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Canadian Atlantic Fisheries  
Scientific Advisory Committee

CAFSAC Research Document 89/8

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Comité scientifique consultatif des  
pêches canadiennes dans l'Atlantique

CSCPCA Document de recherche 89/8

**Observations on 4RST capelin in the Gulf of St. Lawrence  
(A retrospective, 1984-1987)**

by

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## ABSTRACT

This document presents the unpublished data collected from the divisions 4RST commercial capelin landings from 1984 to 1987.

The relatively low landings are mainly concentrated on the west coast of Newfoundland where most of the purse seiner operations occur. Only fixed gears are used in the rest of the Gulf.

The catches are characterized by the dominance of 3 year old individuals in Division 4R while in Division 4T age 3 individuals alternate with the age 2 capelin. This document also presents the length-weight relationships, the conversion factors from frozen to fresh lengths, and suggests that the data collected from research cruises not directed toward the species are of little use in assessing the status of the population.

A discriminant analysis using morphometric characters is presented and suggests no significant differentiation of the subpopulations from the three divisions 4R, 4S and 4T.

## RESUME

Le présent document constitue une synthèse des données non publiées recueillies à partir des débarquements de capelan du golfe du Saint-Laurent de 1984 à 1987.

Les débarquements relativement faibles sont principalement concentrés sur la côte-ouest de Terre-Neuve où la pêche avec des senneurs y est surtout pratiquée. Pour les autres régions du Golfe, seulement les engins fixes sont utilisés.

La composition des captures est caractérisée par la dominance des individus de 3 ans dans la Division 4R, alors que ces derniers alternent avec les individus de 2 ans dans la Division 4T. De plus, ce document présente les relations longueur-poids ainsi que les facteurs de conversions pour les longueurs frais/congelé, et suggère que les données provenant de missions de relevés de recherche non dirigées à l'espèce sont de peu d'utilité quant à l'évaluation des populations. Finalement, une analyse discriminante des caractères morphométriques y est présentée, et démontre une différenciation non-significative des sous-populations de capelan des trois Divisions 4R, 4S et 4T.

## INTRODUCTION

Capelin in the Gulf of St. Lawrence have gained importance not only from their commercial value but also as a dominant element in the food web (Carscadden, 1983). Previous studies have reported on their general ecology (Templeman, 1948; Jangaard, 1974), spawning distribution (Parent and Brunel, 1976) and stock discrimination (Sharp *et al.*, 1978; Carscadden and Misra, 1980), as well as their early life history in the estuary (Jacquaz *et al.*, 1977), in the North-West Gulf (de Lafontaine, 1979), southern Gulf (Kohler *et al.*, 1975), in the Baie des Chaleurs (Lambert, 1983), and in St. Georges Bay (Lambert, 1984). O'Boyle and Lett (1977), Carscadden (1979) and Nakashima *et al.*, (1982), in updating the information on these stocks, pointed out the lack of basic knowledge and historical data which creates obstacles to the assessment of the status of 4RST capelin stock.

The purpose of this study therefore is to present the unpublished data since 1984 as well as to present the current catch trends and the results of the latest biological monitoring and surveys.

## METHODS

### SAMPLING

The number of samples collected through the years in the Divisions 4S and 4T depends mainly on the availability of fish, since a more or less artisanal fishery occurred. In Division 4R, samples were collected in accordance to the commercial landings, averaging one sample per 250 tons landed.

The number of samples collected in recent years are as follow:

Years	Divisions		
	4R	4S	4T
1984	6	0	1
1985	7	0	1
1986	12	8	8
1987	3	3	7

For each sample in the Gulf of St. Lawrence, 250 fish were randomly collected, sexed and total length was measured to the nearest millimeter (1.0 mm). A subsample of 2 fish per 5.0 mm was frozen for further detailed examination.

The analysis performed on individuals in the laboratory included the total weight of the fish, gonad weight, separation into maturity groups according to Winters (1970), as well as the collection of otoliths. The age determination was done using the Newfoundland method to remain consistent with previous studies. However, it should be pointed out that authors (Templeman, 1948; Bailey *et al.*, 1977a) have mentioned difficulties involved in the age determination especially for the 4T capelin. In addition, for 1986 and 1987, morphometric measurements were collected according to criteria established by Hubbs and Lagler (1967), for stock discrimination analysis in Divisions 4R, 4S and 4T.

#### **LENGTH STANDARDIZATION**

In the recent years, fresh total length, and thawed total length were recorded according to the availability of fish. A general coefficient of standardization was applied to convert the lengths to fresh total lengths (Anon., 1980). The fresh lengths of frozen fish were estimated using the regression in Figure 1 of the thawed lengths, which corresponds to a conversion factor of 1.036. This value is comparable to those calculated by Bailey *et al.* (1977a) and Winters (1970), of 1.04 and 1.03, respectively. Because of a different response to freezing from small and larger individuals, this general standardization coefficient had to be slightly modified in order to retrace fish to their original length classes of the fresh length frequencies.

#### **HISTORY OF FISHERY**

Capelin catches in Division 4T have been recorded since the early 1950's. Although this fishery has always had a more or less artisanal status (Maranda *et al.*, 1981), the nominal catches reached a maximum of 2165 t in 1979, with the participation of the seiners from the Acadian Peninsula (Table 1). The latter ceased their activities in 1981 in response to a decrease in the Japanese roe market in search of large females, therefore preferring Newfoundland capelin.

The fixed gear landings remained somewhat constant over the years. The total landing reached 545 t in 1985 with a second attempt from the Caraquet purse seiners. Again capelin were under size and all of them were processed as fish meal. In 1987, the noticeable decrease in the fishery with only 8 t landed, is again the response to low market demand.

In Division 4S, the fishery has always been an artisanal fixed gear type. The landings were constantly very low except in the early 1950's when it peaked at 826 t (Maranda *et al.*, 1981). For 1988, in order to develop this fishery,

75 fixed gear exploratory permits were issued. In addition 10 permits were also issued for small seiners less than 50 feet. The landings are therefore expected to increase should the market demand be restored.

In Division 4R purse seining activities started in the Port-au-Port, St. Georges Bay area in 1977. According to local observers the landings are directly dependent on fluctuations in the Japanese roe market. The quality of capelin sought by processors obliged the fishermen to release sets with a high proportion of males as well as when "redfeed" is observed or when the fish are under 150 mm. The total landings reached a maximum of 8211 t in 1978, and decreased to 155 t in 1982 when purse seining activities stopped. Since then, the increasing catches have responded to the market demand to reach 906 t in 1987. The proportion of fixed gear/seiner landings varies from 51% in 1983 to 6% in 1986.

In the Gulf of St. Lawrence the capelin fishery is a market generated fishery. Assuming market demand is restored, indications are that the resources would be sufficient to fulfill the requirements. Indeed, shrimp trawlers have already reported unusually high captures of capelin which cannot be processed due to the actual market situation.

#### FISHING EFFORT

Since most capelin catches in the Gulf of St. Lawrence are reported by the seiners from Division 4R, their fishing logbooks were analysed. Unfortunately from 1977 to 1984, fishermen were not required to fill logbooks, and in the recent years the information included is such that it is impossible to retrace their fishing activity or to associate the latter with the landing statistics. The Commercial Fishery Vessel reports and "catch per purchase slip" were thus preferred in order to estimate a fishing effort. Therefore, since the "catch per searching hour" which is the usual effort associated with the purse seiners, are unreliable, the "catch per day" were estimated and are presented in Figure 2 as an indication of the rate of fishing. From 1977 to 1981 the number of fishing days and the total landings show very similar patterns, which led to a relatively high catch rate. In recent years, again the same patterns are observed but the low catch rate is a result of low landings and high numbers of days at sea. From this, one would be tempted to make conclusions about the small size of the resource but it is more likely the result of an artifact created by the imposition of a quota per day by the processors to the fishermen in accordance with the market requirements. Therefore the available data do not represent a satisfactory means of reflecting the status of the population. If available, the number of hours searched or the catch per set, in order to capture a pre-determined market quota, would be more useful to estimate the relative abundance of the capelin resource.

**POPULATION PARAMETERS**

**SEX RATIO**

The random samples from each Division and year reveal sex ratios as follows:

Years	Divisions					
	4R		4S		4T	
	M	F	M	F	M	F
1984	.4	.6	-	-	.8	.2
1985	.4	.6	-	-	.3	.7
1986	.4	.6	.7	.3	.9	.1
1987	.4	.6	.9	.1	.9	.1

In division 4R, the ratios are similar with the females always being more abundant. This is consistent with the purse seiner fishing activities as sets with a high proportion of males are released.

In Division 4T and 4S, the males are predominant. Although these ratios seem to contradict the ones estimated by Labonté (1982) and in some instances by Bailey *et al.* (1977b) for samples collected at sea, they are consistent with the tendency of male capelin to remain near shore to join successive small groups of females (Templeman, 1948; Jangaard, 1974), hence being more vulnerable to fixed gear.

