REPORT ON COMPARATIVE TRAWLING EXPERIMENT BETWEEN F.R.V.'s "EXPLORER" and "SCOTIA".

February, 1949.

The delay in the completion of "EXPLORER'S" overhaul and the need for "SCOTIA" to return to Leith by February 11th, restricted the time available for the above experiment to the period February 6th - 10th. It was necessary therefore, that as little time as possible should be spent in steaming and selection of grounds and for this reason it was decided that, providing fish were present in sufficient numbers, operations should be conducted in the Firth of Forth. A suitably stocked ground was found in the mid-firth region off Largo Bay in 15-25 fathoms, and subsequent operations were carried out there.

Ten hauls, each of one hour's duration, were made by each ship with the standard scientific gear, the position of shooting being gauged in each case from land bearings. Both ships towed on parallel courses, the relative position of each being such that the same ground was covered throughout the experiment.

Trawling was confined to the hours of daylight. This restriction was necessary in the absence of more than one trawl skipper on each ship, and because Captain Bruce, who handled "SCOTIA'S" gear, in the absence of Mr. Craig, had had little experience of working it in darkness.

Gear:

The gears used by the two ships, with their dimensions were as follows:-

"EXPLORER" - 58 ft. otter trawl with small meshed cover, but with no legs or bridles. Headline 112 ft. Groundropes 50 ft. Bosom 22 ft. Trawlboards 9 ft. 6 ins. by 4 ft. 3½ ins.

"SCOTIA" - 20 ft. Otter Trawl with small meshed cover and with 20 ft. wire legs. Headline 32 ft. Groudrope 20 ft. Bosom 8 ft. Trawlboards 4 ft. 6 ins. by 2 ft. 6 ins.

Both ships towed at approximately the same speeds, although slight variations in the towing speed of "SCOTIA" were adopted from haul to haul. Variations in the length of warp used by "SCOTIA" were also made towards the end of the series of hauls, to gauge its affect on the catch of bottom living forms.

Of the 10 hauls made by each ship during the course of the experiment, 8 gave comparable results, the remaining two being spoilt by snags experienced with "SCOTIA'S" trawl. In the first of these it was discovered that the trawl had failed to spread due to the interlocking of the trawl boards, whilst in the second, the complete gear, with trawl boards, was lost when the trawl struck a major obstruction. "EXPLORER" experienced no snags and sustained no damage to gear throughout the course of the experiment.

Results:

The catches of the two ships show that the population of fish sampled during the course of the experiment was of a mixed nature. The catches of round fish consisted principally of cod, 0+ group whiting and Gadus esmarkii; and those of flatfish were of dabs, witches, lemon soles and plaice. Small clupeiods were also present in great abundance in "EXPLORER'S" hauls.

The catches of the principal species by number and weight in each of the

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eight comparable hauls are given in Tables I and II. Table II also contains the weights of invertebrates caught by the two ships. Owing to the small numbers of fish involved however, and the great influence which a few large fish can have on the total weight, the analysis which follows has been confined to the numbers of fish caught by each ship. The ratios of numbers of the principal species caught by the two ships have been calculated for each haul and are tabulated below.

Ratio. "EXPLORER'S" catch/"SCOTIA'S" catch.

Haul.	1	2	4	5	6	7	8	9	Total.
Cod	1.64	2.39	0.68	3.60	0.67	0.61	0.31	0.50	1.09
Dabs	0.24	1.42	1.37	1.55	0.42	0.66	0.59	0.41	0.70
Other Flats	0.38	0.56	1	0.77	1.24	0.50	0.14	0.33	0.57
Clupeoids	382.0	53.4	856.7	827.0	17.3	147.6	298.1	776.2	283.7
Small Gadoids	3.07	3.34	0.35	8.47	0.38	0.90	0.85	2.0	1.50
Total (Excluding Clupeoids)	1.03	1.89	0.58	4.36	0.42	0.74	0.58	0.85	1.06

An examination of the results shows that despite considerable fluctuations in the numbers of fish caught by the two ships from haul to haul, the trawls behaved differently in their capacity to catch and retain fish of different types. Thus, "EXPLORER" caught more small gadoids and clupeoids but fewer of the bottom living forms such as flatfish, anglers, skates and invertebrates, whereas the total catches of cod were approximately equal. The most striking difference between the catches of the two ships was in those of clupeoids. These forms were present in great abundance in almost all the "EXPLORER'S" catches, but were, in all cases, a minor constituent of "SCOTIA'S". Although the overall catch of roundfish (cod and small gadoids) was also greater in "EXPLORER'S" catches, the fluctuations in the numbers caught from haul to haul were too great for much significance to be attached to the average differences between the two ship's catches. "SCOTIA'S" results, on the other hand, showed greater overall catches of flatfish, anglers, skate and invertebrates. In all but two hauls, the catch of "other flats" was greatest with "SCOTIA'S" gear, the difference in this case being significant at the 5% level. Dabs, which were the most abundant of the flatfish, were caught in greater numbers by "SCOTIA" in five of the 8 hauls, but the difference in average catch is not significant at the 5% level. Invertebrates were also caught in significantly greater quantities by "SCOTIA'S" gear.

