COMPARATIVE FISHING EXPERIMENTS IN RELATION TO SELECTIVITY

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INTRODUCTION

Up to now, selectivity experiments mainly dealt with the selection properties of different codend materials and mesh sizes. Little attention has been paid to the influence on selectivity of factors extraneous to the codend itself, such as the fishing vessel and the towing speed, the fishing gear and its rigging etc.

At the 1973 meeting of ICES, it was decided to recommend that : "as it is recognised that selectivity of fish by codends may be influenced by towing speed, shape of gear, type of vessel and other parameters, member countries be urged to carry out comparative fishing experiments to assess the magnitude of such variations" (C. Res. 1973/5:6).

The paper gives the results of some investigations designed to evaluate the effect of vessel characteristics on selectivity. A second experiment, dealing with the influence of the fishing gear, will be carried out later.

MATERIAL AND METHODS

The measurements took place aboard two commercial fishing vessels of different size fishing with similar bottom trawls and identical codends.

The vessels' engine power was 200 HP and 375 HP respectively and their gross tonnage 79.51 BT and 98.39 BT. Further data about the two ships are given in table 1.

The nets, characteristics of which are also noted in table 1, had codends made of polyamide yarn (R3500 tex), with a mesh size of 75 mm. A whole cover, made of polyethylene netting with a mesh size of 55 mm, was used. Cover and codend are shown in figure 1, whereas the data on the yarns are given in table 1.

The measurements on board both ships took place during the same period, viz. from April 20th to May 1st, 1974, and on the same fishing ground, viz. the Botney Gut and the southern part of the Outer Silver Pit (ICES div. IVb).

Catches consisted mainly of whiting and dab. Cod, sole and Norway lobster were also caught, but in smaller quantities.

Three species were measured : whiting, dab and sole. The number of soles caught however was too small to draw any conclusions about the selectivity, so that only the results for whiting and dab are discussed in this paper. The total length of each fish was measured to the nearest centimeter. As whiting and dab were generally too numerous to be measured only representative samples were taken.

The selectivity curve was fitted for each haul separately as well as for all hauls combined. It was accepted that the selectivity curve can be expressed by the logistic function. The parameters of this function were estimated by the method of maximum likelihood (Pope, 1966). The fitting of the logistic function to the observed proportions was tested by the χ^2-test. Limits for significance were set at 5 %. Only those hauls for which the difference between observed and calculated proportions was not significant were retained (*).

Table 2 shows the number of hauls carried out and retained for each species and vessel.

The three discarded whiting catches on board the smallest vessel came from hauls carried out in rough weather. It is probably so that the fishing

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(*) The mathematical treatment of the data was carried out with the assistance of the "Bureau of Biometry" (Government Agriculture Research Centre, Ghent, Belgium).

efficiency of the net decreased under these circumstances so that no
selection curve could be fitted. No clinching explanation could be found
for the discarded dab catches.

The length distribution of the fish measured is shown in figures
2 and 3.

The mesh size of the codends were regularly measured with an ICES
gauge operating at a pressure of 4 kg. As no large and systematic changes
in mesh size were noted, the mean of all measurements was taken as the true
mesh size.

RESULTS AND DISCUSSION

The results for the grouped whiting catches are noted in table
3. The selectivity curves are given in figure 4.

For vessel 1, no logistic curve with a non-significant χ^2 could
be calculated. The best estimate (χ^2 = 24.023 with 8 degrees of freedom)
was used for the calculations of the 50 % retention length and the 25-75 %
selection range.

From the results it appears that the selection factor is the same
for both vessels, namely 3.7. A possible influence of the vessel however
is observed in the 25-75 % selection range. The selectivity curve for the
larger vessel is steeper than the selectivity curve for the smaller one.
Smaller fish caught by the larger vessel consequently have more chances to
escape, as can clearly be seen from figure 4.

Tables 4 and 5 give the data for single hauls. The selectivity
factors for vessel 1 range between 3.5 and 3.9 with a mean of 3.7. The
selectivity factors for vessel 2 range between 3.5 and 4.0 with the same
mean. The selection ranges are from 49 mm to 79 mm for vessel 1 and from
34 mm to 71 mm for vessel 2. The conclusions made for the entire experiment
are thus confirmed when considering the hauls separately. The relative
great range of the results could not be explained by the available data
from each haul. The time of fishing (day or night), catch size, catch
composition and weather conditions had no systematic influence on the
selection factor and the selection range.

