

Gulf of St. Lawrence Redfish Assessment

by

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Abstract

Because of the problems with catch and effort data unadjusted survey data was used to estimate the biomass of the Gulf of St. Lawrence redfish stock to key in the cohort. Using the survey data indicated the stock was larger than previously indicated. Thus some moderate increase in the T.A.C was indicated. The recruitment prospects of year-classes from the early 70's indicate some moderate increase in the TAC over the next few years. But if subsequent year-classes remain as low in abundance as indicated the stock will revert to the general decline which has been noted.

Résumé

Par suite de difficultés avec les données de prises et d'effort, les données brutes des relevés pour estimer la biomasse du stock de sébastes du golfe Saint-Laurent ont été utilisées pour ajuster l'analyse des cohortes. Selon

les relevés, le stock serait plus abondant que calculé antérieurement. On peut donc songer à une augmentation modérée du TPA. Les prévisions de recrutement des classes d'âge du début des années 70 indiquent qu'il pourrait y avoir augmentation modérée des TPA dans les quelques années à venir. Si, par contre, les classes d'âge subséquentes demeurent à un niveau aussi bas qu'indiqué, il y aura retour au déclin général du stock déjà noté.

### INTRODUCTION

Nominal catches of redfish in the Gulf of St. Lawrence increased from 7000 MT in 1962 to 130,000 MT in 1973 as a result of recruitment of the large 1956 and 1958 year classes. These year classes are the largest on record and they have mainly sustained the fishery up to the present. Since 1973 the stock has continued to decline so that the catch was 15267 MT (provisional) in 1979 under quota regulation. Since the introduction of a TAC 30,000 MT in 1976 it has been necessary to decrease the TAC to 16000 MT in 1979 mainly due to dismal recruitment during the 1960's.

A further consideration in evaluating this stock is the measure of the commercial catch rate which up to present is being calculated by using tonnage class 4 vessels. With current changes in the regulations these vessels have been largely excluded from fishing redfish in the Gulf and historically there have not been any other vessel class (which supply catch statistics) which has consistently fished the area. Thus traditional methods used to calculate terminal fishing mortality are being impaired. This point has been brought forward on several occasions over the

past 3 years. A solution to the problem would be to instigate log books on small vessels but this has been slow in development. The longer this problem is delayed the more difficult it will be to get accurate measurements of catch rates.

The CAFSAC assessment meetings in the spring of 1979 deferred the assessment of this stock to the early spring of 1980 mainly due to not being able to fix terminal fishing mortality. Commercial catch rates in the early spring of 1980 again have proven to be suspect and there is an absence of a sufficiently long time series in research thus again fixing terminal fishing mortality is suspect. There is, however, some evidence from research that the cohort runs used in previous years may be underestimating the stock size. Thus the TAC for 1980 was set at the 1979 level of 16000 MT with the provision that adjustments could be made at the spring meeting if warranted. The present paper incorporates the research biomass estimates in attempting to fix terminal F.

#### METHODS

Trends in catches and catch per unit effort:

Historical catches are from ICNAF statistical bulletins. The 1978 figure has been supplied from preliminary runs of data from ICNAF. The 1979 catch figure was derived from Newfoundland economic reports for the Newfoundland and Maritime regions and from figures provided by the Quebec region.

Catch per hour was determined from Canadian tonnage class 4 using all data in which redfish constituted greater than 50% of the catch.

Table 11 shows the trends in catches, effort and catch per unit effort from 1954 to 1979. All three can be seen to fluctuate, catches ranging from 6,585 MT in 1962 to 130,164 in 1973; effort ranging from 16,541 standard hours in 1962 to 236,404 standard hours in 1973; and catch per unit effort fluctuating between 0.40

in 1962 and 1.28 in 1967 and to 0.50 in 1979.

#### Numbers at age

Commercial sampling length frequencies and otolith collections of male and female redfish were applied to the reported commercial catches to determine numbers caught at age. Additionally for 1976-79 the estimated removals from the Port au Choix shrimp fishery were added to the removals at age (Table 14). These catches mainly were in ages 5-10 year olds. The calculated numbers of males and females were combined and cohorts were run using the 1972-79 data.

#### Average weight at age

The average weight at age was calculated from the average length at age for each sex from the following:

$$\text{Male } wt = 0.01659 l_t^{2.9548}$$

$$\text{Female } wt = 0.01372 l_t^{3.0210}$$

The results for male and female were averaged to yield a combined weight at age (Table 12). A check was made to determine whether the reported weight caught agreed with weight caught from weight length relationship. These two estimates were found to be in reasonably good agreement with each other.

#### Partial recruitment

Partial recruitment was calculated assuming research survey frequencies represent the proportions in the population. The percent at age determined from research cruises of the Beothic Venture and A.T. Cameron in 1979 were compared with the percent at age caught commercially (sexes combined) and a ratio of % commercial to % research averaged over 3 ages was determined. The vector was calculated by assuming all ages over 13 are fully recruited and averaging the vector from the Beothic Venture and that from the A.T. Cameron for ages 8-29. For ages 5-7 the proportion recruited was estimated from the

ratios calculated for the Beothic Venture as the catchability of the A.T. Cameron for young age groups tend to underestimate year-class strength (Table 12).

#### Abundance indices

Since 1976 there have been a number of random stratified cruises in the Gulf of St. Lawrence. The A.T. Cameron carried out surveys mainly aimed at determining the adult biomass in 1977-79 and the *Gadus Atlantica* has surveyed the Gulf in 1978-80 mainly aimed at estimating cod biomass. A charter boat the Beothic Venture surveyed the Gulf in 1976, 78, and 79 aimed at estimating the biomass of small redfish and shrimp. Additionally, survey data collected from 1976-79 in the Gulf by the province of Quebec were re-stratified to the scheme used in the A.T. Cameron cruises and these results are offered for comparison with the other cruises.

The A.T. Cameron and *Gadus Atlantica* surveys used the same stratification scheme (Figure 2) but the Beothic Venture surveys used a scheme outlined in Figure 1. From year to year the areas covered by the A.T. Cameron and *Gadus Atlantica* varied as a result of unforeseen circumstances and the availability of the vessels but the Beothic Venture succeeded in covering approximately the same area each year (Figures 2-10). The minimum number of sets in a stratum aimed for was two but in known redfish areas the number of samples were increased to attempt to decrease the variance (Fig. 1-4). Further it was attempted at least to fish at an intensity relative to the ICNAF requirement of one set per 350 square miles in each stratum for each survey (Table 1-4).

Each of the vessels operated in the Gulf at different times of the year. The A.T. Cameron surveys varied between September and October depending on the availability of the vessel each year. The *Gadus* surveys were carried out in January-February period each year while the Beothic Venture surveyed the Gulf in July-August.

The A.T. Cameron and *Gadus Atlantica* fished on a 24 hour schedule so that there was no attempt to segregate sets into day and night. The Beothic Venture on the other hand only fished during the day. Each of the vessels used different bottom trawling gear (1) A.T. Cameron - Yankee 41.5. (2) *Gadus* Ingles model 145, and (3) Beothic Venture - 36 shrimp trawl. Apparently each vessel and its net has a different catchability for the various age group in the areas surveyed (Figs. 11-13); particularly the Beothic Venture in which greater numbers of young fish in the 1-8 year old groups were caught relative to older fish. The total numbers estimated from the random stratified cruises by stratum fluctuate from year to year making it difficult to determine any stratum trends (Table 5 and 7). To see the effect of the largest set from a stratum with the highest estimated number, it was decided to remove the set and the total biomass for the trip was reestimated. In as much as there may be estimates from a stratum which are greater than the absolute numbers and equally there maybe estimates which are under the absolute numbers, no attempt was made to estimate what the numbers might be in the stratum which were unfished. Similarly the biomass estimates for each stratum for the random stratified cruises fluctuate as was found with the numbers (Table 6-7). To estimate the impact on the total biomass estimate for a survey the largest set from the largest weight caught in a stratum was removed and recalculated.

Tables 8 and 9 give the average weight caught per fish caught in each stratum and for the trip. Because of the catchability problems mainly due to some vessels catching younger fish better than others the random stratified surveys for 1978 and 1979 were broken down into numbers and biomass of 5-9 year-olds and 10-29 year-olds (Table 10). Similarly for comparative purposes the numbers and biomass of 5-9 year-olds and 10-29 year-olds as estimated by cohort in 1979 for various terminal fishing mortalities were determined. The research estimates for 1978 and 79 by number and biomass were averaged by age grouping.

### Terminal fishing mortality

An attempt was made to establish terminal fishing mortality for 1979 by using catch per unit effort from reported statistics. Again catch per unit effort statistics are considered suspect and, therefore, were not used. In the last three years a number of survey trips have been carried out in the Gulf of St. Lawrence. These surveys were not all aimed at the commercially fishable stock of redfish, all carried out at different times of the year and did not survey all areas of the Gulf equally each year. For the purposes of assessing the stock an attempt was made to estimate the size of the fishable stock by averaging the arithmetic abundance estimates from all surveys from 1978 and 1979 for ages 10-29, (Table 10). The younger age groups were omitted from the estimates as they would greatly bias estimates due to the nature of some of the surveys. The fishable stock size estimated from research surveys was approximately 155,000 t and a terminal fishing mortality from cohort of 0.10 was selected as giving the nearest stock size estimate (Tables 15-16).

### Projections

For projections the numbers at age (ages 7, 8 and 9) and the partial recruitment were adjusted to reflect the abundances indicated in the 1979 Beothic Venture survey. The population numbers were adjusted by applying mortality to 6, 7, and 8 year olds from 1979 survey to give estimates of abundances of these year-classes in 1980 (Table 19). Further year-class abundance at age 7 in 1981 and 82 were derived by applying mortality to 4 and 5 year-olds from the 1979 survey. In all other years the geometric mean of 7 year-olds from the cohort for years 1972-76 was used.

The partial recruitment for ages 10-29 remained the same as used in the cohort (Table 12) but for ages 7-9 the partial recruitment was adjusted to reflect the mortality indicated for these year-classes for the Beothic Venture surveys (Table 17).

Estimates of  $F_{0.1}=0.132$  used for the projection was calculated by yield per recruit using mean weights and partial recruitment from Table 17 (Table 18). Stock size and catches were projected for the years 1980-81 assuming the T.A.C. of 16,000 would be caught in 1980 and fishing at  $F_{0.1}$  for 1981 (Tables 19-20). Further stock size and catches were projected for the years 1980 and 1981 assuming fishing at  $F_{0.1}$  (Tables 21-22).

#### RESULTS AND DISCUSSION

The use of the arithmetic mean abundance from surveys as an estimate of the absolute abundance of the Gulf of St. Lawrence redfish stock to key in the cohort has many pit falls. Foremost of these problems is that the catch data is not normally distributed and thus the use of the arithmetic mean could result in considerable bias. Additionally the biomass estimates from 3 different research vessels with differing catchabilities and differences in the timing of the surveys were not adjusted. Further the area covered varied between vessels and from year to year. The estimates of adult biomass from the different vessels however were relatively consistent for 1978 and 1979 from Newfoundland surveys and these estimates agreed well with results from Quebec surveys (Table 10).

Estimates of the stock biomass are thought to be reasonable in light of problems with the data, although biases could result in either overestimation of the stock size or underestimation.

Recruitment estimates from the Beothic Venture surveys indicate the year-classes from the early 70's are not as abundant as previously thought. These year-classes, however, are larger than preceding years and appear to be larger than succeeding year-classes. If recruitment trends continue the year-classes from the 70's can only be expected to contribute some small gains in catches for the next 5 years and then the stock will continue in the general decline which has been evident for a number of years.



Table 1. Number of tows per stratum and by depth zone during research cruises Gulf of St. Lawrence ICNAF Divs. 4RST  
 January, September, October-November 1977-1980 (A.T.C.=R/V A.T. Cameron;  
 Gadus= R/V Gadus Atlantica)

Stratum	Division 4R		Number of Tows						4R Sampling Intensity						
	Depth Range FMS	Depth Range Meters	ATC Trip 267 1977 Sept	ATC Trip 283 1978 Oct-Nov.	ATC Trip 294 1979 Sept	Gadus Trip 4 1978 Jan.	Gadus Trip 16 1979 Jan.	Gadus Trip 31 1980 Jan.	Area of Stratum Sq.N. Miles	ATC 267 1977	ATC 283 1978	ATC 294 1979	Gadus 4 1978	Gadus 16 1979	Gadus 31 1980
820	51-100	93-183	3	2	2	4	4	4	396	2.7	1.8	1.8	3.5	3.5	3.5
821	"	"	-	2	3	4	4	4	371	0.0	1.9	2.8	3.8	3.8	3.8
822	"	"	4	3	2	4	4	5	946	1.5	1.1	0.7	1.5	1.5	1.8
823	"	"	-	2	2	2	3	2	162	0.0	4.3	4.3	4.3	6.5	4.3
824	"	"	-	2	2	-	2	2	244	0.0	2.9	2.9	0.0	2.9	2.9
811	101-150	184-274	-	3	3	5	5	4	439	0.0	2.4	2.4	4.0	4.0	3.2
812	"	"	2	4	4	5	5	3	1355	0.5	1.0	1.0	1.3	1.3	0.8
813	"	"	2	4	4	3	4	5	1154	0.6	1.2	1.2	0.9	1.2	1.5
801	151-200	275-366	4	2	2	3	3	2	354	4.0	2.0	2.0	3.0	3.0	2.0
809	"	"	3	2	3	3	3	3	451	2.3	1.6	2.3	2.3	2.3	2.3
810	"	"	-	2	2	3	3	4	223	0.0	3.1	3.1	4.7	4.7	6.3
802	201+	367+	-	2	2	3	2	3	399	0.0	1.8	1.8	2.6	1.8	2.6
TOTAL:			18	30	31	39	42	41	6,494	1.0	1.6	1.7	2.1	2.3	2.2
820-824	51-100	93-183	7	11	11	14	17	17	2,119	1.2	1.8	1.8	2.3	2.8	2.8
811-813	101-150	184-274	4	11	11	13	14	12	2,948	0.5	1.3	1.3	1.5	1.7	1.4
801,809, 810	151-200	275-366	7	6	7	9	9	9	1,028	2.4	2.0	2.4	3.1	3.1	3.1
802	201+	367+	-	2	2	3	2	3	399	0.0	1.8	1.8	2.6	1.8	2.6
TOTALS			18	30	31	39	42	41	6,494						

Table 2.

