Distribution and Relative Abundance of Age 0-3 Demersal Juvenile Cod (Gadus morhua) in NAFO Divisions 2J3KL in 1995 compared to that in 3KL, 1992-1994

by

E.L. Dalley, J.T. Anderson and D. J. Davis

Science Branch, Newfoundland Region
Department of Fisheries and Oceans
P.O. Box 5667
St. John's, NF
A1C 5X1

ABSTRACT

Distribution of juvenile cod was examined in inshore and offshore areas of NAFO Divisions 2J3KL during fall and early winter 1995. Inshore fixed stations were fished in the same locations as juvenile cod surveys from 1992-94. In the offshore, a composite of stations from the more intensive random stratified design was utilized to compare with the fixed stations design of the three previous years. Age 0 cod were almost exclusively restricted to the inshore. Consistent with the previous observations there was an age dependent distribution whereby with increasing age there was a logarithmic decrease in the ration of mean catch inshore to offshore, reiterating the importance of the inshore as a nursery area for cod during rebuilding phase. The abundance index for the inshore only and inshore/offshore combined decreased for ages 0, 1 and 2 from 1994 to 1995. Catch rate of age 3's was extremely low all years. Catch rate of age 1's was relatively low in the offshore in all years. In the inshore, catch rate of juveniles was low in Bonavista and White Bays whereas Trinity and Conception Bays consistently ranked high relative to the other large Northeast coast bays. It is suggested that trawl derived, abundance indices for juvenile cod may be biased by virtue of the fact that large areas are untrawlable, particularly in Bonavista Bay, and these areas maybe preferred by juvenile cod.

RÉSUMÉ

La répartition de la morue juvénile dans les eaux côtières et hauturières des divisions 2J3KL de l'OPANO a été étudiée au cours de l'automne et au début de l'hiver 1995. Dans les eaux côtières, la pêche a été effectuée aux mêmes stations pêchées de 1992 à 1994, tandis que dans les eaux hauturières, un complexe de stations établi d'après un protocole d'échantillonnage aléatoire stratifié intensif a été utilisé à des fins de comparaison avec le protocole d'échantillonnage à des stations fixes utilisé au cours des trois années précédentes. La morue d'âge 0 fréquentait presque exclusivement les eaux côtières. Comme il l'avait déjà été observé par le passé, la répartition était fonction de l'âge, c'est-à-dire que le rapport entre les prises moyennes dans les eaux côtières et hauturières diminuait de façon logarithmique en fonction d'une augmentation de l'âge, mettant à nouveau en lumière l'importance des eaux côtières comme zone d'alevinage de la morue pour le rétablissement des stocks. L'indice d'abondance 1995 de la morue d'âge 0, 1 et 2 dans les eaux côtières et dans les eaux côtières et hauturières combinées a baissé par rapport à 1994. Le taux de capture de morue d'âge 3 était extrêmement faible pour toutes les années, tandis que le taux de capture de morue d'âge 1 dans les eaux hauturières était aussi relativement faible. Dans les eaux côtières, le taux de capture de juvéniles était faible dans le cas de la baie de Bonavista et de la baie Blanche, tandis que dans les baies de la Conception et de la Trinité, il était uniformément élevé par rapport aux autres grandes baies de la côte nord-est. On est d'avis que les indices de l'abondance des juvéniles obtenus par relevés au chalut sont biaisés du fait que les grandes régions ne sont pas chalutables, en particulier la baie de Bonavista, et qu'il se peut que les juvéniles favorisent ces régions.

Introduction

Historically, indices of prerecruit abundance of northern cod (NAFO Divs 2J3KL) have not been derived from the annual groundfish survey (Bishop et al. 1993) due to selection characteristics of the survey trawl. However, more recently (since 1992) several indices have been presented at the annual assessment exercise, particularly from pelagic 0-group surveys (Anderson and Dalley 1993), nearshore beach seine surveys (Schneider et al. 1995), and Campelen 1800 trawl surveys comparing relative abundance of demersal juvenile cod in inshore compared to offshore areas of 3KL (Dalley and Anderson 1994). These surveys are of particular interest in recent years in recognizing early signs of stock recovery.

In 1995 the Campelen trawl was adopted for the first year as the standard trawl for the fall groundfish random stratified (RS) survey (Shelton et al. 1996). Since the random stratified design covered the offshore portion of 3KL more intensively than the offshore transects of the demersal juvenile cod survey (Dalley and Anderson 1997), the offshore fixed locations were not fished in 1995. The fixed stations of the inshore portion of the juvenile cod survey were fished similar to 1992-94.

This document reports on distribution and mean catch rates of juvenile cod from the fixed inshore stations, in addition to all the offshore sets fished in 2J3KL during the 1995 RS survey. Also representative stations from the random stratified design are selected to obtain an abundance index from the offshore, to compare with those obtained from the fixed station design during 1992-94. Finally, bay to bay variability in mean catch rate is examined for the inshore catch rate index from 1992-95.

Methods

In 1995 the same inshore fixed stations were fished as those of the demersal juvenile cod surveys from 1992 to 1994 (Fig. 1). These were sampled during three trips (Templeman 181, Teleost 21, and Teleost 22) of the annual Random Stratified (RS) Groundfish survey, between December 1995 and January 1996.

In the offshore a total of 84 sets were done in 2J, 131 in 3K, and 169 in 3L during the RS survey. The fixed stations from the offshore transects portion of the demersal juvenile cod survey (1992-94) were not fished in 1995 since: 1) the RS Groundfish survey adopted the same trawl in 1995 that was used in the demersal juvenile cod surveys, and 2) the RS survey covered the offshore area more intensively (Fig. 2) than the juvenile cod survey (Fig. 1).

An abundance index for the offshore in 1995 was obtained in the following manner. Each fixed station on the offshore transects of the previous juvenile cod survey design (Dalley and Anderson 1997), (Fig. 1) was taken to represent the center of a 55km x 55 km. square. Only RS sets done within these squares were included (Fig. 3). The number of tows used to calculate the mean catch for each square ranged from 0 (for 2 fixed stations) up to eight. The mean catch rate of each age group of juveniles from the RS sets that fell within each 55 km. square was taken to represent the catch of that age at the fixed station in the old design. The mean offshore juvenile catch rate was obtained from an overall mean of the derived catch rates for stations in the old design (N = 39). In 1995 the overall (inshore + offshore) index was calculated using 25 fixed stations in the inshore (inshore index) plus the composite catch rates for the old fixed offshore portion (offshore index), as described above.

As in previous demersal juvenile cod surveys (Dalley and Anderson 1997) the fishing gear

used was the Campelen 1800 shrimp trawl, with a 12.7 mm codend liner. The trawl was fished as in previous surveys. Although the survey protocol called for 15 minute tows in 1995, catch rate was standardized to 30 minutes to compare with previous abundance indices. Other sampling protocols are similar to that of Dalley and Anderson (1997). Similar to the protocol in the 1993 to 1994 surveys, the sampling was carried out late one calendar year (1995) and January the next (1996).

Results

Distributions

General distributions of age 0 to age 3 juvenile cod in 2J3KL in 1995 are presented using all sets from the RS survey in the offshore, in combination with the 25 fixed stations in the large bays of 3KL (Fig. 2). The distribution of age 0's (Fig. 4) is for the most part restricted to the inshore bays of 3KL. In the offshore, age 0 cod occurred in only 1 set (8 fish per 30 minute set) of 84 sets in 2J, 3 sets (maximum 4 fish) of 131 sets in offshore 3K and 1 set (2 fish) of 169 sets in offshore 3L. Age 0's were taken in 11 of the 25 inshore fixed stations, maximum catch being 126 fish in a set near the head of Trinity Bay.

Consistent with other recent demersal juvenile cod surveys the highest mean catch rates of any age groups in 1995 were 1 year olds. Catch rates were higher inshore compared to offshore, highest catch being 304 per 30 minutes in Conception Bay. Age 1's were however fairly widely distributed in the offshore areas particularly the Northeast Newfoundland shelf (Fig. 5). They occurred near the shelf edge only in the northern part of the survey area (outside Hamilton Bank) and in relatively deep water between Hamilton and Funk Isle Bank. Maximum standardized catch of age 1's in offshore was 64 fish in 2J, 50 in 3L but only 8 in 3L. Age 1 juvenile cod occurred infrequently

near the shelf edge on the northeast Newfoundland shelf and infrequently in the offshore, south of 49.5°.

Age 2 juvenile cod (Fig. 6) were widely distributed throughout the survey area, both inshore and offshore. Mean catch rates were higher in the inshore, particularly Conception and Trinity Bays, but the single largest catch of 2 year olds (62 fish) was taken near the shelf break in 2J where several other relatively high catches were taken. Highest offshore catch rate was 28 in 3K and 32 in 3L. Catch rates of age 2's were relatively consistent throughout the northeast Newfoundland shelf. As with age 1's, very few age 2's were encountered in the southern portion of the survey area.

Age 3 cod were also fairly widely distributed (Fig. 7), although mean catch rates were higher in the offshore portion than in the inshore sets. Highest catch rates in the northern and central parts of the survey area occurred near the shelf edge. Distribution of age 3 fish in the southern portion (3L) was quite restricted to a few sets near the shelf edge and off the southern Avalon Peninsula. The highest catch of 3 year olds (68 fish) was taken just off the Bonavista Peninsula. Maximum catches in the offshore were 50 fish in 2J, 26 fish in 3K and 68 fish in 3L. Maximum catch of 3 year olds in any inshore set was 4 fish.

