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Second Year Results of Surveys Directed at Cod in NAFO Division 3Ps

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Abstract

To enhance the fisheries research database in NAFO Division 3Ps, the Groundfish Enterprise Allocation Council (GEAC) has funded surveys during fall 1997 and fall 1998 directed at cod. The continuing intent is to create a series of annual fall surveys in 3Ps to complement current resource assessment activities carried out by the Department of Fisheries and Oceans (DFO). GEAC funded and performed the surveys with scientific guidance from DFO in the design and execution of a stratified random survey and the associated sampling. The data collected during these surveys have been subsequently analysed on behalf of GEAC for the express intent of providing this information to DFO, for their databases and their assessment work. This is the second such GEAC survey in 3Ps following on the 1997 survey (CSAS Research Document 99/20). One trip to perform the 1998 survey was carried out from 30 November to 11 December 1998. This time period matches the 8-17 December period in which the 1997 stratified random survey was conducted. During the trip, set details and length frequencies were logged in the DFO FFS system and otoliths were collected for subsequent aging. Catch statistics, length and age distribution, and stratified analysis estimates of cod abundance and biomass, including age distribution estimates are presented.

Résumé

Afin d'améliorer la base de données de recherche sur les pêches pour la Division 3Ps de l'OPANO, le Conseil des allocations aux entreprises d'exploitation du poisson de fond (GEAC) a financé des relevés de la morue, réalisés à l'automne de 1997 et de 1998. L'objectif, depuis le début, est de mettre en œuvre une série de relevés annuels automnaux dans 3Ps, qui viendraient compléter les évaluations actuelles faites par le ministère des Pêches et des Océans (MPO). Le GEAC a financé et réalisé les relevés, avec l'aide des conseils scientifiques du MPO, en ce qui concerne la conception et l'exécution suivant la technique d'échantillonnage aléatoire stratifié ainsi que des échantillonnage connexes. Les données recueillies lors de ces relevés ont été analysées pour le compte du GEAC, dans le seul but de transmettre les renseignements obtenus au MPO, qui pourra s'en servir pour compléter ses bases de données et ses travaux d'évaluation. Ce relevé est le deuxième du genre exécuté par le GEAC dans 3PS, le premier ayant été effectué en 1997 (document de recherche SCÉS 99/20). L'échantillonnage de 1998 a été effectué en une seule sortie, du 30 novembre au 11 décembre 1998, qui correspond à celle du 8 au 17 décembre en 1997, où avait eu lieu l'échantillonnage aléatoire stratifié de 1997. Au cours de cette sortie, les détails des stations et des fréquences de longueur ont été enregistrés dans le système FFS du MPO, des otolithes ont aussi été prélevés pour déterminer l'âge des prises. Ce document présente des données sur les prises, la répartition de la taille et des âges ainsi que des estimés à partir des analyses stratifiées sur l'abondance et la biomasse de la morue et la répartition des âges.

Introduction

To enhance the fisheries research database in NAFO Division 3Ps, the Groundfish Enterprise Allocation Council (GEAC) has funded surveys during fall 1997 and fall 1998 directed at cod. The continuing intent is to create a series of annual fall surveys in 3Ps to complement current resource assessment activities carried out by the Department of Fisheries and Oceans (DFO). GEAC funded and performed the surveys with scientific guidance from DFO in the design and execution of a stratified random survey and the associated sampling. The data collected during these surveys have been subsequently analysed on behalf of GEAC for the express intent of providing this information to DFO, for their databases and their assessment work. This is the second such GEAC survey in 3Ps following on the 1997 survey (CSAS Research Document 99/20 [1]). Interest in this survey was directed both at cod and at american plaice and witch flounder. The results for the flatfish are presented in the companion CSAS Research Document 99/59 [2]. One trip to perform the 1998 survey was carried out from 30 November to 11 December 1998. This time period matches the 8-17 December period in which the 1997 stratified random survey was conducted. During the trip, set details and length frequencies were logged in the DFO FFS system and otoliths were collected for subsequent aging.

Under contract to GEAC, AGRA Earth & Environmental has taken the data logged using the DFO FFS system, combined with the aged otoliths, created digital data files appropriate for inclusion in the DFO (VAX computer system) databases, and performed a first analysis of the survey results. This document presents these results.

Methods and Materials

A Stratified Random survey was carried out in 3Ps by the M.V. Pennysmart. A summary of the trip is presented below.

Trip 3: Stratified Random Survey

Trip 3 was carried out from 30 November to 11 December 1998. This time period is consistent with the 1997 random stratified survey sets which were taken between 8-17 December 1997. The Pennysmart, same boat as in 1997 and with the same captain, sailed from Marystown for operation in 3Ps, St. Pierre Bank, Halibut Channel, and Green Bank. The survey was directed at cod, american plaice, and witch flounder. Set details, length, sex, and otolith information were sampled. Weather and seas were poor for the first seven days limiting the number of sets completed and being a possible factor in gear performance.

Tows of duration 30 minutes using an Engels 96 high lift trawl with a 135 mm diamond mesh cod end (not lined) were conducted. The trawl was fitted with rock hopper foot gear and Bergen #7 trawl doors. Performance of the trawl was checked onboard using NETMIND sensors: bridge display of doorspread,

wingspread, and net opening (headline height) was visually monitored and measurements were noted by Winse Legge on the written bridge log for each set every five minutes. The trawl gear and configuration were identical to those used in the 1997 survey.

A total of 86 successful stratified random tow sets were completed. Three sets were unsuccessful.

Data were logged using FFS with the length and otolith sampling carried out on board. The resulting ages were input to create an age and growth digital file.

Results and Discussion

Shore-based Analysis

The set details and cod length frequencies were exported from FFS to create ASCII data files. The age and growth data were keyed in following completion of the otolith aging by Norm Batten (otolith reader for 1997 as well). The sole focus in the work presented here is for cod.

The cod were sampled in 1 cm length groupings and all ratio/percentages of catch measured were applied.

ACON plots of the spatial distribution of catch numbers and weights were carried out. These are presented in Figures 1 and 2. Table 1 presents a summary of the cod set details and catch numbers and weights.

The mean cod catch for the 86 stratified random sets is 25 fish and a mean catch weight of 127 kg. The largest catch of 1239 cod and weight 8035 kg was from set 59 in the Halibut Channel. A total of 10 sets had catches over 100 kg, four sets with catches over 200 kg. The mean cod weight for all sets was 1.92 kg per cod. The mean weight for the largest catch set 59 was 6.5 kg.

Gear Performance

During the first day of the survey, the trawl was fouled on the bottom and lost. The NETMIND sensors and hydrophone were used by the skipper to locate and retrieve the trawl. During recovery of the gear, the headline sensor suffered a severe impact. It is believed that this blow caused the transmit crystal inside the sensor to weaken and eventually fail which ultimately caused the sensor to stop working after set 50. The doorspread slave sensor failed due to water leakage. It is believed the unit had suffered damage on an earlier trip, an attempt was made to repair; however, the sensor did leak again. No doors other than a value for set 33 were reported after set 25. The wing sensor failed after set 25. Some of the towing was over rough sea bottom and it is suspected that the sensors took a severe beating, ultimately leading to failure of the transducer inside the sensor housing. This history of likely events with the NETMIND system installed on the Pennysmart was provided by the NETMIND manufacturers [3] who go on

to comment that the NETMIND system is in wide use in Canada and the US and has proven to be very reliable.

