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Further results of selectivity experiments with beam trawls

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ABSTRACT

Selectivity experiments on beam trawlers of different sizes were carried out. Cod-end mesh sizes of 75, 80, 85 and 90 mm were used. The selection factors for soles varied from 3.1 to 3.3. The experiments indicated an interference of the state of the sea.

RESUME

Des expériences de sélectivité sur des chalutiers à gaules de puissances différentes ont été effectué. Des ouvertures de maille de 75, 80, 85 et 90 ont été utilisée dans la poche. Le facteur de sélection pour les soles variait entre 3,1 et 3,3. Les expériences indiquaient que la sélectivité était influencée par la condition de la mer.

INTRODUCTION

A national programme has been set up in 1980 to investigate the relationship between selectivity and horse-poer in the Belgian beam trawl fishery for soles.

These selectivity experiments were to be carried out on three types of commercial vessels with a horse power in the order of 250,500 and 1200. The first results of the "low horse power" vessel were presented in 1980 (ICES C.M. 1980/B:21). This paper is dealing with the results of all vessel types and a general approach has been made on the whole experiment.

MATERIAL AND METHODS

Table 1 gives information on the characteristics of the vessels concerned and the dates of the cruises. The main fishing areas are shown in figure 1.

The vessels were equipped for beam trawling with beams of 4, 6 and 10 metres for respectively vessel 1, 2 and 3.

Apart from the different cod-ends no alternation was made to the normal commercial equipment and operation of the vessels. In the cod-end four different mesh sizes were used alternatively, viz. 75 mm, 80 mm, 85 mm and 90 mm. The 75 mm and 85 mm cod-ends as well as the 80 mm and 90 mm cod-ends were used simultaneously. For each cod-end half of the hauls were carried

out on starboard, the other half on portside). This arrangement did not show any significant differences (see also C.M. 1980/B:21). The cod-end cover (whole cover) had a mesh size of 63 mm.

The physical properties of the netting used for cod-ends and cover are shown in table 2. Mesh sizes were measured regularly during the experiments with an ICES spring-loaded gauge having an operating pressure of 4 kg. Some hauls were carried out without a cover to ensure that no masking occurred.

For each haul the soles were measured to the nearest cm and rough estimates of the by-catches were made.

In order to determine any secondary influences on the selectivity, records were made of the weather conditions (wind speed and direction, state of the sea), duration of the haul, depth, current direction and catch composition (commercial and non-commercial).

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 %.

RESULTS

1. The selection ogives for all hauls of each vessel are shown in figures 2 to 5. A compilation of these selection data is given in table 3.

For vessel 1 the 50 % retention length (L_{50}) varied from 24.5 cm for the 75 mm cod-end to 28.1 cm for the 90 mm cod-end. An increase in mesh size from 80 mm (minimum mesh size enforced in the North Sea) to 90 mm resulted in an increase of L_{50} with 1.8 cm.

The selection factors for each cod-end were of the same order, viz. from 3.12 to 3.21.

For vessel 2 two cruises were made, the first being characterized by bad weather conditions, up to state 7 (wave height 6-9 m), while using the 80 mm and 90 mm cod-ends.

Cruise one showed a variation of L_{50} from 25.2 cm for the 75 mm cod-end to 30.4 cm for the 90 mm cod-end. The difference of L_{50} between the 80 mm and the 90 mm cod-ends amounted to 3.3 cm. The high values of L_{50} for the 80 mm cod-end (L_{50} = 27.1 cm) and the 90 mm cod-end (L_{50} = 30.4 cm) were due to the above mentioned bad weather conditions. This appeared also from the data-analysis according to the state of the sea (see point 3). These conditions resulted in the 80 mm cod-end being even more selective than the 85 cod-end and 11 % of the soles larger than 35 cm being able of escaping through the 90 mm netting.

In the second cruise L_{50} varied from 25.9 cm (75 mm cod-end) to 28.9 cm (90 mm cod-end). As for vessel 1 the difference in L_{50} for the 80 mm and 90 mm cod-end was 1.8 cm.

With the exception of the 85 mm cod-end (S.F. = 3.09) the selection factors for both cruises varied between 3.21 and 3.37.

Vessel 3 showed values of L_{50} ranging from 24.2 cm for the smallest mesh size to 27.8 cm for the largest. The difference in L_{50} between the 80 mm and 90 mm cod-ends was again 1.8 cm. The selectivity factors for this vessel lied between 3.12 and 3.28.