Abundances

Mean inshore and offshore abundances of juvenile cod in sets done in each statistical area during the 1995 survey are summarized in Table 1. Variation in catches was high, the standard deviation being larger than the mean in all cases. Highest mean catch rate of age 0's and age 1's occurred in inshore 3L with inshore 3K ranking next. Mean catch rates of age 2's were also higher inshore but with less of a discrepency between inshore and offshore catch rates than the younger age

groups. Mean catch rate of the 1992 year class at age 3 (which had the lowest mean catch rate of the age groups) decreased from north to south. Highest catch rate occurred in 2J with offshore 3K ranking second and offshore 3L third.

Mean offshore abundances are presented using 3 different sets of stations for offshore 3KL (Fig. 8) for comparison with the previous three years (Dalley and Anderson, in press). 'All 3KL' includes all stations in offshore 3KL while ' >47.5° N' includes only those north of 47.5°, which eliminates the area south of which the original juvenile cod surveys did not sample. The mean abundances of age 1, in particular, and 2 year olds was slightly higher using 'index' when stations were grouped into the 55km. x 55 km.squares to approximate the old design. The lowest mean abundances of all ages were obtained using all fishing sets in 3K and 3L, including those to the southern extremity of 3L where distribution was sporadic and abundances quite low. When the offshore sets in 3KL were limited to those north of 47.5° N (> 47.5° N) the mean abundances more closely approximated the mean of the 39 values used to approximate the old design . Since the composite of 39 sets most closely approximates locations of sets done in 1992 - 1994 those are used as the indices to compare with the previous years and are used in further comparisons.

Abundance indices derived in 1995 are compared with those of the previous three years. (Fig. 9). The top panel, from the inshore areas of 3K and 3L, is a direct comparison since inshore fishing sets were done at the same locations in 1995 as in the previous fixed station surveys. A trend which saw an increase in catch rates of age 0 and age 1 fish in the inshore between 1992 and 1994 ended with the most recent survey and catch rate of both these age groups declined in 1995 compared to 1994. Although there was a a decline in mean inshore catch rate of age 0 fish from 1994 to 1995 catch rate of age 0's in 1995 ranked higher than in 1992 or 1993.The inshore catch rate of age 1's in

1995 ranked third highest of the 4 years, higher only than the catch rate in 1992. Mean inshore catch rate of age 2's in 1995 ranked third, ahead only of that in 1993. Catch rate of age 3's in the inshore was low, consistent with that of previous years, ranking ahead of 1993 only.

In the offshore (Figure 9, middle panel) catch rates of age 0's were consistently low in all years. Although abundance of age 1's was low compared to the inshore there is a consistent increase in catch rate the past 2 years, such that offshore catch rate of age 1's is the highest of the 4 years in the offshore. The mean catch rate of age 1's was higher using the 'index' , however, than if a straight arithmetic mean of the catch rate of all sets in offshore 3KL were used (4.3 to 2.8 fish per tow). Catch rate of age 2's in the offshore, on the other hand, is the lowest having declined the past 2 years. catch rates of age 3's in the offshore showed a slight increase in 1995 having had declined the previous 2 years.

The combined inshore and offshore indices (Fig 9, bottom panel) is similar to, and shows similar trends as that of the inshore only. This is attributable to the fact that overall catch rates, especially for age 0 and age 1, are much higher inshore.

The Inshore Index

Since the overall abundance index of age 0 and age 1 juvenile cod is predominated by the inshore, the inshore is examined in more detail for bay to bay variability. Catch rate of age 0 cod were consistently low in White, and particularly Bonavista Bays, relative to the other 3 large Northeast coast bays (Fig. 10). In terms of rank Conception or Trinity Bays ranked first or second in three of the four years. Only in 1993 did Notre Dame Bay rank highest with Conception and Trinity Bays second and third respectively. The overall inshore index for age 0's showed a peak in

1994. It can be seen that this increase in overall mean inshore catch rate was restricted to Trinity Bay and was not a pervasive event along the Northeast coast. Aside from the large increase in Trinity Bay in 1994 overall catch rate levels of age 0's in the inshore have remained relatively stable from 1992 to 1995.

Trinity and Conception Bays also rank first and second among the 5 large bays, in terms of catch rates of age 1 juvenile cod, for each of the 4 years (Fig.11). As with age 0's, there was a peak in overall inshore mean catch rate of age 1's in 1994, which was attributable to a localized increase in catch rate in Trinity Bay only. In Conception and Notre Dame Bays mean catch rate of age 1's actually decreased in 1994 relative to 1993. Bonavista and White Bays consistently ranked low in catch rates of age 1, whereas Notre Dame was the most variable in mean catch rate of age 1's from year to year.

Discussion

Since the demersal juvenile surveys (Dalley and Anderson 1997) did not fish north of 3K, and 1995 was the first year the Campelen 1800 trawl was used in the annual random stratified groundfish survey , the 1995 observations in 2J represent the first in a potential time series of pre-recruit indices from 2J.

The general pattern of inshore/offshore distribution of juvenile cod observed in 1995 is consistent with that observed 1992 -1994. Increasing age of juvenile cod continues to be associated with a logarithmic decrease in the ratio of mean catch rate inshore compared to offshore (Figure 12). Although the relative contribution of inshore versus offshore spawning is still not known, the observation points out that the inshore is important as juvenile nursery areas, and that it will be

important to stock rebuilding. Several authors (Bulatova 1971, Helbig et al. 1992, Davidson and DeYoung 1995, Pepin and Helbig 1997) support the premise that progeny of spawning on the northeast Newfoundland shelf (3KL) will remain mostly offshore, and Anderson and Dalley (1997) concluded that inshore distributions of pelagic juvenile cod reflect inshore spawning. The inshore, being of considerable significance, should therefore be included in annual assessments for this stock, especially in any examination of pre-recruit indices.

The overall mean abundances of juvenile cod in 1995 did not show large increases or decreases compared with catch rates in recent years. With the relatively high abundance of age 0 cod in 1994 in a) the demersal juvenile cod survey (Dalley and Anderson 1997), b) the pelagic 0-group survey (Anderson and Dalley 1997) and c) the nearshore beach seine survey, (Schneider et al. 1997) cautious optimism may have allowed a prediction of relatively good catch rates of demersal age 1's in 1995. However, the mean catch rate of age 1 in the demersal juvenile cod survey was the lowest since 1992. Although indications last year were that the 1994 year class (measured as age 0's) was relatively strong, results from the present survey indicate that as age 1's were less abundant than either the 1992 or the 1993 year classes. The mean catch rate of age 0's (the 1995 yearclass) was also the lowest since 1992. The relatively low catch rate of age 0's and the unexpected decrease in the catch rate of age 1's compared to 1994 is consistent with findings from the 1995 beach seine survey carried out in the coastal zone. (Schneider et al. 1996)

Although mean catch rate of age 1's was substantially lower in the offshore, compared to the inshore, there was a trend for increasing catch rate of age 1's in the offshore (opposite to the inshore trend) each of the last 2 years. However, including all offshore RS sets in 3KL, instead of the 'index', negates the increase in offshore catch rate of age 1's from 1994 to 1995 (Fig. 8).

Mean catch rates of age 0's and 1's are considerably higher inshore. The data indicate, however, that an inshore abundance index using mean catch rates may be highly influenced by catch rates in a relatively small area, as in inner Trinity Bay in 1994. This difference among areas indicates that an abundance index using a simple arithmetic mean may be heavily influenced by abundance in a relatively localized area. This observation is consistent with the concept that recruitment success among different inshore spawning groups may not be synchronous. Alternatively the fact that both age 0's and age 1's increased in the same year (1994) suggests there may be a year effect in the Trinity Bay data in 1994 which resulted in higher catch rates.

Bonavista Bay consistently had low catch rates of age 0 and 1 cod during the demersal trawl surveys. However, it is not apparent that there was less juvenile cod habitat available in Bonavista compared to the other large Northeast coast bays. Historic and recent nearshore beach seine surveys have not found that age 0 and 1 juvenile cod were less abundant in Bonavista Bay compared to the other bays along the coast of Newfoundland (Schneider et al. 1997). It is postulated, therefore, that the low catch rates of juvenile cod in Bonavista Bay is an artifact of the survey methods (i.e. the fishing gear, which is limited to relatively smooth bottoms). An abundance index from a trawl survey can only represent trawlable areas. A large proportion of the inshore areas, Bonavista Bay in particular, are untrawlable. Recent observations (Gregory and Anderson, in press) indicate that juvenile cod utilize such 'high bathymetric relief areas' and that habitat selection for such areas may be age specific.

In order to accurately assess abundance of cod for the northern cod stock (2J3KL), particularly pre-recruits, it will be necessary to include the inshore areas. However, knowing that a large proportion of the inshore areas are untrawlable, it will be necessary to account for this in the

survey design. Previously, we have proposed an approach that would delineate the inshore into trawlable and untrawlable areas (Anderson and Dalley, unpubl. report, 1995). For trawlable areas, strata can be assigned based on the same principles used for the offshore. For untrawlable areas, specific surveys must be carried out to quantify the abundances of cod. These surveys would use acoustic techniques to measure cod abundance and habitats (Gregory and Anderson 1996), as well as alternate sampling techniques which may include gill nets, seines, handlining and cameras. A research program developing the acoustic techniques in now underway.