In table 6 the results from the combined dab catches are noted. The corresponding length selection curves are shown in figure 5. The selection factors obtained from both ships have the same value, viz. 2.5.

The 25-75 % selection ranges however differ considerably.

In contrast with whiting, the smallest selection range, 21 mm, for dab occurs with the smaller vessel, and the largest selection factor, 49 mm, with the larger one. The smaller vessel thus shows the steepest length selection curve, in other words small fish caught by this vessel can escape more easily than those caught by the larger vessel. This can clearly be seen in figure 5.

The comparison of the single hauls confirm these observations. The selection factors for vessel 1 range between 2.4 and 2.6 with a mean of 2.5 ; those for vessel 2 range between 2.4 and 2.7 with a mean of 2.5. The selection range fluctuates between 22 mm and 39 mm for the smaller ship and between 34 mm and 58 mm for the larger one. As is the case for whiting, no explanation for the occurring variations could be found.

The difference in selection range can probably be explained by the relative importance of several causal factors. The greater fishing speed of the larger vessel leads to a difference in mesh shape, larger by-catches and consequently to a different water flow pattern through the net in comparison with the smaller vessel. The difference in mesh shape may explain the difference in results for roundfish and flatfish, whereas the difference in catches, speed and water flow pattern certainly affects the possibility of fish escaping.

SUMMARY

The influence of the fishing vessel on selectivity was examined for two ships of different size, fishing however with the same type of net and identical codends.

For the two fish species considered in this paper, whiting and dab, no difference in selection factor could be established.

A possible influence of the vessels' size however found expression in the 25-75 % selection range. Indeed, the selection range for whiting

is the largest for the smaller vessel, whereas for dab a larger selection range is found with the larger vessel.

Hence, small whiting seems to be able to escape more easily with the larger vessel, small dab with the smaller. These results may have some importance in relation to the protection of undersized fish.

For both ships however relative large variations between the different hauls were observed.

Final conclusions on the influence of the vessel on selectivity requires further research involving   fishing vessels with greater differences in power.and fishing speed as well as more fish species.

REFERENCES

Pope, J.A., 1966 - Manual of methods for fish stock assessment. Part III. Selectivity of fishing gear - FAO Fisheries Technical Paper no. 41.

Table 1 - General data.

Ship	I	II
Length over all (m)	19.67	27.20
Gross tonnage	79.51	98.39
Engine horse-power	200	375
Average towing speed (Kn)	2.5 - 3	3 - 3.5
Fishing gear	Bottom trawl	Bottom trawl
Length of the ground rope (m)	24.8	26.8
Length of the headline (m)	19.0	21.4
Netmaterial	Polyethylene	Polyethylene
Mesh size (mm)	80-70	85-80
Locality	Botney Gut ; Southern part Outer Silver Pit	
Depth range (m)	50-70	
Experimental method	Whole cover	
Codend		
Material	Polyamide, multifilament	
R...tex	3500	
Braiding	Double twine	
Twine construction	Twisted	
Mesh size, mean (mm)	74.6	74.4
Range (mm)	70-83	68-85
S.E. of mean (mm)	0.1	0.2
No of measurements	270	264
Wet knot breaking strength (kg)	159.6	
Twine diameter, wet (mm)	2.6	
Cover		
Material	Polyethylene, monofilament	
R...tex	2100	
Braiding	Double twine	
Twine construction	Twisted	
Mesh size (mm)	55	

Table 2 - Number of hauls.

	Whiting		Dab	
	Number of hauls	Number of retained hauls	Number of hauls	Number of retained hauls
Vessel 1	13	10	9	7
Vessel 2	15	15	10	5

Table 3 - Selection data of whiting for grouped hauls.