Number of tows per stratum and by depth zone during research cruises Gulf of St. Lawrence ICNAF Divs. 4RST  
January, September, October-November 1977-1980 (ATC = R/V A.T. Cameron; Gadus = R/V Gadus Atlantica).

DIV. 4S			NUMBER OF TOWS						4S SAMPLING INTENSITY						
STRATUM	DEPTH RANGE fms	DEPTH RANGE meters	ATC	ATC	ATC	GADUS	GADUS	GADUS	AREA OF STRATUM SQ.N. MILES	ATC	ATC	ATC	GADUS	GADUS	GADUS
			TRIP 267 1977 SEPT.	TRIP 283 1978 OCT.-NOV.	TRIP 294 1979 SEPT.	TRIP 4 1978 JAN.	TRIP 16 1979 JAN.	TRIP 31 1980 JAN.		TRIP 267 1977	TRIP 283 1978	TRIP 294 1979	TRIP 4 1978	TRIP 16 1979	TRIP 31 1980
833	<50	<92	4	2	-	3	-	2	163	8.6	4.3	0.0	6.4	0.0	4.3
834	"	"	-	2	-	2	-	2	56	0.0	12.5	0.0	12.5	0.0	12.5
825	51-100	93-183	2	2	-	2	-	3	1156	0.6	0.6	0.0	0.6	0.0	0.9
826	"	"	-	-	-	-	-	2	902	0.0	0.0	0.0	0.0	0.0	0.8
827	"	"	-	2	2	4	-	2	942	0.0	0.7	0.7	1.5	0.0	0.7
828	"	"	-	-	-	2	-	2	710	0.0	0.0	0.0	1.0	0.0	1.0
829	"	"	4	2	2	3	-	3	785	1.8	0.9	0.9	1.3	0.0	1.3
830	"	"	2	3	-	2	2	3	559	1.3	1.9	0.0	1.3	1.3	1.9
831	"	"	-	4	2	2	-	3	351	0.0	4.0	2.0	2.0	0.0	3.0
832	"	"	-	-	-	-	-	2	1155	0.0	0.0	0.0	0.0	0.0	0.6
814	101-150	184-274	-	2	2	3	-	3	300	0.0	2.3	2.3	3.5	0.0	3.5
815	"	"	3	4	4	3	4	3	1285	0.8	1.1	1.1	0.8	1.1	0.8
816	"	"	-	6	5	5	3	3	1467	0.0	1.4	1.2	1.2	0.7	0.7
817	"	"	-	4	-	-	-	2	1063	0.0	1.3	0.0	0.0	0.0	0.7
818	"	"	-	2	2	2	-	3	630	0.0	1.1	1.1	1.1	0.0	1.7
819	"	"	-	2	-	2	2	3	420	0.0	1.7	0.0	1.7	1.7	2.5
805	151-200	275-366	-	4	-	-	-	3	1680	0.0	0.8	0.0	0.0	0.0	0.6
806	"	"	-	4	2	3	-	3	620	0.0	2.3	1.1	1.7	0.0	1.7
807	"	"	-	2	-	3	2	3	691	0.0	1.0	0.0	1.5	1.0	1.5
808	"	"	3	3	3	3	3	3	708	1.5	1.5	1.5	1.5	1.5	1.5
803	201+	367+	-	2	-	6	-	7	2034	0.0	0.3	0.0	1.0	0.0	1.2
804	"	"	-	2	2	3	-	2	726	0.0	1.0	1.0	1.4	0.0	1.0
Totals			18	54	26	53	16	62	18,403	0.3	1.0	0.5	1.0	0.3	1.2
833-834	<50	<92	4	4	-	5	-	4	219	6.4	6.4	0.0	8.0	0.0	6.4
825-832	51-100	93-183	8	13	6	15	2	20	6560	0.4	0.7	0.3	0.8	0.1	1.1
814-819	101-150	184-274	3	20	13	15	9	17	5165	0.2	1.4	0.7	1.0	0.6	1.2
805-808	151-200	275-366	3	13	5	9	5	12	3699	0.3	1.2	0.5	0.9	0.5	1.1
803-804	201+	367+	-	4	2	9	-	9	2760	0.0	0.5	0.3	1.1	0.0	1.1
Totals			18	54	26	53	16	62	18,403						

Table 3.

Number of tows per stratum and by depth zone during research cruises Gulf of St. Lawrence ICNAF Divs. 4RST  
 January, September, October-November 1977-1980 (ATC = R/V A.T. Cameron; Gadus = R/V Gadus Atlantica).

DIV. 4T			NUMBER OF TOWS						4T SAMPLING INTENSITY						
STRATUM	DEPTH RANGE fms.	DEPTH RANGE meters	ATC	ATC	ATC	GADUS	GADUS	GADUS	AREA OF STRATUM SQ. N. MILES	ATC	ATC	ATC	GADUS	GADUS	GADUS
			TRIP 267 1977 SEPT.	TRIP 283 1978 OCT.-NOV.	TRIP 294 1979 SEPT.	TRIP 4 1978 JAN.	TRIP 16 1979 JAN.	TRIP 31 1980 JAN.		TRIP 267 1977	TRIP 283 1978	TRIP 294 1979	TRIP 4 1978	TRIP 16 1979	TRIP 31 1980
401	101-150	184-274	-	-	-	2	-	2	159	0.0	0.0	0.0	4.4	0.0	4.4
402	"	"	-	-	-	-	2	2	265	0.0	0.0	0.0	0.0	2.6	2.6
403	"	"	-	2	2	-	-	-	347	0.0	2.0	2.0	0.0	0.0	0.0
404	151-200	275-366	-	-	-	2	-	2	231	0.0	0.0	0.0	3.0	0.0	3.0
405	"	"	-	-	-	-	2	2	431	0.0	0.0	0.0	0.0	1.6	1.6
406	"	"	-	2	2	-	-	-	752	0.0	0.9	0.9	0.0	0.0	0.0
407	201+	367+	-	-	-	2	-	2	681	0.0	0.0	0.0	1.0	0.0	1.0
408	"	"	-	-	-	-	2	2	797	0.0	0.0	0.0	0.0	0.9	0.9
Totals			-	4	4	6	6	12	3,663	0.0	0.4	0.4	0.6	0.6	1.1
401-403	101-150	184-274	-	2	2	2	2	4	771	0.0	0.9	0.9	0.9	0.9	1.8
404-406	151-200	275-366	-	2	-	2	2	4	1,414	0.0	0.5	0.0	0.5	0.5	1.0
407-408	201+	367+	-	-	-	2	2	4	1,478	0.0	0.0	0.0	0.5	0.5	0.9
Totals			-	4	4	6	6	12	3,663						

Table 4. Number of tows per stratum and by depth zone during research cruises  
Gulf of St. Lawrence ICNAF Divs. 4RST July & August 1976, 1978, 1979  
M.V. Beothic Venture

STRATUM	DEPTH RANGE FATHOMS	DEPTH RANGE METERS	NUMBER OF TOWS			AREA OF STRATUM SQ. N. MILES	SAMPLING INTENSITY		
			BEOTHIC VENTURE JULY&AUG. 1976	BEOTHIC VENTURE JULY&AUG. 1978	BEOTHIC VENTURE JULY&AUG. 1979		BEOTHIC VENTURE 1976	BEOTHIC VENTURE 1978	BEOTHIC VENTURE 1979
506	77-98	141-180	3	2	2	394	2.7	1.8	1.8
510	"	"	2	2	6	847	0.8	0.8	2.5
501	77-120	141-220	5	8	4	1164	1.5	2.4	1.2
502	"	"	5	4	3	704	2.5	2.0	1.5
503	99-120	181-220	6	4	4	823	2.6	1.7	1.7
507	"	"	4	4	2	448	3.1	3.1	1.6
112	"	"	3	4	4	264	4.0	5.3	5.3
122	"	"	2	5	7	784	0.9	2.2	3.1
508	121-142	221-260	7	3	5	464	5.3	2.3	3.8
113	"	"	3	8	6	523	2.0	5.4	4.0
123	"	"	3	4	4	858	1.2	1.6	1.6
213	"	"	6	7	2	534	3.9	4.6	1.3
223	"	"	6	6	3	388	5.4	5.4	2.7
313	"	"	5	4	2	316	5.5	4.4	2.2
323	"	"	3	2	4	205	5.1	3.4	6.8
504	121-164	221-300	2	4	4	357	2.0	3.9	3.9
511	"	"	4	7	3	689	2.0	3.6	1.5
114	143-164	261-300	4	3	4	267	5.2	3.9	5.2
124	"	"	4	3	5	458	3.1	2.3	3.8
214	"	"	5	5	4	1110	1.6	1.6	1.3
224	"	"	2	4	4	243	2.9	5.8	5.8
314	"	"	5	3	2	631	2.8	1.7	1.1
324	"	"	3	3	3	207	5.1	5.1	5.1
424	"	"	3	2	2	300	3.5	2.3	2.3
434	"	"	2	3	3	86	8.1	12.2	12.2
444	"	"	4	2	3	243	5.8	2.9	4.3
500	165-186	301-340	3	3	6	224	4.7	4.7	9.4
505	"	"	4	4	7	1788	0.8	0.8	1.4
509	"	"	3	4	4	1236	0.8	1.1	1.1
Totals			111	117	112	16,555	Ave. 2.3	2.5	2.4

Table 5. Total numbers estimated ( $\times 10^{-3}$ ) from stratified random cruises - Gulf of St. Lawrence

Stratum	A.T. Cameron			Gadus			Stratum	Beothic Venture		
	1977	1978	1979	1978	1979	1980		1976	1978	1979
801	18022	5753	5155	4942	7370	279	112	1978881	72714	66706
802	-	18390	3489	5441	29531	17551	113	2038854	125101	21250
803	-	5420	-	13283	-	29860	114	71065	3505	3347
804	-	20572	2752	400	-	2752	122	279569	200772	120761
805	-	24623	-	-	-	2648	123	1655693	973655	57335
806	-	35231	16475	745	-	1008	124	118841	228578	46964
807	-	10322	-	17445	2490	934	213	445457	295881	14379
808	37627	109551	73801	8025	23905	7334	214	1034334	206250	186434
809	68606	40354	25650	16090	32421	31010	223	41191	24415	4968
810	-	29369	39981	28301	146129	9253	224	24451	4060	10209
811	-	47617	154056	43610	224345	100466	313	93339	81785	200424
812	94948	66876	86303	87757	120203	4272	314	134323	50010	18854
813	82163	39197	25381	60002	3032	780	323	203129	426591	85723
814	-	4413	5855	17565	173	150	324	124505	53097	21712
815	293327	27346	219030	7331	8151	4662	424	27501	37524	7366
816	-	43057	22178	5043	13361	3744	434	9096	6421	6281
817	-	14582	-	-	-	758	444	41897	64630	59944
818	-	13572	89237	10002	-	378	500	9309	40072	21882
819	-	28421	-	4256	17876	2133	501	719619	630963	60562
820	783	2512	9155	1553	1137	4006	502	33754	15267	19867
821	-	9552	84	738	821	1065	503	195449	349779	35624
822	18660	970	6000	88	1775	710	504	9589	6702	4507
823	-	663	188	261	53	20	505	101367	303105	191544
824	-	1062	714	-	192	-	506	5756	12001	4837
825	217	6551	-	1909	-	260	507	61632	19405	72508
827	-	21718	28072	1379	-	71	508	235154	311497	24150
828	-	-	-	799	-	933	509	193577	832640	159535
829	2342	4184	34000	2907	884	39	510	4866785	11673	4292
830	8996	1832	-	2413	-	14	511	290141	467703	397673
831	-	3333	2740	13	-	-				
832	-	-	-	-	-	390				
833	-	-	-	-	-	-				
834	-	23	-	-	-	6				
401	-	-	-	2208	-	78				
402	-	-	-	-	2416	129				
403	-	2162	39162	-	-	-				
404	-	-	-	728	-	191				
405	-	-	-	-	760	162				
406	-	2794	4516	-	-	-				
407	-	-	-	2556	-	1738				
408	-	-	-	-	2214	927				
Total	625691	642020	893975	347790	639236	230712		15044258	5855796	1929638
Remove one set	381702	556492	783074	260032	579590	167175		10571723	5319406	1735877
Difference	243,989	85,528	110,901	87,758	59,646	63,537		472,472	560,479	193,75
%	39	13	12	25	9	28		32	9	1

Table 6. Total Biomass estimates (mt) from stratified random cruises  
- Gulf of St. Lawrence

