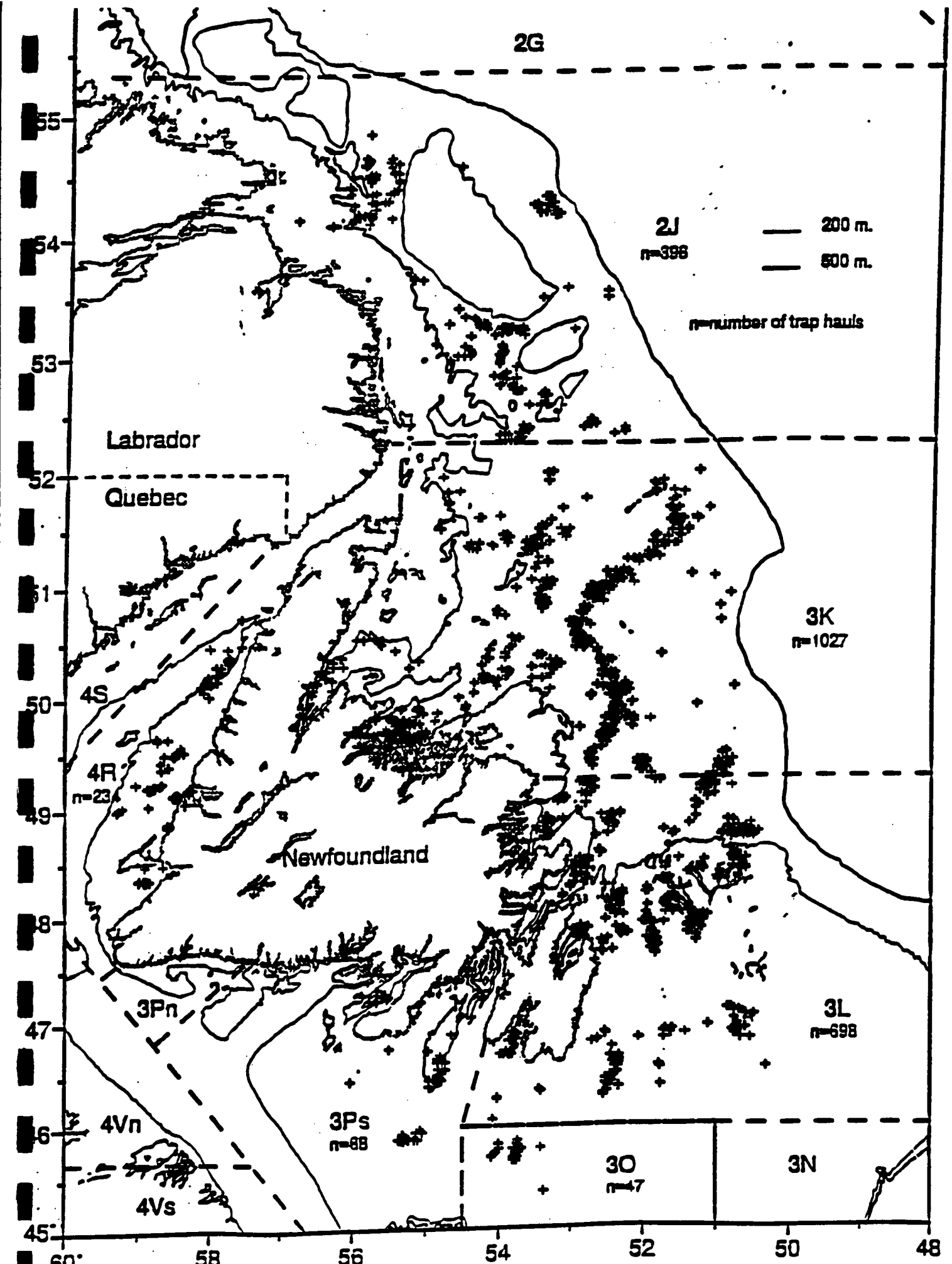

Figure 2a. 1994 Newfoundland and Labrador snow crab fishing positions as reported in logbook entries.

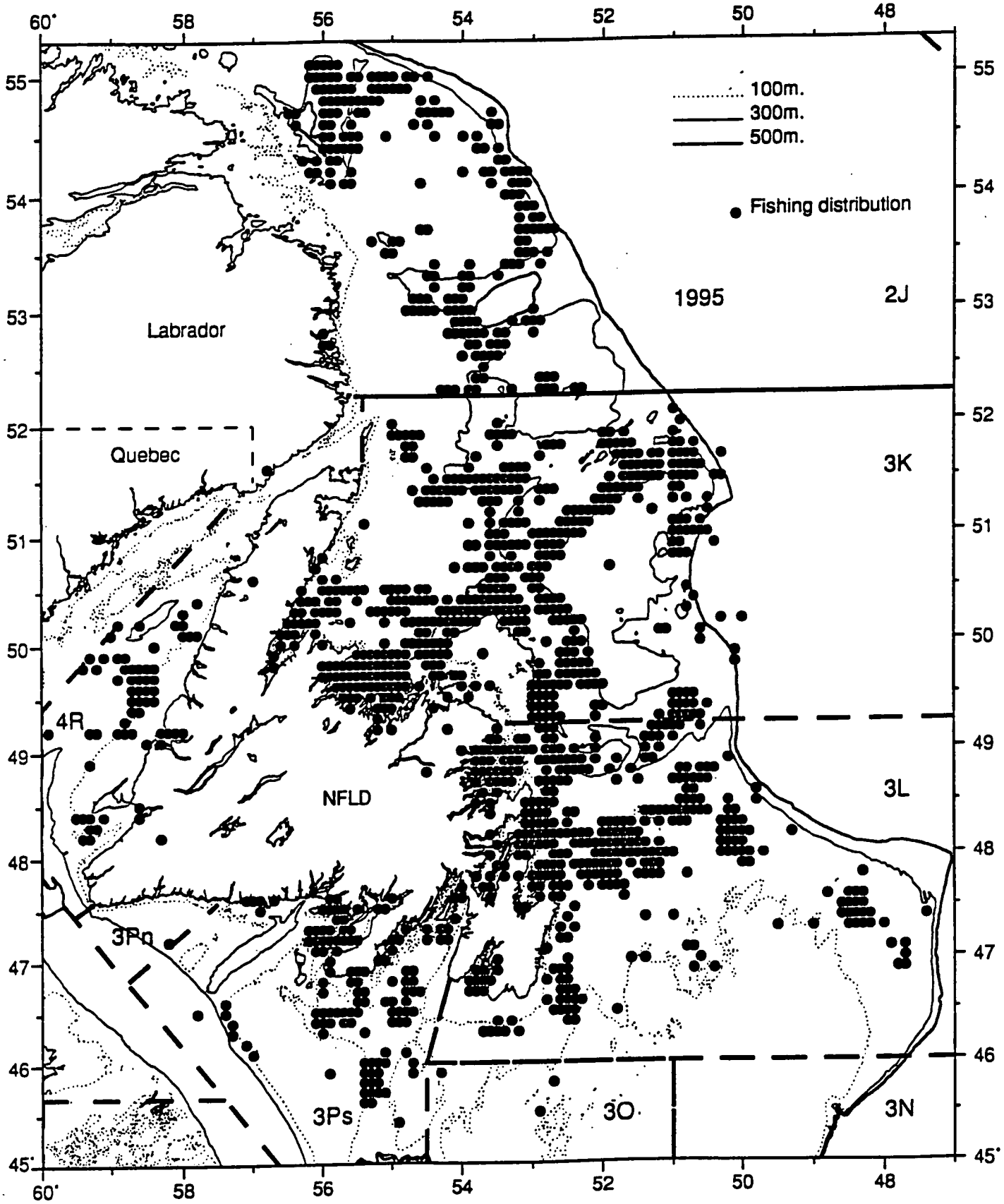

Figure 2b. 1995 Newfoundland and Labrador snow crab fishing positions as reported in logbook entries.

