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MESH SELECTIVITY STUDIES ON BOARD A LOW POWERED GERMAN SOLE BEAM TRAWLER

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1. Abstract

First data on selectivity of a low powered (180 Hp.) German sole beam trawler in the area North of Norderney were collected end of June 1980. The results show that a net with codend-meshes of 62 mm trawled on grounds with bottom organisms as starfish, sea-urchins, Portunus and other "rubbish" results in a selection factor of 1.9 for plaice and 2.1 for dab. The selectivity of such a net however is remarkably reduced if sand is being caught.

2. Introduction

For stock assessments of plaice and sole the level of the destruction of undersized flatfish mainly plaice and sole in the beam trawl is important to know. During some months of the year and in certain areas of the southern North Sea large beam-trawler with high powered engines are able to catch a lot of rubbish and invertebrates, which reduce the selectivity of the codend meshes to such an extent that often even sand is caught. As a result young fish have no possibility to escape through the codend meshes and have hardly any chance to survive after being returned to the sea.

The amount of invertebrates etc. being caught is highly dependent on the area, the trawling speed the number of tickler chains attached and the mesh size of the codend.

The aim of this investigation was to find out whether a low powered fishing vessel would catch a lot of invertebrates and rubbish resulting in a reduced selectivity for fish especially for flatfish. Even though we were aware of the fact that small undersized soles especially those of the yearclass 1979 were not present at that time in the area N. of Norderney, first experiments to study the selectivity of plaice and dab on board a chartered low powered coastal beam trawler were carried out during 4 nights (Fig. 1). Next year it is planned to conduct similar experiments with larger mesh sizes in about the same area.

2. Vessel, gear and method

The vessel used for this experiment was an east frisian shrimp beam trawler which normally also is being rigged for catching flatfish particularly soles and plaice during the summer months. The size of the vessel was 15.5 m equipped with a 180 Hp engine and a maximal towing speed of 3 knots.
5 light tickler chains were attached to both of the beams, 4 between the heads and one in the bosom The size of the beams were different, one of 5.73 m at port side, the other one of 6.44 m at starboard side. The beam trawl nets were the Dutch designed "V"-nets. The meshsize of the codends of the three nets was determined by 17 single mesh measurements conducted in one row along the top of the codend.
For measuring the meshsize the ICES spring-loaded gauge with an operating pressure of 4 kg was used.
Measurements of the codend and the codend cover (fullcover) at port side were untertaken before fishing and once again after 11 hauls. (Table 1).

Table 1: Mean meshsize of codend and codend cover

	dry, new	damp	after 11 hauls
starboard	-	64.4	66.8
port	-	62.1	62.4
codend cover	51.9	-	49.6

The codend was made of double twine and fitted with underside blinders. The portside codend was covered with a smaller mesh single

twine full codend cover. The codend cover with a mesh size of 49.6 mm was 1.5 m longer and 1 1/2 times broader than the codend (Bohl 1964).

Both beam trawls were shot and hauled simultaneously. The trawling duration varied between 30 and 60 minutes, the trawling speed was 3 nm. Due to the small size of the vessel the fishing took place only within a limited area mostly not further than 12 nm off the East Frisian Islands and went on not longer than 12 hours during the night (18.30 - 6.30 h).

In order to avoid errors no subsamples were taken. Thus the whole catch of both codends plus the codend cover were analysed completely. The weight of fish was determined as well as the weight of starfish, Portunus, Buccinum etc.. Often the amount of fish or invertebrates was given in liters. In addition a sufficient number of nearly all flatfish and roundfish species were measured each haul. Due to the lack of time and staff not every haul was analysed by the way, described above. For several hauls just the total amount of soles and the total catch in liters was recorded.

3. Results

Table 1 gives the amount of fish, invertebrates and rubbish caught within one hour trawling for the codend cover, the port side net and the starboard net. The invertebrates are given separately in % for the portside net and the codend cover.

Comparing the total fish catches and also the amount of invertebrates and rubbish caught by both starboard and portside trawls it is obvious that in most cases the starboard side net was catching slightly more than the other side. This is definately linked with the larger size of the beam (71 cm longer). However since the net of the smaller beam was fitted with a full codend, and a masking effect (Davis 1943) reducing the flow of water through the meshes resulting in a lower fish catch could not be excluded, a correction of the catches for both nets has been omitted. In general it is interesting to mention that the catch composition, the number, the length distribution of fish and the amount of invertebrates caught in both nets are very similar.