<u>A.T. Cameron</u>			<u>Gadus</u>			<u>Beothic Venture</u>				
<u>Stratum</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>Stratum</u>	<u>1976</u>	<u>1978</u>	<u>1979</u>
801	5223	2606	3318	909	1130	20	112	57117	3987	6788
802	-	6826	2087	2629	20138	9964	113	60216	6549	3598
803	-	3154	-	8202	-	16423	114	3751	1524	2106
804	-	4194	1138	206	-	627	122	16324	14913	15866
805	-	4201	-	-	-	456	123	76277	77131	14459
806	-	5906	3993	141	-	199	124	20529	34919	14173
807	-	2213	-	6374	683	107	213	31704	39910	5643
808	15176	35500	20838	4110	6315	1364	214	50340	42823	53212
809	16049	7331	7804	6679	13663	5617	223	11061	2901	1069
810	-	9629	18961	16519	40890	4378	224	1053	1302	5341
811	-	7141	31268	15137	34275	9509	313	5896	19883	32274
812	17385	10690	36249	10824	17667	687	314	7206	18859	5839
813	5584	10662	14178	5060	295	120	323	12289	32630	13239
814	-	1421	1585	6973	34	14	324	10887	6737	3527
815	75906	9480	67165	504	1916	563	424	12741	18487	3100
816	-	12606	5739	405	1933	389	434	568	1947	2574
817	-	3813	-	-	-	132	444	8823	15345	15962
818	-	1224	33697	655	-	95	500	4320	8699	6898
819	-	5439	-	326	2584	180	501	34099	38158	14757
820	288	236	3927	725	374	1182	502	1860	4209	3569
821	-	2117	6	70	217	89	503	26014	31255	6232
822	4500	49	822	12	270	69	504	4209	3014	1502
823	-	161	17	25	6	6	505	35792	34496	39433
824	-	410	135	-	8	-	506	446	5371	1960
825	6	2009	-	217	-	22	507	8961	4258	9987
827	-	9851	15098	60	-	4	508	23296	27441	8265
828	-	-	-	42	-	107	509	36161	112838	50800
829	441	2020	10607	147	94	4	510	66947	578	547
830	2039	254	-	119	-	1	511	18219	63983	70846
831	-	659	1091	7	-	-				
832	-	-	-	-	-	22				
833	-	-	-	-	-	-				
834	-	2	-	-	-	-				
401	-	-	-	238	-	13				
402	-	-	-	-	236	11				
403	-	1082	15344	-	-	-				
404	-	-	-	318	-	43				
405	-	-	-	-	279	18				
406	-	1589	3184	-	-	-				
407	-	-	-	708	-	639				
408	-	-	-	-	1236	227				
TOTAL										
	142,597	164,475	298,251	88,341	144,243	53,301		647,104	674,147	413,566
Remove one set	74,138	136,867	280,279	83,288	143,108	47,104		579,987	629,831	379,494
Difference	68,459	27,610	17,899	5,053	1,135	6,194		67,116	47,182	34,072
%	52	17	6	6	1	12		10	8	8

Table 7. Total numbers and weights estimated from stratified random cruises by Quebec in the Gulf of St. Lawrence.

Stratum	Numbers (X 10 <sup>-3</sup> )				Weight (t)			
	1976	1977	1978	1979	1976	1977	1978	1979
801			4121	4551			1455	1414
802		578	1848	8533		347	1155	5638
803	86452		53473		70041		29053	
804		23430	15807	16690		9025	11183	10048
805	20896		30093		12452		9274	
806				36213				18956
807	53498	71424			30330	37773		
808	48897	48910			32771	8774		
809		5084				2403		
810		7955		47753		4649		17045
811			219460				32463	
812	236395		726964	407853	18894		92116	102003
813		1713869	96762	11462		63706	5257	2940
814		19642	19300	16139		1934	6393	2345
815		660711	22844			62455	3051	
816	135035	31465	53235	62328	13421	6218	6541	12718
817	5725	46335	14691	36871	185	20429	2914	9172
818		231510		363827		29586		80806
819		48520				6226		
820								
821	55449				6531			
822		349202				27938		
823		151307				3940		
824	382041			10540	15358			3221
825	4351				1740			
827	219283	1442140		62348	84659	292778		7746
828			27656	21544			2905	4632
829	6318				591			
830			37704	928			3975	65
831								
832	1248	14001	459	223	401	2118	96	45
833								
834								
Total	1,255,587	4,866,083	1,324,417	1,107,803	287,374	580,299	207,831	278,793

Table 8. Mean weight (gms) of fish caught in stratum from stratified random cruises Gulf of St. Lawrence

Stratum	A.T. Cameron			Gadus			Beothic Venture			
	1977	1978	1979	1978	1979	1980	Stratum	1976	1978	1979
801	290	453	644	184	153	72	112	29	55	102
802	-	371	598	483	682	568	113	30	52	169
803	-	582	-	617	-	550	114	53	435	629
804	-	204	414	515	-	228	122	58	74	131
805	-	171	-	-	-	172	123	46	79	252
806	-	168	242	189	-	197	124	173	153	302
807	-	214	-	365	274	115	213	71	135	392
808	403	324	282	512	264	186	214	49	208	285
809	234	182	304	415	421	181	223	25	119	215
810	-	328	474	584	280	473	224	43	321	523
811	-	150	203	347	153	95	313	63	243	161
812	183	160	420	123	147	161	314	54	377	310
813	63	272	559	84	97	154	323	60	76	154
814	-	322	271	397	197	93	324	87	127	162
815	259	347	307	69	235	121	424	463	493	421
816	-	293	259	80	145	104	434	62	303	410
817	-	261	-	-	-	174	444	211	237	266
818	-	90	378	65	-	251	500	464	217	315
819	-	191	-	77	145	84	501	47	60	244
820	368	94	429	467	329	295	502	55	276	180
821	-	222	71	95	264	84	503	133	89	175
822	241	51	137	136	117	97	504	439	450	333
823	-	243	90	96	113	300	505	353	114	206
824	-	386	189	-	42	-	506	77	256	405
825	28	307	-	114	-	85	507	145	219	138
827	-	454	538	44	-	56	508	99	88	342
828	-	-	-	53	-	115	509	187	136	318
829	188	483	312	51	106	103	510	14	50	127
830	227	139	-	49	-	71	511	63	137	178
831	-	198	398	538	-	-	-	-	-	-
832	-	-	-	-	-	56	Ave	126	192	271
833	-	-	-	-	-	-	-	-	-	-
834	-	87	-	-	-	3	-	-	-	-
401	-	-	-	108	-	167	-	-	-	-
402	-	-	-	-	98	85	-	-	-	-
403	-	500	392	-	-	-	-	-	-	-
404	-	-	-	437	-	225	-	-	-	-
405	-	-	-	-	367	111	-	-	-	-
406	-	569	705	-	-	-	-	-	-	-
407	-	-	-	277	-	368	-	-	-	-
408	-	-	-	-	558	245	-	-	-	-
Ave	226	276	359	252	236	179	-	-	-	-



Table 9. Mean weight (gms) of fish caught in stratum from stratified random cruise in Gulf of St. Lawrence from Quebec sampling for 1976-79.

Stratum	1976	1977	1978	1979
801			353	311
802		600	625	661
803	810		543	
804		385	707	602
805	596		308	
806				523
807	567	529		
808	670	179		
809		473		
810		584		357
811			148	
812	80		127	250
813		37	54	257
814		98	331	145
815		95	134	
816	99	198	123	204
817	32	443	198	249
818		128		222
819		128		
820				
821	118			
822		80		
823		26		
824	40			306
825	400			
827	386	203		124
828			105	215
829	94			
830			105	70
831				
832	321	151	209	202
833				
834				
Average	324	255	271	294

Table 10. Total numbers and biomass of population from cohort for ages 5-9 and 10-29 for various terminal Fs in 1979 as compared to total numbers and biomass estimates from research for 1978-79.

<u>Cohort terminal fishing mortality</u>						<u>Numbers<sup>1</sup> ( x 10<sup>-3</sup>)</u>		<u>Research Vessel</u>			
Age	.05	.075	.10	.15	.20	Age	A.T. Cameron	Gadus	B. Venture	Quebec	
								1978			
						5-9	402,115	197,063	4,904,271	920,657	
						10-29	211,106	111,696	446,307	257,669	
							<u>613,221</u>	<u>308,759</u>	<u>5,350,578</u>	<u>1,178,326</u>	
								1979			
5-9	1,190,998	796,080	598,624	401,173	302,455	5-9	532,916	464,563	1,417,022	742,291	
10-29	583,822	393,836	298,870	203,958	156,555	10-29	345,959	152,860	290,127	319,181	
Total	<u>1,774,820</u>	<u>1,189,916</u>	<u>897,494</u>	<u>605,131</u>	<u>459,010</u>		<u>878,875</u>	<u>617,423</u>	<u>1,707,149</u>	<u>1,061,472</u>	
Average for 1978-1979						Ages		Newfoundland Surveys only	Newfoundland plus Quebec Surveys		
						5-9		1,319,658	1,197,472		
						10-29		259,678	266,876		
<u>Cohort terminal fishing mortality</u>						<u>Biomass<sup>2</sup> (tonnes)</u>		<u>Research Vessel</u>			
Age	.05	.075	.10	.15	.20	Age	A.T. Cameron	Gadus	B. Venture	Quebec	
								1978			
						5-9	49,341	24,129	429,696	99,719	
						10-29	127,165	75,927	213,395	145,174	
							<u>176,506</u>	<u>100,056</u>	<u>643,091</u>	<u>244,893</u>	
								1979			
5-9	160,058	106,994	80,463	53,934	40,669	5-9	79,023	60,006	216,958	99,618	
10-29	322,477	217,581	165,148	112,745	86,574	10-29	219,932	96,866	186,913	183,865	
Total	<u>482,535</u>	<u>324,575</u>	<u>245,611</u>	<u>166,679</u>	<u>127,243</u>		<u>298,955</u>	<u>156,872</u>	<u>403,871</u>	<u>283,483</u>	
Average for 1978-1979						Ages		Newfoundland Surveys only	Newfoundland plus Quebec surveys		
						5-9		143,192	132,311		
						10-29		153,366	156,155		

1 The 29+ group has been omitted.

2 Total weights calculated from sample weights and weight at age may differ due to sampling error.

Table 11. Trends in catch, and standardized catch per unit effort and effort for years 1954-1979

Year	Catch	CPUE tonnes/hr	Effort hours
1954	32,768	1.2278	26,688
1955	49,857	1.2387	40,249
1956	46,854	0.8645	54,198
1957	34,331	0.6939	49,475
1958	22,570	0.6176	36,545
1959	16,978	0.5603	30,302
1960	12,218	0.5624	21,725
1961	10,391	0.5400	19,243
1962	6,585	0.3981	16,541
1963	19,794	0.7667	25,817
1964	29,700	0.8644	34,359
1965	48,827	0.9728	50,192
1966	65,215	1.1486	56,778
1967	70,036	1.2832	54,579
1968	90,963	1.2145	74,897
1969	88,875	0.8050	110,405
1970	87,588	0.7064	123,991
1971	79,406	0.6409	123,898
1972	80,329	0.6041	132,973
1973	130,164	0.5506	236,404
1974	63,458	0.4860	130,572
1975	65,401	0.4556	143,549
1976	37,983	0.4929	77,060
1977	15,840	0.5310	29,828
1978	15,252*	5000*	30,504*
1979	15,267*		

\*Provisional estimates of catch, CPUE and effort and the catch weight does not include the weight removed in Port au Choix shrimp fishery.

Table 12. Average weight at age of males and females combined and the proportion recruited for Division 4RST redbfish.

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Age	Average Weight gms	Proportion Recruited
5	90.00	.235
6	103.00	.265
7	135.00	.120
8	169.00	.190
9	205.00	.520
10	243.00	.785
11	281.00	.975
12	322.00	.990
13	362.00	1.000
14	403.00	1.000
15	443.00	1.000
16	459.00	1.000
17	498.00	1.000
18	559.00	1.000
19	596.00	1.000
20	631.00	1.000
21	665.00	1.000
22	698.00	1.000
23	730.00	1.000
24	759.00	1.000
25	788.00	1.000
26	815.00	1.000
27	841.00	1.000
28	866.00	1.000
29	889.00	1.000

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Table 13. The yield per recruit using Thompson and Bell method for estimate of  $F_{0.1}$ .

	FISHING MORTALITY	CATCH (NUMBER)	YIELD (KG)	AVG. WEIGHT (KG)	YIELD PER UNIT EFFORT
	0.030	0.13908	0.060	0.430	1.000
	0.060	0.23412	0.094	0.404	0.789
	0.090	0.30152	0.115	0.380	0.639
	0.120	0.35110	0.127	0.360	0.529
F0.1---	0.132	0.36683	0.129	0.353	0.491
	0.150	0.38884	0.134	0.343	0.446
	0.180	0.41847	0.138	0.329	0.383
	0.210	0.44236	0.140	0.316	0.334
	0.240	0.46208	0.141	0.306	0.295
	0.270	0.47868	0.142	0.296	0.264
	0.300	0.49288	0.142	0.288	0.238
FMAX---	0.316	0.49989	0.142	0.284	0.225
	0.330	0.50520	0.142	0.281	0.216
	0.360	0.51602	0.142	0.275	0.198
	0.390	0.52561	0.142	0.270	0.182
	0.420	0.53419	0.141	0.265	0.169
	0.450	0.54192	0.141	0.260	0.157
	0.480	0.54894	0.141	0.256	0.147
	0.510	0.55535	0.140	0.252	0.138
	0.540	0.56122	0.140	0.249	0.130
	0.570	0.56664	0.139	0.246	0.122
	0.600	0.57166	0.139	0.243	0.116

Table 14. Division 4RST redfish catch-at-age for 1972-79 from commercial fishery including estimated Port au Choix removals.

