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A COMPARISON OF CATCH COMPOSITION WITH DIFFERENT NET MESH SIZES USING A PARALLEL HAUL TECHNIQUE IN THE NORTHERN IRELAND NEPHROPS FISHERY x

BY

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ABSTRACT

The catch composition of a dual purpose trawl fitted with a 40mm cod-end mesh was compared to that of a similar net fitted with a cod-end of 70mm. The two nets were towed in parallel by similar vessels at the same speed. It was found that despite an overall reduction of 22.1% in prawn catch there was a higher proportion of large individuals in the net with the 70mm cod-end. Although there was no significant difference in catches of marketable finned fish there was a greater proportion of juvenile fish caught with the small meshed net (40mm). A similar comparison between a dual purpose trawl with a 40mm cod-end and a prawn trawl of 40mm mesh throughout gave no significant difference between catches.

RÉSUMÉ

Une comparaison s'est faite entre la composition d'une prise d'un chalut a double usage, équipé au bout de filet a mailles de 40mm, avec un filet semblable mais à mailles de 70mm. Deux vaisseaux semblables ont remorqué, en parallèle et a la même vitesse, les deux filets.

On a recueilli les résultats qui suivent. Dans le cas du filet ayant au bout des mailles de 70mm, la prise totale des Nephrops avait été réduite mais il y avait une plus grande proportion de grands individus.

En même temps tandis qu'il n'y avait pas une différence significative entre les poissons (à nageoires) vendables, il y avait une plus grand proportion de poissions juveniles prise par le filet auc au bout des mailles de 40mm.

Une comparaison semblable entre un chalut à double usage n'ayant qu'au bout des mailles de 40mm et un chalut à Nephrops ayant des mailles de 40mm partout, n'a pas donné une différence significative entre les prises.

INTRODUCTION

The Northern Ireland fishery for Nephrops norvegicus is economically the most important of the province with 1979 landings worth over £4M at first sale. Apart from a decline in 1974, due to marketing problems, landings have shown a steady increase since 1954 when the first significant prawn landings took place. Until mid 1979, the use of nets with less than 50mm meshes in their cod-end was permitted in I.C.E.S. area VIIa where the Northern Ireland fishery is concentrated. Losses in juvenile whitefish (Watson and Parson, 1974 and Brander, 1975) coupled with an overall reduction in mean prawn size in the catchable stock (Watson, 1973), led to the introduction in 1979 of legislation forbidding the use of nets with a cod-end mesh size of less than 70mm. Although earlier studies (Thomas, 1965 and Pope and Thomas, 1975) compare catches in nets of different mesh sizes, the data they presented was not obtained simultaneously from parallel hauls. This paper compares the catch composition of similar nets (dual purpose trawl) one fitted with a large mesh (70mm) and the other with a small mesh (40mm) cod-end, towed simultaneously parallel to each other, by similar vessels. The same technique was used to compare a dual purpose trawl with a 40mm mesh cod-end to a standard prawn trawl with a 40mm mesh throughout.

METHODS

During September 1974, two similar vessels (appendix A) were chartered for a two week period from the Co. Down port of Kilkeel. The three nets used were (a) two dual purpose trawls of 70mm mesh size with detachable

cod-ends of mesh sizes 70mm and 40mm respectively and (b) a long-winged prawn trawl of 40mm mesh throughout (appendix B). The net trial was conducted in two phases.

Phase I (9-13 September 1974) A comparison between the catch composition of dual purpose trawls; one fitted with a 70mm and the other with a 40mm cod-end mesh, towed in parallel (Fig 1). Nets were exchanged between the two vessels on the third day in order to compensate for possible differences between the "Seamew" and the "Janet Mary" (Appendix A).

Phase II (16-20 September 1974) A comparison between catches in a dual purpose trawl fitted with a 40mm cod-end and a standard prawn trawl of 40mm mesh throughout towed in parallel (Fig 2). Nets were exchanged between vessles on the third day as in phase I. During both phases of this study every effort was made to reproduce commercial conditions with each tow being of approximately three hours duration and the crews selecting marketable and discardable prawns as in normal fishing practise.

The total catch from each haul was sampled by filling an eight stone fish box from the catch shortly after it had been deposited on the deck. The fin-fish component of the sample was removed and the remaining prawns sub-sampled by taking half or quarter of the volume to give a sample size of 200-300 prawns, subsequently used for length frequency analysis. The length composition and weight of the fish by-catch species was also recorded. Both rejected and landed prawn components of the catch were studied by sampling the "rubbish" discarded after the marketable size catch had been removed. A sample of discard material

from each haul was divided into juvenile fish, small unmarketable prawns and prawn heads resulting from tailing. Tailing occurred because in normal commercial practice heads of Nephrops are discarded at sea and not marketed. Carapace length composition of landed catch was therefore obtained from the "prawn head" component of discard samples.

In addition to catch composition data, records were kept of landed catch, water depth, weather and geographic location of hauls for each day's fishing.

RESULTS

Nephrops

Length frequency data from both phases of the study are presented in figure 3 and 4. Figures 5 and 6 show Nephrops length frequency distributions for each comparison superimposed. Tables 1, 2, and 3 summarise total, rejected and landed catch length composition data for Nephrops together with the relevent means and standard deviations for the two comparisions. Table 4 gives the proportion of large ($\geq$ 34mm CL) and small ($<$25mm CL) Nephrops in total catch samples. This arbitrary size selection is based upon that used by O'Riordan (1964) for comparative purposes. In Table 4 data from comparable tows has been pooled to give an overall view of the catch composition with the different net combinations. Analysis of carapace length composition indicates a shift toward fewer small prawns being caught in the larger meshed net. The mean carapace length of total catch samples from each haul are given in figure 7 and the overall mean lengths were 25.8mm and 25.1mm for the 70mm and 40mm cod-end respectively on a dual purpose trawl, a difference found to

be significant ($p < 0.001$). In reality however, it is the proportion of small prawns not caught with the large mesh that is important. Although there was no significant difference between the mean carapace length of prawns caught in the prawn trawl compared to the dual purpose trawl with a 40mm cod-end, there tended to be a higher proportion of small prawns in catches with the prawn trawl. This difference is thought to be due to the escape of small prawns through the wings and belly of the dual purpose trawl where larger mesh occurs (appendix B).

The size of prawn actually landed in the Northern Ireland Nephrops fishery depends upon crews' selection at tailing which is influenced by market demand and the minimum legal landing size of 25mm carapace length (though this regulation was not operative in 1974). By plotting carapace length frequencies of discarded Nephrops and those of landed Nephrops on the same axis the average rejection size is obtained from the point where the two curves intercept. Analysis of both phase I and phase II data indicates that there is no significant difference between the average selection point by the two crews (Fig 8) employed on the net trial. Since selection by the crew is therefore constant, landed catch with the different nets may be compared. As indicated in table 5A an overall reduction of 22.1% occurred with the larger mesh (70mm) cod-end on a dual purpose trawl. The phase II comparison, however, did not indicate any consistant significant difference between landed catch with the dual purpose trawl and the prawn trawl (table 5B). Catch per unit effort (cpue), expressed as kg landed per hour fished, was highest with the prawn trawl and lowest with the dual purpose trawl fitted with a 70mm cod-end (table 6A/B).

By-catch

The major by-catch species caught was the cod, Gadus morhua and the whiting, Merlangius merlangus. Whiting length frequency composition (Fig 9) indicates that more juvenile whiting are caught (length<25cm) in the small mesh nets (40mm cod-end). Marketable whiting catch per unit effort did not appear to differ between net types. Table 7A/B gives the quantities of commercially important fish species landed during this trial.