References

Anderson, J.T., and Dalley, E.L. 1993. Inshore/offshore distributions and abundances of pelagic 0-group cod in NAFO Divisions 3K and 3L in fall of 1991 and 1992. NAFO SCR Doc. 93/32, Ser No. N2212.

Anderson, J.T., and Dalley, E.L. 1997. Spawning and year-class strength of northern cod (*Gadus morhua*) as measured by pelagic juvenile cod surveys, 1991-1994. Can. J. Fish. Aquat. Sci. 54(Supp.1): 000-000.

Bishop, C.A., Murphy. E.F., Davis, M.B., Baird, J.W., and Rose, G.A. 1993. An assessment of the cod stock in NAFODivisions 2J+3KL. NAFO SCR Doc. 93/86 , Ser No. N2212.

Bulatova, A.Y. 1971. Estimation of young cod in the Labrador and Newfoundland areas in 1961-67. Proc. Polar Res.Ins. Mar. Fish. Ocean. 23: 262-278 (1968). Fish. Res. Bd. Can. Trans. Ser. No. 1917.

Dalley E.L., and Anderson, J.T. Anderson. 1994. Distribution and abundance of demersal juvenile cod (*Gadus morhua*) from inshore to offshore locations on the northern Grand Bank and Northeast Newfoundland shelf in December, 1992.NAFO Sci. Coun. Studies, 21:91-103.

Dalley E.L., and Anderson, J.T. Anderson. 1997. Age dependent distribution of demersal juvenile cod (*Gadus morhua*) in inshore/offshore Northeast Newfoundland. Can J. Fish. Aquat. Sci. 54 (Suppl. 1): 000-000.

Davidson, F. J. M. and DeYoung, B. 1995. Modelling advection of cod eggs and larvae on the Newfoundland shelf. Fish. Oceanogr. 4:1, 33-51.

Gregory R.S. and Anderson, J.T. (In press) Substrate selection and use of protective cover by juvenile Atlantic cod (*Gadus morhua*) in inshore waters of Newfoundland. Mar. Ecol. Progr. Ser. 00:000-000.

Gregory R.S., Anderson, J.T. and Dalley, E.L. 1996. Use of habitat information in conducting assessments of juvenile cod abundance. NAFO SCR. Doc. 96/23, Ser. No. N2696.

Helbig, J., Mertz, G., and Pepin, P. 1992. Environmental influences on the recruitment of Newfoundland/Labrador cod. Fish. Oceanogr. 1:39-56.

Schneider, D.C., Dalley, E.L., and Methven D.A. 1997. Geographic contraction in juvenile fish: a

test with northern cod at low abundances. 1997. Can. J. Fish. Aquat. Sci. 54 (Suppl. 1):000-000.

Schneider, D.C., Hennebury, P., Methven, D., Ings, D., Howell, J., White, S., Pinsent, D., and Bailey, W. 1996. Results of the 1995 Fleming Survey of demersal juvenile cod in the coastal zone of eastern Newfoundland. DFO Atl. Fish. Res. Doc. 96/46

Shelton, P.A., Stansbury, D.E., Murphy, E.F., Lilly, G.R., and Brattey, J. 1996. Assessment of the cod stock in NAFO Divisions 2J+3KL. NAFO SCR Doc. 96/62.

Table 1. Summary of mean catch rates for each age group of juvenile cod in inshore and offshore areas of 2J3KL during the 1995 survey. 'Index'represents the mean catch rates of composite sets which best approximate the line transect design of previous juvenile cod surveys (see methods); 'All 3KL' represents the mean catch rates of all sets done in offshore 3K and 3L during the RS survey; '> 47.5° N' represents the mean catch rates of all offshore sets in 3K, plus those north of 47.50 N in 3L. (Numbers in brackets are the standard deviations of the means.)

Area	In/Off	# sets	Age 0 '95 YC	Age 1 '94 YC	Age 2 '93 YC	Age 3 '92 YC
2J	**Off**	84	0.1 (0.9)	5.4 (10.7)	4.2 (9.5)	3.5 (7.3)
3K	**In**	9	13.6 (32.3)	22.2 (33.0)	6.2 (10.1)	1.1 (1.5)
3K	**Off**	131	0.06 (0.4)	4.3 (8.8)	3.1 (4.6)	2.6 (5.1)
3L	**In**	16	22.1 (41.6)	61.5 (88.6)	16.6 (17.1)	0.5 (1.2)
3L	**Off**	169	0.01 (0.2)	0.2 (1.0)	0.6 (2.6)	1.2 (5.6)
3KL	**In**	25	19.0 (38.1)	47.4 (75.1)	12.9 (15.6)	0.7 (1.3)
3KL	**Index**	39	0.07 (0.3)	4.3 (7.7)	2.9 (3.3)	2.3 (2.9)
3KL	**All 3KL**	300	0.03 (0.3)	2.0 (6.2)	1.7 (3.9)	1.8 (5.4)
3KL	**>47.5°N**	204	0.04 (0.3)	2.8 (7.3)	2.4 (4.5)	2.5 (6.5)

List of Figures

Figure 5. Distribution of demersal age 1 cod caught during demersal trawl surveys carried out in NAFO Divisions 2J3KL in 1995. The expanding symbols represent a linear scale based on catches per 30 minute tow. Crosses represent zero catch.

Figure 6. Distribution of demersal age 2 cod caught during demersal trawl surveys carried out in NAFO Divisions 2J3KL in 1995. The expanding symbols represent a linear scale based on catches per 30 minute tow. Crosses represent zero catch.

Figure 7. Distribution of demersal age 3 cod caught during demersal trawl surveys carried out in NAFO Divisions 2J3KL in 1995. The expanding symbols represent a linear scale based on catches per 30 minute tow. Crosses represent zero catch.

Figure 8. Comparison of the 3 mean offshore catch rates of age 0 - 3 juvenile cod derived from in 1995 survey. The 3 means include 1) the 'index' using a composite value for each set in the fixed station design, 2) all sets from the RS survey in 3KL, and 3) similar to 2 but limited to stations in 3KL north of 47.5°N.

Figure 9. Comparison of mean catch rates of age 0 - 3 juvenile cod in 1995 with those of 1992 - 1994, for inshore (top panel), offshore (middle panel) and combined (bottom panel) areas of the survey.

Figure 10. Comparison of mean catch rates of age 0 demersal juvenile cod in each of the large

Northeast coast bays, 1992-1995. The overall mean inshore catch rate is also presented.

Figure 11. Comparison of mean catch rates of age 1 demersal juvenile cod in each of the large Northeast coast bays, 1992-1995. The overall inshore index (mean catch rate) is also presented.

Figure 12. Ratio of mean inshore/offshore catch rate for age 0-3 demersal juvenile cod caught in demersal trawl surveys 1992 - 1995.

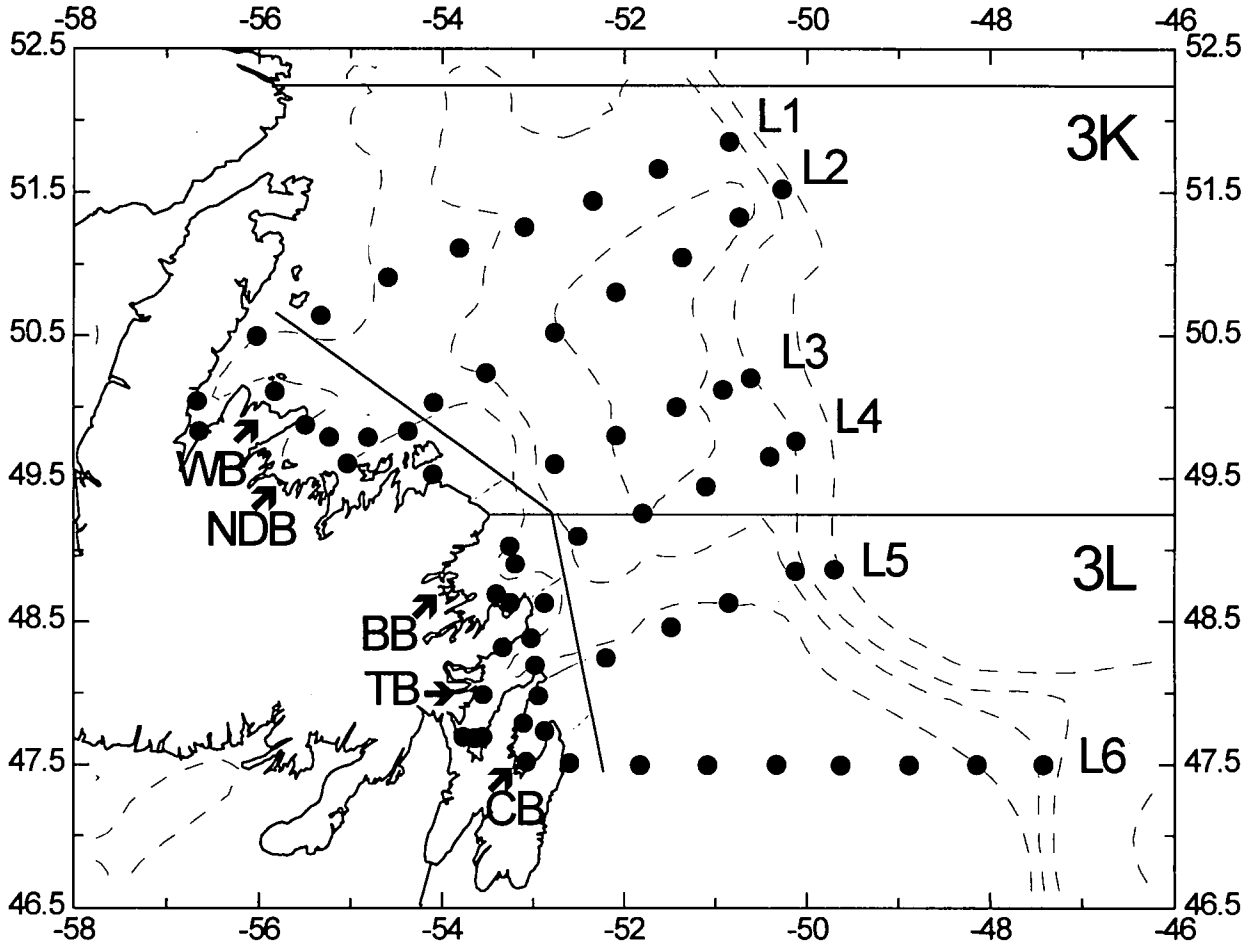
-58
-56
-54
-52
-50
-48
-46
52.5
51.5
50.5
49.5
48.5
47.5
46.5
L1
L2
3K
L3
L4
WB
NDB
L5
3L
BB
TB
L6
CB

