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THE DISTRIBUTION AND ABUNDANCE OF SCYPHOMEDUSAE IN THE NORTH  
SEA DURING THE SUMMER OF 1979

by

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Abstract

This preliminary report presents data on the scyphomedusae collected by four vessels during the international O-group gadoid survey, together with data from a survey north and west of Scotland. These surveys were conducted between 5 June and 5 July 1979. The species caught were Cyanea capillata (L.), Cyanea lamarckii (Peron and Lesuer) and Aurelia aurita (L.).

These species were, as in previous years' surveys, most abundant off the coasts of England, Scotland, around Orkney and in the area fished north-west of Denmark. Cyanea capillata was more abundant than Cyanea lamarckii and more widely distributed than C. lamarckii or Aurelia aurita. Aurelia aurita was the most abundant species off the Scottish coast. Cyanea lamarckii was the most abundant species in the area fished north-west of Denmark. The size frequency distributions for five sub-areas are tabulated for Cyanea spp. and the opportunity for commensal association between Cyanea spp. and the five main gadoid species is assessed. The data indicate some increases in size and number of jellyfish during the survey period and that opportunity for association was greatest for whiting and haddock, less for cod and least for Norway pout and saithe.

Résumé

Ce bulletin préliminaire présente des données sur les scyphoméduses recueillies par quatre navires pendant l'étude internationale des gadoides du groupe O avec des données d'une étude au nord et à l'ouest de l'Ecosse. Ces études ont été effectuées entre le 5 juin et le 5 juillet 1979. Les espèces prises étaient Cyanea capillata (L.), Cyanea lamarckii (Péron et Lesuer) et Aurelia aurita (L.).

Ces espèces ont été comme dans les études des années précédentes les plus nombreuses au large des côtes de l'Angleterre et de l'Ecosse dans la région des Orcades et aussi dans la région pêchée au nord-ouest du Danemark. Cyanea capillata a été plus nombreuse que Cyanea lamarckii et plus répandue que C. lamarckii ou qu'

Aurelia aurita. Aurelia a été l'espèce la plus nombreuse au large de la côte de l'Ecosse. Cyanea lamarckii a été l'espèce la plus nombreuse dans la région pêchée au nord-ouest du Danemark. On a fait pour cinq sous-régions une classification des espèces de Cyanea selon la fréquence et la distribution par la taille et on a évalué l'occasion du commensalisme entre les espèces de Cyanea et les cinq espèces principales des gadoïdes. Les données indiquent des accroissements de taille et de nombre des méduses pendant la durée de l'étude et aussi que l'occasion du commensalisme s'est présentée le plus souvent chez le merlan et l'églefin, moins souvent chez la morue et le moins souvent chez le tacaud norvégien et le lieu noir.

## Introduction

This preliminary report presents data on the scyphomedusae collected during the international O-group gadoid survey of 1979 (Benjaminsen et al., 1979). Also presented are results from a survey to the north and west of Scotland, which supplement the data from the international survey. Results from previous years surveys are given by: Hay and Adams (1975); Hay, Adams and Hislop (1976) and Hay and Hislop (1977, 1978 and 1979).

## Method

The international survey was carried out in the period 13 June to 5 July by 4 vessels, CORELLA (England), EXPLORER (Scotland), JOHAN HJORT (Norway) and TRIDENS (The Netherlands). The fishing gear, method and experimental design were all as described for the 1976 survey by Daan et al. (1976). The additional survey by RV CLUPEA was carried out in the standard manner between 5 and 14 June.

Figures 1 and 2 show the statistical rectangles fished by each vessel during the international survey. All rectangles in the standard survey were fished twice except rectangles 47E8, 47E9, 47F0, 46E6 and 46E9 which were fished once. Four statistical rectangles; 45E7, 44E7, 41E8 and 41E7 were fished three times. Six rectangles outside the standard survey area (see Daan et al., 1976) were also fished, these were 40F4, 40F5, 40F6, 40F7, 39F5 and 38F5. The time interval between sampling each rectangle varied from 1-14 days. The hauls were grouped according to survey, to show temporal differences, if any. Figure 9 displays the area fished and the results of the survey by RV CLUPEA. The scyphomedusae caught in each haul were identified, counted and measured across the umbrella disc diameter. It was not always possible to measure Aurelia aurita (L.) as this species was frequently damaged during capture.

## Results

Distribution and abundance of Cyanea capillata (L.), Cyanea lamarckii (Peron and Lesuer) and Aurelia aurita (L.) are charted for each species and survey of the international survey (Figures 3-8), and for the west coast survey (Figure 9).

### Distribution and Abundance

In inshore areas around mainland Scotland, Orkney and Shetland and especially in the Moray Firth, Aurelia was usually the most abundant scyphomedusae caught; it was also numerous in the area surveyed north-west of Denmark. Although consistently



present, Cyanea lamarckii was seldom very numerous off the Scottish coast or around Orkney and Shetland, whereas Cyanea capillata was most abundant in these areas. However, in the area north-west of Denmark, C. lamarckii was very abundant, much more so than Aurelia or C. capillata. Cyanea capillata was more widely distributed and was more abundant further offshore than C. lamarckii or Aurelia, particularly north of 57°N. All three scyphomedusae showed increased numbers and extended distribution between surveys one and two. Scyphomedusae were scarce along the English coast.

#### Comparison with Previous Years

As in previous surveys, Cyanea capillata was the most widely distributed species. In the area east of the Scottish mainland, C. capillata was more abundant in 1979 than in any previous years survey. North of 58°30'N (and between Orkney/Shetland and Norway) C. capillata was, as in previous years, very abundant although less so and with a more westerly distribution than in 1978. North-west of Denmark, C. capillata abundance was similar to previous years.

Compared to previous surveys, Cyanea lamarckii were scarce off the coast of Britain although more widely distributed. Off the west of Denmark however, C. lamarckii continued the trend shown since 1975 (when this area was first surveyed), and became even more abundant in 1979.

Aurelia aurita, although, like C. lamarckii, fairly widespread compared to previous years, was considerably less abundant than in 1978 or 1977 and similarly abundant to 1976 and 1975, in the area east of Britain. To the west of Denmark however, Aurelia was as abundant as in 1978 and 1977 but more abundant than in 1976 and 1975.

#### Percentage Size Frequency Distribution of Cyanea spp.

The size frequency distributions are shown in Tables 1 (numbers) and 2 (weights) for each Cyanea species and each survey in each of five sub-areas. These areas consist of those rectangles fished within the following limits:-

Area 1	58°30'N to 61°30'N and 01°W to 04°E
Area 1a	58°30'N to 60°00'N and 05°W to 01°W
Area 2	54°00'N to 58°30'N and 04°W to 01°E
Area 3	57°00'N to 58°30'N and 01°E to 04°E
Area 4	54°30'N to 57°00'N and 03°E to 08°E

These areas are the same as those defined for 1978 and 1977 and similar to 1976 and 1975, apart from area 4 which has been extended 1° West and 1.5° South. The Cyanea spp. in area 3 were thought to belong to the same population as that in area 2 and therefore both areas are considered together here.