	Vessel 1	Vessel 2
Date	20.4 - 25.4.74	23.4 - 25.4.74
Number of hauls	10	15
Average duration of haul (min)	220	210
Average towing speed (kn)	2.5 - 3	3 - 3.5
Average weight of total catch/tow (kg)		
codend	190	262
cover	155	233
Number of measured fish	3,110	6,399
codend	1,208	2,398
cover	1,902	4,001
25-75 % selection range (mm)	61	43
Number of fish in selection range		
codend	795	999
cover	939	1,133
50 % retention length (mm)	278	277
Type of mesh gauge	ICES ; 4 kg	ICES ; 4 kg
Codend		
mesh size ; mean (mm)	74.6	74.4
range (mm)	70-83	68-85
S.E. of mean (mm)	0.1	0.2
Number of measurements	270	264
Selection factor	3.7	3.7

Table 4 - Selection data of whiting for individual hauls - vessel 1

Haul no.	1	16	17	18	23	24	25	26	28	30
Total catch (kg) codend/cover	200/125	100/100	250/150	200/150	200/175	150/150	150/150	200/150	300/250	150/150
Duration of haul (min)	190	240	215	220	210	215	250	240	210	210
Measured part of catch	1/1	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Total number of whiting	337	266	360	450	215	224	220	305	457	276
Number of whiting in codend	94	116	138	142	89	97	80	126	198	127
cover	243	150	222	308	126	127	139	179	259	149
25-75 % selection range (mm)	51	59	60	74	61	42	52	51	48	79
Number of whiting in selection range										
codend	47	84	108	108	59	45	50	75	103	91
cover	72	87	114	167	79	50	54	72	195	106
50 % retention length (mm)	283	270	264	289	270	262	273	273	283	275
Mesh size, mean (mm)	74.6	74.6	74.6	74.6	74.6	74.6	74.6	74.6	74.6	74.6
Selection factor	3.8	3.6	3.5	3.9	3.6	3.5	3.7	3.7	3.8	3.7

for individual hauls - vessel 2

7	8	9	10	11	12	14	15	16
500/400	350/350	350/350	300/300	250/250	200/200	600/500	200/150	200/200
210	210	210	210	210	210	210	205	210
1/2	1/4	1/2	1/2	1/4	1/4	1/6	1/2	1/2
607	530	456	398	378	396	663	194	228
288	183	142	179	97	142	314	28	81
319	347	314	219	281	254	349	166	147
38	39	40	68	62	35	34	40	46
83	66	56	111	42	53	103	10	42
97	77	74	116	53	54	116	12	44
273	288	280	270	294	275	274	288	260
74.4	74.4	74.4	74.4	74.4	74.4	74.4	74.4	74.4
3.7	3.9	3.8	3.6	4.0	3.7	3.7	3.9	3.5

Table 6 - Selection data of dab for grouped hauls

	Vessel 1	Vessel 2
Date	20.4 - 22.4.74	29.4 - 30.4.74
Number of hauls	7	5
Average duration of haul (min)	216	210
Average towing speed (kn)	2,5 - 3	3 - 3,5
Average weight of total catch/tow (kg)		
codend	200	214
cover	143	204
Number of measured fish	2,787	1,972
codend	986	871
cover	1,801	1,101
25-75 % selection range (mm)	21	49
Number of fish in selection range		
codend	281	435
cover	321	505
50 % retention length (mm)	185	184
Type of mesh gauge	ICES ; 4 kg	ICES ; 4 kg
Codend		
mesh size ; mean (mm)	74.6	74.4
range (mm)	70 - 83	68 - 85
S.E. of mean (mm)	0.1	0.2
number of measurements	270	264
Selection factor	2.5	2.5

Table 7 - Selection data for dab for individual hauls - vessel 1

Haul no.	2	5	6	7	11	12	13
Total catch (kg) codend/cover	200/150	150/100	150/150	150/150	300/150	200/100	250/200
Duration of haul (min)	225	210	225	210	210	210	225
Measured part of catch	1/8	1/4	1/4	1/4	1/4	1/4	1/4
Total number of dab	484	554	355	403	387	365	239
Number of dab in codend	165	191	166	140	155	111	58
cover	319	363	189	263	232	254	181
25-75 % selection range (mm)	22	22	31	25	21	39	29
Number of dab in selection range							
codend	51	56	55	56	36	58	25
cover	63	72	54	57	43	59	22
50 % retention length (mm)	184	185	188	186	177	193	193
Mesh size, mean (mm)	74.6	74.6	74.6	74.6	74.6	74.6	74.6
Selection factor	2.5	2.5	2.5	2.5	2.4	2.6	2.6

