American Plaice and Witch Flounder Catch Results
from Surveys 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 and flatfish. 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. One trip to perform the 1998 survey was carried out from 30 November to 11 December 1998. During the trip, set details and length frequencies were logged in the DFO FFS system and american plaice and witch flounder otoliths were collected for subsequent aging. Plaice and witch catch statistics, length and age distribution, and stratified analysis estimates of 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 et des poissons plats réalisés à l'automne de 1997 et 1998. Ces travaux ont pour but d'obtenir une série de relevés annuels d'automne dans 3Ps afin de compléter les activités d'évaluation actuelles du ministère des Pêches et des Océans (MPO). Le GEAC a financé et réalisé les relevés avec l'aide du MPO, qui a fourni des conseils scientifiques pour la conception et la réalisation d'un relevé aléatoire stratifié et des échantillonnages connexes. Les données ainsi obtenues ont ensuite été analysées pour le compte du GEAC mais dans le but explicite de communiquer cette information au MPO qui l'incluera à ses bases de données et l'utilisera pour ses travaux d'évaluation. Une sortie destinée au relevé de 1998 a été effectuée du 30 novembre au 11 décembre 1998. Pendant la sortie, les détails de la pêche et les fréquences de longueurs ont été enregistrés dans le système FFS du MPO et des otolithes de plies canadiennes et de plies grises ont été prélevées pour la détermination de l'âge. On trouve dans le document des données statistiques sur la plie canadienne et la plie grise, la répartition des longueurs et des âges et des estimations par analyse stratifiée de l'abondance et de la biomasse, notamment des estimations de 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 and flatfish. 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. Interest in this survey was directed both at cod and at american plaice and witch flounder. The results for cod are presented in the companion CSAS Research Document 99/34 [1]. 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 plaice and witch otiliths, 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 [2]. 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 plaice and witch 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. The sole focus in the work presented here is for plaice and witch.

The plaice and witch 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 for plaice and Figures 3 and 4 for witch. Table 1 presents a summary of the set details and catch numbers and weights.

The mean plaice catch for the 86 stratified random sets is 18 fish and a mean catch weight of 13 kg. The largest catch of 176 plaice and weight 202 kg was from set 51 on the St. Pierre Bank. Two other sets had catches of 93 kg. A total of seven sets had catches over 50 kg. The mean plaice weight for all sets was 0.5 kg per fish. The mean weight for the largest catch set 51 was 1.2 kg.

The mean witch catch for the 86 stratified random sets is 7 fish and a mean catch weight of 3 kg. The largest catch of 104 witch and weight 52 kg was from set 58 in the Halibut Channel. Nine sets had catches over 10 kg. A total of five sets had catches of 18 kg or greater. The mean witch weight for all sets was 0.12 kg per fish. The mean weight for the largest catch set 58 was 0.5 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 (NETMIND values are graphed in Figure 3 of the cod document [1]). 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.

Plaice Length, Age, and Biomass Estimates
Figure 5 presents the plaice length composition of the 1998 survey. The distribution shows a peak between 36 and 43 cm, centred about the mean value of 40 cm. The fish range in size between 19 cm up to 68 cm (with age 18 in set 47).

Figure 6 presents length versus age distribution of 515 sampled plaice. Figures 7a and 7b present bar charts of the sampled numbers and percent occurrence of plaice at age. Several plaice as old as 18 were sampled. The 1998 survey shows the greatest number of fish at ages 8 to 10.

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. A wingspread of 60 feet was used for both plaice and witch analysis.

Table 2 presents the STRAP output of estimated abundance and biomass for plaice. The estimated total number of plaice is 12.7 million (with 95% confidence limits of 8 and 17.4 million). The mean number of plaice per standard 1.5 nautical mile tow is 15.3 (with limits of 10 and 21 fish). The estimated total plaice biomass is 9,206 tonnes (with limits of 4,482 and 13,929 tonnes). The mean catch weight per tow is 11 kg (with limits of 5.4 and 16.7 kg).

Table 3 presents the STRAP age composition of numbers per tow, with sexes combined for plaice. The total mean number per tow is 15.3 (consistent with the value in Table 2, smaller than the mean of 17.7 in Table 1), with the greatest

numbers expected at ages 10 (3.3 fish per tow), 9 (2.53 fish), 12 (2.08 fish), 11 (1.97 fish) and 8 (1.94 fish).

Figures 8a and 8b present the STRAP-estimated mean numbers per tow for plaice and the relative percent occurrence that these numbers represent per tow. Approximately 78% of the estimated age composition is comprised of fish between the ages 8 to 12.   Consistent with the sampled population this means that the 1986 to 1990 year classes are strong, the 1990 being the strongest.

Witch Length, Age, and Biomass Estimates
Figure 5 presents the witch length composition of the 1998 survey. The distribution shows a peak between 37 and 42 cm, centred about the mean value of 39 cm. The fish range in size between 22 cm up to 54 cm (with age 13 in set 40).

Figure 10 presents length versus age distribution of 295 sampled witch. Figures 11a and 11b present bar charts of the sampled numbers and percent occurrence of witch at age. Several witch as old as 13 were sampled. The 1998 survey shows the greatest number of fish at ages 7 to 10 with a peak at age 9.

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. A wingspread of 60 feet was used for both plaice and witch analysis.

Table 4 presents the STRAP output of estimated abundance and biomass for witch. The estimated total number of witch is 4.7 million (with 95% confidence limits of 2.1 and 7.2 million).   The mean number of witch per standard 1.5 nautical mile tow is 5.6 (with limits of 2.5 and 8.7 fish). The estimated total witch biomass is 1,803 tonnes (with limits of 534 and 3,072 tonnes). The mean catch weight per tow is 2.2 kg (with limits of 0.6 and 3.7 kg).

Table 5 presents the STRAP age composition of numbers per tow, with sexes combined for witch. The total mean number per tow is 5.6 (consistent with the value in Table 4, smaller than the mean of 7.2 in Table 1), with the greatest numbers expected at ages 9 (1.93 fish per tow), 8 (1.27 fish), and 10 (1.00 fish).

Figures 12a and 12b present the STRAP-estimated mean numbers per tow for witch and the relative percent occurrence that these numbers represent per tow. Approximately 75% of the estimated age composition is comprised of fish between the ages 8 to 10.   Consistent with the sampled population this means that the 1988 to 1990 year classes are strong, the 1989 being the strongest.

References

[1] McClintock, J., 1999. "Second Year Results of Surveys Directed at Cod in NAFO Division 3Ps". CSAS Research Document 99/34."

[2] 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).

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

Table 1 Summary of Flatfish Catches for Stratified Random Survey Sets, NAFO Division 3Ps, 30 Nov - 11 Dec 1998.

