RESTRICTED

INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES
Serial No. 1671 ICNAF Res. Doc.66-29
(D.c. 8)

ANNUAL MEETING - JUNE 1966

The effect of the approved ICNAF topside chafer on codend selectivity

by H. Bohl

Introduction

At the 1965 Annual Meeting, the Standing Committee on Research and Statistics noted a request by the ad hoc Committee on ICNAF Trawl Regulations for new information on the effect of the approved ICNAF topside chafer on codend selectivity (1965 Meeting Proc. 13, section 2) and recommended that a review of the available information on this item - including, if possible, an analysis of the effects of catch size on selectivity with the chafer - should be prepared for the 1966 Annual Meeting (Redbook 1965, Part I, p. 19).

Topside chafer regulations in force

Hitherto regulations regarding topside chafer only entered into force for Subareas 3, 4 and 5. The regulations valid for Subareas 4 and 5 read as follows (ICNAF Handbook, 1965, pp.95-98):

"IV. That the Contracting Governments permit....(2) a rectangular piece of netting to be attached to the upper side of the codend of the trawl net to reduce and prevent damage so long as such netting conforms to the following conditions:

(a) This netting shall not have a mesh size less than that specified in paragraph I. .....

(b) This netting may be fastened to the codend only along the forward and lateral edges of the netting and at no other place in it, and shall be fastened in such a manner that it extends forward of the splitting strap no more than four meshes and ends not less than four meshes in front of the cod line mesh.

(c) The width of this netting shall be at least one and a half times the width of the area of the codend which is covered, such widths to be measured at right angles to the long axis of the codend."

The chafer regulations in force for Subarea 3 differ from those for Subareas 4 and 5 only in the wording of the subparagraph IV(b) which reads (ICNAF Handbook, 1965, p.93):

"IV. (b) This netting may be fastened to the codend only along the forward and lateral edges of the netting and at no other place in it and shall not exceed 16 meshes in length counted parallel to the long axis of the codend."

Experimental data

In the last decennium a fair number of papers has been written about topside chafing gear and its influence on codend selectivity, but relatively few of them are, in whole or in part, concerned with the approved ICNAF topside chafer. Most of the experimental data relevant to this report are contained in papers by Clark (1958), Saetersdal (1958), Beverton, Parrish and Trout (1959), McCracken (1959 and 1960) and Bohl (1966). The remaining data worthy of consideration are drawn from various sources mentioned below.

To find an answer to the question whether and to what extent codend selectivity is impaired by the ICNAF topside chafer, it is first of all necessary to recapitulate the experimental results available.

Clark (1958) used underwater television equipment to observe the effect of the ICNAF chafer on the escapement of haddock. Two hauls with a 127 mm manila codend were made off Cape Cod in June 1957 by Albatross III in 18 fathoms depth at a towing speed of 3 1/2 kn. The number of fish of the escape size taken per hour of tow amounted to 400 specimens (750 pounds). During the first haul the fish were observed inside the codend. The behaviour of haddock did not differ from that

observed in codends without chafer under similar conditions. During the second haul the camera was attached to the external upper side of the codend. The chafer "was seen very clearly to flow up away from the codend, allowing about two feet clearance at its after end." The chafer seemed not to be under heavy strain, and its mesh angles varied from 90° at the rear end to 60° at the forward end.

Visual observations of the escape patterns were supplemented by moving picture recordings of the television screen. From a 3 1/2 minute film it could be seen that of the 68 haddock which escaped from the codend, 42 escaped through the chafer meshes (14 after considerable struggling with the chafer meshes and 28 without struggle) and 26 escaped through the rear opening of the chafer (4 after struggling with the chafer and 22 without touching the chafer). Clark came to the conclusion that the chafer "flows up clear of the codend under tow and does not obstruct the codend meshes nor interfere with the escapement of haddock through them." He concluded further that this chafer "does not prevent haddock from completing their escape once they have emerged from the codend. Since fish escaped through the meshes as well as through the rearward opening of the chafing gear, it appears desirable to control both mesh size and degree of clearance."