2. When comparing the 50 % retention lengths of each vessel fishing with a same cod-end, the most distinctive differences seemed to occur between vessel 2 and vessel 3, vessel 3 being the less selective. For the 75 mm cod-end the difference in L_{50} was 1.0 cm or 1.7 cm, depending on whether the first or the second cruise of vessel 2 was concerned. These differences reached 1.1 cm for the 80 mm cod-end, 0 and 1.0 cm for the 85 mm cod-end and 2.6 cm and 1.1 cm for the 90 mm cod-end. The comparison of the selection factors also showed the rather small differences apart from the higher values due to the influence of the weather during the first cruise of vessel 2. The extremes were : for the 75 mm cod-end 3.37 and 3.20, for the 80 mm cod-end 3.35 and 3.28, for the 85 mm cod-end 3.21 and 3.12 and 3.36 and 3.14 for the 90 mm cod-end.

As to vessel 1 the situation was less clear. Taking the size of the vessel into account one would expect a selectivity somewhat higher than observed for vessel 2. In fact the 50 % retention lenghts of vessel 1 had values between those of vessels 2 and 3. As to the selectivity factors, the values obtained for vessel 1 were slightly lower than those for vessel 3 for the 75 mm, 80 mm and 90 mm cod-ends and slightly higher for the 85 mm cod-end. A possible explanation may be found in the good weather conditions during these experiments (see below).

3. Table 4 gives the results of the analysis according to the state of the sea. The data were grouped according to three ranges of wave height, viz. S_1 : 0-0.5 m, S_2 : 0.5-4.0m and S_3 : +4.0 m.

The 50 % retention lengths showed a distinct increase with increasing wave height for vessel 2 and vessel 3. This increase was not apparent for vessel 1. The reason may be found in the fact that only wave heights up to 1.25 m for S_2 were reached. This low value made it impossible to make a good comparison between S_1 and S_2 for vessel 1.

The influence of the state of the sea on selectivity was most obvious for vessel 3, as selectivity data were available for S_1, S_2 and S_3. The differences in L_{50} were 1.5 cm for the 75 mm cod-end and 2.5 cm, 2.3 cm and 2.4 cm for the 80 mm, 85 mm and 90 mm cod-ends respectively. The extent of these differences was at least of the same order as these obtained for identical cod-ends used on different vessels.

4. The results of the data-analysis according to the nature of the sea-bottom are given in table 5. Starting from the catch composition each haul was classified in one of the following codes : B_1, clean, B_2, moderately clean

and B_3, rubbish.

From table 5 it can be seen that no significant relation between selectivity and nature of the bottom could be found.

CONCLUSIONS

No distinct differences in selectivity for soles could be found between vessels with different horse power. However the state of the sea including the wind speed seemed to interfere with the selectivity whereas the nature of the fishing ground seemed to have none.

REFERENCES

ICES, C.M. 1980/B:21 : R. De Clerck and G. Vanden Broucke - Preliminary results of selectivity experiments with beam trawls.

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

Table 1 - Vessel characteristics - Dates of cruises

Vessels	Gross tonnage	Horse-power	Length overall	Dates
1 - Z12 "Sabrina"	49.96	285	20.8 m	25.5/15.6.80
2 - Z189 "Shamrock"	111.07	420	29.0 m	Cruise 1 -16.11/26.11.80 Cruise 2 - 20.1/29.1.81
3 - Z105 "Atlas"	232.45	1 320	35.44 m	8.10/22.10.80

Table 2 - Properties of the netting used for cod-ends and cover.

Cod-end				
Material R ... tex Twine construction Braiding	Polyamide multifilament 12 200 Braided. Single twine			
Mesh size (mm)	"75"	"80"	"85"	"90"
Vessel 1 - Mean	78.47	81.84	87.26	90.32
Range	74 - 82	78 - 87	82 - 92	85 - 96
N	540	320	540	320
Vessel 2				
cruise 1 - Mean	77.42	81.00	85.87	90.22
Range	73 - 82	76 - 86	82 - 91	84 - 94
N	160	220	160	220
Cruise 2 - Mean	76.88	80.69	85.63	89.75
Range	74 - 81	78 - 85	83 - 89	86 - 95
N	120	100	120	100
Vessel 3 - Mean	75.85	79.26	85.04	88.56
Range	73 - 79	74 - 84	82 - 88	84 - 95
N	220	420	220	420
Type of mesh gauge	ICES, 4 kg			

Cover	
Material	Polyethylene monofilament
R ... tex	6 200
Twine construction	Braided
Braiding	Single twine
Mesh size (mm)	63

Table 3 - Sole selection data for all hauls.