C A T C H M A T R I X

AGE/YEAR	1972	1973	1974	1975	1976	1977	1978	1979
5	142.	273.	170.	355.	7359.	3801.	3369.	2266.
6	1272.	639.	698.	620.	1482.	2119.	2657.	2368.
7	784.	3112.	292.	290.	1073.	824.	519.	2199.
8	944.	2380.	444.	401.	372.	669.	295.	2845.
9	1887.	803.	510.	448.	223.	732.	928.	2338.
10	4297.	3434.	216.	286.	150.	465.	813.	2701.
11	2938.	8043.	403.	161.	149.	416.	551.	1867.
12	6366.	2497.	463.	329.	127.	236.	479.	1802.
13	2588.	12850.	2240.	974.	390.	171.	147.	713.
14	14034.	7060.	5381.	1654.	716.	177.	147.	500.
15	7971.	76633.	6364.	2956.	1836.	79.	168.	320.
16	66593.	8222.	28739.	4572.	3913.	123.	97.	339.
17	5102.	88382.	7593.	25149.	4025.	509.	278.	870.
18	7659.	5583.	37269.	5771.	15842.	379.	1127.	1109.
19	4299.	9916.	2989.	41020.	3380.	2959.	1572.	2345.
20	3697.	7166.	3387.	4156.	16519.	1273.	4068.	1905.
21	2471.	4548.	1371.	3453.	1533.	5259.	1454.	3310.
22	2598.	4333.	1233.	3489.	2131.	2519.	3897.	1512.
23	2366.	4934.	471.	2634.	1431.	2314.	4972.	2988.
24	1168.	1306.	1168.	1632.	1317.	1814.	1154.	993.
25	5480.	2277.	825.	1356.	543.	1160.	815.	852.
26	1.	7963.	1815.	1186.	430.	1027.	249.	887.
27	1.	1.	5844.	2080.	408.	229.	250.	496.
28	1.	1.	1.	7259.	659.	515.	354.	512.
29	1.	1.	1.	1.	2370.	196.	116.	100.

Table 15.

4RST REDFISH LANDINGS  
F I S H I N G M O R T A L I T I E S

AGE/YEAR	1972	1973	1974	1975	1976	1977	1978	1979
5	.003	.007	.003	.005	.035	.017	.033	.024
6	.048	.017	.019	.011	.023	.011	.013	.026
7	.051	.144	.009	.009	.021	.014	.003	.012
8	.101	.192	.025	.013	.013	.015	.006	.019
9	.135	.105	.051	.028	.008	.028	.023	.052
10	.132	.343	.034	.033	.011	.019	.036	.078
11	.081	.344	.054	.029	.020	.033	.026	.098
12	.074	.083	.026	.052	.026	.035	.044	.099
13	.036	.188	.090	.064	.072	.039	.025	.100
14	.053	.116	.100	.080	.056	.038	.039	.100
15	.111	.395	.130	.066	.107	.007	.042	.100
16	.199	.144	.224	.117	.106	.008	.010	.100
17	.094	.391	.172	.278	.129	.016	.021	.100
18	.151	.127	.252	.171	.253	.014	.041	.100
19	.103	.266	.083	.428	.129	.061	.069	.100
20	.138	.223	.122	.143	.272	.059	.101	.100
21	.110	.225	.054	.159	.065	.116	.080	.100
22	.189	.254	.079	.170	.125	.129	.107	.100
23	.323	.574	.035	.215	.088	.174	.359	.100
24	.121	.265	.227	.148	.142	.138	.110	.100
25	.161	.323	.238	.395	.061	.161	.076	.100
26	.204	.330	.410	.555	.186	.140	.042	.100
27	.205	.288	.381	1.026	.332	.128	.041	.100
28	.334	.289	.461	1.012	.986	.795	.266	.100
29	.334	.574	.461	1.026	.986	.795	.359	.100

Table 16.

## 4RST REDFISH LANDINGS

## POPULATION NUMBERS

F = 0.1

AGE/YEAR	1972	1973	1974	1975	1976	1977	1978	1979
5	44469.	43005.	66624.	75873.	225253.	243673.	108676.	102502.
6	28318.	40102.	38653.	60122.	68315.	196817.	216869.	95130.
7	16684.	24413.	35678.	34311.	53811.	60404.	176072.	193704.
8	10318.	14350.	19130.	32005.	30770.	47669.	53872.	158823.
9	15730.	8438.	10721.	16887.	28578.	27488.	42497.	48465.
10	36614.	12438.	6871.	9215.	14854.	25646.	24176.	37570.
11	39478.	29043.	7988.	6012.	8066.	13298.	22764.	21102.
12	94006.	32927.	18628.	6845.	5287.	7157.	11636.	20073.
13	77889.	79005.	27418.	16415.	5880.	4663.	6251.	10073.
14	287687.	68015.	59263.	22678.	13926.	4950.	4057.	5517.
15	79758.	246961.	54827.	48505.	18947.	11920.	4310.	3531.
16	387632.	64586.	150564.	43556.	41077.	15397.	10710.	3740.
17	59943.	287399.	50619.	108898.	35062.	33446.	13815.	9599.
18	57315.	49385.	175978.	38579.	74613.	27897.	29779.	12236.
19	46214.	44575.	39375.	123780.	29418.	52443.	24882.	25873.
20	30065.	37727.	30901.	32785.	72981.	23403.	44638.	21018.
21	25039.	23687.	27320.	24738.	25712.	50323.	19965.	36520.
22	15859.	20306.	17107.	23416.	19100.	21807.	40532.	16682.
23	9014.	11878.	14252.	14306.	17869.	15255.	17335.	32968.
24	10804.	5906.	6055.	12447.	10439.	14807.	11602.	10956.
25	38696.	8665.	4101.	4367.	9710.	8193.	11673.	9400.
26	6.	29801.	5674.	2926.	2662.	8270.	6310.	9787.
27	6.	4.	19390.	3408.	1520.	2000.	6506.	5473.
28	4.	4.	3.	11986.	1105.	987.	1592.	5649.
29	4.	2.	3.	2.	3940.	373.	403.	1103.

## POPULATION BIOMASS AGES 5 TO 29

YEAR	1972	1973	1974	1975	1976	1977	1978	1979
BIOMASS	602560.	526980.	392199.	330135.	274644.	254218.	249970.	245611.

## TOTAL POPULATION NUMBERS AGES 5 TO 29

YEAR	1972	1973	1974	1975	1976	1977	1978	1979
TOTAL N	1411551.	1182623.	887142.	774063.	818896.	918286.	910921.	897494.



Table 17. AGE MEAN WEIGHT PROPORTION RECRUITED

7	135.00	.060
8	169.00	.050
9	205.00	.400
10	243.00	.785
11	281.00	.975
12	322.00	.990
13	362.00	1.000
14	403.00	1.000
15	443.00	1.000
16	459.00	1.000
17	498.00	1.000
18	559.00	1.000
19	596.00	1.000
20	631.00	1.000
21	665.00	1.000
22	698.00	1.000
23	730.00	1.000
24	759.00	1.000
25	788.00	1.000
26	815.00	1.000
27	841.00	1.000
28	866.00	1.000
29	889.00	1.000

NATURAL MORTALITY RATE IS .100

Table 18. SUMMARY OF YIELD PER RECRUIT CALCULATED FROM PARTIAL RECRUITMENT AND AVERAGE WEIGHT AT AGE OVER AGES 7 TO 29

F	Y/R(KG)
.001	.0031
.050	.1030
.100	.1456
.150	.1635
.200	.1712
.250	.1744
.300	.1755
.350	.1757
.400	.1754
.450	.1749
.500	.1743
.550	.1736
.600	.1729
.650	.1722
.700	.1716
.750	.1709
.800	.1703
.850	.1697
.900	.1692
.950	.1686
1.000	.1681
1.050	.1676
1.100	.1671
1.150	.1667
1.200	.1663
1.250	.1659
1.300	.1655
1.350	.1651
1.400	.1647
1.450	.1644
1.500	.1640
1.550	.1637
1.600	.1634
1.650	.163
1.700	.1628
1.750	.1625
1.800	.1622
1.850	.1619
1.900	.1617
1.950	.1614
2.000	.1612

Table 19.

CATCH PROJECTION FOR 1980 USING POPULATION ESTIMATES FROM COHORT WITH TERMINAL F OF .100

AGE	POPULATION NUMBERS (000S)	POPULATION WEIGHT (MT)	FISHING MORTALITY	CATCH NUMBERS (000S)	CATCH WEIGHT (MT)	RESIDUAL NUMBERS (000S)	RESIDUAL WEIGHT (MT)
7	397966.	53725.	.006	2432.	328.	357782.	48301.
8	517462.	87451.	.005	2637.	446.	465712.	78705.
9	62920.	12899.	.043	2518.	516.	54539.	11180.
10	41631.	10116.	.084	3205.	779.	34624.	8414.
11	31428.	8831.	.105	2975.	836.	25611.	7197.
12	17320.	5577.	.106	1664.	536.	14091.	4537.
13	16451.	5955.	.107	1595.	578.	13370.	4840.
14	8247.	3324.	.107	800.	322.	6702.	2701.
15	4517.	2001.	.107	438.	194.	3671.	1626.
16	2891.	1327.	.107	280.	129.	2350.	1078.
17	3062.	1525.	.107	297.	148.	2489.	1239.
18	7859.	4393.	.107	762.	426.	6387.	3570.
19	10018.	5971.	.107	972.	579.	8142.	4852.
20	21183.	13366.	.107	2054.	1296.	17216.	10863.
21	17208.	11443.	.107	1669.	1110.	13985.	9300.
22	29900.	20870.	.107	2900.	2024.	24300.	16961.
23	13658.	9970.	.107	1325.	967.	11100.	8103.
24	26992.	20487.	.107	2618.	1987.	21937.	16650.
25	8970.	7068.	.107	870.	685.	7290.	5745.
26	7696.	6272.	.107	746.	608.	6255.	5098.
27	8013.	6739.	.107	777.	654.	6512.	5477.
28	4481.	3881.	.107	435.	376.	3642.	3154.
29	5528.	4914.	.107	536.	477.	4493.	3994.
TOTAL	1265401.	308107.		34504.	16000.	1112198.	263586.

Table 20.

CATCH PROJECTION FOR 1981 USING POPULATION ESTIMATES FROM COHORT WITH TERMINAL F OF .100

AGE	POPULATION NUMBERS (000S)	POPULATION WEIGHT (MT)	FISHING MORTALITY	CATCH NUMBERS (000S)	CATCH WEIGHT (MT)	RESIDUAL NUMBERS (000S)	RESIDUAL WEIGHT (MT)
7	314954.	42519.	.008	2365.	319.	282734.	38169.
8	357782.	60465.	.007	2240.	379.	321605.	54351.
9	465712.	95471.	.053	22803.	4675.	399721.	81943.
10	54539.	13253.	.104	5113.	1242.	44491.	10811.
11	34624.	9729.	.129	3983.	1119.	27546.	7740.
12	25611.	8247.	.131	2989.	962.	20335.	6548.
13	14091.	5101.	.132	1660.	601.	11174.	4045.
14	13370.	5388.	.132	1575.	635.	10602.	4272.
15	6702.	2969.	.132	790.	350.	5315.	2354.
16	3671.	1685.	.132	432.	199.	2911.	1336.
17	2350.	1170.	.132	277.	138.	1863.	928.
18	2489.	1391.	.132	293.	164.	1973.	1103.
19	6387.	3807.	.132	752.	448.	5065.	3019.
20	8142.	5137.	.132	959.	605.	6456.	4074.
21	17216.	11448.	.132	2028.	1349.	13651.	9078.
22	13985.	9762.	.132	1648.	1150.	11089.	7740.
23	24300.	17739.	.132	2863.	2090.	19269.	14066.
24	11100.	8425.	.132	1308.	993.	8802.	6680.
25	21937.	17286.	.132	2584.	2036.	17395.	13707.
26	7290.	5941.	.132	859.	700.	5781.	4711.
27	6255.	5260.	.132	737.	620.	4960.	4171.
28	6512.	5640.	.132	767.	664.	5164.	4472.
29	8134.	7232.	.132	958.	852.	6450.	5734.
TOTAL	1427152.	345065.		59983.	22289.	1234349.	291054.

Table 21.

