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DISTRIBUTION AND ABUNDANCE OF JOHN DORY (*Zeus faber*, Linnaeus 1758) IN THE PORTUGUESE CONTINENTAL WATERS (ICES Div. IXa) DURING 1986-1991

by

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ABSTRACT

The objectives of this study are to describe the distribution pattern, provide abundance indices by depth range and present length frequency distributions of John Dory in the Portuguese continental waters. The results are based on data from a series of groundfish surveys carried out on board of the R/V "Noruega", during 1986-1991.

John Dory is distributed along all the Portuguese coast being more abundant from 41°N to 37°N and in the western border of the south coast. Estimated indices of abundance remained stable throughout the study period. The highest mean catches and biomass values were recorded in the depth range]100-200]m in most of the surveys. Length frequency distributions indicate the presence of, at least, two year classes in the population. Younger individuals are preferentially distributed in the range [20-100]m.

INTRODUCTION

John Dory (*Zeus faber* Linnaeus, 1758) is a demersal fish distributed in the coastal waters of the Atlantic, Indian and Pacific oceans and in the Mediterranean and Black seas (Wheeler, 1973 *in* Quéro, 1978). It is exploited by the fishing fleets of South Africa, Morocco, Australia, Japan, New Zealand, France and Portugal (FAO 1987, 1988, 1989, 1990, 1991).

Off the Portuguese continental coast, *Zeus faber* is caught by the trawl and gillnet multispecific fisheries. In the past six years, both landings and market price of this species increased significantly suggesting that it may become a counterpart of more traditional and heavily exploited demersal fishes.

Apart from general information on the diagnosis, description and geographical distribution of the species (Quéro 1978, 1981; Heemstra, 1980; Maurin & Quéro, 1982), existing knowledge on John Dory is scarce; Franca *et al.* (1970) analyze the catches made during bottom trawl experiments off the coast of Angola, Janssen (1979) provides some information on the population structure in The Netherlands, and more recently, Stergiou & Fourtouni (1991) examine the trophic biology of this species in the eastern Mediterranean. Silva (1992) presents information on the fishery and landings of John Dory on the portuguese coast, based on the analysis of the official fisheries statistics.

This study describes the distribution pattern, provides abundance indices and examines the length frequency distributions of John Dory along the Portuguese continental coast (ICES Div.IXa) during 1986-1991, based on a series of groundfish surveys.

MATERIAL AND METHODS

Nine groundfish surveys were carried out along the Portuguese continental coast in the period 1986-1991, on board of the research vessel "Noruega" from Instituto Nacional de Investigação das Pescas (Table I). The main objective of these surveys is to provide abundance indices and study the distribution of the most important commercial fishes of the Portuguese coast (Cardador, 1983; Anon, 1991; Azevedo, 1991; Borges *et al*, 1991).

From 1986 to 1988, the surveys covered the depth range between 20 m and 500 m, having since 1990 been extended to the area between 500 m and 750 m depth. A stratified random design was used until 1989; from 1990, a fixed station sampling strategy was adopted. The survey area was divided in 36 (from 1986 to 1988) or 48 (from 1989 to 1991) strata, based on latitude and depth, each one subdivided in sampling units of 25 square nautical miles (Figure 1). Table II represents the number of sampling units and hauls per stratum in each survey.

Fishing operations were carried out during daylight. A Norwegian Campell Trawl with a 20 mm cod-end mesh size and 14.5 m horizontal opening (between wings) was used. Mean tow duration was 30 minutes at a trawl speed of 3 knots in 1986-1988 surveys and 60 minutes at a trawl speed of 3.5 knots in 1989-1991 surveys.

John Dory did not occur in the]500-750]m depth range so, only the area between 20 and 500 m was considered in this study.

The methods used to estimate the indices of abundance and corresponding precision measures were taken from Cardador (1983) and follow, in general, the methodology proposed in Cochran (1966). When only one haul was made per stratum, a zero standard error was assumed.

Fish length was not sampled in "Autumn 86" and "Autumn 87" surveys.

A log(x+1) transformation was applied to the catch per hour (in weight) in each haul in order to simplify the representation of geographical distribution.

RESULTS

Geographical distribution

The distribution of the log transformed catch in weight per hour along the Portuguese coast in each survey is represented in Figures 2a-i)

John Dory is distributed along all the coast, being more abundant in the sectors from Matosinhos (MAT, 41°15'N) to Arrifana (ARR, 37°00'N) and in the western area of the south coast (Sagres, SAG, 8°48'W). In the remaining south coast (sectors POR and VSA) it occurs only occasionally. North of Matosinhos (sector CAM) it occurs frequently but in small numbers. Overall, sectors MAT, FIG, SIN, ARR and SAG presented higher abundance of this species. The highest catches were recorded in the sectors MAT (53.5 Kg/hour, "Summer 90"), SIN (27.6 Kg/hour, "Summer 90") and ARR (23.0 Kg/hour, "Autumn 87").

Indices of abundance

Figures 3-5 (see also Table III) present the estimates and corresponding 95% confidence limits of the stratified mean catch per hour, in number and weight, and of the minimum trawlable biomass by depth range and in the whole survey area. Standard errors, confidence intervals and coefficients of variation of these estimates are presented in Table III. Figure 6 shows the mean fish weight by depth range and survey.

All the abundance estimates have a high variance.

Stratified mean catches per hour in the total area (Figures 3a and 4a) varied between 1.0 Kg (CV=0.18, "Autumn 88") and 4.3 Kg (CV=0.35, "Summer 90") and between 3.0 fish (CV=0.03, "Autumn 87") and 8.1 fish (CV=0.23, "Summer 90"). Minimum trawlable biomass ranged from 328 t (CV=0.18, "Autumn 88") to 1241 t (CV=0.35, "Summer 90").

Confidence limits of the abundance indices of most surveys overlap, indicating that the observed differences are not significant at the 5% level (Figures 3a, 4a and 5a). The only exceptions are: a significant decrease in the mean number of fish/hour from "Autumn 86" (6.9 fish/hour, CV=0.04) to "Autumn 87" (3.0 fish/hour, CV=0.03) and a decline in the mean catch in weight from "Autumn 87" (2.7 Kg/hour, CV=0.65) to "Autumn 88" (1.0 Kg/hour, CV=0.22).

No significant differences between surveys are also recorded in mean weight/hour and biomass within each of the depth ranges (Figures 4b-d, 5b-d). The mean catch in number in the depth range [20-100]m (Figure 3b) decreased from "Summer 89" (3.5 fish/hour, CV=0.19) to "Autumn 89" (1.2 fish/hour, CV=0.32). In "Summer 91" this index was higher than in the previous Autumn survey and declined again in the following Autumn.

The analysis of the depth distribution of John Dory shows that the two boundary ranges, [20-100]m and]200-500]m, have comparable abundance indices, except in "Autumn 88" where these are lower in the range]200-500]m (Figures 3b,d 4b,d and 5b,d). In the range]100-200]m, indices of abundance are higher or similar to those observed in the other two depths (Figures 3b-d, 4b-d and 5b-d).

The highest mean fish weight was recorded in "Autumn 87" (1.0 Kg/fish) and the lowest in "Autumn 88" (0.2 Kg/fish) (Figure 6). In the other surveys, this parameter was around 0.4 Kg/fish. Seasonal variations are observed in the individual mean weight of John Dory within two of the three depth ranges (Figure 6); in the [20-100]m range, mean fish weight was higher in the Autumn than in the Summer and in the]200-500]m range the opposite situation was found, that is, mean fish weight increased in the Summer.

Length frequency distributions

Length frequency distributions of John Dory in each survey are presented in Figures 7a-g). The length of fish caught was in the range 5-61 cm. Except in "Autumn 88" survey where most fish were bewteen 9 and 38 cm, this range presented no significant variations between surveys.

In the Summer surveys, a higher frequency of the smaller length groups, with a modal class between 10 and 14 cm is observed. A second frequency peak is evident in "Summer 89" (modal class: 23-24 cm) and in "Summer 91" (modal class: 25-26 cm) histograms. The highest abundance of the smaller individuals was recorded in "Summer 90" survey, indicating a particularly good recruitment in this year. In all the Autumn surveys, a distinct peak is observed between 18 and 22 cm. These data suggest that John Dory grows from 10-14 cm to 18-22 cm between the Summer and Autumn of the same year and attain 23-26 cm in the following Summer. The histograms also suggest that this population comprises, at least, two distinct year classes.

The distribution of fish larger than 30 cm does not show clear modes and further interpretation of the histograms would benefit from the use of statistical methods.

Figures 8a-g) describe the distribution of fish length per depth range in each survey. In the ranges [20-100]m and]100-200]m, all the lengths are observed. On the other hand, the smallest individuals (less than 12 cm length) do not occur between 200 and 500 m. In the Autumn surveys, the larger individuals (greater than 40 cm length) are also absent from this depth range.

In order to examine the relative abundance of fish lengths by depth range, four length groups were arbitrarily established, ≤15cm, [16-30]cm, [31-45]cm and ≥46cm, and the proportion of each group in each depth range was computed (Table IV). The depth range distribution of each group was compared with that of the whole population; when a length group shows a depth distribution different from that of the whole population it was concluded that there is segregation of this length group with depth.

Group [16-30]cm is distributed in the three depth ranges according to the proportions of the whole population. The distribution of group [31-45]cm is variable between surveys but its proportions in the intermediate depth range,]100-200]m, tend to be higher than the corresponding values for the population. The smaller length group, ≤15cm, is rare or absent in the]200-500]m range. In the Summer surveys, its concentration in shallower waters, [20-100]m, is evident. In the Autumn surveys, group ≥46cm is more abundant in the range [20-100] m, less in the range]100-200]m and often absent from the]200-500]m. In the Summer, the proportions of this group in the [20-100]m and]200-500]m depth ranges are higher than those of the whole population. These data suggest that the larger individuals move inshore before the Autumn and offshore before the Summer. This migration explains the observed seasonal variations of the mean fish weight in the two boundary depth ranges: in the Summer, younger fish enter the [20-100]m area and older fish move offshore decreasing the mean fish weight in this area and raising it in the range]200-500]m; in the Autumn mean fish weight becomes higher in the range [20-100]m and lower in the range]200-500]m due to the onshore migration of the larger fish.

DISCUSSION

Z. faber has a wide geographical distribution but is apparently only a summer visitor in the North of Europe (Janssen, 1979). Portuguese landings are stable around the year (Silva, 1992) and estimated indices of abundance show no significant differences between Summer and Autumn, indicating that there is a resident population of this species in the Portuguese waters.

The depth distribution of John Dory on the Portuguese coast is comparable to that reported for the Northwest Africa (Quéro, 1978), for the coast of Angola (Franca *et al.*, 1970) and for the Galician shelf (Fariña *at al.*, 1985). Our results concerning the depth distribution of the smaller fish are also similar to those in Franca *et al.* (1970).

The hypothesis of a seasonal migration of the older individuals is referred here for the first time.

The length compositions of the population indicate the presence of, at least, two distinct year classes off the Portuguese coast. Janssen (1979), using an age-length key determined by Wheeler (1969 *in* Janssen, 1979), considered the occurrence of three year classes off the Dutch coast the first one corresponding to one year old fish (15 cm), the second to two year old fish (27 cm) and the third one to three year old (37 cm) individuals. The same author reports that in the North European Atlantic, spawning takes place in the summer (June through August).

In the Portuguese coast, spawning appears to take place earlier in the year; the first length frequency peak observed in the summer survey histograms (10-14 cm) may correspond to fish aged nearly one and half years and the second one (23-26 cm) to individuals around two and half years old. Further analysis of these data and information on the age and growth of this species is needed to test these hypotheses.