However comparing the hauls with each other the amount of invertebrates and rubbish caught varied from 3 kg to 108 kg/hour and was 10, sometimes more than 100 % of the fish catch. In two of the 29 hauls conducted sand and shells were caught in such quantities that the analysis of those hauls was not carried out. From a rough check however it was obvious that a lot more small fish were retained and that selectivity was remarkably reduced. By analysing the catches it became aparent that within the 12 nm zone off Norderney there were two areas which could be clearly distinguished by a different length distribution and abundance of plaice and dab and the type of bottom (less invertebrates inshore than offshore). Since the filling of the net with fish and or invertebrates and rubbish was expected to have an influence on the selectivity of the net the 17 completely analized hauls were grouped into offshore catches, haul No. 4, 6, 11, 13, 15, 17, 22, 23, 25 26, 28 and inshore catches haul No. 1, 2, 9, 18, 19, 20 (Table 2 and 6).

4. Selectivity

As already mentioned before sole had to be left out since the yearclass 1979 which could have been of interest for a selectivity study was not available. Flounder was regularly present but too large and out of the range of selection length. Whiting of different sizes were often available in the catches and also found in the codend cover. However since most of the whiting particularly in coastal area were infested with the gill parasite Lernaeocera branchialis and as a consequence their body circumference was remarkably reduced they would have lead to wrong conclusions and were therefore left out as well.

Plaice mainly consisting of the rich yearclass 1978 and dab have been dealtwith in this paper.

For the following selectivity study the analysis of the portside net only and its codend-cover is being used.

4. 1. Plaice

Offshore area

During 11 hauls (1 hour trawling) 5640 plaice were caught in the portside codend and 23 plaice only were released into the

codend-cover (Table 3 and 4). The length distribution varied from 12 - 27 cm the average length was 19.4 m. The calculated 50 % retention length was 13.5 cm, the selection factor 2.2 (Fig. 2). From these 23 plaice released into the codend-cover 18 plaice were caught in a haul with the lowest amount of invertebrates (16.4 kg) of all offshore hauls.

Inshore area

During 5 hauls (1 hour trawling) 7310 plaice were caught in the portside codend and 1005 plaice were released into the codend cover (Table 3 and 4). The 50 % retention length has been calculated as 11.7 cm, the selection factor as 1.9 (Fig. 2). In order to show the influence of invertebrates and rubbish on the selectivity the hauls 1, 2, 9 and 19, 20 were grouped together (Fig. 2).

In haul 1, 2, 9, 20, 25, 20 kg invertebrates were caught.
In haul 19, 20, 5.9 kg invertebrates were caught.
The 50 % retention length for the first group was 11.4; Sel. factor 1.9
The 50 % retention length for the second group was 13.4; Sel. factor 2.1.

4. 2. Dab offshore area

In 11 hauls of 1 hour trawling 2 191 dabs were caught in the portside codend and 279 were found in the codend cover. The 50 % retention length for dab in the offshore area was 12.8 and the selection factor 2.1 (Fig. 3).

Dab inshore area

The number of dabs in the 5 inshore hauls was 152 (only 6 % of the amount in the offshore area) but 203 dabs were found in the codend-cover. The 50 % retention length was 13.2 cm the selection factor again 2.1, which is in full agreement with Bohl (1964) for another trawl of similar codend-meshes.

5. Discussion

Even with a low trawling speed of 3 nm/h using a light gear with few light chains only, in the inshore area invertebrates and rubbish amounted to 13.0 % of the total catch (109 kg/haul).