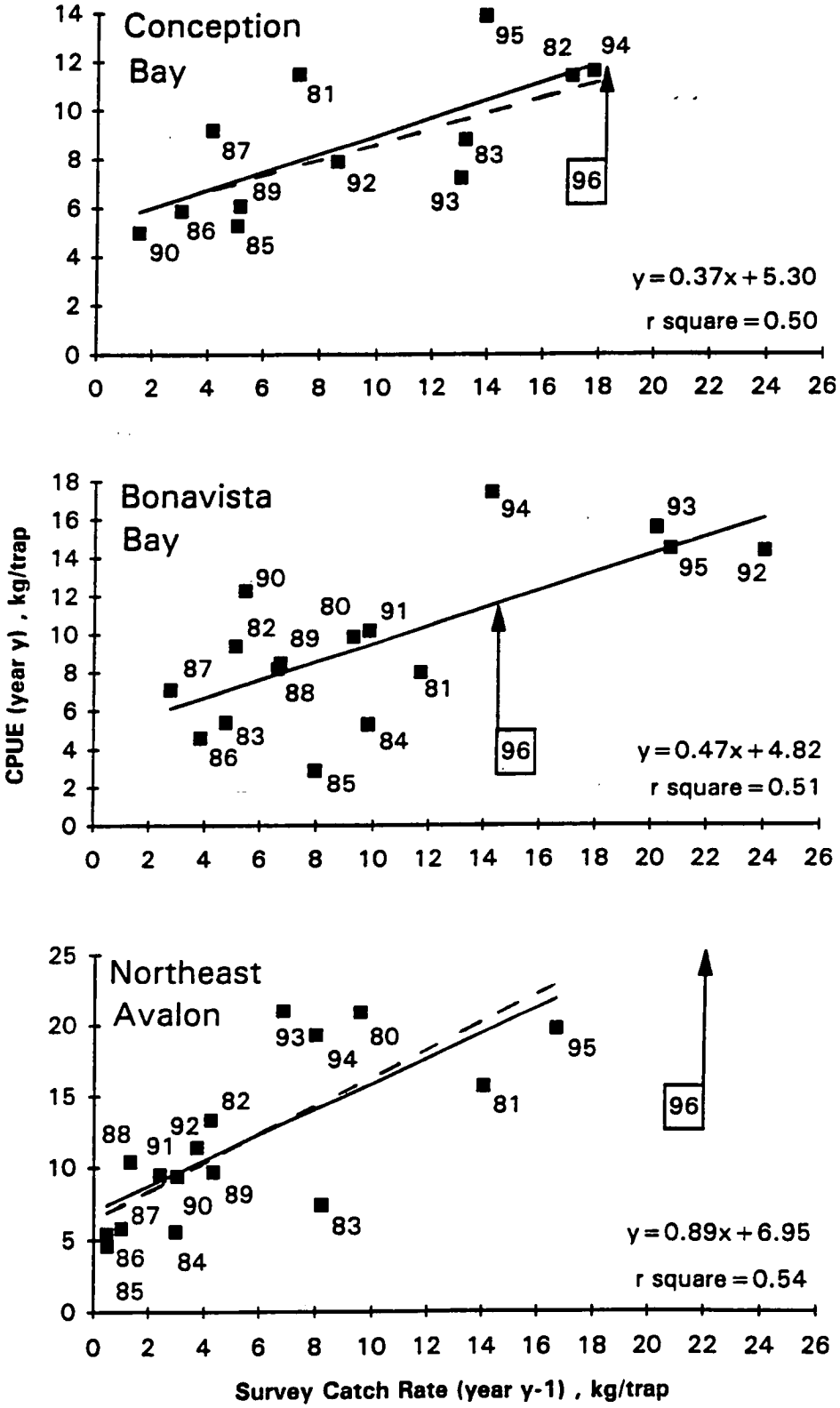

Figure 3. Relationship of commercial CPUE in any year to the survey catch rate of legal-sized crabs from large-meshed traps in the previous year, by survey area. Dashed lines represent regressions which did not include 1995 data. Arrows show projected CPUE's for 1996.

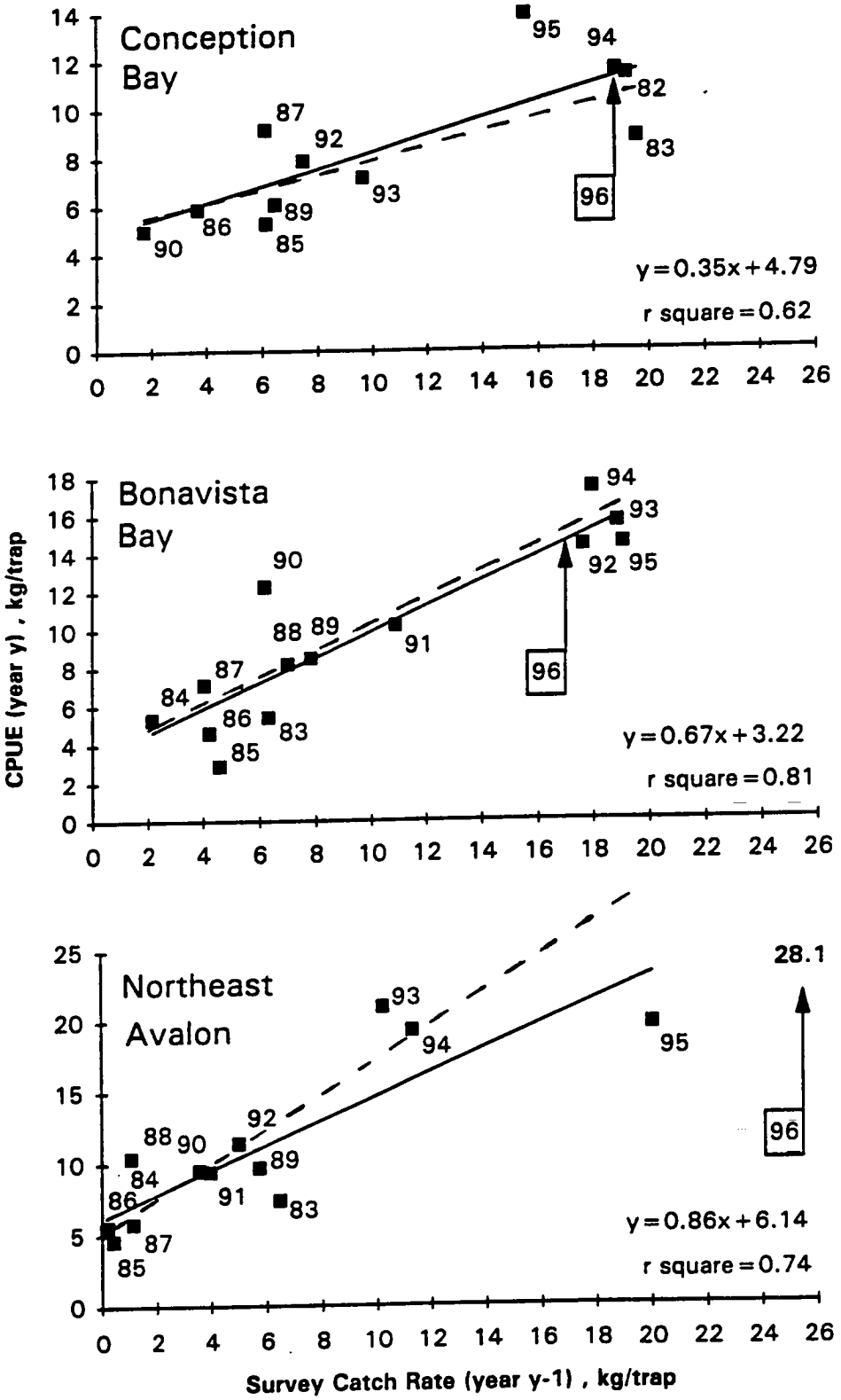

Figure 4. Relationship of commercial CPUE in any year to the survey catch rate of legal-sized crabs from small-meshed traps in the previous year, by survey area. Dashed lines represent regressions which did not include 1995 data. Arrows show projected CPUE's for 1996.