For the reported sets, doorspread exhibited values varying from 60 to 90 m, while wingspread was fairly consistent with a mean value of 17.6 m (Figure 3). This wingspread value is consistent with the 60 foot estimate used in the 1997 survey for which some net parameter measurements were collected by a SCANMAR system; however, that system performed with some problems in the later sets. No wingspread data are available from that 1997 survey: the 1997 best estimate of 60 feet was used again for the 1998 stratified analysis as described below.

Figure 4 presents the length composition of the 1998 survey and, for comparison, results from stratified random surveys sets on the St. Pierre Bank from the 1997 survey. The 1998 distribution shows two peaks, one at 88 cm and extending between 82 to 95 cm and a second peak near 62-65 cm and extending between about 55 and 73 cm. The fish range in size between less than 40 cm up to 118 cm (with age 15 in set 59). The 1997 distribution is not as broad. Fish range in size between less than 40 cm up to 102 cm, with very few fish larger than about 85-90 cm in dramatic contrast to the 1998 numbers at those lengths. The 1997 distribution shows one broad peak in the 55 to 70 cm range, similar to the smaller lengths peak in 1998 but with noticeably greater numbers at those lengths.

Figures 5a to 5c present age composition of the 1998 sampled cod again including comparisons with the 1997 results. Figures 5a and 5a-97 present length versus age distribution. Figures 5b and 5c present bar charts of the percent occurrence and sampled numbers of cod at age. Several cod as old as 13 and 15 were sampled. The 1998 survey shows a greater number of fish at ages 6, 9 and above, than for 1997, with considerably fewer fish at ages 7 and to a slighter lesser extent 8 and 5 than in 1997. Results appear quite similar for age 4 although from Figure 5a and consistent with the larger length distribution in Figure 4 it appears that the mean length at age 4 is somewhat larger for 1998 than for 1997.

Stratified Random surveys analysis was carried out using the DFO stratified analysis STRAP software and applying the French Exclusion Zone around St. Pierre et Miquelon for area calculations. The 1997 STRAP estimates were repeated with this new stratum areas files. The wingspread of 60 feet was used in all cases. Table 2 presents the STRAP output of estimated abundance and biomass. The estimated total number of cod is 10.5 million (with 75% confidence limits of 9.1 and 11.9 million). The mean number of cod per standard 1.5 nautical mile tow is 12.6 (with limits of 11 and 14 fish). The estimated total cod biomass is 47,875 tonnes (with limits of 38,933 and 56,818 tonnes). The mean catch weight per tow is 57.5 kg (with limits of 46.8 and 68.3 kg). Note that the variances are too large to estimate lower confidence limits at the 95% level.

Problematic in this regard are large variances in catches exhibited for the three sets in stratum area 318 (set 40, 46 fish, 156 kg; set 59, 1239 fish, 835 kg; set 63, 1 fish, 1.2 kg). Table 2-97 presents corresponding 1997 STRAP abundance and biomass estimates. Total estimated abundance in 1997 was 31 million, and a mean number per set of 52.6, four times the 1998 estimate. Biomass estimates for 1997 were 99,330 tonnes with a mean catch weight of 169 kg.

Table 3 presents the STRAP age composition of numbers per tow, with sexes combined. The total mean number per tow is 12.6 (consistent with the value in Table 3, smaller than the mean of 25 in Table 1), with the greatest numbers expected at ages 9 (3.4 fish per tow), 5 (2.32 fish), 6 (1.81 fish), 4 (1.76 fish) and 8 (1.64 fish). Table 3-97 presents corresponding 1997 STRAP results.

Figures 6a and 6b present the STRAP-estimated mean numbers per tow and the relative percent occurrence that these numbers represent per tow. In Figure 6a the numbers are greater in 1997 for all ages except 9 and 12 and above. In Figure 6b, the much greater age 9 representation for 1998 is accentuated, while age 6 now appears to be more frequent, relatively speaking, in 1998 than from the 1997 numbers.

Figures 7a and 7b present a reworking of Figure 6a and 6b presenting age composition by year class as opposed to age. The strong 1989 and 1992 year classes seen in the 1997 survey are visible in the 1998 results, similarly the 1991 year class remains weak from 1997 to 1998. Figure 7b illustrates that while the estimated numbers were four times larger in 1997, that the 1989 year class is more prevalent (relatively speaking) in 1998 and that the numbers are comparable for the 1993 and 1988 year classes.

The author would like to thank Noel Cadigan, Barry McCallum, Joanne Morgan, Eugene Murphy, and Don Stansbury of DFO for their assistance and technical input in this survey work.

References

[1] McClintock, J., 1998. "Results of Surveys Directed at Cod in NAFO Division 3Ps". CSAS Research Document 99/20." (Results of fall 1997 survey reworked February 1999).

[2] McClintock, J., 1999. " American Plaice and Witch Flounder Catch Results from Surveys in NAFO Division 3Ps." CSAS Research Document 99/59."

[3] Hall, J, 23 February 1999. "NETMIND System". Fax communication.

Table 2 Stratified Analysis Estimated Cod Abundance and Biomass

COD GEAC 3PS 1998 No Zone
 ANALYSIS FOR TRIP 3 1998
 VESSEL 49
 ICNAF 3P
 SPECIES 0438

NUMBERS						
STRATUM	NO. SETS	TOTAL	AV./SET	UNITS	TOTAL NO	VAR.
310	2	151.00	75.50	9255.	698784.	220.50
311	2	7.00	3.50	17903.	62660.	12.50
312	2	4.00	2.00	16281.	32563.	0.00
313	2	30.00	15.00	11147.	167206.	98.00
314	5	90.00	18.00	61748.	1111461.	996.50
315	5	139.00	27.80	52357.	1455532.	603.70
316	2	56.00	28.00	11147.	312117.	450.00
317	2	57.00	28.50	11620.	331168.	1404.50
318	3	1286.00	428.67	8715.	3735810.	492986.34
319	7	39.00	5.57	66477.	370371.	27.29
320	8	154.00	19.25	79988.	1539777.	1740.50
321	7	18.00	2.57	73503.	189007.	7.29
322	8	8.00	1.00	94648.	94648.	1.43
323	5	5.00	1.00	47020.	47020.	1.50
324	3	7.00	2.33	33374.	77872.	16.33
325	6	1.00	0.17	63775.	10629.	0.17
326	2	0.00	0.00	11215.	0.	0.00
705	2	1.00	0.50	13174.	6587.	0.50
706	3	3.00	1.00	28509.	28509.	1.00
707	2	72.00	36.00	4999.	179974.	1682.00
708	2	2.00	1.00	8512.	8512.	2.00
712	3	0.00	0.00	49385.	0.	0.00
713	3	1.00	0.33	57492.	19164.	0.33