CATCH PROJECTION FOR 1980 USING POPULATION ESTIMATES FROM COHORT WITH TERMINAL F OF .100

AGE	POPULATION NUMBERS (000S)	POPULATION WEIGHT (MT)	FISHING MORTALITY	CATCH NUMBERS (000S)	CATCH WEIGHT (MT)	RESIDUAL NUMBERS (000S)	RESIDUAL WEIGHT (MT)
7	397966.	53725.	.008	2988.	403.	357254.	48229.
8	517462.	87451.	.007	3240.	547.	465139.	78608.
9	62920.	12899.	.053	3081.	632.	54004.	11071.
10	41631.	10116.	.104	3903.	948.	33961.	8253.
11	31428.	8831.	.129	3616.	1016.	25003.	7026.
12	17320.	5577.	.131	2021.	651.	13752.	4428.
13	16451.	5955.	.132	1938.	702.	13045.	4722.
14	8247.	3324.	.132	972.	392.	6539.	2635.
15	4517.	2001.	.132	532.	236.	3582.	1587.
16	2891.	1327.	.132	341.	156.	2292.	1052.
17	3062.	1525.	.132	361.	180.	2428.	1209.
18	7859.	4393.	.132	926.	518.	6232.	3484.
19	10018.	5971.	.132	1180.	703.	7944.	4734.
20	21183.	13366.	.132	2495.	1575.	16797.	10599.
21	17208.	11443.	.132	2027.	1348.	13645.	9074.
22	29900.	20870.	.132	3522.	2459.	23709.	16549.
23	13658.	9970.	.132	1609.	1175.	10830.	7906.
24	26992.	20487.	.132	3180.	2413.	21403.	16245.
25	8970.	7068.	.132	1057.	833.	7113.	5605.
26	7696.	6272.	.132	907.	739.	6103.	4774.
27	8013.	6739.	.132	944.	794.	6354.	5344.
28	4481.	3881.	.132	528.	457.	3553.	3077.
29	5528.	4914.	.132	651.	579.	4383.	3897.
TOTAL	1265401.	308107.		42017.	19454.	1105065.	260308.

Table 22..

CATCH PROJECTION FOR 1981 USING POPULATION ESTIMATES FROM COHORT WITH TERMINAL F OF .100

AGE	POPULATION NUMBERS (000S)	POPULATION WEIGHT (MT)	FISHING MORTALITY	CATCH NUMBERS (000S)	CATCH WEIGHT (MT)	RESIDUAL NUMBERS (000S)	RESIDUAL WEIGHT (MT)
7	314954.	42519.	.008	2365.	319.	282734.	38169.
8	357254.	60376.	.007	2237.	378.	321130.	54271.
9	465139.	95353.	.053	22775.	4669.	399229.	81842.
10	54004.	13123.	.104	5063.	1230.	44055.	10705.
11	33961.	9543.	.129	3907.	1098.	27019.	7592.
12	25003.	8051.	.131	2918.	940.	19852.	6392.
13	13752.	4978.	.132	1620.	586.	10905.	3947.
14	13045.	5257.	.132	1537.	619.	10344.	4169.
15	6539.	2897.	.132	770.	341.	5185.	2297.
16	3582.	1644.	.132	422.	194.	2840.	1304.
17	2292.	1142.	.132	270.	134.	1818.	905.
18	2428.	1357.	.132	286.	160.	1925.	1076.
19	6232.	3714.	.132	734.	438.	4941.	2945.
20	7944.	5012.	.132	936.	591.	6299.	3975.
21	16797.	11170.	.132	1979.	1316.	13319.	8857.
22	13645.	9524.	.132	1607.	1122.	10820.	7552.
23	23709.	17308.	.132	2793.	2039.	18800.	13724.
24	10830.	8220.	.132	1276.	968.	8588.	6518.
25	21403.	16866.	.132	2521.	1987.	16972.	13374.
26	7113.	5797.	.132	838.	683.	5640.	4597.
27	6103.	5132.	.132	719.	605.	4839.	4070.
28	6354.	5502.	.132	749.	648.	5038.	4363.
29	7937.	7056.	.132	935.	831.	6293.	5595.
TOTAL	1420019.	341542.		59256.	21896.	1228586.	288239.

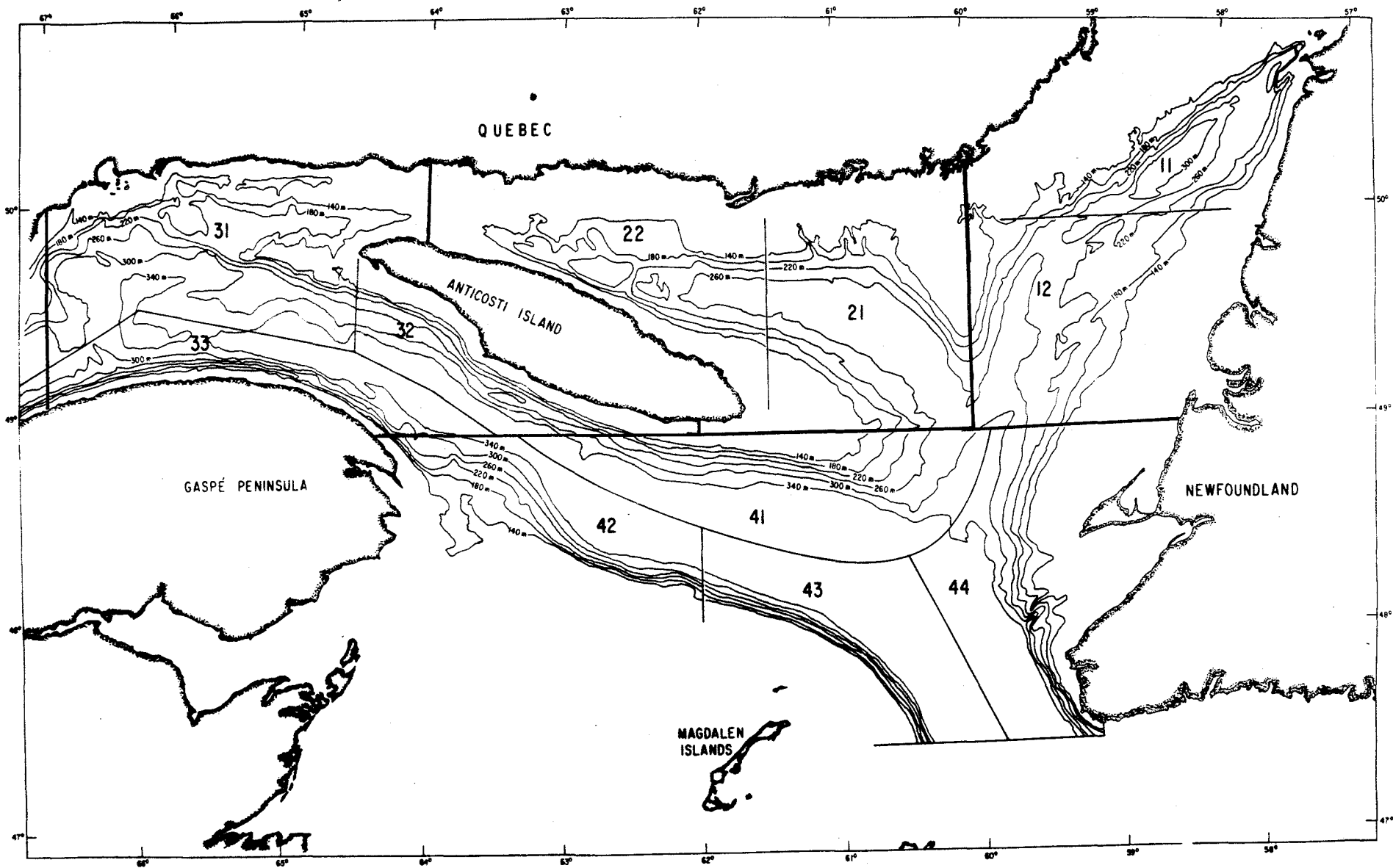


Fig. 1. Stratification system of Beothic Venture surveys.

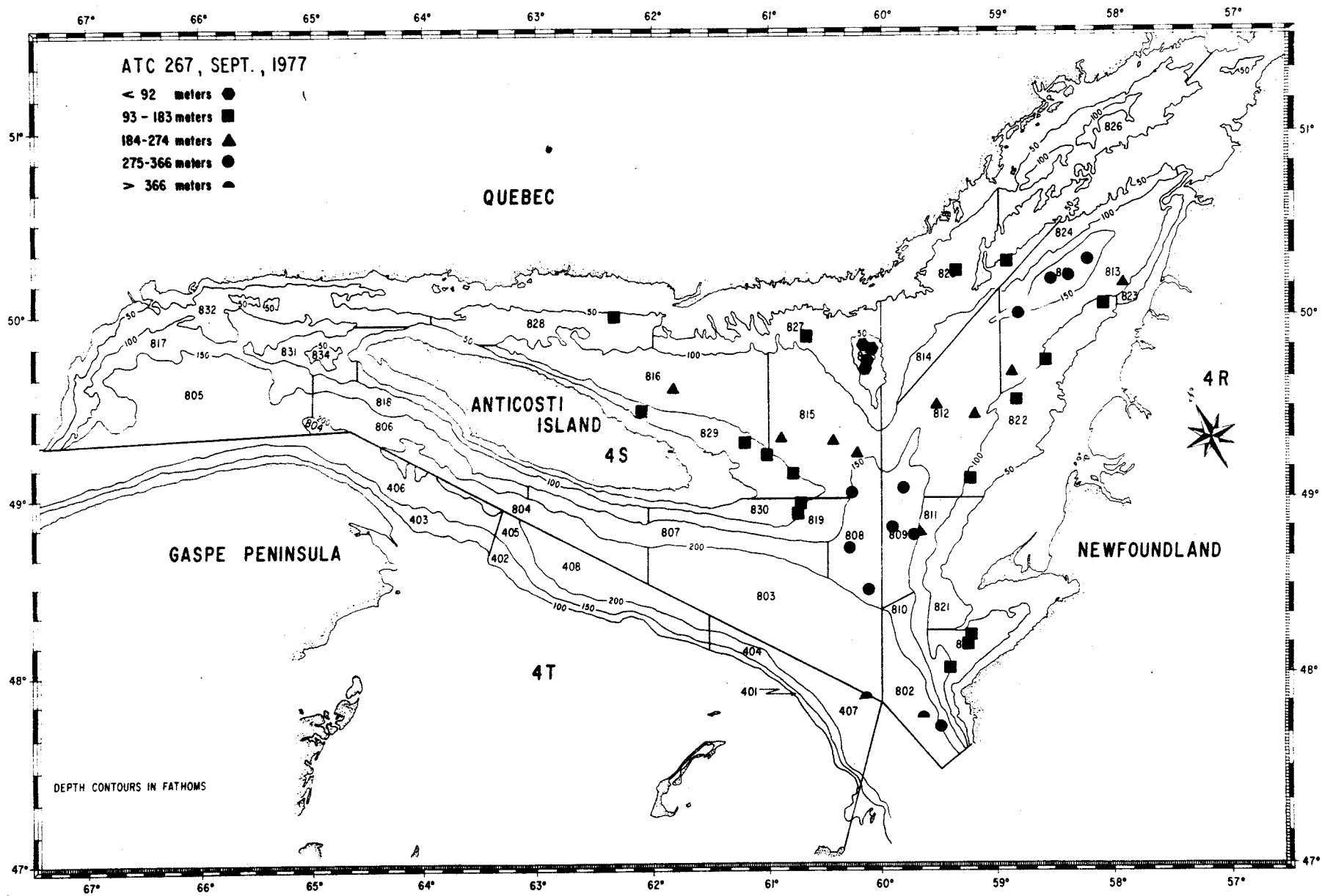


Fig. 2. Stratification system of A.T. Cameron and *Gadus Atlantica* and the distribution of bottom trawl sets made by depth in 1977.



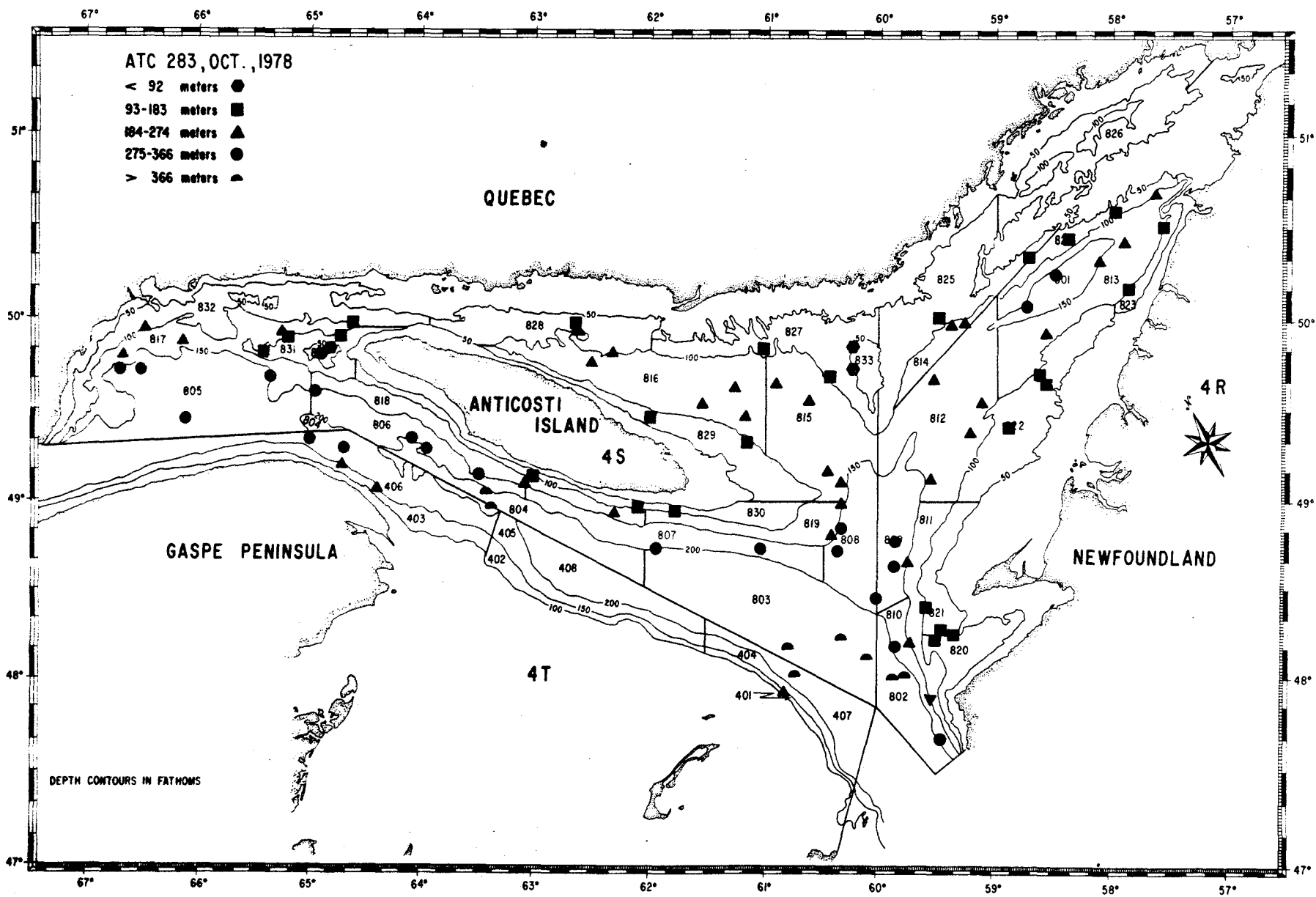


Fig. 3. The distribution of bottom trawl sets made by A.T. Cameron by depth in 1978.