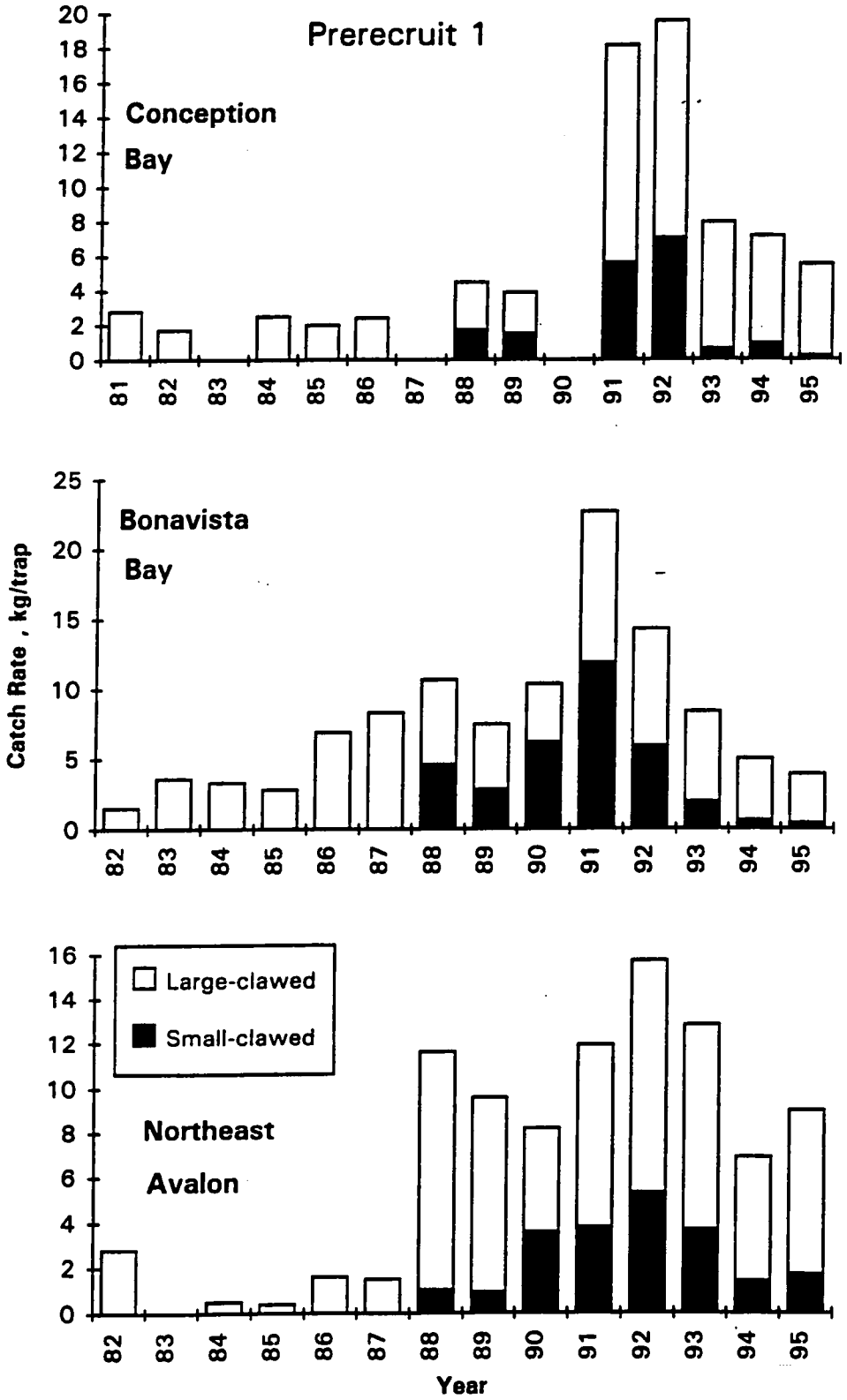

Figure 5. Yearly trends in survey catch rate of Prerecruit 1 crabs (76-94 mm CW) from small-meshed traps, by survey area. Catch rates are partitioned by chela allometry since 1988.

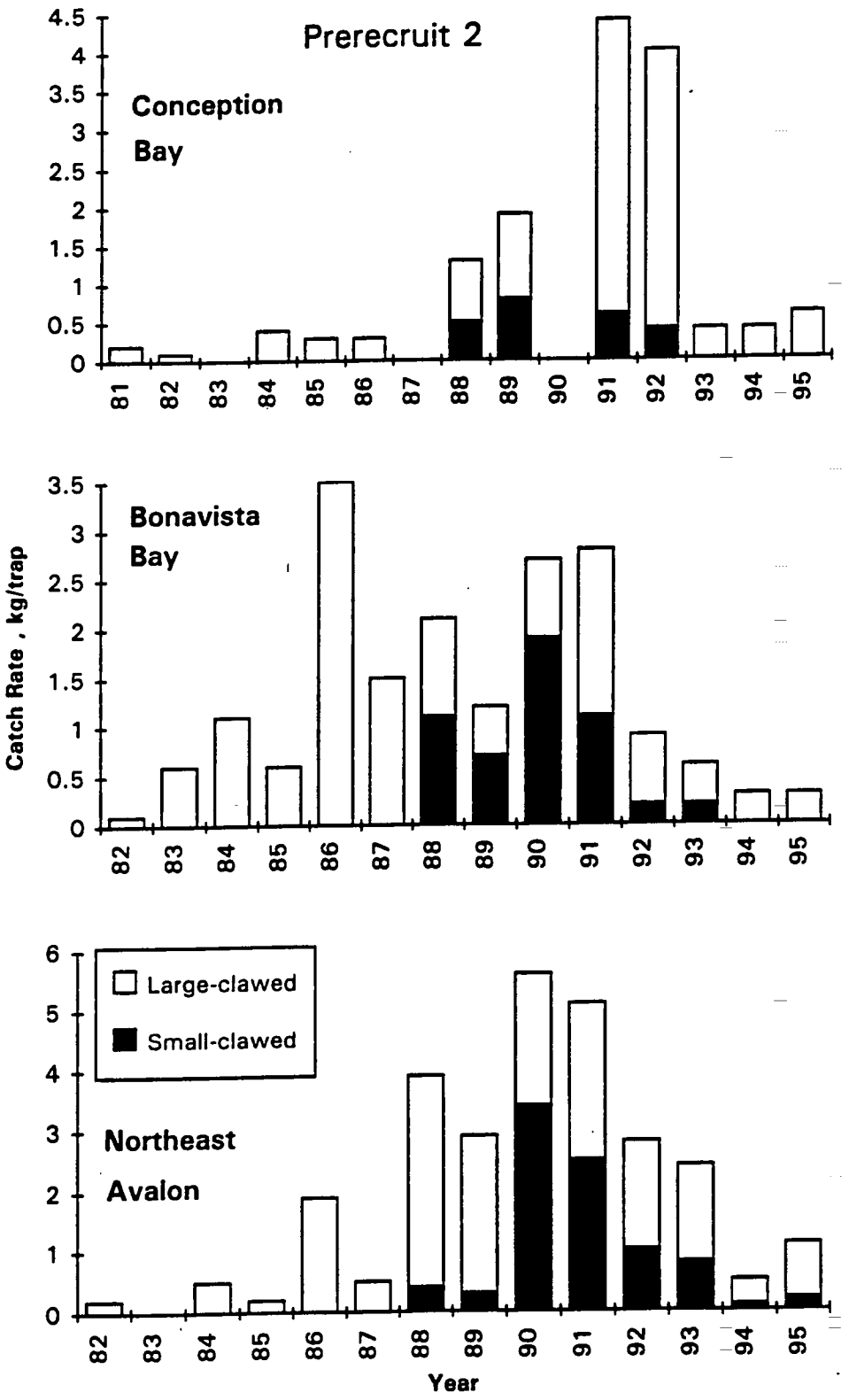

Figure 6. Yearly trends in survey catch rate of Prerecruit 2 crabs (60-75 mm CW) from small-meshed traps, by survey area. Catch rates are partitioned by chela allometry since 1988.