In case of the offshore area the amount increased up to 34.2 % out of 107 kg total catch. According to the information from local fishermen the amount of invertebrates varies from year to year and can be several times higher than at the time of investigation. The classification "clean and dirty" ground as given by Burd and Vince (1979) is always dependend in which area and with what type of gear and trawling speed experiments have been carried out. Only a total coverage of the whole sole fishing area of the Southern North Sea with one vessel and one particular gear would give the key for a classification in "clean and dirty". For a small fishing boat like this we used, 1 hour trawling is the appropriate trawling time for the type of ground present. Mesh selectivity for certain fish species still takes place, however the correlation 50 % retention length (cm) / filling of the net with fish and debris as shown by Burd and Vince (1979) in case of whiting and sole could not be found significantly for plaice and dab. Most of the fish especially plaice (yearclass 1978) and dab were dead after a short time of exposure on deck as a consequence of one hour trawling only together with a moderate amount of invertebrates and rubbish. However the fish being caught in the much wider designed codend cover were in a much better condition even though small amounts of debuss invertebrate were also present. The results of other nations beamtrawl selectivity experiments with more horse power and faster trawling speed, with different mesh sizes on the various grounds will help us to understand the very complex mesh selectivity in the commercial beam trawl fishery much better. Even though the use of larger meshsize (80 or 90 mm) has not yet tried in Germany for low powered vessels there is no doubt that an increase of the codend meshsize up to 90 mm as planned to be in force on 1 July 1982 would be deadly for these small and low powered vessels.
The selectivity experiments carried out by Belgium and Holland on board of high powered commercial beam trawlers however will show whether higher speed and heavier gear is able to make up for a higher mesh size, 80 or 90 mm.

References

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Table 1: Catch of fish and invertebrates (kg/h)

Haul No.		CC Fish	CC Invertebr.	BB Fish	BB Invertebr.	Stb Fish	Stb Invert.	Invertebrates (%) CC Eup. Port Bucc.	BB Port Bucc	CC Starf.	BB Starf.	CC Seeurch	BB Seeurch.	CC others and rubbish	BB others and rubb.
1		19.0	12.0	43.4	20.6	44.8	21.0	91.4	51.5	8.3	48.5	-	-	-	-
2		10.3	9.4	83.2	25.6	85.6	26.0	80.8	60.1	19.2	39.8	-	-	-	-
3		na	na	na	na	na	na	na	na	na	na	na	na	na	na
4	*	8.8	4.9	79.6	27.2	95.9	32.5	63.2	44.8	34.7	55.1	-	+	2.1	-
5		na	na	na	na	na	na	na	na	na	na	na	na	na	na
6	*	2.4	5.1	47.1	35.6	48.0	44.2	7.8	49.7	70.4	44.9	+	0.8	7.8	4.5
7		na	na	na	na	na	na	na	na	na	na	na	na	na	na
8		na	na	na	na	na	na	na	na	na	na	na	na	na	na
9		34.9	9.0	214.7	20.5	182.7	19.0	55.6	43.9	44.6	37.1	+	-	-	19.0
10		na	na	na	na	na	na	na	na	na	na	na	na	na	na
11	*	16.0	7.8	80.2	16.4	79.5	15.0	48.7	65.2	51.8	34.8	-	-	-	4.3
12		na	na	na	Sand	na	Sand	na	na	na	na	na	na	na	na
13	*	6.6	10.0	117.3	40.0	133.8	54.0	40.0	30.0	56.0	60.0	-	-	4.0	10.0
14		na	na	na	na	na	na	na	na	na	na	na	na	na	na
15	*	1.3	4.8	71.0	38.8	77.3	37.3	44.4	36.1	50.0	53.5	-	2.7	10.0	7.9
16		na	na	na	na	na	na	na	na	na	na	na	na	na	na
17	*	1.7	5.9	90.5	107.9	96.9	94.8	21.1	21.6	73.7	73.4	-	1.5	5.2	2.8
18		open	open	92.1	4.4	70.8	3.0	open	81.8	open	18.2	open	-	open	-
19		4.6	5.2	43.6	5.2	52.6	3.2	96.1	84.6	3.9	15.4	+	-	-	-
20		1.0	6.5	93.9	8.9	90.5	11.7	96.0	58.8	4.0	41.2	+	-	-	-
21		na	na	na	na	na	na	na	na	na	na	na	na	na	na
22	*	2.0	9.0	87.7	24.6	94.8	26.4	84.4	50.4	15.6	49.6	+	+	-	+
23	*	2.6	3.0	59.9	19.7	59.3	20.3	64.0	45.1	24.0	53.0	-	-	12.0	1.8
24		na	na	na	na	na	na	na	na	na	na	na	na	na	na
25	*	2.1	4.0	57.7	22.2	62.8	19.3	60.0	39.6	33.3	58.9			6.7	1.6
26	*	2.3	1.6	34.0	43.3	42.1	45.6	6.2	30.7	43.8	64.7	43.8	3.9	6.2	0.7
27		na	na	shells + sand		shells + sand		na	na	na	na	na	na	na	na
28	*	4.2	3.7	52.5	28.6	51.7	28.0	56.7	28.0	29.7	66.4		3.6	13.6	1.4
29		na	na	na	na	na	na	na	na	na	na	na	na	na	na

