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Distribution of 0 and 1 group cod in nearshore waters of Placentia Bay (NAFO Subdivision 3Ps), 1997-1998

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Abstract

Predicting recruitment and understanding its variability are important problems in fishery science. In Placentia Bay, in 1997 and 1998, 0 and 1-group cod were surveyed in nearshore eelgrass habitats. The distribution and relative abundance was compared among sites and between years. The mean catch rate of 0-group cod was 0.8 and 3.7 fish per set in 1997 and 1998, respectively. The 5-fold increase in catch likely represents an increase in total biomass of 0-group cod in the nearshore environment. Catch of 1-group cod followed similar patterns to the 0-group cod catch. Given catch magnitudes for 0 and 1-group cod in 1997 and 1998, we speculate that the year class strengths are as follows: 1998 > 1997 > 1996.

Résumé

La prévision du recrutement et la connaissance de sa variabilité constituent deux problèmes importants pour les spécialistes des pêches. Un relevé des morues des groupes d'âges 0 et 1 a été effectué en 1997 et 1998, dans des habitats à zostère marine de la baie Placentia. Les répartitions et abondances relatives ont été comparées entre sites et entre années. Le taux de capture moyen des morues d'âge 0 a été de 0,8 et de 3,7 poissons par station pour 1997 et 1998 respectivement. L'augmentation par un facteur de cinq des captures traduit probablement un accroissement de la biomasse totale des morues du groupe d'âge 0 dans cet environnement côtier. Les captures de morues du groupe d'âge 1 ont suivi un patron semblable. Étant donné les valeurs obtenues pour les morues des groupes d'âges 0 et 1 en 1997 et 1998, nous supposons que l'importance relative des classes d'âge était la suivante : 1998 > 1997 > 1996.

Introduction

Predicting recruitment and understanding its variability are important problems for fishery scientists and managers. Historically, the focus of research effort has been the early life stages which have relatively high mortality rates, such as the first feeding larval stage (McGurk, 1986). Recently, focus has shifted to later life stages (post-metamorphose juveniles) because they tend to be more reliable indices of recruitment to the fishery (Sissenwine, 1984; Bradford, 1992; Bradford and Cabana, 1997).

In Placentia Bay, in 1997 and 1998, we surveyed 0 and 1-group cod in nearshore eelgrass habitats. The objective was to identify which physical and biotic factors may be associated with strong year classes, and to identify important nursery sites in the bay.

In this paper, we report the distribution and size of 0 and 1-group cod catches throughout the bay in the two study years. The distribution and relative abundance is compared among sites and between years. Also, we make a prediction of relative strength of the 1996, 1997 and 1998 year-classes for Placentia Bay cod.

Materials and Methods

Field work:

Once a month from September to December in both 1997 and 1998, juvenile cod were sampled by beach seining at 18 sites in Placentia Bay. The sites, shown in Figures 1 and 3, were chosen based on distribution around the bay, accessibility by small craft, consistent catchability of fishing gear, and presence of nearshore eelgrass habitat. Sampling at any site was not confined to a particular tide level or time of day, although all sampling was done during daylight hours. All sites were sampled in as short a period as possible at the start of every month, in an order that was largely determined by weather.

The gear used was a 25 m bottom seine hauled by two people toward the shore after being deployed from a small boat. The seine is described in detail in Lear *et al.* (1980). Deployment of the seine is described in Schneider *et al.* (1997). The seine fishes a standardized area of 880 m on each tow (16 m along shore x 55 m offshore).

At each site, two sets, approximately 30-100 meters apart, were made in immediate succession. The sets were far enough apart to be treated as independent if necessary, but close enough to be similar in depth, eelgrass cover, salinity, and exposure. Within a meter, the same sets were made each month. The sum of the two sets is used in all analyses in this report. Time, depth, temperature, and salinity were recorded for each set approximately 55 m offshore. Depth was determined using a weighted line marked at 1 m intervals. Temperature and salinity were measured with a probe at the surface and at approximately 1m depth.