LOWER CONFIDENCE LIMIT IS LESS THAN OR EQUAL TO ZERO

****-VARIANCE TOO LARGE FOR VALID CONFIDENCE INTERVAL AT THIS VALUE OF ALPHA-****

		TOTAL	AVERAGE			
TOTAL	UPPER	LOWER	MEAN	UPPER	LOWER	
10479370.	27227464.	-6268723.	12.59	32.72	-7.53	
75% Limits	11.9M	9.1M		14.3	10.9	

EFFECTIVE DEGREES OF FREEDOM= 2 STUDENTS T-VALUE= 4.30 ALPHA=0.05

WEIGHTS						
STRATUM	NO. SETS	TOTAL	AV./SET	UNITS	TOTAL NO	VAR.
310	2	394.00	197.00	9255.	1823317.	2888.00
311	2	13.40	6.70	17903.	119949.	56.18
312	2	17.00	8.50	16281.	138392.	19.22
313	2	82.20	41.10	11147.	458143.	1104.50
314	5	604.40	120.88	61748.	7464076.	63398.77
315	5	388.80	77.76	52357.	4071302.	3326.79
316	2	144.00	72.00	11147.	802586.	3200.00
317	2	161.40	80.70	11620.	937729.	10053.62
318	3	8191.80	2730.60	8715.	23797052.	196774.00
319	7	132.20	18.89	66477.	1255463.	273.52
320	8	528.80	66.10	79988.	5287234.	17231.36
321	7	53.20	7.60	73503.	558622.	138.12
322	8	12.50	1.56	94648.	147888.	4.64
323	5	11.00	2.20	47020.	103444.	14.72
324	3	15.60	5.20	33374.	173542.	81.12
325	6	5.20	0.87	63775.	55271.	4.51
326	2	0.00	0.00	11215.	0.	0.00
705	2	1.60	0.80	13174.	10539.	1.28
706	3	12.40	4.13	28509.	117839.	14.25
707	2	192.00	96.00	4999.	479930.	8978.00
708	2	3.80	1.90	8512.	16173.	7.22
712	3	0.00	0.00	49385.	0.	0.00
713	3	3.00	1.00	57492.	57492.	3.00

LOWER CONFIDENCE LIMIT IS LESS THAN OR EQUAL TO ZERO

****-VARIANCE TOO LARGE FOR VALID CONFIDENCE INTERVAL AT THIS VALUE OF ALPHA-****

		TOTAL	AVERAGE			
TOTAL	UPPER	LOWER	MEAN	UPPER	LOWER	
47875980.	153238064.	-57486100.	57.53	184.13	-69.07	
75% Limits	56,818t	38,933t		68.3	46.8	

EFFECTIVE DEGREES OF FREEDOM= 2 STUDENTS T-VALUE= 4.30 ALPHA=0.05

Table 2-97 Stratified Analysis Estimated Cod Abundance and Biomass (1997 survey)

COD GEAC 3PS 1997 No Zone
 ANALYSIS FOR TRIP 2 1997
 VESSEL 49
 ICNAF 3P
 SPECIES 0438

NUMBERS						
STRATUM	NO. SETS	TOTAL	AV. /SET	UNITS	TOTAL NO	VAR.
310	2	32.50	16.25	9255.	150401.	153.13
311	2	92.94	46.47	17903.	831921.	1864.31
312	2	89.00	44.50	16281.	724523.	2520.50
313	2	79.56	39.78	11147.	443443.	663.85
314	8	11.14	1.39	61748.	85975.	1.03
315	5	195.39	39.08	52357.	2046053.	1417.60
316	2	647.00	323.50	11147.	3606065.	72580.50
317	2	38.93	19.47	11620.	226204.	307.92
318	2	77.79	38.89	8715.	338949.	640.31
319	8	2095.15	261.89	66477.	17409906.	213081.33
320	11	550.69	50.06	79988.	4004420.	7906.81
321	10	23.81	2.38	73503.	175029.	7.85
323	6	28.77	4.80	47020.	225468.	27.06
325	9	7.01	0.78	63775.	49666.	2.70
326	2	3.00	1.50	11215.	16822.	4.50
705	2	15.61	7.80	13174.	102799.	12.59
706	4	72.00	18.00	28509.	513169.	351.33
707	2	11.65	5.83	4999.	29125.	47.79
		TOTAL			AVERAGE	
	TOTAL	UPPER	LOWER	MEAN	UPPER	LOWER
	30979938.	57109456.	4850420.	52.61	96.99	8.24

EFFECTIVE DEGREES OF FREEDOM= 8
 STUDENTS T-VALUE= 2.31 ALPHA=0.05

WEIGHTS						
STRATUM	NO. SETS	TOTAL	AV. /SET	UNITS	TOTAL NO	VAR.
310	2	56.81	28.41	9255.	262920.	348.10
311	2	174.09	87.04	17903.	1558328.	9900.00
312	2	149.20	74.60	16281.	1214594.	4086.08
313	2	203.09	101.54	11147.	1131912.	3177.04
314	8	33.96	4.24	61748.	262118.	14.73
315	5	1066.84	213.37	52357.	11171418.	64252.97
316	2	2218.01	1109.01	11147.	12362116.	1138253.88
317	2	164.66	82.33	11620.	956658.	4971.73
318	2	209.06	104.53	8715.	910962.	9066.27
319	8	5792.51	724.06	66477.	48133468.	1601469.25
320	11	2600.05	236.37	79988.	18906740.	233912.69
321	10	40.98	4.10	73503.	301178.	13.89
323	6	43.57	7.26	47020.	341414.	56.35
325	9	12.63	1.40	63775.	89487.	5.91
326	2	6.40	3.20	11215.	35887.	20.48
705	2	42.01	21.01	13174.	276722.	20.25
706	4	184.80	46.20	28509.	1317134.	1597.63
707	2	38.57	19.29	4999.	96415.	482.72
		TOTAL			AVERAGE	
	TOTAL	UPPER	LOWER	MEAN	UPPER	LOWER
	99329488.	174227408.	24431584.	168.69	295.89	41.49

EFFECTIVE DEGREES OF FREEDOM= 10
 STUDENTS T-VALUE= 2.23 ALPHA=0.05

Table 3 Stratified Analysis Age Composition, Numbers per Standard Tow

COD GEAC 1998 3PS No Zone (S1 BY AGE)
 ANALYSIS FOR TRIP 3 1998
 VESSEL 49
 ICNAF 3P

AGE COMPOSITION-NUMBERS PER STANDARD TOW

SUMMARY TABLE

SPECIES:SPECIES 0438

SEX:COMBINED

AGE

IN YEARS	TOTAL NUMBERS	UPPER LIMIT	LOWER LIMIT	MEAN PER TOW	UPPER LIMIT	LOWER LIMIT	D.F.
0.0	0.	0.	0.	0.00	0.00	0.00	0
1.0	11831.	39806.	-16144.	0.01	0.05	-0.02	7
2.0	45926.	92375.	-523.	0.06	0.11	0.00	12
3.0	333870.	472016.	195723.	0.40	0.57	0.24	17
4.0	1466610.	2232467.	700753.	1.76	2.68	0.84	13
5.0	1932198.	2901447.	962950.	2.32	3.49	1.16	15
6.0	1505809.	2293813.	717806.	1.81	2.76	0.86	13
7.0	289392.	540577.	38207.	0.35	0.65	0.05	4
8.0	1362951.	4676060.	-1950157.	1.64	5.62	-2.34	2
9.0	2827606.	10763987.	-5108775.	3.40	12.93	-6.14	2
10.0	329791.	1314891.	-655309.	0.40	1.58	-0.79	2
11.0	35955.	112095.	-40184.	0.04	0.13	-0.05	2
12.0	110770.	447792.	-226252.	0.13	0.54	-0.27	2
13.0	179565.	820457.	-461328.	0.22	0.99	-0.55	2
14.0	0.	0.	0.	0.00	0.00	0.00	0
15.0	29306.	117470.	-58859.	0.04	0.14	-0.07	2
UNKNOWN	19128.	51261.	-13005.	0.02	0.06	-0.02	7
TOTAL	10480707.	27234014.	-6272601.	12.59	32.72	-7.54	2