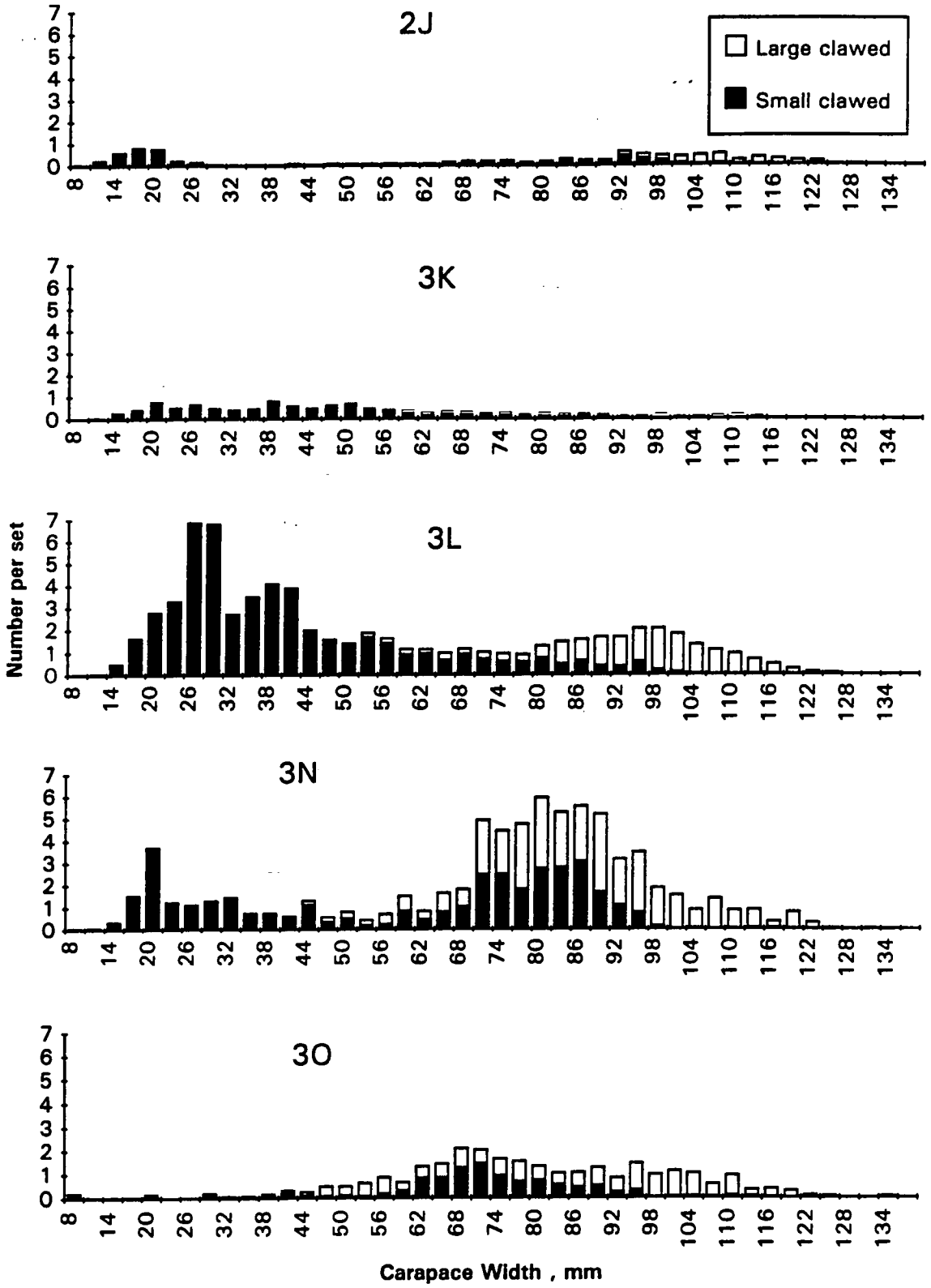

Figure 7. Fall 1995 bottom trawl survey catch rates by size interval and chela allometry for each NAFO Division.