M.V. Pennysmart Vessel	Trip	Set	Year	Month	Day	StrLin	Division	Unit Area	Set Location Lat (N)	Long (W)	AMERICAN PLAICE Catch # of Fish	Catch Weight (kg)	WITCH Catch # of Fish	Catch Weight (kg)	Set Duration (min)	Tow Distance (n.mi.)	PLAICE Mean Wgt (kg)	WITCH Mean Wgt (kg)
49	3	1	98	11	30	322	3P	M29	46.64	55.46	0	0.0	0	0	20	1		
49	3	2	98	11	30	322	3P	M29	46.60	55.57	1	0.1	0	0	30	1.5	0.1	
49	3	3	98	11	30	322	3P	M30	46.44	55.94	13	5.0	0	0	30	1.5	0.4	
49	3	4	98	11	30	322	3P	L30	46.44	56.08	12	2.8	0	0	30	1.5	0.2	
49	3	5	98	12	1	314	3P	L30	46.29	56.53	0	0.0	0	0	30	1.5		
49	3	7	98	12	1	314	3P	K30	46.34	57.05	0	0.0	0	0	30	1.5		
49	3	8	98	12	1	314	3P	K29	46.50	57.10	0	0.0	0	0	30	1.5		
49	3	10	98	12	1	310	3P	K29	46.88	57.15	8	4.0	0	0	30	1.5	0.5	
49	3	11	98	12	1	310	3P	K29	46.82	57.26	87	55.0	15	3	30	1.5	0.6	0.2
49	3	12	98	12	2	311	3P	K29	46.78	57.10	6	3.2	0	0	30	1.5	0.5	
49	3	13	98	12	2	314	3P	K29	46.64	57.04	16	9.4	0	0	30	1.5	0.6	
49	3	14	98	12	2	314	3P	L30	46.39	57.00	0	0.0	0	0	30	1.5		
49	3	15	98	12	2	311	3P	K29	46.56	57.39	1	1.6	0	0	30	1.5	1.6	
49	3	16	98	12	3	313	3P	K29	46.61	57.45	70	57.4	31	11.2	30	1.5	0.8	0.4
49	3	17	98	12	3	705	3P	K29	46.55	57.60	13	8.8	23	6.8	30	1.5	0.7	0.3
49	3	18	98	12	3	705	3P	K30	46.39	57.47	21	13.0	14	3.4	30	1.5	0.6	0.2
49	3	19	98	12	3	713	3P	K30	46.27	57.54	6	6.0	10	2.8	30	1.5	1.0	0.3
49	3	20	98	12	3	713	3P	K30	46.17	57.54	2	1.0	12	3	30	1.5	0.5	0.3
49	3	21	98	12	3	713	3P	K30	46.13	57.43	3	1.4	10	4	30	1.5	0.5	0.4
49	3	22	98	12	3	712	3P	K31	45.89	57.54	0	0.0	5	1	30	1.5		0.2
49	3	23	98	12	3	712	3P	K31	45.77	57.47	0	0.0	5	1.6	30	1.5		0.3
49	3	24	98	12	3	712	3P	K31	45.85	57.31	1	0.2	4	0.8	30	1.5	0.2	0.2
49	3	25	98	12	3	316	3P	L31	45.99	56.99	4	2.2	65	26	30	1.5	0.6	0.4
49	3	26	98	12	4	313	3P	K30	46.12	57.17	5	4.4	21	7	30	1.5	0.9	0.3
49	3	27	98	12	4	312	3P	K30	46.17	57.05	14	14.4	4	1.6	30	1.5	1.0	0.4
49	3	28	98	12	4	312	3P	L30	46.15	56.89	4	5.6	1	0.2	30	1.5	1.4	0.2
49	3	29	98	12	4	320	3P	L30	46.08	56.73	1	1.0	0	0	29	1.5	1.0	
49	3	30	98	12	4	320	3P	L30	46.03	56.56	0	0.0	0	0	30	1.5		
49	3	31	98	12	4	320	3P	L31	45.92	56.57	40	36.4	0	0	30	1.5	0.9	
49	3	32	98	12	4	320	3P	L31	45.98	56.78	5	4.4	0	0	30	1.5	0.9	
49	3	34	98	12	4	316	3P	L31	45.86	56.85	5	3.6	41	18	30	1.5	0.7	0.4
49	3	35	98	12	4	706	3P	L31	45.76	56.89	10	10.8	12	4.2	30	1.5	1.1	0.4
49	3	36	98	12	5	317	3P	L31	45.56	56.51	90	92.6	0	0	30	1.5	1.0	
49	3	37	98	12	5	706	3P	L32	45.49	56.60	18	20.2	16	5.8	30	1.5	1.1	0.4
49	3	38	98	12	5	706	3P	L32	45.44	56.55	22	35.8	30	10.8	30	1.5	1.6	0.4
49	3	39	98	12	6	317	3P	M33	44.98	55.97	165	92.6	0	0	30	1.5	0.6	
49	3	40	98	12	6	318	3P	M33	44.91	55.91	22	14.0	42	14	30	1.5	0.6	0.3
49	3	41	98	12	6	708	3P	M33	44.89	55.63	0	0.0	0	0	30	1.5		
49	3	42	98	12	6	315	3P	M32	45.08	55.68	117	52.0	1	0.4	30	1.5	0.4	0.4
49	3	43	98	12	6	315	3P	M32	45.11	55.85	25	19.6	0	0	30	1.5	0.8	
49	3	44	98	12	7	315	3P	M32	45.34	55.95	24	13.2	0	0	30	1.5	0.6	
49	3	45	98	12	7	320	3P	L32	45.42	56.06	23	17.6	0	0	30	1.5	0.8	
49	3	46	98	12	7	315	3P	M32	45.37	55.79	85	62.8	0	0	30	1.5	0.7	
49	3	47	98	12	7	320	3P	M32	45.40	55.74	55	39.4	0	0	30	1.5	0.7	
49	3	48	98	12	7	315	3P	M32	45.43	55.54	20	12.0	0	0	30	1.5	0.6	
49	3	49	98	12	7	319	3P	M32	45.48	55.46	40	20.0	0	0	30	1.5	0.5	
49	3	50	98	12	7	321	3P	M31	45.60	55.43	11	8.4	0	0	30	1.5	0.8	
49	3	51	98	12	7	320	3P	M31	45.59	55.63	176	202.6	10	2.8	30	1.5	1.2	0.3
49	3	52	98	12	7	321	3P	M31	45.74	55.65	5	6.2	0	0	30	1.5	1.2	
49	3	53	98	12	7	321	3P	M31	45.82	55.68	2	1.8	0	0	30	1.5	0.9	
49	3	54	98	12	7	323	3P	M31	45.74	55.35	7	1.4	0	0	30	1.5	0.2	
49	3	55	98	12	7	323	3P	M31	45.65	55.30	8	2.2	0	0	30	1.5	0.3	
49	3	56	98	12	7	319	3P	M32	45.46	55.12	57	17.8	0	0	30	1.5	0.3	
49	3	57	98	12	7	319	3P	M32	45.25	55.11	38	21.0	56	24	30	1.5	0.6	0.4
49	3	58	98	12	8	319	3P	M32	45.19	55.24	14	9.2	104	52.4	30	1.5	0.7	0.5
49	3	59	98	12	8	318	3P	M32	45.11	55.24	0	0.0	0	0	30	1.5		
49	3	60	98	12	8	707	3P	M33	45.00	55.32	5	2.0	1	0.4	30	1.5	0.4	0.4
49	3	61	98	12	9	707	3P	N32	45.08	54.79	42	22.0	13	13	30	1.5	0.5	1.0
49	3	62	98	12	9	708	3P	N32	45.02	54.64	5	2.2	9	2.6	30	1.5	0.4	0.3
49	3	63	98	12	9	318	3P	N32	45.08	54.63	7	12.8	58	19.8	30	1.5	1.8	0.3
49	3	64	98	12	9	319	3P	N32	45.23	54.77	2	1.0	3	2	30	1.5	0.5	0.7
49	3	65	98	12	9	319	3P	N32	45.20	54.83	2	1.0	0	0	30	1.5	0.5	
49	3	66	98	12	9	319	3P	N32	45.25	54.93	52	29.0	0	0	30	1.5	0.6	
49	3	67	98	12	9	325	3P	N31	45.54	54.58	4	3.6	0	0	30	1.5	0.9	
49	3	68	98	12	9	326	3P	N31	45.71	54.37	0	0.0	0	0	30	1.5		
49	3	69	98	12	9	326	3P	N31	45.76	54.33	0	0.0	0	0	30	1.5		
49	3	70	98	12	9	325	3P	N31	45.74	54.65	0	0.0	0	0	30	1.5		
49	3	71	98	12	9	325	3P	N31	45.83	54.69	0	0.0	0	0	30	1.5		
49	3	72	98	12	9	325	3P	N31	45.78	54.76	0	0.0	0	0	30	1.5		
49	3	73	98	12	9	323	3P	M31	45.76	54.88	1	0.3	0	0	30	1.5	0.3	
49	3	74	98	12	9	323	3P	M31	45.82	55.23	12	3.4	0	0	30	1.5	0.3	
49	3	75	98	12	9	321	3P	M31	45.95	55.60	2	0.4	0	0	30	1.5	0.2	
49	3	76	98	12	10	321	3P	M31	45.97	55.78	0	0.0	0	0	30	1.5		
49	3	77	98	12	10	320	3P	L31	45.92	56.15	2	1.6	0	0	30	1.5	0.8	
49	3	78	98	12	10	321	3P	L30	46.06	56.02	0	0.0	0	0	30	1.5		
49	3	79	98	12	10	321	3P	M30	46.18	55.81	0	0.0	0	0	30	1.5		
49	3	80	98	12	10	323	3P	M30	46.09	55.35	0	0.0	0	0	30	1.5		
49	3	81	98	12	10	323	3P	N30	46.04	54.99	1	0.1	0	0	30	1.5	0.1	
49	3	82	98	12	10	325	3P	N30	46.13	54.64	0	0.0	0	0	30	1.5		
49	3	83	98	12	10	324	3P	N30	46.33	54.80	0	0.0	0	0	30	1.5		
49	3	84	98	12	10	324	3P	N30	46.46	54.61	1	1.0	0	0	30	1.5	1.0	
49	3	85	98	12	10	324	3P	N29	46.60	54.68	0	0.0	0	0	30	1.5		
49	3	86	98	12	10	322	3P	M30	46.48	55.08	0	0.0	0	0	30	1.5		
49	3	87	98	12	10	322	3P	M30	46.40	55.36	4	1.0	0	0	30	1.5	0.3	
49	3	88	98	12	11	322	3P	M30	46.36	55.53	0	0.0	0	0	30	1.5		
49	3	89	98	12	11	322	3P	M29	46.51	55.33	5	2.2	0	0	30	1.5	0.4	
									Minimum		0.0	0.0	0.0	0.0	20.0	1.0	0.0	0.0
									Maximum		176.00	202.60	104.00	52.40	30.00	1.50	1.83	1.00
									Mean		17.66	12.76	7.16	2.82	29.87	1.49	0.49	0.12
									Median		5.00	2.20	0.00	0.00	30.00	1.50	0.61	0.35
									Standard Error		0.39	0.33	0.20	0.09	0.01	0.00	0.01	0.00
									Total		1519.00	1097.70	616.00	242.60	2569.00	128.50	42.45	10.24
									Count		86	86	86	86	86	86	86	86