The standard length and taxon of every fish caught in each tow was recorded, and whenever possible, fish were returned alive to the sea. Only Atlantic cod are considered in this report. Standard length was used to divide the catch into length classes that corresponded to age groups:

0-group cod were less than 100 mm; 1-group cod were between 100 and 230 mm. The three individuals caught which were larger than 230 mm are ignored here.

In 1998, five more sites, shown in Figures 2 and 4, were added to the survey. Three of these sites, chosen in a manner similar to that described above, increased coverage of the bay into the Eastern and Central Channels; areas previously inaccessible because we used a slower boat in 1997. The two other new sites had no eelgrass growing nearshore, and were chosen for comparison to the eelgrass sites. Except where otherwise noted, only data from the 18 sites sampled in both years are discussed below.

Statistical Analyses:

Nonparametric statistics were used since catch data rarely comply with the assumptions of parametric statistics. To test for an effect of catch between years and among sites, the Scheirer-Ray-Hare two-way extension of the Kruskal-Wallis test was used. Post-hoc comparisons of catch between years were done using Wilcoxon's signed ranks test for paired observations to control for any effects of site and month.

Results:

Catch figures:

In 1997, a total of 117 0-group cod and three 1-group cod were caught in 36 sets at 18 sites. In 1998, 526 0-group and 80 1-group cod were caught. The catch distribution of 1997 and 1998 0-group cod are shown in Figures 1 and 2, respectively; that of 1-group cod are shown in Figures 3 and 4 (Figures 2 and 4 show data from the 5 new sites). Total catches by year and month are shown in Table 1. The length distribution of 0-group cod, including data from the new sites, is shown for each month in Figure 5.

There was a significant effect of site and of year on catch of both 0-group and 1-group cod. No significant site by year interaction was detected (Scheirer-Ray-Hare statistics are shown in Table 2). Catch at each site and each month was significantly higher in 1998 than in 1997 for both 0-group ($t_s = -6.31$; $p < 0.0001$) and 1-group ($t_s = -7.32$; $p < 0.005$) cod.

Discussion:

0-group cod:

The catch of 0-group cod from the 18 sites, fished once a month throughout the fall, was 117 fish in 1997 and 526 fish in 1998. There is a 5-fold increase in catch from 1997 to 1998. This increase was widespread among sites: virtually all sites, every month, had equal or higher catch in 1998 than in 1997. Furthermore, there were fewer sites in 1998 than in 1997 at which no 0-group cod was caught. Therefore, the 5-fold increase in catch was not due to one big catch 1998, but to many smaller increases in catch over the whole bay. This marked increase likely represents an increase in total biomass of 0-group cod in the nearshore environment of Placentia Bay.

The mean catch rate for the nearshore region of Placentia Bay in 1997 was 0.8 0-group cod per set. The mean catch per set for September and October 1997 were 0 and 0.5 0-group cod, respectively. These numbers are very low relative to those of other bays around Newfoundland, as measured from late September to late October in the annual Fleming survey by Methven *et al.* (1998). The mean catch per set for other bays in 1997 ranged from 1.7 0-group per set in Conception Bay to 75.5 in Trinity Bay. In the only other South Coast bay surveyed, St. Mary's Bay, catch rates were 4.4 0-group cod per set.

Mean catch rate for 1998 of Placentia Bay 0-group cod was 3.7 fish per set. This is typical compared to 1990's catch rates for many other bays around Newfoundland (Schneider *et al.*, 1997). Unfortunately, no direct comparisons can be made since there is no Fleming survey data for 1998.

There was a trend, consistent between years, in the way the catch of 0-group cod varied from month to month, both in numbers and lengths. The trend occurred earlier in 1998 than in 1997. Early in the fall (October 1997, September 1998) the few fish which were caught tended to be approximately 45 mm SL. A month later (November 1997, October 1998), the number of fish had increased considerably, and the average length increased to about 60 mm SL. Towards the end of the fall (December 1997, 1998), the catch of these 60+ mm SL fish decreased considerably. Instead the catch was dominated by large numbers of very small cod, approximately 40 mm SL. Throughout the fall, the larger 0-group cod (45+ mm SL) tended to be distributed mainly in the head of bay, while the very small cod were more widely distributed throughout the head of the bay, and down the western side.