**LENGTH FREQUENCY/AGE COMPOSITION**

Figures 3 and 4 illustrate the yearly length frequencies and age composition of the male capelin for each division. The main feature is the between year variation in the modal length from 1984 to 1987, for the west coast of Newfoundland. The same situation occurs in the Division 4T as well as in Division 4S where the fish are relatively smaller than in Division 4R. The age composition (Figure 4) and the mean length at age (Table 2) in the latter division illustrate the relative stability of the proportions of the age 3 individuals. The shifts of the modal lengths is a result of the relative importance of the presence of the age 2 or age 4 individuals. It is justified to keep in mind that these data reflect composition of the landings and that they could be a result of the artifact created by fishermen being more or less selective at sea in accordance to the processors requirements. In Division 4T the situation is somewhat different since the proportion of the

3 year old individuals is relatively unstable over the years, and a decrease to the profit of the 2 year old individuals reflects the shift in the dominant lengths. In Division 4S in 1986, the composition of the landings seems to be more associated with Division 4T than with 4R. The age structures are very similar leading to a strong domination of 3 year old individuals. In 1987, the proportions at age and length are better represented throughout all age classes.

The composition of the landings of female capelin illustrated in Figures 5 and 6, shows similar patterns to the one observed for the males. In Division 4R the shift of the modal length is associated to the relative stability of the 3 year old individuals in the latter division. Division 4T is marked by a change in the strength of the successive year-classes.

In Division 4S, the age structures seem somewhat similar from year to year but the length compositions differ. This is a result of the mean length at age in 1987 (Table 3) being smaller than in 1986, as well as a very low number of females present in the random samples collected in Division 4S.

#### LENGTH - WEIGHT RELATIONSHIPS

From the commercial random stratified samples fish with mature gonads (Table 4) were selected and the round weight on length was calculated for males and females in divisions 4RST (Figure 7). For all years, the weight of capelin increased with length at a rate more or less associated with that expected from the cubed relationship of weight to length. However, in Division 4T in 1985 and in Division 4R in 1986 and 1987, females are heavier at length than males which contradicts the observations of Templeman (1948), Winters (1970), Jangaard (1974) and Labonté (1982). As Ricker (1975) pointed out, several variables including the exact maturity stages and age groups of fish should be considered in establishing such relationships. Also, the conversion factor for the effect of freezing on weight could not be applied, because it was unavailable. This subject is, to date, under investigation. Therefore, these curves are presented only as indicative, suggesting that the "one fits all" curve does not represent an adequate tool in further studies.

#### RESEARCH SURVEYS

The capelin by-catches from a random stratified survey carried out on board the shrimp trawler Saida, in the Northern Gulf of St. Lawrence from September 12 to November 22, 1985 were analysed. The sampling was done at depths greater than 150 m, since broken bottoms were found in shallow waters throughout the area surveyed. The gear used was a Western IIA shrimp trawl



with 19 mm mesh cod end. Tows were 30 min. in duration and trawling was done only in daylight.

The number of capelin per tow was recorded on distribution maps (Figure 8) with references to previous surveys. It is obvious that no concentrations of capelin comparable to October 1981 (Labonté, 1982) were found during the current survey, although similar gear was used. The same situation occurred during a 1984 shrimp survey, where the catch rate comparison (kg/tow) (Tremblay, D., unpubl. data) indicates concentrations far below those reported by Labonté (1982).

Nakashima et al. (1982), using data from the Gadus Atlantica (Jan. 1981), also reported concentrations lower than the October 1981 survey. However, in this case, different gear was used, which made the interpretation of such differences more difficult. From a detailed observation of the magnitude of concentrations reported by both authors, it seems that this discrepancy cannot be attributed to the gear used alone, suggesting that cepelin were more abundant in the Northwest Gulf in October than in January 1981. These observations are consistent with Bailey et al. (1977b), however, who mentioned contranant migration of dense schools of adults and juveniles into the spawning areas in the lower estuary in November.

Nevertheless, comparisons with the 1985, survey are somewhat difficult. The general disributions are similar, but the high concentrations of capelin in 1981 in the northwest in Gulf, strongly dominated by 2 years old individuals (Labonté, 1982), would have led to a high spawning population in 1982 (Winters, 1970; Jangaard, 1974). Furthermore, this should have led to a potentially strong year-class, evident in September-October 1985. Either that survey failed to give an indicative image of the status of capelin in the Gulf, or the population suffered losses other than from the fishery, since catches were below their potential.

### STOCK DISCRIMINATION

Effective management of capelin in the Gulf of St. Lawrence requires a knowledge of the occurrence and distribution of distinct spawning stocks. Carscadden and Misra (1980) and Misra and Carscadden (1987) have reported on the separation of the stocks from around the coast of Newfoundland. Sharp et al. (1978) have discriminated the capelin populations from Gaspé coasts, Québec North-Shore and east coast Newfoundland. Therefore, since the management of capelin in the Gulf of St. Lawrence addresses recommendations for the divisions 4R, 4S and 4T, the present study reports on the separation of these three subpopulations for 1986 and 1987.

## METHODS

Samples were collected through the commercial sampling program. The sampling procedures are described in the sampling chapter of the present study.

Only spawning fish were selected and the morphometric measurements were made using an electronic caliper according to the criteria established by Hubbs and Lagler (1967), to an accuracy of 0.1 mm. These morphometric characters included head length, body depth, snout length and eye diameter, which were identified by Sharp et al. (1978) as characteristics which contribute significantly to the definition of separate populations.

All measurements were standardized using the method of Meng and Stocker (1984). Morphometric data were not log-transformed because of the small length range of fish in the samples. Males and females as well as both years were treated separately in all statistical comparisons. The Generalized Distance of Mahalanobis which provides a measure of distance between groups was calculated to illustrate the population boundaries. This Generalized Distance was then converted to percent overlap (Mais, 1972) employing the concept described by Royce (1964), as an estimate of the proportion of one group having identical characteristics with another. Multivariate discriminant function analysis (Clayton and MacCrimmon, 1987) were used to assess the degree of statistical separation between groups. All calculations were made using SAS software, version 6.3.

## RESULTS

In order to appreciate the raw data, Figure 9 gives the basic statistics for each character adjusted for standard fish sizes ie. the effect of length is removed. The means and standard deviations illustrate a strong overlap between the regions for all morphometric measurements for both years, which visually indicates the similarity of individuals within the Gulf.

From these data, the Generalized Distance of Mahalanobis was calculated as well as the percent overlap associated with the coefficients and are presented in Table 5. Again, the latter indicates a strong between regions overlap ranging from 49% to 76% which are considerably higher than the values observed by Sharp et al. (1978). In addition, the overlap does not differ significantly between males and females or between both years.

The discriminant function analysis revealed different aspects of the contribution of the morphometric characters to the separation of the populations. From Table 6, the contribution varies for both sexes and years, where the snout length, head length and eye diameter contribute significantly

to the analysis for males in 1986 and 1987. For the females there is a change in the contribution of the characters for each year; only eye diameter was identified as a significant character in both 1986 and 1987.

From the classification function based on standardized morphometric values (Table 7), the posteriori classification of groups was derived (Table 8). As observed, only half of the cases are correctly classified to their original groups. In the previous studies, Misra and Carscadden, (1987) and Sharp et al., (1978) had identified these four morphometric characters being significantly discriminant and observed a strong percentage of correct classified cases, 93% for males and 73% females according to the latter authors. In the present study, in 1987 for the males, 60.8% are correctly classified, which represent the highest score. Therefore the populations in divisions 4RST, are not separated according to the variables previously identified as discriminant characters.

As indicated, Figure 10 represents the plots of the canonical variables of the studied characters. In general there seems to be a slight tendency for Division 4R to be discriminated from Division 4T with Division 4S being more or less in between, according to sexes or years. Only a vague separation of the subpopulations is encountered. This differs from previous studies, although the latter were not addressed to the exact same populations. Nevertheless, the present study failed to discriminate the 4RST capelin stocks. The results seem to come not from the discrimination techniques but from the raw data. Indeed, the Mahalanobis Distances in Table 5, give no ambiguity in terms of the overlapping of subpopulations. However it should be pointed out that these calculations are based on the standardized values of morphometric characters, and that a polemic is encountered over the various methods of standardization (Claytor and MacCrimmon, 1987). Another attempt was therefore done to reanalyse the data with a different method of standardization. The method of Somers (1987) was preferred. This method constrains principal component analysis to extract the first component that summarizes isometric size alone. The remaining information is partitioned according to variation in shape. The results lead to the same conclusions: a very strong overlapping of subpopulations.

According to these results, it seems that the morphometric characters previously identified being discriminant are not significant in the present study which failed to discriminate the capelin populations of divisions 4RST.

CONCLUSIONS

The present study reports on the analysis of the unpublished data since 1984. Some results are presented only as indicative since they are based on partial information. The available data continue to impose constraints as far as drawing definite conclusions about the status of 4RST capelin. With the issuance of new fishing permits, scientific effort will be increased and hopefully this paper and previous studies will serve as historical data leading to the assessments on the status of the 4RST capelin.

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Table 1. Yearly capelin landings(t) from the Gulf St-Lawrence 1977-1987.