In 1979, for all areas and both Cyanea spp., the number and percentage of larger individuals caught increased between the two surveys. This reflected similar results in previous years.

### Comparison with Previous Years

Area 1 For Cyanea capillata the modal size group (5-9 cm) and the total size range were less than in 1978, about the same as in 1977 and greater than in 1976. C. lamarckii had the same modal size group (5-9 cm) as in 1978 and 1977 (in 1976 the modal size was 1-4 cm). However, the total size range in 1979 was less than in any previous year.

Area 1a For this area the modal size groups for Cyanea capillata (5-9, 10-14 cm) and C. lamarckii (5-9 cm) were greater in 1979 than in 1978, 1977 and 1976. The total size ranges for both species were also greater than in the previous years.

Areas 2 and 3 In this combined area the 1979 modal size group of C. capillata (5-9 cm) and the total size range were greater than in 1978, 1977 and 1976. C. lamarckii however, had a smaller modal size group (1-4 cm) and smaller total size range than in the three previous years.

Area 4 In this area the modal size group of Cyanea capillata (5-9 cm) was less than in 1978 and the same as in 1977 and 1976. The total size range of C. capillata was less than in the three previous years. For C. lamarckii modal size group (5-9 cm) and total size range were also less than in 1978 but modal size was the same as 1977 and 1976 and total size range was greater than in these two years.

Table 2 presents, for each survey, the total weight of each Cyanea species caught in the five areas and the distribution of these weights over 5 cm groups. The regressions of  $\log_{10}$  umbrellar disc weight on  $\log_{10}$  umbrellar disc diameter, which were used were:

$$\text{Cyanea capillata } W \text{ (g)} = 0.0924 D \text{ (cm)}^{2.6320}$$

$$\text{Cyanea lamarckii } W \text{ (g)} = 0.0851 D \text{ (cm)}^{2.6240}$$

These regressions were derived from data obtained in 1972, 1973 and 1974. The weights obtained from these relationships were umbrellar disc weights only and for Table 2 were corrected to include the weight of the tentacles/gonad/mouthmass. For C. capillata the umbrellar wet weight represents approximately 40% of the wet weight of the entire organisms and for C. lamarckii umbrellar weight represents approximately 50%.

Table 3 presents as examples the results of those hauls where C. capillata, C. lamarckii and Aurelia respectively were most abundant in 1979. The regressions and corrections given above were used to convert the numbers of Cyanea spp. into wet weight and the regression equation given by Yasuda (1971) as:

$$W \text{ (g)} = 0.1673 D \text{ (cm)}^{2.498}$$

was used to convert Aurelia to wet weight.

Wet to Dry weight conversion was made assuming Cyanea is approximately 96.47% water (Koizumi and Hosoi, 1936) and Aurelia is 96.2% water (Hyman, 1938). The conversion to g dry weight/100 m<sup>3</sup> was made assuming the volume of water filtered by the trawl was approximately 65 000 m<sup>3</sup> (Hay and Adams, 1975). The young gadoid pelagic trawl is very inefficient as a quantitative sampling instrument with large numbers of



smaller medusae lost through the trawl meshes. However, it is still very evident from the data presented here that the scyphomedusae constitute at times a considerable standing stock of important predators.

Figure 10 shows the weight of the two Cyanea spp. caught in the five areas expressed as g dry weight/100 m<sup>2</sup>. This figure illustrates differences in distribution of standing stock of Cyanea, with C. capillata in the north and C. lamarckii in the east central area of the North Sea. It should be noted that if the Aurelia standing stock were to be included, the stock of medusae in area 2 (east of Britain) would be at least equivalent to the stock in other areas. These figures for standing stock, compare well with those given in Hay and Adams, (1975) although calculated by a slightly different method. Also, as stated in the 1975 report the standing stock of scyphomedusae may be higher than the standing stock of other planktonic carnivores.

#### Opportunity for Commensal Association between O-group gadoids and Cyanea spp.

Although the association of O-group gadoids and Cyanea spp. is well known, (Dahl, 1961; Mansueti, 1965 and Russell, 1970) evidence from data presented here can only be derived circumstantially. Table 4 repeats the attempts made each year since 1975, to quantify the opportunities for fish and jellyfish to associate, by assessing the relative abundance of Cyanea spp.\* in rectangles where each O-group fish species (whiting, haddock, cod, saithe and Norway pout) were present or "abundant". The number of each fish species chosen to define the lower limit of "abundance" was chosen subjectively, but with regard to the arithmetic mean number of each species over those rectangles where each was caught. These limits were the same as in previous years except for cod which were more numerous in 1979 than previously. Saithe have been included in the assessment for the first time since the catch rates of this species in 1979 were unusually high. As in all years since 1975, the opportunity for association was greatest for whiting and haddock, less for cod and least for Norway pout (and saithe in 1979). It is of interest that in 1979 haddock and, to a lesser extent, cod had a greater opportunity for association than in earlier surveys. The opportunity for association increased between the two surveys in 1979 for all five fish species, as it did in previous years.

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\* The 1975 paper included Aurelia in calculating percentages of rectangles in each jellyfish abundance category.

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Table 1

Percentage Size Frequency Distribution by Number for Cyanea capillata and Cyanea lamarkii

Area	Species	Survey No.	100% Total Number	% at 1-4 cm	% at 5-9 cm	% at 10-14 cm	% at 15-19 cm	% at 20-24 cm	% at 25-29 cm	% at 30-34 cm	% at 35-39 cm	% at 40-50 cm	
<u>Area 1</u>	C. o.	1	577	9.7	50.3	28.9	7.1	2.4	0.9	0.7			
		2	1398	13.3	29.0	25.9	16.2	7.8	4.1	2.2	0.9	0.6	
	C. l.	1	5	40	60								
		2	315	46.0	48.3	5.7							
<u>Area 1a</u>	C. o.	1	257	21.0	45.1	21.8	7.8	3.5	0.8				
		2	470	7.9	27.4	28.9	24.5	6.6	2.3	1.9	-	0.4	
	C. l.	1	122	38.5	48.4	13.1							
		2	243	30.9	54.3	14.0	0.8						
<u>Area 2</u>	C. o.	1	1212	27.9	39.1	20.4	9.2	3.0	0.2	0.2			
		2	1141	24.9	37.6	20.3	10.1	5.0	1.4	0.5	0.2	0.1	
	C. l.	1	103	74.8	25.2								
		2	147	52.4	38.1	8.2	0.7	-	-	0.7			
<u>Area 3</u>	C. o.	1	555	2.0	38.4	36.0	19.5	4.1					
		2	977	9.7	19.1	30.4	21.5	13.8	4.5	0.9			
	C. l.	1	0	-	-	-	-	-	-	-	-	-	
		2	49	91.8	8.2								
<u>Area 4</u>	C. o.	1	61	31.1	44.3	18.0	6.6						
		2	258	8.5	50.8	25.6	13.6	1.2	0.4				
	C. l.	1	7903	29.6	54.1	13.2	3.0	0.1					
		2	8718	26.8	55.6	15.6	1.9	0.1					