The inter-year patterns in the distribution and magnitude of the catch of 0-group cod described here seem to match those of cod larvae measured in the summer and early fall of 1997 and 1998 by Bradbury *et al.* (1999). There were more larvae and more 0-group cod in 1998 than in 1997. The large catches of both larvae and 0-group cod tended to occur in the head of the bay, and on the western side in 1998.

1-group cod:

Catch of 1-group cod followed similar patterns to the 0-group cod catch. The catch in 1997 and 1998 was 3 and 80, respectively. There was one very large catch (55 fish) at Southern Harbour

in 1998. However, nonparametric tests are not sensitive to large outliers, and there was nonetheless a statistically significant increase in the number of fish caught per set in 1998 versus 1997. Similar to the trend for the younger fish, the number of sites where 1-group cod were caught was higher in the latter year.

In 1997, the catch rate of 1-group cod in Placentia Bay was 0.02 fish per set, similar in magnitude to that from Saint Mary's Bay that year. The catch rates for other bays around Newfoundland as measured in the Fleming survey in 1997 range from 0 in Saint Mary's Bay to 4.1 in Trinity Bay (Methven *et al.*, 1998).

Mean catch rate for 1998 of Placentia Bay 1-group cod was 0.6 fish per set. This is typical compared to recent catch rates for many other bays around Newfoundland (Schneider *et al.*, 1997); however no direct comparisons can be made since there is no Fleming survey data for 1998.

Year Class Strength:

Given catch magnitudes for 0 and 1-group cod in 1997 and 1998, we speculate that the year class strengths are as follows: 1998 > 1997 > 1996. The 1998 class appears stronger than that of 1997, when the 0-group data from those years are compared. In addition, the 1997 class appears stronger than that of 1996 when the 1-group data from 1998 and 1997 are compared. This hierarchy matches that of cod biomass as measured acoustically for Placentia Bay in those years (Rose and Lawson, 1999).

Literature Cited:

- Bradbury, I. R., Snelgrove, P. V. R., Fraser, S. (1999). Transport and development of cod eggs and larvae in Placentia Bay (3Ps) Newfoundland 1997 - 1998. CSAS Res. Doc. 99/71.
- Lear, H. M., Fleming, A. M., Wells, R. (1980). Results of small cod surveys in eastern Newfoundland during 1959-1964. NAFO SCR Doc. 80/IX/144
- Schneider, D. C., Methven, D. A., E. L. Dalley. (1997). Geographic contraction in juvenile fish: a test with Northern cod (*Gadus morhua*) at low abundances. Can. J. Fish. Aquat. Sci. 54 (Suppl 1): 187-199.
- Methven, D. A., Schneider, D. C., Ings, D. W. (1998). Results of the 1997 Fleming survey of demersal juvenile cod in the coastal zone of eastern Newfoundland. CSAS Res. Doc. 98/77.
- Rose, G. A., Lawson, G. L. (1999). . Acoustic surveys in Placentia Say and 3Ps, June 1996-1998. CSCS Res. Doc. 99/41.