GEARS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
-----											
4R											
BB seine	109	90	37	112	236	146	312	235	206	36	
Traps				2	1	4			19	90	5
Stationary lift net										88	60
Purse seine	1513	8121	5706	4661	1927	5	608	1490	2318	3460	841
TOTAL CATCH	1622	8211	5743	4775	2164	155	920	1725	2543	3674	906
TAC			20000	20000	20000	20000	20000	20000	20000	20000	20000
-----											
4S											
Traps	69	37	15	16	2	1	*	*	7	*	*
TAC			5000	5000	5000	5000	5000	5000	5000	5000	5000
-----											
4T											
Traps	73	121	360	472	236	237	103	180	345	227	8
Purse seine		1202	1805	1093					200		
TOTAL CATCH	73	1323	2165	1565	236	237	103	180	545	227	8
TAC			5000	5000	5000	5000	5000	5000	5000	5000	5000
-----											

\* negligible landings



Table 2. Mean Lengths (mm) at age of male capelin from the commercial fishery in Div. 4RST, 1976-1987.

YEAR	AGE				
	2	3	4	5	6
DIVISION 4R					
1976	123	184	188	190	-
1977	-	181	191	185	-
1978	155	178	187	197	-
1979	161	172	191	198	-
1980	143	169	178	187	-
1981	-	171	189	193	-
1984	158	172	180	187	-
1985	156	171	183	192	-
1986	161	177	183	194	-
1987	158	172	184	192	-
DIVISION 4S					
1986	158	172	183	187	-
1987	156	168	186	193	197
DIVISION 4T					
1984	-	176	184	-	-
1985	158	165	177	-	-
1986	157	170	183	-	-
1987	154	169	182	-	-

Note: 1976-81 data from Nakashima *et al.* 1982.  
 1984-1985 data from Tremblay (unpublished data).

Table 3. Mean Length(mm) at age of female capelin from the commercial fishery in Div. 4RST, 1976-1987.

YEAR	AGE				
	2	3	4	5	6
DIVISION 4R					
1976	121	160	169	172	-
1977	139	156	169	183	200
1978	144	161	168	179	187
1979	148	162	179	185	192
1980	145	157	165	166	173
1981	-	160	174	180	187
1984	141	155	167	-	-
1985	143	154	172	177	-
1986	152	162	177	184	-
1987	145	158	170	177	-
DIVISION 4S					
1986	143	156	168	-	-
1987	135	152	167	-	-
DIVISION 4T					
1984	140	156	166	182	-
1985	138	150	160	-	-
1986	147	158	169	177	-
1987	140	152	166	-	-

Note: 1976-81 data from Nakashima *et al.* 1982.  
 1984-85 data from Tremblay (unpublished data).

Table 4 Maturity stages for male and female. Divs. ARST 1984-1987. Stages :  
1=immature, 2=resting or recovering, 3=ripening, 4=ripe, 5=spawning (Winters, 1970).

YEARS	R		S		T	
	M	F	M	F	M	F
	Stage %	Stage %	Stage %	Stage %	Stage %	Stage %
1984	2	19	2	4	2	57
	5	81	5	96	5	43
						4 23 5 64
1985	2	73	2	1	2	34
	5	27	5	99	4	33
					5	33
1986	2	40	2	8	2	21
	4	53	4	57	4	21
	5	7	5	35	5	57
				4	22	
				5	47	
				5	35	
1987	2	11	2	5	2	40
	3	32	3	27	3	4
	4	26	4	28	4	35
	5	31	5	40	5	39
				2	26	
				3	6	
				4	40	
				5	26	
				3	3	
				4	39	
				5	46	

Table 5. Corrected Mahalanobis  $D^2$  and percent overlap comparisons of female (below diagonal) and male (above diagonal) morphometric characters (snout length; eye diameter; head length) for 1986-1987.

$D^2$			1986	overlap %		
R	S	T	R	S	T	
R	0.6908	0.9533		67.4	62.4	R
S	0.7579	0.3657	66.0		76.4	S
T	1.5844	0.5579	52.9	71.1		T

$D^2$			1987	overlap %		
R	S	T	R	S	T	
R	1.5770	1.8198		52.9	49.7	R
S	0.5617	1.4617	70.4		54.2	S
T	0.9297	0.7197	63.1	67.4		T

Table 6. F values for test of significance of contribution various morphometric characters to multivariate discrimination between groups.

VARIABLE	1986		1987	
	F		F	
	male	female	male	female
	df=2,165	df=2,152	df=2,218	df=2,142
Snout length	13.08 **	1.68	30.85 **	6.17 **
Head length	4.56 **	0.33	12.84 **	7.29 **
Body depth	1.71	12.66 **	7.82 **	1.46
Eye diameter	3.34 *	4.96 **	12.70 **	10.50 **

\*\* p < 0.01    \* p = 0.01-0.05

Table 7. Classification function for male and female capelin from 4R,4S and 4T (based on standardized morphometric values) for 1986-1987.

1986						
VARIABLE	male			female		
	R	S	T	R	S	T
Eye diameter	64.29065	64.99883	65.57417	55.28149	56.08852	58.35568
Snout length	38.99052	39.82258	40.95153	22.58707	22.33356	23.70093
Head length	11.67481	12.04421	11.64592	18.98574	19.31131	18.74027
Body depth	6.67039	6.42183	6.50208	-0.04079	-0.37455	-0.44504
CONSTANT	-720.11919	-740.47404	-750.00179	-621.05690	-626.89609	-636.62249

1987						
VARIABLE	male			female		
	R	S	T	R	S	T
Head length	26.05700	25.06668	25.72129	32.43375	32.20549	32.89551
Body depth	4.40738	4.76303	4.39435	3.05903	3.17537	2.97968
Eye diameter	1.26959	2.35061	2.27858	17.00755	17.52938	18.56501
Snout length	3.01508	3.93057	4.73474	-9.97796	-8.79814	-9.83902
CONSTANT	-499.19871	-491.02752	-511.43611	-533.69681	-543.18691	-557.70735

Table 8. Percent correct a posteriori classification to groups based on morphometric functions, for 1986-1987.

1986								
No. cases classified into group								
Group	male				female			
	R	S	T	Percent correct	R	S	T	Percent correct
R	39	18	16	53.4	57	16	18	62.6
S	12	13	9	38.2	8	10	10	35.7
T	13	14	34	55.7	5	9	22	61.1
Total	64	45	59	49.1	70	35	50	53.1

1987								
No. cases classified into group								
Group	male				female			
	R	S	T	Percent correct	R	S	T	Percent correct
R	32	11	11	59.3	24	21	15	40.0
S	13	35	9	61.4	4	12	7	52.2
T	21	21	68	61.8	16	13	33	53.2
Total	66	67	88	60.8	44	46	55	48.5