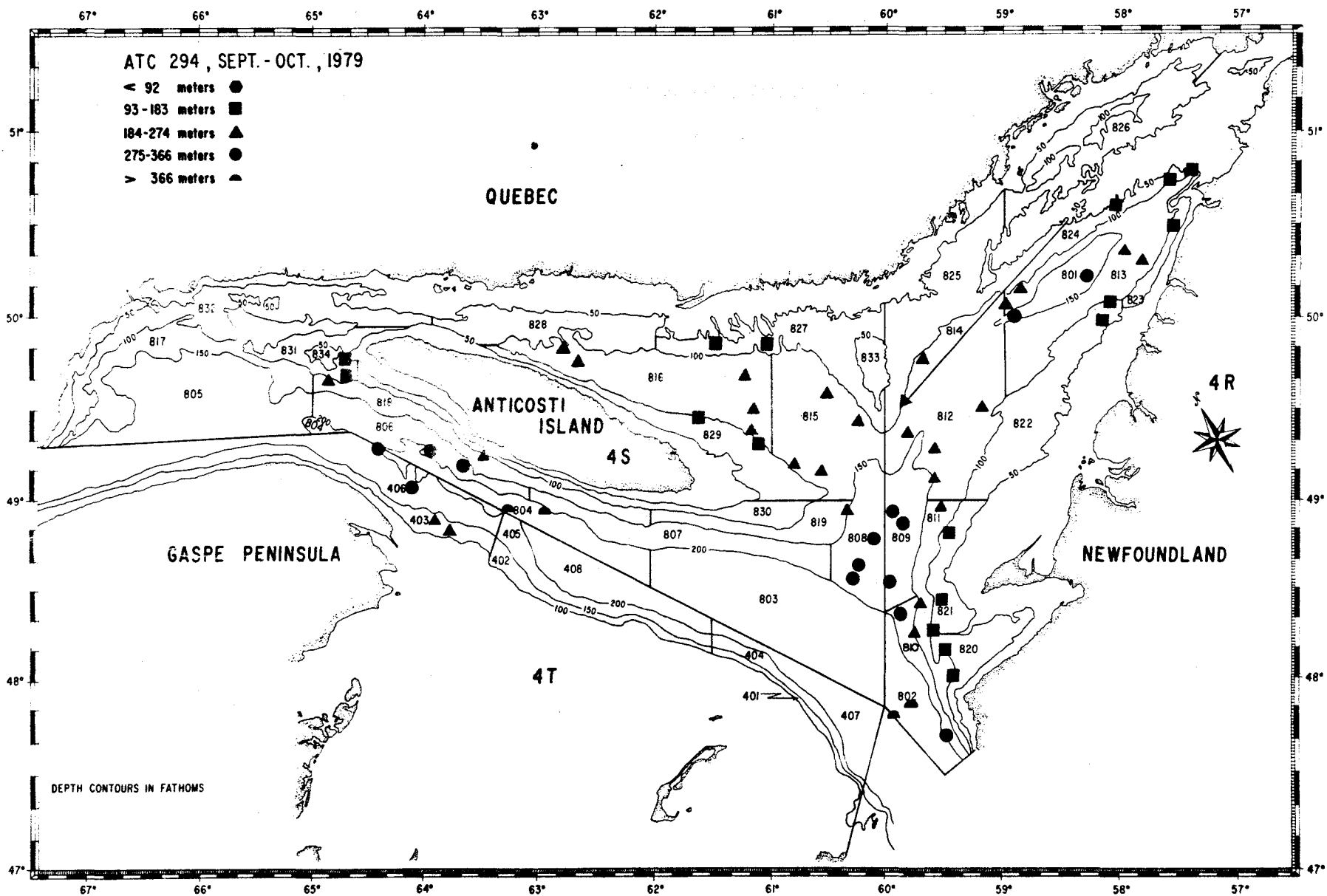


Fig. 4. The distribution of bottom trawl sets made by A.T. Cameron by depth in 1979.

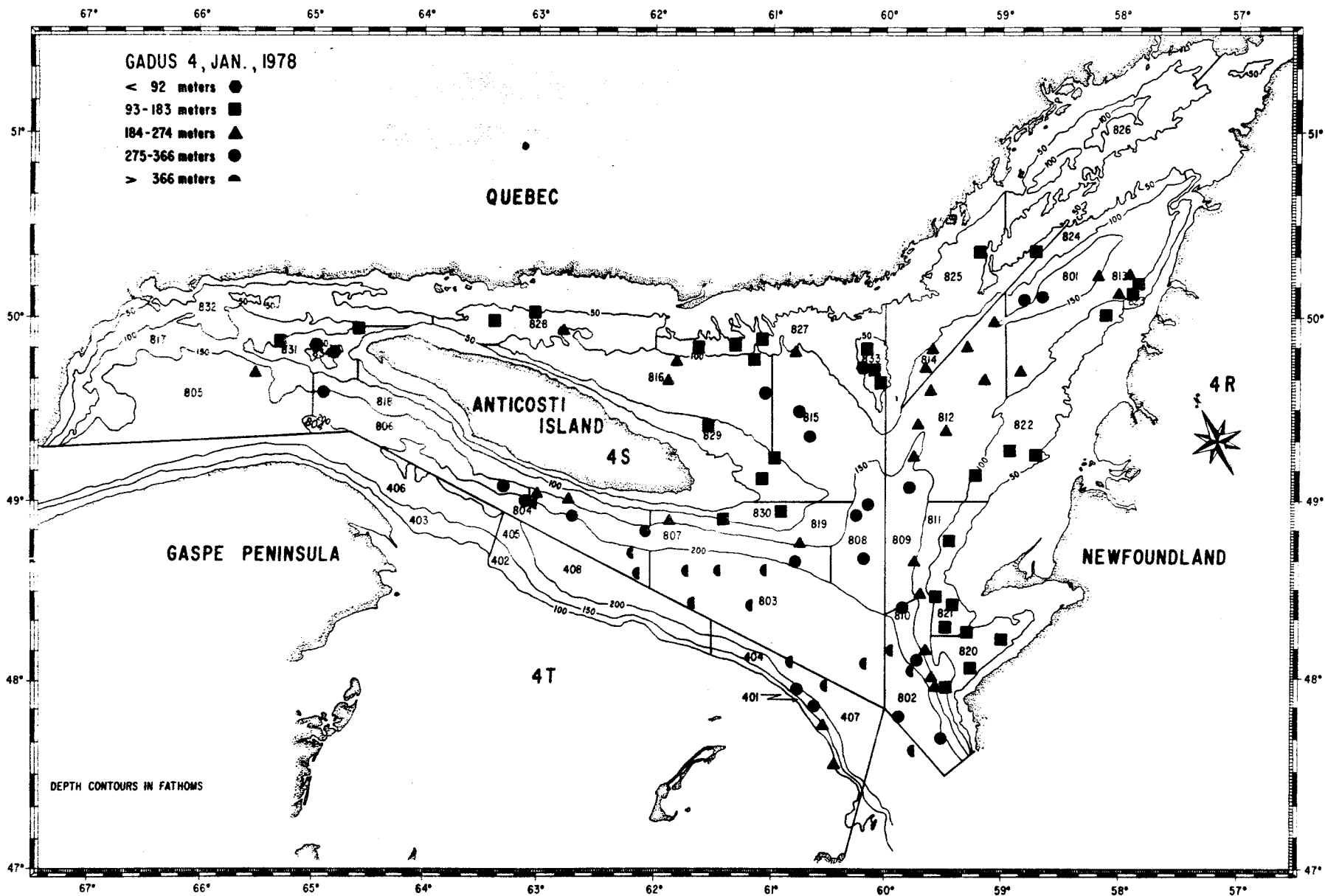


Fig. 5. The distribution of bottom trawl by *Gadus Atlantica* by depth in 1978.

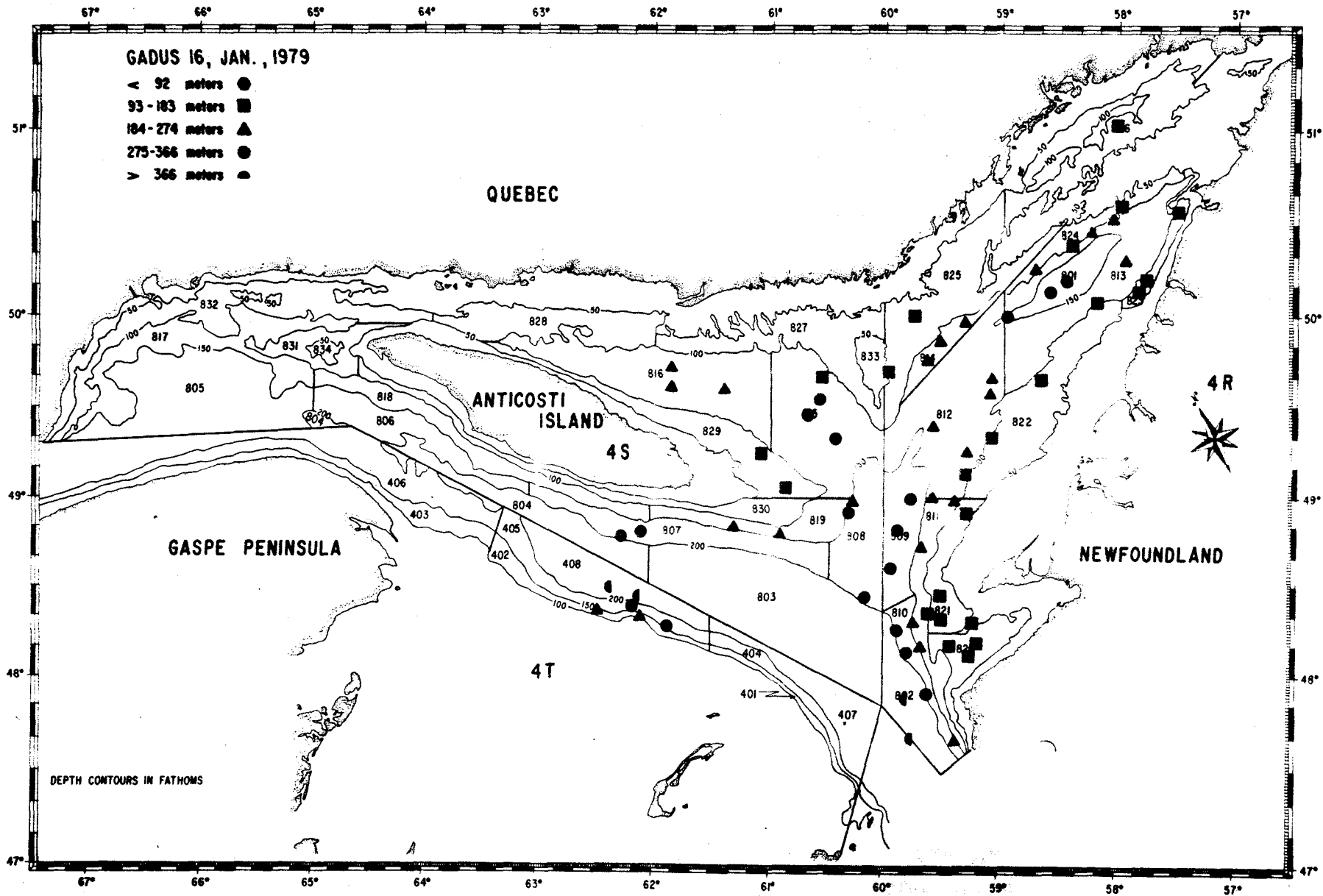


Fig. 6. The distribution of bottom trawl sets made by Gadus Atlantica by depth in 1979