Table 8 - Selection data for dab for individual hauls - vessel 2

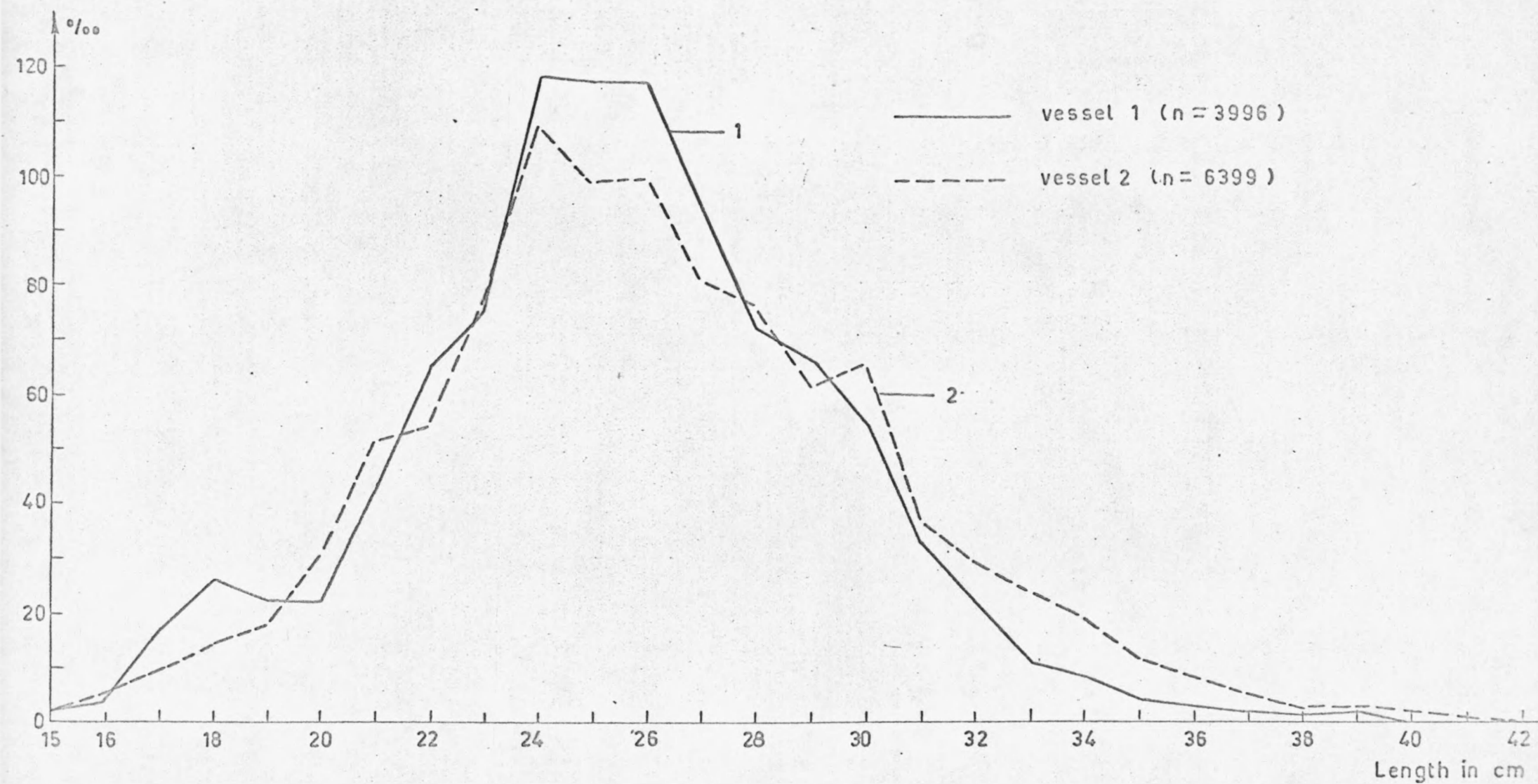| Haul no.	37	38	39	40	44
Total catch (kg) codend/cover	220/200	180/150	220/200	250/220	200/250
Duration of haul (min)	210	210	210	210	210
Measured part of catch	1/6	1/8	1/6	1/12	1/6
Total number of dab	362	222	318	562	508
Number of dab in codend	163	115	161	221	211
cover	199	107	157	341	297
25-75 % selection range (mm)	44	58	41	34	44
Number of dab in selection range					
codend	79	74	71	79	92
cover	96	78	77	105	114
50 % retention length (mm)	176	183	181	176	199
Mesh size, mean (mm)	74.4	74.4	74.4	74.4	74.4
Selection factor	2.4	2.5	2.4	2.4	2.7

Figure 1 — Codend with cover.