Cod-end (mm)		"75"	"80"	"85"	"90"
Vessel 1	L50	24.5	26.3	27.5	28.1
	S.F.	3.12	3.21	3.15	3.11
	S.R.	3.1	2.9	4.0	3.6
	N	2 005	2 193	1 951	2 081
	R	1 570	1 560	987	1 150
Vessel 2 Cruise 1	L50	25.2	27.1	26.5	30.4
	S.F.	3.26	3.34	3.09	3.36
	S.R.	3.4	4.0	4.1	5.0
	N	1 144	2 789	1 232	2 588
	R	737	1 373	644	785
Vessel 2 Cruise 2	L50	25.9	27.1	27.5	28.9
	S.F.	3.37	3.35	3.21	3.22
	S.R.	2.8	3.4	3.5	4.0
	N	3 873	5 249	3 912	4 978
	R	911	855	658	644
Vessel 3	L50	24.2	26.0	26.5	27.8
	S.F.	3.20	3.28	3.12	3.14
	S.R.	3.7	4.1	4.7	4.9
	N	2 957	3 228	3 392	3 214
	R	1 609	2 061	1 356	1 793

L50 : 50 % retention length (cm)
S.F. : selection factor
S.R. : selection range (cm)
N : number of soles in codend + cover
R : number of soles retained in codend

Table 4 - Sole selection data according to the state of the sea

Cod-end (mm)		"75"			"80"			"85"			"90"		
		S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3
Vessel 1	L50	24.8	25.3	-	26.8	25.5	-	27.8	27.1	-	28.2	27.0	-
	S.F.	3.16	3.22	-	3.27	3.12	-	3.19	3.11	-	3.12	2.99	-
	N	1 390	615	-	1 862	331	-	1 250	701	-	1 754	327	-
	R	1 051	520	-	1 295	265	-	547	440	-	949	201	-
Vessel 2	Cruise 1												
	L50	24.8	25.4	-	-	27.0	27.1	25.8	26.8	-	-	30.2	30.4
	S.F.	3.20	3.28	-	-	3.33	3.35	3.00	3.12	-	-	3.35	3.37
	N	350	794	-	-	1 698	1 091	371	861	-	-	1 623	965
	R	240	497	-	-	867	506	229	422	-	-	500	285
	Cruise 2												
	L50	25.9	26.0	-	26.5	26.8	-	27.9	29.3	-	28.4	29.6	-
	S.F.	3.37	3.38	-	3.28	3.32	-	3.26	3.42	-	3.16	3.30	-
	N	3 616	257	-	2 706	2 543	-	3 589	323	-	2 499	2 479	-
	R	846	65	-	503	352	-	633	25	-	356	288	-
Vessel 3	L50	23.9	24.6	25.4	25.3	25.6	27.8	26.1	26.7	28.4	27.4	27.8	29.8
	S.F.	3.15	3.24	3.35	3.19	3.23	3.51	3.07	3.14	3.34	3.09	3.14	3.37
	N	1 507	1 250	196	1 678	1 092	458	1 930	1 277	185	1 702	1 006	506
	R	759	718	132	933	806	322	707	572	77	835	652	306

L50 : 50 % retention length (cm).
S.F. : selection factor
N : number of soles in cod-end + cover
R : number of soles retained in cod-end

Code figure		State of sea
S1	:	0 - 0.5 m wave height
S2	:	0.5 - 4.0 m wave height
S3	:	+ 4.0 m wave height

Table 5 - Sole selection data according to the nature of the sea-bottom.