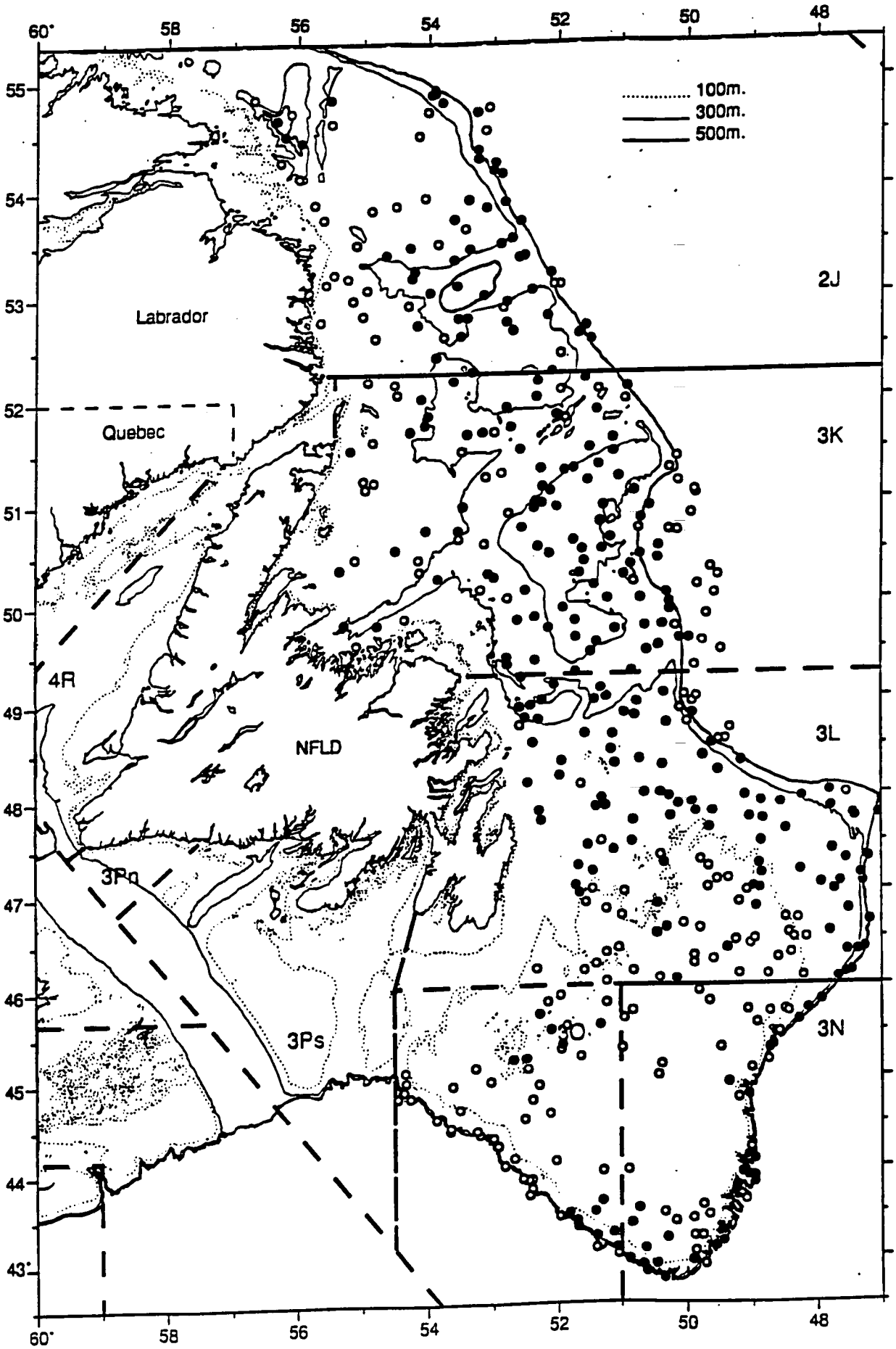

Figure 8. Spatial distribution of those sets where legal-sized crabs were caught (dark circles) in relation to all sets executed in the 1995 fall bottom trawl survey (all circles).

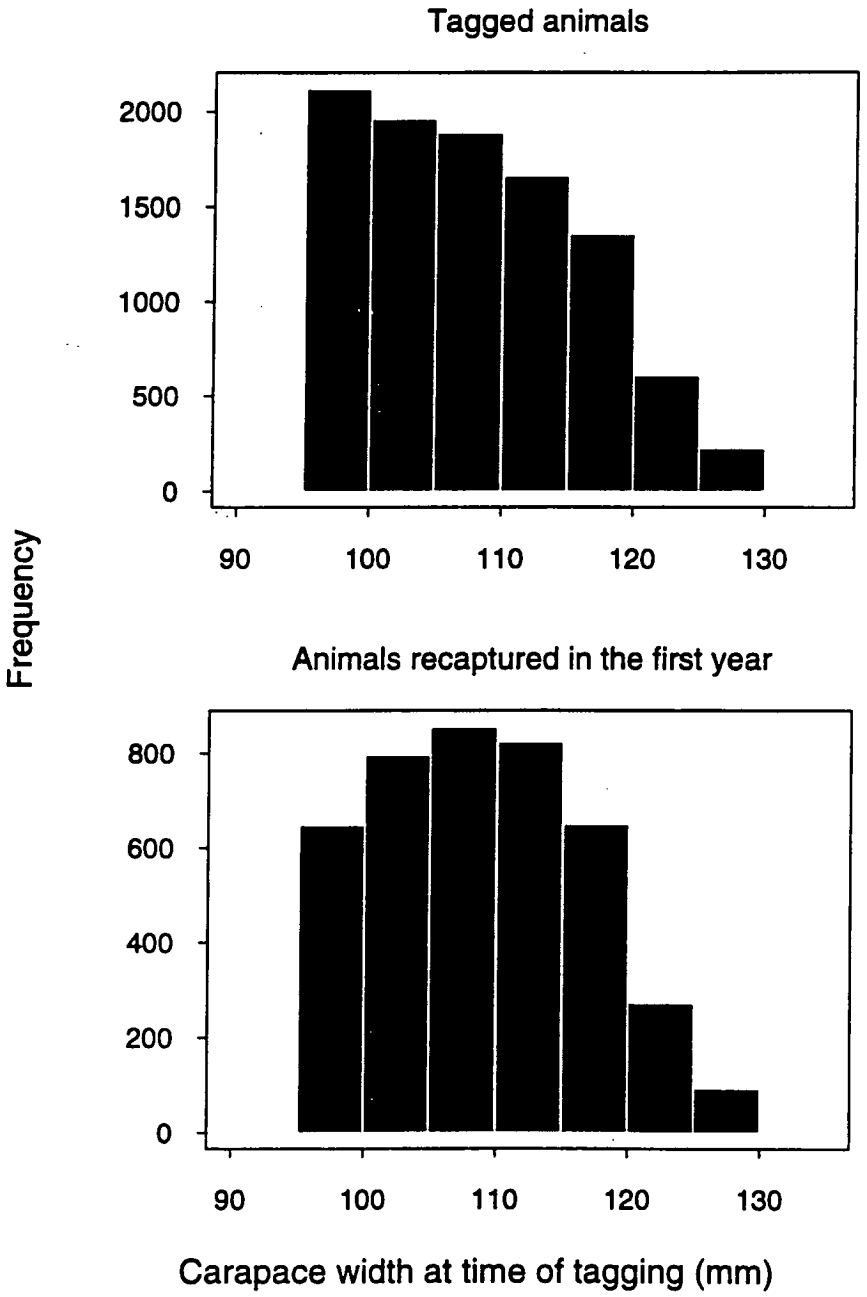

Figure 9. Bonavista Bay taggings and recaptures 1979–1982.

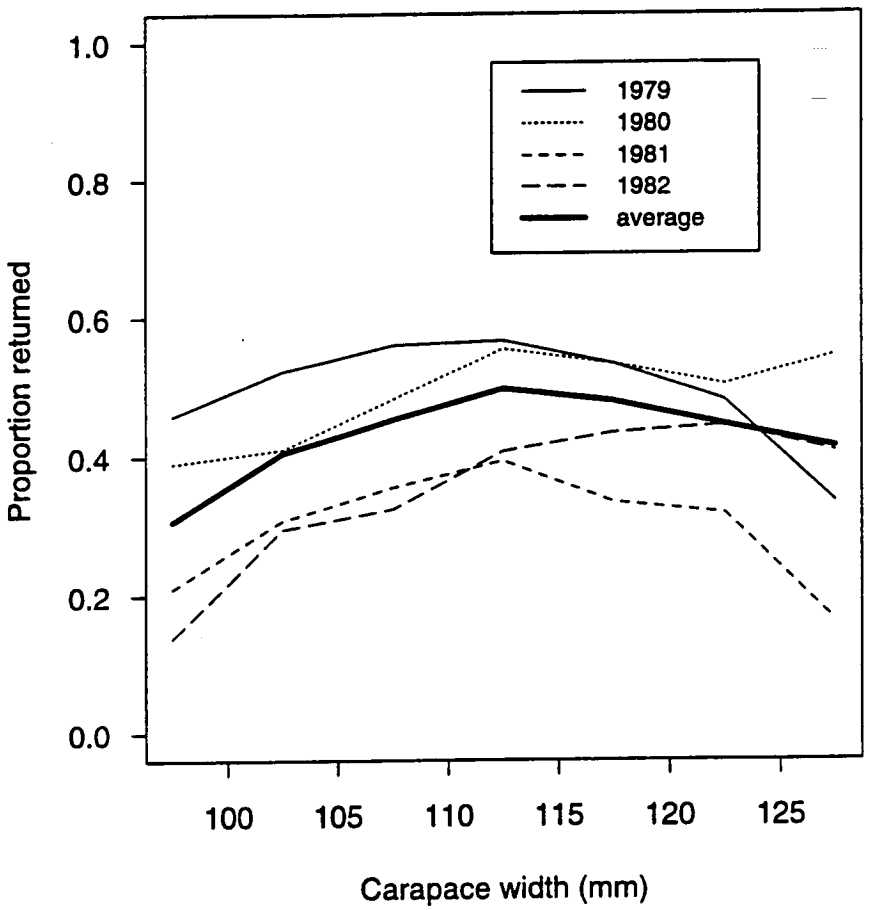

Figure 10. Bonavista Bay taggings 1979–1982.