ESTIMATION TYPE:STANDARD

TRANSFORMATION TYPE:NONE

CONFIDENCE LEVEL: 0.95%

****-ONE OR MORE OF THE LOWER LIMITS IN THE ABOVE TABLE IS LESS THAN OR EQUAL TO ZERO.

VARIANCE IS TOO LARGE FOR VALID CONFIDENCE LIMITS ****

Table 3-97 Stratified Analysis Age Composition, Numbers per Standard Tow (1997 survey)

COD GEAC 1997 3PS No Zone (S1 BY AGE)
 ANALYSIS FOR TRIP 2 1997
 VESSEL 49
 ICNAF 3P

AGE COMPOSITION-NUMBERS PER STANDARD TOW

SUMMARY TABLE

SPECIES:SPECIES 0438

SEX:COMBINED

AGE

IN YEARS	TOTAL NUMBERS	UPPER LIMIT	LOWER LIMIT	MEAN PER TOW	UPPER LIMIT	LOWER LIMIT	D.F.
0.0	0.	0.	0.	0.00	0.00	0.00	0
1.0	0.	0.	0.	0.00	0.00	0.00	0
2.0	171778.	263561.	79995.	0.29	0.45	0.14	4
3.0	1931800.	3300717.	562882.	3.28	5.61	0.96	8
4.0	5547038.	10084754.	1009322.	9.42	17.13	1.71	8
5.0	8020998.	15694904.	347091.	13.62	26.65	0.59	7
6.0	1776711.	3418121.	135302.	3.02	5.80	0.23	7
7.0	5905216.	11110416.	700016.	10.03	18.87	1.19	8
8.0	7046635.	12642847.	1450423.	11.97	21.47	2.46	10
9.0	790460.	1322127.	258793.	1.34	2.25	0.44	20
10.0	318176.	600660.	35693.	0.54	1.02	0.06	8
11.0	142342.	244281.	40403.	0.24	0.41	0.07	21
12.0	21642.	48188.	-4903.	0.04	0.08	-0.01	11
UNKNOWN	5447.	74644.	-63751.	0.01	0.13	-0.11	1
TOTAL	31678248.	57991572.	5364928.	53.80	98.49	9.11	8

ESTIMATION TYPE:STANDARD

TRANSFORMATION TYPE:NONE

CONFIDENCE LEVEL: 0.95%

****-ONE OR MORE OF THE LOWER LIMITS IN THE ABOVE TABLE IS LESS THAN OR EQUAL TO ZERO.

VARIANCE IS TOO LARGE FOR VALID CONFIDENCE LIMITS ****

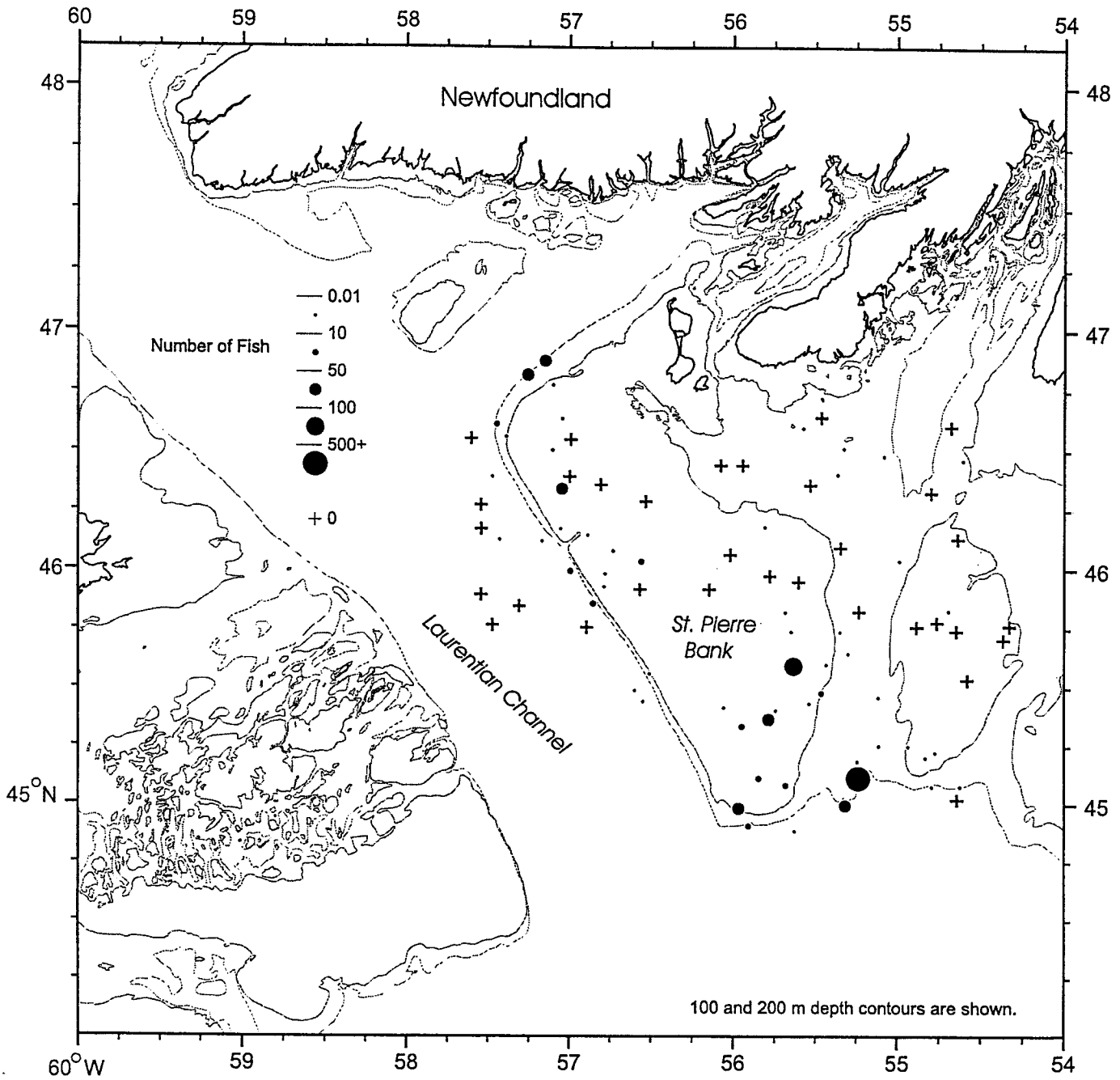


Figure 1 Cod Catch Distribution: Number of Fish, from Pennysmart Trip #3 Random Stratified Surveys, NAFO Division 3Ps, 30 Nov to 12 Dec 1998.