Cod-end (mm)		"75"			"80"			"85"			"90"		
		B1	B2	B3	B1	B2	B3	B1	B2	B3	B1	B2	B3
Vessel 1	L50	24.5	25.5	26.6	26.3	26.8	26.8	27.0	27.9	28.9	28.0	28.4	27.4
	S.F.	3.12	3.25	3.40	3.21	3.27	3.27	3.09	3.20	3.31	3.10	3.14	3.03
	N	1 117	794	94	1 011	912	270	1 141	697	113	1 000	823	258
	R	927	581	62	701	663	196	661	289	37	533	463	152
Vessel 2	Cruise 1												
	L50	25.8	25.4	24.5	27.3	26.8	-	26.9	27.0	26.0	30.2	30.2	-
	S.F.	3.33	3.28	3.16	3.37	3.31	-	3.13	3.14	3.03	3.35	3.35	-
	N	193	528	423	1 538	1 251	-	219	531	482	1 420	1 168	-
	R	129	314	294	780	593	-	118	252	274	452	333	-
	Cruise 2												
	L50	25.4	26.3	25.4	28.3	27.1	26.4	28.1	27.4	26.2	29.2	29.1	28.3
	S.F.	3.30	3.42	3.30	3.50	3.36	3.27	3.28	3.20	3.06	3.25	3.24	3.15
	N	915	2 505	453	822	3 121	1 306	917	2 394	601	942	2 940	1 096
	R	190	619	102	67	518	270	131	454	73	72	392	180
Vessel 3	L50	24.2	24.4	24.0	26.1	25.4	26.8	26.6	26.3	25.5	26.8	27.8	28.7
	S.F.	3.19	3.22	3.16	3.29	3.20	3.38	3.13	3.09	3.00	3.03	3.14	3.24
	N	1 563	1 227	167	1 097	1 134	997	1 978	1 211	203	1 204	1 018	992
	R	744	741	124	576	685	800	635	620	101	587	526	680

L50 : 50 % retention length (cm)
S.F. : selection factor
N : number of soles in cod-end + cover
R : number of soles retained in cod-end