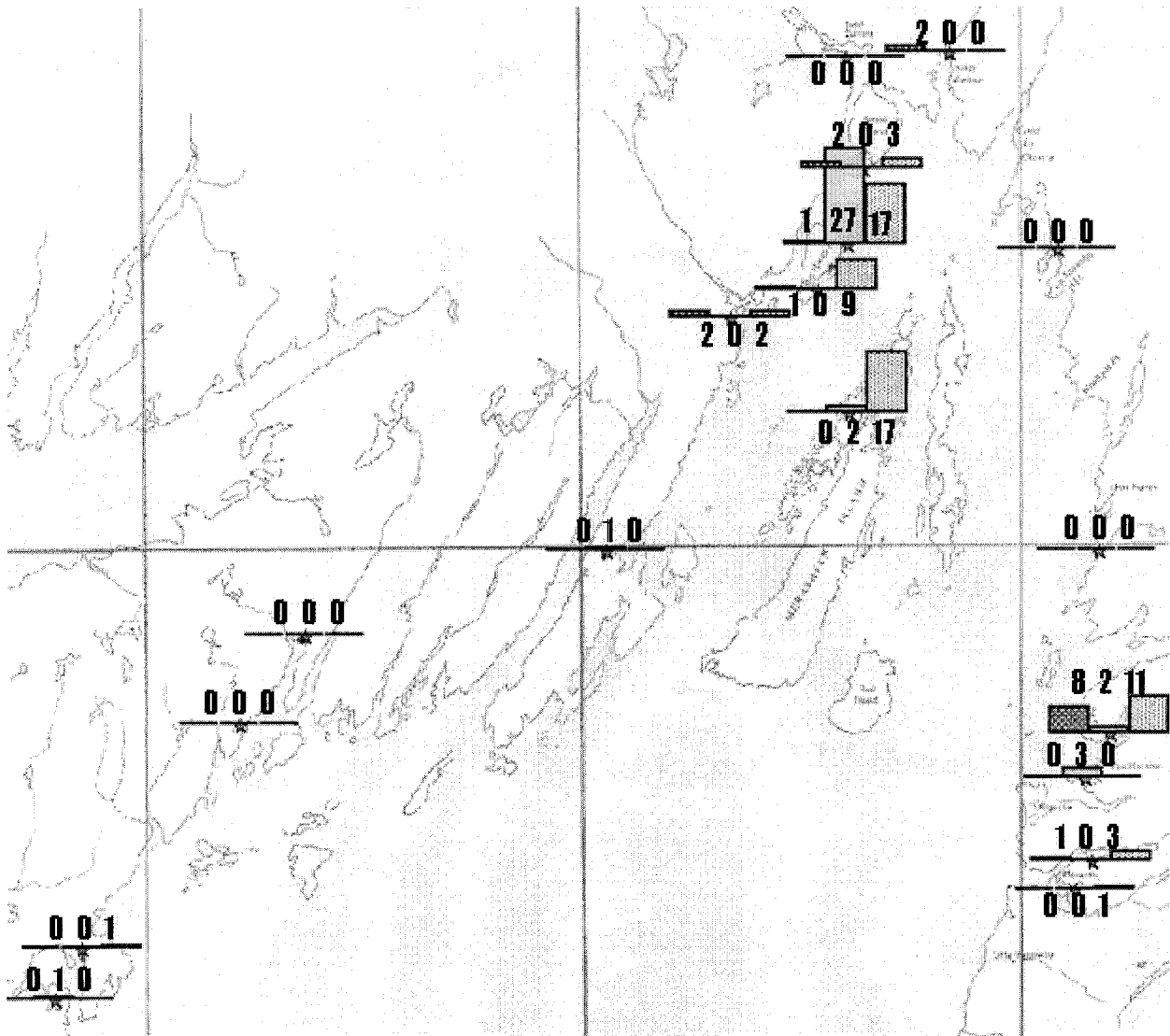


Figure 1: Catch of 0-group cod at each of the 18 sites in 1997. The bars represent catch (in number of fish) for October (leftmost bar), November (center bar) and December (rightmost bar). Catch in September was 0 at all sites and is not included in the figure.

