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International Council for the
Exploration of the Sea

C.M.1974/B:17
Gear and Behaviour Committee
Ref. Demersal Fish (N) Cttee

EXPERIMENTAL FISHING WITH MULTIFILAMENT, MONOFILAMENT, AND MONOTWINE GILLNETS IN THE SPAWNING SEASON OF ARCTO-NORWEGIAN COD IN LOFOTEN IN 1974

by

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INTRODUCTION

For nearly twenty years continuous-multifilament nylon has been the most common material in gillnets used in the Norwegian fisheries for cod and saithe. In the last few years some fishermen have started to use monofilament gillnets and the interest taken in these nets seems to be increasing. In Europe monofilament gillnets have up till now mainly been used in freshwater fisheries and in saltwater fisheries for salmon. In other areas, particularly in the Far East, they are widely used in saltwater fisheries.

A few experiments comparing the fishing efficiency of monofilament gillnets and gillnets made of other types of synthetic fibres have been carried out (e.g. Molin 1959, Steinberg 1964, May 1970). In most cases the results imply that monofilament gillnets are superior to the other gillnets and this is generally ascribed to lower visibility of monofilament nets in the water. Results of experimental fishing for gadoids in the northeast Atlantic, however, have so far not been published.

Canada, USA, and Ireland have forbidden the use of monofilament gillnets in their salmon fisheries, mainly because of too high fishing efficiency. In the ICNAF area renewal of monofilament nets is forbidden.

The spawning stock of Arcto-Norwegian cod is at present at a low level and Norwegian authorities would be careful to allow new and more efficient gears to be introduced to the fisheries for this stock. It was therefore decided that the Institute of Marine Research should carry out experimental fishing in Lofoten during the spawning season 1974 to compare the fishing efficiency of monofilament and multifilament gillnets. Monotwine gillnets were also included in the experiment. Statements from fishermen and others implied that apart from the fishing efficiency differences in the size of the fish caught by the different net types might also be observed.

MATERIAL AND METHODS

Three types of material were used for the nets: Continuous-multifilament nylon 210/12, nylon monofilament 14 (0.65 mm), and nylon monotwine 5/3. The basic characteristics of these materials as regard this experiment are as follows:

Monofilament is made of a single thin and nearly transparent wire which presumably gives a low visibility in water.

Continuous multifilament is made by a number of fibres spun into a yarn. The yarn is usually coloured and the visibility in water is obviously higher than for the monofilament.

The monofilament is stiffer and more elastic than multifilament yarn.

The monotwine consists of a number of monofilament wires (in this case 3) which are twisted into a twine. It is thicker than the corresponding monofilament and the visibility in water is accordingly higher, but probably less than for the multifilament. The twisting reduces the elasticity.

The single net units were 300 meshes long and 50 meshes deep. The mesh size of the different materials was on average (before and after use):

Continuous-multifilament nylon: 94/96 mm. Nylon monofilament: 92.5/91 mm. Nylon monotwine: 92/90 mm.

One half of the units in the gillnet settings were of continuous-multifilament nylon and one quarter each of nylon monofilament and monotwine.

It was suspected that the catch in addition to fishing efficiency of the different net types, might be influenced by the number of nets of the same type in sequence and also by the position of the nets in the setting and relative to the other types of nets. To ensure that the experiment would give the best possible information about the influence of these factors, the sequence of units of different materials in the setting was chosen by the following procedure: The units of one material were assembled into groups of different numbers. Each group was joined to the corresponding groups of the other materials to make up "triples" of n monofilament units, n monotwine units, and 2n multifilament units. The sequence of materials in the "triples" were the same throughout the gillnet setting in order to make sure that groups of the same material were not joined. The sequence of the "triples" was decided at random and was changed three times during the experiment. The number of units used in the settings was from 40 to 92. Table 1 shows the sequence used at the different stations during the experiment. In addition, as often as practically permissable, the position of the setting relative to the main direction of the migration of the cod was changed so that one end alternatively would be nearest to or farthest away from shore.

Two fishing boats were hired for the experiment: M/K "Djupaskjær" (64 ft.) 6 - 28 February and M/K "Skarsjø" (62 ft.) 4 - 30 March.

The gillnet settings made during the experiment are listed in Table 2 and charted on Fig. 1. The nets were always set by daylight and hauled in the morning before noon. In most cases they were left for one night, on five occasions for two nights, and twice for three nights.

A record was kept of the fish caught in each net unit. All fish were measured and in some cases otoliths were collected.

It should be kept in mind that this is a preliminary presentation of the experiment and that a more thorough statistical analysis is needed to discuss the results at full length.