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SURVEY	DATE
Autumn 86	05/10/86-29/10/86
Autumn 87	04/10/87-24/10/87
Autumn 88	13/10/88-19/11/88
Summer 89	14/07/89-08/08/89
Autumn 89	10/10/89-06/11/89
Summer 90	06/07/90-30/07/90
Autumn 90	27/10/90-06/12/90
Summer 91	06/07/91-06/08/91
Autumn 91	12/10/91-14/11/91

Table I - Groundfish surveys carried out during 1986-1991 on board of the R/V "Noruega".

STRATA	S.U. 86-89	S.U. 90-91	SURVEYS								
			Aut. 86	Aut. 87	Aut. 88	Sum. 89	Aut. 89	Sum. 90	Aut. 90	Sum. 91	Aut. 91
CAM1	17	17	8	5	3	4	6	5	7	6	4
CAM2	10	11	6	3	2	2	4	2	3	2	2
CAM3	2	2	2	2	2	2	2	1	1	2	1
MAT1	16	16	4	3	8	3	8	1	4	3	2
MAT2	12	12	2	2	2	3	4	2	2	3	2
MAT3	2	2	1	2	2	2	2	2	2	2	2
AVE1	17	17	7	3	5	4	7	5	6	5	4
AVE2	15	15	2	2	2	2	5	2	4	2	1
AVE3	2	3	2	2	2	2	2	1	2	1	2
FIG1	14	14	7	3	6	3	6	3	4	3	2
FIG2	21	23	5	4	2	4	6	6	6	6	6
FIG3	5	5	2	2	3	2	3	2	1	2	2
BER1	9	10	2	2	1	3	2	2	2	1	1
BER2	12	13	2	2	2	3	6	2	4	4	3
BER3	2	3	1	1	-	2	1	1	1	1	1
LIS1	16	18	4	2	6	2	4	-	3	2	1
LIS2	19	21	3	3	4	4	7	3	6	5	2
LIS3	12	12	2	2	2	3	5	4	3	3	3
SIN1	7	7	2	1	4	2	3	3	4	3	2
SIN2	14	14	6	4	4	4	3	4	4	4	6
SIN3	8	8	2	2	2	3	3	4	4	4	3
MIL1	3	3	2	2	1	2	1	1	1	1	1
MIL2	7	5	5	2	4	2	2	2	2	2	1
MIL3	8	7	3	2	2	3	3	3	2	4	3
ARR1	8	6	3	2	3	2	1	2	2	2	2
ARR2	8	6	6	2	3	3	3	3	3	3	3
ARR3	8	6	4	2	2	2	3	2	2	1	2
SAG1	4	2	1	2	2	2	2	1	1	1	-
SAG2	5	3	2	2	2	2	2	2	2	2	2
SAG3	4	3	2	2	2	2	3	1	2	1	1
POR1	11	12	5	2	2	3	5	2	4	2	2
POR2	5	6	3	2	2	2	4	2	3	3	3
POR3	3	4	2	2	2	2	3	2	1	1	1
VSA1	5	6	1	1	3	2	5	2	3	2	2
VSA2	2	2	2	2	2	2	2	2	2	2	2
VSA3	3	3	2	2	2	2	2	2	3	2	2
TOTAL 1	127	128	45	28	44	32	50	27	41	31	23
TOTAL 2	130	131	47	30	31	33	48	32	41	38	33
TOTAL 3	59	58	25	23	23	27	32	25	24	24	23
TOTAL	316	317	118	81	98	92	130	84	106	93	79

Table II - Number of sampling units (S.U.) and hauls per stratum in each survey. Sectors: CAM-Caminha; MAT-Matosinhos; AVE-Aveiro; FIG-Fig.-da-Foz; BER-Berlengas; LIS-Lisboa; SIN-Sines; MIL-Milfontes; ARR-Arrifana; SAG-Sagres; POR-Portimão; VSA-V.R. Sto. António. Depth ranges: 1:[20-100]; 2:]100-200]m; 3:[200-500]m.

SURVEYS	DEPTH RANGES	N	Nh	S_{Nh}	CL_{Nh}	CV_{Nh}	Y	Yh	S_{Yh}	CL_{Yh}	CV_{Yh}	B	S_B	CL_B	CV_B
	[20-100]m	69	3.1	0.61	1.2-1.8	0.20	48.0	2.2	0.46	1.2-3.1	0.21	249	53.0	141-357	0.21
	]100-200]m	166	11.0	3.48	7.1-3.9	0.32	62.5	4.1	1.23	1.6-6.6	0.30	483	146.0	186-779	0.30
Autumn 86	]200-500]m	51	6.0	4.28	-3.2-15.3	0.71	22.0	2.4	1.70	-1.2-6.1	0.71	131	91.7	-67-329	0.70
	TOTAL	286	6.9	0.27	6.3-7.4	0.04	132.4	3.0	0.10	2.8-3.2	0.03	863	291.8	282-1443	0.34
	[20-100]m	20	1.2	0.63	-0.2-2.5	0.53	28.2	1.6	1.03	-0.6-3.8	0.64	188	119.0	-64-440	0.63
	]100-200]m	79	5.4	1.07	3.2-7.6	0.20	60.1	4.8	1.32	2.1-7.6	0.28	572	156.1	244-900	0.27
Autumn 87	]200-500]m	10	1.7	0.91	-0.3-3.7	0.54	2.5	0.5	0.28	-0.2-1.1	0.56	25	14.9	-8-57	0.60
	TOTAL	109	3.0	0.09	2.8-3.2	0.03	90.7	2.7	0.13	2.5-3.0	0.05	785	36.4	711-858	0.05
	[20-100]m	59	2.6	0.52	1.6-3.7	0.20	12.9	0.6	0.12	0.3-0.8	0.20	75	16.5	41-109	0.22
	]100-200]m	103	10.0	3.44	2.8-17.2	0.34	22.7	1.8	0.40	0.9-2.6	0.22	249	56.1	131-367	0.23
Autumn 88	]200-500]m	2	0.3	0.24	-0.2-0.9	0.80	0.5	0.1	0.07	-0.1-0.2	0.70	5	4.2	-4-14	0.84
	TOTAL	164	5.3	1.43	2.4-8.1	0.27	36.2	1.0	0.17	0.6-1.3	0.17	328	58.7	211-446	0.18
	[20-100]m	101	3.5	0.65	2.1-4.8	0.19	39.6	1.4	0.48	0.4-2.4	0.34	161	55.9	44-278	0.35
	]100-200]m	227	8.3	2.06	4.0-12.5	0.25	72.3	2.7	0.82	1.0-4.4	0.30	315	97.2	113-518	0.31
Summer 89	]200-500]m	51	2.6	1.68	-1.0-6.2	0.65	40.4	2.0	1.41	-1.0-5.0	0.71	109	76.0	-53-271	0.70
	TOTAL	379	5.3	0.94	1.9-3.4	0.18	152.3	2.0	0.47	1.1-3.0	0.24	585	135.4	313-857	0.23
	[20-100]m	32	1.2	0.40	0.4-2.0	0.33	20.2	0.8	0.35	0.04-1.5	0.44	88	41.2	5-171	0.47
	]100-200]m	161	7.0	1.77	3.4-10.6	0.25	68.6	3.4	1.00	1.4-5.4	0.29	404	118.6	164-645	0.29
Autumn 89	]200-500]m	14	0.9	0.11	0.7-1.2	0.12	2.2	0.2	0.06	0.0-0.3	0.30	9	3.3	2-16	0.37
	TOTAL	207	3.6	0.75	2.1-5.0	0.21	91.0	1.7	0.43	0.9-2.6	0.25	501	125.6	252-751	0.25
	[20-100]m	115	3.1	1.01	1.0-5.3	0.33	41.2	1.0	0.71	-0.5-2.5	0.71	115	83.2	-62-291	0.72
	]100-200]m	352	14.1	4.08	5.6-22.7	0.29	201.2	7.5	3.07	1.1-13.9	0.41	899	368.6	130-1668	0.41
Summer 90	]200-500]m	135	5.6	3.11	-1.1-12.3	0.56	119.8	4.3	3.83	-4.0-12.6	0.89	228	203.6	-212-668	0.89
	TOTAL	602	8.1	1.83	4.4-11.8	0.23	362.2	4.3	1.48	1.3-7.3	0.34	1241	429.2	377-2106	429.20
	[20-100]m	45	1.0	0.26	0.5-1.6	0.26	39.2	0.8	0.31	0.2-1.4	0.39	94	35.8	21-168	0.38
	]100-200]m	331	10.4	2.96	4.3-16.5	0.28	169.1	5.3	2.46	0.2-10.3	0.46	631	294.5	28-1233	0.47
Autumn 90	]200-500]m	37	2.4	1.61	-1.1-6.0	0.67	5.3	0.3	0.22	-0.1-0.8	0.73	18	11.4	-7-43	0.63
	TOTAL	413	5.2	1.26	2.6-7.7	0.24	213.6	2.6	1.02	0.5-4.6	0.39	743	296.9	151-1335	0.40
	[20-100]m	135	4.7	0.67	3.3-6.1	0.14	39.1	1.1	0.19	0.6-1.5	0.17	134	22.1	88-180	0.16
	]100-200]m	184	5.4	1.24	2.9-8.0	0.23	106.9	3.0	0.86	1.2-4.7	0.29	355	102.7	144-566	0.29
Summer 91	]200-500]m	27	1.7	1.00	-0.5-3.9	0.59	13.3	0.8	0.45	-0.2-1.8	0.56	41	23.6	-11-93	0.58
	TOTAL	346	4.4	0.61	3.2-5.7	0.14	159.3	1.8	0.37	1.1-2.6	0.21	530	107.7	313-746	0.20
	[20-100]m	31	0.9	0.30	0.2-1.6	0.33	17.6	0.4	0.14	0.1-0.8	0.35	52	16.6	15-88	0.32
	]100-200]m	211	6.9	1.66	3.4-10.3	0.24	85.0	2.8	0.71	1.4-4.3	0.25	341	85.4	163-518	0.25
Autumn 91	]200-500]m	17	1.0	0.63	-0.5-2.3	0.63	4.9	0.2	0.11	-0.0-0.5	0.55	12	5.6	-1-24	0.47
	TOTAL	259	3.4	0.71	2.0-4.8	0.21	107.4	1.4	0.30	0.8-2.0	0.21	404	87.2	228-580	0.22

Table III - Indices of abundance and corresponding precision measures by depth range and survey.

N-nº fish caugth; Nh-nº fish/hour; S_{Nh}-Nh standard error; CL_{Nh}-Nh confidence interval; CV_{Nh}-Nh coefficient of variation; Y-weight of fish caugth (Kg); Yh-kg/hour; S_{Yh}-Yh standard error; CL_{Yh}-Yh confidence interval; CV_{Yh}-Yh coefficient of variation; B-biomass (t); S_B-B standard error; CL_B-B confidence interval; CV_B-B coefficient of variation.