Saetersdal (1958) reported on chafer experiments conducted by R/V Johan Hjort in July 1958 on the East Finnmark and Kildin Banks. Using a wide cover 6 hauls were made with the ICNAF chafer (double manila, appr. 110 mm mesh size) attached to a rather new, double braided manila codend (108-113 mm mesh size). Eight hauls were made without chafer. (The mesh sizes cited for both chafer and codend are not very reliable, since mesh measurements have only been made sporadically and in insufficient numbers.) The length of the chafer was not constant, due to the fact that at first new netting with heavy shrinkage was used. Later on during the experiments this chafer was replaced by a worn-out codend netting having the prescribed dimension. The catches consisted mainly of cod of sizes within the selection range. The quantities caught were small and amounted usually to 20-25 baskets (the net weight of one basket is not stated).

The results of Saeterdal's experiments are shown in the following compilation:

No.of tows	Average mesh size codend/chafer (mm)	(mm)	No. of rearmost codend meshes not covered	Towing speed (kn)	50% length (mm)	S.F.
3	108	110	10 ?	3.60	395	3.66
2	109	110	6	3.75	405	3.72
1	113	110	4	3.47	445	3.94
1*	110	-		3.15	445	4.05
5*	111	-		3.85	405	3.65
2*	112	-		3.78	390	3.48

* Tows without chafer

The average selection factor of the series of hauls with chafer was 3.77 and that of the series of hauls without chafer 3.73. The variability of the results could not be ascribed to variations in catch size or duration of haul, but an indirect relationship was found between towing speed and selection factor. Saetersdal concluded from these experiments that a topside chafer rigged according to ICNAF specifications has no influence on codend selectivity. He stressed, however, that the catches in these trials have been small and that "a complete study of the problem would have to be based on further material, especially from larger catches."

McCracken (1959) reported on chafer studies carried out in September 1958 in Div. 4W. Within 4 days 20 successful tows, each of 45 minutes duration, were made by the R/V Harengus. Haddock were taken in good quantities; the catches averaged about 1,000 pounds per tow. A new, double-strand, 5-inch manila codend covered by a small-meshed Nyak netting was used. The chafer made from the same netting as the codend was 50% wider than the codend, whereas the cover used in these trials was only about 33% wider. That means that the width of the chafer was certainly not wholly effective. This fact, however, was not reflected in the selection data obtained: The selection curves derived from 12 tows without chafer and from 8 tows with chafer were shown to be quite similar in shape and position. Both portions of the trials yielded a 50% retention length of about 41-42 cm and a selection factor of about 3.2 or 3.3. McCracken concluded from these results that "with catches of the size shown, top chafing gear mounted according to ICNAF specifications had no influence on retention within the codend. Since the effective slack of the top chafing gear was less than that specified by ICNAF, the results suggest that netting less than 1 1/2 times the width of the codend might be used."

During September/October 1959 and March 1960 the Canadian chafer experiments were continued in Subarea 4 (McCracken, 1960). On this occasion different types of chafing gear were tested. In the following, however, only that portion of the trials is considered which was concerned with the approved ICNAF topside chafer. Two sets of hauls with chafer and 4 sets of hauls without chafer were conducted by R/V Harengus in September 1959 on Sable Island Bank (Div. 4W). Again the covered codend technique was applied. Fishing was carried out with double braided manila codends having mesh sizes between 114 and 121 mm. The meshes of the manila chafers used were larger than those of the codends by 11 and 15 mm, respectively. Haddock, the species studied, were caught in rather poor quantities; the haddock catches ranged from 1/2 to 26 baskets per tow (1 basket = 38 kg, approximately). The trials gave the following results:

No. of tows	Mesh size codend/chafer (mm)	(mm)	Total catch all species (baskets)	Total no. of haddock (30-50cm)	Sel. range (cm)	50% length (cm)	S.F.
4*	114	-	45	1400	5	34	3.0
5	117	132	63	3500	8	36	3.1
6*	121	-	85	5100	7	39	3.2
6	121	132	150	7800	8	39	3.2
4*	121	-	35	2100	7	40	3.3
6*	121	-	75	3700	6	42	3.5

* Tows without chafer.

