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SELECTIVITY DIFFERENCES BETWEEN CODENDS MADE OF NATURAL AND SYNTHETIC FIBRES, IN THE ICNAF AREA

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Introduction

At the meeting of the Standing Committee on Research and Statistics in 1962, it was agreed that an analysis should be made of the available experimental data for the ICNAF area, on the differences in selectivity between codends made from different materials, with special reference to the heavier, natural fibre twines (e.g. manila) and the "lighter", synthetic fibre ones now in common use in the commercial fisheries. This report summarises the results of an analysis of such data available to the author. A comparison is also made with experimental data for the north-east Atlantic, as contained in relevant ICES documents, especially the "Report of the Mesh Selection Working Group".

Experimental Data

As shown in the 1962 Meeting document No. 6 most of the reported codend selectivity data for the ICNAF area are from experiments with codends made from manila twines of various runnages and mesh sizes. Only for cod in Sub-Area 4 (Canadian experiments), haddock in Sub-Areas 4 and 5 (Canadian and U.S. experiments), silver-hake in Sub-Area 5 (U.S. experiments) and American plaice in Sub-Area 4 (Canadian experiments) have selectivity data for synthetic codend materials also been reported. Furthermore, in very few of these experiments were direct comparisons made between the selectivities of codends of different materials at the same place and time. Therefore, an estimation of the differences in selectivity between materials has to be made from comparisons of data from experiments made mostly in different localities (divisions or sub-divisions) and at different times (months or years). Also, the catch size and composition, the runnages of the materials and the mesh sizes of the codends were not the same for all materials. However, an inspection of the selectivity data for cod and haddock, in the mesh size range 100-168 mm (cod) and 73-167 mm (haddock) for manila and nylon (single and double) shows no clear relation between selection factor ($SF = \frac{50\% \text{ retention length}}{\text{mesh size}}$) and either runnage, mesh size or catch size. Therefore, in this analysis no account has been taken of differences in catch size, and the selection factors have been used as indices for comparing the selective properties of the different materials. The selection ranges have also been compared.

In all cases, the selectivity data were obtained from "covered codend" experiments.

Differences Between Selection Factors

(a) Cod

The only ICNAF region for which cod selectivity data are available for a range of codend materials is Sub-Area 4 (Canadian experiments). The selection factors for experiments made in divisions 4T, and 4V-W, over the period 1953-1960 are given in Table 1. These results show that, despite many fewer data for cotton and the synthetic fibres than for manila, in all cases, the selection factors for them were higher, and outside the range of values for manila. The percentage differences between the mean value for each material and the overall mean for manila in all experiments are as follows:-

Single Cotton	- D. Manila;	8.0%
Single Nylon	- D. Manila;	13.6%
Double Nylon	- D. Manila;	12.4%
Single Terylene	- D. Manila;	21.0%
Courlene	- D. Manila;	15.4%

(b) Haddock

Haddock selectivity data for manila and other materials are available for Sub-Areas 4 (Canadian experiments) and 5 (U.S. experiments The selection factors for these experiments (excluding those in which topside chafers were used) are given in Table 2. With the exception of the one experiment with single, braided "dacron", these results although exhibiting greater variability, show, as with cod, higher selection factors for the experiments with cotton and the synthetic fibres than for those with manila. The corresponding percentage differences between the mean values for each of these materials and the overall mean for manila are as follows:-

Single Cotton	- D. Manila;	5.6%
Single Nylon	- D. Manila;	14.3%
Double Nylon	- D. Manila;	12.7%
Single Terylene	- D. Manila;	14.9%
Single Dacron	- D. Manila;	-3.7%

(c) Silver Hake

Selection data for silver hake with manila and other materials are available from U.S. experiments in Sub-Area 5. The selection factor for these experiments (excluding two made with the very small mesh sizes 35 and 40 mm), are given in Table 3. As pointed out by Clark (1957), the selection factors for this species are substantially lower and more variable than are those for other roundfish species, having similar length/girth relationships. Also, the selection factors appear to increase with increase in mesh size. However, the above results agree with those for other species in showing higher selectivities for nylon and cotton (compared with the overall mean value) than for manila (both double and single braided). The percentage differences between the overall means for all experiments are as follows:-

Single Cotton	- D. Manila;	7.0%
Single Nylon	- D. Manila;	21.4%

(d) American Plaice

Data for American Plaice, from Canadian experiments in Sub-Area 4, with codends made from double manila, single cotton, single nylon and courlene are given in Table 4. Again, with the exception of one experiment with courlene, the selection factors for single cotton and single nylon are substantially higher than those for double manila.