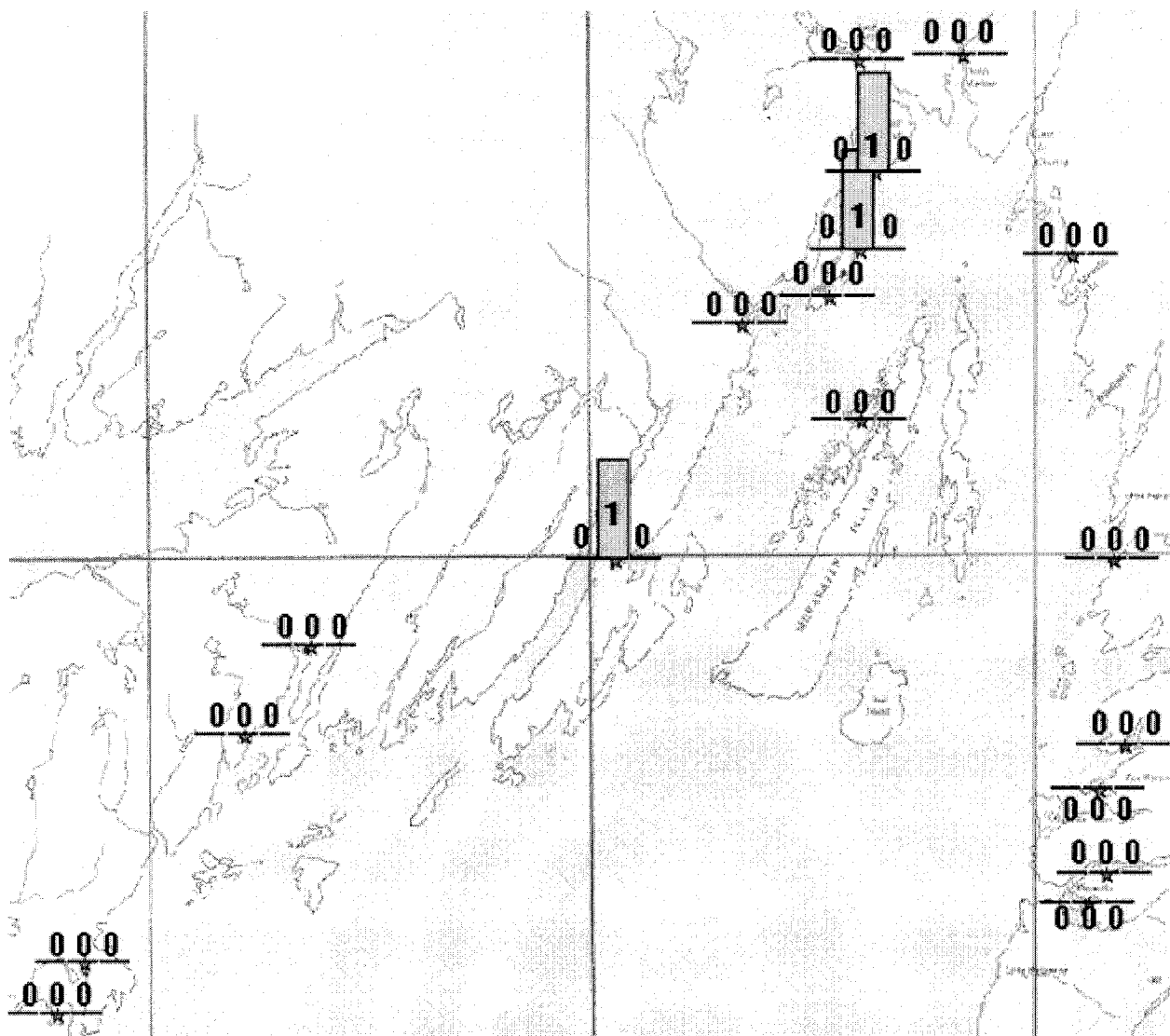


Figure 3: Catch of 1-group cod at each of the 18 sites in 1997. The bars represent catch (in number of fish) for October (leftmost bar), November (center bar) and December (rightmost bar). Catch in September was 0 at all sites and is not included in the figure.