FIGURE 1.

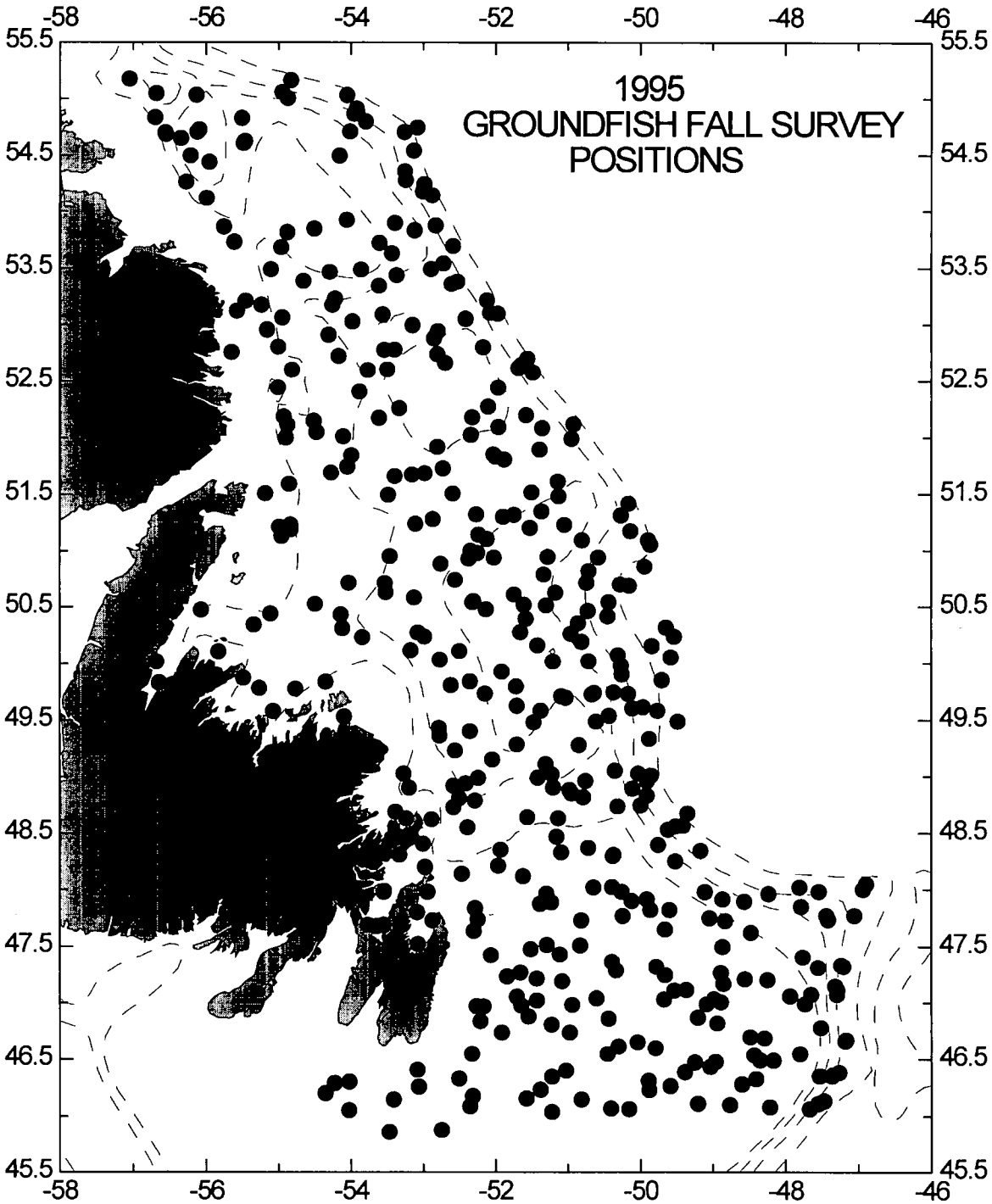
1995
GROUNDFISH FALL SURVEY
POSITIONS
-58
-56
-54
-52
-50
-48
-46
55.5
54.5
53.5
52.5
51.5
50.5
49.5
48.5
47.5
46.5
45.5

FIGURE 2.

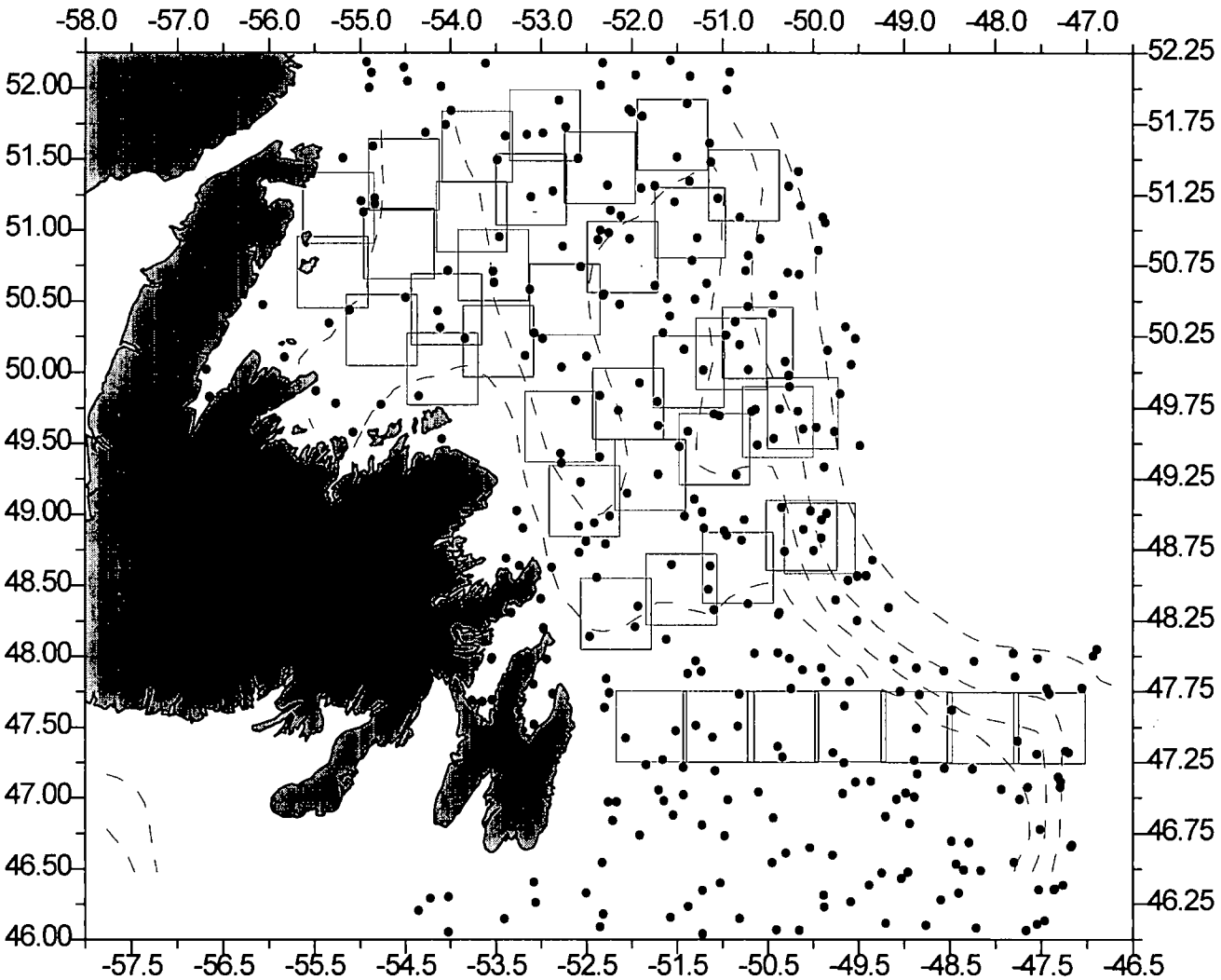
-58.0
-57.0
-56.0
-55.0
-54.0
-53.0
-52.0
-51.0
-50.0
-49.0
-48.0
-47.0
52.00
51.50
51.00
50.50
50.00
49.50
49.00
48.50
48.00
47.50
47.00
46.50
46.00
52.25
51.75
51.25
50.75
50.25
49.75
49.25
48.75
48.25
47.75
47.25
46.75
46.25
-57.5
-56.5
-55.5
-54.5
-53.5
-52.5
-51.5
-50.5
-49.5
-48.5
-47.5
-46.5

FIGURE 3.