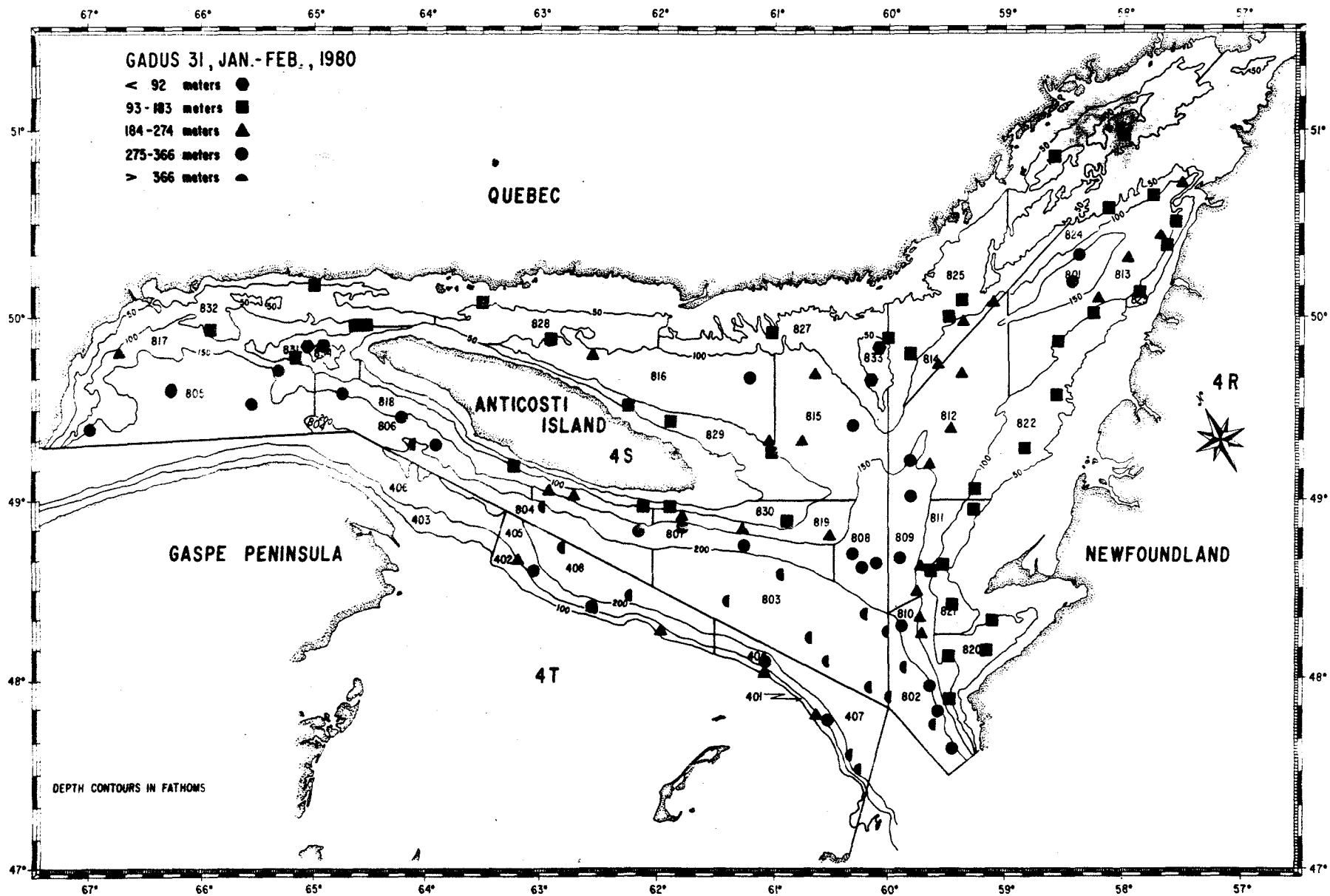


Fig. 7. The distribution of bottom trawl sets made by *Gadus Atlantica* by depth in 1980.

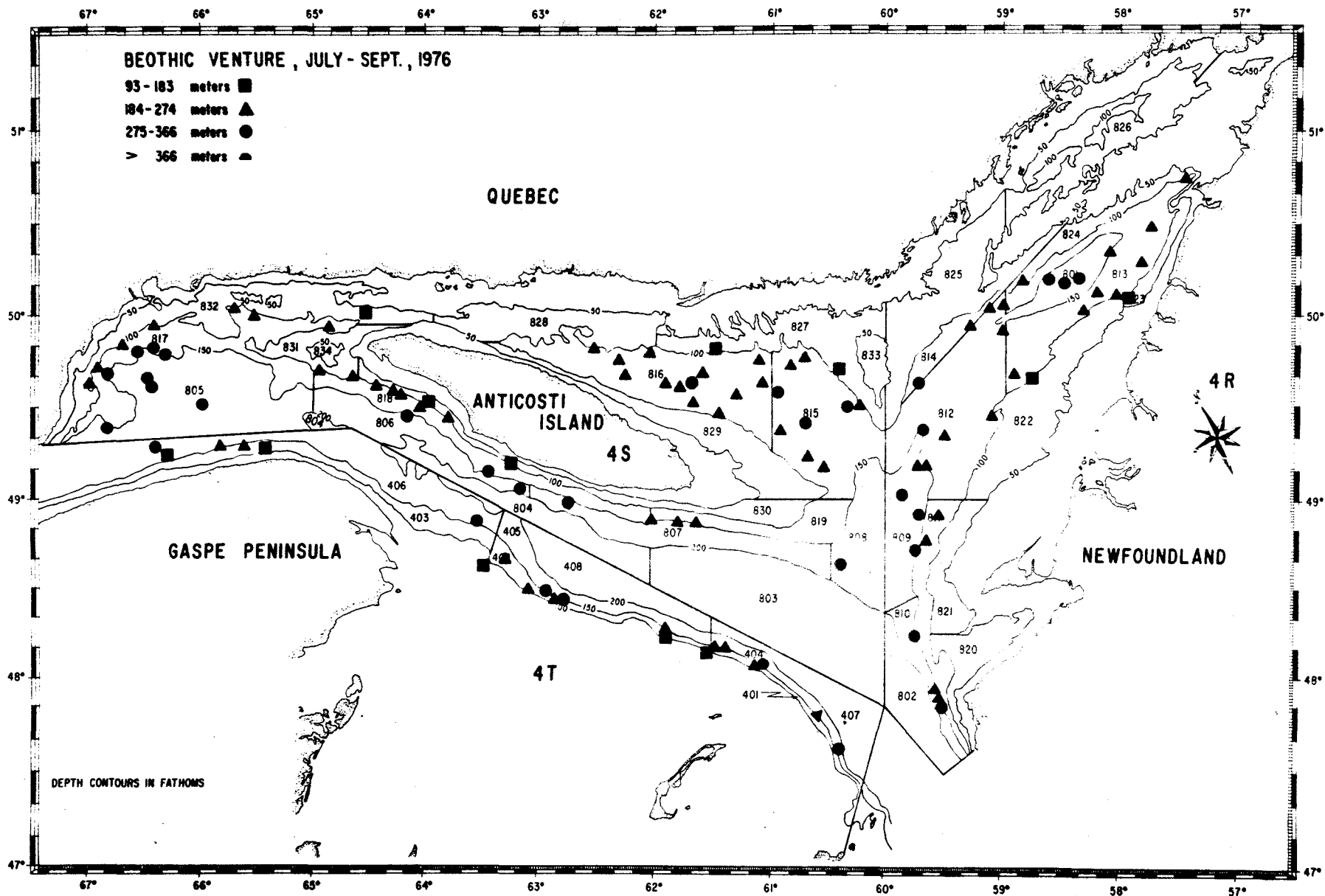


Fig. 8. The distribution of bottom trawl sets made by B. Venture by depth in 1976.

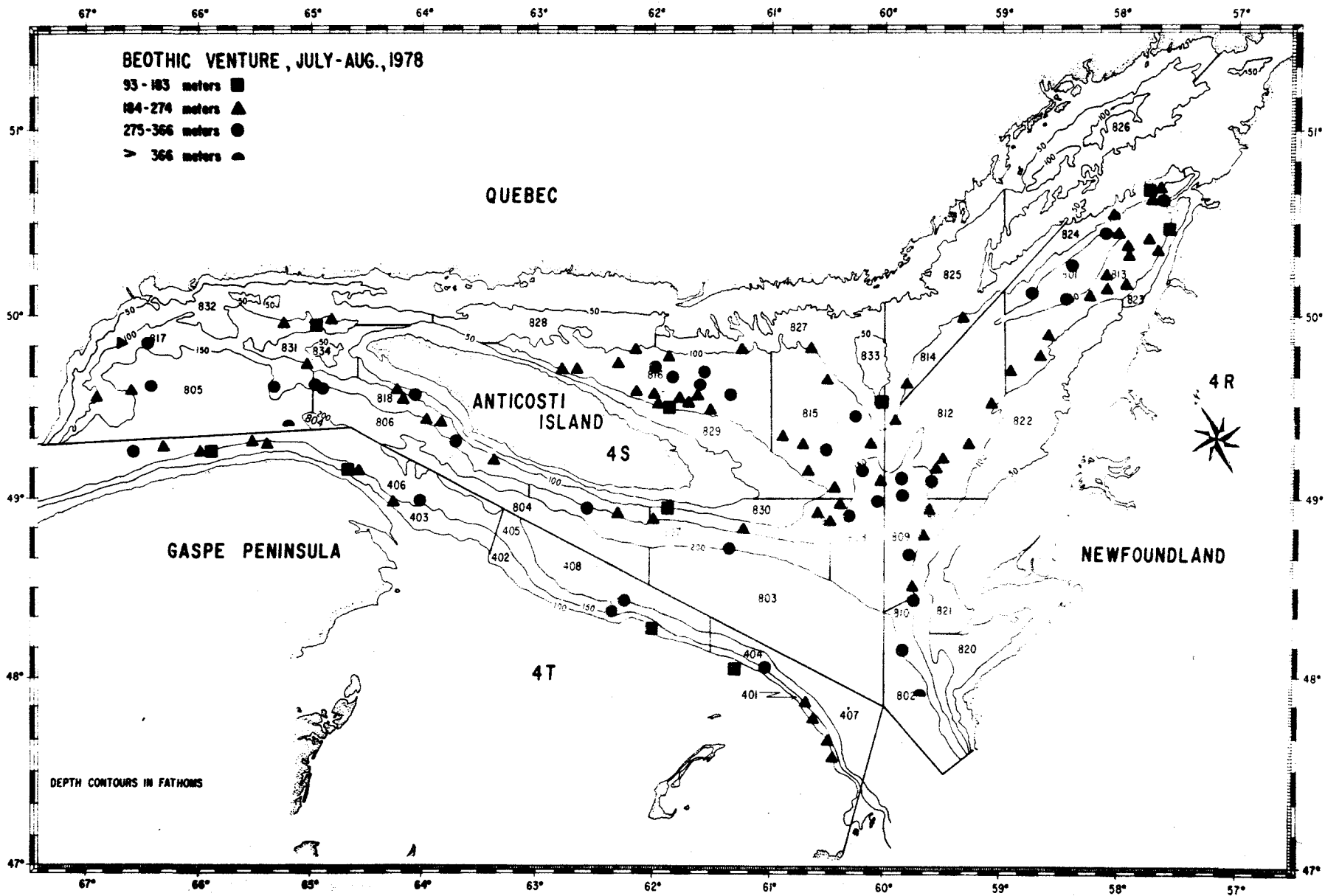


Fig. 9. The distribution of bottom trawl sets made by B. Venture by depth in 1978.

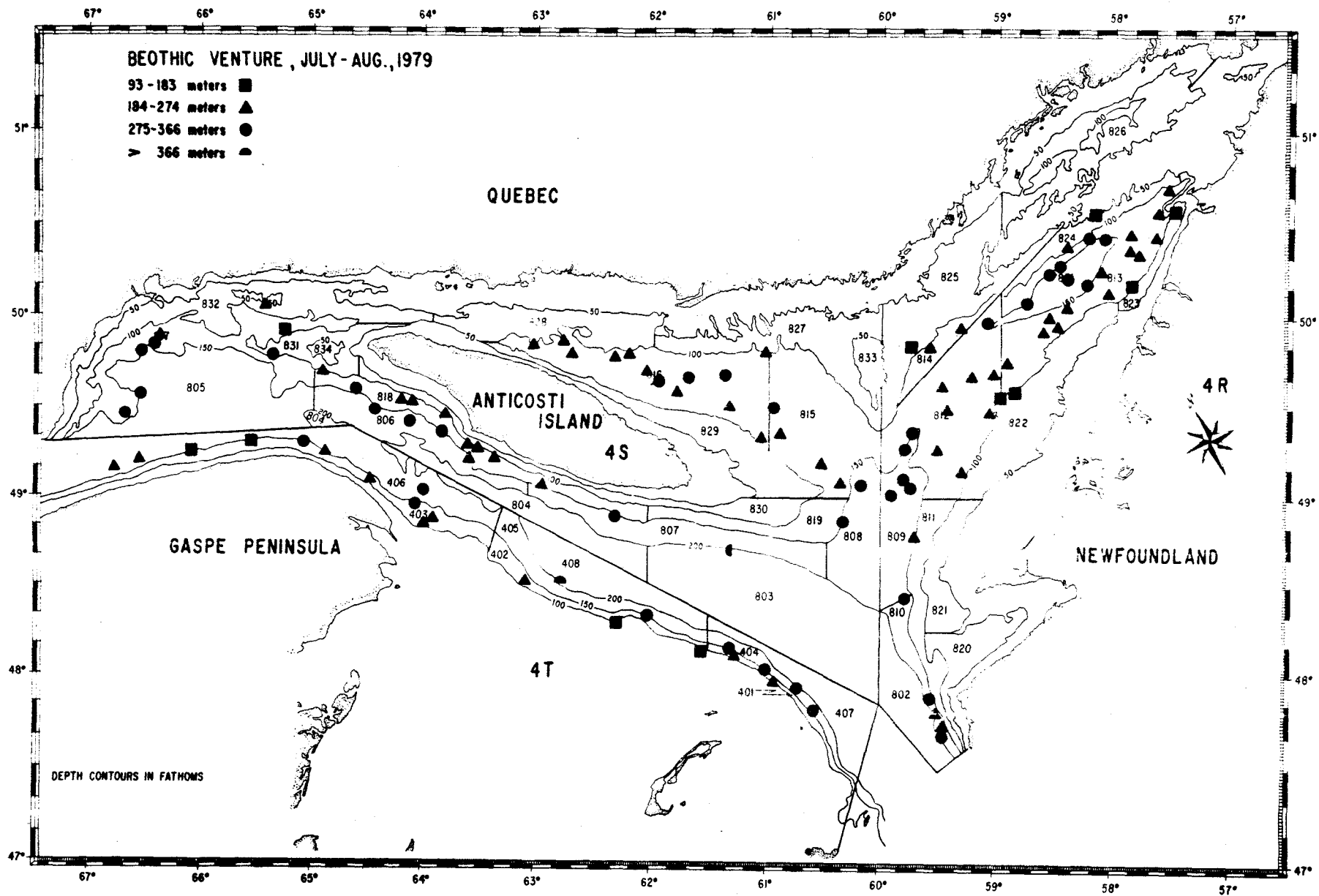


Fig. 10. The distribution of bottom trawl sets made by B. Venture by depth in 1979.