RESULTS AND DISCUSSION

The total catch during the experiment was 3437 cod, 486 saithe, 27 redfish, 8 monks, 6 ling, 3 tusk, 2 haddock, 2 blue ling, 1 lumpsucker, 1 dogfish and 1 ray. Obviously, data on other species than cod and saithe were too scarce to draw any conclusions from. Of the saithe 19 immature specimens (< 50 cm) are left out because of their small size and schooling behaviour. The discussion in the following sections is thus based on the catch of 3487 cod and 467 saithe.

For cod and saithe total catches and catch per net unit of the three materials at each station are given in Table 2. As expected, there was a considerable variation in the total catches. The ratios between the catches by nets of different materials at each station are, however, more consistent. In Table 3 these ratios are given for the different net sequences used during the experiment (Table 1) and for the experiment as a whole. The ratios for cod are far more consistent thoughout the experiment than for saithe. This can, at least partly, be ascribed to the much higher number of cod caught.

For cod the monofilament nets gave the best results, catching 26% more than the mulitfilament nets and 38% more than the monotwine nets. The multifilament nets caught 10% more than the monotwine nets. Judging by the subtotal ratios, these percentages, although hardly accurate, can be taken as a good indication of the true differences in fishing efficiency of cod between the three materials during the experiment.

The ratios for saithe are consistent in so far as the monotwine nets gave the best catches for all net sequences and the monofilament nets likewise gave better results than the multifilament nets (Table 3). The scarce material of saithe makes it difficult to draw firm conclusions. The observed differences are, however, distinct and they probably place the material in correct order as regards fishing efficiency of saithe.

There are a number of factors that may have contributed to the observed differences in fishing efficiency. The number of nets of one material in sequence is apparently of some significance. The catch of cod per net unit at stations 9 - 36 for the different numbers of nets in sequence is given in Table 4. The stations 1 - 8 are not included because all the sequences were not represented (Table 3). For both mono- and multifilament nets the catch rate was highest for the medium long sequences. This is surprising, considering that the multifilament sequences were twice as long as the corresponding sequences of the other materials. For the monotwine nets there was a marked drop in catches with increasing number of nets in sequence. It is possible that the observed variations in catch rate with length of the sequence are caused by pure chance, and so far no other explanation has been found.

On average the highest catch rate was observed in the part of the gillnet setting that was farthest away from shore. The ratio between the number of fish caught per net unit in the "triple" nearest to shore and the number caught in the "triple" farthest away from shore was for the total experiment 0.70 for cod and 0.96 for saithe. A probable explanation of the higher catches of the outermost nets is that the settings on average may have been located slightly nearer to shore than the densest concentrations of the cod which at the time were migrating into the area. The same distribution of the catches might, however, be the result if the cod that discovered the nets tended to turn right (or away from shore) and swim along the setting until they got clear or were caught in one of the other nets. In any case, the effect on the observed fishing efficiency of the different materials for both cod and saithe can be ignored because of the frequent turning of the gillnet setting relative to shore.

The differences between the length frequences of cod and saithe caught by the three materials were distinct and the pattern was similar for the two species. For the experiment as a whole the average lengths of the fish caught were:

Cod:	Cont.-Multifil. Nylon:	94.29 cm
	Nylon-Monofilament:	93.23 "
	Nylon-Monotwine:	89.75 "
Saithe:	Cont.-Multifil. Nylon:	86.39 "
	Nylon-Monofilament:	86.09 "
	Nylon-Monotwine:	84.76 "

The differences in mean length of the fish can hardly be explained by the observed differences in mesh size. The average length, especially of the cod, decreased during the experiment, but the differences in length frequency between the fish caught by the three net types were consistent and undoubtedly reflect different abilities of the nets in capturing the fish.

The fishing efficiency of the nets may be strongly influenced by their selectivity. The difference between the mean lengths of the cod caught by the mono- and multifilament nets is, however, too small to have had any great influence on the observed difference in fishing efficiency, whereas for monotwine the low mean length of cod in the catches have undoubtedly caused reduction in the catch rate. The length distribution of the exploited stock may, however, be of great importance. A low average length of the catch might be ascribed either to a low catch rate of bigger fish or a high catch rate of smaller fish or most likely a combination of both. If high catch rate of smaller fish is the cause, then a low average length does not necessarily imply that the catches will be small compared with other nets. The length distribution of the saithe present in Lofoten during the experiment is not known, but it is quite possible that relatively small fish were more common than indicated by the length distribution of the captured saithe. If the mean length of the saithe caught by monotwine nets reflects a relatively high catch rate of the smaller saithe, this may have caused at least part of the high total catch rate of saithe for monotwine nets.