The percentage differences between the overall means are as follows:-

Single Cotton	- D. Manila;	19.6%
Single Nylon	- D. Manila;	10.1%
Courlene	- D. Manila;	-

Differences Between Selection Ranges

In addition to the selection factors for the different materials, data are also available for their "selection ranges" (the 75% retention length - 25% retention length). The mean values for cod, haddock, silver hake and American plaice, from experiments in which approximately the same mesh sizes were used, are given in Table 5. These results indicate that in the Canadian experiments on cod and haddock in Sub-Area 4, the selection ranges for the double manila codends were, on average, 2-4 cm larger than for the cotton and synthetic fibre ones (except courlene). However in the American experiments for haddock in Sub-Area 5, the ranges for double manila and single nylon were approximately the same. As with the selection factors, the selection range for silver hake varied widely between experiments, but in contrast to cod and haddock, they were larger for cotton and single nylon than for double manila. For American plaice also, they tended to be higher for the synthetic fibres than for manila (but lower for single cotton).

Discussion

With the exception of single experiments with courlene (American plaice) and dacron (haddock) the above results of experiments carried out in the ICNAF area show substantially higher average selection factors for cotton and the synthetic fibre codends than for the manila ones. Since these results are from experiments conducted at different places and times and for a range of mesh and catch sizes only rough estimates of the differentials between materials can be made, but for the two major roundfish species, cod and haddock, it seems that, on average, the 50% retention lengths are, for single cotton, 5-10% and for the main polyamide and polyester snythetic fibres 12-20% greater than those for double manila codends of the same mesh size. These results are broadly the same as those for experiments carried out in the north-east Atlantic (see ICES, "Report of Mesh Selection Working Group Meetings in Copenhagen, December 1959 and 1960"). For example, the results of experiments carried out in the north-eastern part of the ICES area show average differences, for cod, of 10-12% between the selection factors for double nylon and double terylene, and that for double manila. Results for other parts of the ICES area (e.g. North Sea) show similar differences for other roundfish species (e.g. haddock and whiting).

The selectivity differentials for the ICNAF area are based on the differences between the average selection factors for the experiments made with each material. For some of these, twines of different runnages were used; thus, the double manila twines had runnages ranging between 45-75 yds/lb; and there were differences between the constructions and runnages of the double and single nylon twines. An examination of the selectivity data for cod and haddock from the experiments with different runnages of manila show a very small and non-significant increase in average selection factor with increase in runnage, over the range 45-75 yds/lb. Also, the selection factors for these runnages are within the range of those obtained in the north-east Atlantic with manila twines of much higher runnages (112-150 yds/lb). Therefore, the selective properties of double manila twines can be treated as independent of runnage, within the range of twines used in the main commercial fisheries. On the other hand, as the results for haddock in Table 2 show, there were

large differences between the selection factors in different experimer with both single and double nylon twines, which might be associated wi... differences in runnage. However, it is not possible from the data available to determine whether these were associated with runnage and/or construction, or with differences due to times and locality. Further experiments, with nylon twines of a range of runnages, conducted at the same place and time are required.

Another feature of the results was the small differences between the selectivities of single and double braided codends of the same material. This is shown for both cod and haddock with single and double nylon codends and for silver hake for single and double manila. This is again in general conformity with results of experiments in the north-east Atlantic.

The results for cod with a courlene (polyethylene fibre) codend are of interest in showing comparable selectivity with the polyamide and polyester fibres. This is in marked contrast with the results of experiments in the north-east Atlantic, which show courlene to have selective properties similar to manila rather than to the synthetic fibres. However, the results for American plaice in the ICNAF experiments are of this nature.

Although the selection ranges varied widely for the different species and materials, and for different experiments with one material, the results show that, for the two main species, cod and haddock, selection was, on average, sharper with the synthetic fibres than with double manila.

Summary

The published results of codend selectivity experiments with trawl codends of different materials were compared. These show substantially higher selection factors for single and double nylon, (polyamide fibre), single terylene (polyester fibre) and single cotton codends than for double manila ones. Courlene (polyethylene) gave variable results. Average differences of 5-10% for single cotton and 12-20% for single and double nylon and single terylene were obtained for the principal roundfish species, cod and haddock.