Table 2

Percentage Size Frequency Distribution by weight for Cyanea capillata and Cyanea lamarkii

Area	Species	Survey No.	100% Total Weight in grams Dry/Wet	% at 1-4 cm	% at 5-9 cm	% at 10-14 cm	% at 15-19 cm	% at 20-24 cm	% at 25-29 cm	% at 30-34 cm	% at 35-39 cm	% at 40-50 cm	
Area 1	C. o.	1	3214	91034	0.3	15.9	33.6	19.7	13.0	7.8	9.7	8.2	
		2	18117	513218	0.2	3.9	12.9	19.3	17.9	16.1	13.4		
	C. l.	1	4	115	5.5	94.5	28.5						
		2	294	8337	5.5	66.0							
Area 1a	C. o.	1	1252	35481	0.7	16.3	28.9	24.7	21.4	8.0	12.9	6.8	
		2	5438	154062	0.1	4.2	16.1	32.7	17.0	10.2			
	C. l.	1	155	4397	3.4	48.6	48.0	6.2					
		2	358	10137	2.3	47.1	44.3						
Area 2	C. o.	1	5608	158863	0.9	14.9	28.5	30.6	19.7	2.7	2.8	3.0	2.5
		2	7453	211146	0.6	10.2	20.0	23.8	22.8	10.8	6.3		
	C. l.	1	42	1184	20.5	79.5	27.5	5.5			27.5		
		2	203	5755	4.2	35.2							
Area 3	C. o.	1	4024	113981	0.1	9.3	32.1	41.5	17.0	17.8	5.6		
		2	12448	352643	0.1	2.6	15.4	26.1	32.3				
	C. l.	1	-	-	-	-	49.5	50.5					
		2	10	287									
Area 4	C. o.	1	183	5195	1.6	26.0	38.7	33.7	6.7	3.8			
		2	1341	38000	0.2	17.2	31.8	40.3					
	C. l.	1	13366	378630	1.9	40.9	36.4	19.5	1.3				
		2	14726	417176	1.8	42.1	43.2	12.4	0.6				

Table 3

		Species	Size Range cm	Mean Size cm	Number	Wet Weight grams	Dry Weight grams	g Dry wt / 100 m <sup>3</sup>
SHIP Position Date Bottom Depth	TRIDENS 44F1 27 6 70 87 m	Cc	2-31	14	528	203576	7186	
		Cl	2-6	3	45	246	9	
		Aa	-	5	1	15	0.5	
		TOTALS				574	203837	7195
SHIP Position Date Bottom Depth	TRIDENS 42 F6 2 7 79 35 m	Cc			NIL			
		Cl	2-16	7	3904	165562	5844	
		Aa	6-12	8	224	6911	263	
		TOTALS				4128	172473	6107
SHIP Position Date Bottom Depth	CORELLA 45 E6 24 6 79 59 m	Cc	3-18	9	47	6109	216	
		Cl		5	1	15	0.5	
		Aa	2-11	5	5866	75763	2879	
		TOTALS				5914	81887	3096

Table 4

Of the statistical squares in which each gadoid species was a. present b. 'abundant' the percentage which had:

Survey No	Species - present ( $\bar{x}$ ) or 'abundant'	Number of hauls	Nil cyanea spp	1-9 Cyanea spp	10-29 Cyanea spp	30+ Cyanea spp
1	Whiting - present (40) or > 50	17 5	6 -	17 -	12 -	65 100
	Haddock - present (35) or > 100	36 3	6 -	19 -	14 -	61 100
	Cod - present (274) or > 100	26 8	- 12	27 -	12 -	61 88
	Saithe - present (55) or > 50	33 12	24 58	21 8	9 26	46 8
	Norway pout - present (393) or > 1000	36 6	19 33	19 17	28 17	34 33
2	Whiting - present (117) or > 50	28 15	- -	7 -	32 -	61 100
	Haddock - present (154) or > 100	39 13	- -	13 -	23 -	64 100
	Cod - present (343) or > 100	48 9	2 -	15 -	17 11	67 89
	Saithe - present (27) or > 50	33 7	6 -	15 43	12 14	67 43
	Norway pout - present (2476) or > 1000	26 7	4 -	31 -	19 14	46 86

\*  $\bar{x}$  the arithmetic mean number of each fish species over those squares where each was caught

NOTE:-- Aurelia aurita was not included in calculating percentages of squares in each abundance category of jellyfish.