The fishing efficiency of the nets is obviously also influenced by other factors than selectivity. The effect of low visibility of the monofilament nets in water cannot be ignored and might well be the explanation of their relatively high fishing efficiency. The experiment was, however, not designed to test this theory.

SUMMARY

From 6 February to 30 March 1974 during the spawning migration of Arcto-Norwegian cod, a fishing experiment with gillnets made from continuous-multifilament nylon, nylon monofilament, and nylon monotwine was carried out in Lofoten.

The different types of nets were mixed into one gillnet setting comprising from 40 to 90 single nets.

The results for the total experiment were that the monofilament nets caught 26% more cod than the multifilament nets and 38% more than the monotwine nets. For saithe the monotwine nets were the most and the multifilament nets the least efficient.

The average length of the captured fish was slightly higher for the multifilament than the monofilament nets, whereas the fish caught by the monotwine nets were considerably smaller.

The selectivity of the nets has obviously to some extent influenced the observed catch efficiency. The visibility of the nets in water may, however, offer the most likely explanation of the differences in catch efficiency.

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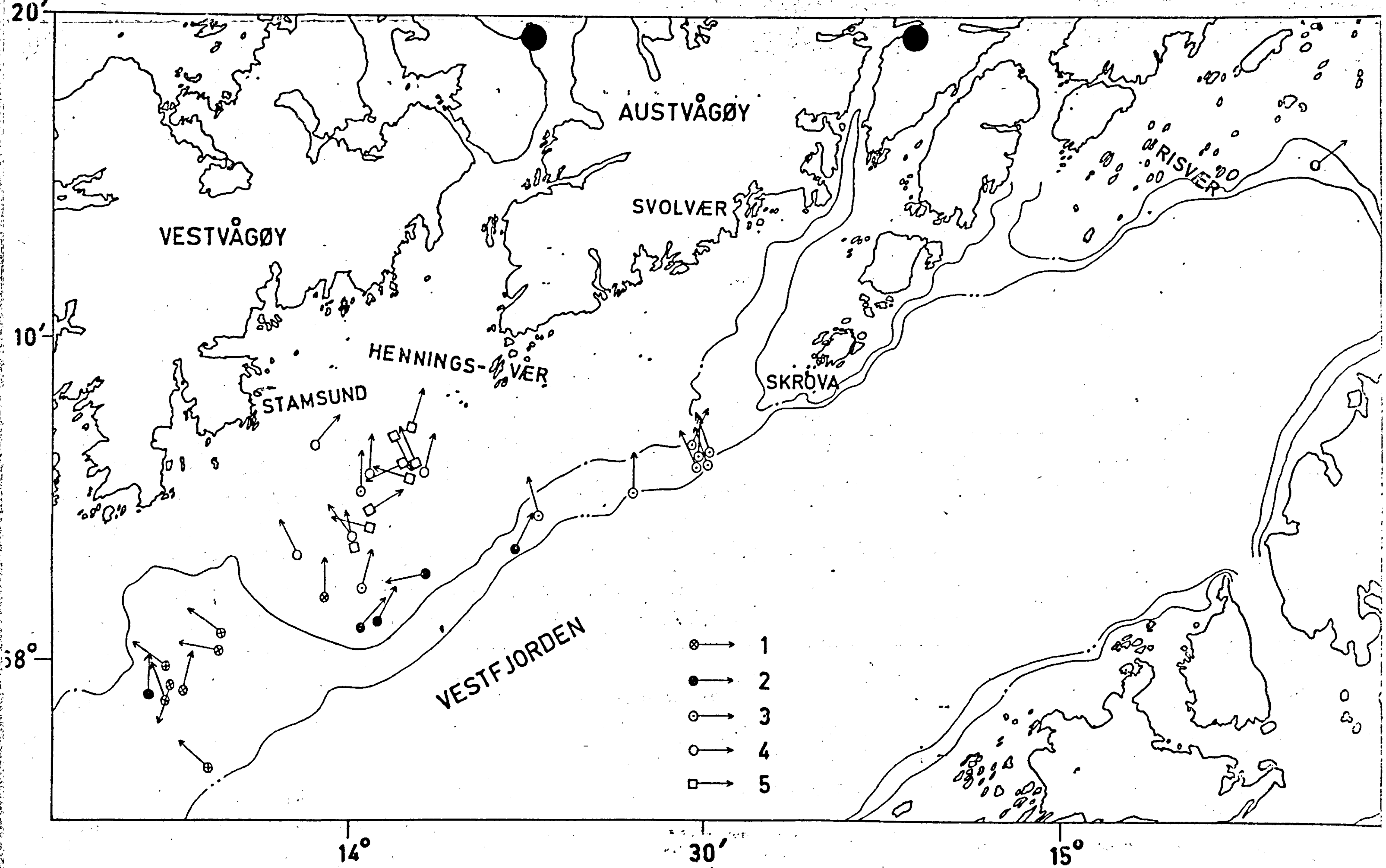