Code figure		Nature of the bottom
B1	:	clean
B2	:	moderately clean
B3	:	rubbish

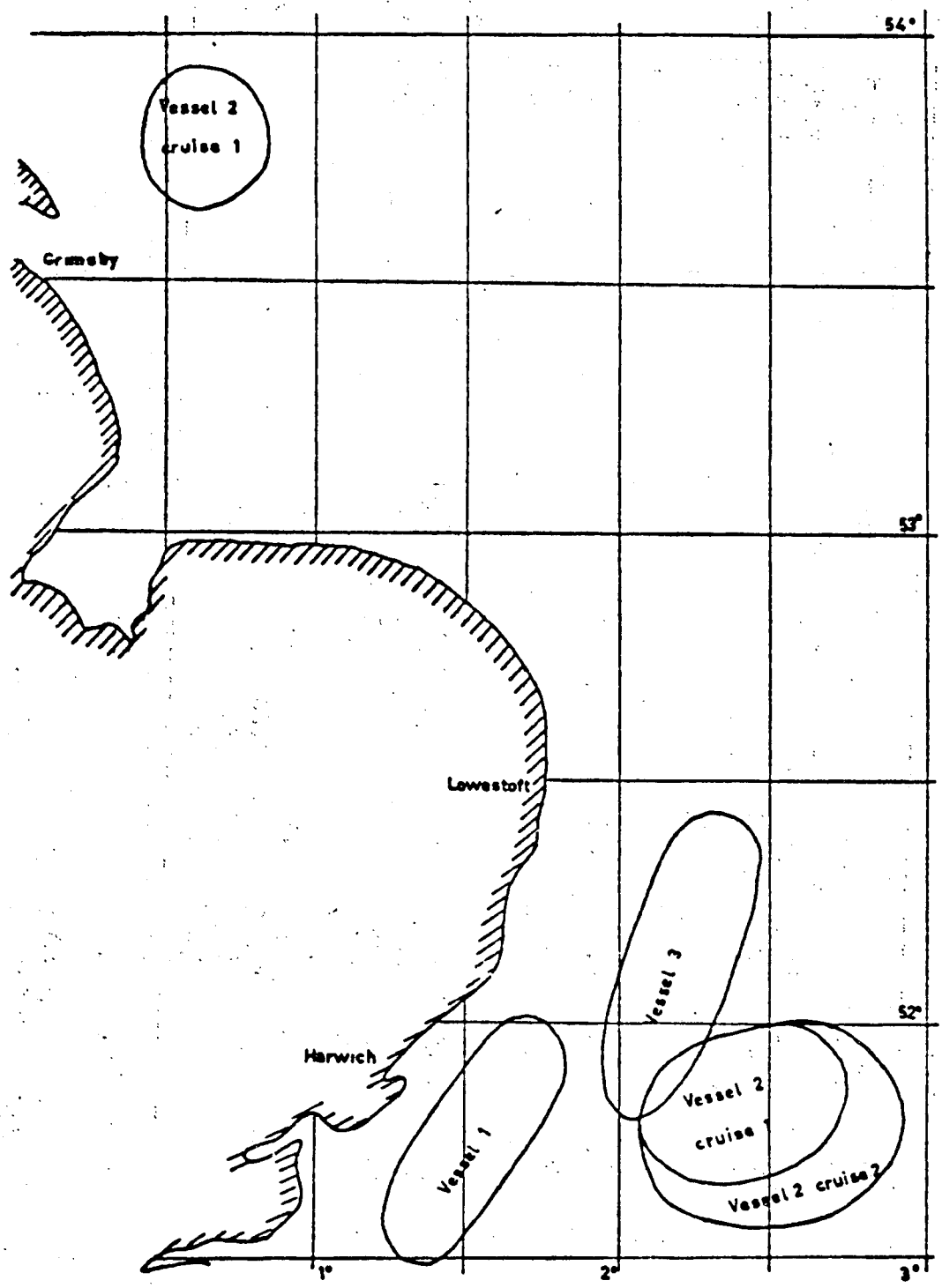

Figure 1_ Main fishing grounds.