DISCUSSION & CONCLUSIONS

The findings of this net trial indicate that a large mesh (70mm) cod-end will catch fewer juvenile Nephrops than a 40mm cod-end, with a mean reduction in marketable catch (by weight) of 22.1%. Although catch per unit effort dropped with the larger meshed net it would appear that these losses are concentrated in the smaller size classes allowing more juvenile prawns to escape, grow and breed before being taken by the fishery. This is of particular importance when it is noted that sexual maturity occurs in Irish Sea Nephrops at 19-22mm carapace length (Farmer 1974) with 50% maturity size at 23mm carapace length (Watson 1975). The similarity in catch composition in the phase II comparison suggested that only a few prawns escape through the wings and belly of the dual purpose trawl. Although catches of marketable sized whitefish did not differ between nets there was a reduction in the number of undersized fish in the dual purpose trawl with a 70mm cod-end compared to the fine mesh (40mm) nets, as was proposed by Watson & Parsons (1974) who estimated pre-recruit mortality rates as high as 2-0 to 2.5 (total instantaneous mortality) with a 40mm net.

In conclusion, it seems that the introduction of a 70mm cod-end to the Northern Ireland Nephrops fishery will cause short term losses of around 20% in landings (by weight) coupled with a reduction in the number of juvenile prawns and fish captured. Although long term predictions of crustacean stocks are complex and beyond the scope of this paper it is likely that the short term losses described will lead to stock recovery and long term gains in both Nephrops and fish yield. Work in hand since the recent introduction of the 70mm net to Northern Ireland waters should varify the effects of this net on the fishery.

ACKNOWLEDGEMENTS

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TABLE 1

NEPHROPS SIZE COMPOSITION (CARAPACE LENGTHS) IN TOTAL CATCH SAMPLES

I DUAL PURPOSE TRAWL : 40mm COD END

sex	sample size	percentage composition in 5mm carapace lengths 10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	MEAN (sd)
male	2043	-	3.0	31.4	47.7	14.8	2.8	0.3	-	-	26.1 (3.96)
female	1573	0.1	7.6	59.5	26.3	51.1	1.0	0.3	0.1	-	23.8 (3.55)
both	3616	0.1	5.0	43.6	38.4	10.6	1.9	0.3	0.1	-	25.1 (3.96)

DUAL PURPOSE TRAWL : 70mm COD END

male	1533	-	1.2	26.9	46.9	20.6	3.5	0.6	0.2	0.1	27.0 (4.19)
female	1018	0.2	5.4	56.7	30.8	5.1	1.6	0.2	-	-	24.1 (3.58)
both	2551	0.1	2.9	38.8	40.4	14.4	2.7	0.5	0.2	-	24.4 (4.06)

II DUAL PURPOSE TRAWL : 40mm COD END

male	1775	0.1	5.3	36.3	43.4	11.3	2.4	0.5	0.7	-	25.5 (4.28)
female	1479	0.3	10.8	62.1	23.1	3.2	0.4	0.1	-	-	23.0 (3.29)
both	3254	0.3	8.0	48.2	34.4	7.8	1.5	0.4	0.2	-	24.4 (4.06)

PRAWN TRAWL : 40mm THROUGHOUT

male	2266	0.1	6.6	39.8	39.9	11.0	2.0	0.5	0.1	-	25.1 (4.15)
female	1969	0.3	14.6	61.7	20.5	2.2	0.6	0.1	-	-	22.6 (3.28)
both	4235	0.2	10.4	50.0	30.7	6.9	1.4	0.3	0.1	-	23.9 (4.00)

TABLE 2

NEPHROPS SIZE COMPOSITION (CARAPACE LENGTHS) IN REJECTED CATCH SAMPLES

I DUAL PURPOSE TRAWL : 40mm COD END

sex	sample size	percentage composition in 5mm carapace lengths 10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	MEAN	(sd)
male	1176	0.2	3.4	45.8	48.0	2.6	-	-	-	24.4	(2.67)
female	1188	0.2	6.7	67.2	25.4	0.7	-	-	-	23.1	(2.49)
both	2364	0.2	5.1	56.5	36.6	1.6	-	-	-	23.7	(2.67)

DUAL PURPOSE TRAWL : 70mm COD END

male	1198	0.1	1.7	48.9	48.6	0.6	-	-	-	24.2	(2.22)
female	1093	0.2	3.4	70.9	25.3	0.3	-	-	-	23.2	(2.18)
both	2291	0.1	2.5	59.5	37.4	0.4	-	-	-	23.7	(2.27)

II DUAL PURPOSE TRAWL : 40mm COD END

male	1319	0.5	7.6	48.8	40.9	2.1	0.1	-	-	23.8	(2.95)
female	1315	0.2	9.0	69.1	20.8	0.8	0.1	-	-	22.7	(22.7)
both	2634	0.3	8.3	58.9	30.9	1.5	0.1	-	-	23.2	(23.2)

PRAWN TRAWL : 40mm THROUGHOUT

male	1292	0.3	7.3	50.8	40.6	1.1	0.1	-	-	23.7	(2.84)
female	1233	0.5	9.9	70.5	18.7	0.5	-	-	-	22.5	(2.53)
both	2525	0.4	8.6	60.4	29.9	0.7	-	-	-	23.1	(2.76)

TABLE 3

NEPHROPS SIZE COMPOSITION (CARAPACE LENGTHS) IN LANDED CATCH SAMPLES

I DUAL PURPOSE TRAWL : 40mm COD END

sex	sample size	percentage composition in 5mm carapace lengths 15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	MEAN	(sd)
male & female	2746	0.1	2.5	42.2	41.5	10.5	2.4	0.7	0.1	+	30.5	(4.13)

DUAL PURPOSE TRAWL : 70mm COD END

male & female	2762	0.2	2.8	43.1	40.2	10.8	1.5	0.9	0.3	0.1	30.4	(4.29)

II DUAL PURPOSE TRAWL : 40mm COD END

male & female	2469	-	2.9	46.3	38.6	9.6	1.9	0.6	0.2	+	30.2	(4.05)

PRAWN TRAWL : 40mm THROUGHOUT

male & female	2356	+	1.2	41.6	43.1	11.1	2.0	0.8	0.1	-	30.6	(3.92)

+ = present but <0.1%

TABLE 4

PROPORTION OF SMALL (<25mm carapace length) AND LARGE (34mm carapace length) PRAWNS IN SAMPLES FROM TOTAL CATCH

(based, for comparative purposes, upon the two lengths used by O'Riordan, 1964)

GEAR USED	PERCENTAGE OF SMALL (<25mm) PRAWNS	PERCENTAGE OF LARGE (>34mm) PRAWNS
PHASE I		
D.P.T. with 40mm cod end	48.7	3.3
D.P.T. with 70mm cod end	41.8	5.1
PHASE II		
D.P.T. with 40mm cod end	56.2	2.8
PRAWN TRAWL (40mm throughout)	60.7	2.3

D.P.T. = dual purpose trawl

TABLE 5

A. THE DIFFERENCE IN LANDED NEPHROPS CATCH (tail weights) BETWEEN A DUAL PURPOSE TRAWL WITH A 40mm COD END AND A SIMILAR NET WITH A 70mm COD END

DAY	kg Nephrops landed		difference	% change with
	40mm cod end	70mm cod end	kg	70mm cod end
1	101.6	92.1	9.5	-9.4
2	63.5	47.2	16.3	-25.7
3	146.1	108.0	38.1	-26.1
4	53.5	36.7	16.8	-31.4
5	76.2	59.4	16.8	-22.0
overall	440.9	343.4	97.5	-22.1

B. THE DIFFERENCE IN LANDED NEPHROPS CATCH (tail weights) BETWEEN A DUAL PURPOSE TRAWL WITH A 40mm COD END AND A PRAWN TRAWL OF 40mm MESH THROUGHOUT

DAY	kg Nephrops landed		difference	% change with
	D.P.T. 40mm	P.T. 40mm	kg	P.T. 40mm
6	38.1	31.8	6.3	-16.5
7	62.6	57.2	5.4	-8.6
8	68.9	84.4	15.5	+22.5
9	91.6	96.6	5.0	+5.5
10	37.2	28.6	8.6	-23.1
overall	298.4	298.6	o.2	+0.1

D. P.T.= dual pupose trawl P.T.= prawn trawl

TABLE 6

CATCH PER UNIT EFFORT (kg tails/hour fished) FOR NEPHROPS AND WHITING LANDED

A. PHASE I COMPARISON : DUAL PURPOSE TRAWLS (D.P.T.) WITH 40mm COD END MESHES RESPECTIVELY

DAY	D.P.T. 40mm COD END		D.P.T. 70mm COD END	
	Nephrops	whiting	Nephrops	whiting
1	11.70	7.82	9.29	12.97
2	6.30	11.58	4.77	17.36
3	15.84	24.93	11.38	21.18
4	8.33	31.48	5.91	28.75
5	11.77	-	9.16	-
MEAN	10.79	15.16	8.10	16.05