Fig. 1. Gillnet settings during the comparative fishing experiment in Lofoten in 1974. 1) Djupaskjær 6 - 16 February, 2) Djupaskjær 18 - 28 February, 3) Skarsjø 4 - 15 March, 4) Skarsjø 18 - 27 March, 5) Skarsjø 15 - 30 March (Floating net).

Table 1. Sequence of nets used at different stations.
N = Continuous-Multifilament Nylon, MF = Nylon Monofilament, MT = Nylon Monotwine.

Station No.	Sequence of nets	Total No.
1-2	6N - 3MF - 3MT - 10N - 5MF - 5MT - 4N - 2MF - 2MT	40
3-5	6N - 3MF - 3MT - 10N - 5MF - 5MT - 4N - 2MF - 2MT - 14N - 7MF - 7MT	68
6-8	6N - 3MF - 3MT - 10N - 5MF - 5MT - 4N - 2MF - 2MT - 14N - 7MF - 7MT - 1N	69
9-14	4N - 2MF - 2MT - 6N - 3MF - 3MT - 12N - 6MF - 6MT - 10N - 5MF - 5MT - 14N - 7MF - 7MT	92
15-23	6MF - 6MT - 12N - 3MF - 3MT - 6N - 7MF - 7MT - 14N - 5MF - 5MT - 10N - 2MF - 2MT - 4N	92
24-36	3MF- 3MT - 6N - 2MF - 2MT - 4N - 7MF - 7MT - 14N - 5MF - 5MT - 10N - 6MF - 6MT - 12N	92

Table 2. Gillnet settings and catches during the comparative fishing experiment in Lofoten in 1974. N = Continuous-Multifilament Nylon, MF = Monofilament Nylon, MT = Monotwine Nylon.