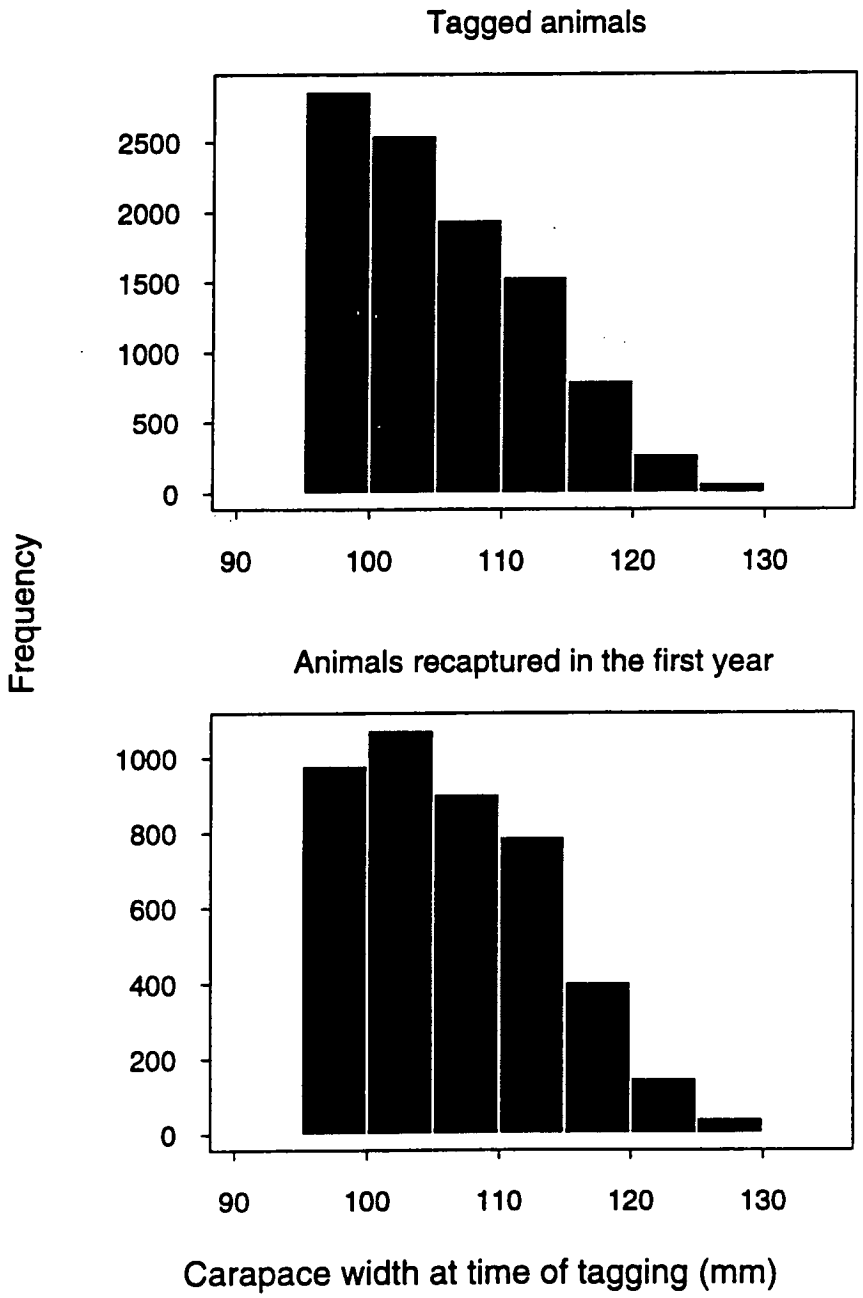

Figure 11. Avalon taggings and recaptures 1979–1982.

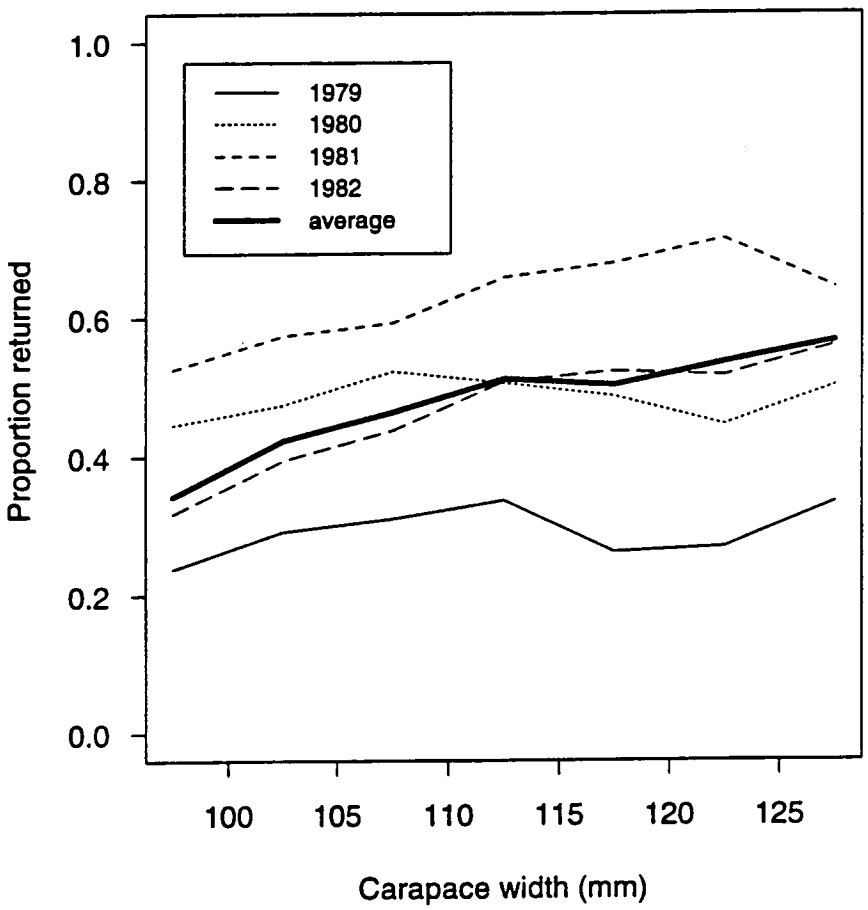

Figure 12. Avalon taggings 1979--1982.