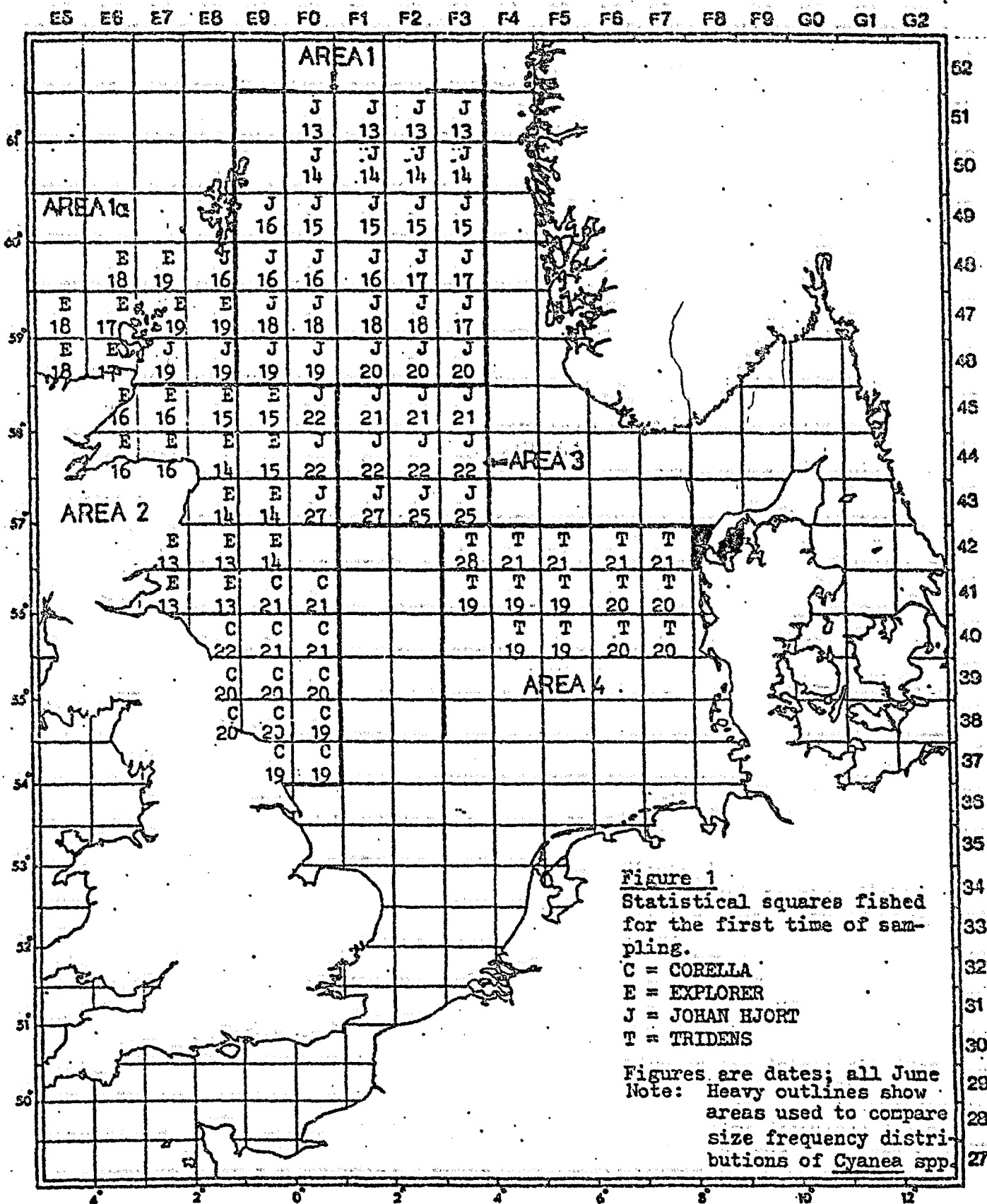


Figure 1  
 Statistical squares fished  
 for the first time of sam-  
 pling.  
 C = CORELLA  
 E = EXPLORER  
 J = JOHAN HJORT  
 T = TRIDENS

Figures are dates; all June  
 Note: Heavy outlines show  
 areas used to compare  
 size frequency distri-  
 butions of *Cyanea* spp.







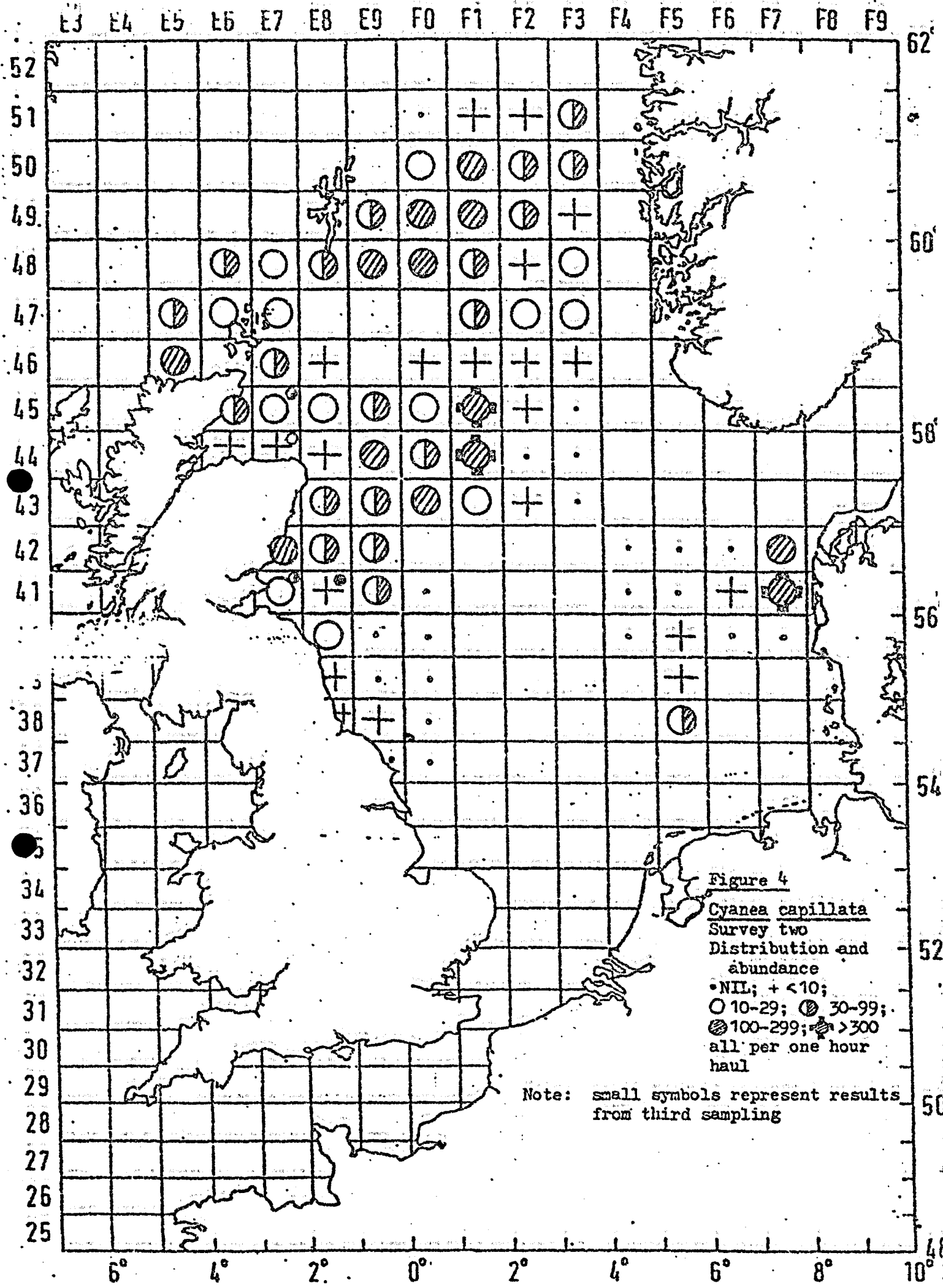
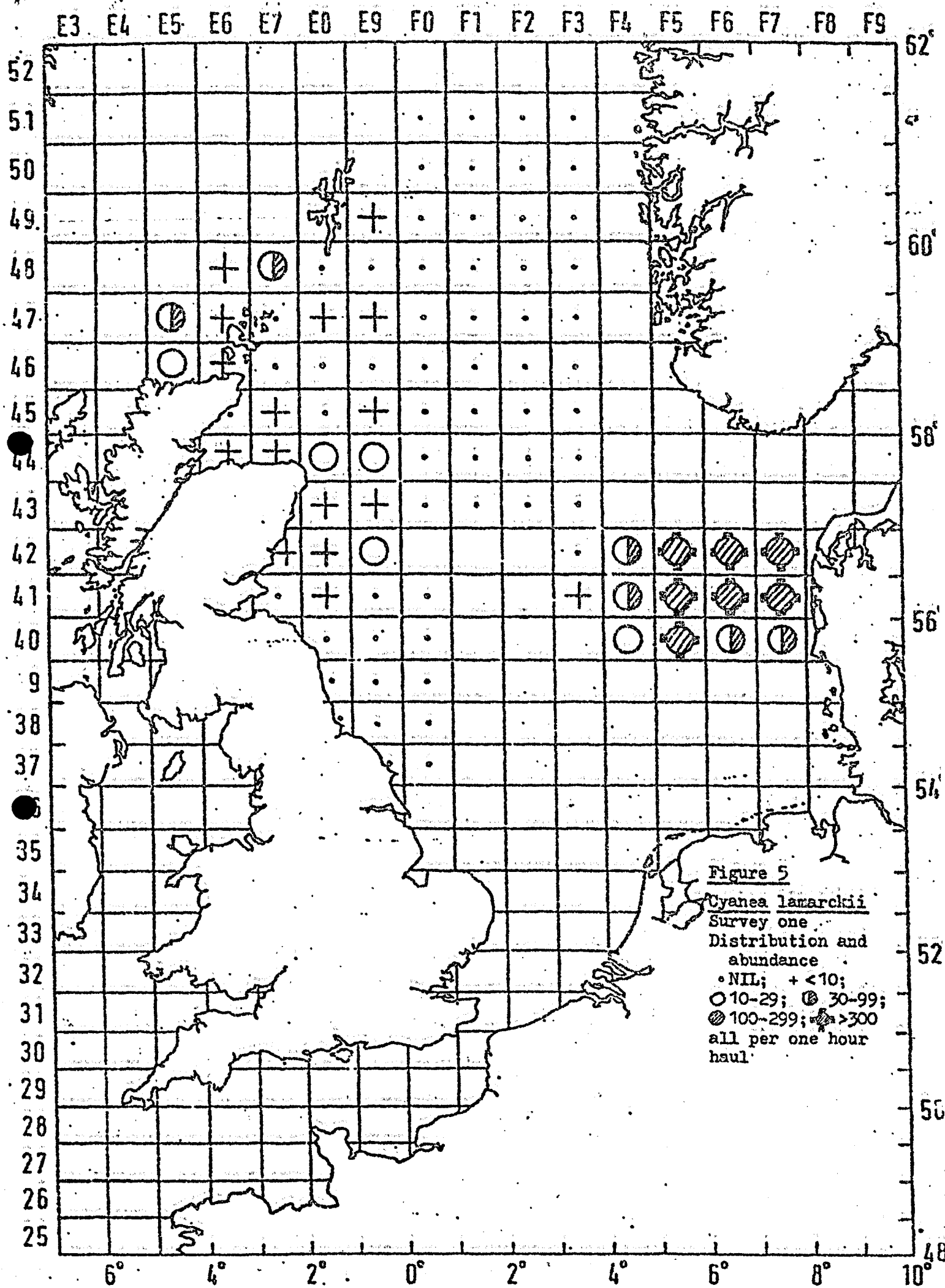