SURVEYS	LENGTH GROUPS	DEPTH RANGES		
		[20-100]m	]100-200]m	]200-500]m
Autumn 88	≤15cm	0.06	0.92	0.03
	[16-30]cm	0.22	0.77	0.01
	[31-45]cm	0.46	0.54	0.00
	≥46cm	0.00	0.98	0.00
	TOTAL	0.19	0.80	0.01
Summer 89	≤15cm	0.36	0.63	0.01
	[16-30]cm	0.28	0.62	0.10
	[31-45]cm	0.21	0.63	0.16
	≥46cm	0.41	0.30	0.28
	TOTAL	0.29	0.61	0.10
Autumn 89	≤15cm	0.12	0.78	0.09
	[16-30]cm	0.13	0.82	0.05
	[31-45]cm	0.15	0.82	0.03
	≥46cm	0.25	0.73	0.00
	TOTAL	0.14	0.81	0.05
Summer 90	≤15cm	0.28	0.62	0.10
	[16-30]cm	0.07	0.77	0.16
	[31-45]cm	0.05	0.85	0.10
	≥46cm	0.19	0.42	0.39
	TOTAL	0.16	0.72	0.13
Autumn 90	≤15cm	0.07	0.92	0.00
	[16-30]cm	0.08	0.78	0.14
	[31-45]cm	0.04	0.95	0.01
	≥46cm	0.35	0.63	0.00
	TOTAL	0.08	0.83	0.09
Summer 91	≤15cm	0.65	0.35	0.00
	[16-30]cm	0.42	0.46	0.12
	[31-45]cm	0.13	0.80	0.07
	≥46cm	0.45	0.44	0.11
	TOTAL	0.42	0.51	0.07
Autumn 91	≤15cm	0.00	0.84	0.15
	[16-30]cm	0.14	0.80	0.06
	[31-45]cm	0.02	0.96	0.02
	≥46cm	0.32	0.64	0.03
	TOTAL	0.11	0.84	0.05

Table IV - Proportion of the length groups by depth range in each survey.

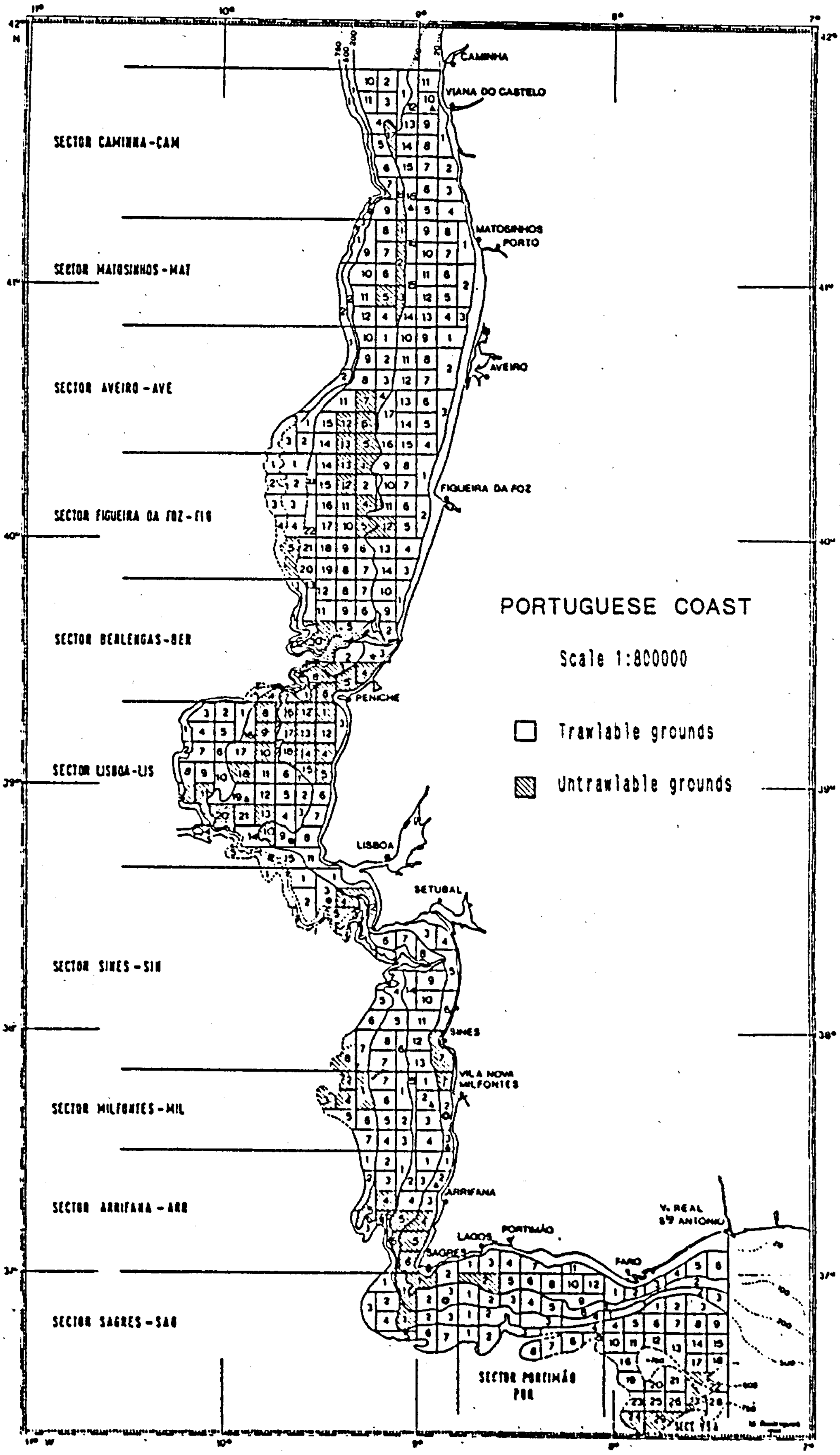


Figure 1 - Design of strata and sampling units used in Portuguese groundfish surveys (1986-1991).

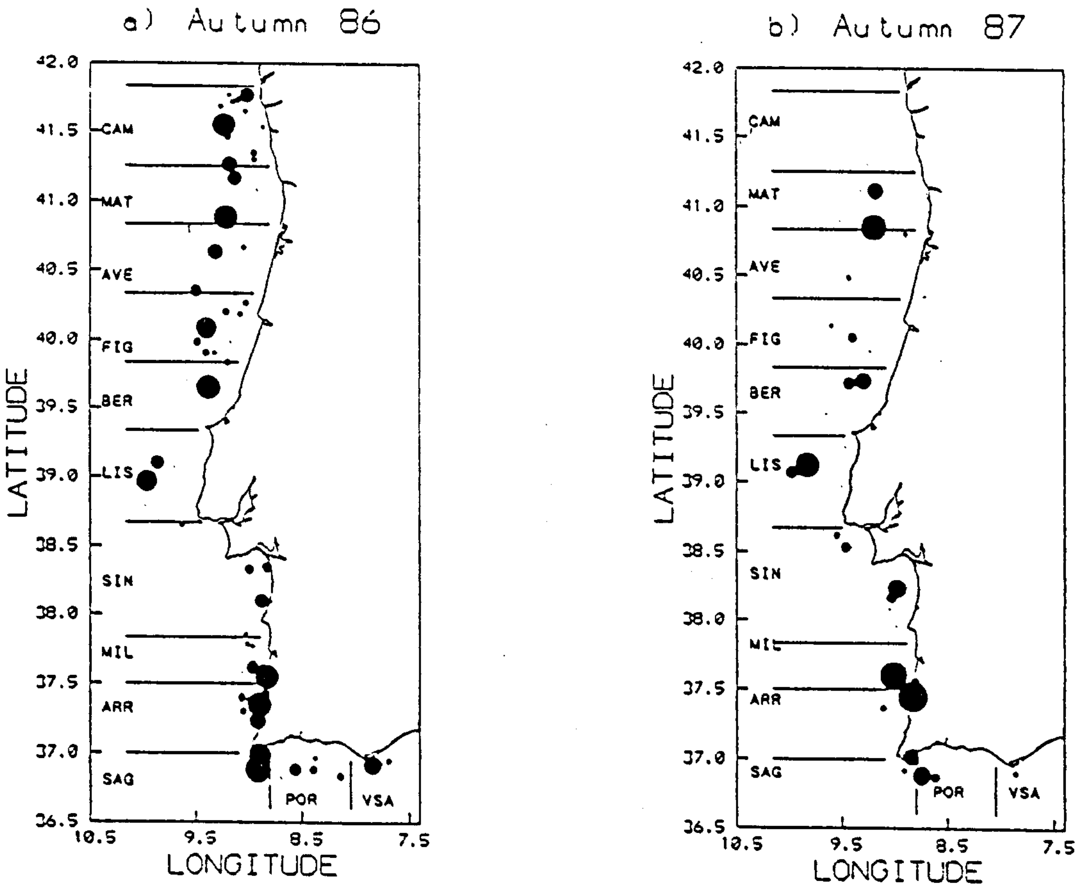


Figure 2 - John Dory catches along the Portúguese coast in each groundfish survey.

NOTE: Symbol height is proportional to the log(x+1) transformed catch in weight per hour in each haul.

Minimum value: . = 0.0 = 0 Kg/hour

Maximum value: ● = 2.1 = 111 Kg/hour

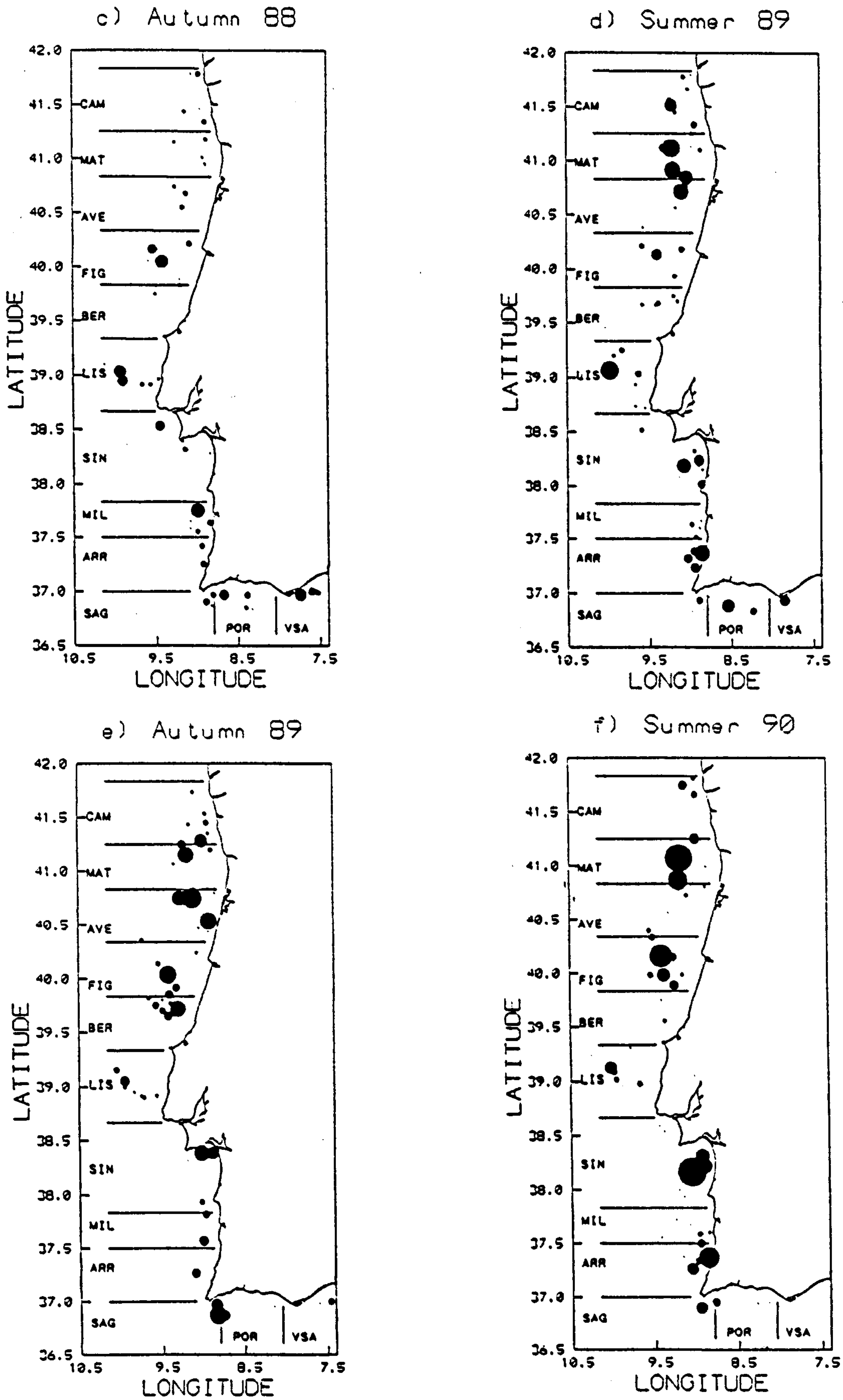


Figure 2 - (cont.)