No significant differences were detected between single and double braided nylon and manila twines or between double manila twines of different runnages.

The selection ranges for cod and haddock tended to be 2-4 cms smaller with the synthetic fibres (nylon and terylene) codends than with double manila ones.

References

ICNAF Sec. 1962. Compilation of selectivity data. ICNAF Meeting Doc. no. 6.

Clark, J. R. 1957. Escapement of silver hake through codends. Summary of US experiments. Doc. no. S.26, ICNAF-ICES-FAO Joint Scientific Meeting. Lisbon.

TABLE 1

MEAN SELECTION FACTORS FOR COD. SUB-AREA 4. 1953-60. RANGE OF MESH SIZE 102-168 MM (4"-6 5/8")

SUB-AREA	DIV.	YEAR	MANILA[1] DOUBLE		COTTON SINGLE		NYLON SINGLE		NYLON DOUBLE		TERYLENE SINGLE		COURLENE ?	
			MEAN* S.F.	RANGE OF VALUES	MEAN* S.F.	RANGE OF VALUES	MEAN* S.F.	RANGE OF VALUES	MEAN* S.F.	RANGE OF VALUES	MEAN* S.F.	RANGE OF VALUES	MEAN* S.F.	RANGE OF VALUES
4	V-W	1953	3.3	3.1-3.5(7)	-	-	-	-	-	-	-	-	-	-
	"	1956	3.5	(3)	-	-	-	-	3.8	(19)	-	-	-	-
	"	1959	-	-	-	-	-	-	-	-	4.1	(8)	-	-
4	T	1954	3.4	3.2-3.5(50)	3.65	3.6-3.7(20)	-	-	-	-	-	-	-	-
	"	1955	3.45	3.4-3.5(23)	-	-	3.88	3.8-3.9(85)	-	-	-	-	-	-
	"	1958	3.3	(26)	-	-	-	-	-	-	-	-	-	-
	"	1959	3.3	(11)	-	-	-	-	-	-	-	-	-	-
	"	1960	-	-	-	-	-	-	-	-	-	-	3.9	(28)
ALL EXPERIMENTS			3.3y ~~3.8~~	3.1-3.5(120)	3.65	3.6-3.7(20)	3.88	3.8-3.9(85)	3.8	(19)	4.1	(8)	3.9	(28)

TOTAL NUMBERS OF HAULS IN BRACKETS.

1) RUNNAGES OF TWINES 45-75 YDS/LB.

* ARITHMETIC MEANS OF VALUES FOR SEPARATE EXPERIMENTS, UNWEIGHTED BY NUMBERS OF HAULS OR SIZE OF CATCH.

TABLE 2

MEAN SELECTION FACTORS FOR HADDOCK. 1952-1960. SUB-AREAS 4 AND 5. RANGE OF MESH SIZE 73-167MM (2 7/8"-6½")

SUB-AREA	DIV.	YEAR	MANILA[1] DOUBLE		COTTON SINGLE		NYLON SINGLE		NYLON DOUBLE		TERYLENE SINGLE		DACRON (BRAIDED) SINGLE	
			MEAN* S.F.	RANGE OF VALUES	MEAN* S.F.	RANGE OF VALUES	MEAN* S.F.	RANGE OF VALUES	MEAN* S.F.	RANGE OF VALUES	MEAN* S.F.	RANGE OF VALUES	MEAN* S.F.	RANGE OF VALUES
4	V-W	1953	3.2	3.1-3.3(13)	-	-	-	-	-	-	-	-	-	-
	"	1956	3.0	(2)	-	-	-	-	3.35	3.3-3.4(25)	-	-	-	-
	"	1959	-	-	-	-	-	-	-	-	3.7	(24)	-	-
4	T	1954	-	-	3.4	(16)	-	-	-	-	-	-	-	-
4	X	1955	3.2	(12)	-	-	3.9	3.8-4.0(42)	-	-	-	-	-	-
4	W	1958	3.1	(15)	-	-	-	-	3.9	(29)	-	-	-	-
	"	1960	3.4	(14)	-	-	-	-	-	-	-	-	-	-
5	"	1952	3.22	3.1-3.3(55)	-	-	-	-	-	-	-	-	-	-
	"	1953	3.25	3.0-3.5(88)	-	-	-	-	-	-	-	-	-	-
	"	1955	3.40	3.3-3.5(30)	-	-	-	-	-	-	-	-	-	-
	"	1956	-	-	-	-	3.45	3.1-3.8(47)	-	-	-	-	3.1	(15)
ALL EXPERIMENTS			3.22	3.0-3.5(229)	3.4	(16)	3.68	3.1-4.0(89)	3.63	3.3-3.9(54)	3.7	(24)	3.1	(15)

TOTAL NUMBER OF HAULS IN BRACKETS.