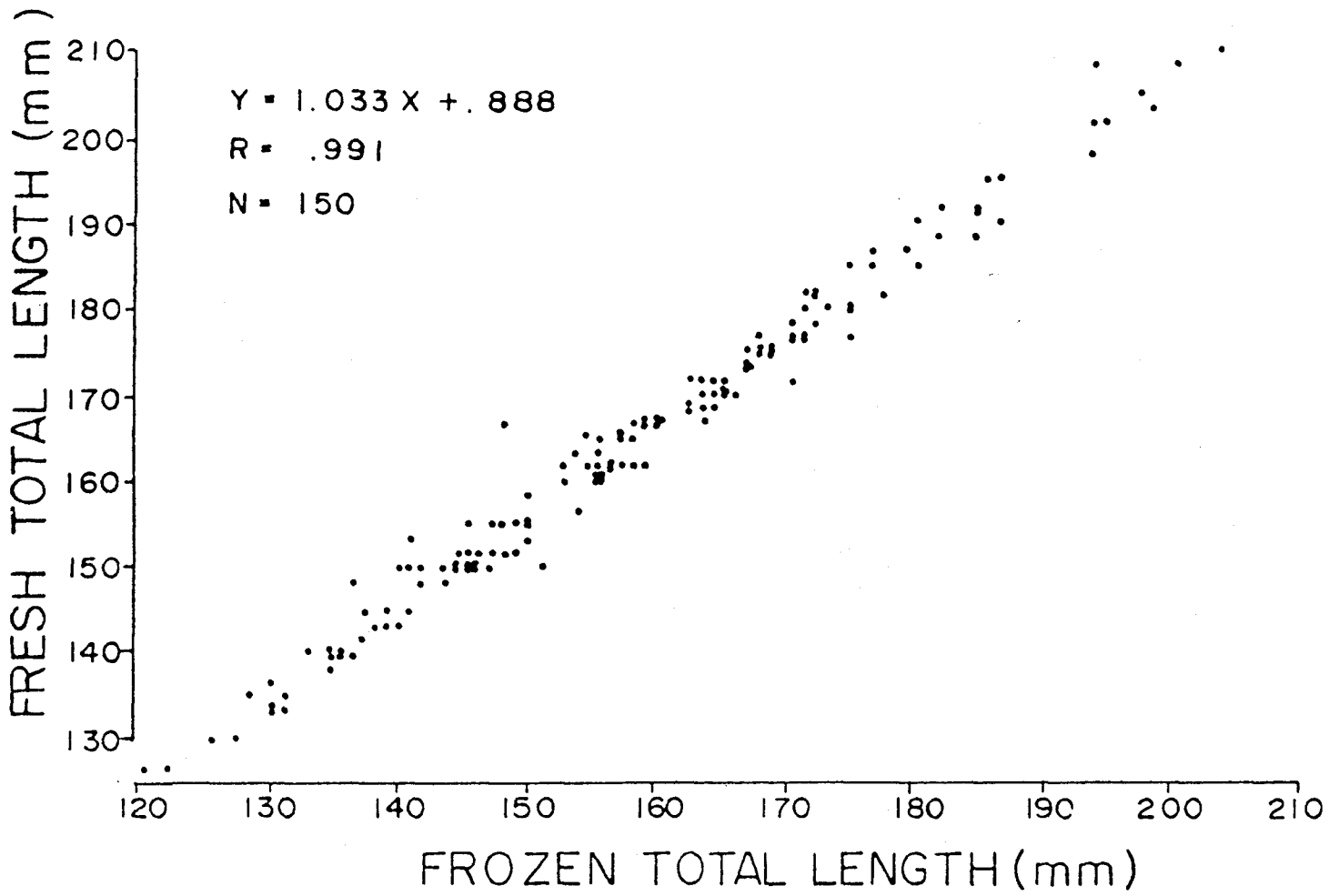


Figure 1. Lengths relationships of capelin (1981 data).



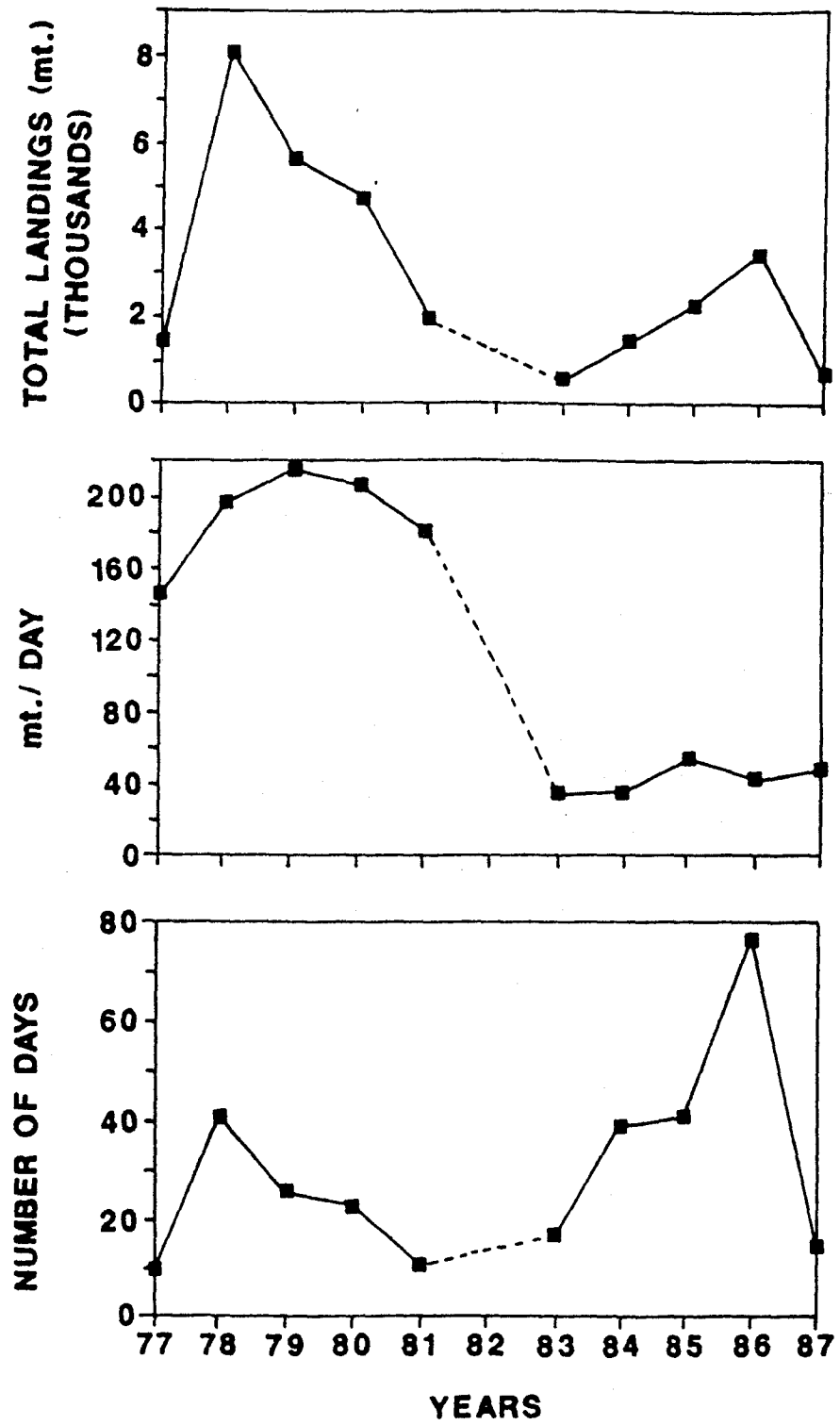


Figure 2. Catches per day and total landings for Division 4R seiners.

4R

4T

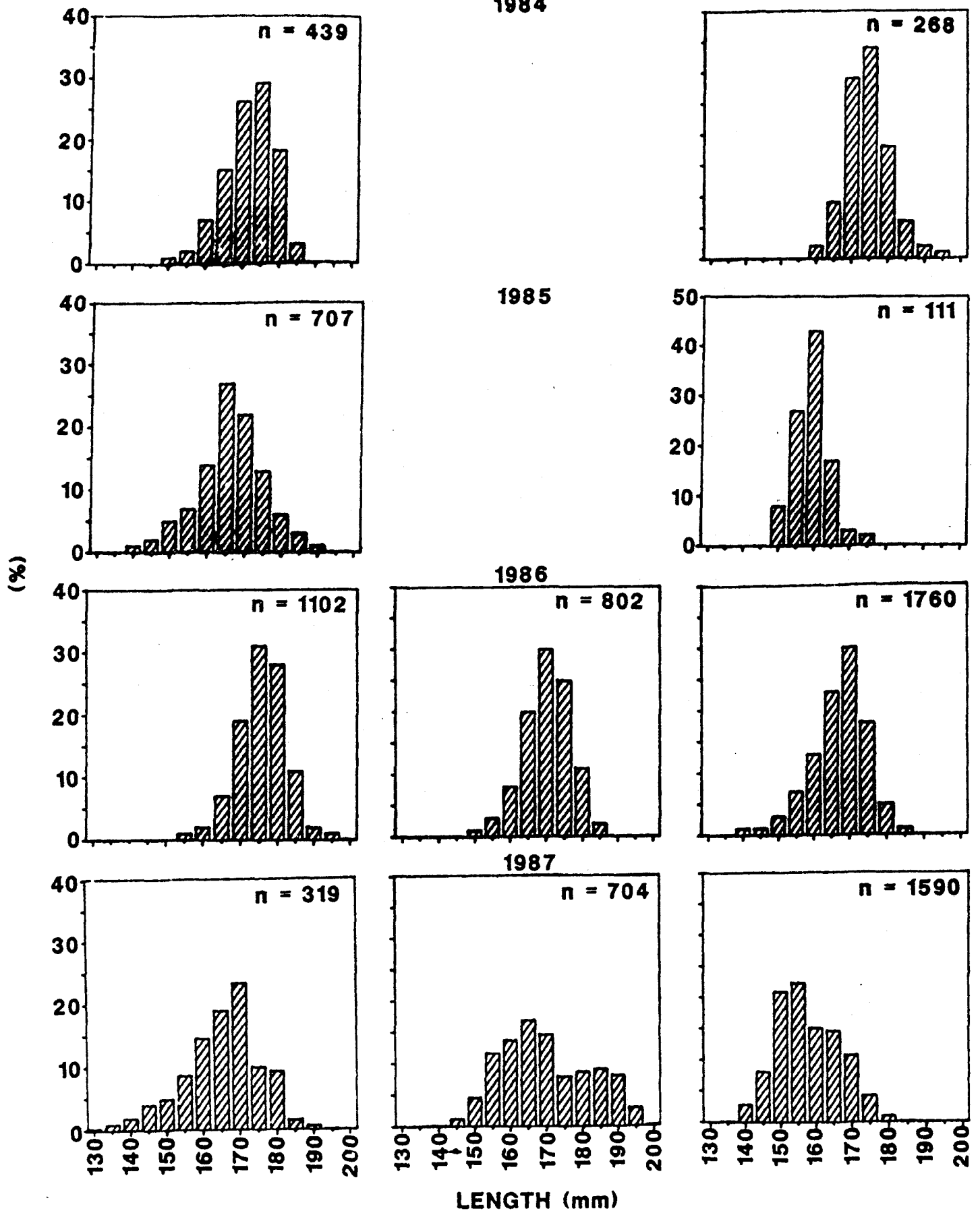


Figure 3. Length frequency distribution of 4RST male capelin, 1984-1987.