B. PHASE II COMPARISON : DUAL PURPOSE TRAWL (D.P.T.) WITH A 40mm COD END AND A PRAWN TRAWL(P.T.) OF 40mmTHROUGHOUT

DAY	D.P.T. 40mm COD END		P.T. 40mm THROUGHOUT	
	Nephrops	whiting	Nephrops	whiting
6	6.30	-	6.81	-
7	6.93	10.68	6.30	7.76
8	7.50	15.14	9.60	27.35
9	10.56	-	11.64	-
10	7.25	-	5.79	-
MEAN	7.71	5.16	8.03	7.02

TABLE 7

F I S H L A N D E D (kg)

A. PHASE I COMPARISON : DUAL PURPOSE TRAWL WITH 40mm COD END (DP40) AND 70mm COD END (DP70) RESPECTIVELY

	WHITING		COD		HAKE		MAKERAL		FLAT-FISH		ANGLER		MIXED	
DAY	DP40	DP70	DP40	DP70	DP40	DP70	DP40	DP70	DP40	DP70	DP40	DP70	DP40	DP70
1	51	86	18	18	11	8	--	10	15	11	15	--	15	--
2	116	171	20	22	15	12	10	--	21	--	33	42	15	10
3	231	201	19	16	--	10	7	15	18	35	59	23	11	--
4	220	329	70	30	61	119	11	31	17	9	147	128	24	27
5	--	--	--	--	--	--	--	--	--	15	--	7	15	--
TOT.	618	787	127	86	87	149	28	56	71	70	254	200	80	37

B. PHASE II COMPARISON : DUAL PURPOSE TRAWL WITH 40mm COD END (DP40) AND PRAWN TRAWL OF 40mm THROUGHOUT (PT)

	WHITING		COD		HAKE		MAKERAL		FLAT-FISH		ANGLER		MIXED	
DAY	DP40	PT	DP40	PT	DP40	PT	DP40	PT	DP40	PT	DP40	PT	DP40	PT
6	--	--	--	--	--	--	--	--	--	--	25	20	13	14
7	97	70	57	87	--	24	--	11	16	7	54	59	20	--
8	139	235	24	--	--	--	--	--	11	9	--	37	62	12
9	--	--	12	--	10	--	21	--	21	11	--	--	10	8
10	--	--	--	--	--	--	--	--	26	--	--	--	11	15
TOT.	236	305	93	87	10	24	21	11	74	27	79	116	116	49