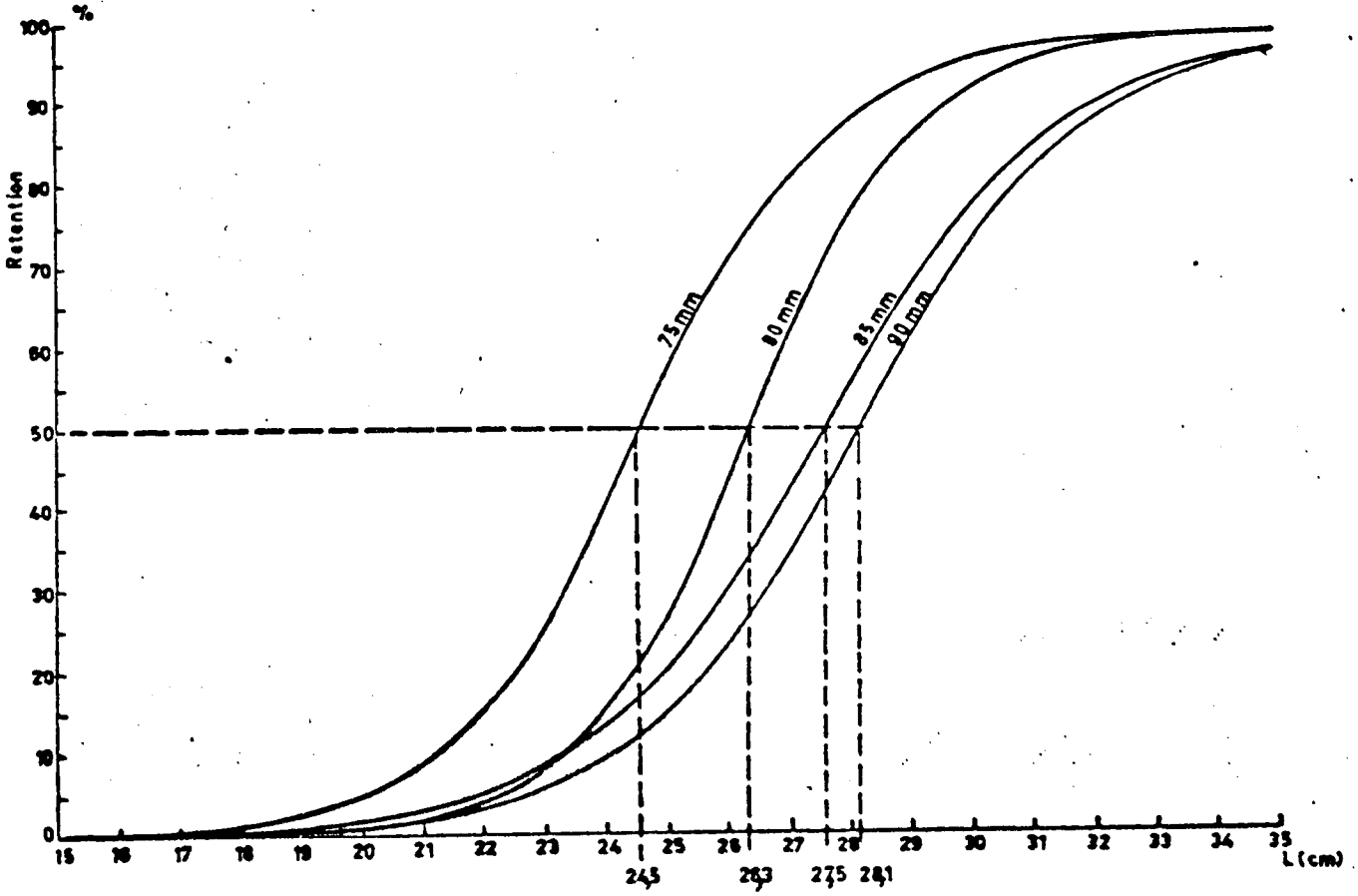

Figure 2 _ Selection ogives for vessel 1

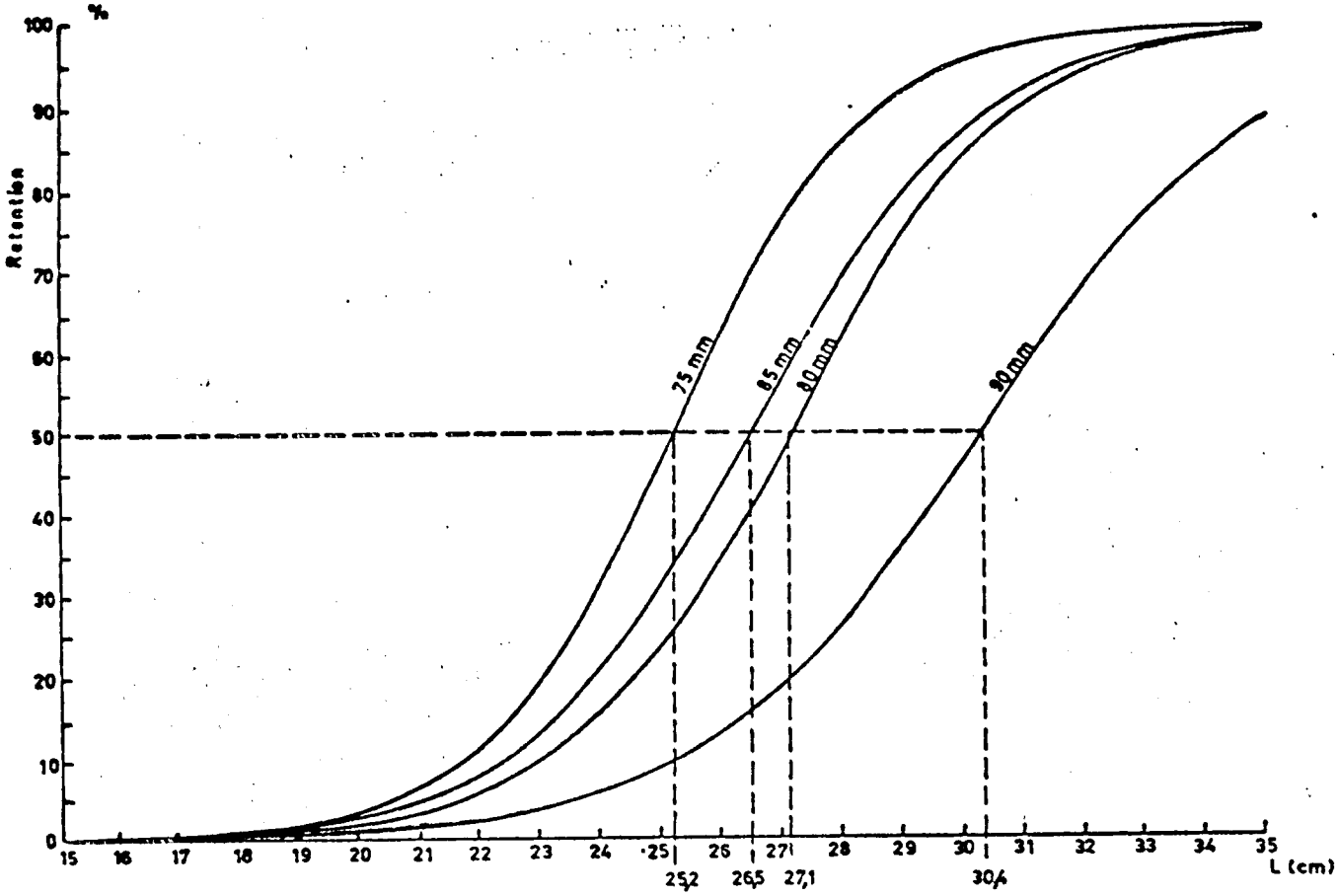