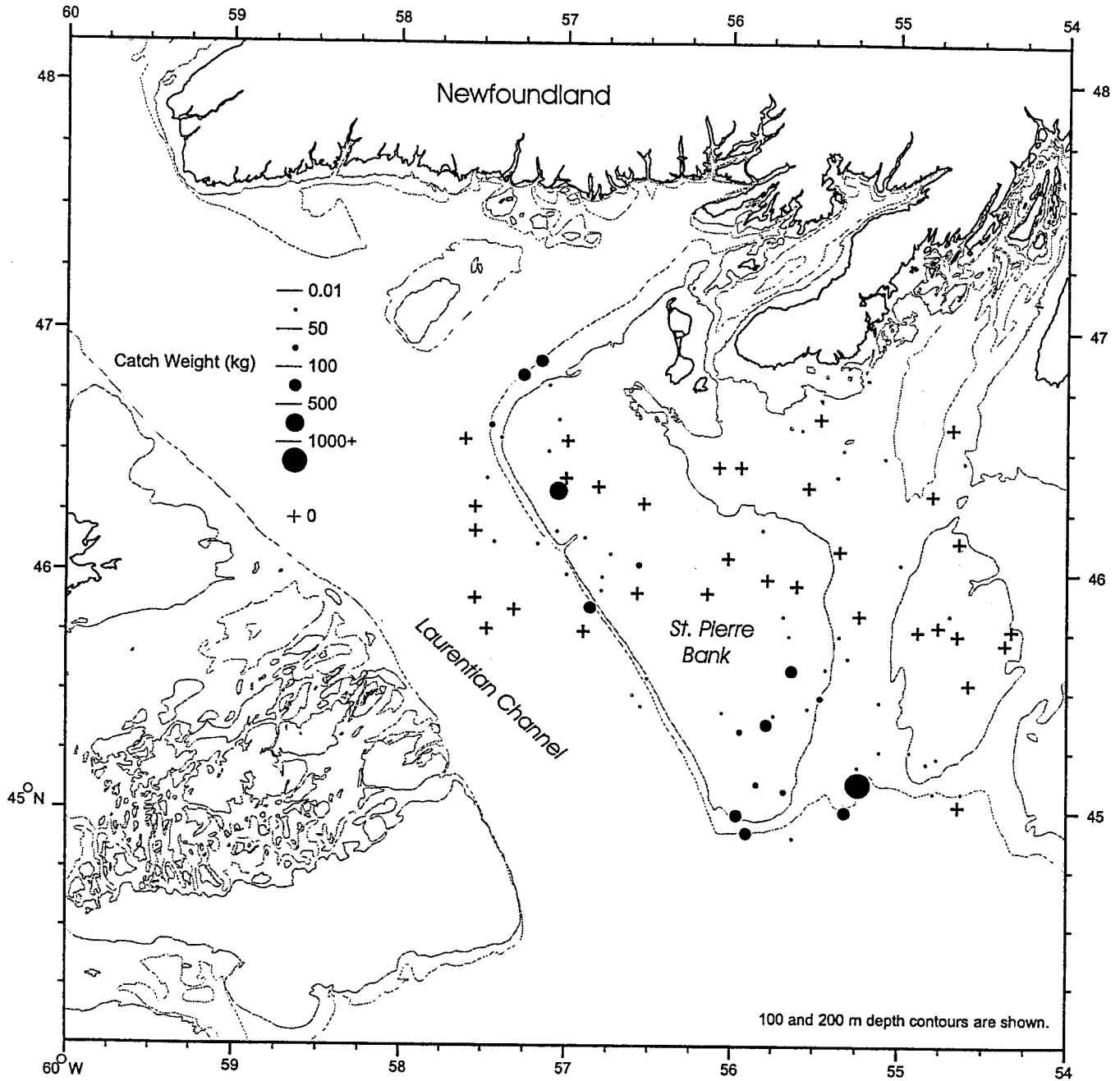


Figure 2 Cod Catch Distribution: Catch Weight, from Pennysmart Trip #3 Random Stratified Surveys, NAFO Division 3Ps, 30 Nov to 12 Dec 1998.