FIG. 1 PHASE 1 COMPARISON - LOCATION OF HAULS

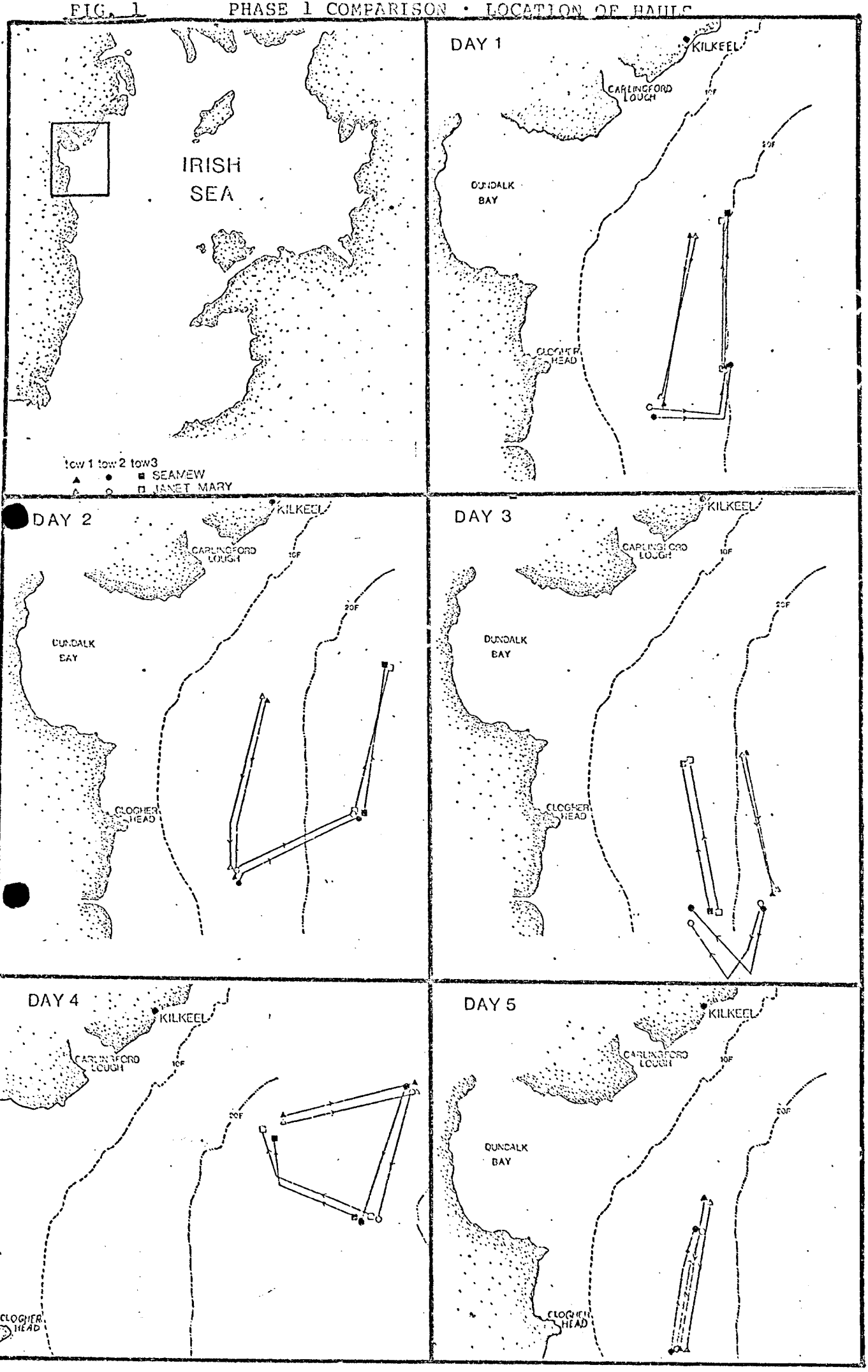


FIG. 2 PHASE 2 COMPARISON : LOCATION OF HAULS

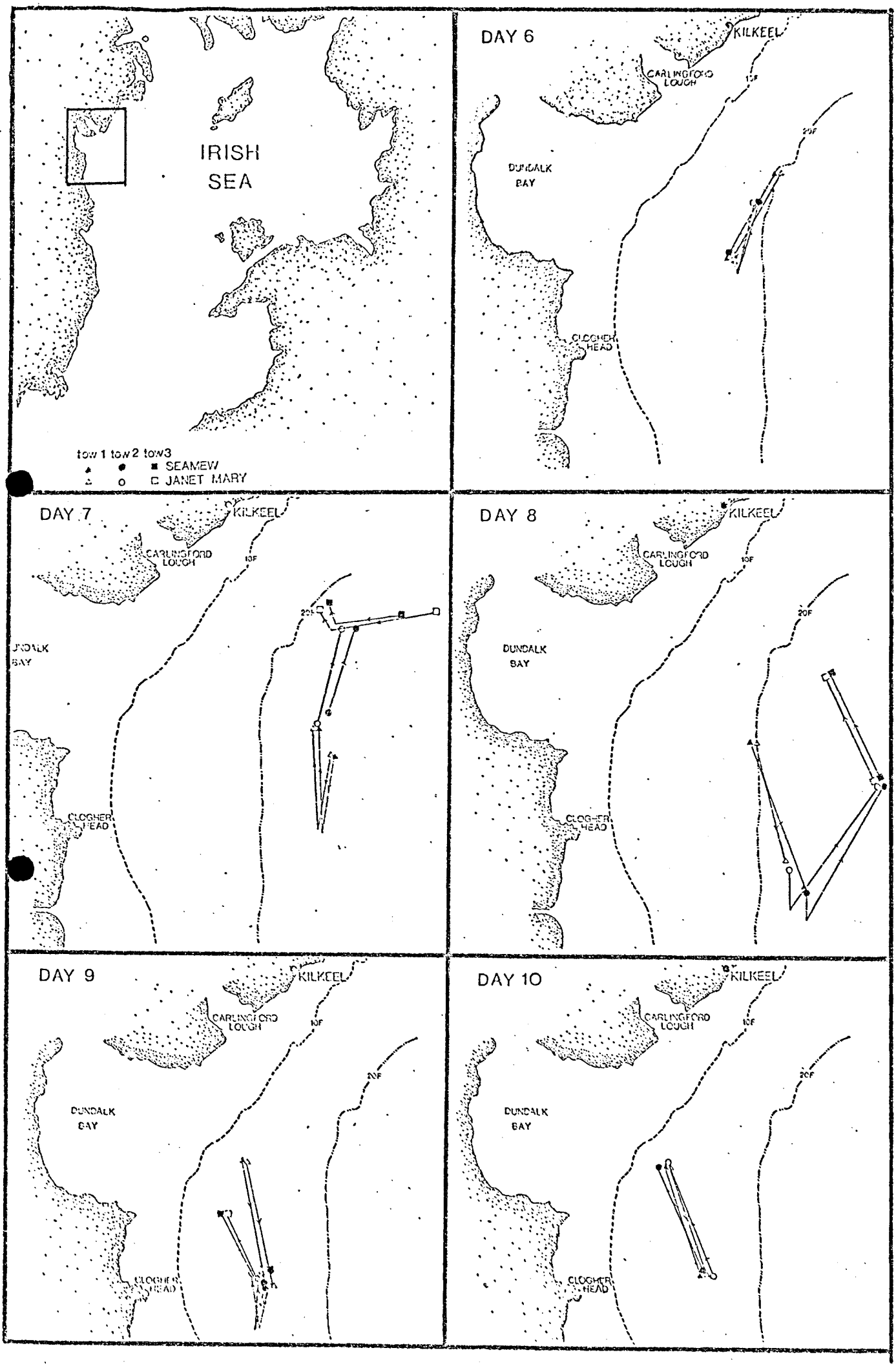


FIG 3 NEPHROPS CARAPACE LENGTH FREQUENCY HISTOGRAMS