Figure 3 _ Selection ogives for vessel 2 (cruise 1)

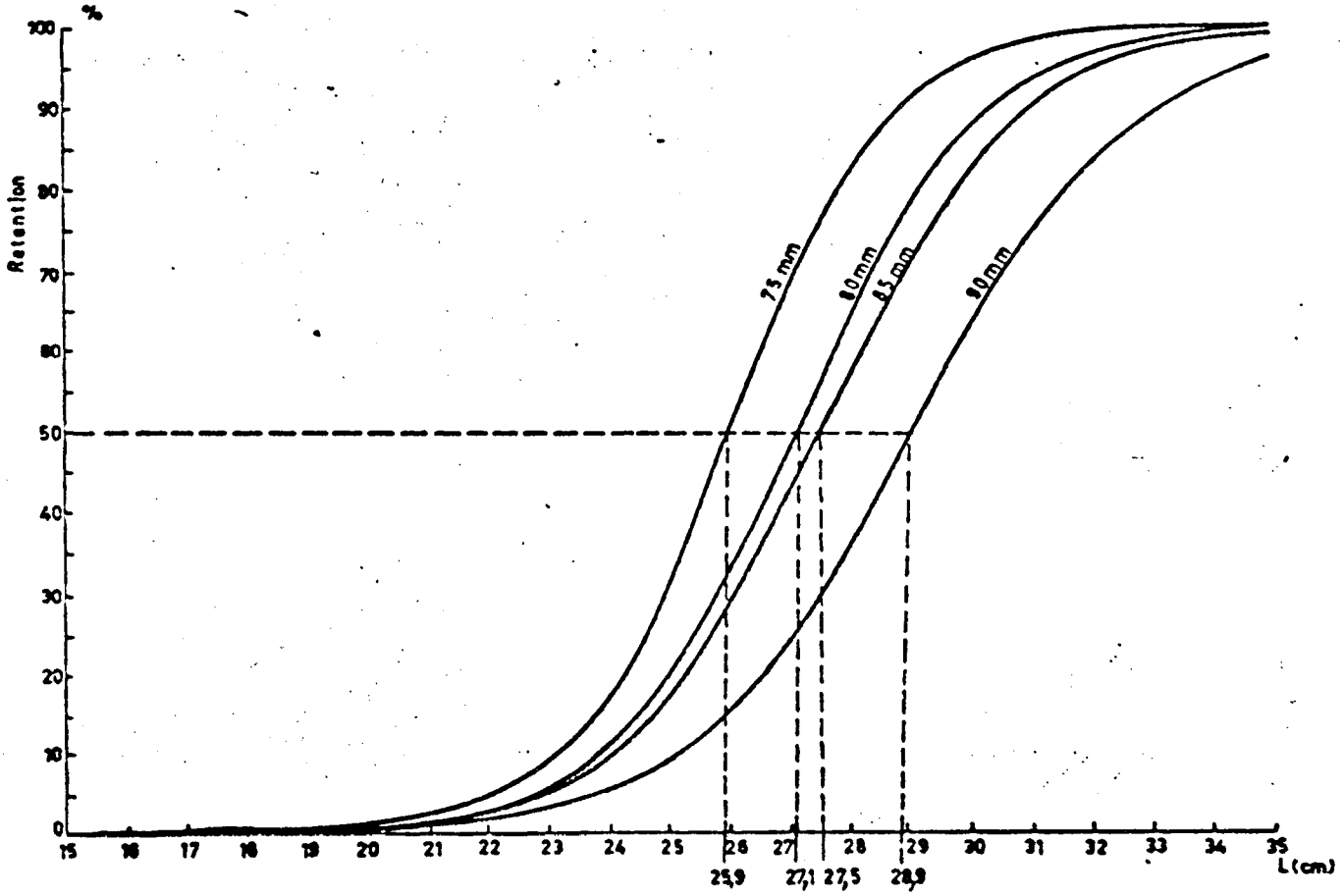

Figure 4 – Selection ogives for vessel 2 (cruise 2)