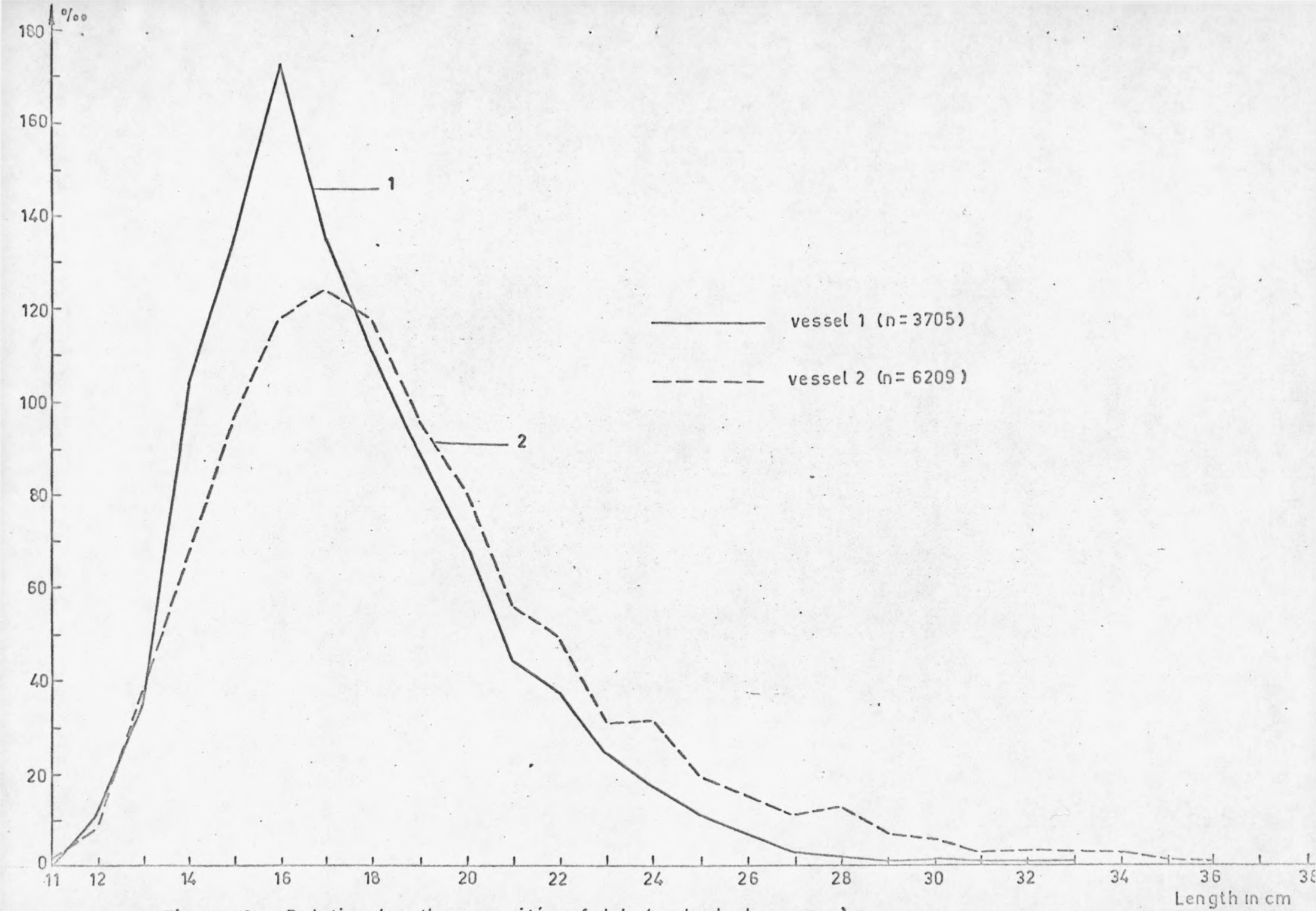Figure 2 — Relative length composition of whiting (codend plus cover)