PHASE 1 COMPARISON

NEPHROPS

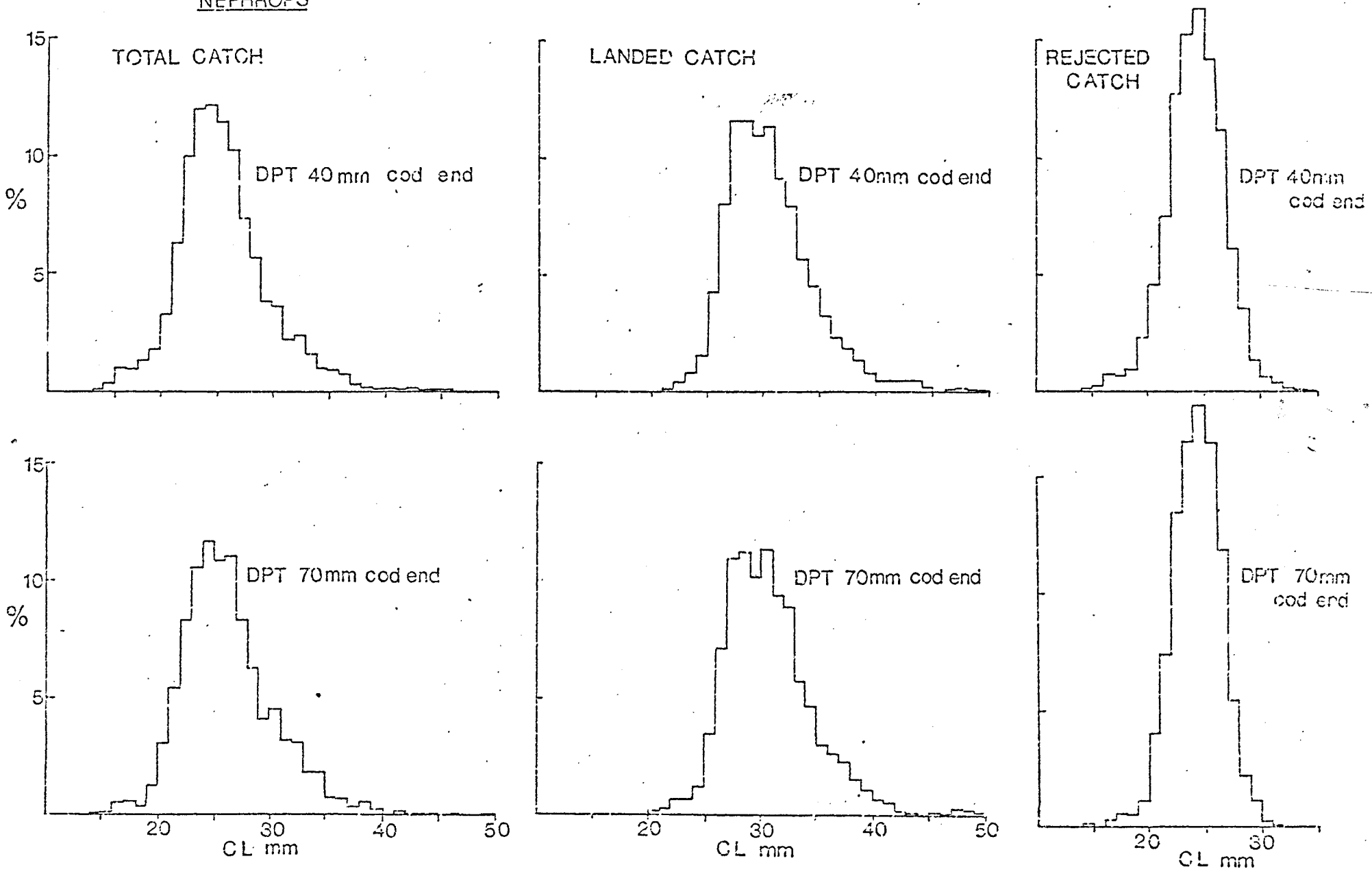


FIG. 4 NEPHROPS CARAPACE LENGTH FREQUENCY HISTOGRAMS
PHASE II COMPARISON

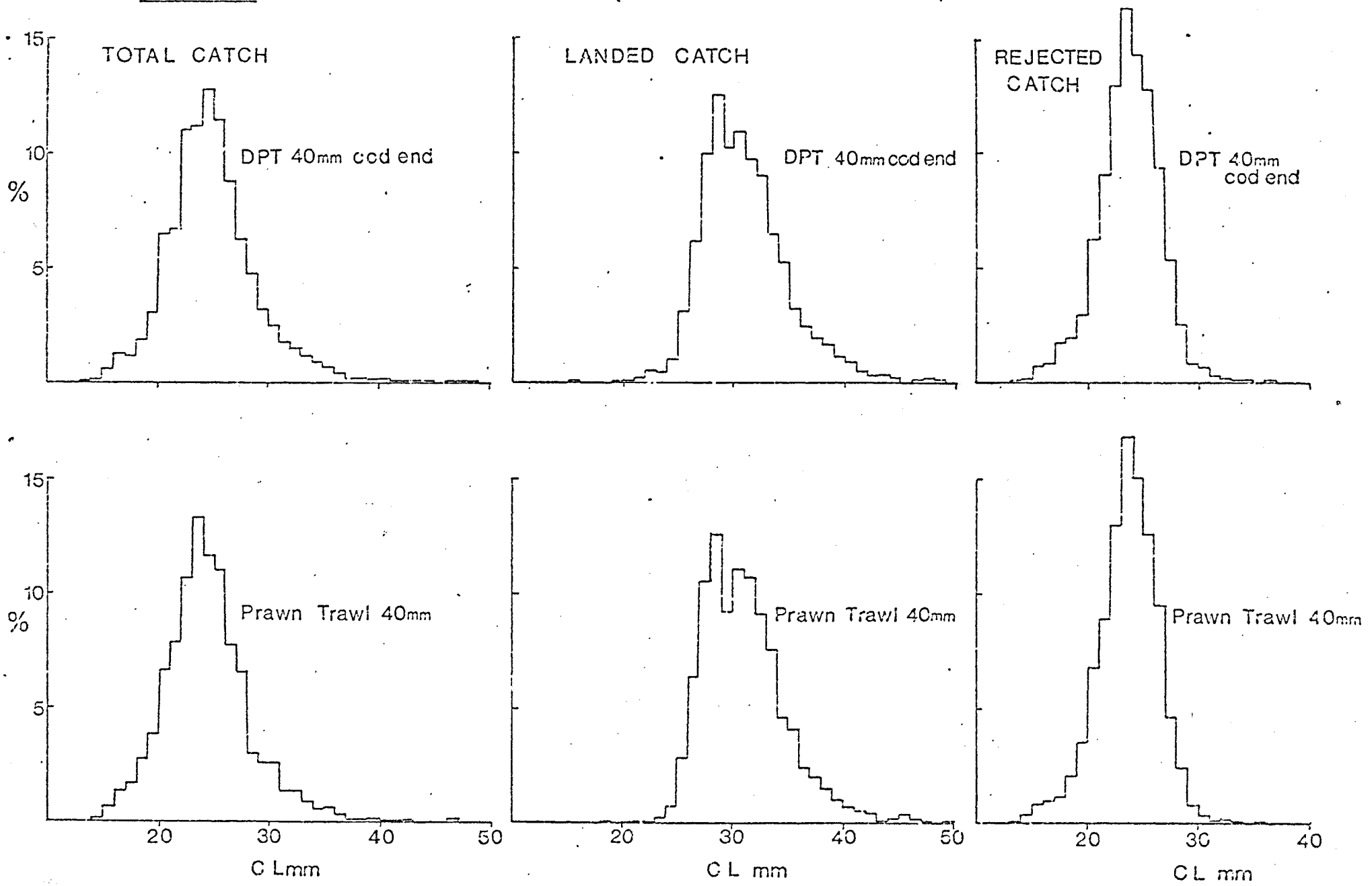