4R

4T

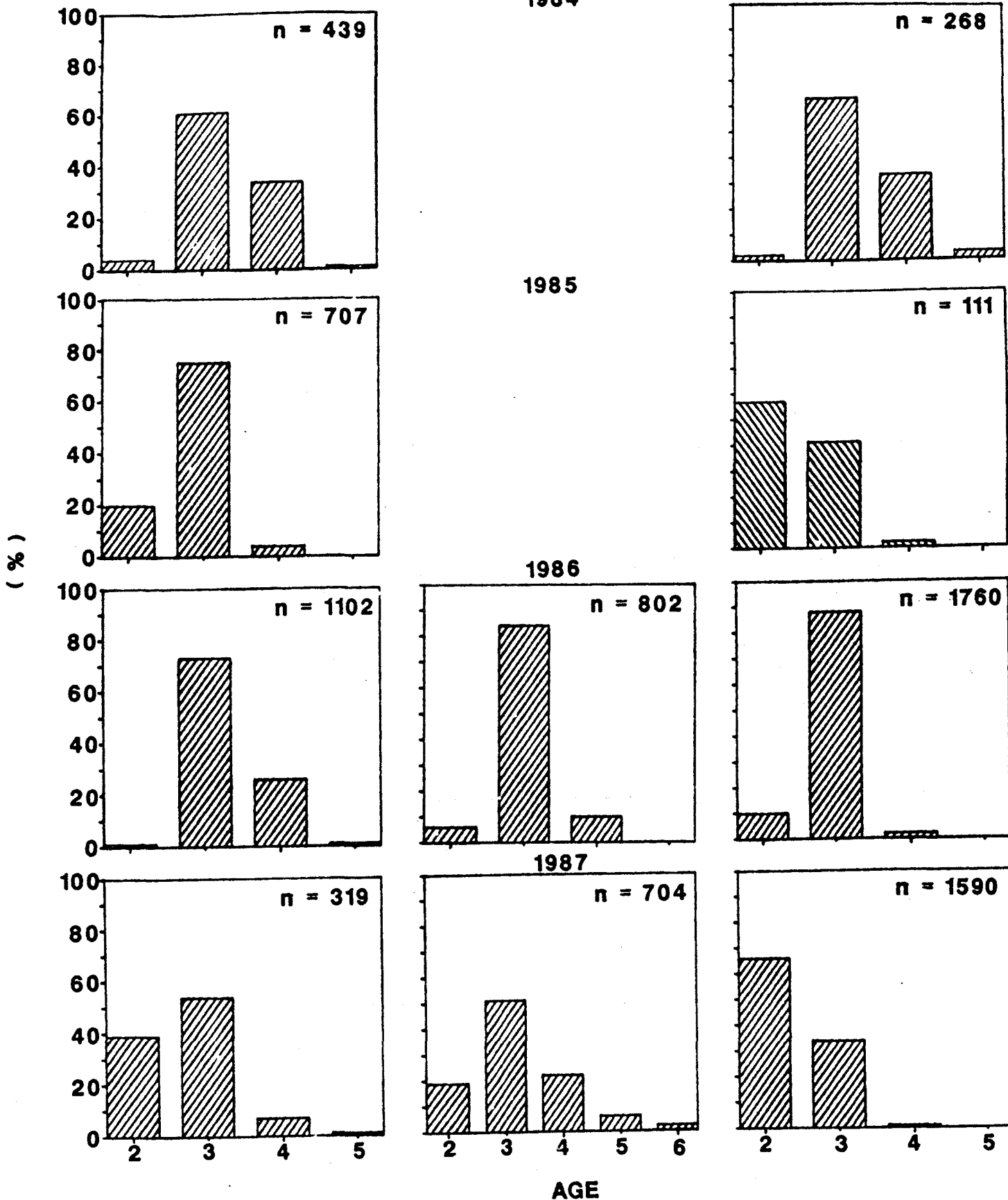


Figure 4 . Males capelin age composition in Div. 4RST, 1984-1987.

4R

4T

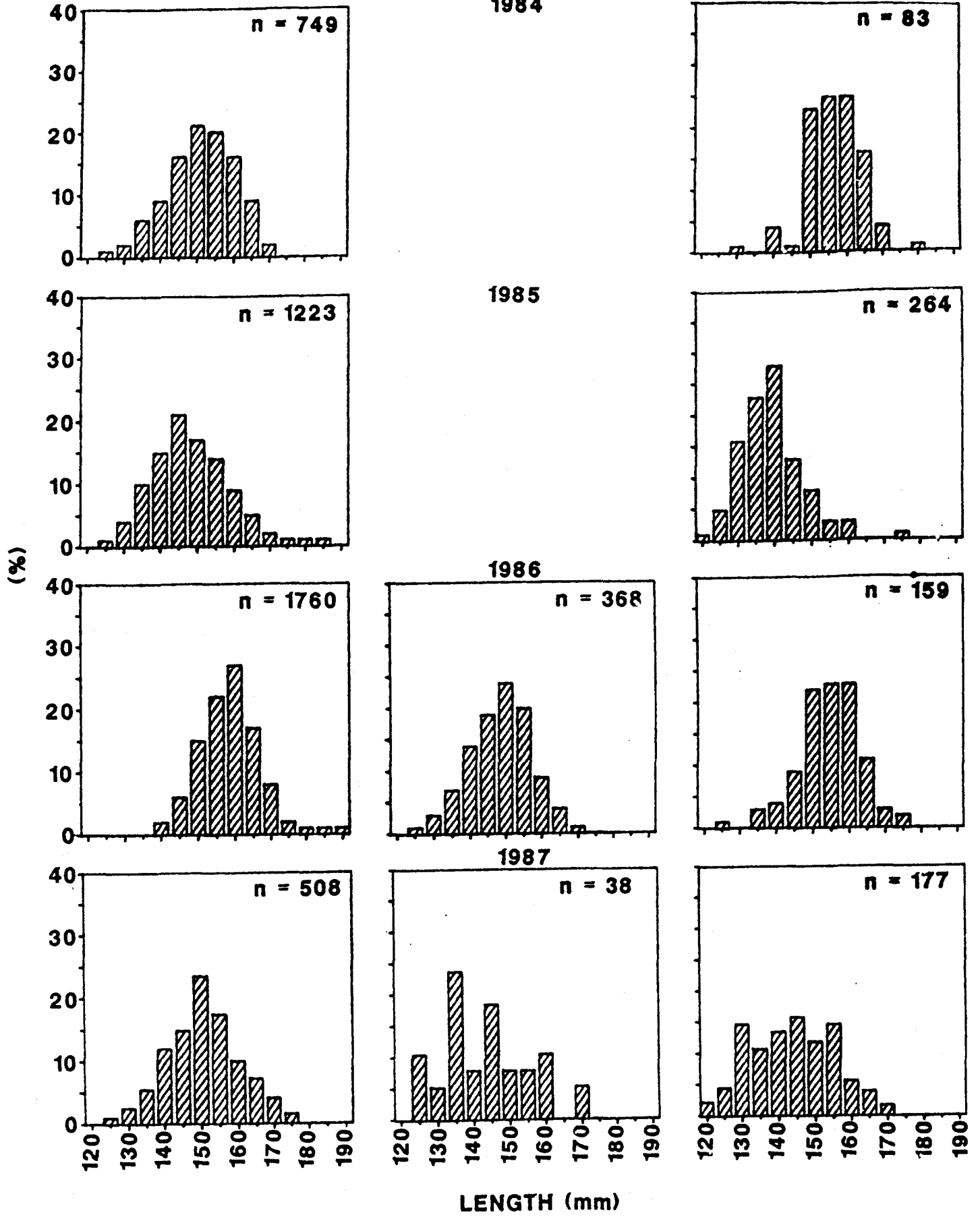


Figure 5. Length frequency distribution of 4RST female capelin, 1984-1987.