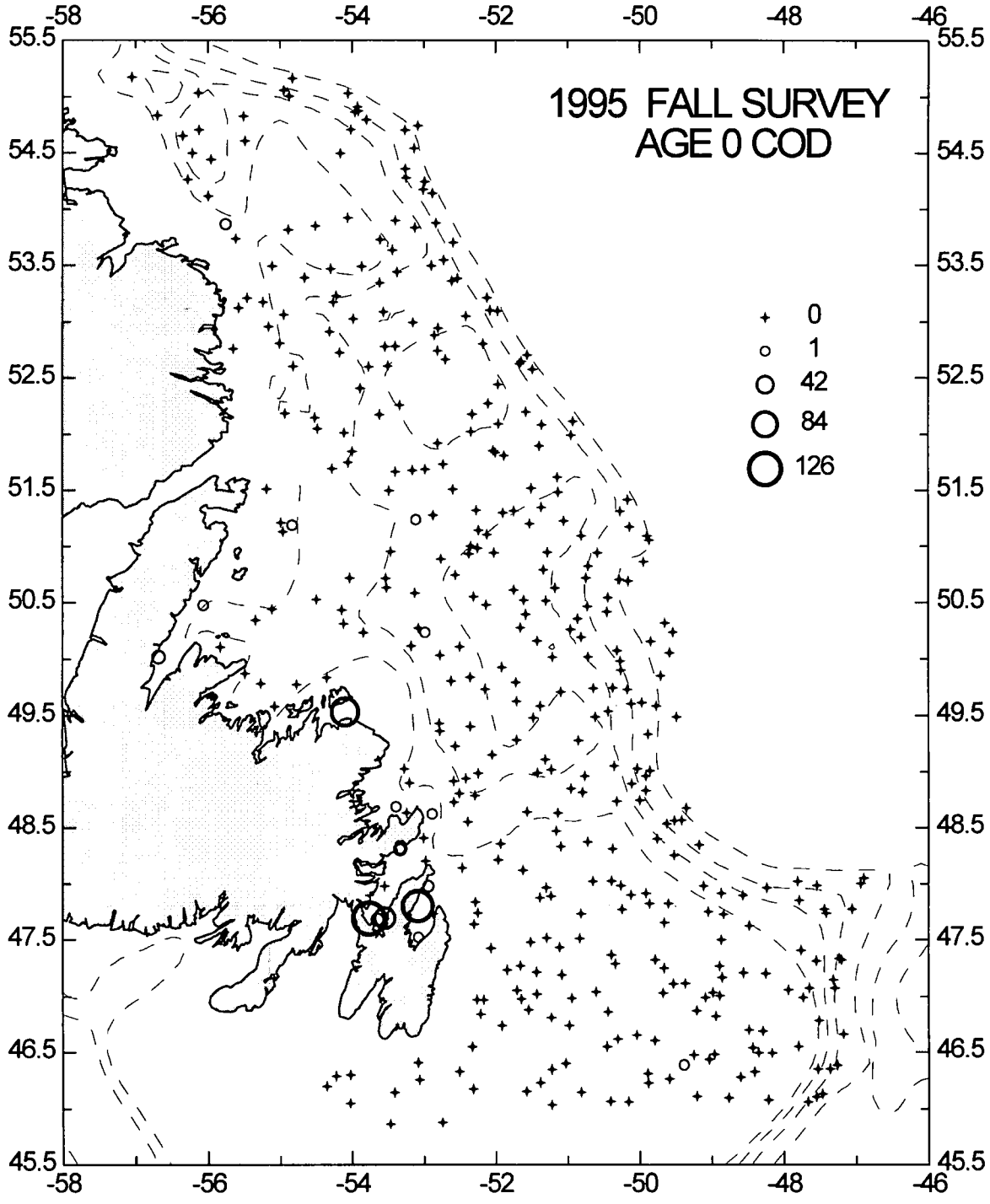
1995 FALL SURVEY
AGE 0 COD
0
1
42
84
126
-58
-56
-54
-52
-50
-48
-46
55.5
54.5
53.5
52.5
51.5
50.5
49.5
48.5
47.5
46.5
45.5

FIGURE 4.

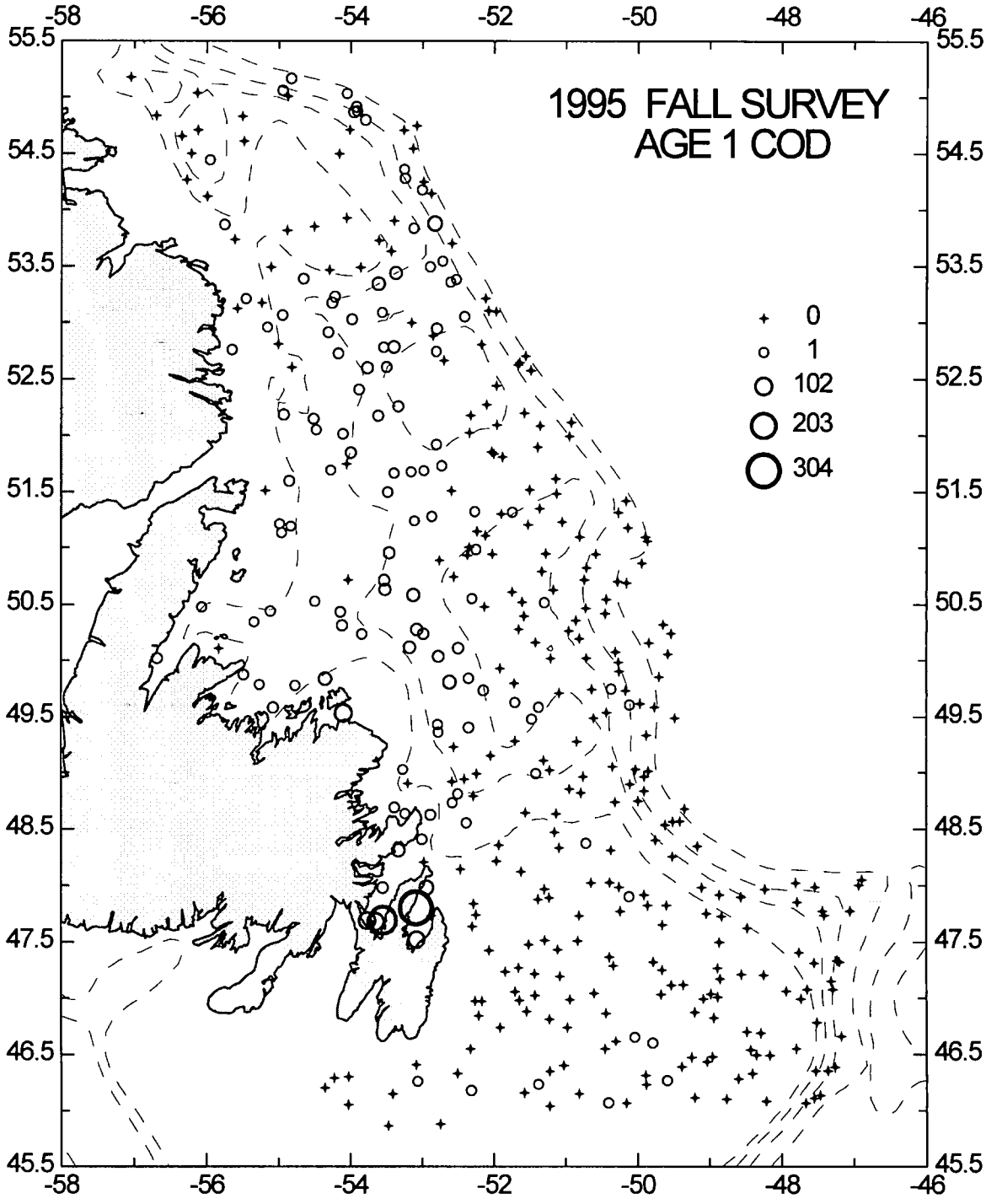
1995 FALL SURVEY
AGE 1 COD
0
1
102
203
304
-58
-56
-54
-52
-50
-48
-46
55.5
54.5
53.5
52.5
51.5
50.5
49.5
48.5
47.5
46.5
45.5

FIGURE 5.