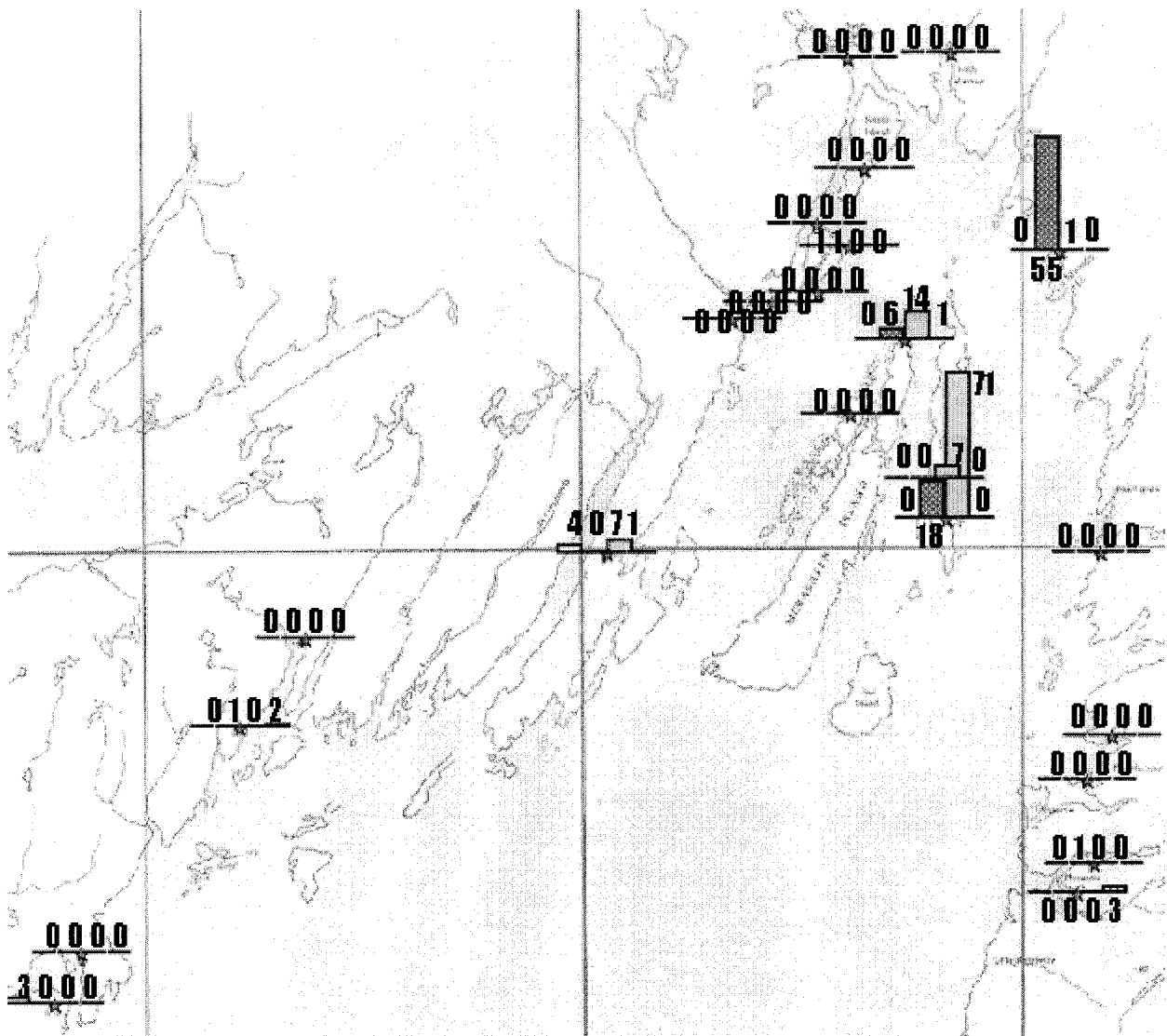


Figure 4: Catch of 1-group cod at each of the 23 sites in 1998. The bars represent catch (in number of fish) for September (leftmost bar), October (second bar), November (third bar) and December (rightmost bar).

