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Observations with Echo-Sounding on the Behaviour of a Herring Shoal towards a Bottom Trawl.

by

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The present observations were made during the third voyage of the fishery research vessel ANTON DOHRN on 18th of August, 1955, between 1425 and 1600 Central European time at 58°06' N and 0°35' E. The fishing gear was a usual German herring bottom trawl with normal otter boards (1,35 x 3,30 m), bridles (20 fathoms), Danlenos, legs (12 fathoms) and two auxiliary headlines with a kite each (0,8 x 1,2 m). The bag of the net with 160 ft. groundrope was made of Manila in the usual way. The length of the warps amounted in the existing depth of water of 150 to 157 m to 325 fathoms. The trawling speed was 3,6 knots. The wind was S 1, the waves were 0,5 m in height .

The echo soundings of the fishery research vessel ANTON DOHRN, which towed the gear, were carried out by a fish detector from Atlas-Werke AG, Bremen, type "Fishfinder", with the measuring range of 0 to 200 m. For the sounding above the fishing gear the rubber boat of the "Institut für Netzforschung" equipped with the institute's measuring sounder from Atlas Werke AG, type SH 37 tr, 42 d tr with the measuring range of 80 - 160 m, was used. The two echograms A (fishery research vessel ANTON DOHRN) and B (rubber boat) have therefore a varying depth- and time scale. (See picture on last page).

The position of the fishing gear was exactly astern during the soundings. It was therefore towed safely over the path of the bottom searched by the sounder of ANTON DOHRN. Whilst the towing research vessel kept a straight course, the rubber boat cruised in far-ranging zig-zag courses over the trawling gear. The intention was to record variations in the formation of the fish shoals beside the fishing gear (up to approximately 100 m towards either side) as compared with those before and above the fishing gear. This method of observation resulted in small differences within the whole picture of the fish traces of the two echograms. Owing to the varying manoeuvres of the two vessels, the echogram A can only be compared with those traces of echogram B, where traces from the fishing gear are recorded.

The vertical marks on the echogram B (boat) indicate the change of the course during the zig-zag cruising. The arrows over the fish traces in that echogram shall always indicate the course taken by the boat and at the same time the changed position in relation to

the fishing gear. ↗ for instance, means that the boat cruised over the fishing gear from port to starboard in diagonal direction and drew up at the same time. ↙ means then a crossing from starboard to portside with falling back at the same time. ↕ means an overtaking or falling back laterally of the fishing gear. ↔ indicates a short-ranging zig-zag course in about the same position over the fishing gear.

The marking lines later inserted into echogram A (towing vessel) correspond as far as possible to those of echogram B. Their position was not determined by the fish traces but by the characteristic points of the profile of the bottom. Therefore, two corresponding marking lines limit in both echograms in the towing direction the water area above approximately the same bottom section which, however, is generally wider in echogram B than in echogram A because of the far-ranging zig-zag courses. The sections between two marking lines are continuously numbered.

The echogram A recorded by the research vessel ANTON DOHRN which towed the fishing gear, shows near the bottom a fish shoal trace, from which a shoal of medium density can be supposed. The superior edge of that shoal is irregularly curved and reaches a maximum distance from the sea-bottom of about 25 m. The shoal is generally 10 to at most 15 m in thickness. Its lower edge is up to 10 m over the ground. Considering the catch of 60 baskets of herring, 3 baskets of Gadus esmarki and 7 baskets of mixed species after a trawling period of 2 hours and 35 minutes, it may be supposed, that the shoal consisted practically exclusively of herring. The fact, that the shoal was nearly all the time in a certain distance from the bottom, appeared to be favourable for the intended investigations. It had thus the opportunity, possibly to evade into all directions. The amount of the catch of totally 70 baskets leads to the conclusion that the superior parts of the shoal had not been caught. The main amount of the catch might have been taken in the sections 18-24 and 30-41.

A general comparison between the two echograms shows a surprisingly good conformity of the contours of the two shoal-traces. There exist, for instance, in both echograms striking indentations in the superior edges of the shoal-traces in the sections 10-11, 16, 20-21 and 33-35. The same refers to the peaks at the upper edges of the shoal-traces in the sections 6-7, 14-15, 17-18, 28 and 36-37 as well as to the increase and decline of the shoal-traces in section 43 and the subsequent sections. The co ntours of the shoal-traces are so congruent, that a remarkable change in the position of the shoals between the corresponding soundings of the two vessels cannot have taken place. This good qualitative conformity leads to the conclusion that the fishing gear had scarcely produced a far-reaching frightening effect.