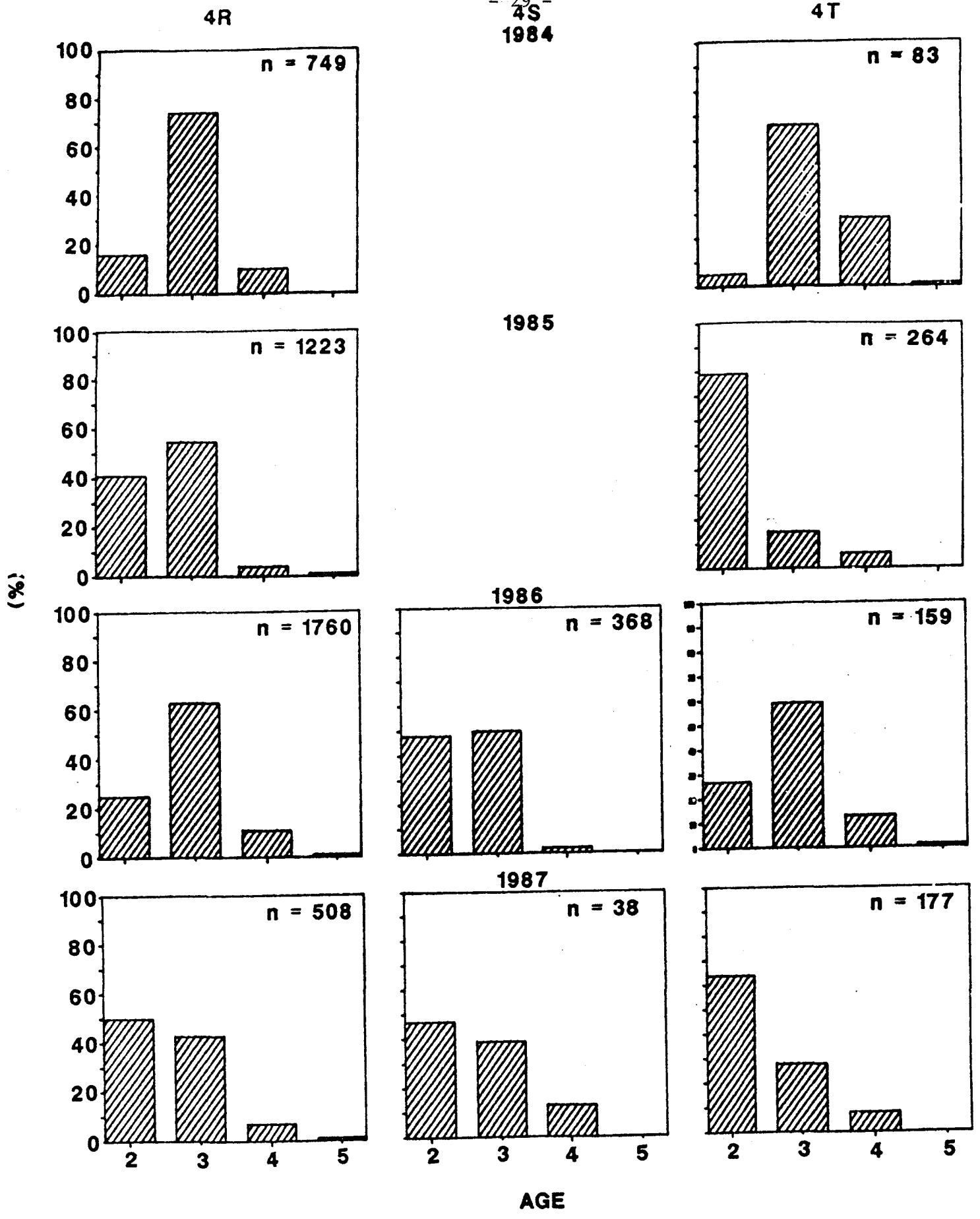


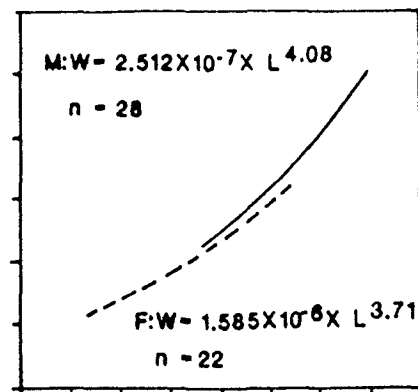
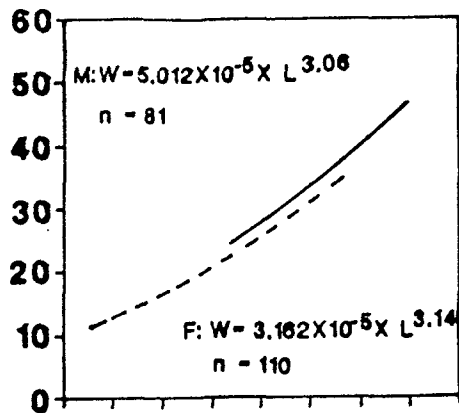
Figure 6. Females capelin age composition in Div. 4RST, 1984-1987.

4R

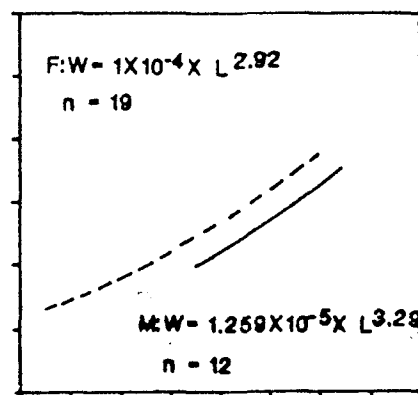
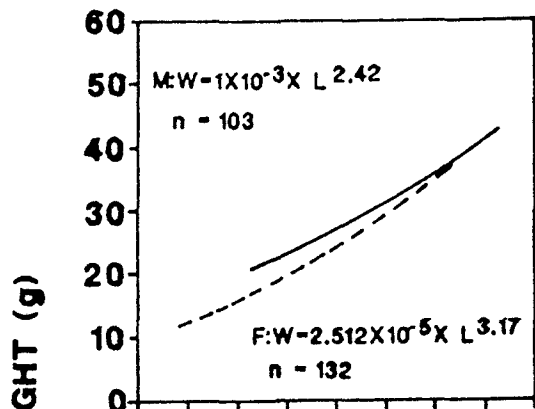
- 30 -  
4S

4T

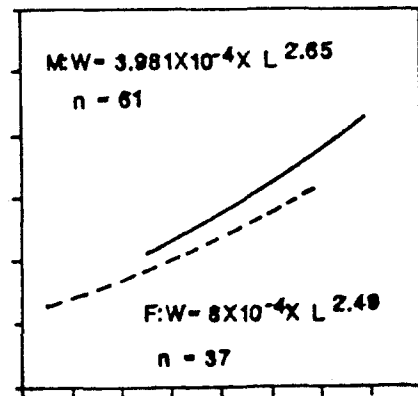
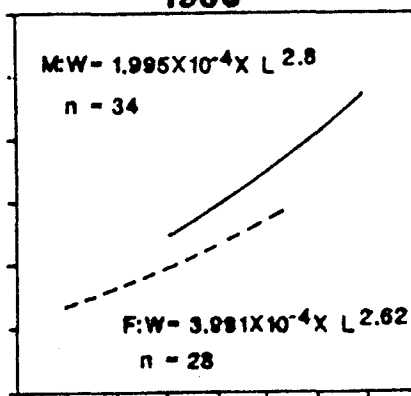
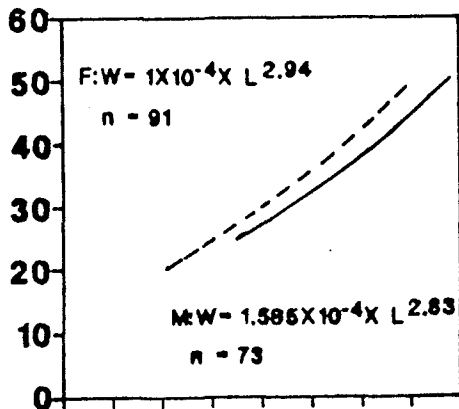
1984



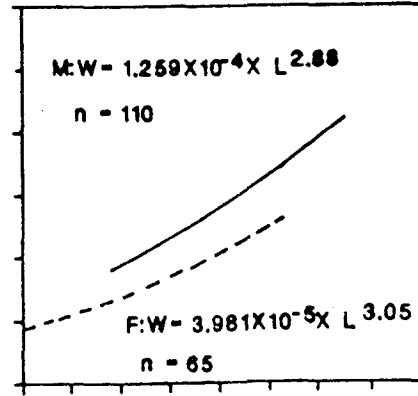
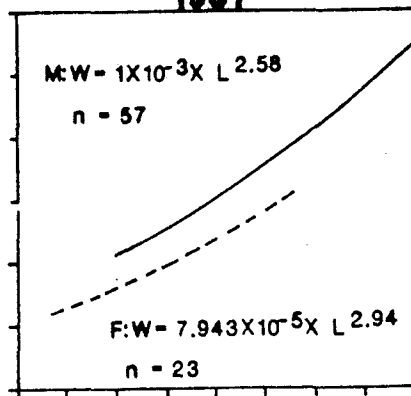
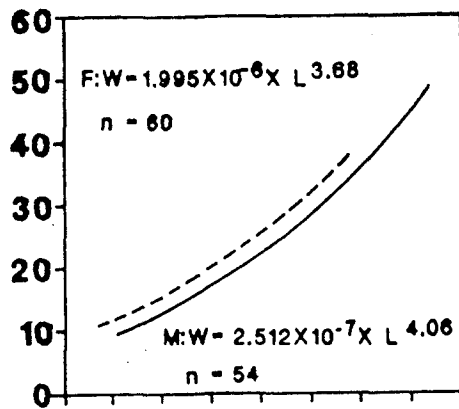
1985



1986



1987



120 140 160 180 200 120 140 160 180 200 120 140 160 180 200

TOTAL LENGTH (mm)

Figure 7. Length-weight relationships of 4RST capelin (males - ; females ---), 1984-1987.