CC = codend cover
BB = portside
Stb = starboardside
Eup. = Eupagurus bernhardus
Port. = Portunus holsatus
Bucc. = Buccinum undatum
Starf. = Starfish
Seeurch. = Seaurchin
na = not analysed
* = offshore catches

Table 2: Length distribution and number of plaice (starboard side) per hour trawling

Haul No. / cm	offshore area												inshore area						
	4	6	11	13	15	17	22	23	25	26	28	Σ	1	2	9	18	19	20	Σ.
6																			
7																			
8																			
9																			
10													4						4
11													8						8
12													26	22	184				232
13													80	114	732		86	55	1067
14	29		42	18					19			108	106	502	732		246	83	1669
15	87		142	18		7	16		47		13	330	106	320	488		160	138	1212
16	116	6	242	54		28	64	17	56		13	596	50	364	366		208	334	1322
17	116	25	286	124	87	43	96	17	121	17	25	957	32	46	184		110	305	677
18	144	44	114	124	100	99	160	41	121	29	113	1089	18	22	244		36	305	625
19	101	50	72	72	72	83	64	66	168	63	63	874	14	92	62		24	112	304
20	130	75	58	178	72	135	160	49	84	63	100	1104	10	68	62		24	29	193
21	58	44	28	36	115	92	96	24	9	34	25	561	10	22				29	61
22	43	56	14	72	43	92	80	49		17	38	504					12	29	41
23	58	25		18	15	28	48	58	9	4	13	276	14		122				136
24	29	6		36	15	21	32	32			13	184	8				12		20
25		6					16	17				39							
26	29			18								47		22					22
27																			
28								8				8							
29																			
30																			
31																			
32																			
total	940	337	998	768	519	628	832	378	634	227	416	6677	486	1594	3176	(1228)	918	1419	7593 (8821)

Table 3: Length distribution and number of plaice (port side) per hour trawling

Haul No. / cm	offshore area												inshore area						
	4	6	11	13	15	17	22	23	25	26	28	Σ	1	2	9	18	19	20	Σ
6																			
7																			
8																			
9																			
10													4						4
11													28	28	40				96
12													92	108	198	20			418
13													112	368	554	234	84		1352
14								8			6	14	86	232	554	330	234	55	1491
15	24	8	146	18		8	10	17			6	237	82	368	832	428	300	196	2206
16	12	15	194	38	53	8	38	8	40	3	30	439	82	122	238	234	166	224	1066
17	36	15	122	56	32	23	94	17	128	3	90	616	28	190	198	98	50	279	843
18	107	38	194	74	84	39	48	49	207	26	72	938	24		198	98	34	83	437
19	48	46	98	130	105	77	48	32	59	45	66	754	4	40	40	38	16	112	250
20	107	54	24	112	53	77	104	89	29	29	42	720	10	28	118	20	16	55	247
21	95	46	24	112	53	77	160	24	69	26	60	746	4	14	80	58		141	297
22	59	38	24	56	43	77	48	89	9	6	36	485	4	14	80	20			118
23	48	23		56	21	47	84	65		13	6	363	20	14					34
24	36	15	24	18	11	39	28	32		10		213				20		29	49
25						8	10	24		3	6	51							
26	24											24							
27	12	15					10			3		40							
28																			
29																			
30																			
31																			
32																			
total	608	313	850	670	455	480	682	454	541	167	420	5640	580	1526	3130	1598	900	1174	8908

Table 4: Length distribution and number of plaice in the cod and codendcover (C.C.) per hour trawling