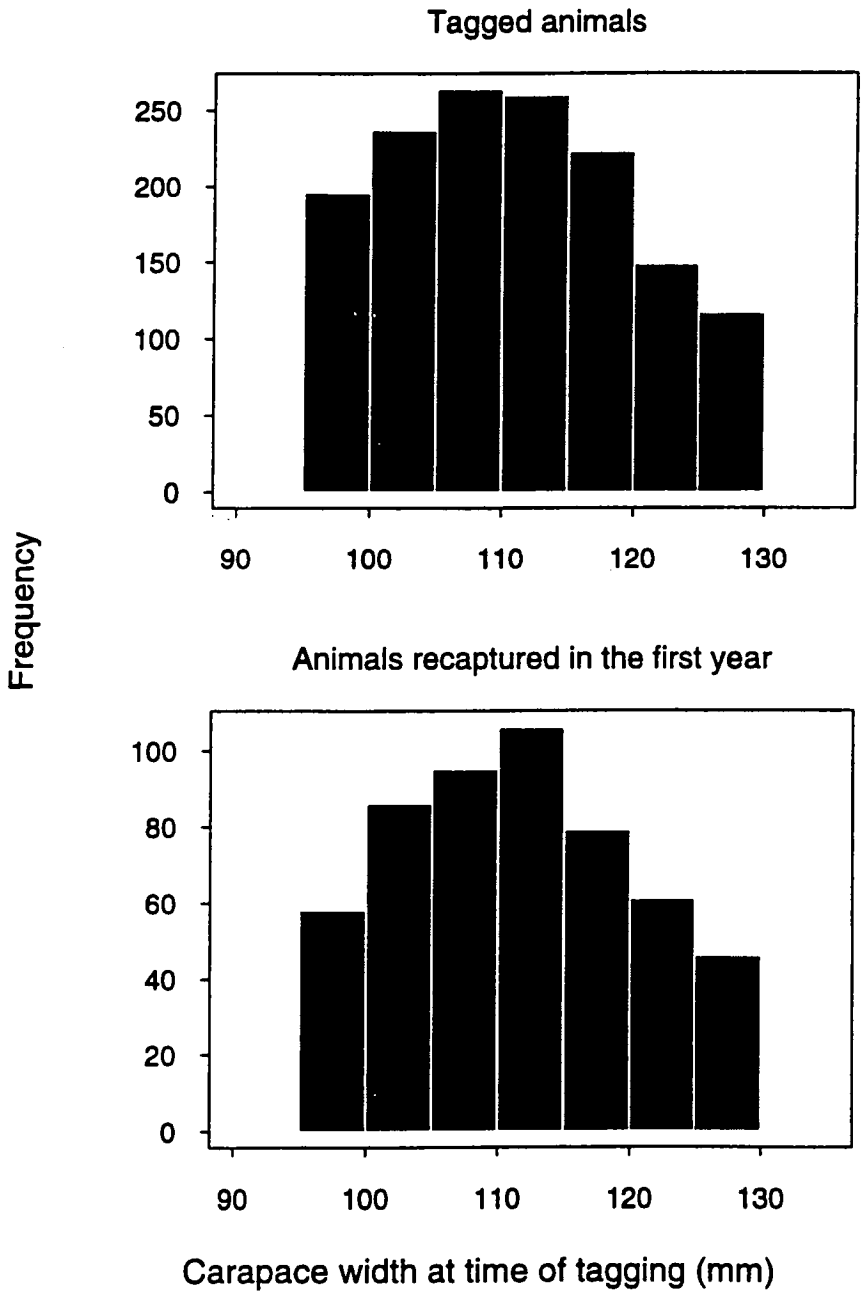

Figure 13. Notre Dame Bay 1982 taggings and recaptures.

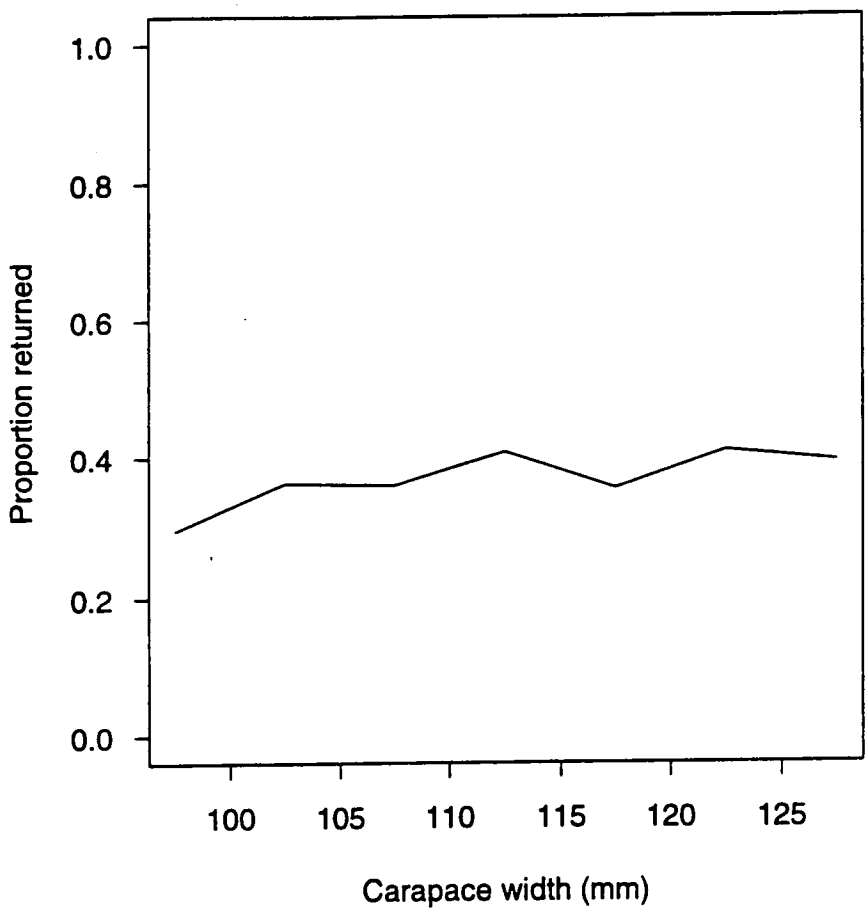

Figure 14. Notre Dame Bay 1982 taggings.

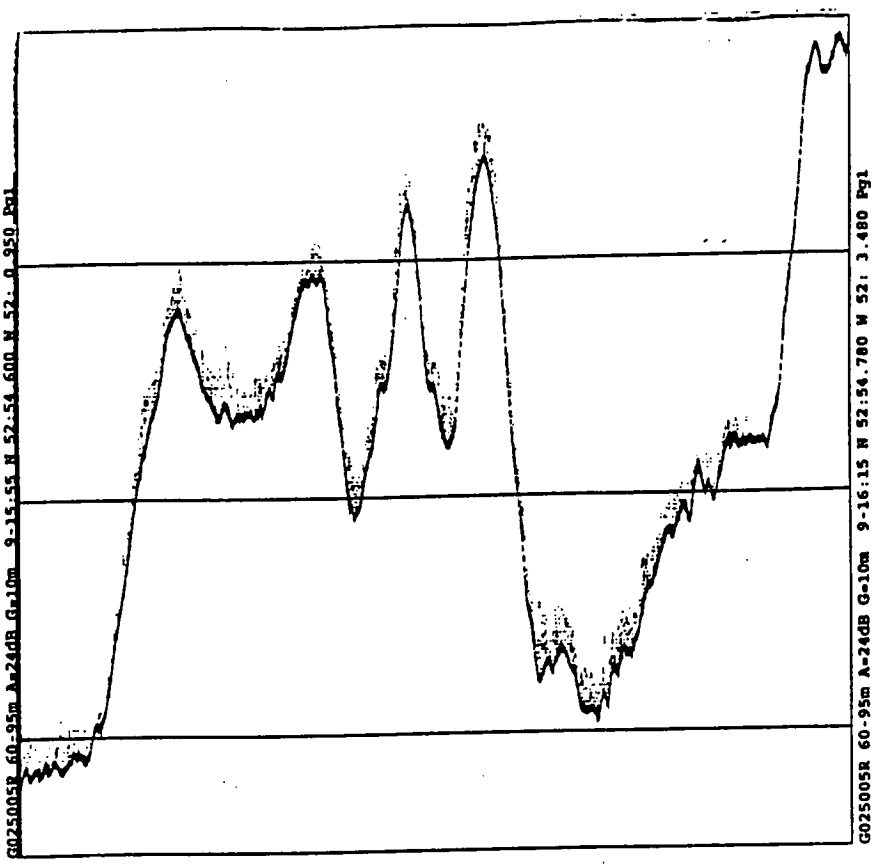

Figure 15. Low density shrimp backscatter - 99% shrimp from trawling.