Table 2 Stratified Analysis Estimated Plaice Abundance and Biomass

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PLAICE GEAC 3PS 1998 No Zone
ANALYSIS FOR TRIP    3 1998
VESSEL 49
ICNAF  3P
                        SPECIES 0889
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NUMBERS

STRATUM	NO.SETS	TOTAL	AV./SET	UNITS	TOTAL NO	VAR.
310	2	95.00	47.50	9255.	439632.	3120.50
311	2	7.00	3.50	17903.	62660.	12.50
312	2	18.00	9.00	16281.	146533.	50.00
313	2	75.00	37.50	11147.	418014.	2112.50
314	5	16.00	3.20	61748.	197593.	51.20
315	5	271.00	54.20	52357.	2837765.	1956.70
316	2	9.00	4.50	11147.	50162.	0.50
317	2	255.00	127.50	11620.	1481542.	2812.50
318	3	29.00	9.67	8715.	84245.	126.33
319	7	205.00	29.29	66477.	1946822.	532.90
320	8	302.00	37.75	79988.	3019562.	3537.07
321	7	20.00	2.86	73503.	210008.	16.14
322	8	35.00	4.38	94648.	414087.	28.84
323	5	28.00	5.60	47020.	263313.	25.30
324	3	1.00	0.33	33374.	11125.	0.33
325	6	5.00	0.83	63775.	53145.	2.57
326	2	0.00	0.00	11215.	0.	0.00
705	2	34.00	17.00	13174.	223954.	32.00
706	3	50.00	16.67	28509.	475156.	37.33
707	2	47.00	23.50	4999.	117483.	684.50
708	2	5.00	2.50	8512.	21281.	12.50
712	3	1.00	0.33	49385.	16462.	0.33
713	3	11.00	3.67	57492.	210803.	4.33

	TOTAL	TOTAL UPPER	LOWER	MEAN	AVERAGE UPPER	LOWER
	12701345.	17384786.	8017904.	15.26	20.89	9.63

```
EFFECTIVE DEGREES OF FREEDOM= 15
STUDENTS T-VALUE=   2.13 ALPHA=0.05
```

WEIGHTS

STRATUM	NO.SETS	TOTAL	AV./SET	UNITS	TOTAL NO	VAR.
310	2	59.00	29.50	9255.	273035.	1300.50
311	2	4.80	2.40	17903.	42967.	1.28
312	2	20.00	10.00	16281.	162814.	38.72
313	2	61.80	30.90	11147.	344443.	1404.50
314	5	9.40	1.88	61748.	116086.	17.67
315	5	159.60	31.92	52357.	1671244.	563.95
316	2	5.80	2.90	11147.	32326.	0.98
317	2	185.20	92.60	11620.	1076006.	0.00
318	3	26.80	8.93	8715.	77854.	60.21
319	7	99.00	14.14	66477.	940173.	114.22
320	8	303.00	37.88	79988.	3029561.	4682.95
321	7	16.80	2.40	73503.	176407.	12.01
322	8	11.10	1.39	94648.	131325.	3.33
323	5	7.10	1.42	47020.	66769.	2.07
324	3	1.00	0.33	33374.	11125.	0.33
325	6	3.90	0.65	63775.	41453.	2.10
326	2	0.00	0.00	11215.	0.	0.00
705	2	21.80	10.90	13174.	143594.	8.82
706	3	66.80	22.27	28509.	634809.	159.45
707	2	24.00	12.00	4999.	59991.	200.00
708	2	2.20	1.10	8512.	9364.	2.42
712	3	0.20	0.07	49385.	3292.	0.01
713	3	8.40	2.80	57492.	160977.	7.72

	TOTAL	TOTAL UPPER	LOWER	MEAN	AVERAGE UPPER	LOWER
	9205615.	13929226.	4482004.	11.06	16.74	5.39

```
EFFECTIVE DEGREES OF FREEDOM=  9
STUDENTS T-VALUE=   2.26 ALPHA=0.05
```

Table 3 Stratified Analysis Plaice Age Composition, Numbers per Standard Tow

```
PLAICE 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 0889
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             0.           0.            0.          0.00          0.00          0.00          0
   3.0             0.           0.            0.          0.00          0.00          0.00          0
   4.0         28464.       63084.        -6157.          0.03          0.08         -0.01         12
   5.0        103742.      170922.        36562.          0.12          0.21          0.04         13
   6.0        255755.      419392.        92118.          0.31          0.50          0.11         11
   7.0        602831.      904583.       301079.          0.72          1.09          0.36         12
   8.0       1615198.     2322611.       907786.          1.94          2.79          1.09         10
   9.0       2107305.     2948616.      1265993.          2.53          3.54          1.52         10
  10.0       2772179.     3731378.      1812980.          3.33          4.48          2.18         16
  11.0       1639739.     2244460.      1035018.          1.97          2.70          1.24         13
  12.0       1727287.     2626373.       828201.          2.08          3.16          1.00          9
  13.0        908398.     1618460.       198337.          1.09          1.94          0.24          8
  14.0        404067.      753361.        54774.          0.49          0.91          0.07          8
  15.0        311210.      595698.        26722.          0.37          0.72          0.03          8
  16.0        124293.      229736.        18849.          0.15          0.28          0.02         12
  17.0         21054.       41803.          304.          0.03          0.05          0.00          4
  18.0         79825.      151213.         8437.          0.10          0.18          0.01         10
UNKNOWN           0.           0.            0.          0.00          0.00          0.00          0
TOTAL      12701346.    17384788.      8017905.         15.26         20.89          9.63         15
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 4 Stratified Analysis Estimated Witch Abundance and Biomass