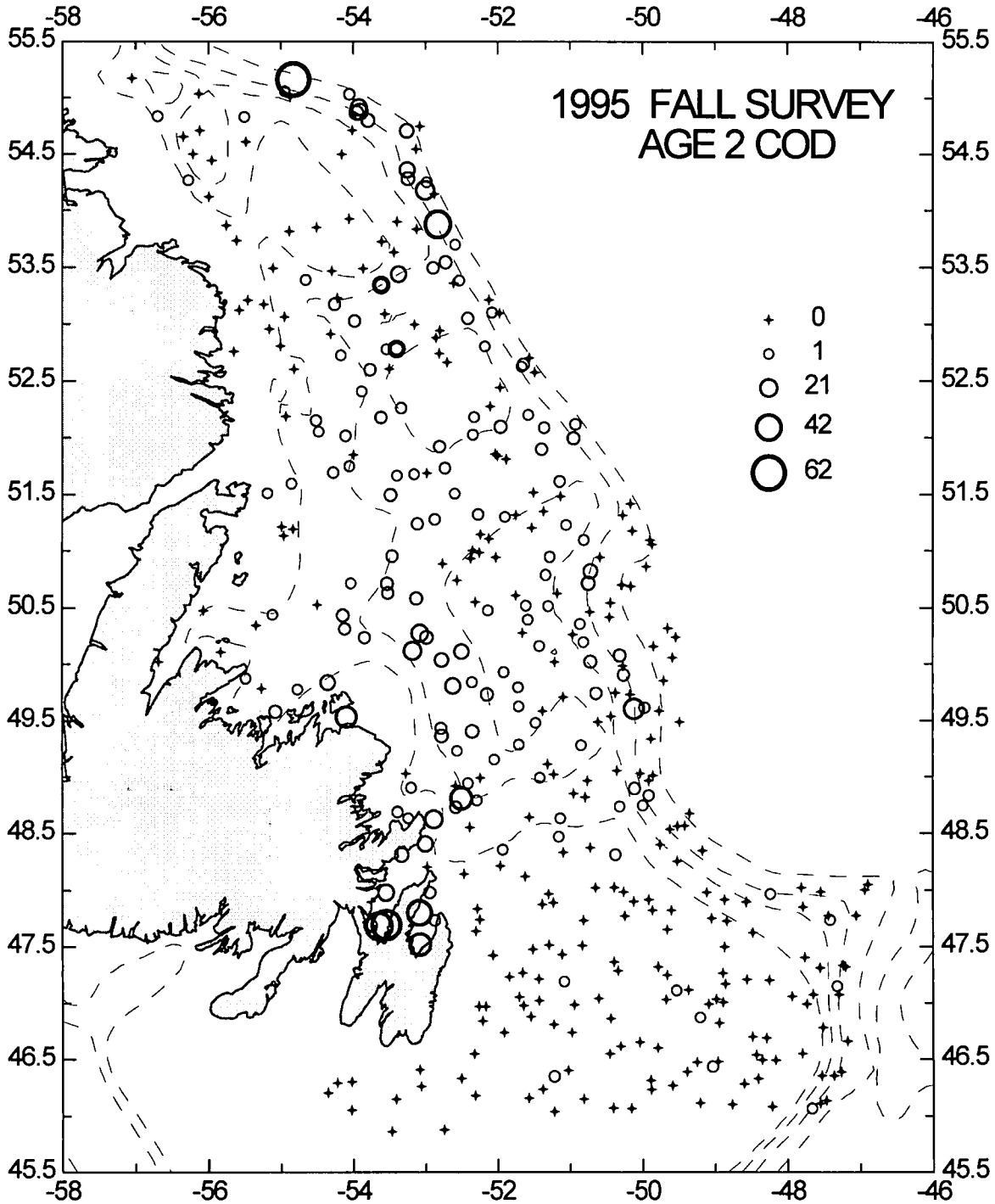
1995 FALL SURVEY
AGE 2 COD
0
1
21
42
62
-58
-56
-54
-52
-50
-48
-46
55.5
54.5
53.5
52.5
51.5
50.5
49.5
48.5
47.5
46.5
45.5

FIGURE 6.

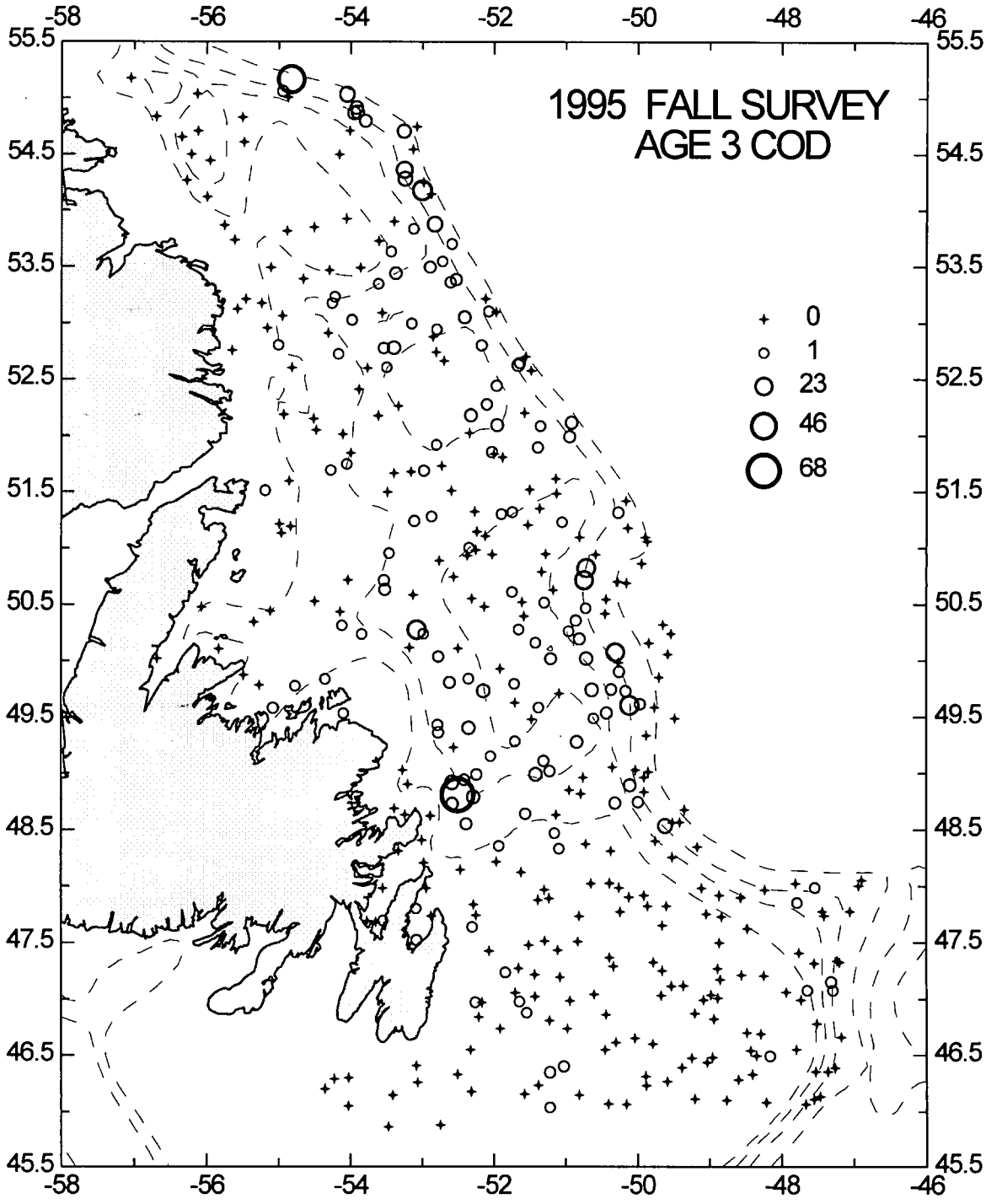
1995 FALL SURVEY
AGE 3 COD
0
1
23
46
68
-58
-56
-54
-52
-50
-48
-46
55.5
54.5
53.5
52.5
51.5
50.5
49.5
48.5
47.5
46.5
45.5

FIGURE 7.