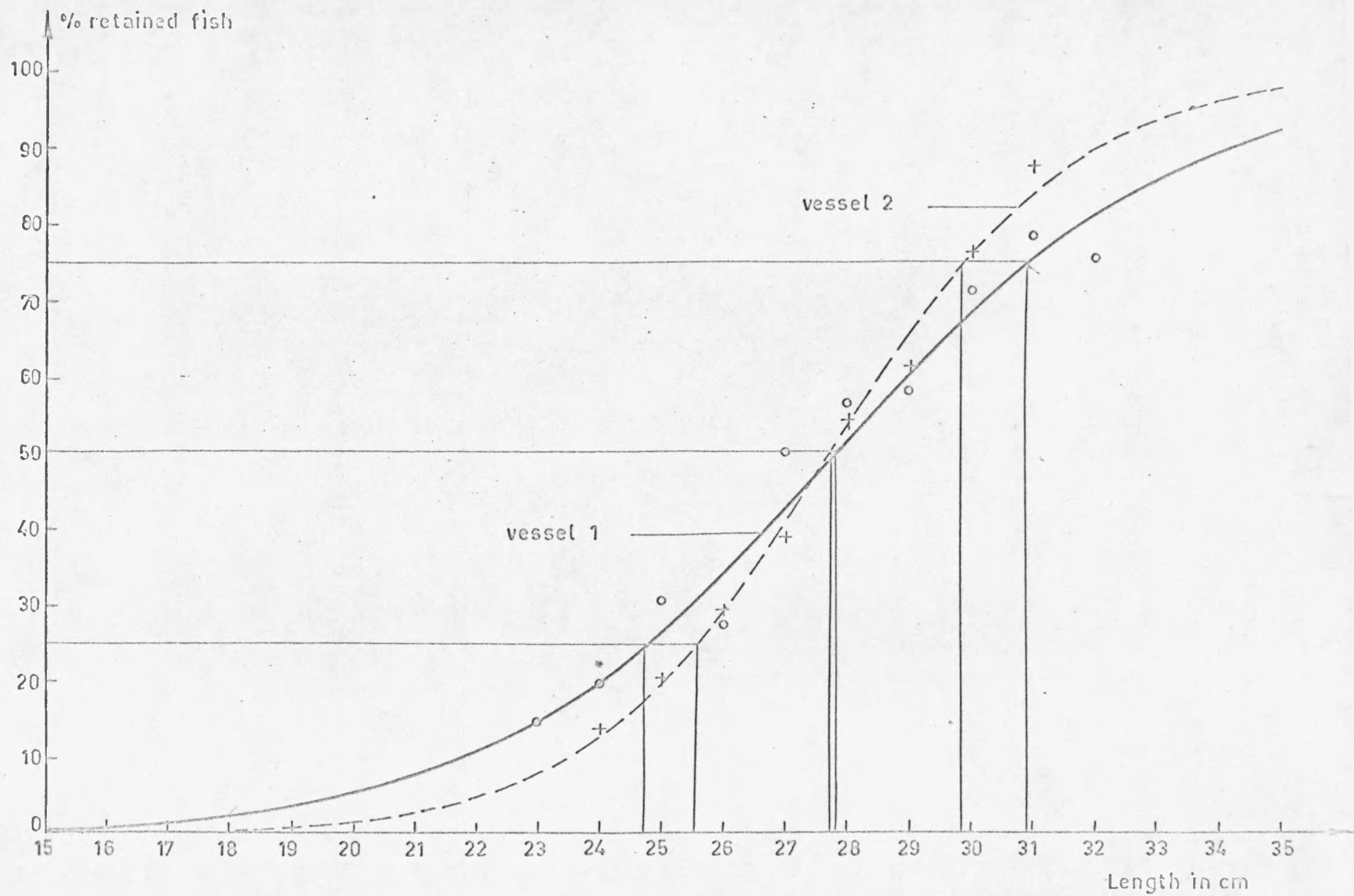Figure 3 — Relative length composition of dab (codend plus cover)