The average selection factor for the sets of tows with chafer was 3.15 and that of the sets of tows without chafer 3.25. (The latter is reduced to 3.17, if the last group of tows, which was made about 10 days after the previous series and in a slightly different area, is left out of account). Thus the results show that ICNAF chafers 11-15 mm larger than the codend mesh "did not reduce escapement appreciably".

Beverton, Parrish and Trout (1959) outlined some provisional results of English and Scottish chafer experiments carried out in 1958. As to the English experiments, the general data given by the three authors are supplemented by selection curves contained in the Compilation of Selectivity Data (ICNAF, 1962) as well as by curves and tables in the NEAFC document NC 3/25, 1965. Moreover, additional data on the English experiments were obtained by letter from the Fisheries Laboratory, Lowestoft (Mr. R.W.Blacker).

Tests in which double manila codends and double manila ICNAF chafers of about the same mesh size were used, have been carried out by the covered codend technique during two cruises of R/V Ernest Holt in June/July 1958 on Sorkapp Bank/Spitsbergen (Cruise IV), and in October 1958 on Hornsund Bank/Spitsbergen and in the region of Bear Island (Cruise VI). On both cruises mainly cod were caught; the catches were only occasionally mixed with moderate quantities of haddock. The results obtained were as follows:

Cruise	No. of tows	Mesh-size codend/chafer (mm)	(mm)	Duration of tow (hrs)	Catch sizes (basket+) only cod range	average	50% length (mm)	S.F.
IV	5	103	105	1	31-66	45	320	3.1
	4*	103	-	1	3-86	42	351	3.4
VI	9	110	105	1½-2	4-63	18 1/3	436	4.0
	6*	110	-	1 -2	8-82	26	449	4.1

*Tows without chafer + 1 basket = 30 kg. approximately

It appears from these data that the ICNAF chafer did impair the codend selectivity on Cruise IV, whereas the same chafer left the selectivity practically unimpaired on Cruise VI. In this context, however, it has to be stressed that the results obtained from Cruise IV are apparently not very reliable. The selection factor of 3.4 for the tows without chafer seems to be over-estimated. Judging from the selection curves published (ICNAF, 1962; NEAFC, 1965), a selection factor of 3.3 or even 3.2 would probably be more adequate. Anyway, really reliable selection factors cannot be given for Cruise IV, because scarcely any cod of the 0-50% retention lengths were caught

with the 103 mm codend mesh used. So it remains to be stated that the data of Cruises IV and VI offer no proof that the ICNAF chafer has appreciably reduced the selectivity of the codend.

During Cruise VII of the Ernest Holt (Nov.-Dec. 1958; Barents Sea) some experiments were conducted in which a double manila chafer (ICNAF specification) of above 150 mm mesh size was fitted on alternate hauls to a double manila codend of 130 mm mesh size. The cod selection curves for the codend with and without chafer were virtually identical. Both curves gave a 50% retention length of 47 cm (selection factor 3.6).

Finally, it is worth mentioning that on the occasion of Cruise V of the Ernest Holt (Aug.-Sept. 1958) tests were made with a chafer having a substantially smaller mesh size (81 mm) than the codend used (105 mm). (The mesh size excepted, the chafer complied closely with the ICNAF specifications.) In this case the codend selectivity for cod was found to be markedly reduced (with chafer: 50% length = 34.6 cm, S.F.=3.3; without chafer: 50% length = 39.5 cm; S.F.= 3.8). The statement, however, that "the 50% length corresponded, in fact, to what would have been expected if the mesh size of the chafer had been the determining factor for selection" (Beverton et al., 1959), proves to be false, because the authors erroneously believed that a chafer of 95 mm mesh size had been used in these trials.