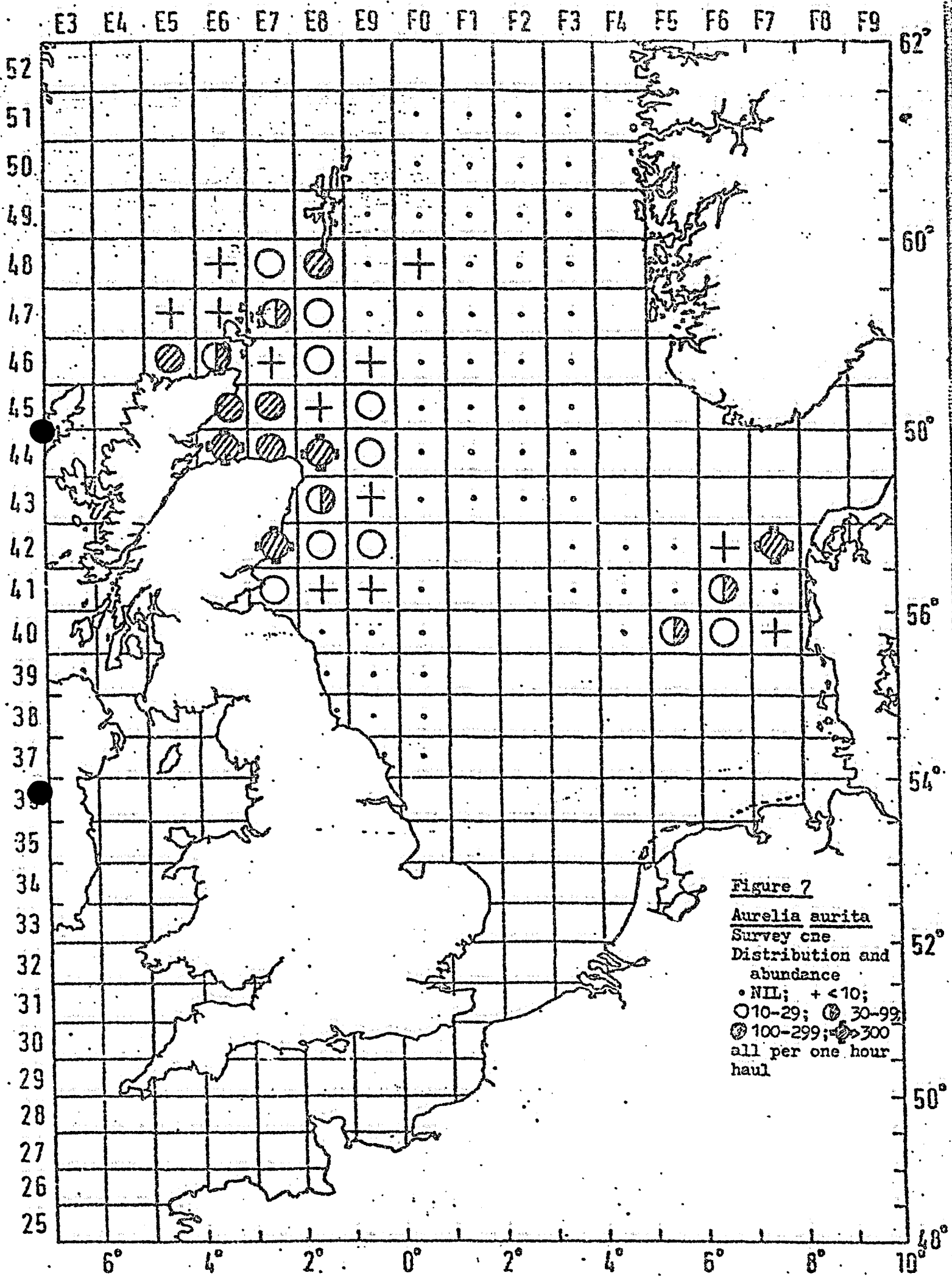
Figure 4  
*Cyanea capillata*  
 Survey two  
 Distribution and  
 abundance  
 • NIL; + <10;  
 ○ 10-29; ◐ 30-99;  
 ◑ 100-299; ◒ >300  
 all per one hour  
 haul