FIG. 5 PHASE I COMPARISON CARAPACE LENGTH FREQUENCIES SUPERIMPOSED

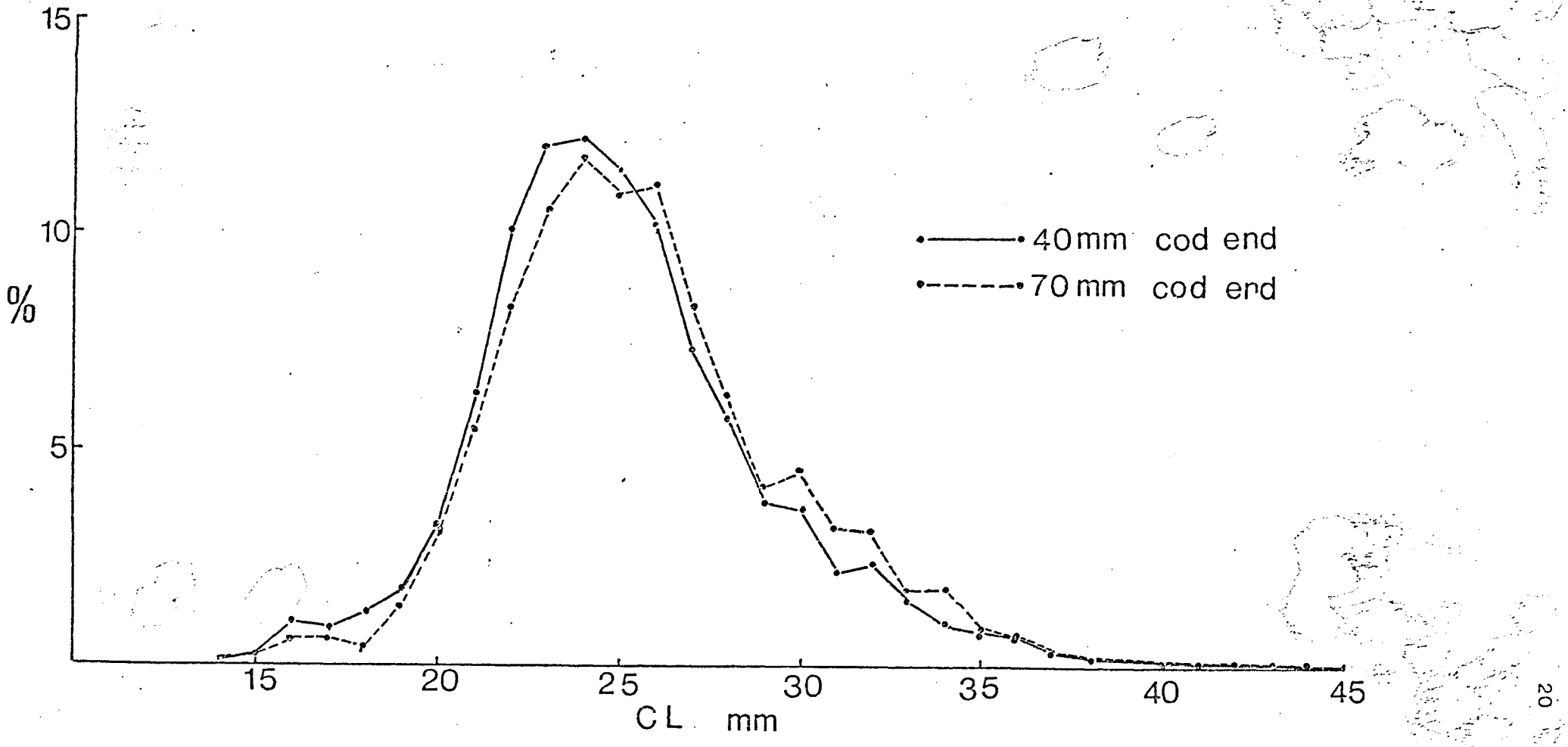


FIG. 6 PHASE II COMPARISON CARAPACE LENGTH FREQUENCIES SUPERIMPOSED

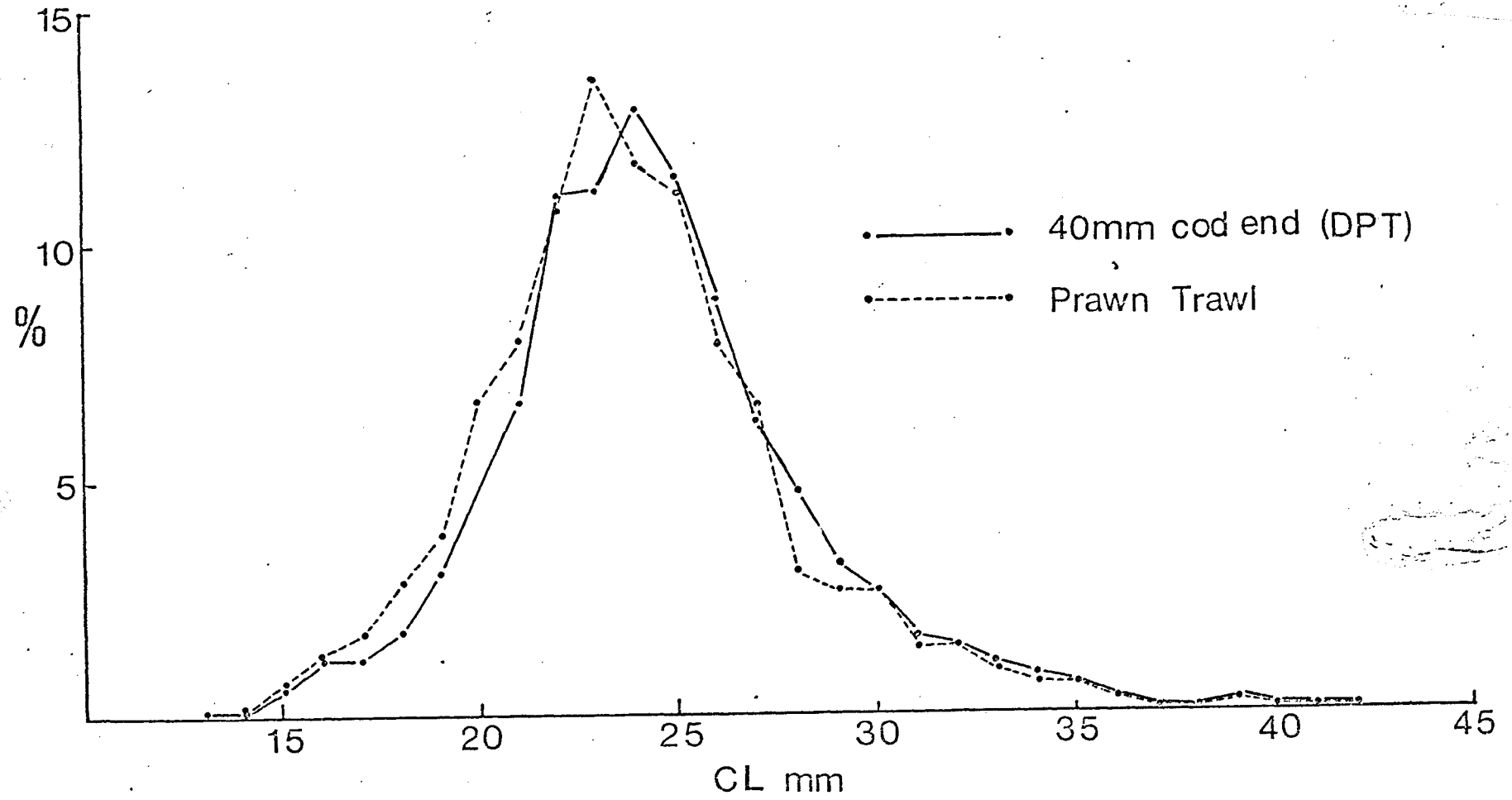