Haul No. / cm	offshore area												inshore area						
	4	6	11	13	15	17	22	23	25	26	28	Σ	1	2	9	18	19	20	Σ
6																			
7																			
8																			
9																			
10													24	6	50				80
11													80	28	138		22	5	273
12			2									2	94	76	124		48	10	352
13			16									16	66	52	78		46	10	252
14									1			1	12	8	4		6	3	33
15														4			2	5	11
16											1	1	2	2					4
17											2	2							
18											1	1							
19																			
20																			
21																			
22																			
23																			
24																			
25																			
26																			
27																			
28																			
29																			
30																			
31																			
32																			
total	-	-	18	-	-	-	-	-	1	-	4	23	278	176	394	-	124	33	1005

Table 5: Length distribution and number of dab (starboard side) per hour trawling

Haul No. / cm	offshore area												inshore area						
	4	6	11	13	15	17	22	23	25	26	28	Σ	1	2	9	18	19	20	Σ
6																			
7										3		3							
8																			
9																			
10																			
11										3		3		2					2
12		1										1		2					2
13	2	6	6	34	15	15				3	3	84		10	4				14
14	8	16	10	122	29	79	2	2		9	10	287		2					2
15	26	20	64	178	29	92	18	2	1	14	5	449		6	2		4	5	17
16	21	16	48	166	73	92	28	1	7	23	18	493		2					2
17	12	13	16	44	36	79	16	4	4	46	10	280		8					8
18	9	14	22	78	51	36	12	2	3	14	18	259		6	4		2	3	15
19	5	7	6	12	15	15	2	2	4	12	5	85		2	4				6
20	1	2	16			7	2		4	12	3	47	4	2	4		2		12
21	1	5		22	15	7	6		1	3	8	68	2		4				6
22	1			22				1	1		8	33		4	8				12
23		1	6	12		7	2	1				29		4	4				8
24			6			7		2		3		18		2				5	7
25	1		10	12	7	7					3	40							
26	1	1					2					4			2			3	5
27								1				1							
28								1				1							
29															2				2
30										3		3							
31																			
32										3		3							
total	88	102	210	702	270	443	90	19	25	151	91	2191	6	52	38	(50)	8	16	120 (170)

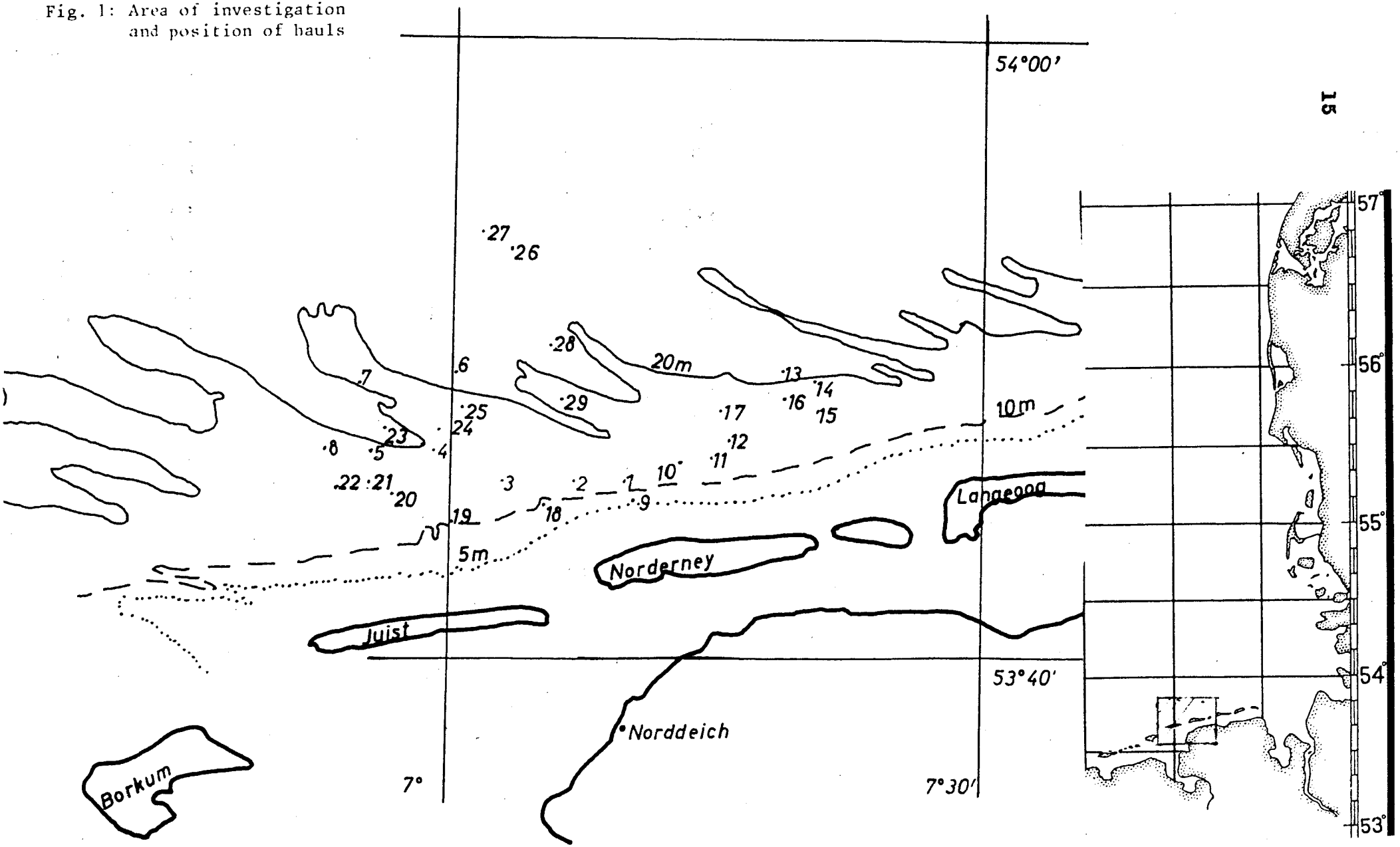
Table 6: Length distribution and number of dab (portside) per hour trawling