Station No.	Fishing Vessel	Date	Position N	Position E	Hours Fishing	Fishing Depth (Fath.)	No. of nets N	No. of nets MF	No. of nets MT	Catch of cod Total No.	Catch of cod No. per net N	Catch of cod No. per net MF	Catch of cod No. per net MT	Catch of saithe Total No.	Catch of saithe No. per net N	Catch of saithe No. per net MF	Catch of saithe No. per net MT
1	"Djupaskjær"	6- 7/2	68°03'	13°58'	20	60 - 88	20	10	10	13	0.10	0.40	0.70	2	-	-	0.20
2	"	7- 8/2	67°57'	13°47'	20	75 - 90	"	"	"	5	0.20	-	0.10	3	0.10	-	0.10
3	"	8- 9/2	67°59'	13°44'	21	60 - 72	34	17	17	31	0.29	1.06	0.18	9	0.03	0.18	0.29
4	"	9-11/2	68°00'	13°43'	44	56 - 64	"	"	"	47	0.74	0.88	0.41	25	0.29	0.53	0.35
5	"	11-13/2	68°01'	13°48'	44	52 - 70	"	"	"	33	0.50	0.71	0.24	74	0.68	1.35	1.65
6	"	13-14/2	68°00'	13°47'	21	58 - 70	35	"	"	29	0.40	0.41	0.47	71	0.63	1.06	1.82
7	"	14-15/2	67°59'	13°44'	21	54 - 70	"	"	"	14	0.20	0.29	0.12	36	0.37	0.88	0.47
8	"	15-16/2	68°00'	13°47'	20	55 - 68	"	"	"	65	1.03	1.24	0.53	19	0.12	0.47	0.41
9	"	18-19/2	68°00'	13°43'	17	55 - 65	46	23	23	84	1.20	0.61	0.65	13	0.02	0.13	0.39
10	"	19-20/2	68°03'	14°05'	18	47 - 50	"	"	"	45	0.52	0.43	0.48	8	0.09	0.13	0.04
11	"	20-21/2	68°02'	14°03'	20	45 - 60	"	"	"	67	0.76	0.91	0.48	8	0.04	0.13	0.13
12	"	21-23/2	68°02'	14°02'	44	62 - 68	"	"	"	170	1.33	3.26	1.48	12	0.02	0.13	0.35
13	"	23-26/2	68°04'	14°15'	67	56 - 67	"	"	"	55	0.63	0.57	0.57	10	-	0.13	0.30
14	"	27-28/2	68°16'	15°23'	20	54 - 70	"	"	"	98	0.93	1.48	0.91	1	-	-	0.04
15	"Skarsjø"	4- 5/3	68°07'	14°30'	16	52 - 64	"	"	"	163	1.83	1.83	1.61	21	0.13	0.30	0.35
16	"	5- 6/3	68°07'	14°29'	16	52 - 62	"	"	"	67	0.67	0.87	0.70	16	-	0.22	0.48
17	"	6- 7/3	68°06'	14°24'	13	45 - 80	"	"	"	61	0.72	0.91	0.30	9	0.02	0.17	0.17
18	"	7- 8/3	68°07'	14°30'	14	70 - 75	"	"	"	22	0.22	0.17	0.35	23	0.20	0.09	0.52
19	"	8-11/3	68°07'	14°30'	69	62 - 65	"	"	"	69	0.91	0.78	0.39	9	0.07	0.09	0.17
20	"	11-12/3	68°06'	14°01'	12	60	"	"	"	172	1.48	2.30	2.22	1	-	-	0.04
21	"	12-13/3	68°03'	14°02'	13	45 - 50	"	"	"	291	2.87	3.91	3.00	4	0.04	0.04	0.04
22	"	13-14/3	68°05'	14°16'	19	40 - 60	"	"	"	96	0.89	1.04	1.35	2	0.02	-	0.04
23	"	14-15/3	68°07'	14°30'	15	50 - 64	"	"	"	34	0.41	0.48	0.17	91	0.52	0.74	2.17
24	"	15-16/3	68°05'	14°03'	12	35 (F)	"	"	"	94	1.09	0.87	1.04	-	-	-	-
25	"	16-18/3	68°06'	14°05'	42	35 (F)	"	"	"	123	1.13	2.13	0.96	-	-	-	-
26	"	18-19/3	68°04'	14°00'	15	44 - 50	"	"	"	50	0.57	0.48	0.57	-	-	-	-
27	"	19-20/3	68°04'	14°00'	13	35 (F)	"	"	"	110	1.35	0.87	1.22	-	-	-	-
28	"	20-21/3	68°06'	14°02'	13	50	"	"	"	91	0.96	1.04	1.00	-	-	-	-
29	"	21-22/3	68°04'	14°00'	12	35 (F)	"	"	"	82	0.80	0.96	1.00	-	-	-	-
30	"	22-23/3	68°04'	13°55'	17	40 - 45	"	"	"	75	0.78	0.39	1.30	-	-	-	-
31	"	23-25/3	68°06'	14°07'	42	45 - 60	"	"	"	410	3.83	6.43	3.74	-	-	-	-
32	"	25-26/3	68°08'	14°06'	14	35 (F)	"	"	"	325	3.52	4.52	2.57	-	-	-	-
33	"	26-27/3	68°07'	13°58'	13	40 - 42	"	"	"	152	1.78	2.13	0.91	-	-	-	-
34	"	27-28/3	68°06'	14°03'	11	35 (F)	"	"	"	127	1.48	1.48	1.09	-	-	-	-
35	"	28-29/3	68°03'	14°05'	11	35 (F)	"	"	"	78	0.89	0.83	0.78	-	-	-	-
36	"	29-30/3	68°06'	14°04'	12	35 (F)	"	"	"	39	0.35	0.52	0.48	-	-	-	-

Table 3. Ratios between the catch in numbers by nets of different material during the experiment. N = Continuous-Multifilament Nylon. MF = Monofilament Nylon. MT = Monotwine Nylon.

	Station No.					
	1 - 8	9 - 14	15 - 23	26, 28, 30, 31, 33	24, 25, 27, 29, 32, 34 - 36 (Floating net)	TOTAL
Cod:						
MF/N	1.43	1.36	1.23	1.33	1.14	1.26
N/MT	1.35	1.17	0.99	1.05	1.17	1.10
MF/MT	1.97	1.59	1.22	1.40	1.33	1.38
Saithe:						
MT/N	2.40	7.00	4.89			3.46
MF/N	2.07	3.67	2.56			2.31
MT/MF	1.16	1.91	1.91			1.50

Table 4. Catch of cod per net unit for the various numbers of nets of each material in sequence at the stations 9 - 36.

Continuous-Multifilament Nylon		Nylon Monofilament		Nylon Monotwine	
No. of nets	Catch per net	No. of nets	Catch per net	No. of nets	Catch per net
4	0.91	2	1.43	2	1.29
6	1.23	3	1.51	3	1.23
10	1.40	5	1.69	5	1.05
12	1.12	6	1.45	6	1.15
14	1.21	7	1.35	7	1.03