FIG 7 MEAN CARAPACE LENGTH OF NEPHROPS SAMPLED FROM THE TOTAL CATCH ON EACH DAY OF THE STUDY

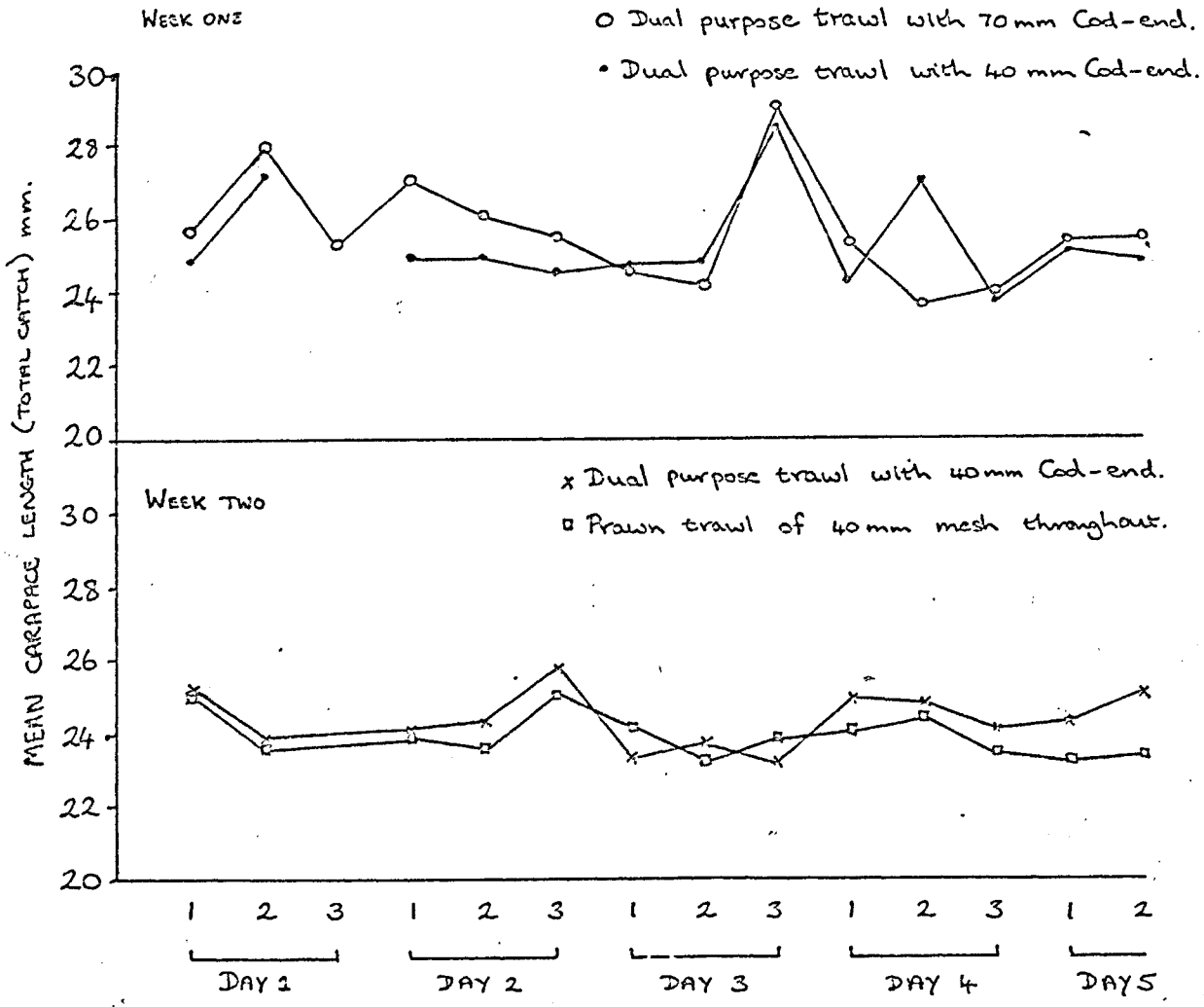
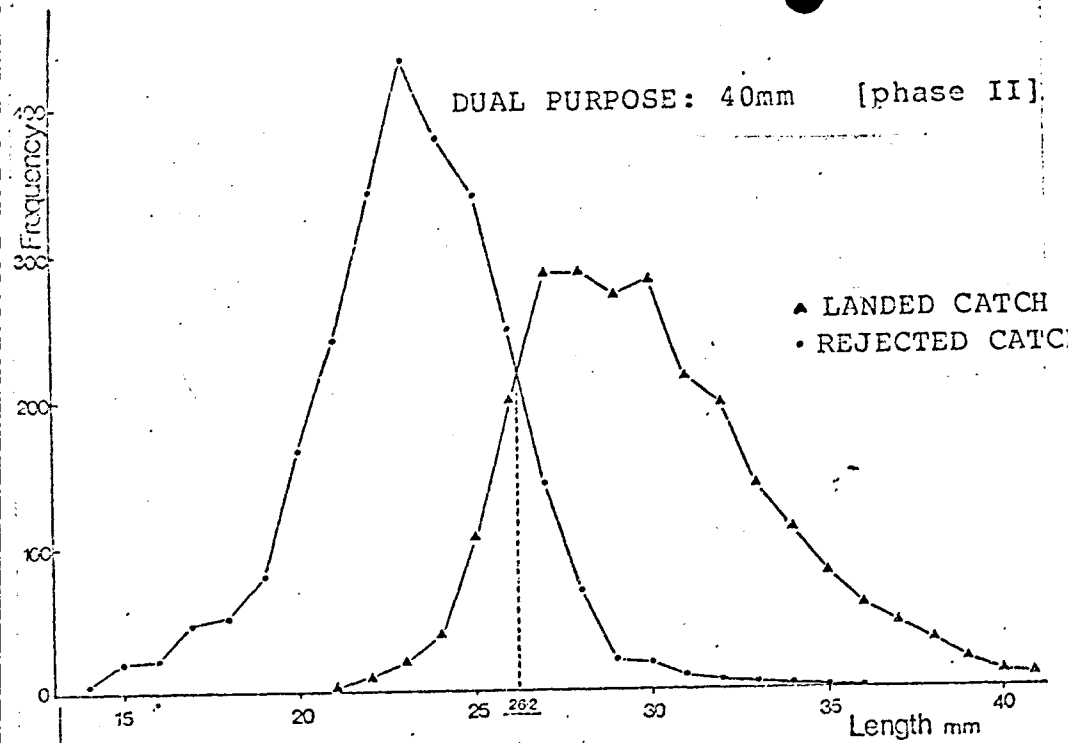
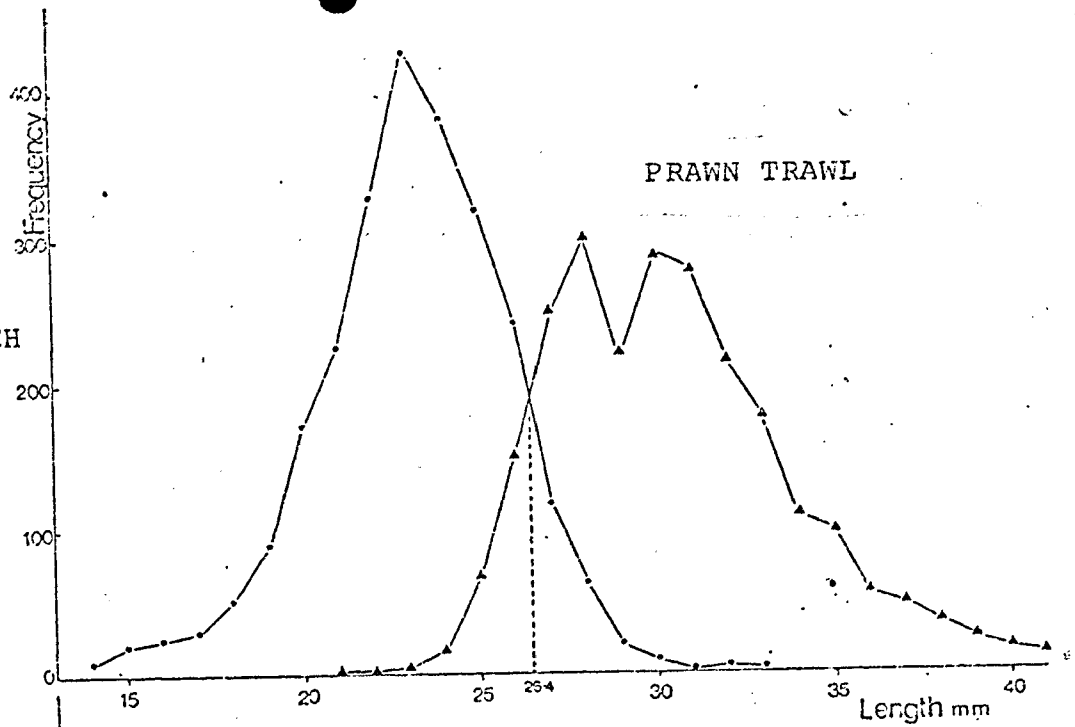
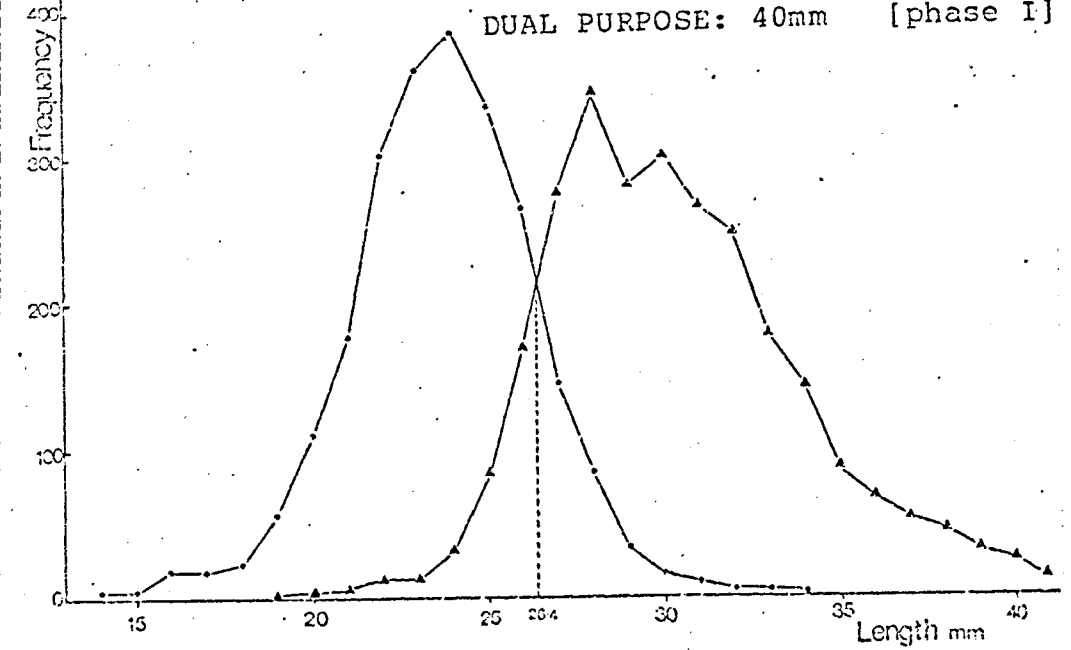