Figure 3 1998 3Ps Survey NetParameters
 Mean values D=74.9m, W=17.6m, O=4.5m

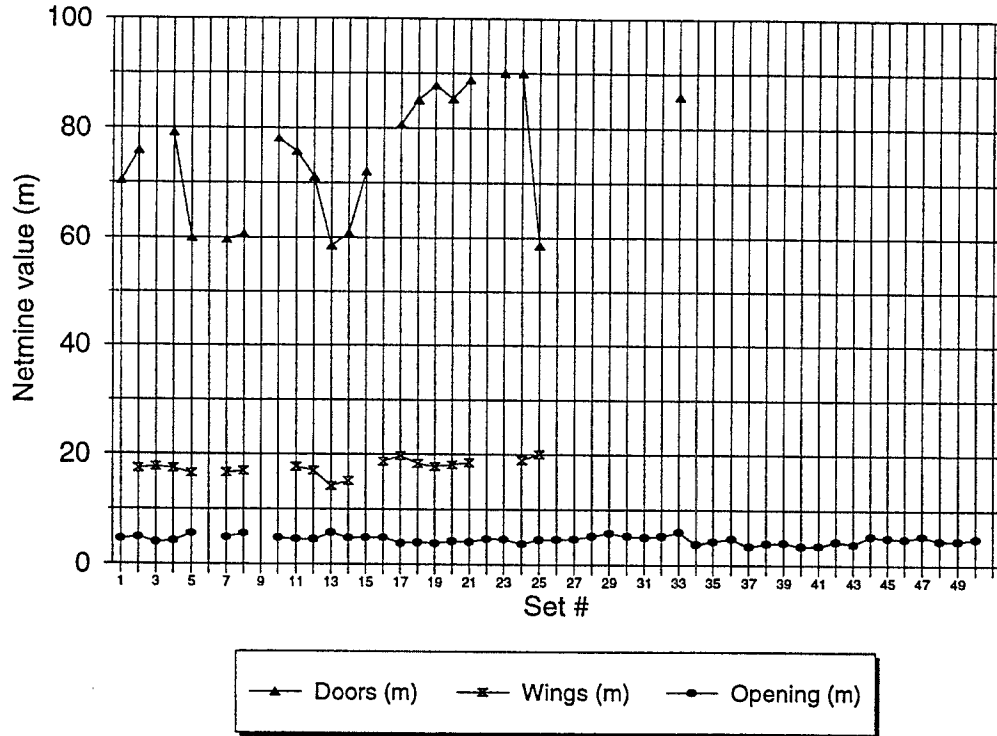


Figure 4 Length Composition of Cod
 3Ps Stratified Random Surveys 1997, 1998

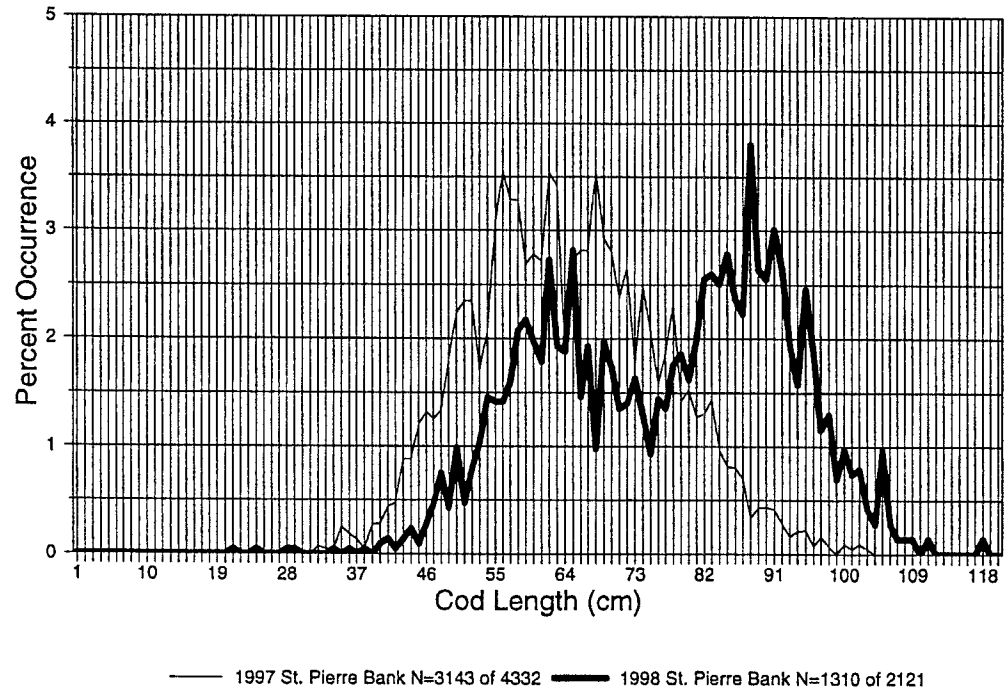


Figure 5a-97 Cod Age-Len Composition
3Ps 1997 (502 samples)

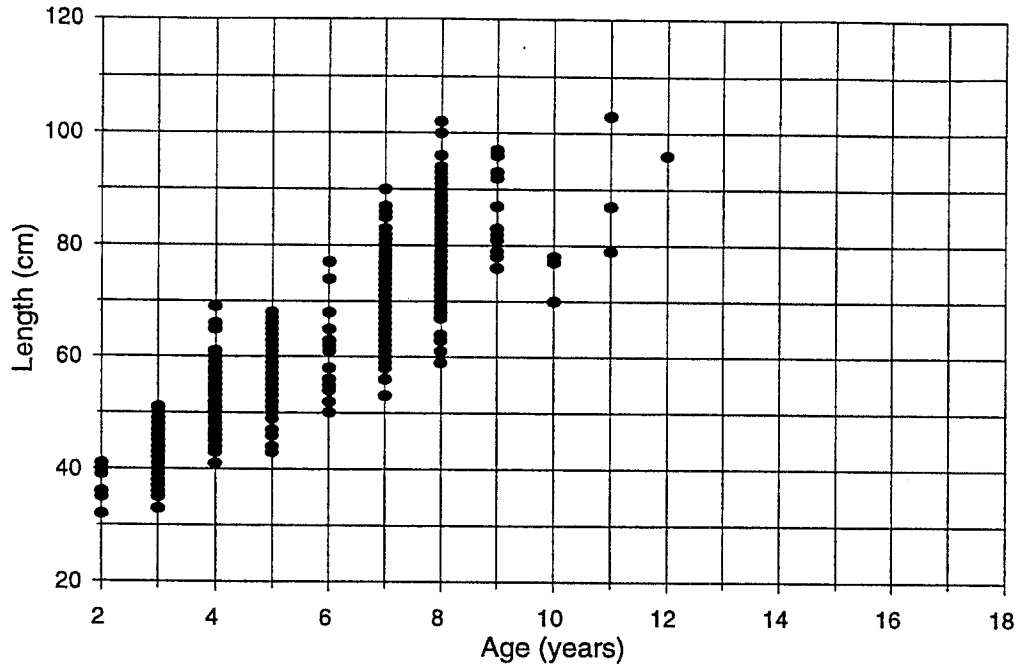


Figure 5a Cod Age-Length Composition
3Ps 1998 (450 samples)