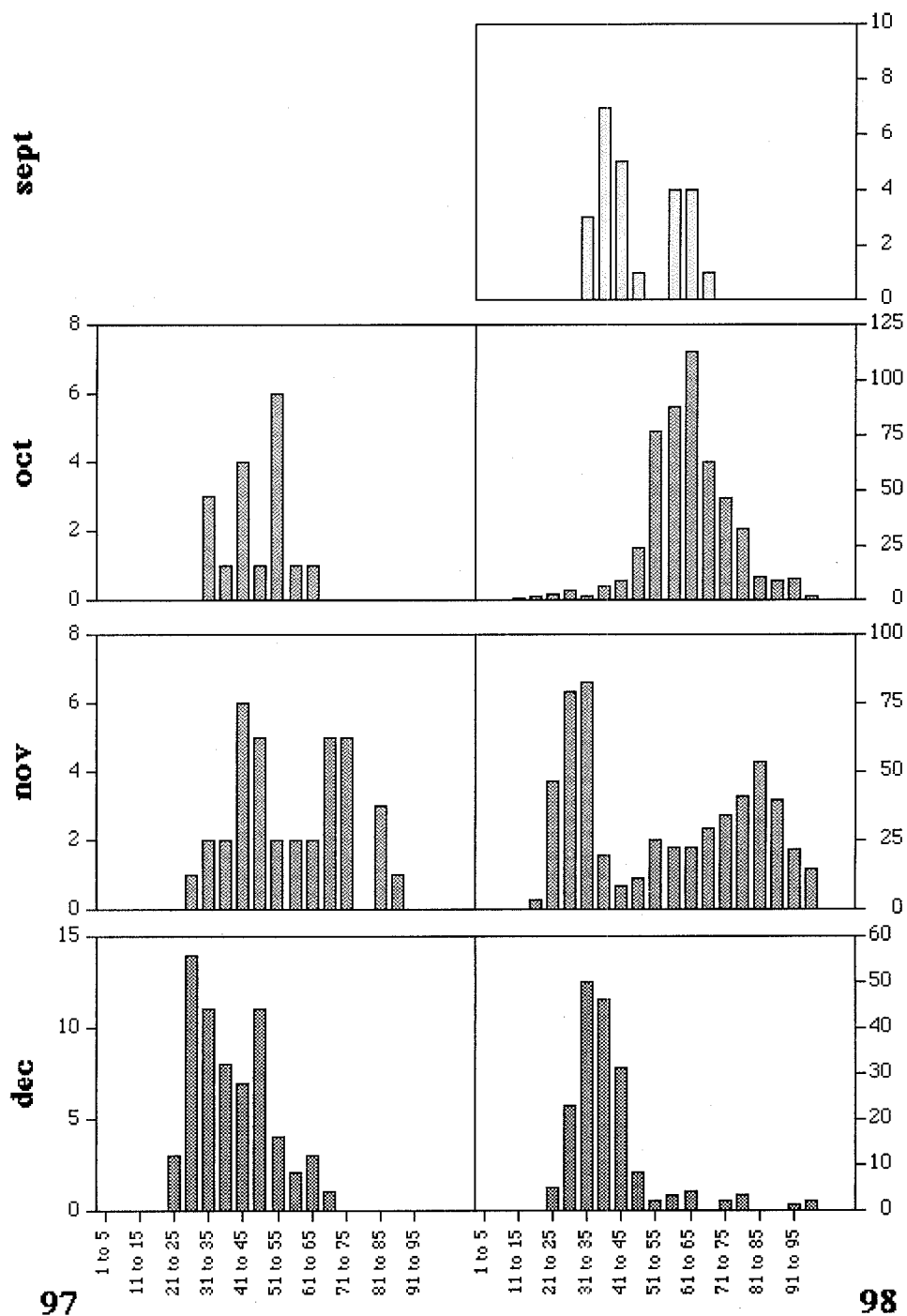


Figure 5: Length distributions for each of the four months surveys in 1997 and 1998. Length distributions for September are in the topmost row. Those for October, November and December are in the second, third and fourth rows, respectively. Note no fish were caught in September 1997. The left column is for 1997, and the right for 1998. Note that the scale of the bars is different in every graph.

Table One: Catches of 0-group and 1-group cod for each month sampled in 1997 and 1998. Each number is the sum of 36 tows at 18 sites in Placentia bay.

0-group		Sept	Oct	Nov	Dec	Total
1997		0	17	36	64	117
1998		13	191	204	118	526

1-group		Sept	Oct	Nov	Dec	Total
1997		0	0	3	0	3
1998		8	58	8	6	80

Table Two: Values of the Scheirer-Ray-Hare statistic, H, for the effects of site, year, and their interaction on the catch of 0-group and 1-group cod in Placentia Bay.

Source	df	0-group H	p	1-group H	p
site	17	35.04	< 0.01	32.53	< 0.05
year	1	15.13	< 0.005	6.3	< 0.05
site*year	17	11.44	ns	17.25	ns

Crit χ^2 for 1 df at $\alpha=0.05$, 0.01 and 0.005 are: 3.84, 6.63, 7.88.
 Crit χ^2 for 17 df at $\alpha=0.05$, 0.01 and 0.005 are: 27.59, 33.41, 35.72.