FIG 8 METHOD USED FOR DETERMINATION OF CREWS' SELECTION POINT







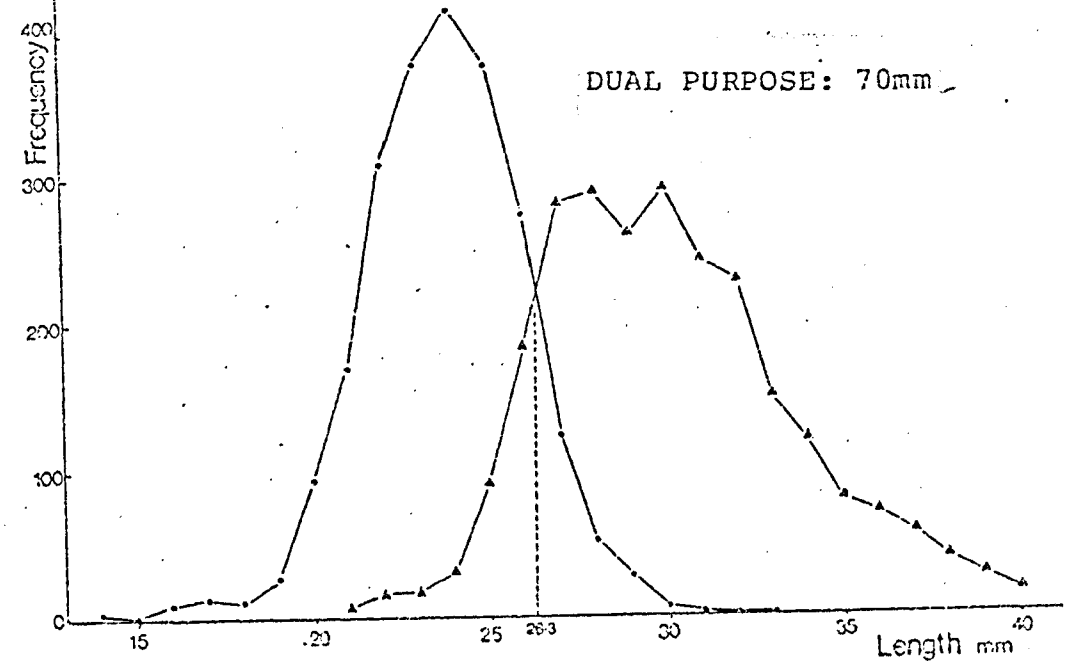
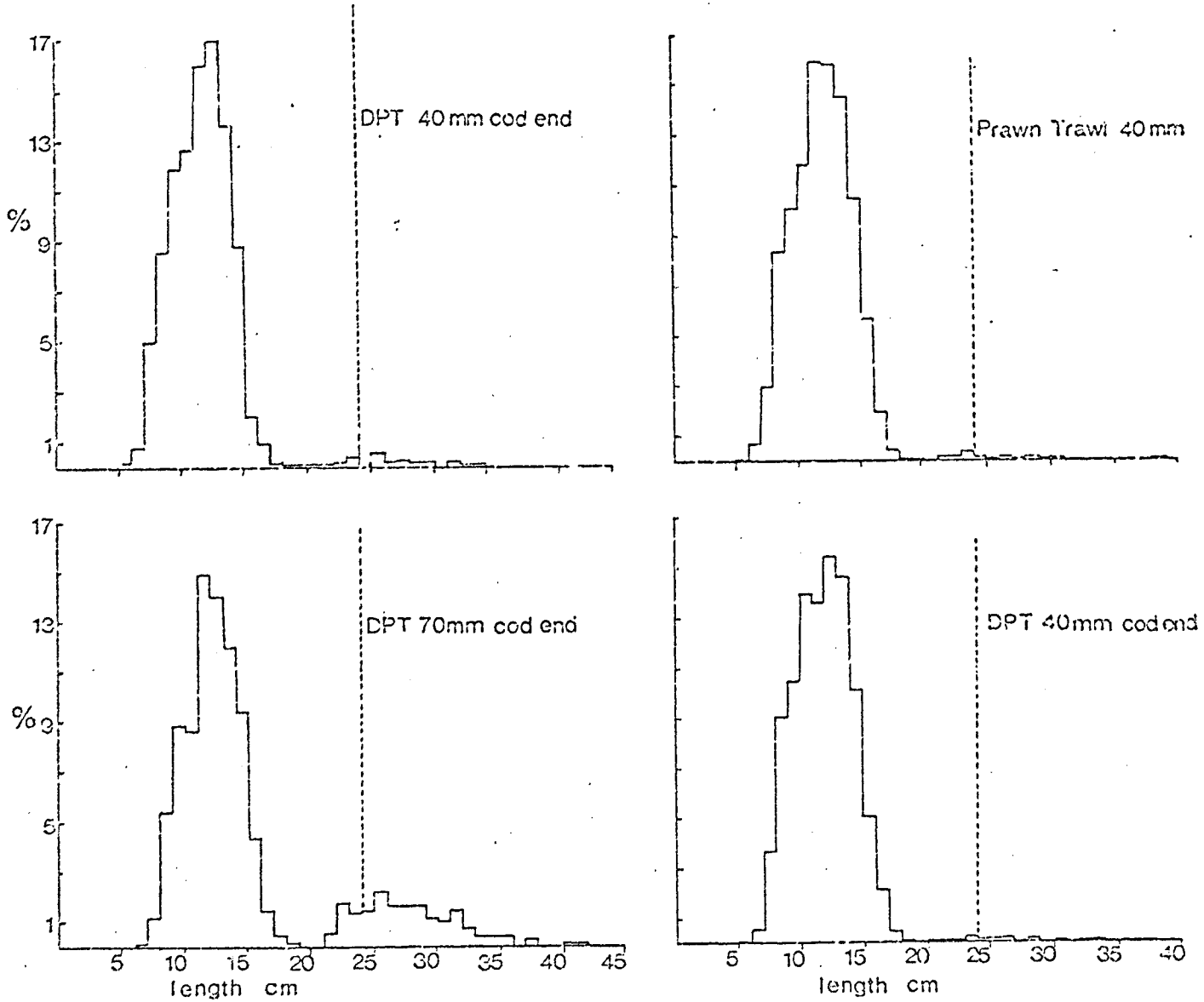


FIG. 9 WHITING LENGTH FREQUENCY HISTOGRAMS

PHASE I COMPAPISON

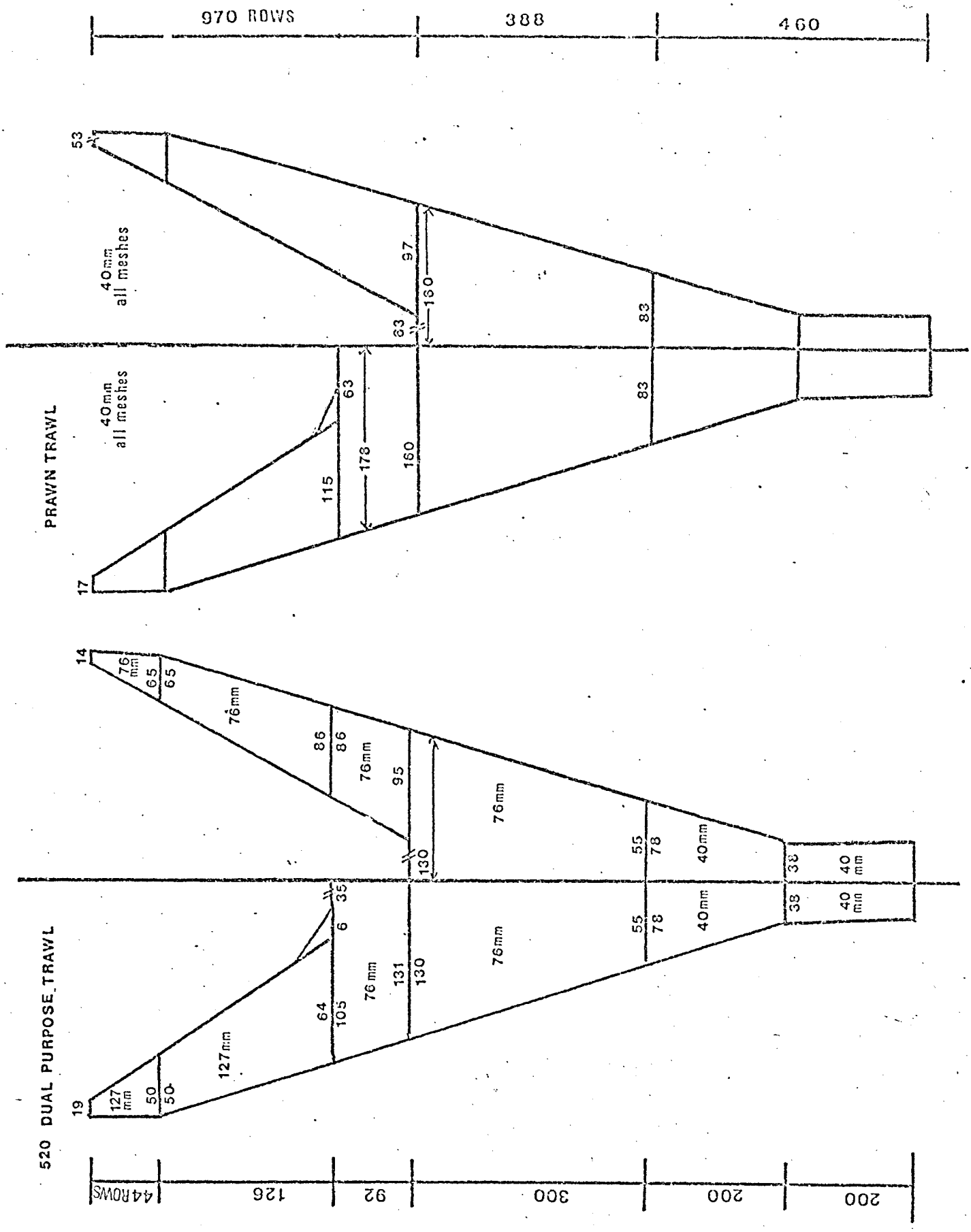
PHASE II COMPARISON



APPENDIX A

SPECIFICATIONS OF VESSELS

Registered Name	"Seamew"	"Janet Mary"
Number	N52	N102
D.A.F.S. Code No	9025	9027
Gross Tonnage	47.06	47.75
Registered Length (ft)	60.9	61.9
Engine HP	114	200



APPENDIX B

Dual purpose trawl and prawn trawl. Units indicate numbers of meshes. Vertical scale in rows of knots. Approximate mesh measurements (in millimetres) are given.