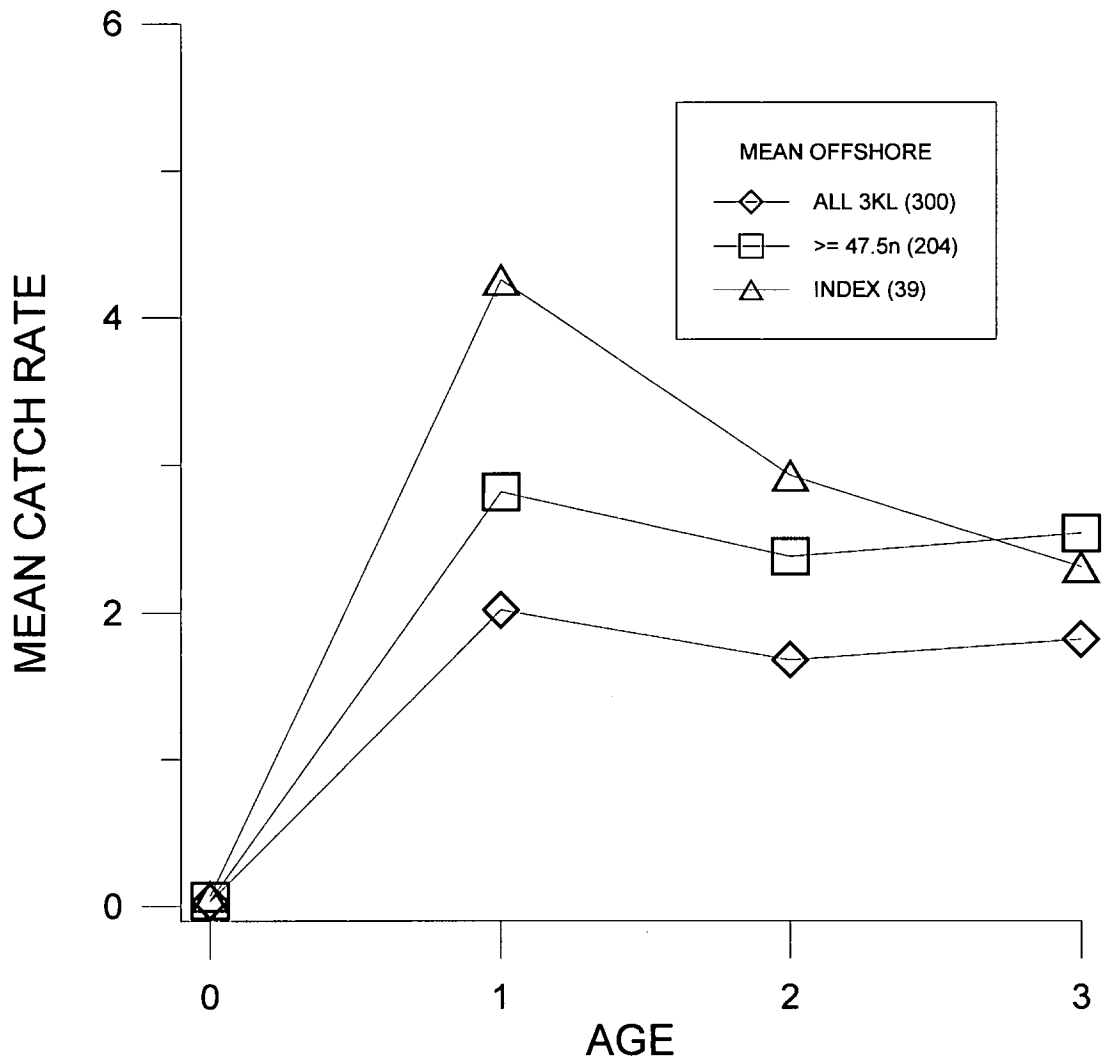
MEAN OFFSHORE
ALL 3KL (300)
>= 47.5n (204)
INDEX (39)
MEAN CATCH RATE
6
4
2
0
0
1
2
3
AGE

FIGURE 8.

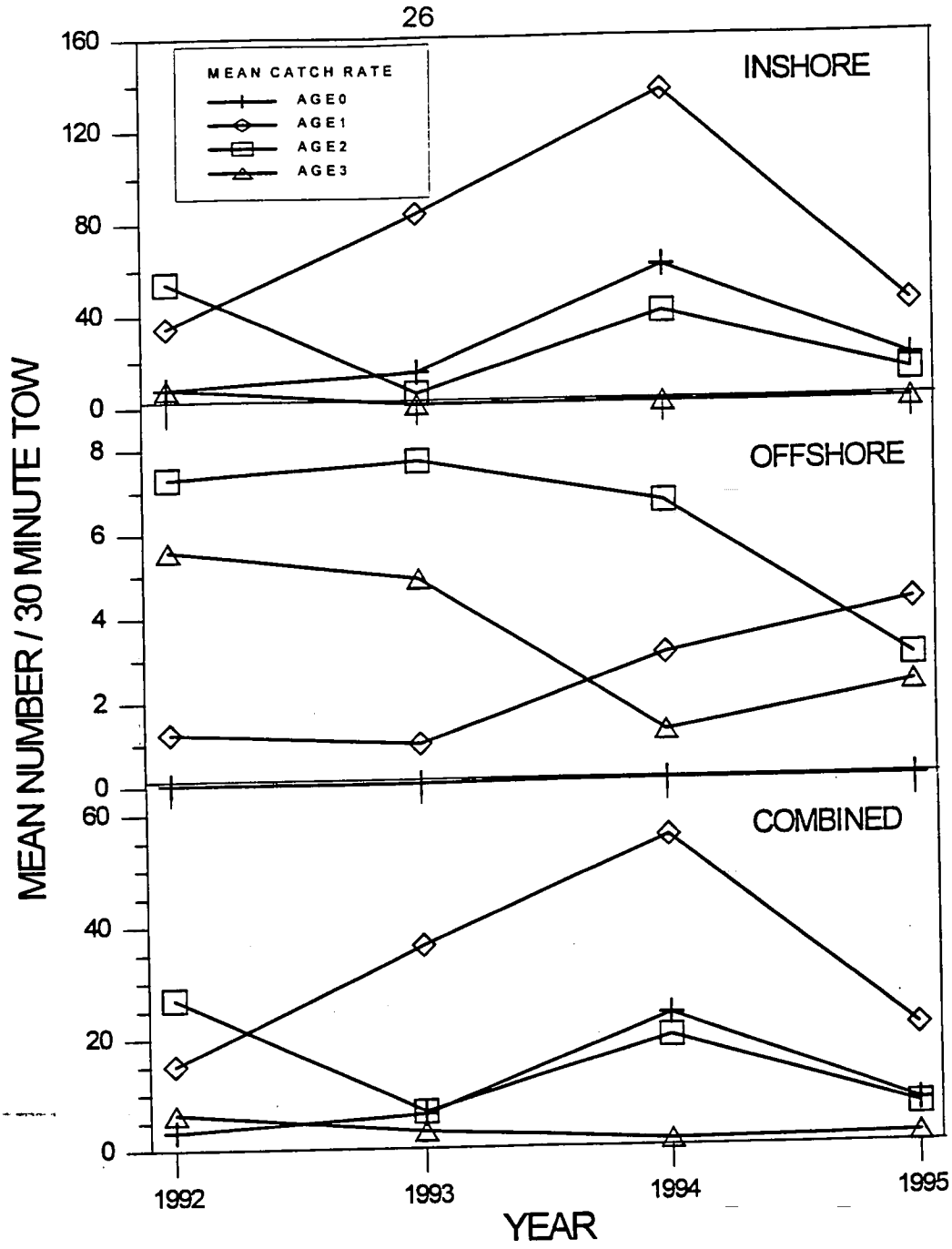
MEAN CATCH RATE
AGE0
AGE1
AGE2
AGE3
INSHORE
OFFSHORE
COMBINED
MEAN NUMBER / 30 MINUTE TOW
YEAR
160
120
80
40
0
8
6
4
2
0
60
40
20
0
1992
1993
1994
1995

FIGURE 9.

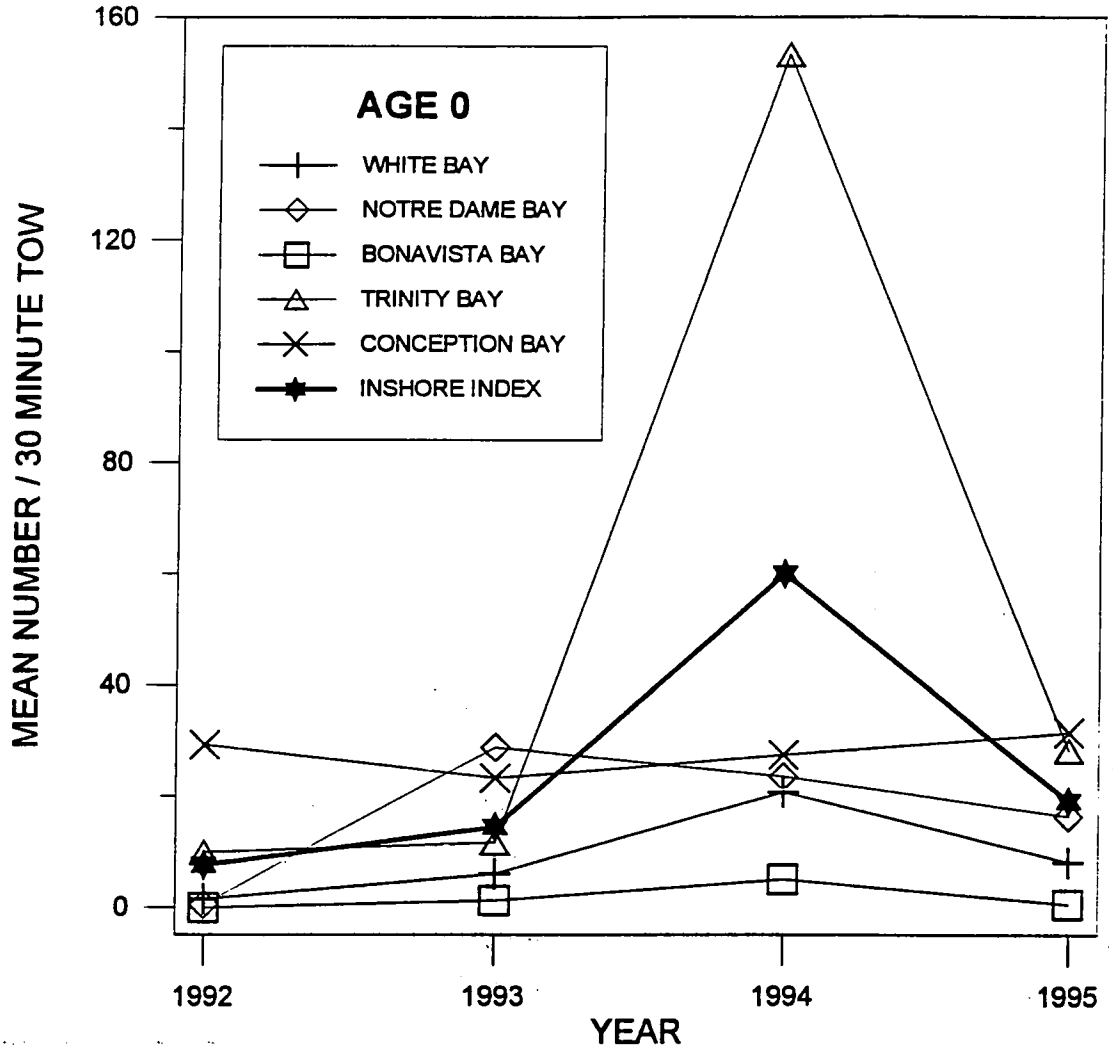
AGE 0
WHITE BAY
NOTRE DAME BAY
BONAVISTA BAY
TRINITY BAY
CONCEPTION BAY
INSHORE INDEX
MEAN NUMBER / 30 MINUTE TOW
160
120
80
40
0
1992
1993
1994
1995
YEAR

FIGURE 10.