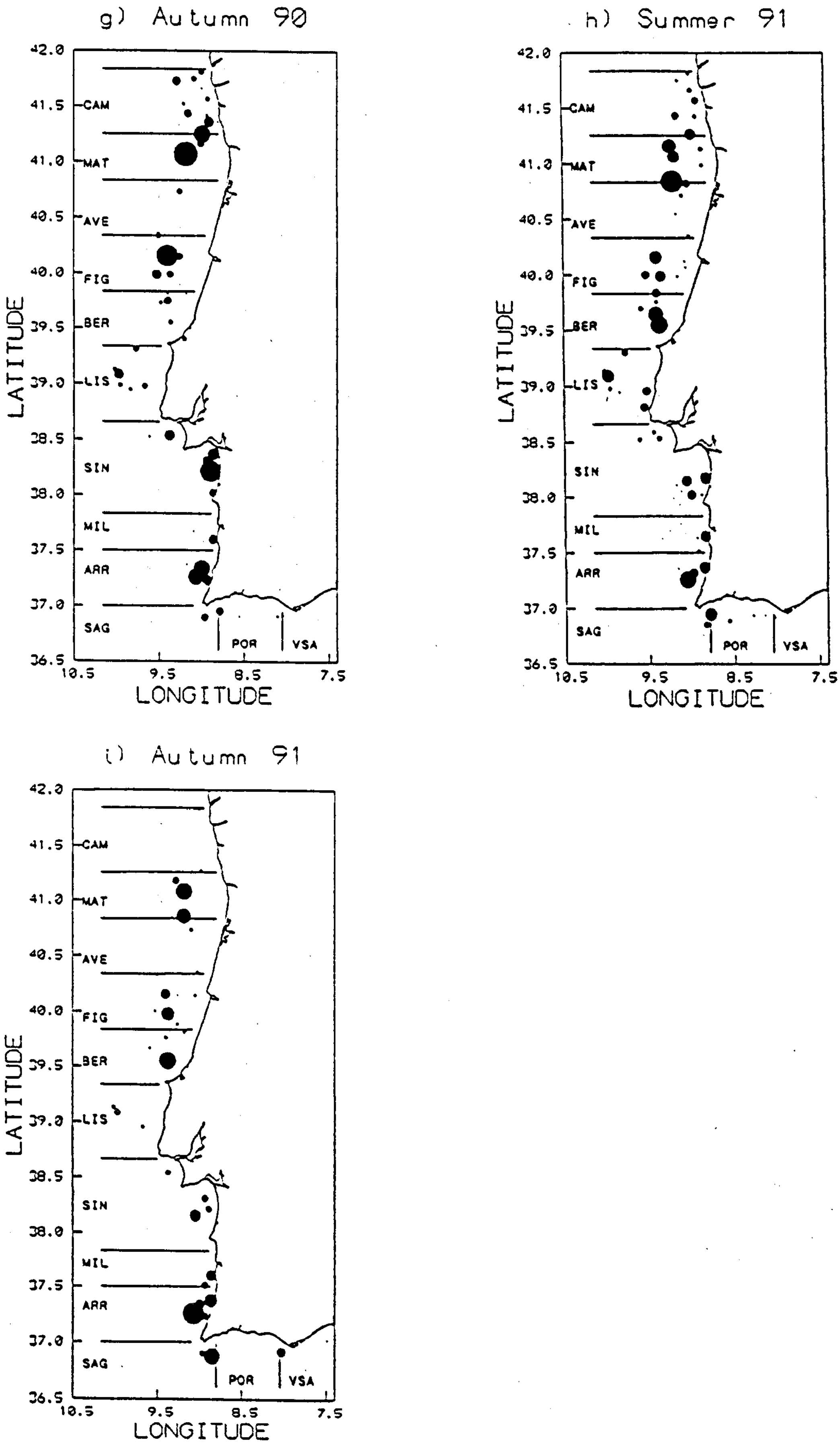


Figure 2 - (cont.)

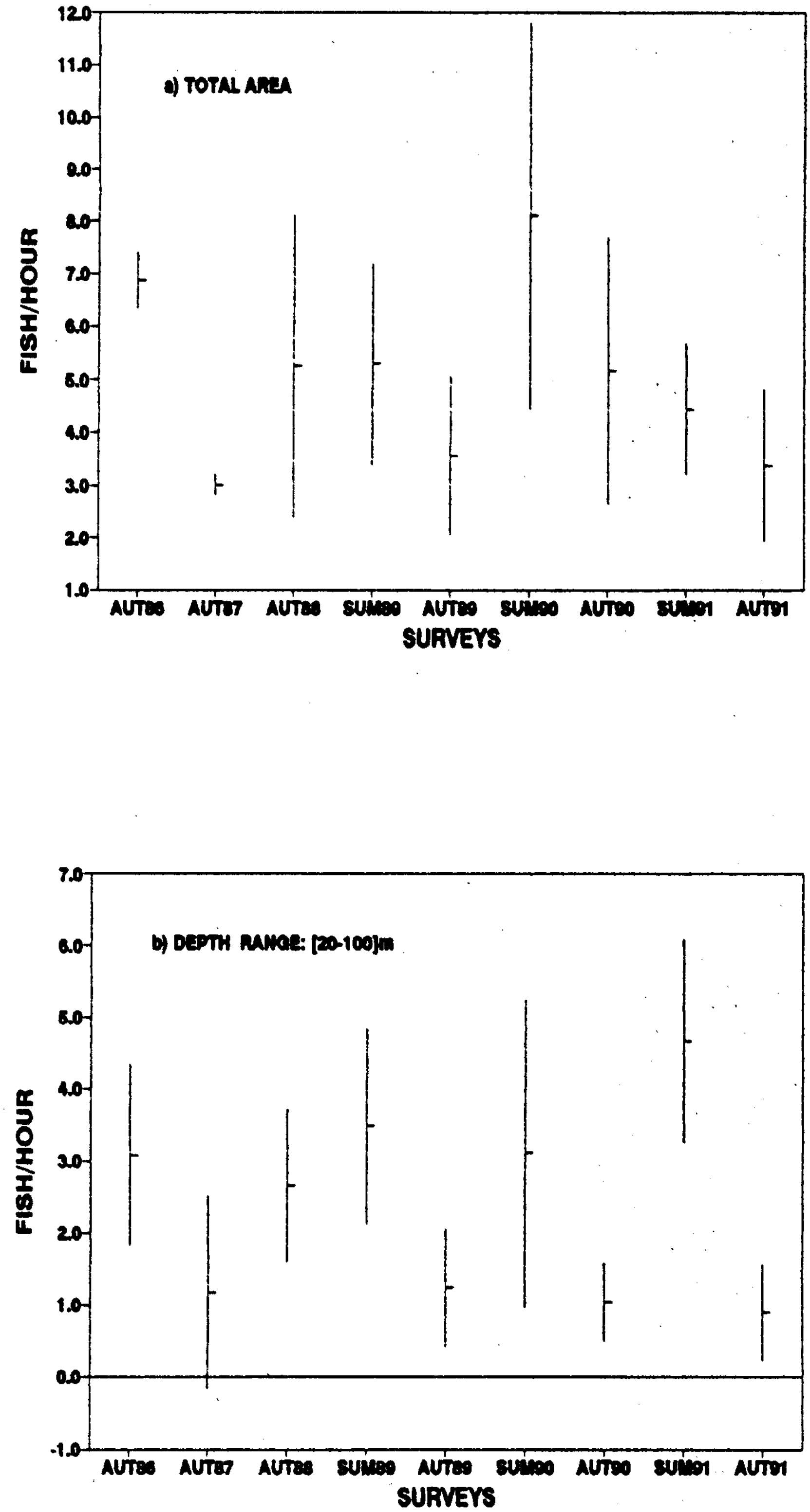


Figure 3 - Stratified mean catch, in number of fish/hour, and corresponding 95% confidence limits, by depth range and survey.

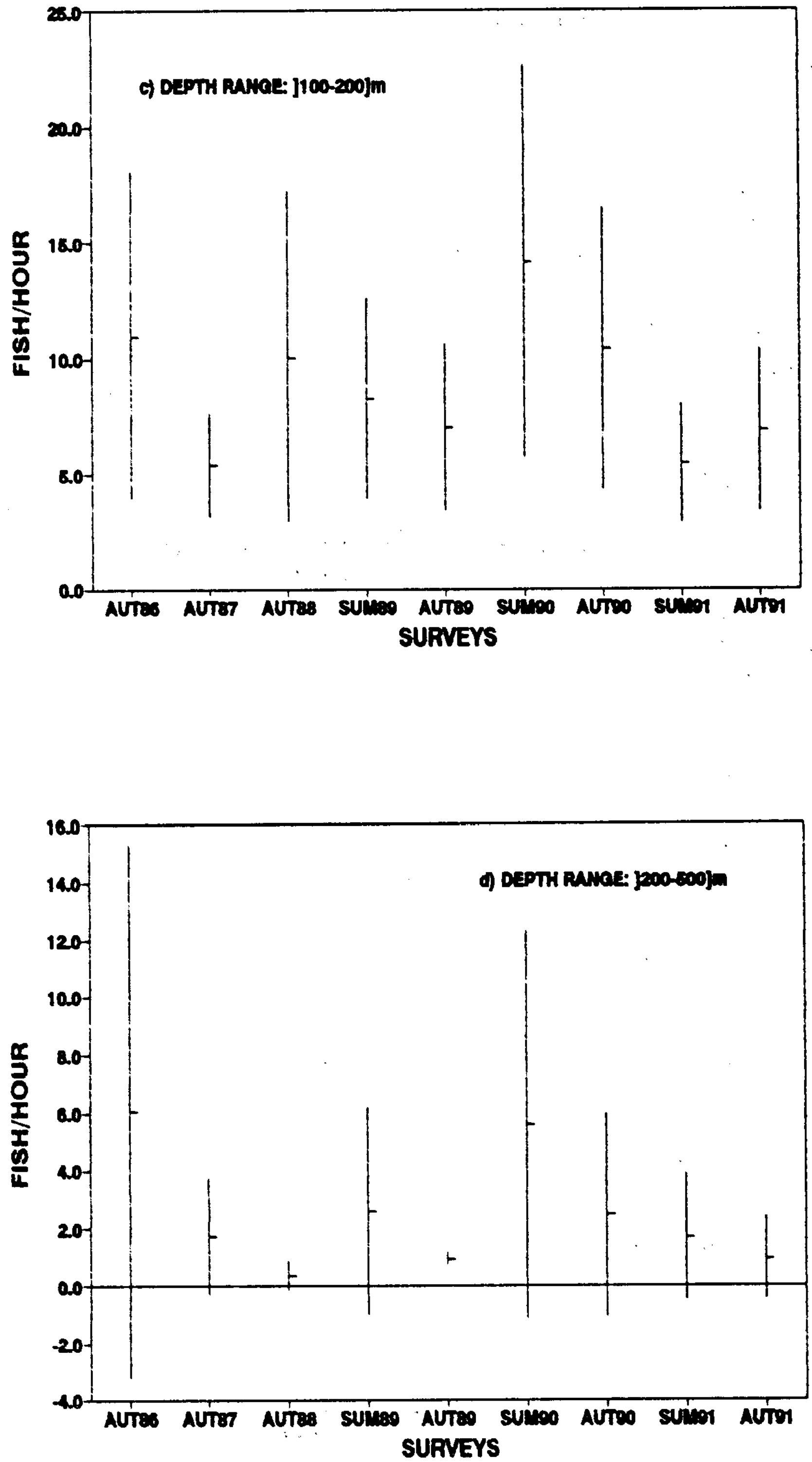


Figure 3 - (cont.)