1) RUNNAGES OF TWINE 45-75 YDS/LB.

* ARITHMETIC MEANS OF VALUES FOR SEPARATE EXPERIMENTS.

TABLE 3

MEAN SELECTION FACTORS FOR SILVER HAKE. 1954-1961. SUB-AREA 5. RANGE OF MESH SIZE 60-103 MM.

SUB-AREA	YEAR	MANILA DOUBLE[1]		MANILA SINGLE		COTTON SINGLE		NYLON SINGLE	
		MEAN* S.F.	RANGE OF VALUES	MEAN* S.F.	RANGE OF VALUES	MEAN* S.F.	RANGE OF VALUES	MEAN* S.F.	RANGE OF VALUES
5	1954	3.4	-(4)	2.8	2.6-3.0(11)	3.1	2.7-3.4(13)	3.52	3.2-3.7(30)
"	1961	2.41	2.2-2.6(34)	-	-	-	-	-	-
ALL EXPERIMENTS		2.9	2.2-3.4(38)	2.8	2.6-3.0(11)	3.1	2.7-3.4(13)	3.52	3.2-3.7(30)

TOTAL NUMBER OF HAULS IN BRACKETS.

1) RUNNAGE 45 YDS/LB.

*ARITHMETIC MEANS OF VALUES FOR SEPARATE EXPERIMENTS.

TABLE 4

MEAN SELECTION FACTORS FOR AMERICAN PLAICE. 1954-1960. SUB-AREA 4. RANGE OF MESH SIZE 113-146 MM.

SUB-AREA	DIV.	YEAR	MANILA[1] DOUBLE		COTTON SINGLE		NYLON SINGLE		COURLENE ?	
			MEAN* S.F.	RANGE OF VALUES	MEAN* S.F.	RANGE OF VALUES	MEAN* S.F.	RANGE OF VALUES	MEAN* S.F.	RANGE OF VALUES
4	4T	1954	2.07	2.0-2.2(32)	2.5	(17)	-	-	-	-
	"	1955	-	-	-	-	2.3	2.2-2.4(29)	-	-
	"	1958	2.1	(7)	-	-	-	-	-	-
	"	1960	-	-	-	-	-	-	2.1	(14)
ALL EXPERIMENTS			2.09	2.0-2.2(39)	2.5	(17)	2.3	2.2-2.4(29)	2.1	(14)

TOTAL NUMBER OF HAULS IN BRACKETS.

* ARITHMETIC MEANS OF SEPARATE EXPERIMENTS.

1) RANGE OF RUNNAGES 45-125 YDS/LB.

TABLE 5

MEAN SELECTION RANGES FOR ALL EXPERIMENTS WITH THE SAME RANGES OF MESH SIZE. 1952-1960

Sub-Area	Species	Manila Double		Cotton Single		Nylon Single		Nylon Double		Terylene Single		Courlene		Dacron	
		Mean S. Range (DM)	Range of values	Mean S. Range (CM)	Range of values	Mean S. Range (CM)	Range of values	Mean S. Range (CM)	Range of values	Mean S. Range (CM)	Range of values	Mean S. Range (CM)	Range of values	Mean S. Range (CM)	Range of values
4	Cod	10.0	6-12	8.0	-	6.5	6-8	8.0	7-9	6.0	-	10.0	-	-	-
4	Haddock	9.0	6-11	?	-	7.5	7-8	6.7	4-9	7.0	-	-	-	-	-
5	"	8.0	4-14	-	-	8.3	5-11	-	-	-	-	-	-	6.1	-
5	Silver Hake	8.6	8-9	10.3	7-15	12.6	7-16	-	-	-	-	-	-	-	-
4	American Plaice	7.0	5-11	4.0	-	7.5	7-8	-	-	-	-	9.0	-	-	-