```
WITCH GEAC 3PS 1998 No Zone
ANALYSIS FOR TRIP    3 1998
VESSEL 49
ICNAF  3P
SPECIES 0890
```

STRATUM	NO.SETS	TOTAL	AV./SET	UNITS	TOTAL NO	VAR.
				NUMBERS		
310	2	15.00	7.50	9255.	69416.	112.50
311	2	0.00	0.00	17903.	0.	0.00
312	2	5.00	2.50	16281.	40704.	4.50
313	2	52.00	26.00	11147.	289823.	50.00
314	5	0.00	0.00	61748.	0.	0.00
315	5	1.00	0.20	52357.	10471.	0.20
316	2	106.00	53.00	11147.	590793.	288.00
317	2	0.00	0.00	11620.	0.	0.00
318	3	100.00	33.33	8715.	290498.	897.33
319	7	163.00	23.29	66477.	1547961.	1694.24
320	8	10.00	1.25	79988.	99986.	12.50
321	7	0.00	0.00	73503.	0.	0.00
322	8	0.00	0.00	94648.	0.	0.00
323	5	0.00	0.00	47020.	0.	0.00
324	3	0.00	0.00	33374.	0.	0.00
325	6	0.00	0.00	63775.	0.	0.00
326	2	0.00	0.00	11215.	0.	0.00
705	2	37.00	18.50	13174.	243715.	40.50
706	3	58.00	19.33	28509.	551181.	89.33
707	2	14.00	7.00	4999.	34995.	72.00
708	2	9.00	4.50	8512.	38305.	40.50
712	3	14.00	4.67	49385.	230462.	0.33
713	3	32.00	10.67	57492.	613245.	1.33

	TOTAL	TOTAL UPPER	LOWER	MEAN	AVERAGE UPPER	LOWER
	4651554.	7198916.	2104193.	5.59	8.65	2.53

```
EFFECTIVE DEGREES OF FREEDOM=   7
STUDENTS T-VALUE=   2.36 ALPHA=0.05
```

STRATUM	NO.SETS	TOTAL	AV./SET	UNITS	TOTAL NO	VAR.
				WEIGHTS		
310	2	3.00	1.50	9255.	13883.	4.50
311	2	0.00	0.00	17903.	0.	0.00
312	2	1.80	0.90	16281.	14653.	0.98
313	2	18.20	9.10	11147.	101438.	8.82
314	5	0.00	0.00	61748.	0.	0.00
315	5	0.40	0.08	52357.	4189.	0.03
316	2	44.00	22.00	11147.	245235.	32.00
317	2	0.00	0.00	11620.	0.	0.00
318	3	33.80	11.27	8715.	98188.	103.61
319	7	78.40	11.20	66477.	744541.	407.95
320	8	2.80	0.35	79988.	27996.	0.98
321	7	0.00	0.00	73503.	0.	0.00
322	8	0.00	0.00	94648.	0.	0.00
323	5	0.00	0.00	47020.	0.	0.00
324	3	0.00	0.00	33374.	0.	0.00
325	6	0.00	0.00	63775.	0.	0.00
326	2	0.00	0.00	11215.	0.	0.00
705	2	10.20	5.10	13174.	67186.	5.78
706	3	20.80	6.93	28509.	197665.	11.85
707	2	13.40	6.70	4999.	33495.	79.38
708	2	2.60	1.30	8512.	11066.	3.38
712	3	3.40	1.13	49385.	55969.	0.17
713	3	9.80	3.27	57492.	187806.	0.41

	TOTAL	TOTAL UPPER	LOWER	MEAN	AVERAGE UPPER	LOWER
	1803311.	3072898.	533724.	2.17	3.69	0.64

```
EFFECTIVE DEGREES OF FREEDOM=   6
STUDENTS T-VALUE=   2.45 ALPHA=0.05
```

Table 5 Stratified Analysis Witch Age Composition, Numbers per Standard Tow