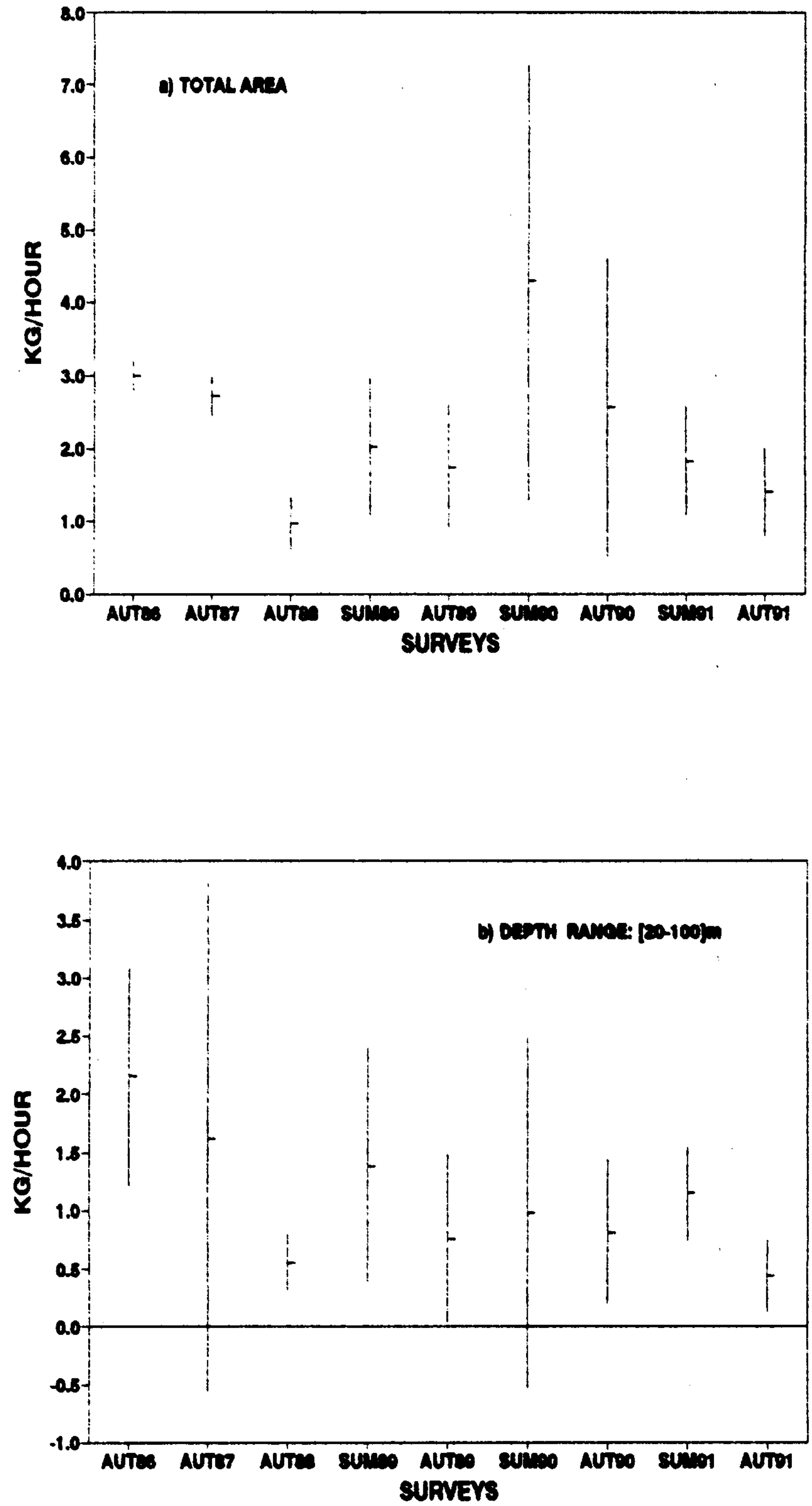
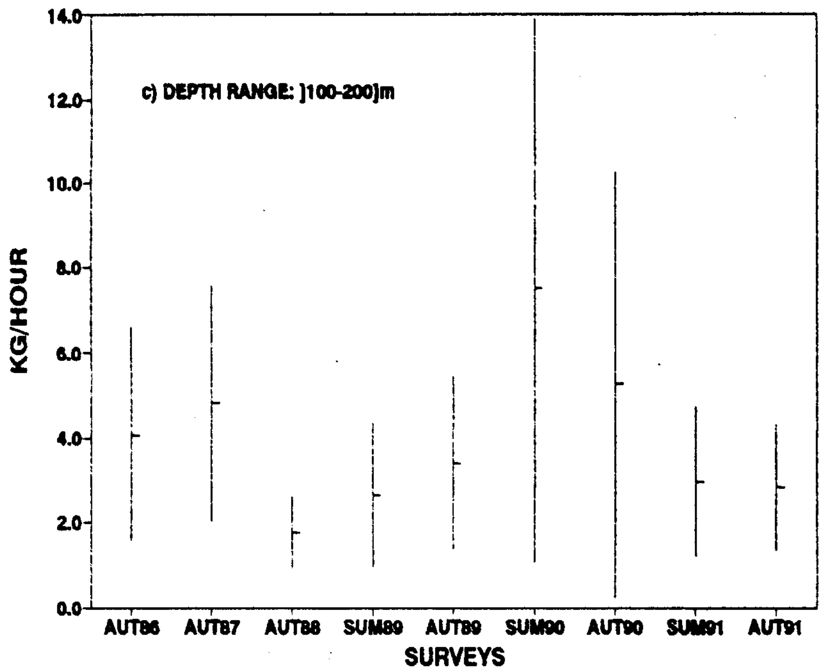


Figure 4 - Stratified mean catch, in Kg/hour, and corresponding 95% confidence limits, by depth range and survey.



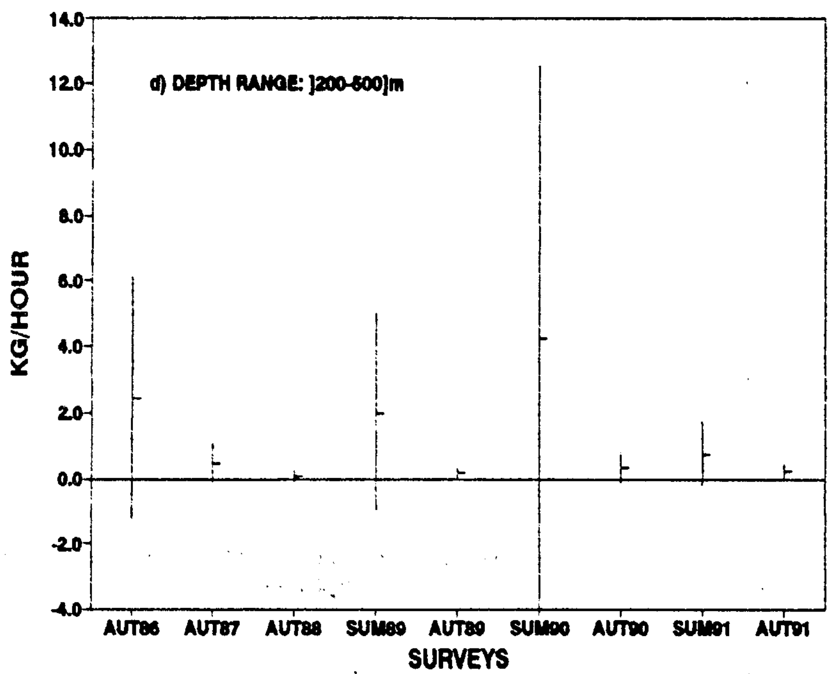
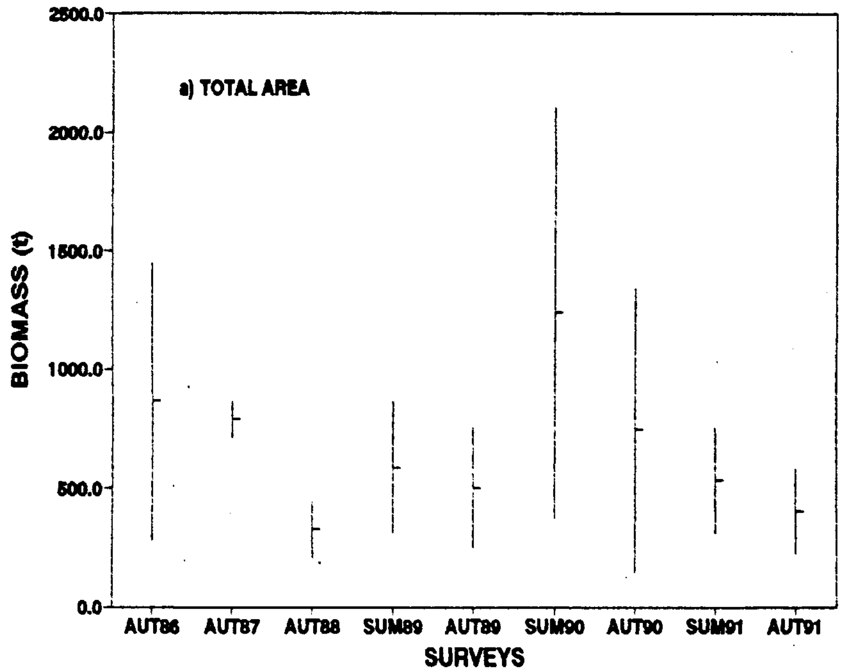


Figure 4 - (cont.)