The preliminary account of the Scottish chafer experiments given by Beverton et al. (1959) has recently been completed and partly corrected by a written communication from the Marine Laboratory, Aberdeen (Mr. J.A. Pope).

The experiments were carried out by R/V Explorer during December 1958 in Faroese waters. Two double braided manila codends of different mesh sizes were used. A series of hauls was made with each codend, hauls within each series being made with or without a large-meshed double manila chafer (ICNAF type) in a random order. By the covered codend technique the following selection data were obtained, the species referred to being haddock:

No. of tows	Average mesh size codend/chafer (mm)	(mm)	Duration of tow (hrs)	Sel. range (cm)	Total number of fish in sel. range	50% length (mm)	S.F.
3	82.0	106.5	1	4.9	466	258	3.15
2*	82.0	-	1	5.1	395	225	2.74
6	99.4	131.3	1	4.0	2152	257	2.59
6*	99.4	-	1	5.7	1448	283	2.85

* Tows without chafer.

Unfortunately, no records of catch weight and catch composition were kept. The above compilation shows conflicting results. The first portion of the trials revealed no chafer effect; quite the contrary, the tows with chafer gave a markedly higher selection factor than those without chafer. The second portion, however, being based on more tows than the first, pointed to a relatively large chafer effect: A reduction of the selection factor for haddock by about 9% (from 2.85 to 2.59) was found on hauls in which the codend (99 mm) was fitted with a large-meshed chafer (131 mm). The extent to which this difference was possibly caused by factors other than the presence of the chafer (e.g. masking effect of the cover), could not be determined from the data.

Bohl (1966) reported on selection experiments with the approved ICNAF chafer which were carried out by F/R/V Walther Herwig (a stern trawler of 83.3 m length o.a.) in December 1965 on the eastern slope of Fyllas Bank (Div. 1D). A double braided polyamide codend of 122 mm mesh size was fished in conjunction with a small-meshed polyamide cover (ICES specification, but double the width of the codend). The chafer having a mesh size of 127.5 mm was made from the same netting as the codend. The catches, ranging from 1 1/4 to 2 3/4 metric tons per 1 1/4 hours' fishing time, were uniformly composed. Cod were clearly predominant; other fish and invertebrates were caught in small quantities. The selection data for cod, obtained from combined hauls, were as follows:

No. of tows	Average mesh size codend/chafer (mm)	(mm)	Duration of tow (hrs)	Average weight of cod (kg)	Sel. range (cm)	No. of cod in sel.range	50% length (mm)	S.F.
2	122.2	127.5	1 1/4	1735	8.5	1432	413	3.38
4*	122.2	-	1 1/4	1558	9.4	2431	413	3.38

* Tows without chafer

Both the set of hauls with chafer and the set of hauls without chafer gave the selection factor 3.38. Since cod were sufficiently numerous in each catch, reliable selection data could be obtained from each individual haul. The selection factors for the 4 hauls made without chafer were found to be 3.28, 3.29, 3.40 and 3.44 (mean selection factor 3.35 ± 0.04). In the two hauls made with chafer, a selection factor of 3.37 was found for each haul. Thus the results represented on a haul-by-haul basis also show the codend selectivity to be unaffected by the presence of the chafer.

An "ICNAF chafer" is reported to have been used in Russian experiments which were carried out at Iceland in July 1962 by the stern trawler Goncharov (Treschev, 1965). However, the designation of the chafer is misleading, for it can be taken from the Cooperative Research Report No. 3 (ICES, 1965), that the Goncharov trials were conducted with a topside chafer "of the same mesh size as the codend, and of the same length, fixed at the forward end and open at the rear, and of a width such that the ratio of perimeter of chafer to perimeter of codend was as 5:4." That is why Treschev's data are omitted from this review.