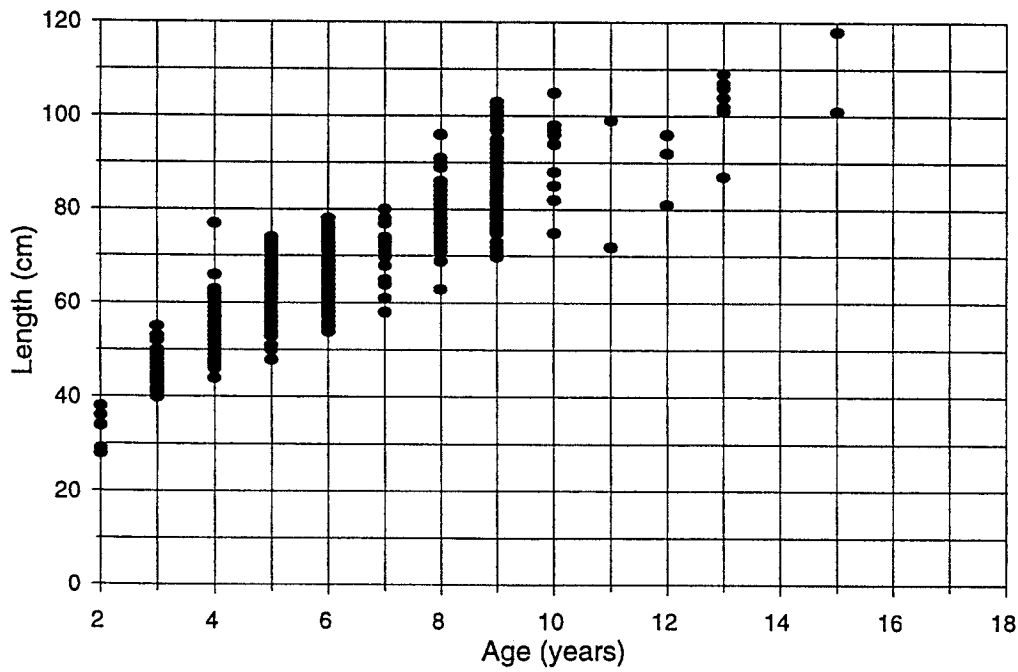
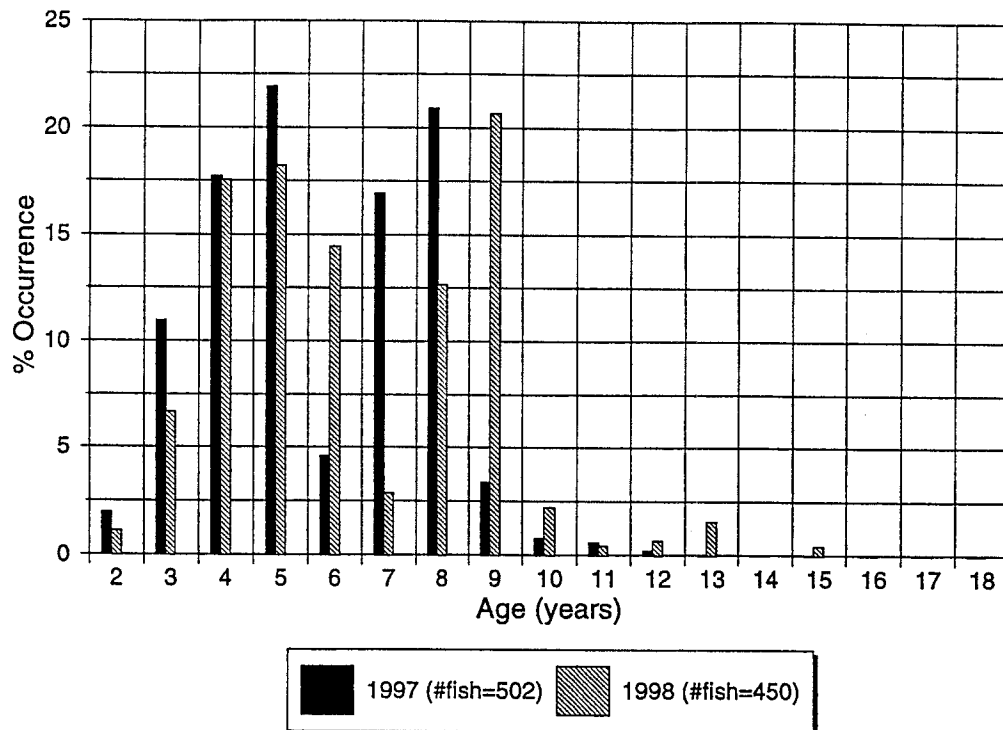
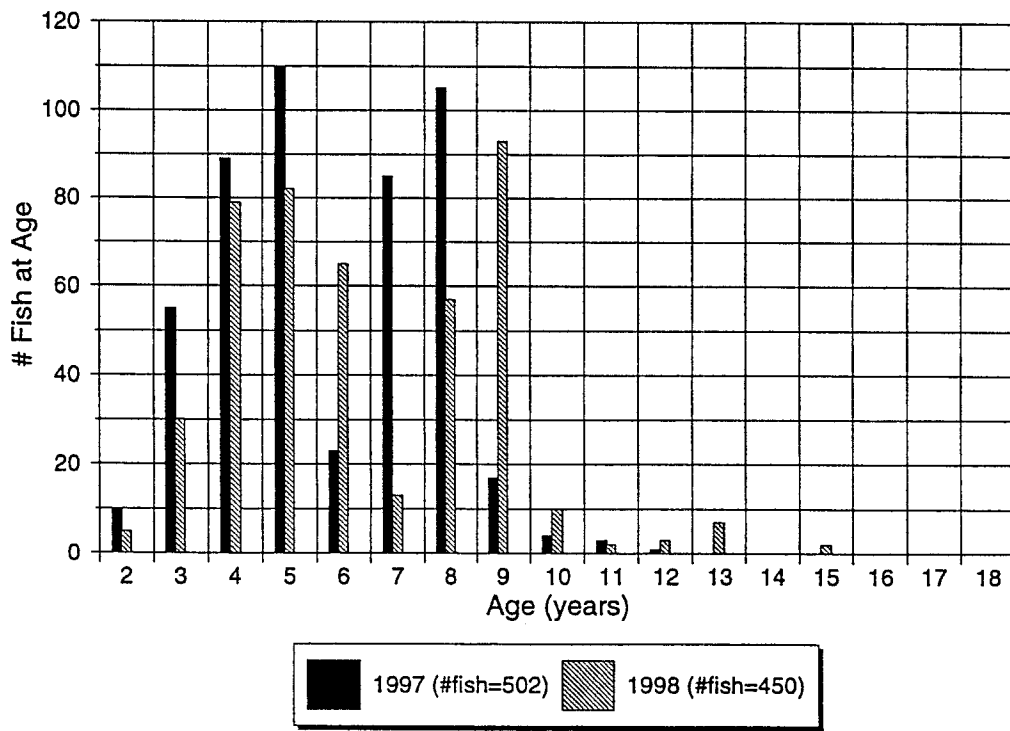


Figure 5b Age Composition of Cod
3Ps Sampled Cod



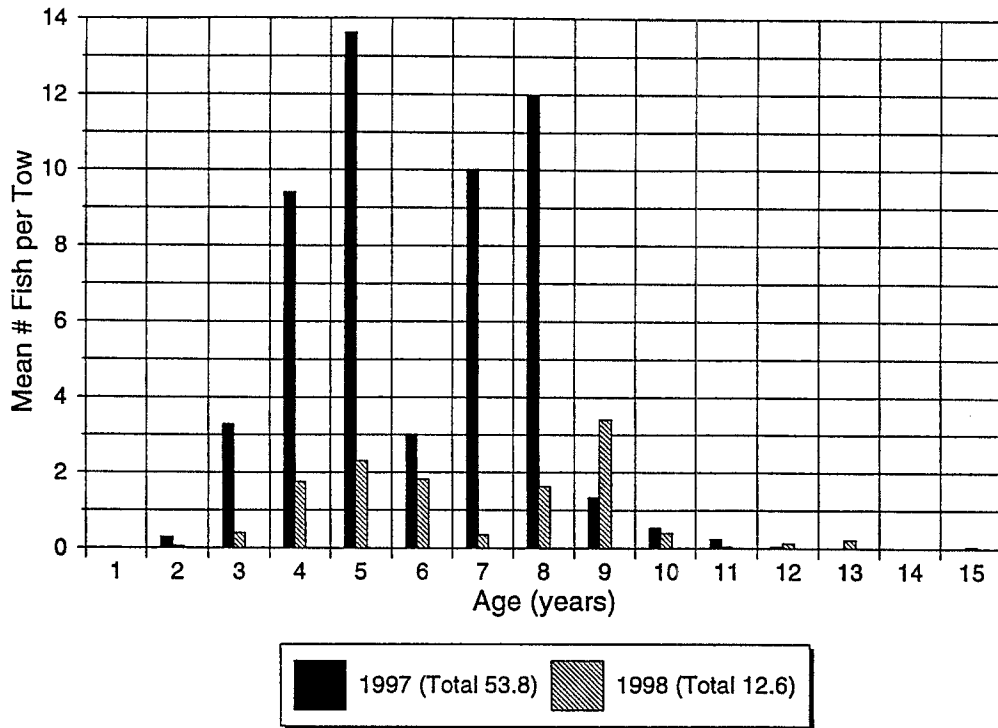
1997 (#fish=502) 1998 (#fish=450)