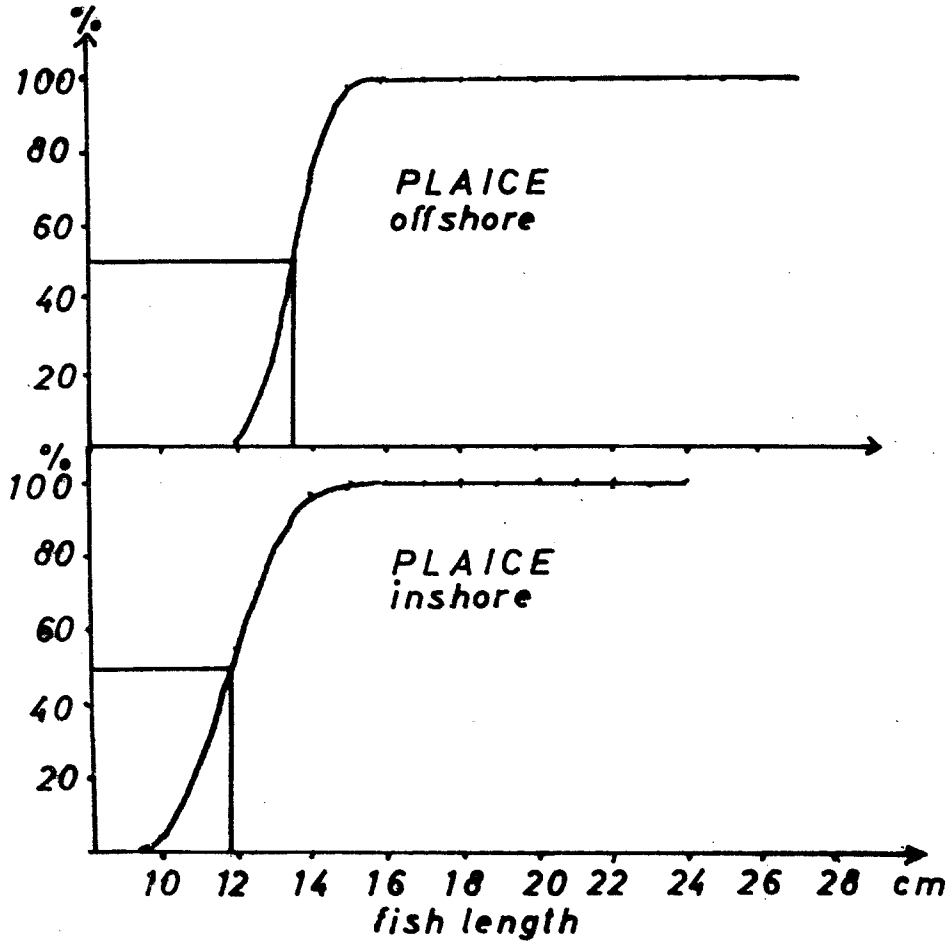
Haul No. / cm	offshore area												inshore area						
	4	6	11	13	15	17	22	23	25	26	28	Σ	1	2	9	18	19	20	Σ
6				2								2							
7																			
8																			
9						8						8							
10										4		4			2	2	2		6
11													2	2	4				8
12			6									6	2	2	4	4			12
13	3		30	64	24	31				11		163		4	2	6			12
14	8	5	48	84	53	47	4		1	33	11	294		10		10	4		24
15	20	24	42	210	48	101	20	1		33	11	510	2	6	2	16	4		30
16	14	26	30	168	72	93	12	2	3	33	18	471		4	2	10		3	19
17	10	17	36	148	48	39	22	7	7	55	26	415	2		2	2		3	9
18	4	10	42	22	24	23	10	1		11	18	165		2	10	6			18
19	7	6	42		12	16	2	2	1		4	92		2	8	2			12
20	2	4		22	5	16	6	1	3	11	11	81	2	2	10	6			20
21	1	2	12		5	8	2		4		4	38		2	6	2		3	13
22	2	3	12	22				2	1		4	46			6	2	2		10
23		1	6				4			4		15	2		2	2		3	9
24		1			5		4			4		14					2		2
25	2	4		22	5	8		1		4	4	50		4	4			3	11
26											4	4		2					2
27		1										1			2				2
28	1							1	1			3				2			2
29																			
30																			
31																		3	3
32								1				1							
total	74	104	306	764	301	390	86	19	21	203	115	2383	12	42	66	72	14	18	224