```
WITCH 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 0890
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            0.            0.             0.           0.00           0.00           0.00            0
    3.0            0.            0.             0.           0.00           0.00           0.00            0
    4.0        12875.        56468.        -30717.           0.02           0.07          -0.04            2
    5.0        89531.       304213.       -125151.           0.11           0.37          -0.15            2
    6.0        86897.       181324.         -7529.           0.10           0.22          -0.01            3
    7.0       474537.       596380.        352694.           0.57           0.72           0.42           18
    8.0      1054527.      1463425.        645630.           1.27           1.76           0.78           10
    9.0      1606530.      2642244.        570816.           1.93           3.17           0.69            7
   10.0       830224.      1540650.        119799.           1.00           1.85           0.14            6
   11.0       385857.       788909.        -17194.           0.46           0.95          -0.02            6
   12.0        94374.       179973.          8775.           0.11           0.22           0.01            7
   13.0        16201.        30405.          1996.           0.02           0.04           0.00            9
UNKNOWN            0.            0.             0.           0.00           0.00           0.00            0
TOTAL        4651554.      7198916.       2104193.           5.59           8.65           2.53            7
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 ****
```
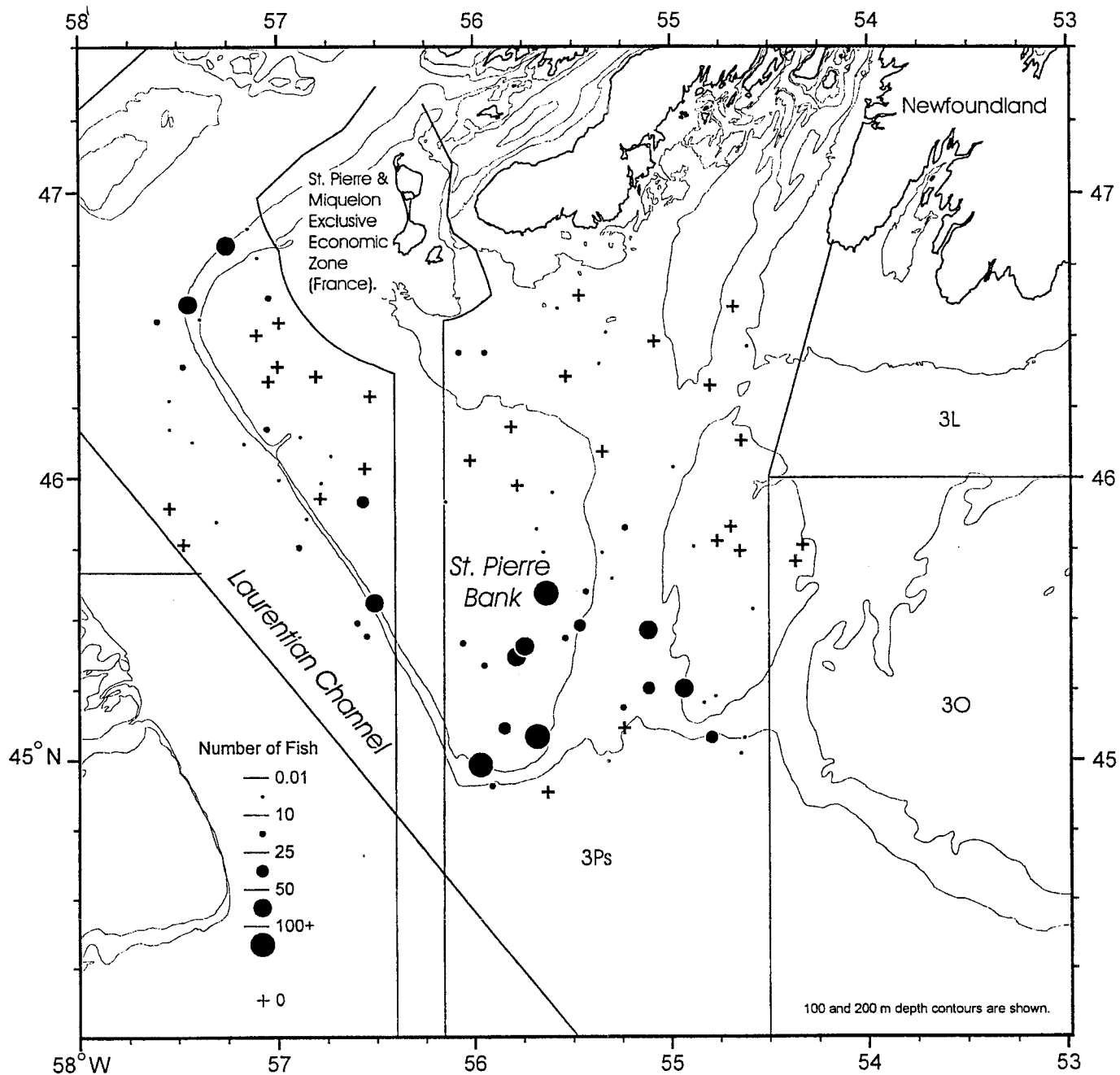
Figure 1 American Plaice Catch Distribution: Number of Fish, from Pennysmart Trip #3 Random Stratified Surveys, NAFO Division 3Ps, 30 Nov to 12 Dec 1998.
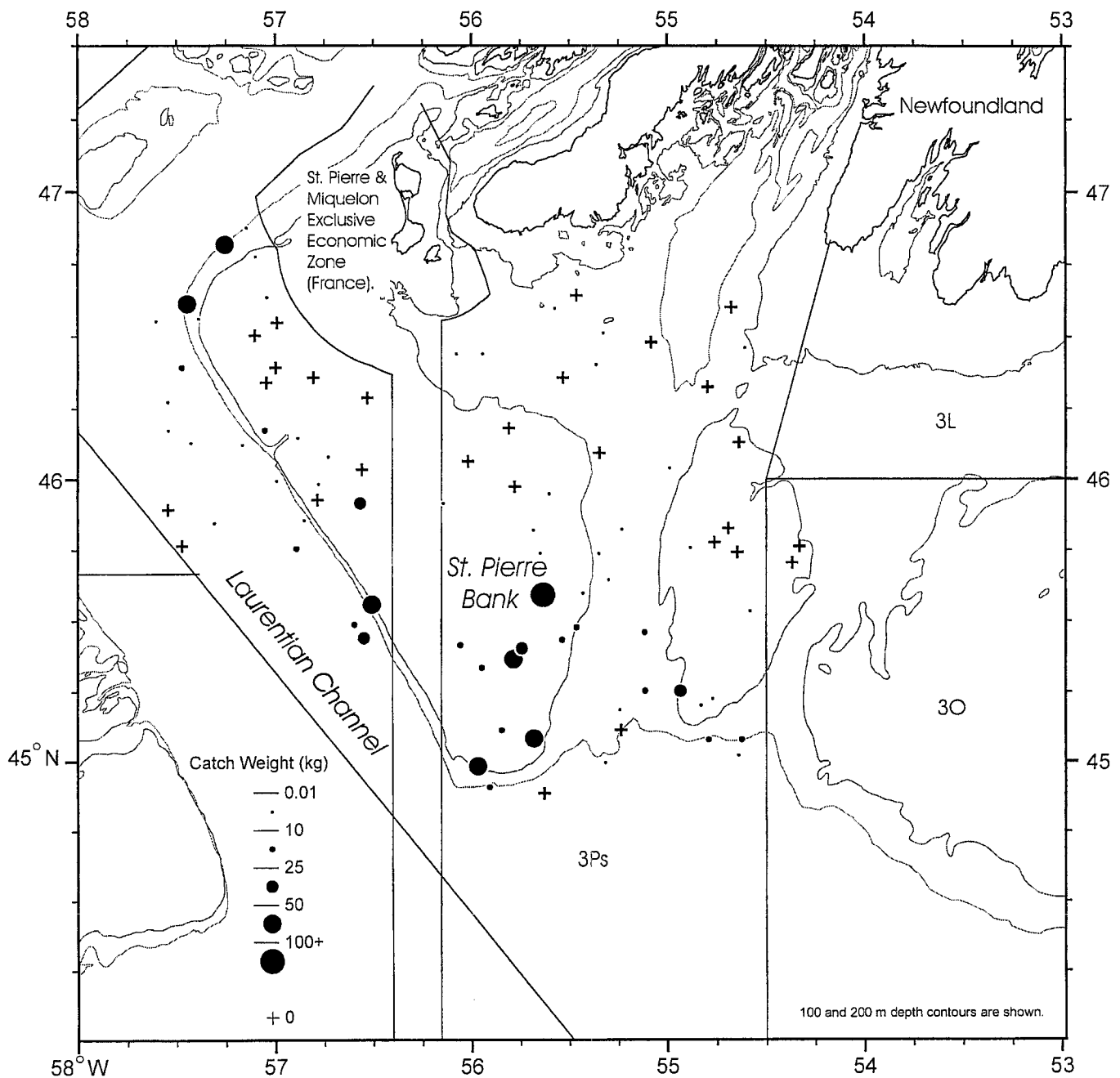