A more exact quantitative comparison confirms that impression and gives, moreover, interesting details. For that purpose the distance of the superior edge of the fish shoal trace from the bottom trace was measured at the corresponding spots of the two echograms. In echogram B (rubber boat) the spots direct over the trace of the

fishing gear (net-opening) or between the traces of the two sides of the fishing gear (legs, bridles or warps) were chosen. The comparative spots in echogram A (towing vessel) were chosen depending on the distance from the concerned marking lines. The exactness of these measurements is, of course, limited, owing to the inadequate exactness of the superior edge of the shoal trace. Their results, collected in the enclosed table, give nevertheless a certain general view.

The arithmetical means of the 40 individual measurements of each echogram show only a small difference, i.e. 17,8 m (echogram A, towing vessel) as compared with 17,2 m (echogram B, boat). The small difference of minus 0,6 m confirms the first impression, that a far-reaching frightening of the fish shoal by the fishing gear did not occur.

As can be understood from a closer examination of the individual values belonging to one complex, the term "far-reaching" should be particularly emphasized, for hints to a locally limited frightening effect can positively be noticed from the echograms.

This refers in particular to the warps. In the section 12, 17, 19-21, 31-34 the traces from the warps are included in the superior edge of the shoal traces. The arithmetical means of the individual values belonging to those sections are for echogram A (towing vessel) 16,1 m and for echogram B (boat) 12,6 m. The difference of minus 3,5 m (variation - 1 m to - 10 m) is here so distinctly greater than the general difference of the arithmetical means, that one may certainly suggest a locally limited frightening effect of the warps. The radius of that frightening effect can only be estimated. Considering the gaps between the fish traces below the warp traces (section 12, 17, 19, 21, 30, 33 and 34) it might have been not less than about 2 to 4 m.

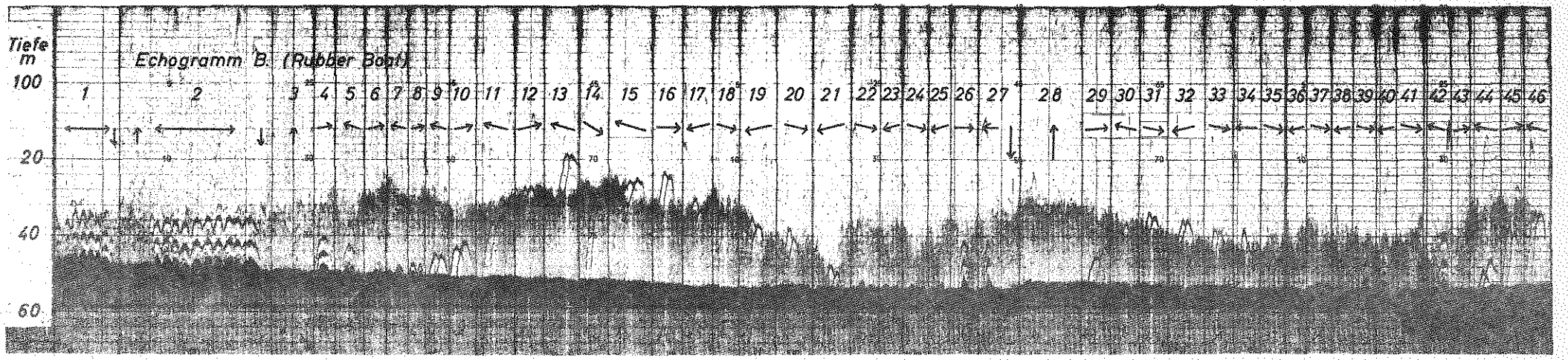
Here the question arises, whether that obvious frightening effect of the warps affects the catching ability. This can be examined by means of those sections where the warp traces are within the trace of the shoal. The arithmetical means for the individual values belonging to the sections Nos. 9, 11, 14, 18, 29 and 35 amount for echogram A (towing vessel) to 19,4 m and for echogram B (boat) to 19,6 m. Both the values are practically equal. From that fact it may be concluded that the shoal after passing the warps recovers its previous shape. The frightening effect of the warps should therefore have no severe adverse influence to the catching ability of the fishing gear. Owing to the too small sound concentration of the echo sounder used for these investigations, it was impossible to record the frightening zone which certainly also occurs within the shoal around the warps. As compared with the diameter of the effective sound-beam, the suggested area free from fish is too small not to be covered by the traces from the side-echos of the same period.