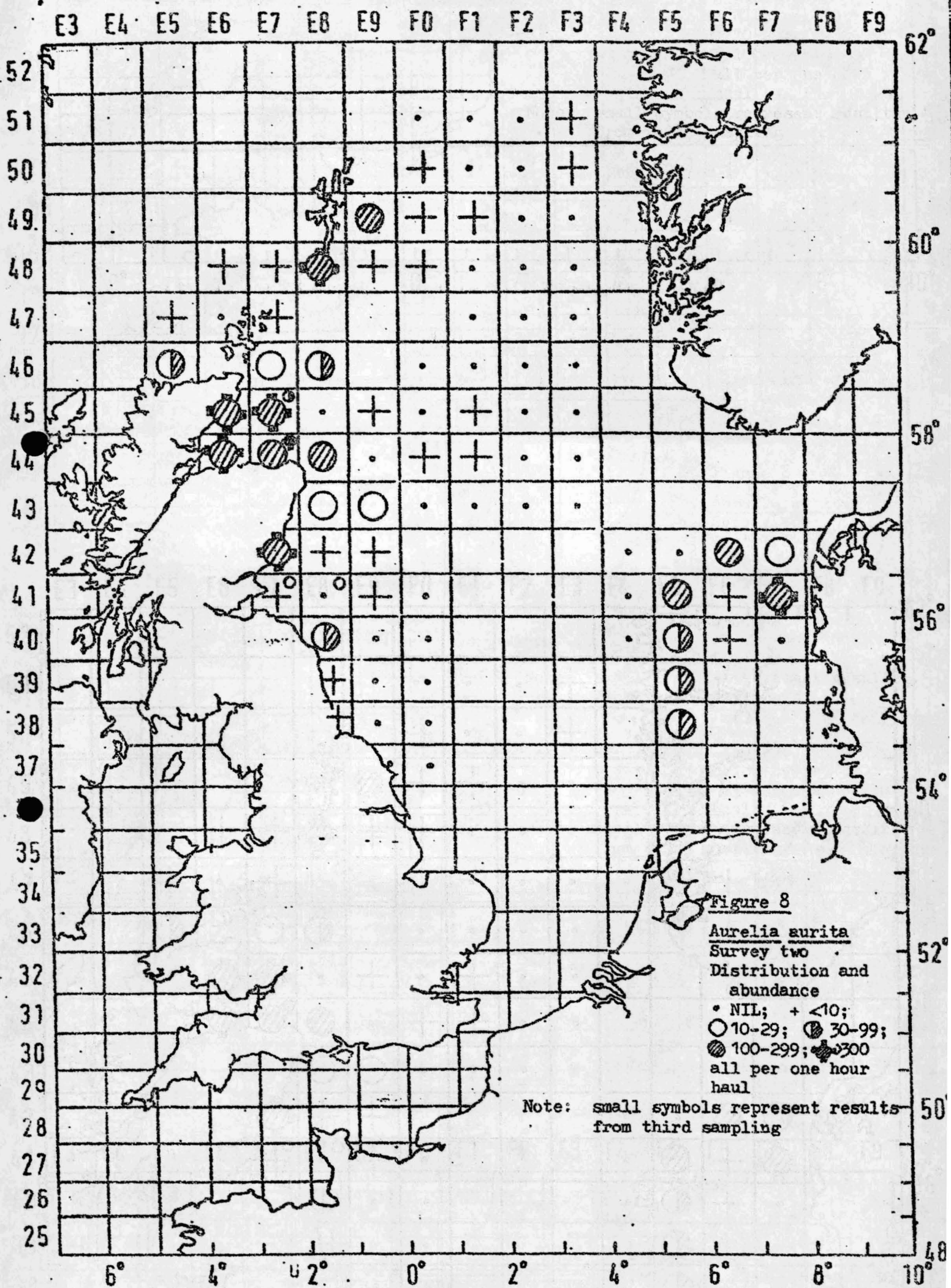
Note: small symbols represent results from third sampling