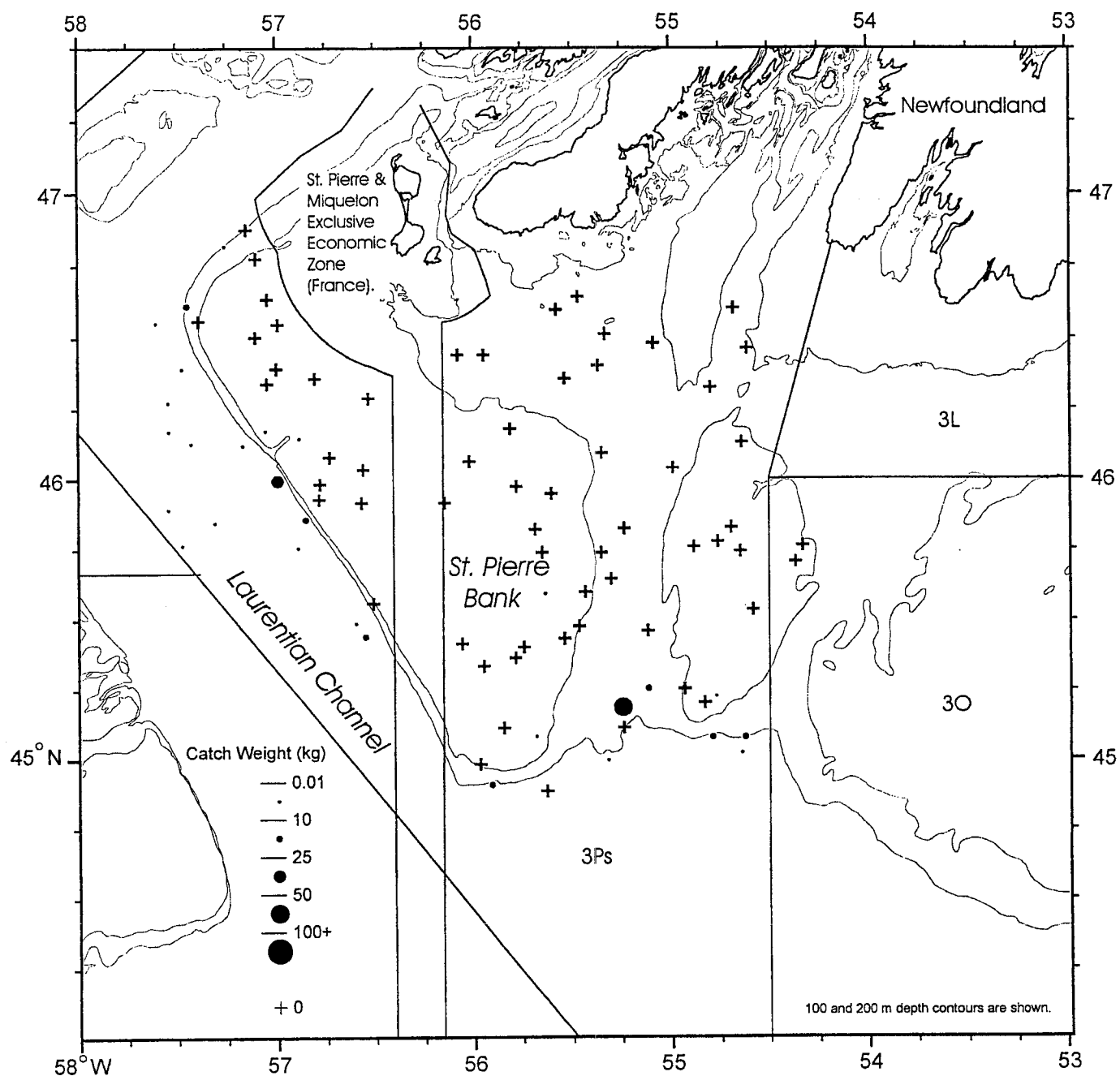Figure 2 American Plaice Catch Distribution: Catch Weight, from Pennysmart Trip #3 Random Stratified Surveys, NAFO Division 3Ps, 30 Nov to 12 Dec 1998.
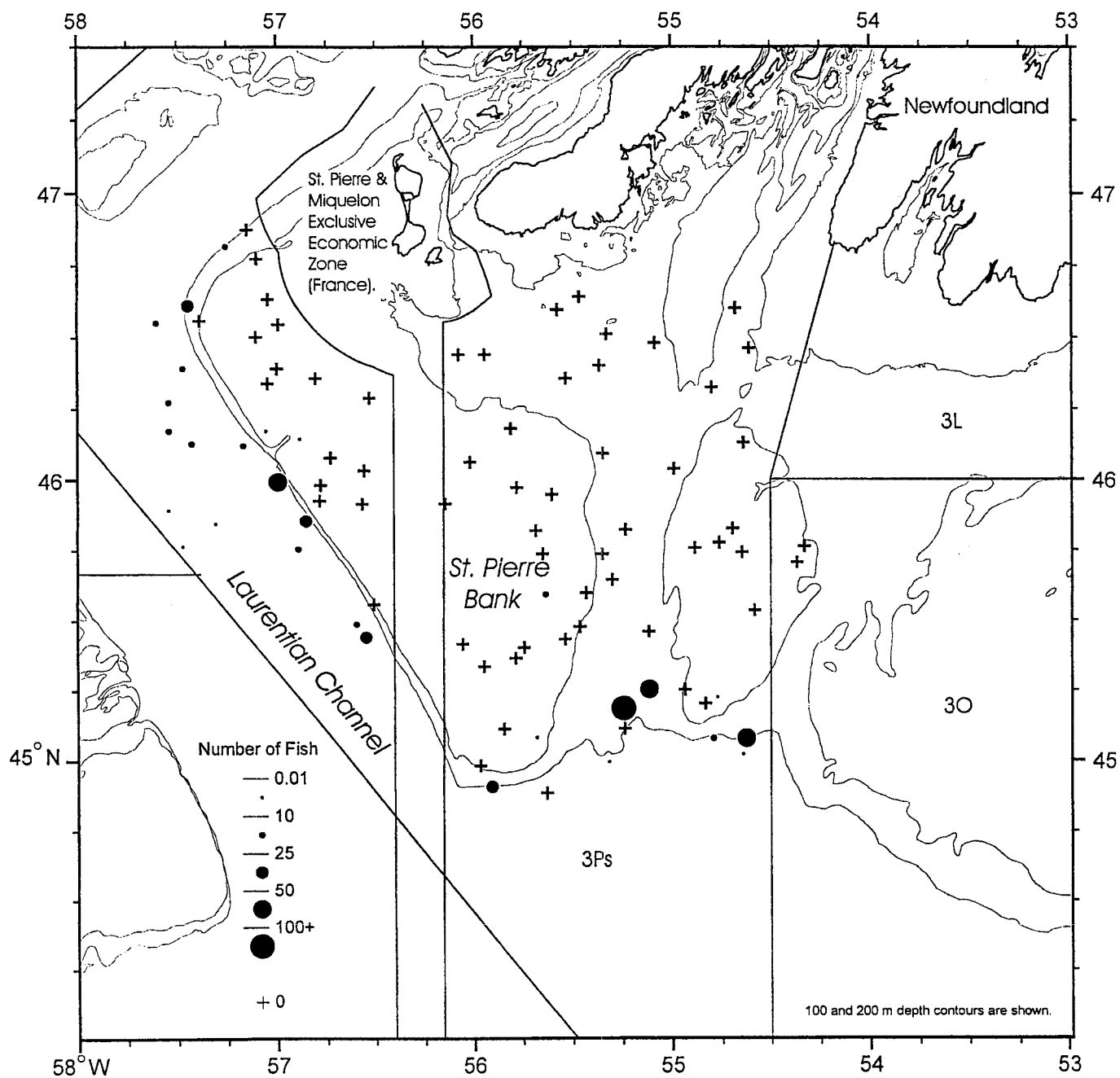
Figure 3 Witch Catch Distribution: Number of Fish, from Pennysmart Trip #3 Random Stratified Surveys, NAFO Division 3Ps, 30 Nov to 12 Dec 1998.

Figure 4 Witch Catch Distribution: Catch Weight, from Pennysmart Trip #3 Random Stratified Surveys, NAFO Division 3Ps, 30 Nov to 12 Dec 1998.

Figure 5 Plaice Length Composition
3Ps StratifiedRandom Survey 1998

1998 St. Pierre Bank N=1519 samples
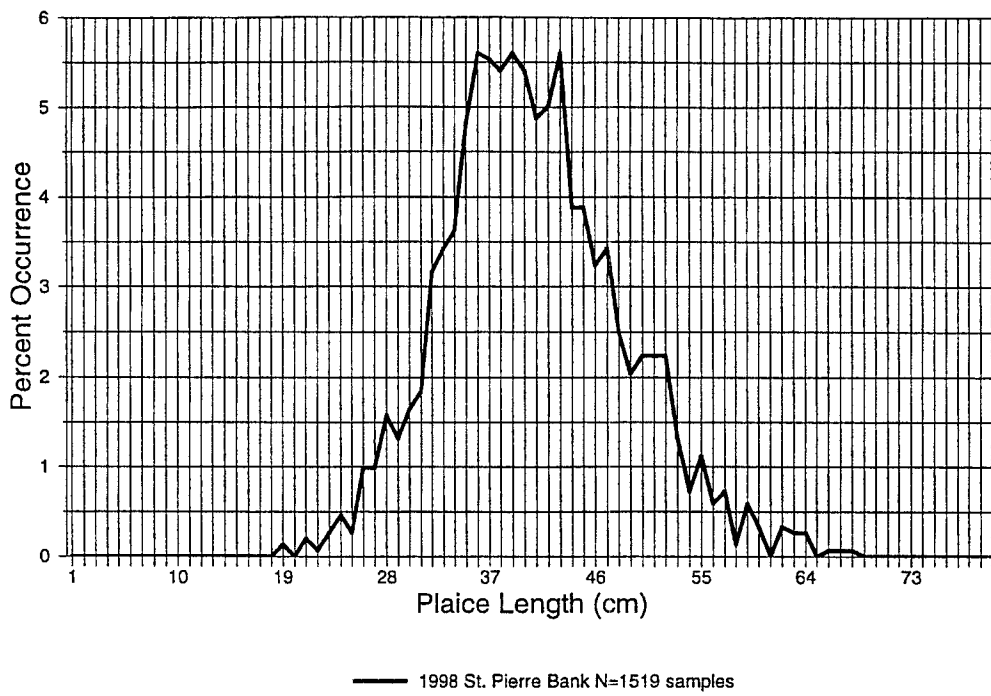
Figure 6 Plaice Age-Length Composition
3Ps 1998 (515 samples)

18
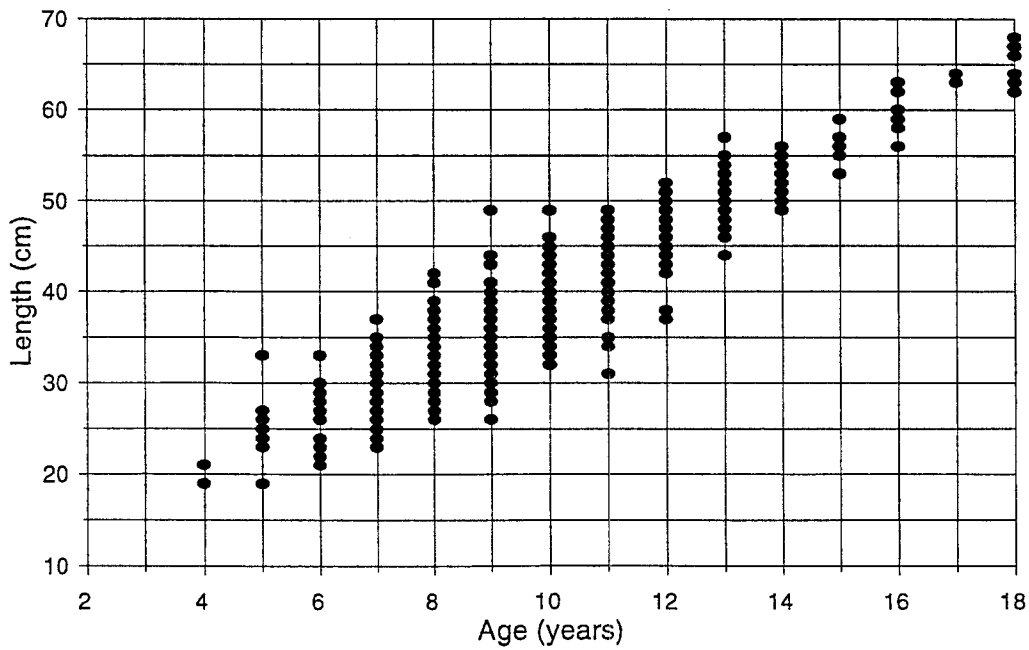
Figure 8a Age Composition of Plaice
Estimated Mean #s per tow
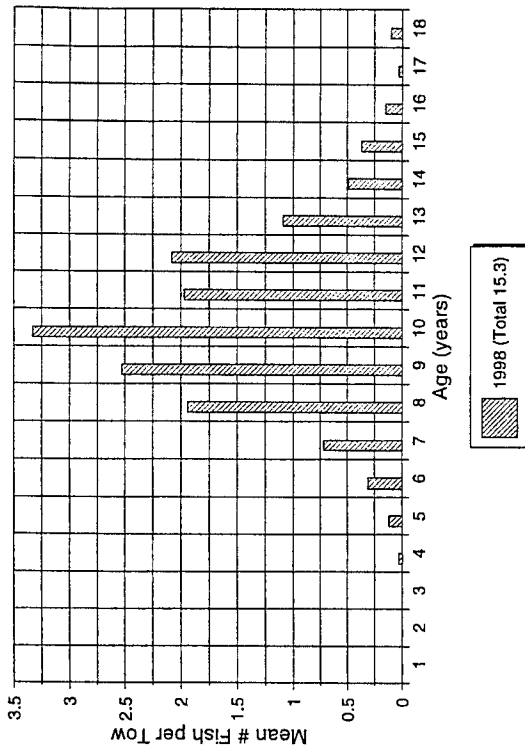
Figure 8b Age Composition of Plaice
Estimated % of Total Mean #s per tow
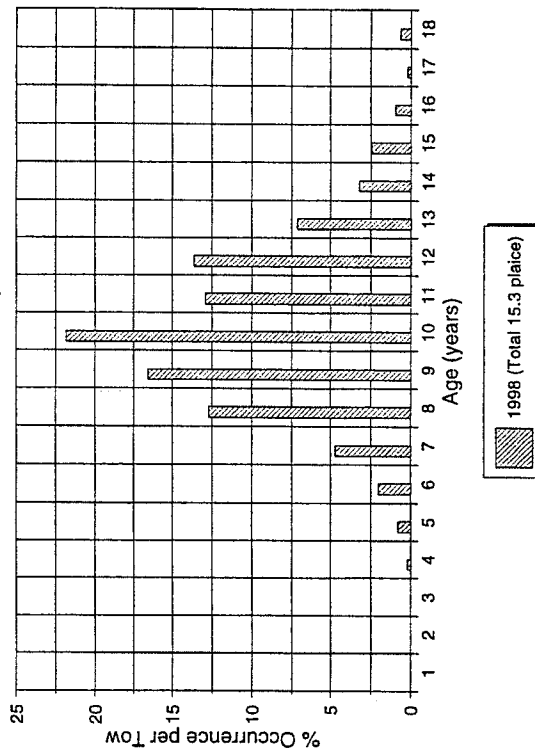
Figure 7a Age Composition of Plaice