HRST  
REDFISH (MENTELLA)  
A.T. CAMERON

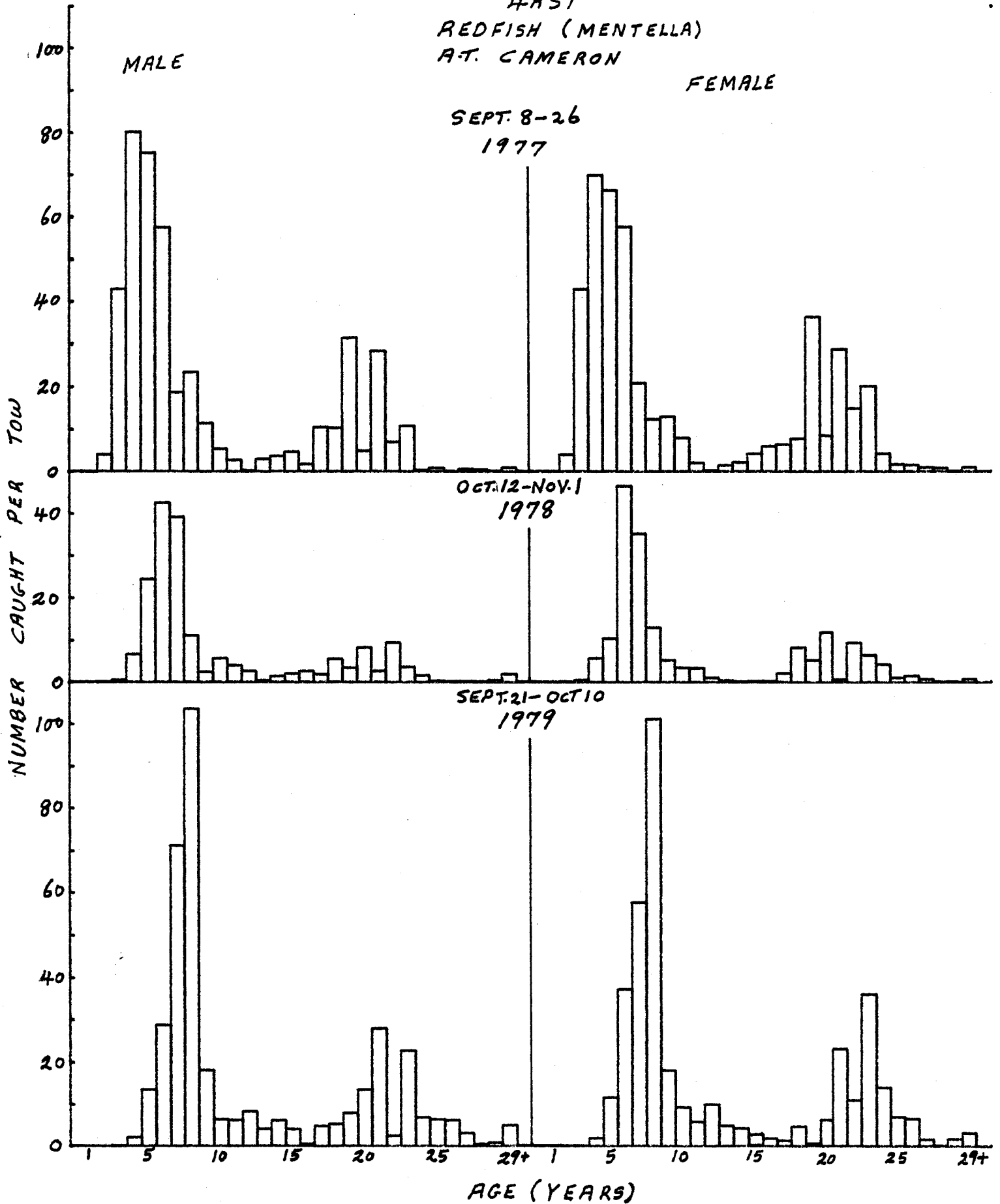


Fig. 11. Mean number at age per tow adjusted to the area surveyed for the A.T.Cameron surveys in 1977-79.

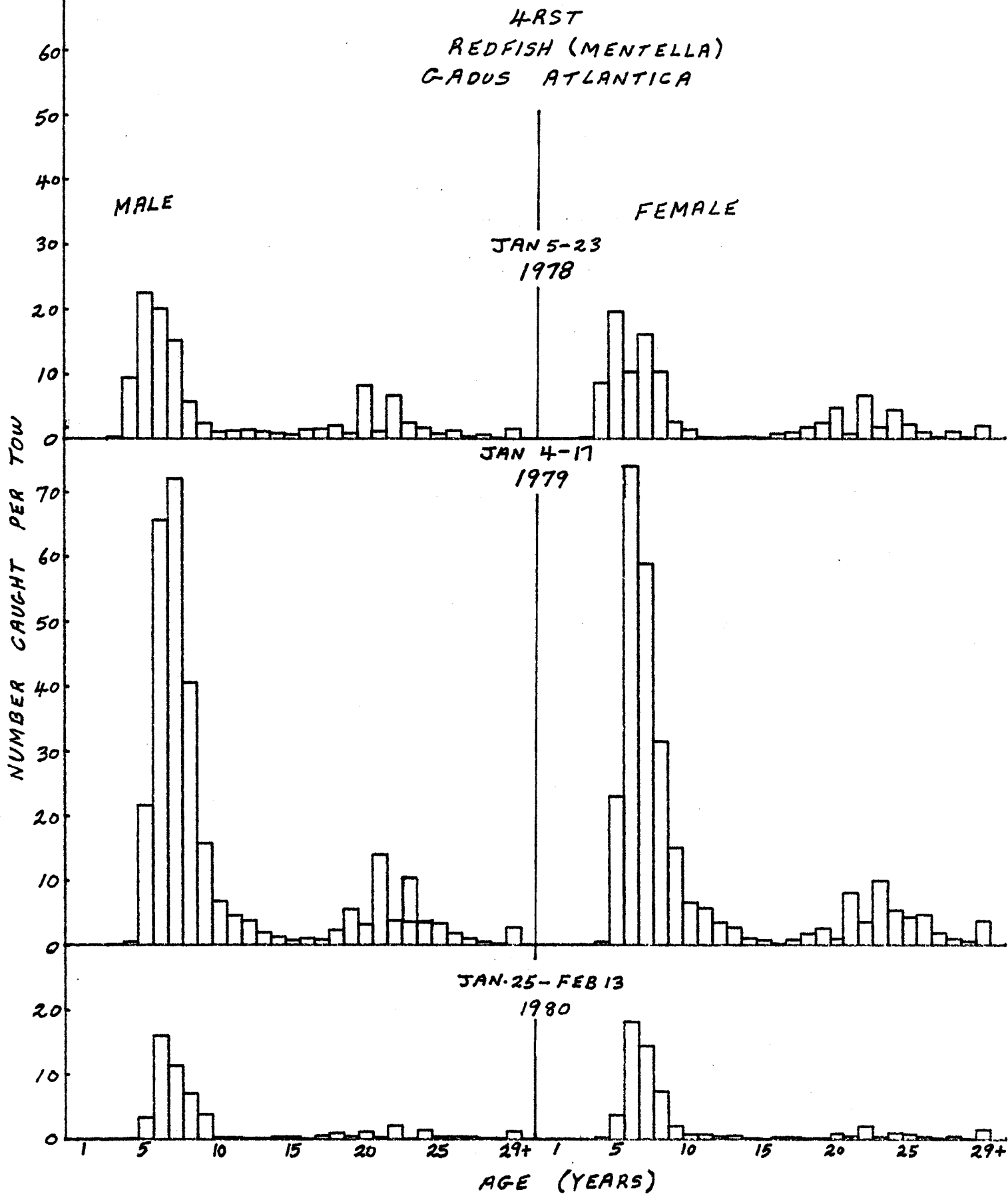


Fig. 12. Mean number at age per tow adjusted to the area surveyed for the Gadus Atlantica surveys in 1978-80.

4-RST  
REDFISH (MENTELLA)  
BEOTHIC VENTURE

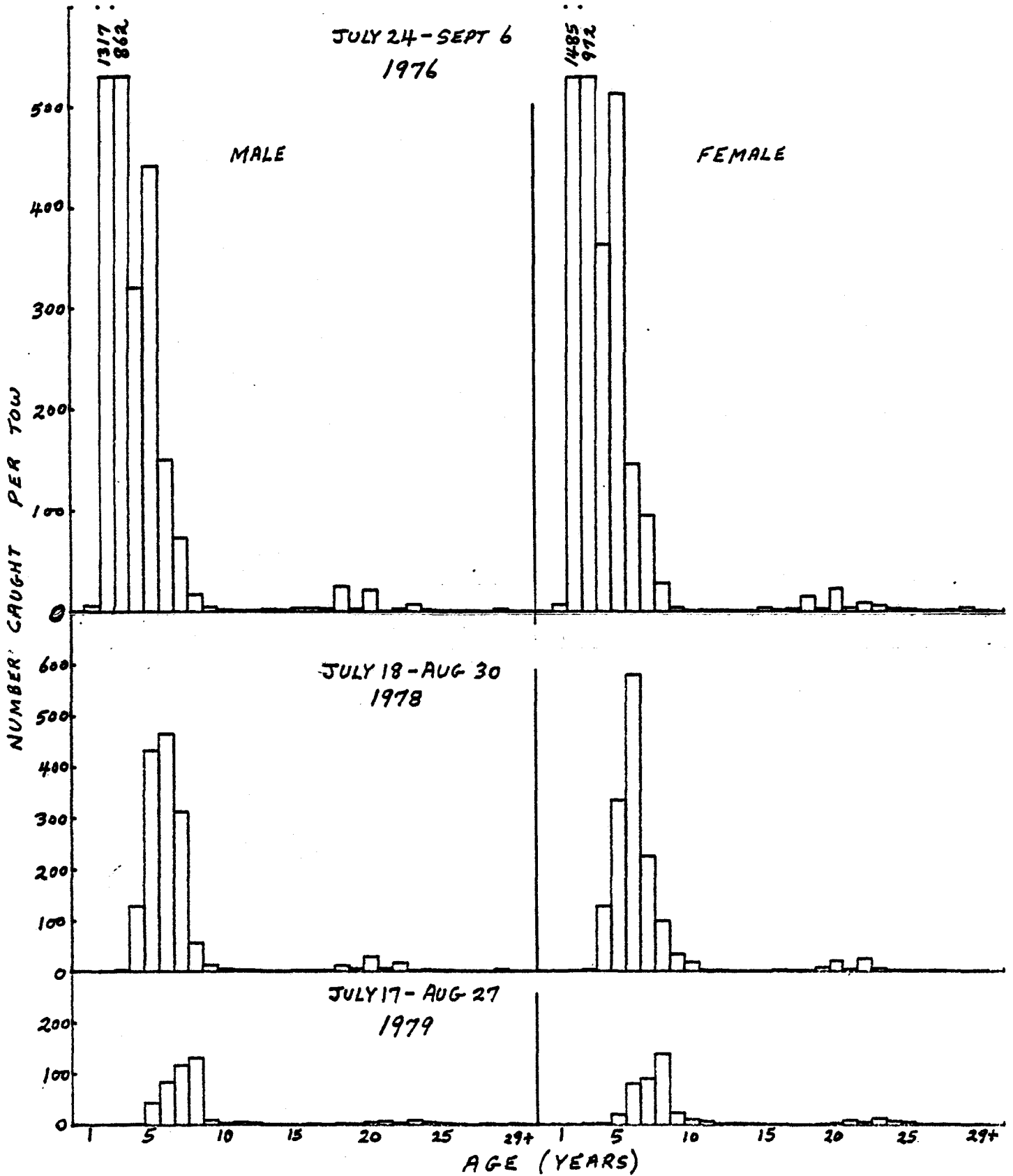


Fig. 13. Mean number at age per tow adjusted to the area surveyed for the Beothic Venture surveys in 1976 and 1978-79.