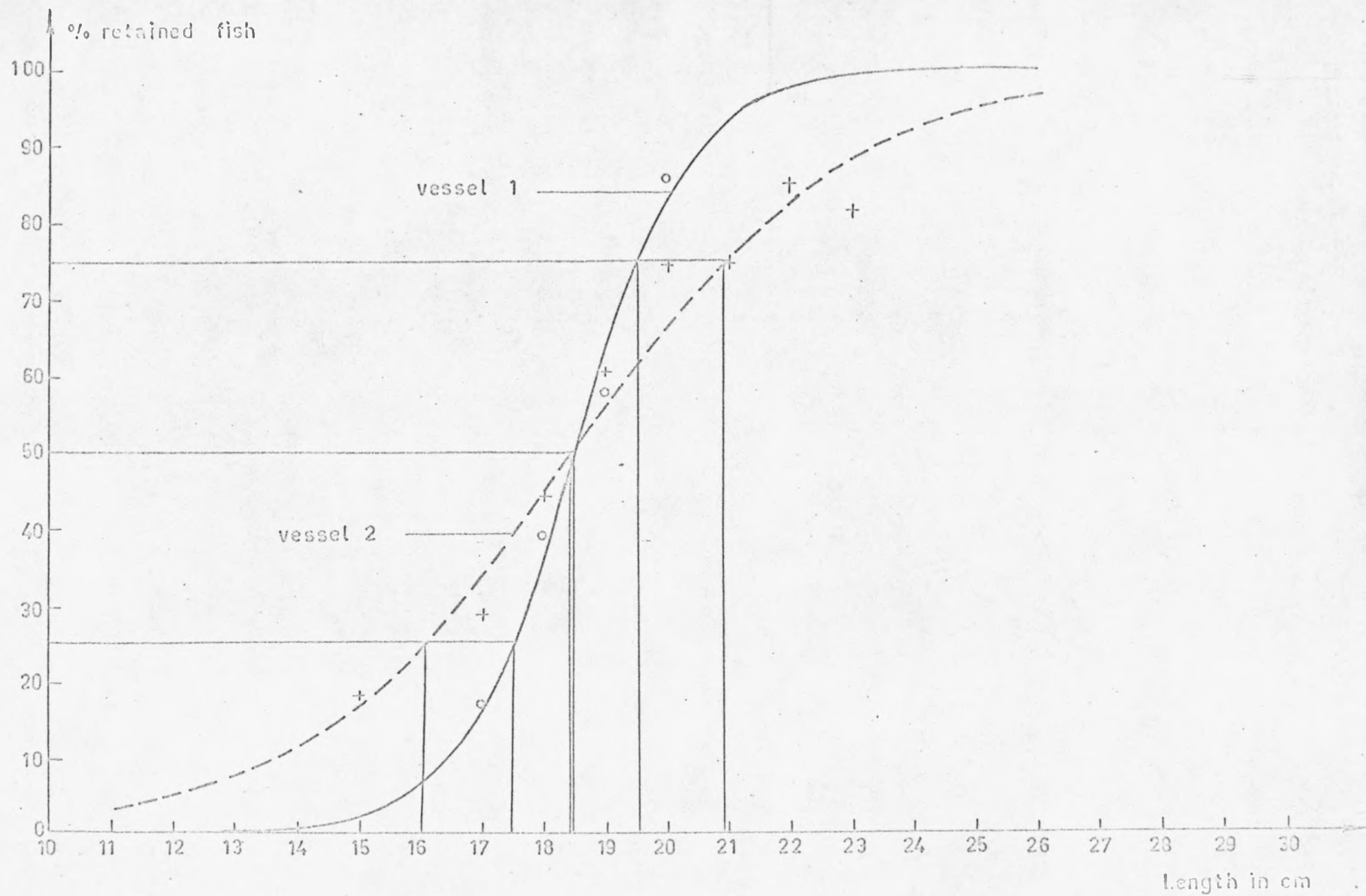Figure 4 — Selection curves of whiting for combined hauls

Figure 5 _ Selection curves of dab for combined hauls