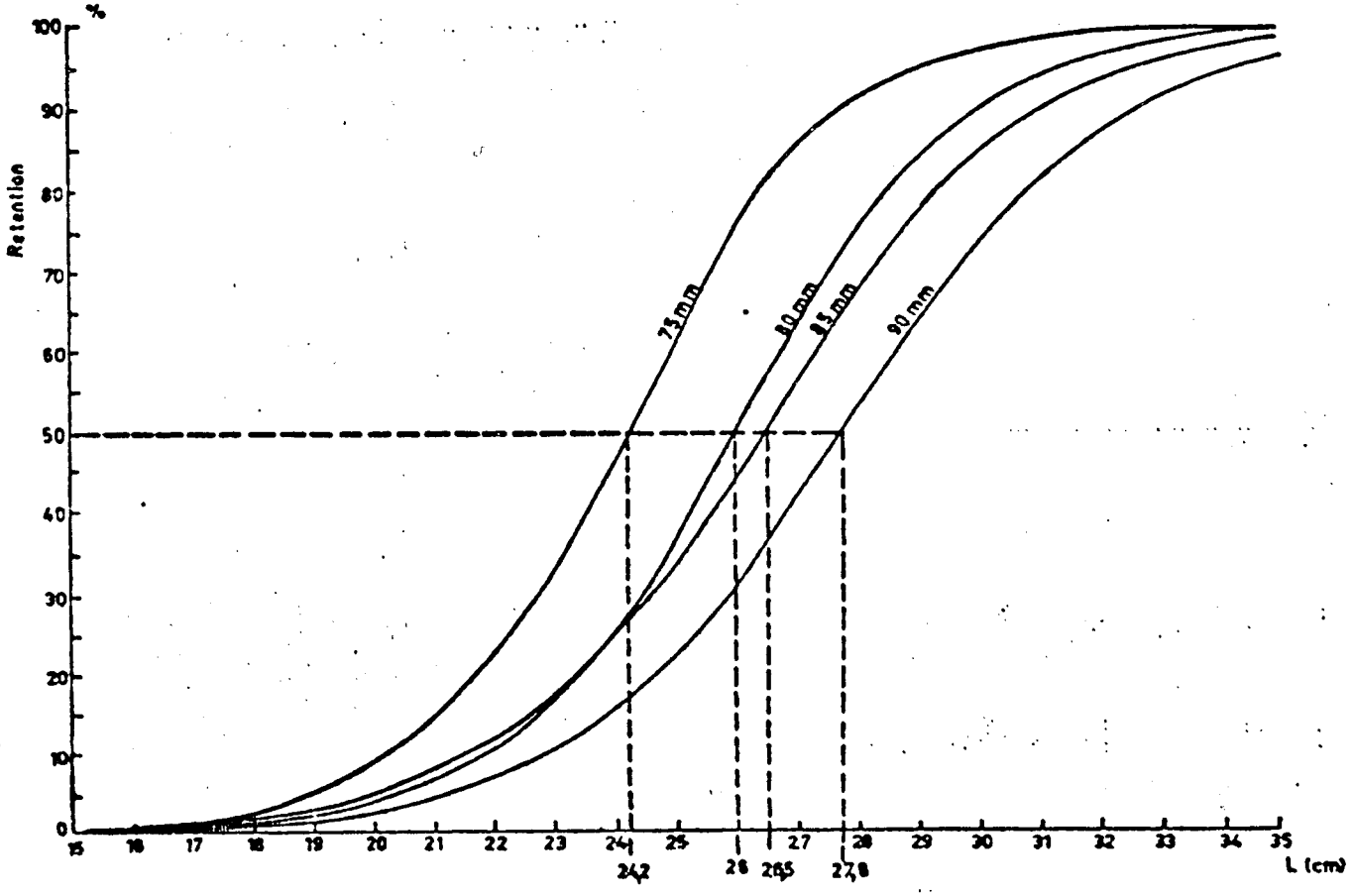

Figure 5 – Selection ogives for vessel 3