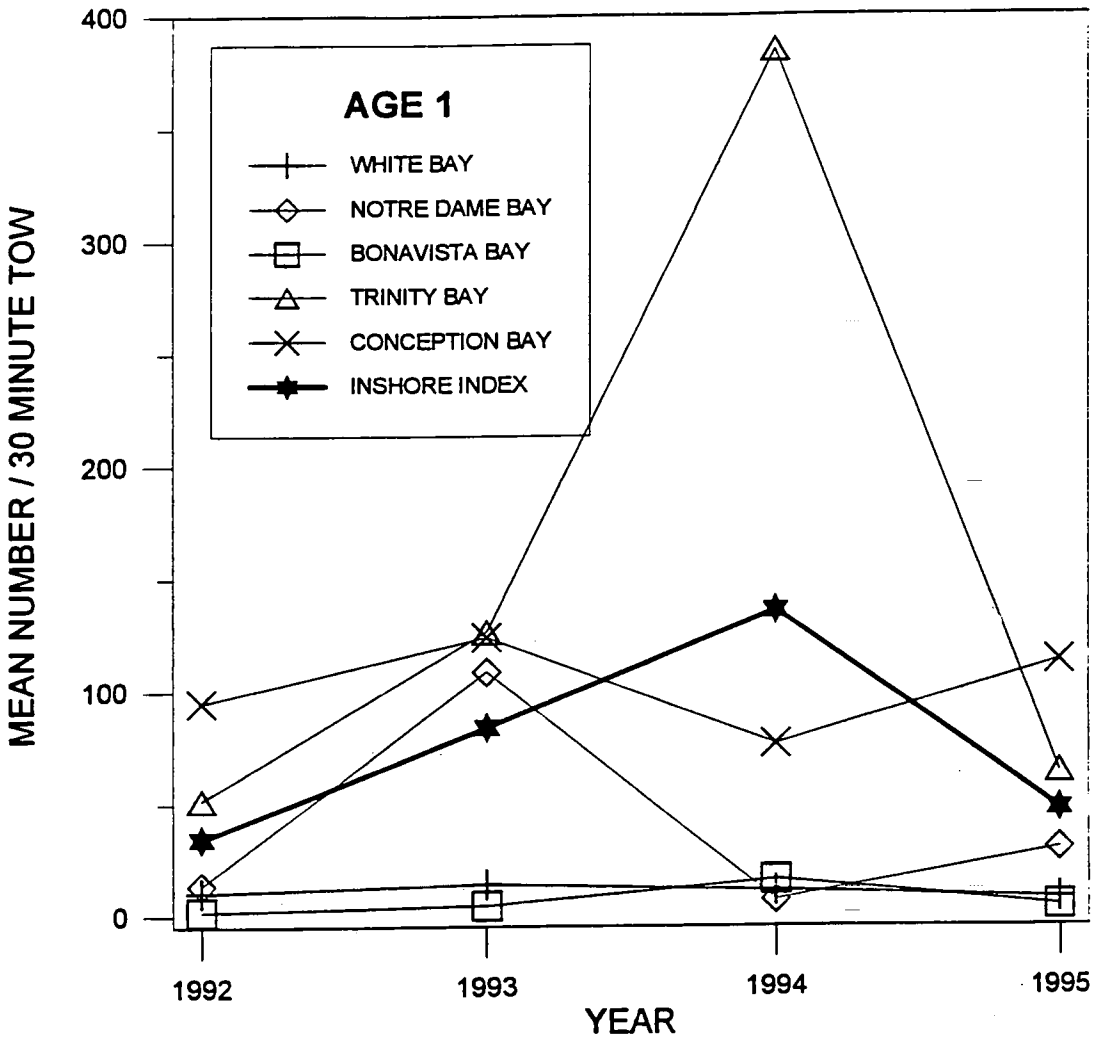
AGE 1
WHITE BAY
NOTRE DAME BAY
BONAVISTA BAY
TRINITY BAY
CONCEPTION BAY
INSHORE INDEX
MEAN NUMBER / 30 MINUTE TOW
400
300
200
100
0
1992
1993
1994
1995
YEAR

FIGURE 11.

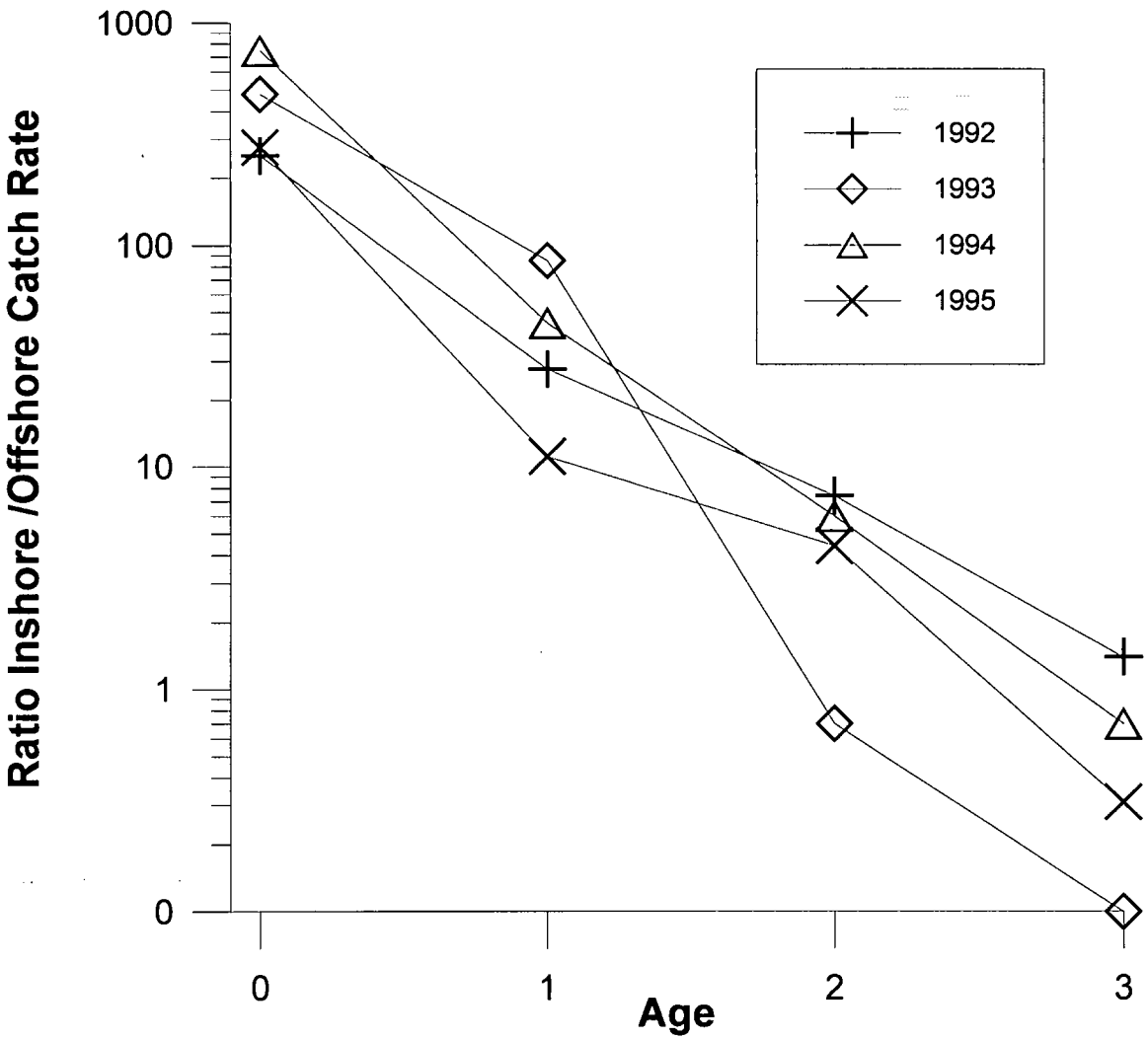
Ratio Inshore /Offshore Catch Rate
1000
100
10
1
0
0
1
2
3
Age
1992
1993
1994
1995

FIGURE 12.