Table 7: Length distribution and number of dab in the codend cover (CC.) per hour trawling

Haul No. / cm	offshore area												inshore area						
	4	6	11	13	15	17	22	23	25	26	28	Σ	1	2	9	18	19	20	Σ
6																			
7																			
8															4				4
9				2		1		1				4			10				10
10	4	1		10	3	3		1		3	4	29	10	8	34		2		54
11	3	1	2	6		1				2	4	19	12	22	28		4		66
12	1	3	2	16	4		6				3	35		20	8		10	3	41
13	3	2	12	44	5	4	2		1	11	3	87		8	2		4	3	17
14	4	1	16	36	9	1	8	1		3	1	80		2			4		6
15		2	2	8		3	6				1	22	2					3	5
16	1										2	3							
17																			
18																			
19																			
20																			
21																			
22																			
23																			
24																			
25																			
26																			
27																			
28																			
29																			
30																			
31																			
32																			
total	16	10	34	122	21	13	22	3	1	19	18	279	24	60	86	-	24	9	203

Fig. 1: Area of investigation and position of hauls





Retention curves for plaice in offshore and inshore area

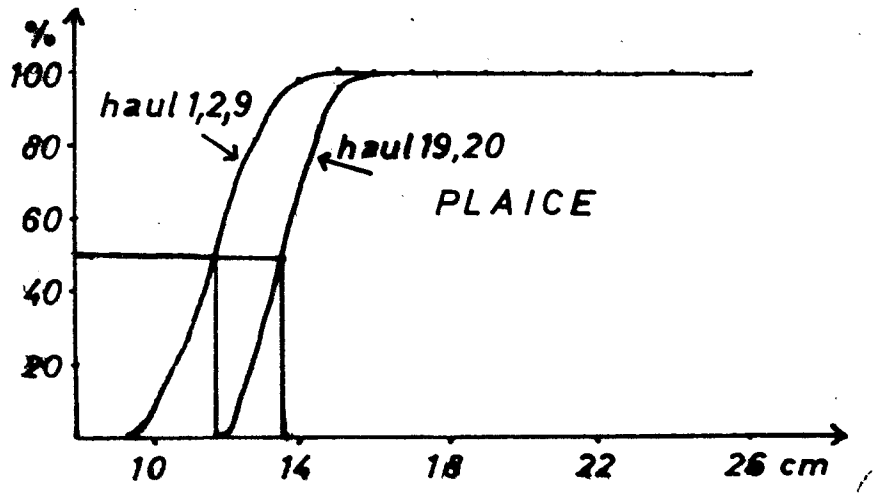


Fig. 3: Retention curves for plaice in hauls with 20-25 kg invertebrates (haul 1, 2, 9) and 5- 9 kg invertebrates (haul 19, 20)