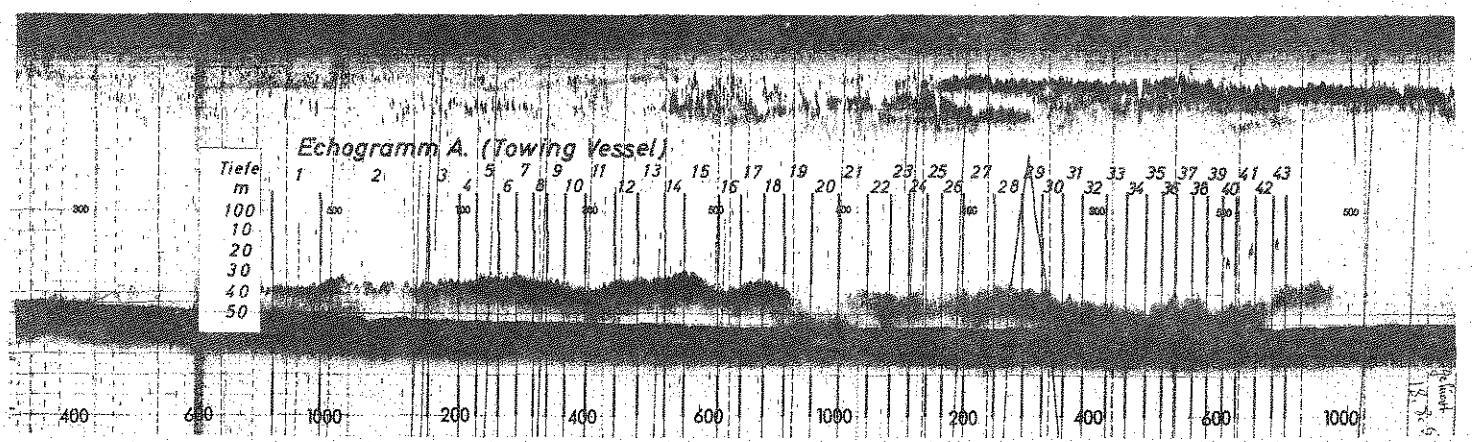
It can not be suggested from the existing material that the opening of the fishing gear, together with its auxiliary headlines and kites, develop a particular frightening effect to the shoal. The arithmetical means for the individual measurements of the concerned sections 1-2b, 4, 5, 26, 27, 39, 40, 42 amount to 16,9 m for both the echograms (variation -2 to +2 m) and are thus exactly equal. Moreover, it cannot be proved by the echograms that the kites are frightening the fishes into the depth, thus improving the fishing yield, as it is supposed by the fishermen. That could scarcely be expected because of the too small sound concentration mentioned above, as there, too, it should be suggested that the gaps were covered by the side-echos.

For the investigations of such problems, which require even records from small gaps of few metres within the fish shoals, echo sounders with an extremely narrow concentration of sound-beams should be employed, of which the diameter of the effective zone in the concerned depth and for the detected fish would be smaller than the gap to be expected within the fish shoal. Moreover, it would be more suitable for various reasons, to carry out such more exact investigations in smaller depths of water, than it had to be done with these observations (about 150 m in depth).

Section No.	Echogram A towing vessel m	Echogram B rubber boat m	Difference m
1	16	15	-1
2a	20	19	-1
2b	18	17,5	-0,5
4	20	18,5	-1,5
5	23	18	-5
6	22	21	-1
7	23,5	23	-0,5
8	22	21,5	-0,5
9	22	21,5	-0,5
10	20	20	---
11	19	19	---
12	23	22	-1
13	22	22	---
14	25	25	---
15	24	21	-3
16	19	19,5	+0,5
17	22	20	-2
18	20	20	---
20	12	9	-3
21	17	7	-10
22	18	18,5	+0,5
23	16	18	+2
24	18	15	-3
25	16	17	+1
26	17	18	+1
27	17	18	+1
29	17	17	---
30	17	17	---
31	16	15	-1
32	15	14	-1
33	12	7	-5
34	12	7	-5
35	13	15	+2
36	13	13	---
37	12	12	---
38	16	16	---
39	11	13	+2
40	14	16	+2
41	15	16	+1
42	16	16	---

Survey of the comparable distances of the superior edge of the fish shoal traces from the bottom traces for the two echograms.





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