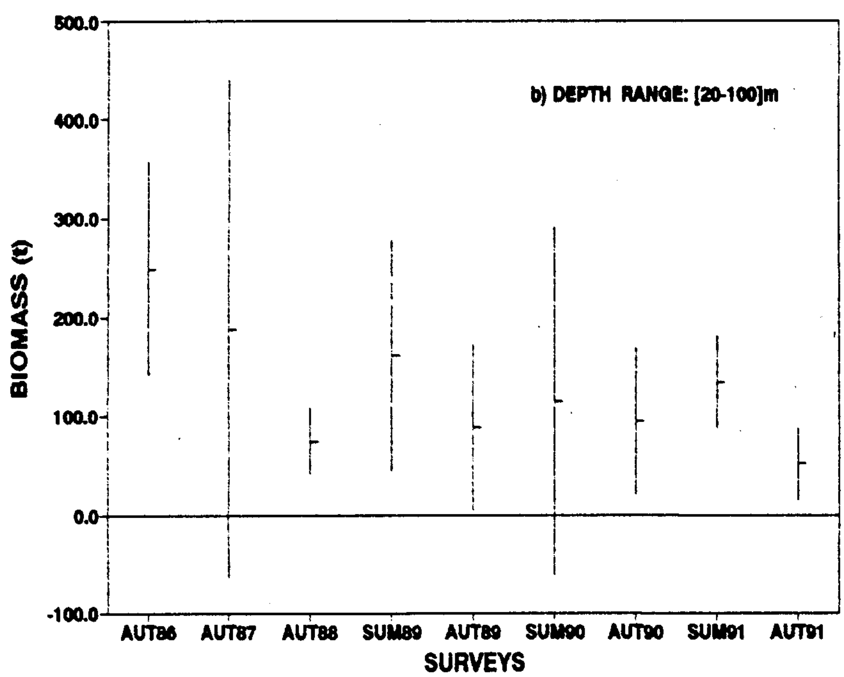
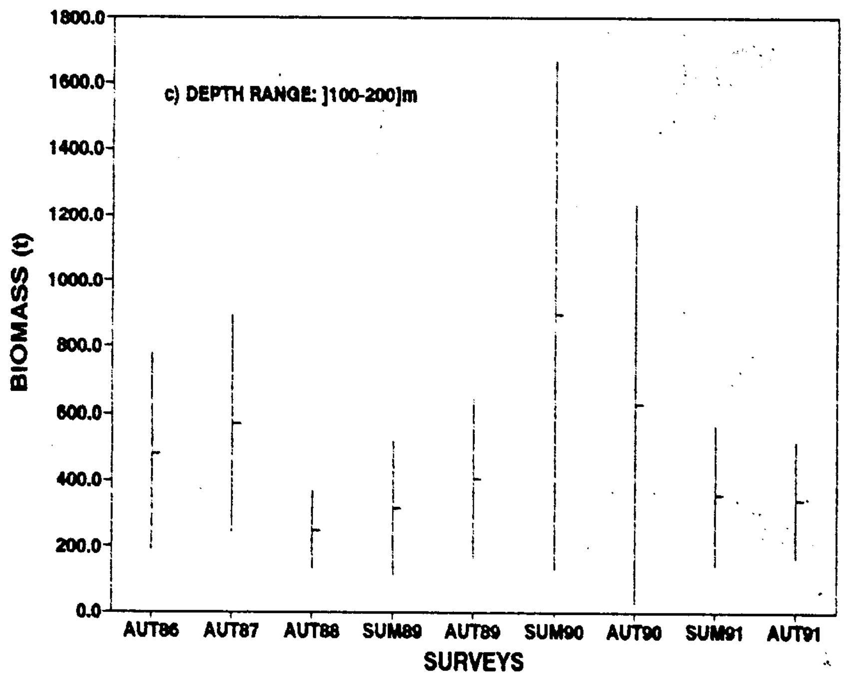


Figure 5 - Minimum trawlable biomass and corresponding 95% confidence limits, by depth range and survey.



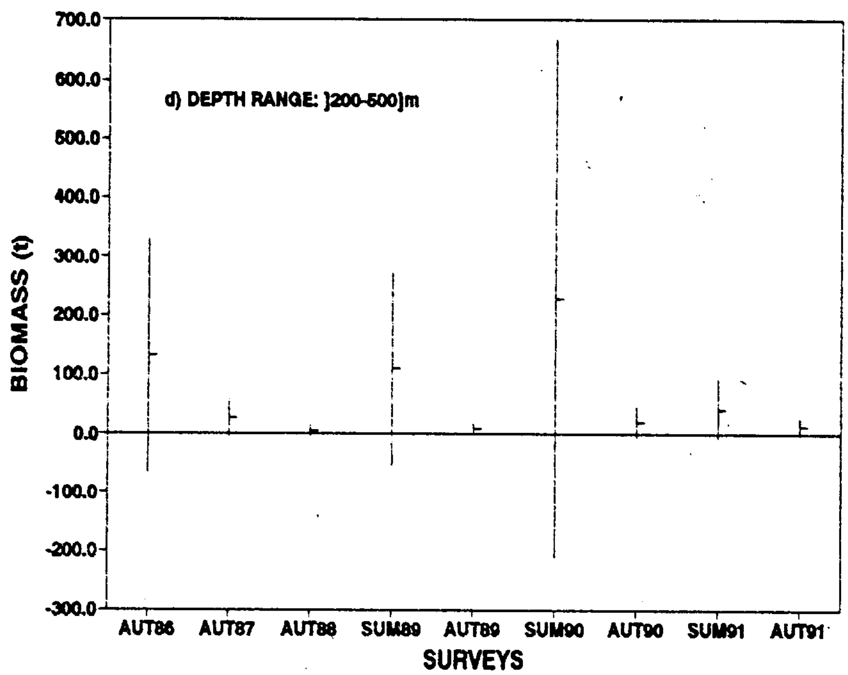


Figure 5 - (cont.)

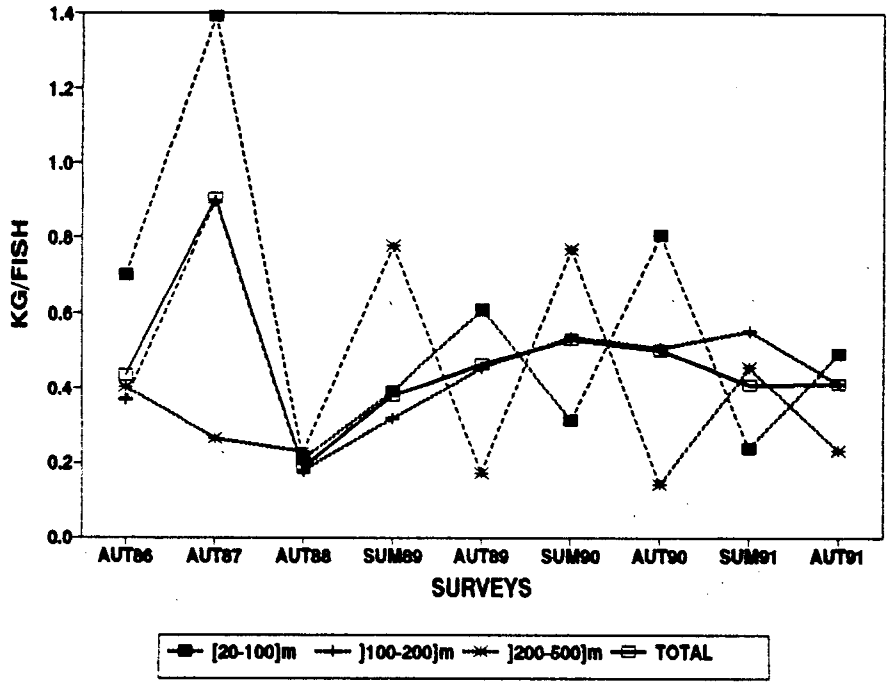
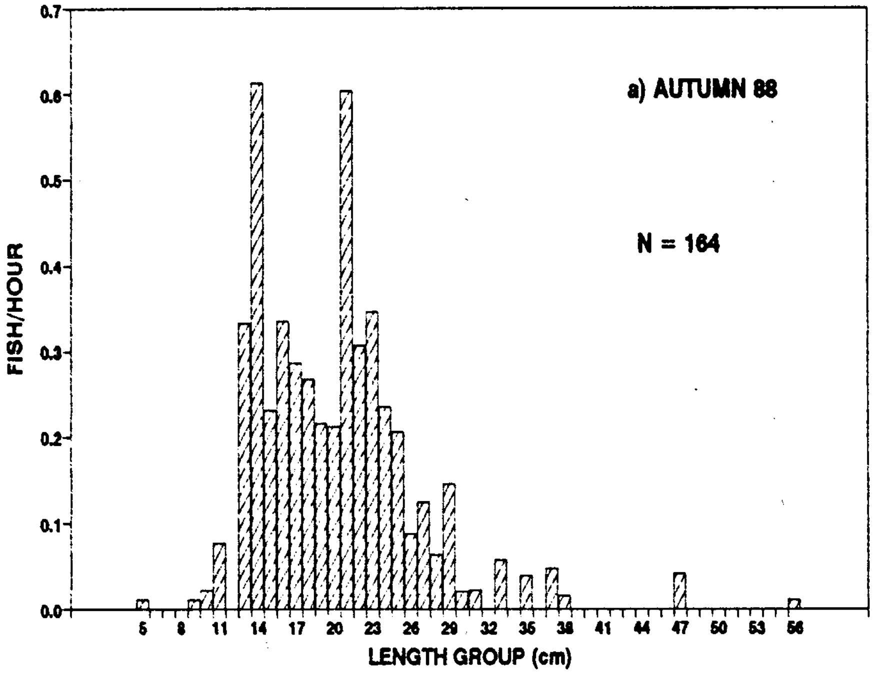


Figure 6 - Mean individual fish weight by depth range and survey.



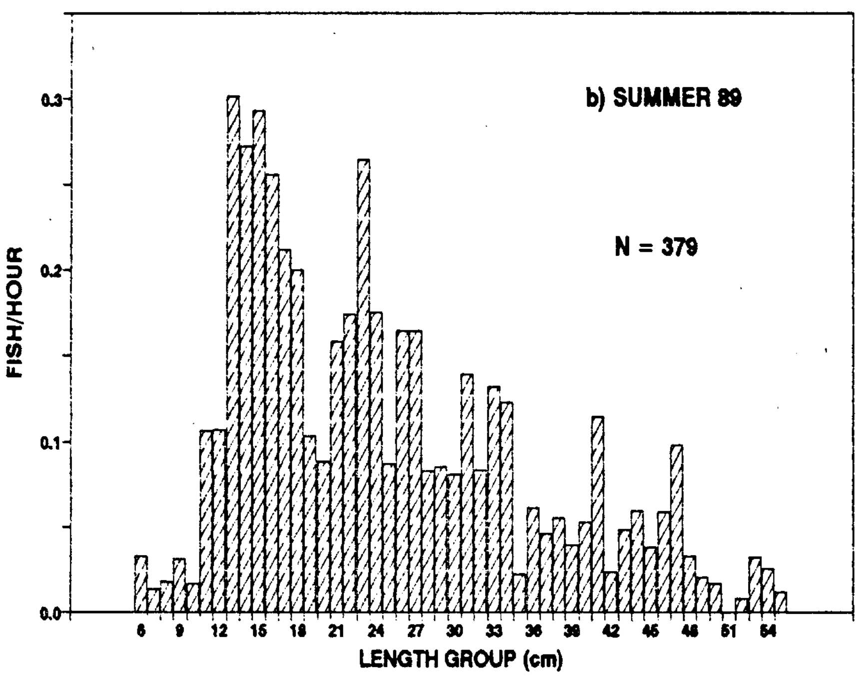
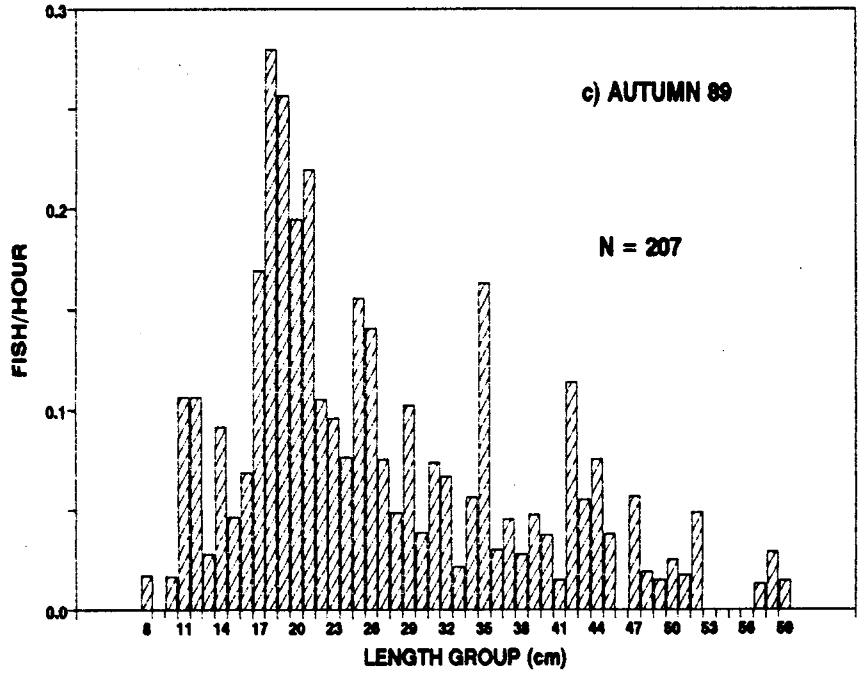


Figure 7 - Length frequency distributions of John Dory in each groundfish survey.