Discussion

The above results of covered codend experiments carried out between 1958 and 1965 to determine the effect of the approved ICNAF topside chafer on codend selectivity can be summarized as follows: In most of the trials similar selection data were found for chafered and unchafered codends. The selection factors obtained for cod and haddock from tows with chafer were slightly larger than, the same as, or slightly smaller than those obtained from tows without chafer; the maximum difference observed was 0.1. In other words, the majority of the trials revealed no chafer effect.

Differences in selection factors being larger than 0.1 were only found in the following three cases:

1) During the Scottish experiments (R/V Explorer, Dec. 1958, Faroese waters) an 82 mm manila codend was used with and without chafer (107 mm mesh size). The resulting selection factors for haddock were 3.15 for the chafered codend and 2.74 for the unchafered codend. This unexpected result, indicating a better selectivity for the codend with chafer, is not very reliable, because it is based on a small number of hauls with rather poor catches.

2) On the same occasion Explorer also used a 99 mm manila codend with and without chafer (131 mm mesh size) This time the haddock selection factors obtained were 2.59 for the chafered codend and 2.85 for the unchafered codend. That means, a reduction of the selection factor by about 9% was found on hauls in which the chafer was attached to the codend. This result, being based on a sufficient number of hauls, points to a relatively large chafer effect. It should, however, not be left out of account that it is not clear whether and to what extent the reduction of the codend selectivity was due to factors other than the presence of the chafer. So it may have been that the cover, although being rigged extra-wide, "was having a masking effect, overlaying the chafer and forcing it to lie closer to the codend than it would normally" (Beverton et al., 1959).

3) On one of the cruises of R/V Ernest Holt (English experiments, June/July 1958, Spitsbergen) a 103 mm manila codend was used with and without chafer (105 mm mesh size). The resulting selection factors for cod were about 3.1 for the chafered codend and about 3.4 for the unchafered codend (NEAFC, 1965). Both factors, however, have been shown above to be unreliable: They were obtained from catches in which cod of the 0-50% retention lengths were almost entirely absent. In addition to this it has been pointed out that the selection factor for the codend with chafer was obviously over-estimated. Therefore, no special importance should be attached to this portion of the English trials.

With the single exception of that Scottish trial in which a 131 mm chafer was found to reduce the selectivity of a 99 mm codend for haddock by 9%, the experiments reviewed in this report show no chafer effect. So it may be concluded from all the results available that the approved ICNAF topside chafer has little or no influence on the selectivity of the codend for cod and haddock.

It has been supposed that extra large catches may cause the chafer to alter escapement (McCracken, 1960). However, it is not possible to substantiate this assumption by experimental data, because all the data available are based on small or medium-sized catches. Yet it can be seen from the German experiments that catches up to 2.6 metric tons per tow do not cause the chafer to reduce the codend selectivity for cod (Bohl, 1966). The results obtained from the British, Canadian and Norwegian chafer experiments are, in contrast to the German results, not presented on a haul-by-haul basis. Therefore it is in these cases practically impossible to analyse the effects of catch size on the selectivity of chafered codends.

To guarantee an unimpaired codend selectivity, it is necessary that the rigging of the chafer complies closely with the ICNAF specifications. By means of underwater television, Clark (1958) could observe that haddock, once emerged from the codend, complete their escape through the meshes as well as through the rearward opening of the chafer. He concluded from this observation that it would be essential to control both mesh size and slack of the chafer. Selection experiments carried out later with different modifications of the ICNAF chafer led to the same conclusion: Chafers having the prescribed slack of 50% but smaller mesh sizes than the codend, reduced the selectivity (Ernest Holt Cruise V/1958, Beverton et al., 1959, etc.). Chafers having the same mesh size as the codend but a slack of only 10-20%, affected also the selectivity of the codend (McCracken, 1959; Bohl, 1964).