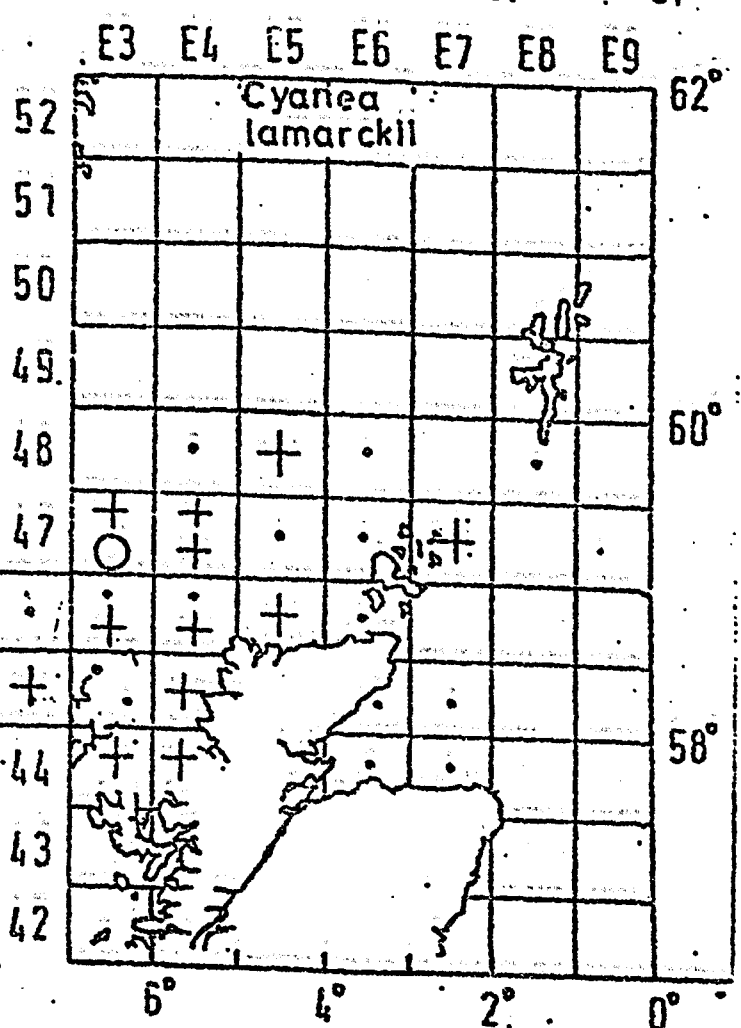
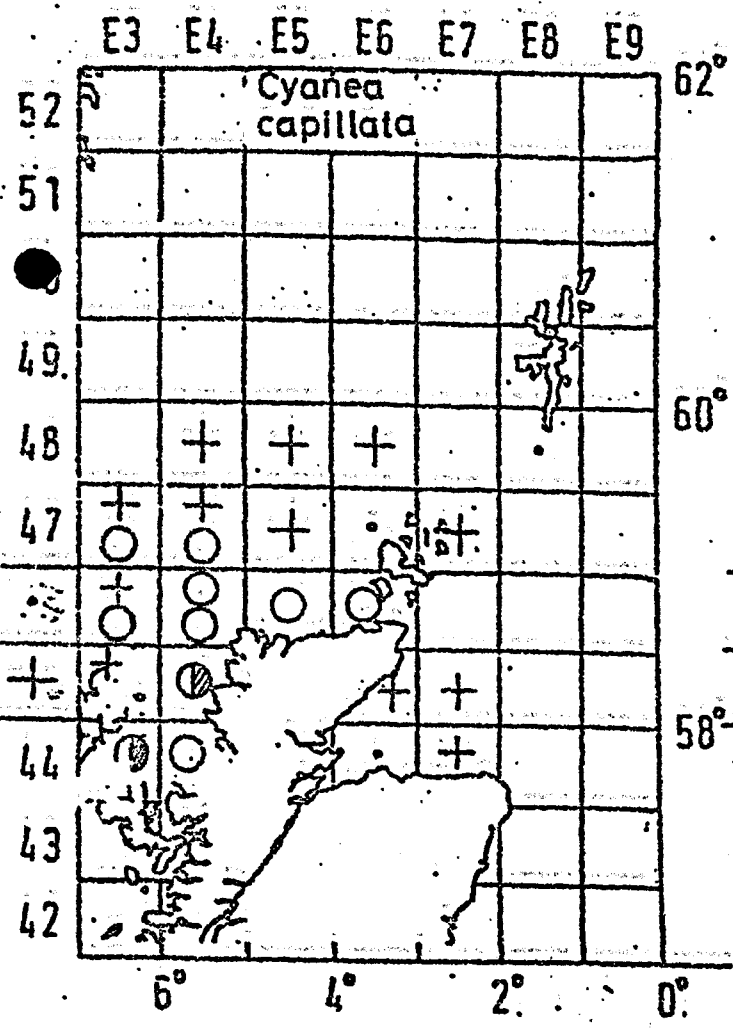
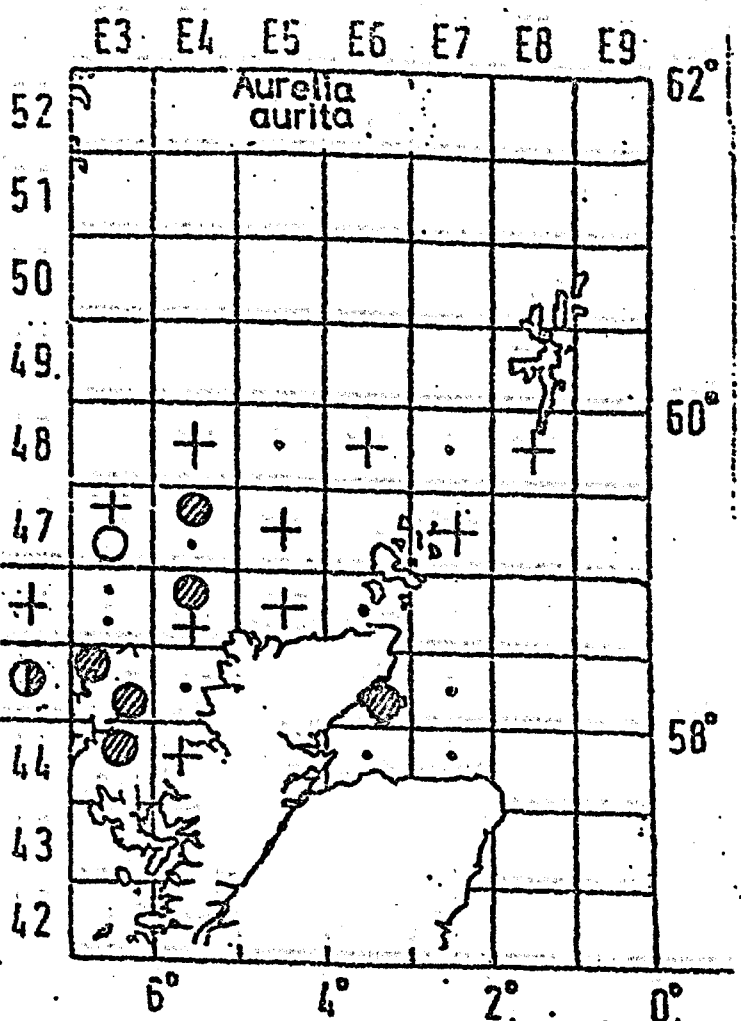
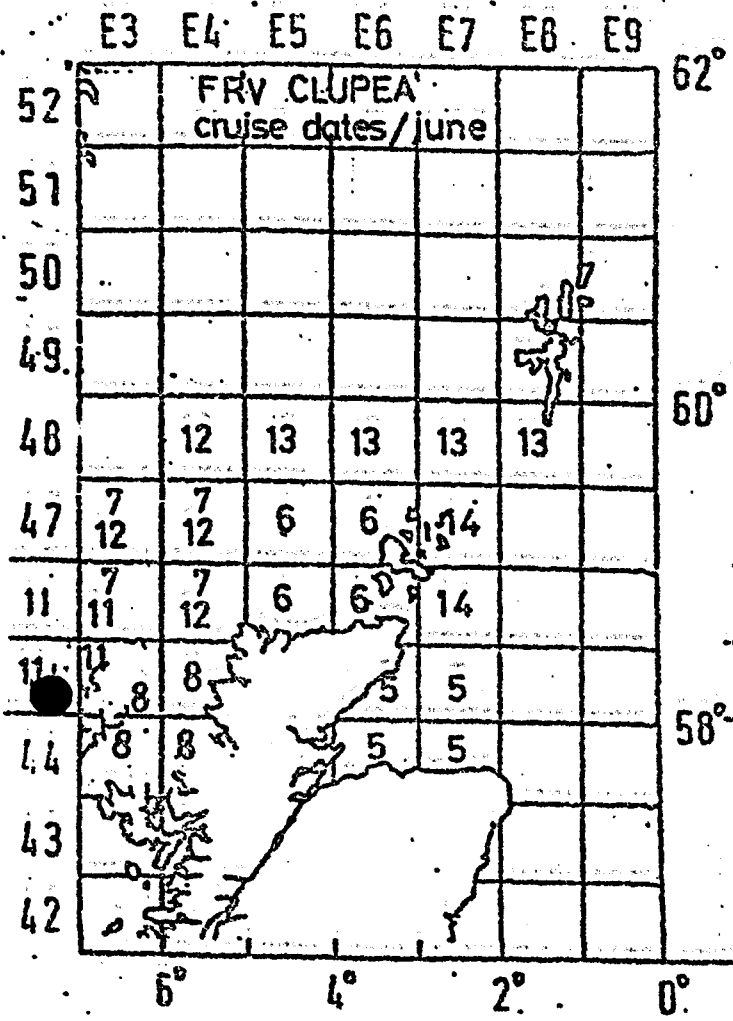
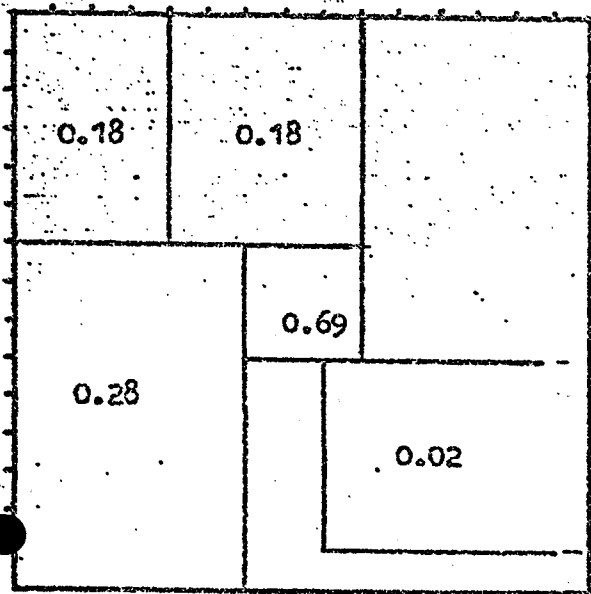
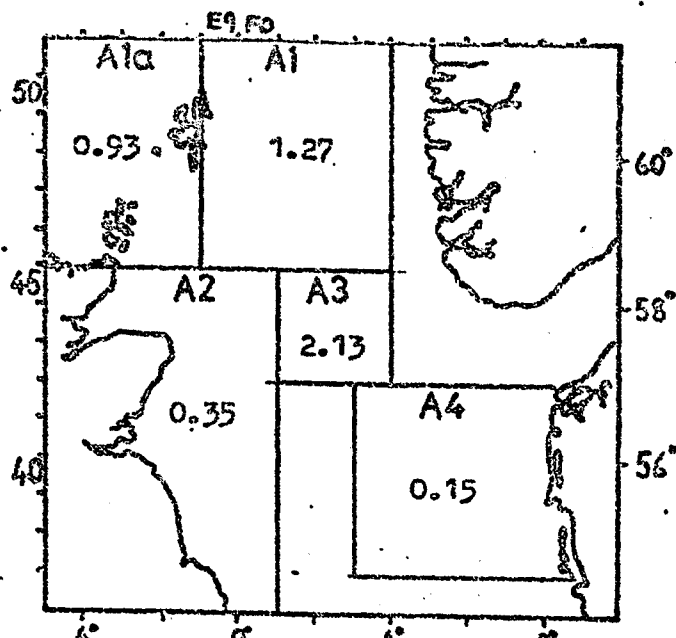