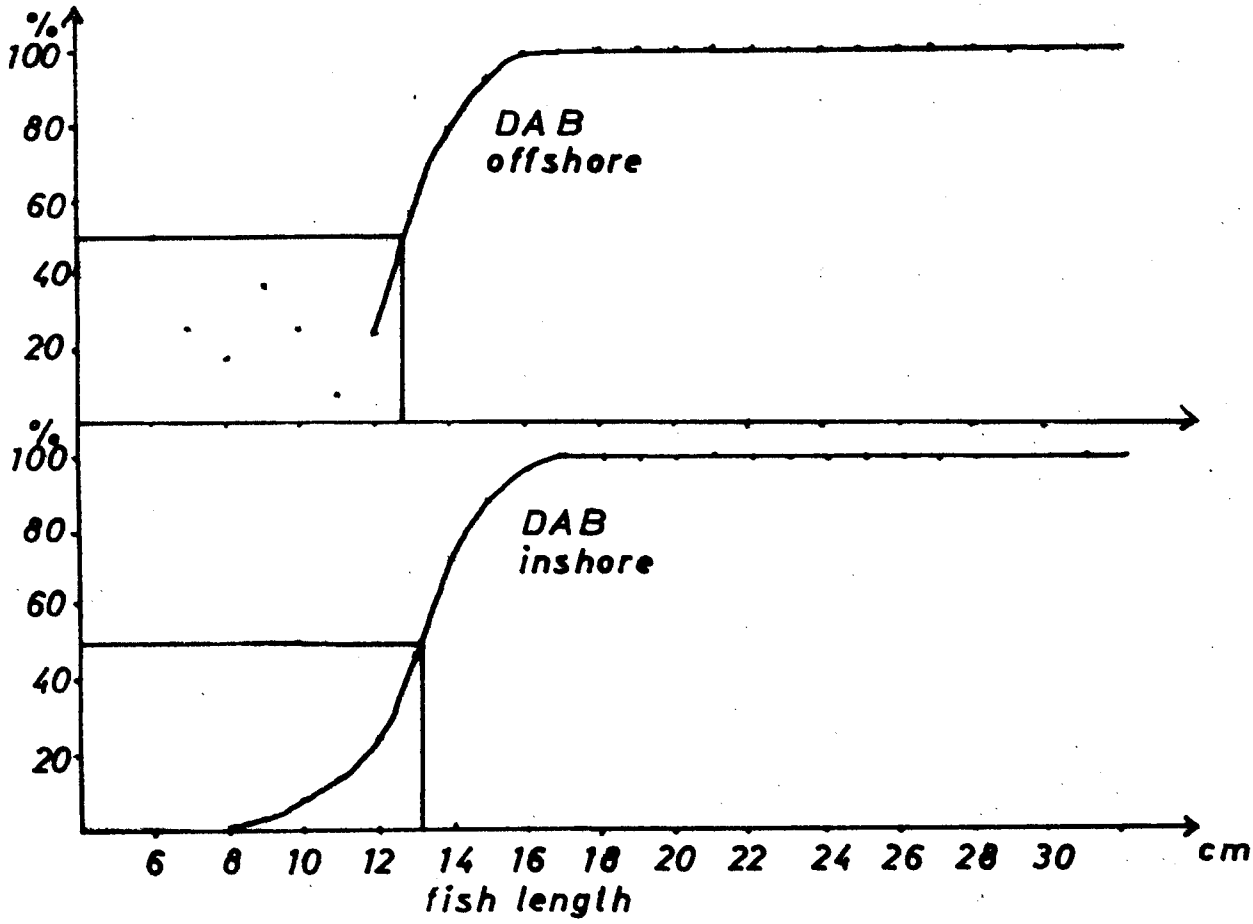


Fig. 3: Retention curves for dab in offshore and inshore area