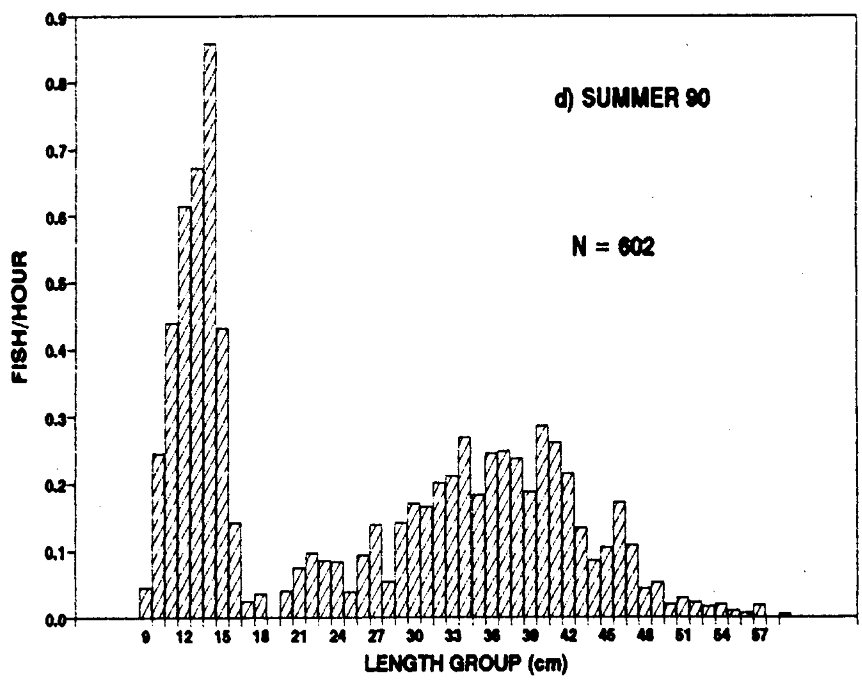
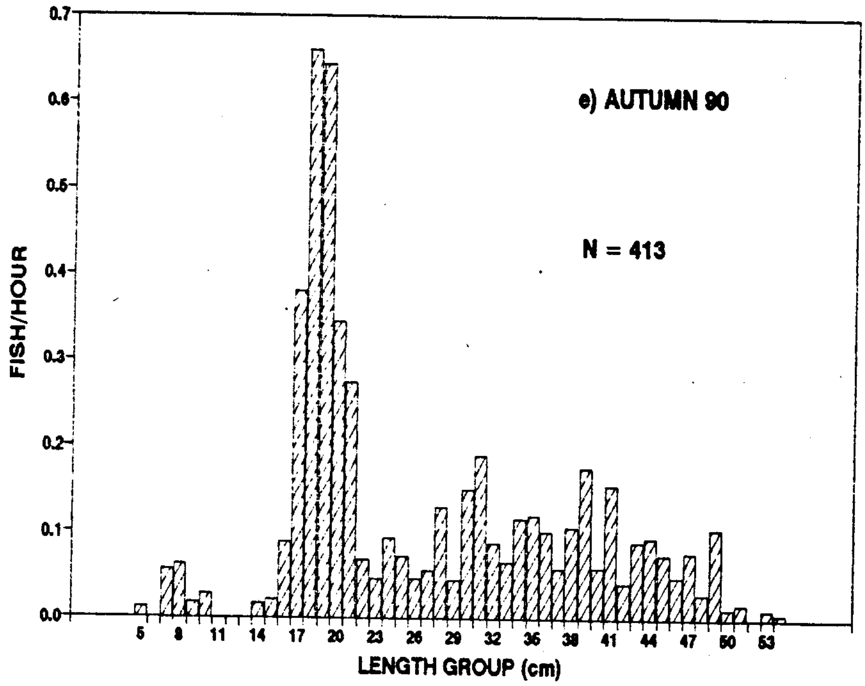


Figure 7 - (cont.)



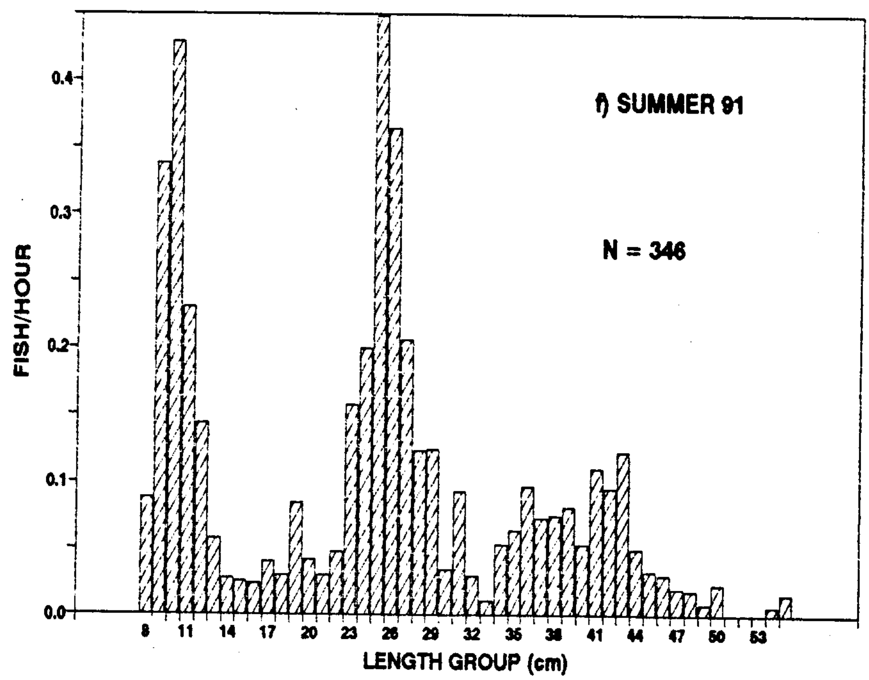


Figure 7 - (cont.)

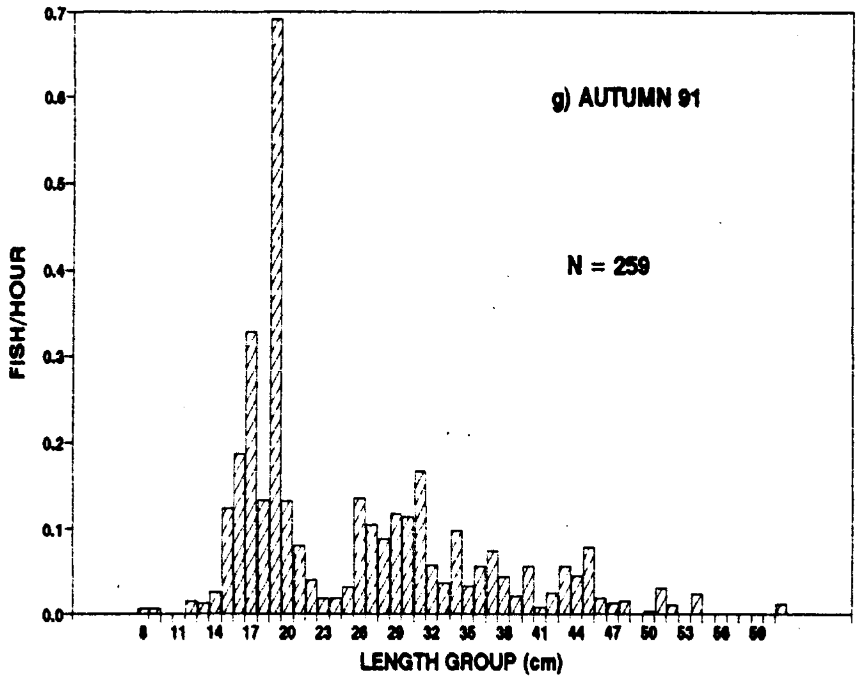
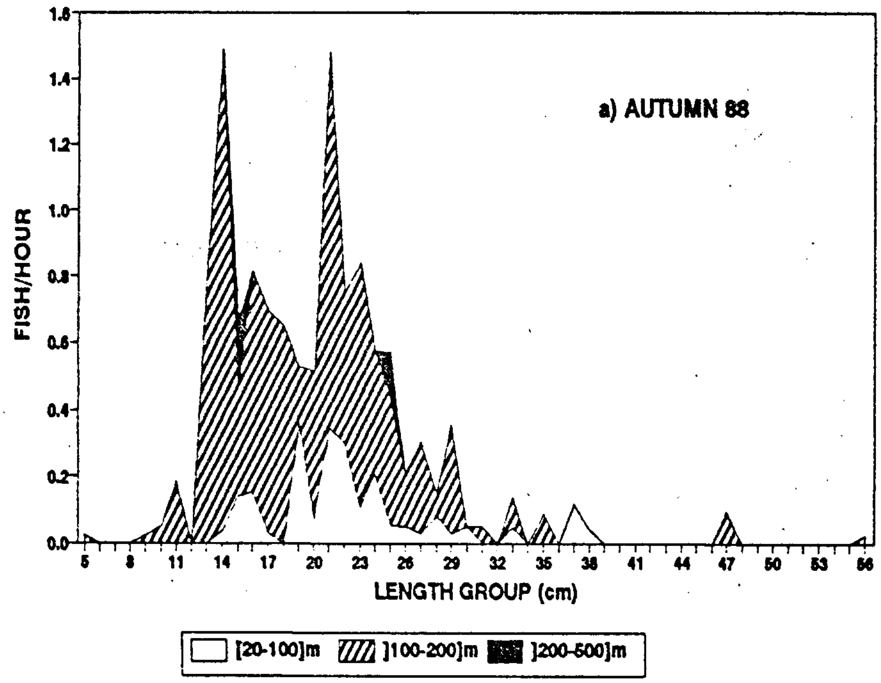


Figure 7 - (cont.)