Figure 9 Clupea cruise jellyfish distribution and abundance. Symbols as in Figures 3-8

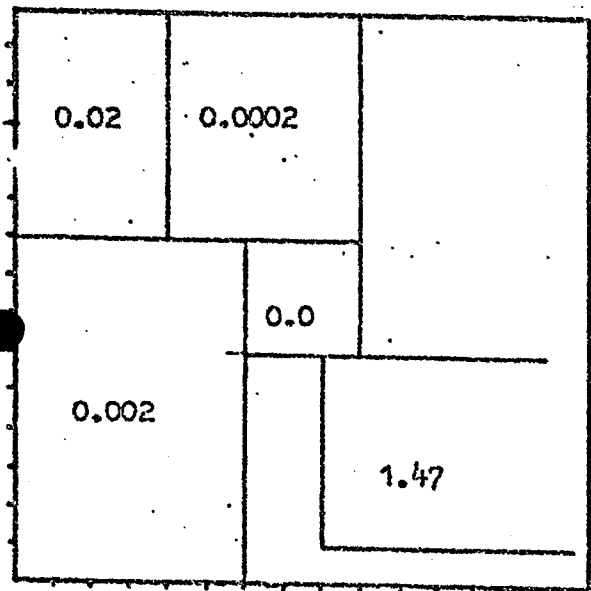
Figure 10 *Cyanea* spp. Dry Weight (g/100cm<sup>3</sup>)



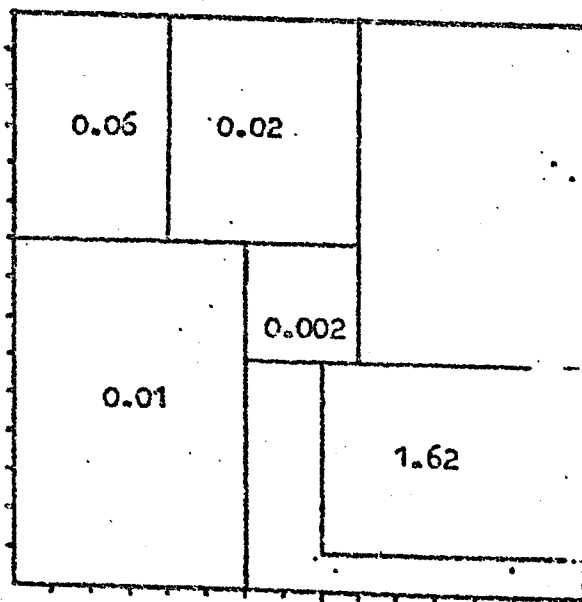
*Cyanea capillata* Survey 1



*Cyanea capillata* Survey 2



*Cyanea lamarckii* Survey 1



*Cyanea lamarckii* Survey 2