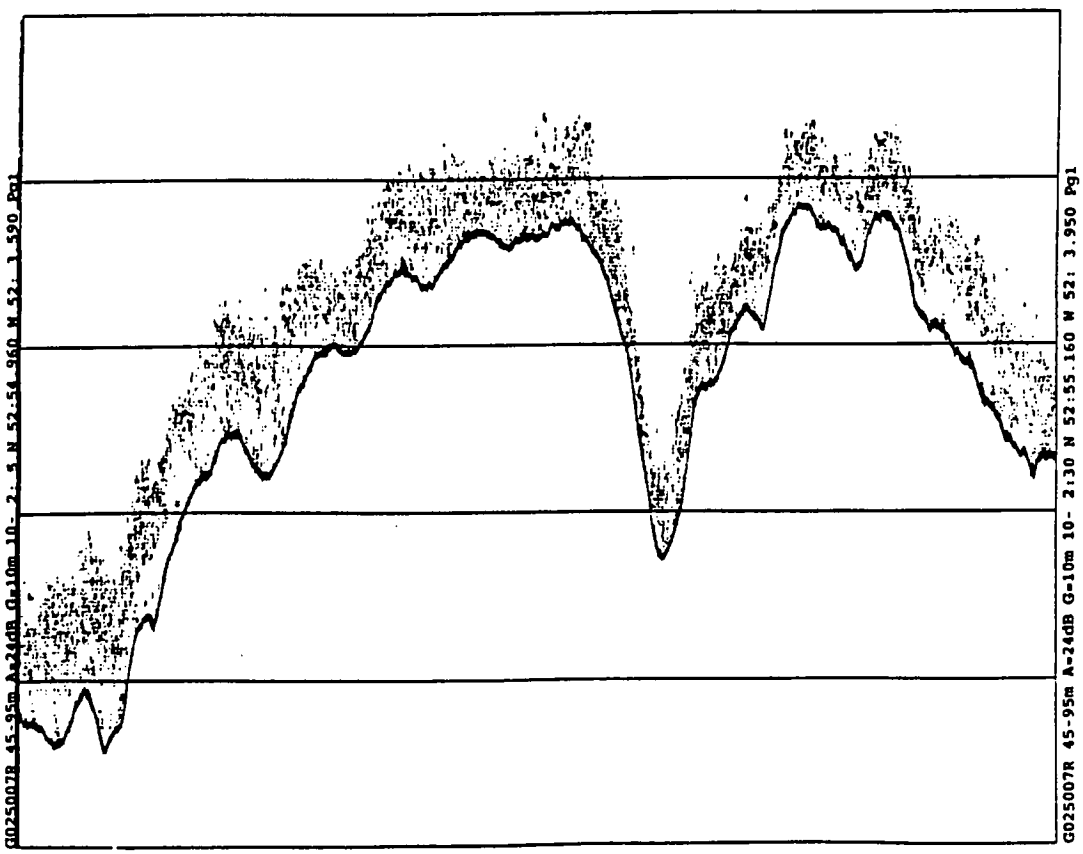

Figure 16. Medium density shrimp - no trawl data.

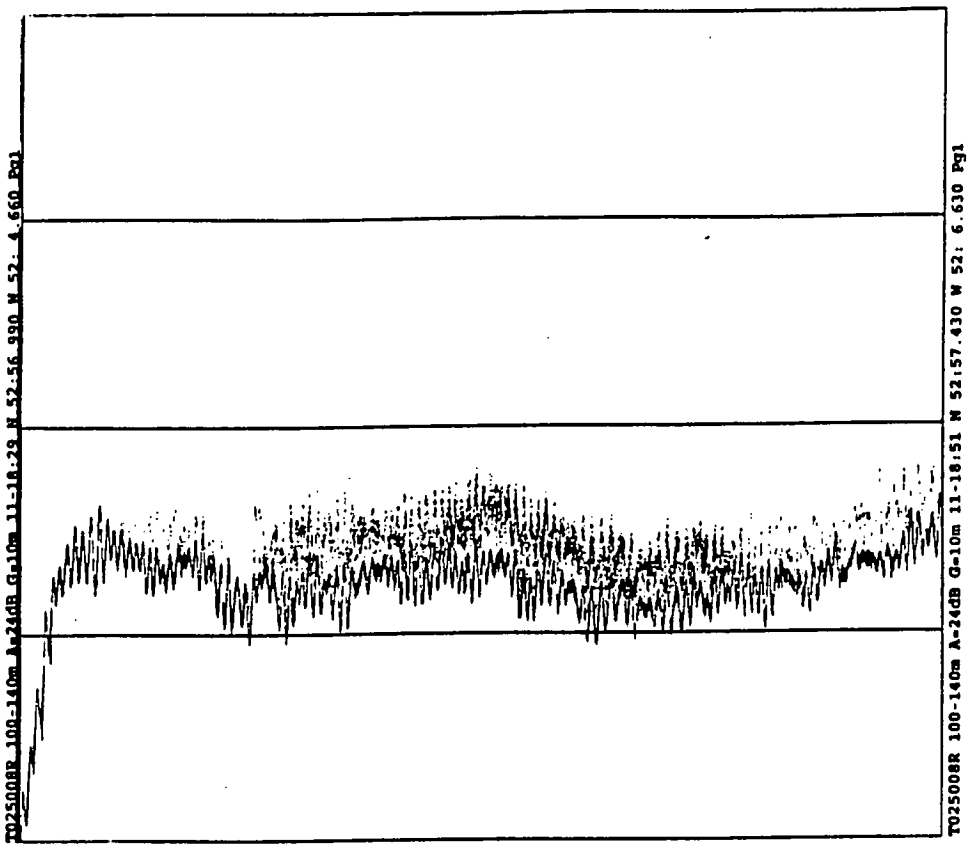

Figure 17. High density shrimp - 94% shrimp from trawling.

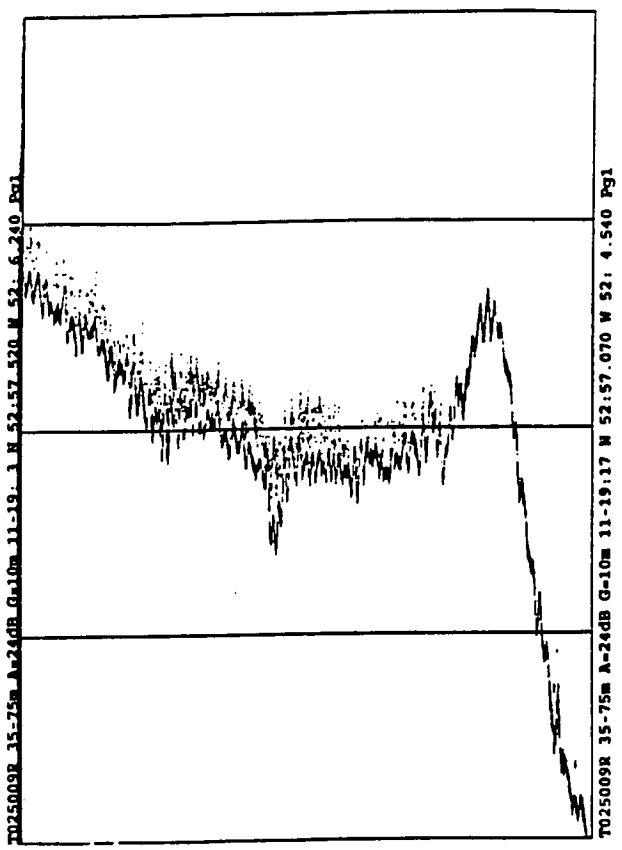

Figure 18. High density shrimp - 94% shrimp from trawling.