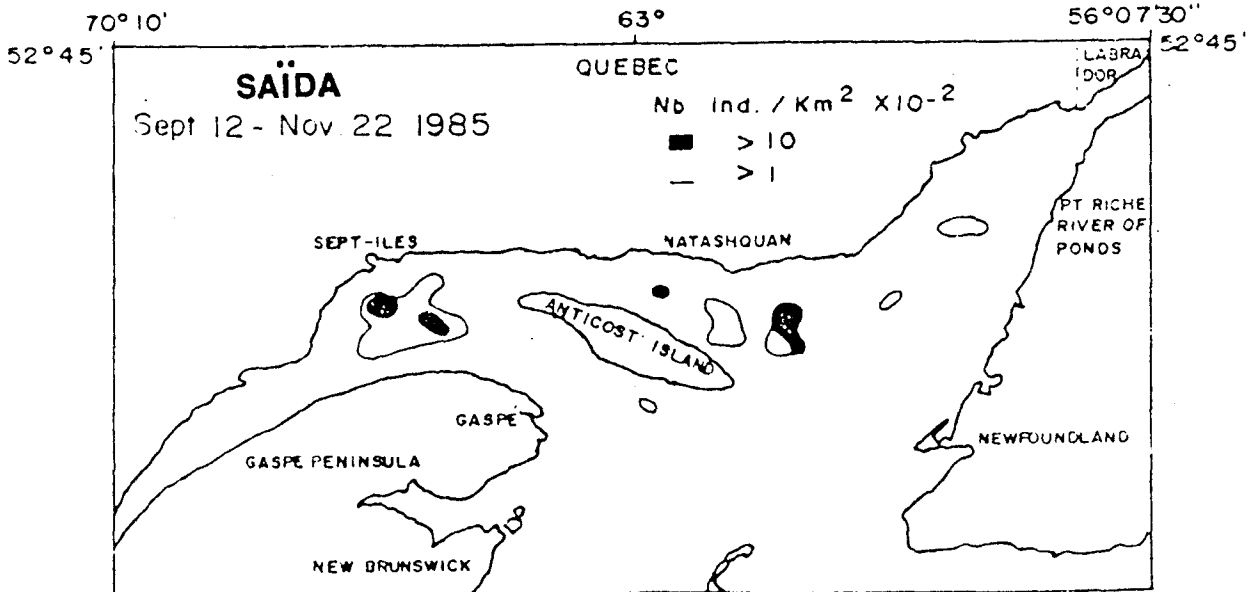
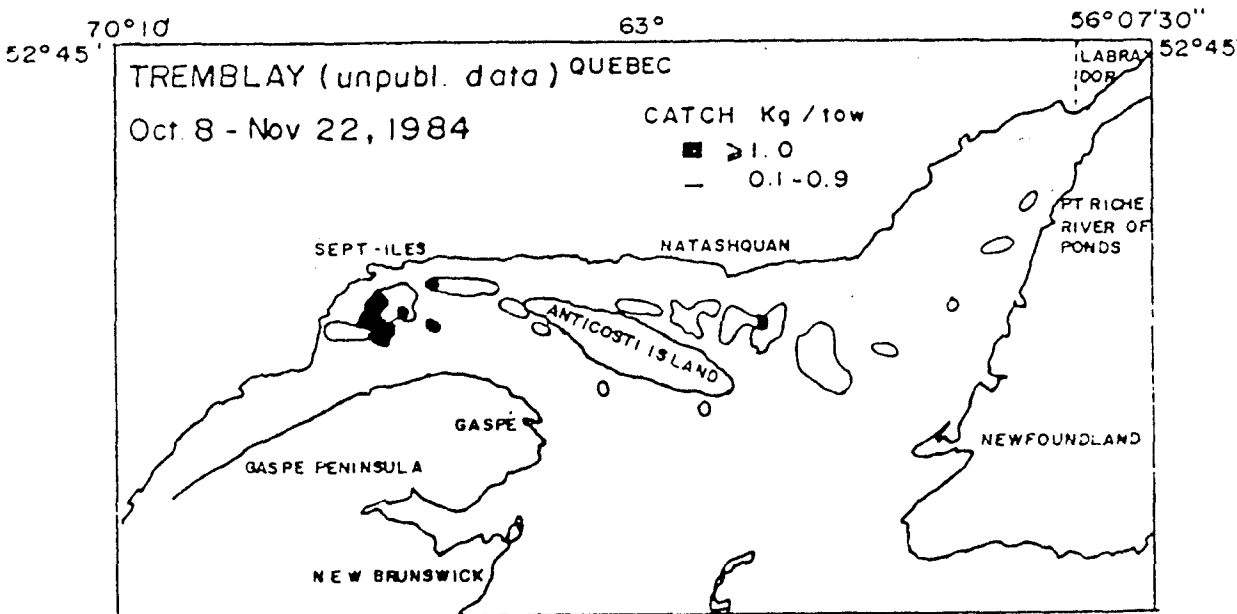
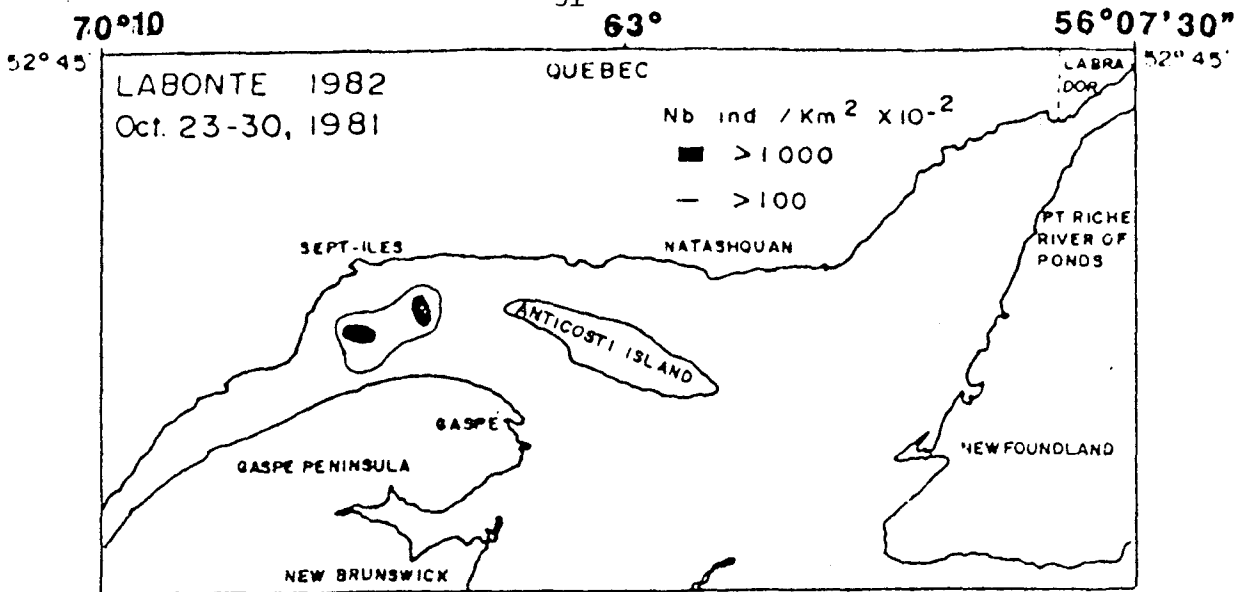
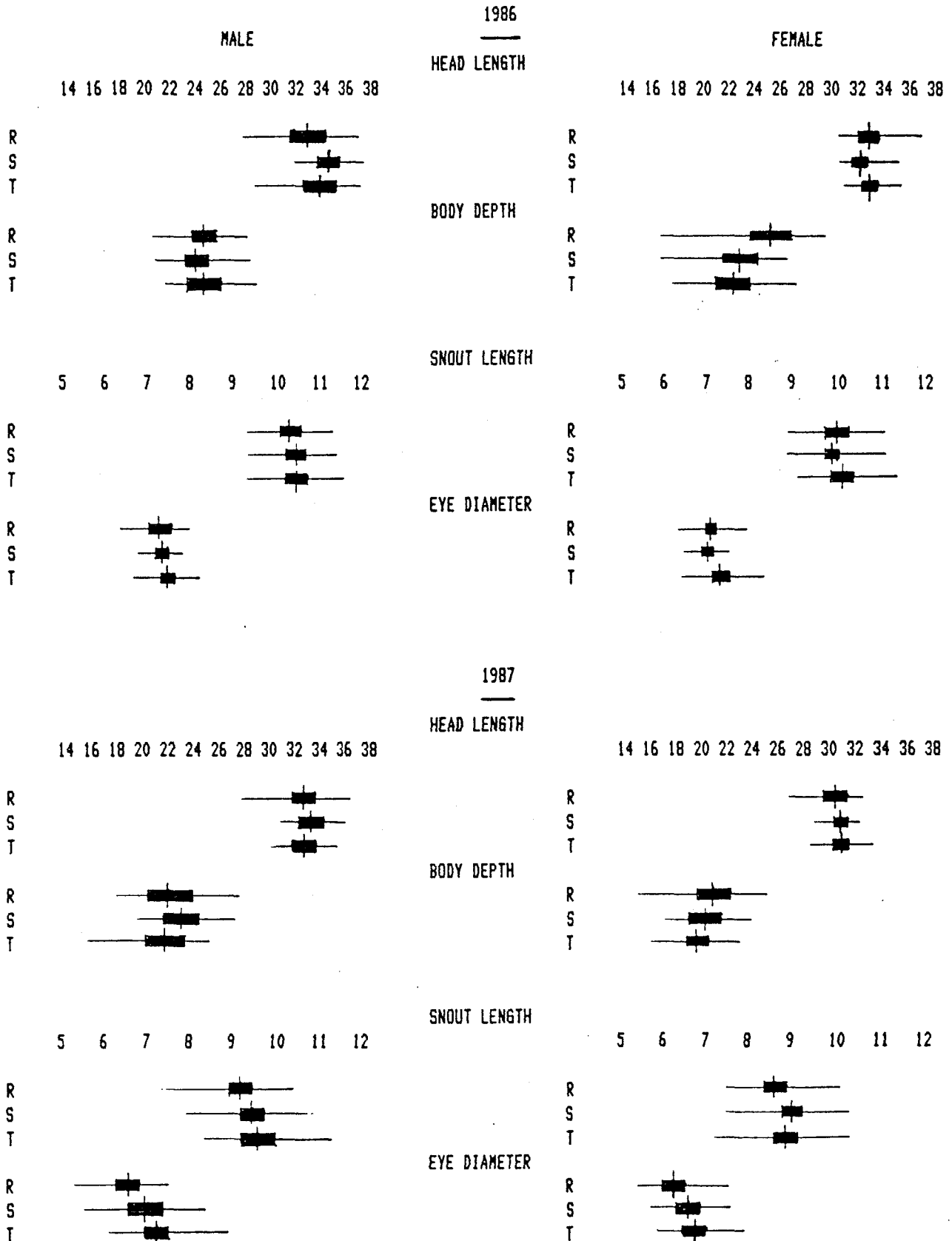