Figure 5c Age Composition of Cod
3Ps Sampled Cod



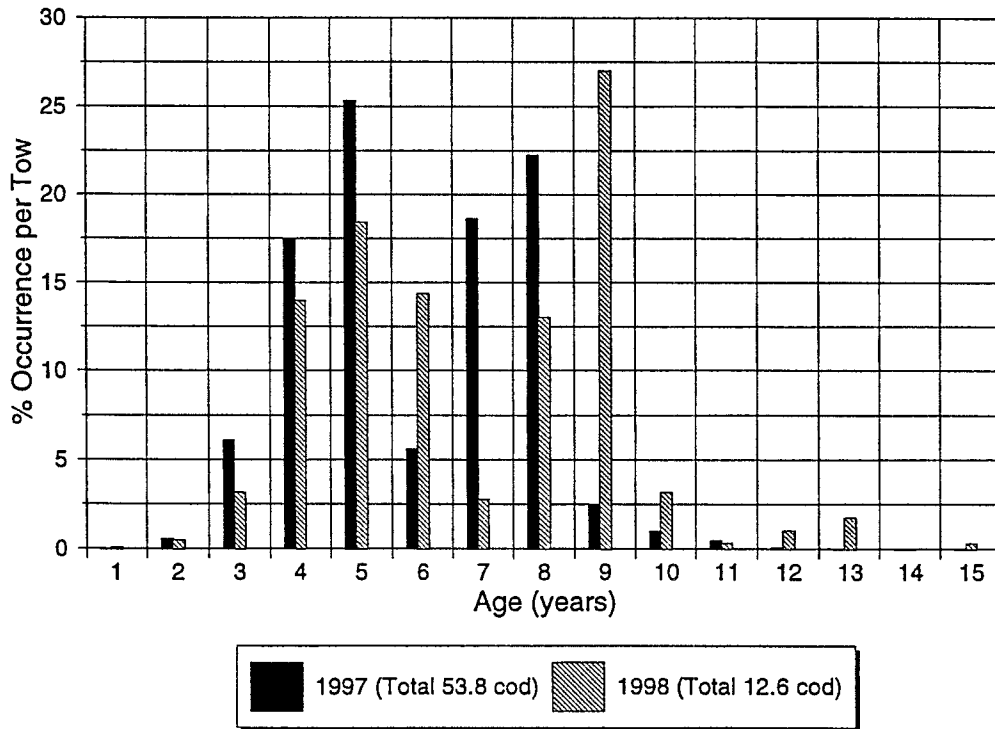
1997 (#fish=502) 1998 (#fish=450)

Figure 6a Age Composition of Cod
Estimated Mean #s per tow



1997 (Total 53.8) 1998 (Total 12.6)

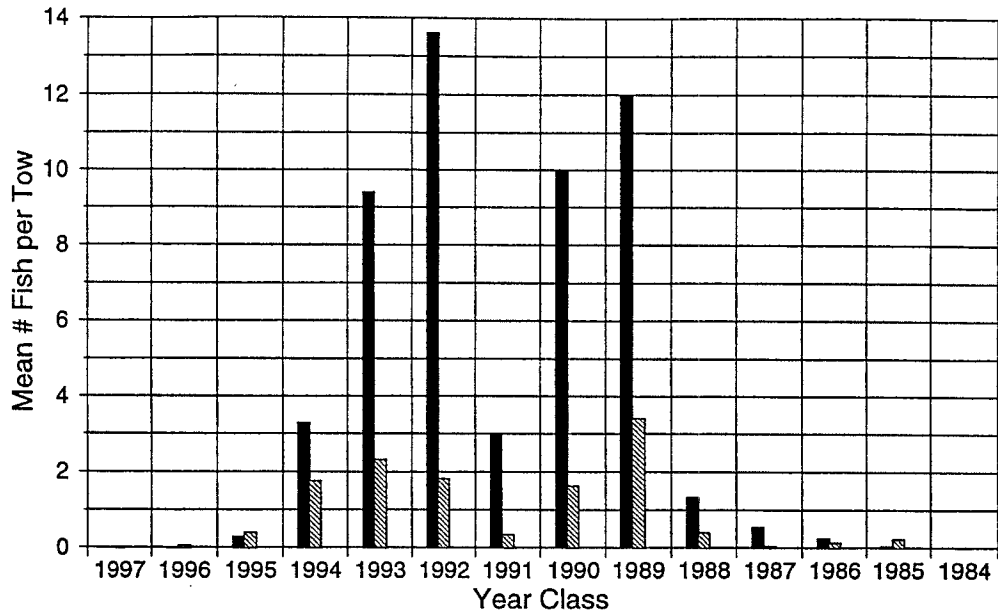
Figure 6b Age Composition of Cod
Estimated % of Total Mean #s per tow



1997 (Total 53.8 cod) 1998 (Total 12.6 cod)

Figure 7a Age Composition of Cod

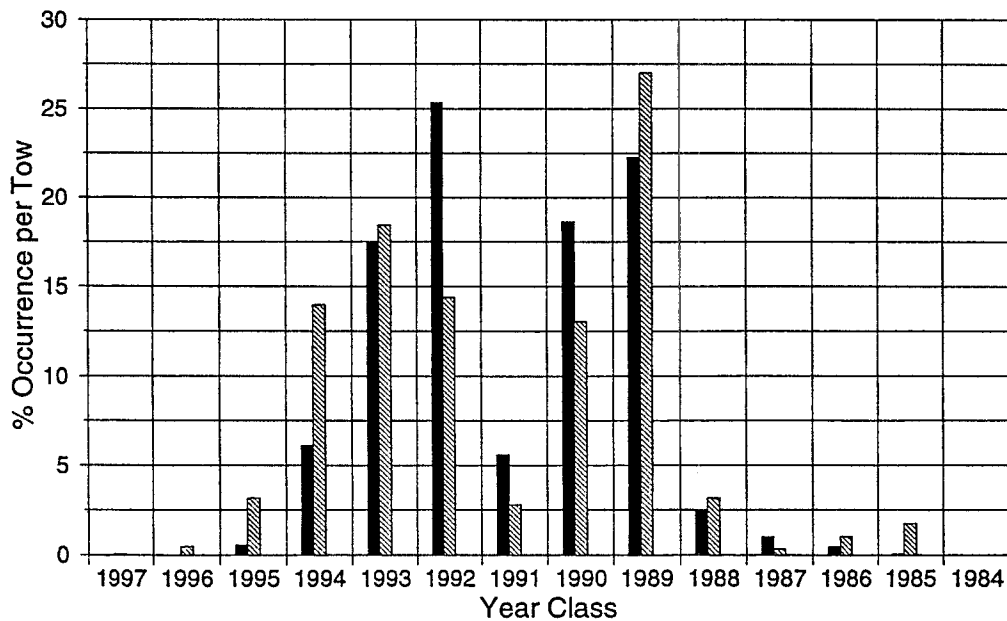
Estimated Mean #s per tow



1997 (Total 53.8 cod)
 1998 (Total 12.6 cod)

Figure 7b Age Composition of Cod

Estimated % of Total Mean #s per tow



1997 (Total 53.8 cod)
 1998 (Total 12.6 cod)