3Ps Sampled Plaice
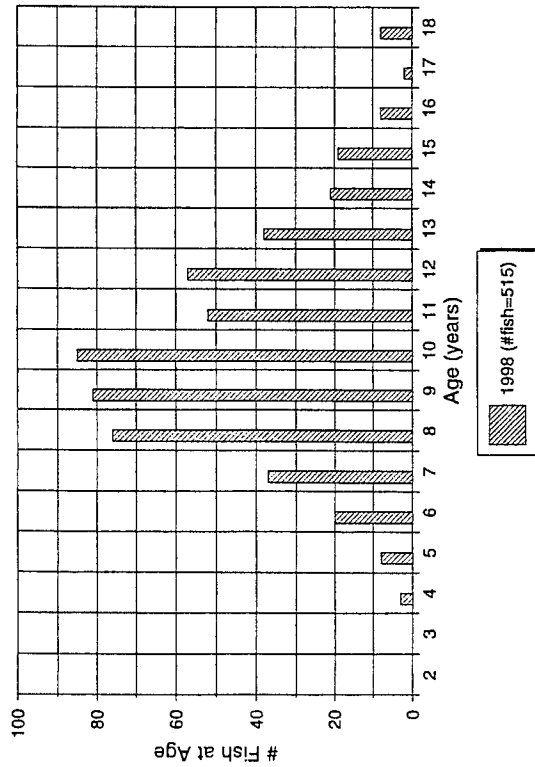
Figure 7b Age Composition of Plaice
3Ps Sampled Plaice
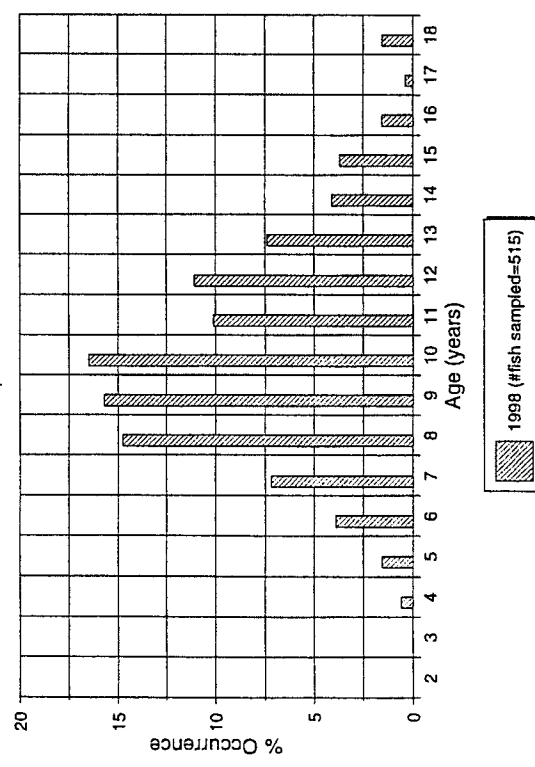
Figure 9 Witch Length Composition
3Ps StratifiedRandom Survey 1998

1998 St. Pierre Bank N=616 samples
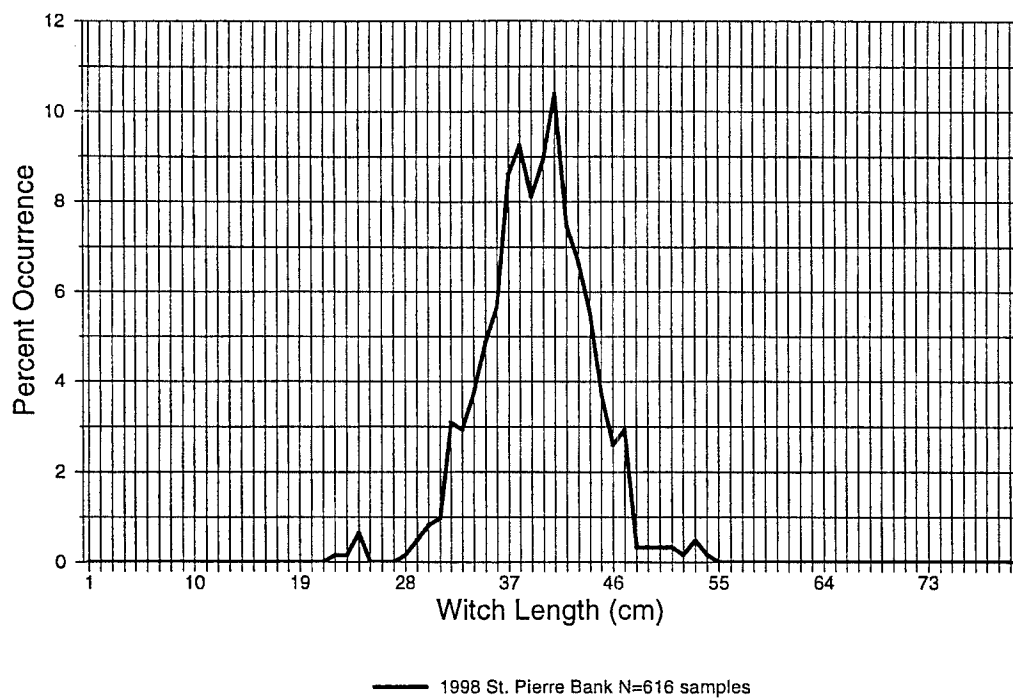
Figure 10 Witch Age-Length Composition
3Ps 1998 (295 samples)

Figure 11a Age Composition of Witch
3Ps Sampled Witch

Figure 11b Age Composition of Witch
3Ps Sampled Witch
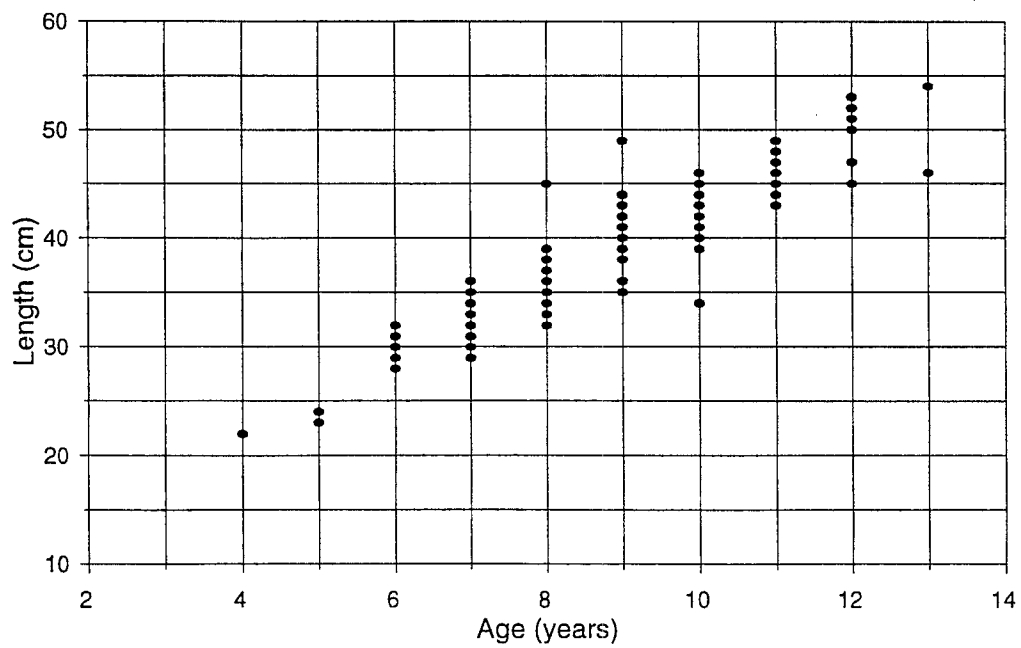
Figure 12a Age Composition of Witch
Estimated Mean #s per tow
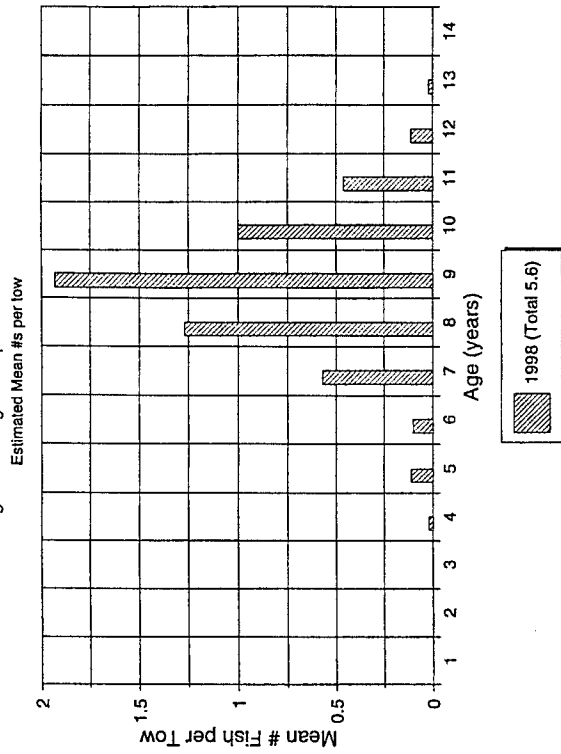
Figure 12b Age Composition of Witch
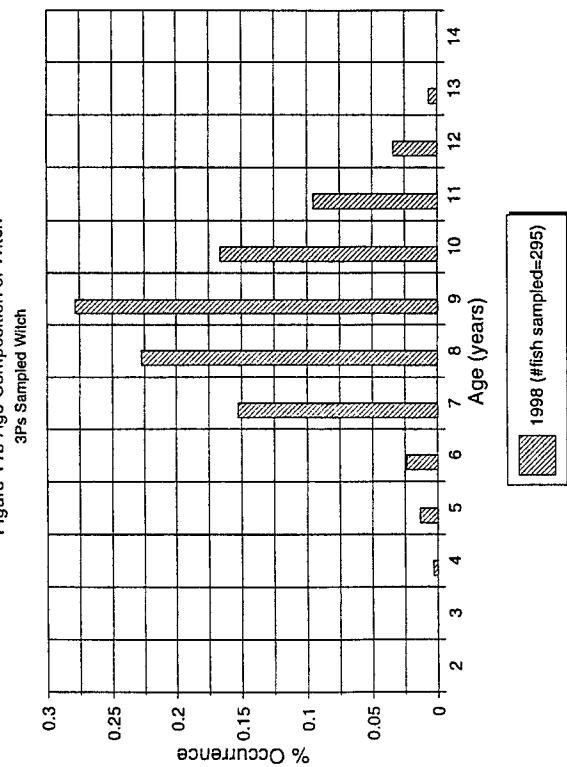Estimated % of Total Mean #s per tow

Figure 13 Flatfish LengthComposition

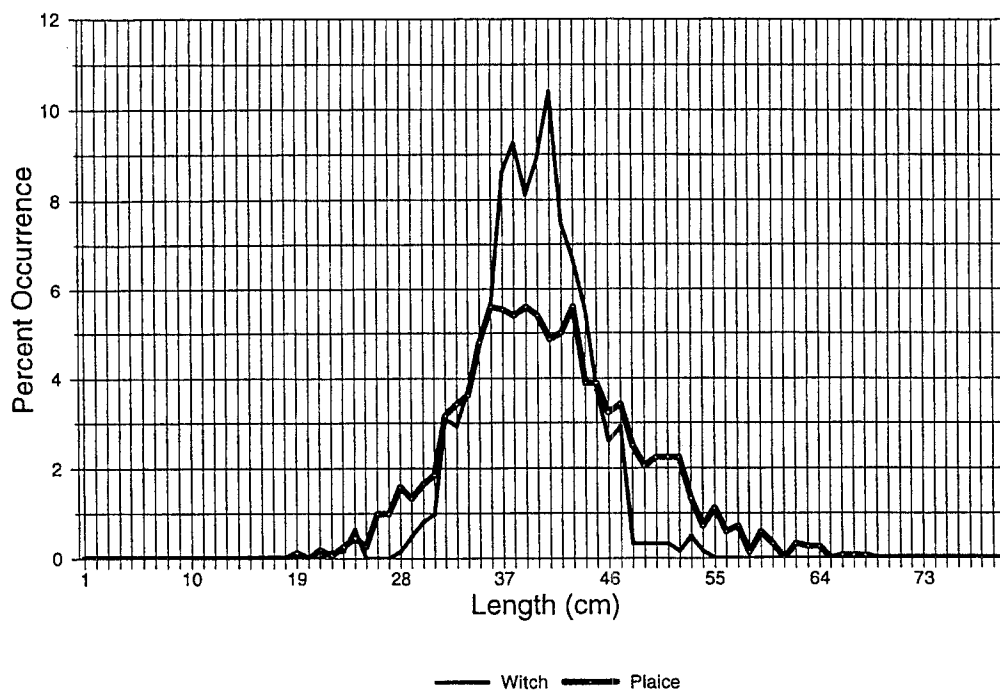3Ps StratifiedRandom Survey 1998

— Witch ——• Plaice

Figure 14 Age Composition of Flatfish

Estimated % of Total Mean #s per tow

Plaice (Total est. #s 15.3) Witch (Total est. #s 5.6)