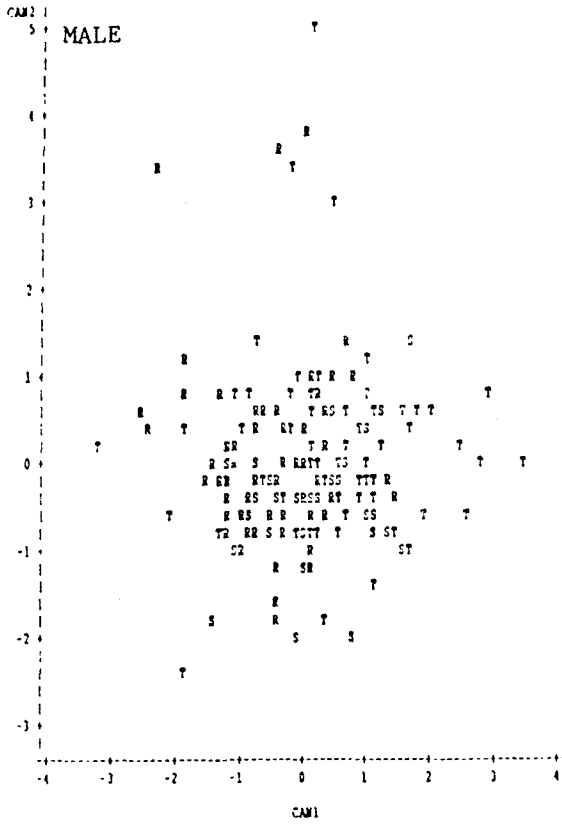
Figure 8. Spatial distribution of capelin during 3 research surveys.

Figure 9. Statistic plots of standardized morphometric characters for 1986-1987. Graphic represents mean, standard deviation and range.

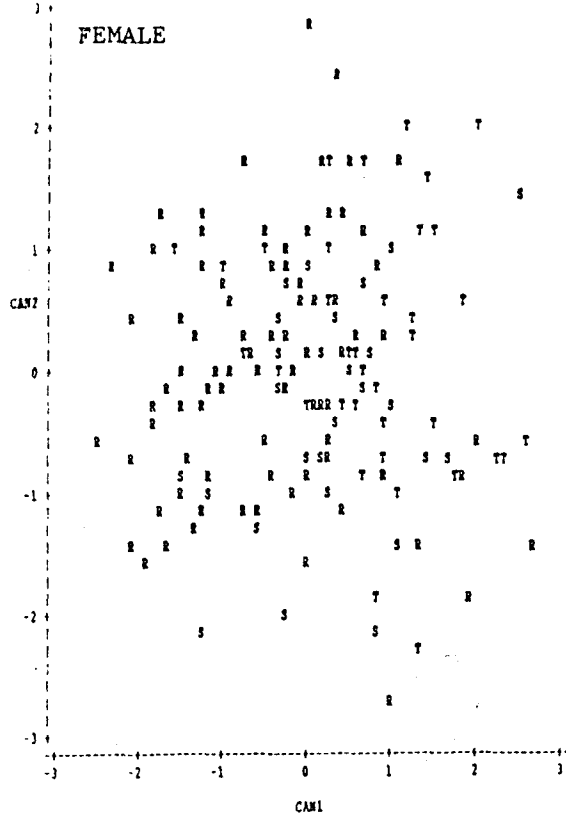




1986

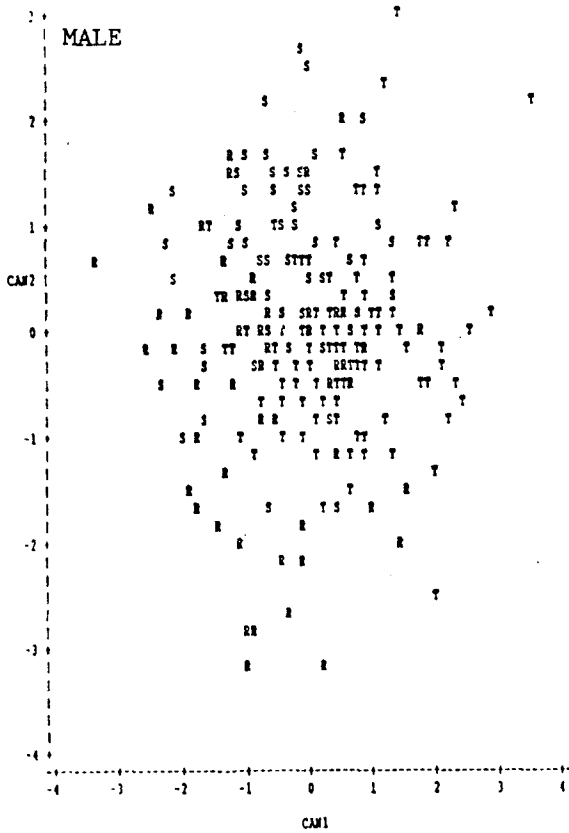


NOTE: 26 obs hidden.

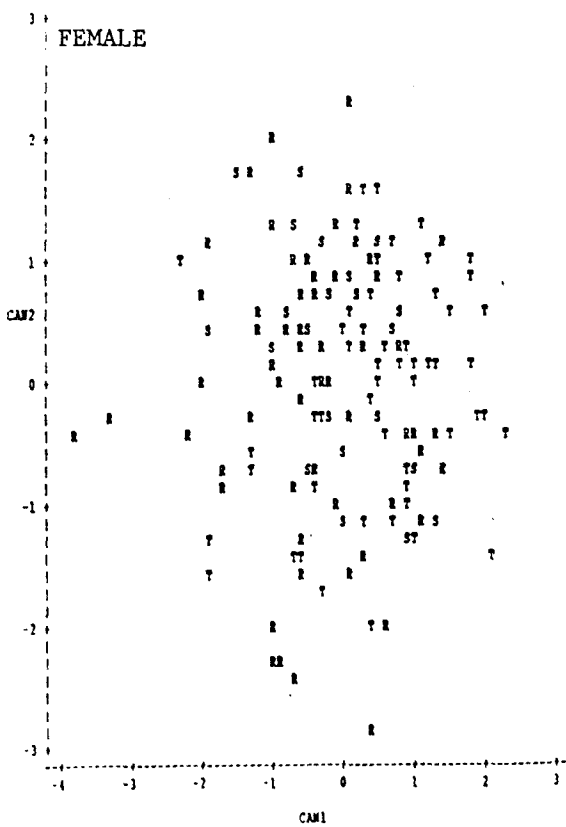


NOTE: 10 obs hidden.

1987



NOTE: 26 obs hidden.



NOTE: 10 obs hidden.

Figure 10. Plots of first(x axis) and second (y axis) canonical variables of four morphometric characters.1986-1987.Symbol(RST) is value of zone.