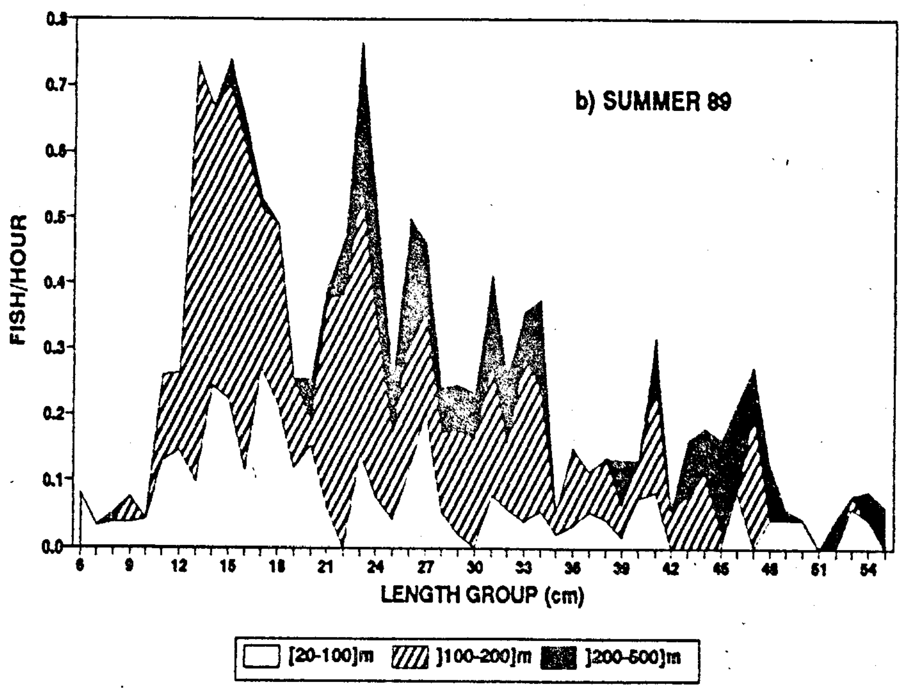
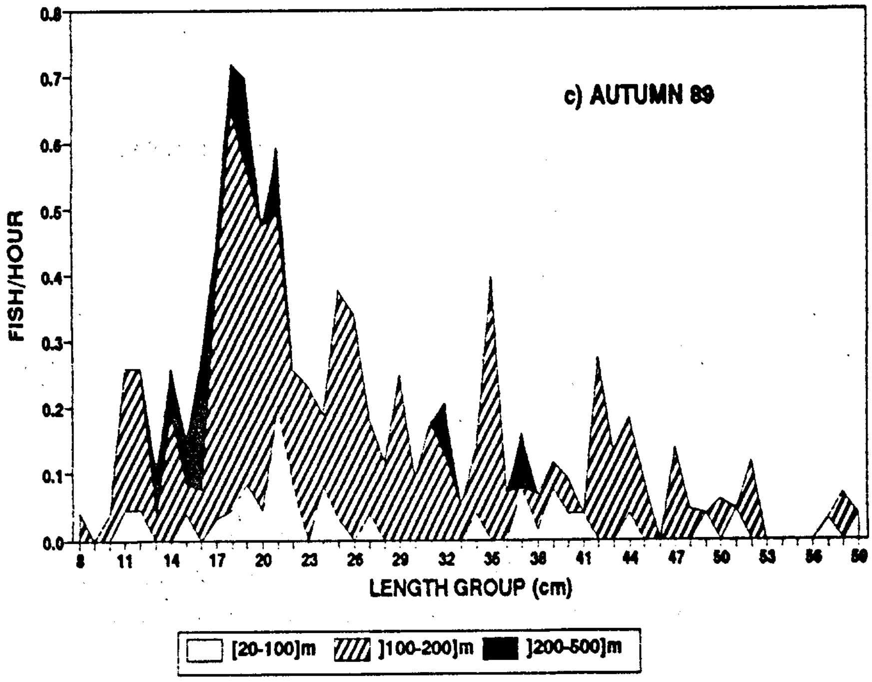


Figure 8 - Depth range distribution of John Dory lengths in each survey.



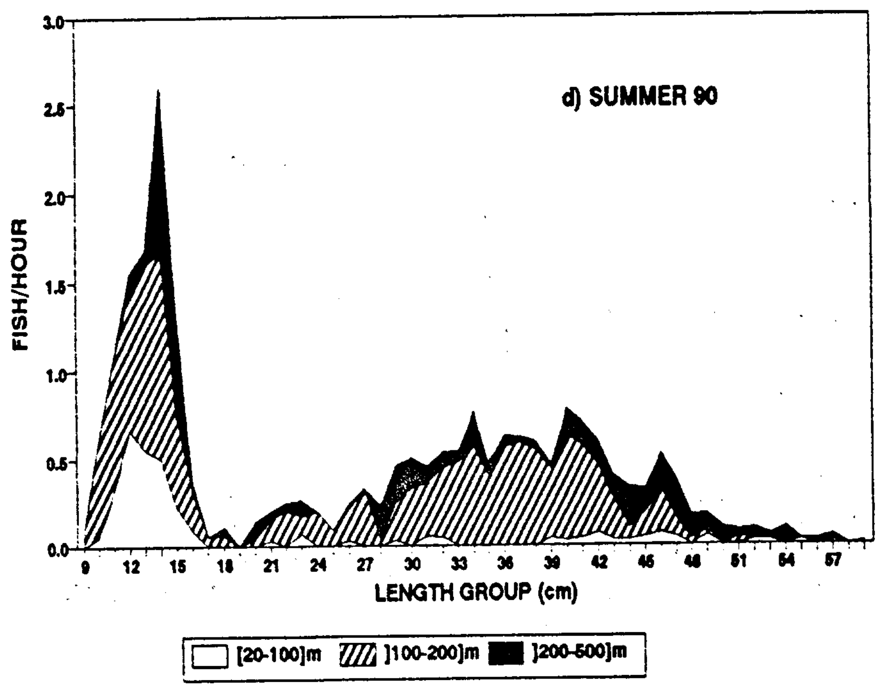
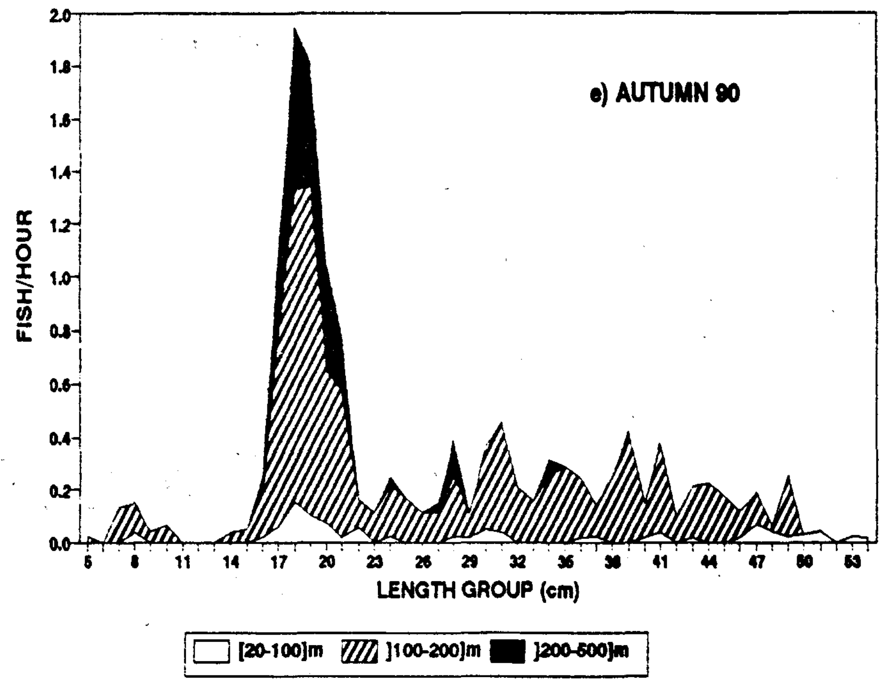


Figure 8 - (cont.)



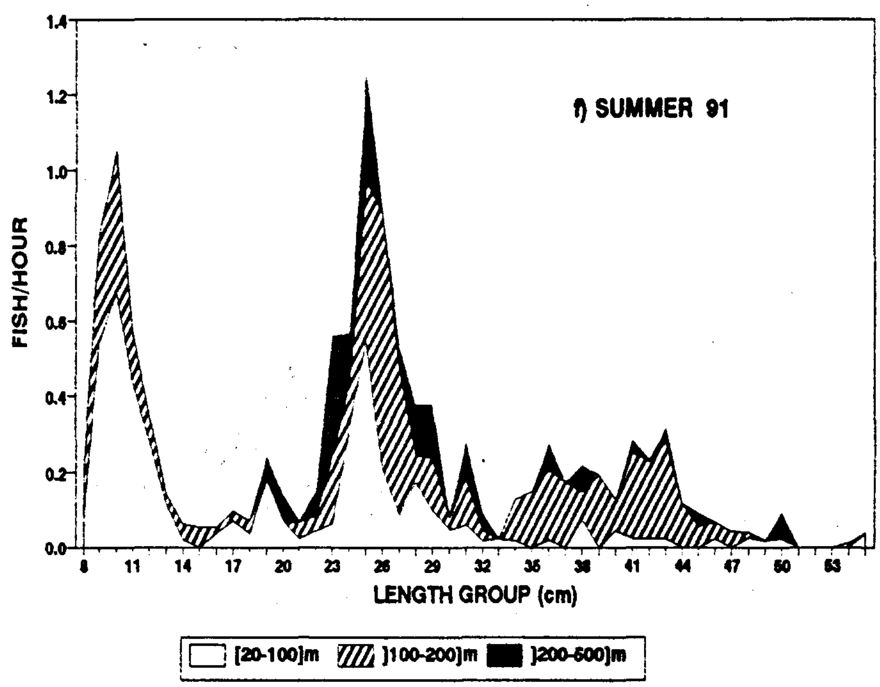


Figure 8 - (cont.)

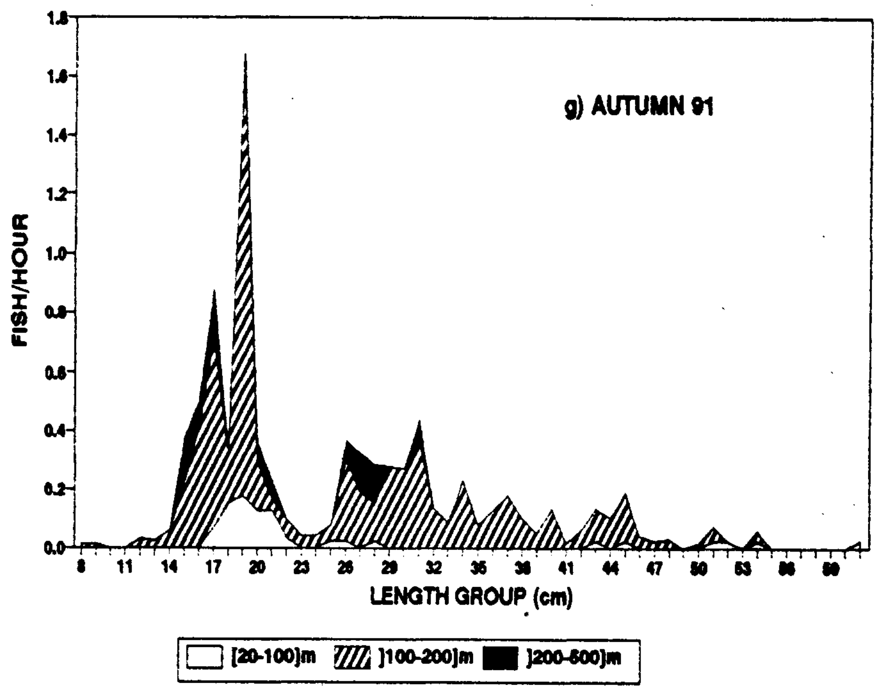


Figure 8 - (cont.)