On the other hand, no reduction in selectivity was detected, when a chafer was attached to a codend of the same mesh size with an effective slack of about 33% (McCracken, 1959). Not even a chafer having a slack of 25% and the same mesh size as the codend, impaired the selectivity (Treschev, 1965; ICES, 1965). These results indicate that the prescribed 1 1/2 times width of the chafer is more than sufficient and that a chafer somewhere between 1 1/4 and 1 1/2 times as wide as the codend would be adequate. That, however, does not mean that the 1 1/2 times width specified by ICNAF regulations should be reduced. Quite the contrary, as long as there is no more scientific evidence, it is deemed absolutely necessary to maintain this width.

"ICNAF chafers" being applied almost tightly (laceage wider by only 5-8 meshes) had a severe effect on the selectivity of the codend, when the mesh size of the chafer was only slightly larger than that of the codend. However, they had no effect when the size of the chafer mesh (165 mm) was considerably larger than that of the codend mesh (111 mm) (McCracken, 1960). In the light of this evidence it seems to be possible to use tight chafers with extra-large mesh sizes.

Finally, it must be mentioned that not only the width and the mesh size but also the length of the chafer may be relevant to the selectivity of the codend. Canadian trials (Martin, 1957) showed that an excessive length of the chafer reduced escapement appreciably, but Russian experiments (Treschev, 1965; ICES, 1965) gave opposite results.

Conclusions

By the scientific evidence summarized in this report it is clearly shown that, with catch sizes up to 2.6 metric tons, the ICNAF topside chafer rigged in the prescribed manner has little or no influence on the codend selectivity for cod and haddock. Improper application of the chafer, however, can seriously reduce escapement. This reduction can be caused by insufficient width, insufficient mesh size and/or excessive length of the chafer.

References

Beverton, R.J.H., B.B. Parrish and G.C. Trout. 1959. Progress Report on Trials of Top-Side Chafers. Annu.Proc.int.Comm.Northw.Atlant.Fish., 9: 86-87.

Bohl, H. 1964. Preliminary results from selection experiments with polypropylene codends and top-side chafers. ICES Comparative Fishing Committee, Paper No. 149, 1964.

Bohl, H. 1966. Recent selection experiments with the approved ICNAF topside chafer. ICNAF Res.Doc. 66-15.

Clark, J.R. 1958. Underwater Television Observations on the Effect of Chafing Gear on Escapement of Haddock. Annu.Proc.int.Comm.Northw.Atlant.Fish., 8: 101-102.

ICES. 1965. Report of the 1962 Iceland Trawl Mesh Selection Working Group. ICES Cooperative Research Report No.3, p. 2 and 9.

ICNAF Sec. 1962. Compilation of Selectivity Data. ICNAF Meeting Doc.No.6, p.15, 1962.

Martin, W.R. 1957. Canadian Researches, 1956. Subarea 4. Mesh Selections. Annu. Proc.int.Comm.Northw.Atlant.Fish., 7: 25-26

McCracken, F.D. 1959. Top Chafing Gear Studies. Annu.Proc.int.comm.Northw.Atlant. Fish., 9: 101-103.

McCracken, F.D. 1960. Selectivity of Codends with Various Types of Topside Chafers. ICNAF Standing Committee on Res.and Stat., Proceedings and Selected Reports: p. 66-69.

NEAFC. 1965. Top Side Chafer. Document NC 3/25, Annex VI: United Kingdom.

Saetersdal, G. 1958. Selectivity experiments with topside chafers. ICES Comparative Fishing Committee, Paper No. 72, 1958.

Treschev, A.I. 1965. The Effect of Chafers on Strength, Durability and Selectivity of Trawls in Relation to Cod. ICNAF Res.Doc. No. 66, 1965.