A consideration of the differences in the sizes of the two trawls used by the two ships emphasises the greater capacity of "SCOTIA'S" trawl to catch the bottom living forms. It is seen from the relative dimensions of the two nets that the maximum spread of "EXPLORER'S" is approximately four times that of "SCOTIA'S" but if allowance is made for increased efficiency of "SCOTIA'S" gear, by virtue of the 20 ft. steel legs, this greater spread is decreased to approximately two. When the "SCOTIA'S" figures are raised by

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this factor, it is found that they are greater for all species except clupeoids, the difference being very significant for the bottom living grounds.

Discussion:

Despite the small numbers of hauls made by each vessel in this experiment, the differences in the catches of the major constituent species were sufficiently constant for tentative conclusion to be drawn regarding the sampling of the two gears. It is not possible from these results alone, however, to determine reliable factorial estimates to be used in future surveys, of the differences between the two ships' catches of the principal demersal species.

It is evident that "SCOTIA'S" gear sampled the bottom living forms more effectively than did "EXPLORER'S". This is probably explained by a deeper "bite" of the small trawl into the seabed. Evidence of this was afforded by the large collection of mud, stones and other rubbish in "SCOTIA'S" trawl in almost every haul, and their absence from "EXPLORER'S". This was experienced over the whole range of warp lengths and towing speeds (75-100 fathoms) and (60-65 revs.). No tendency for "SCOTIA'S" trawl to fish in mid-water was experienced. This condition canbe associated with the very heavy bosom and footropes used during these trials. It is important to note however, that the ground sampled in this experiment was of a soft muddy nature so that very little damage to the trawl was experienced until the final haul (see below) and it is probable that on rougher ground this gear would have experienced much greater damage. Also, as a result of the small size of gear in relation to the size of ship, loss of the complete gear is a serious danger. Such a loss was experienced in "SCOTIA'S" final haul, when a major obstruction was encountered and the complete gear, with boards, was lost. In this instance the breakage occurred at the swivel chain by which the warps are attached to the trawl boards.

As regards the roundfish, no reliable estimates of specific differences in the catching capacities of the two gears were obtained, due apparently to the spotty natures of the shoals. The very great differences in the catches of herring and sprats, however, suggest that the headline of "EXPLORER'S" net was higher than "SCOTIA'S", the latter's headrope passing beneath the lower depth limit of the shoals. If trawl board height be taken as a measure of the height of the headrope during towing, "EXPLORER'S" net would have maintained a vertical gape approximately twice that of "SCOTIA'S". It is hoped that some measure of "EXPLORER'S" headline height will be obtained from the "EXPLORER"-"CLUPEA" trials. It is possible also, that the upper steel leg attached to "SCOTIA'S" net would create a downward pull on the headrope. However, a further possible contributing factor which might result in the difference in the catch of clupeoids must be borne in mind. Hauling the net on "EXPLORER" is carried out with the ship turning at slightly less than towing speed, whereas on "SCOTIA" it is effected from the almost stationary ship, with the result that "SCOTIA'S" gear would be less likely to fish during the hauling process and thus might fail to sample the pelagic forms.

Conclusions:

From the foregoing, the following tentative conclusions may be made regarding the relative fishing capacities and behavioural differences between "EXPLORER'S" and "SCOTIA'S" trawls.

1. "SCOTIA'S" trawl proved a more effective sampling apparatus for flatfish and other bottom living forms than did "EXPLORER'S".

2. By virtue of the very much smaller trawl dimensions, especially of headrope height, "SCOTIA'S" trawl would probably fail to sample roundfish (e.g. haddock and whiting) adequately,

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except when they were close to the bottom. "EXPLORER'S" on the other hand would give more representative sampling.

3. "SCOTIA'S" trawl when fitted with heavy bosom and footropes, sampled the bottom forms effectively with a warp/depth ratio of 3:1 and at a towing speed of 65 revs.

4. The deep 'bite' of "SCOTIA'S" gear would result in a high incidence of damage when used on rough and stoney ground. Also, owing to the disproportionate sizes of trawl and ship the loss of the complete gear on striking a major obstacle would be a serious danger.

Recommendations:

1. Although differences in the behaviour of "EXPLORER'S" and "SCOTIA'S" trawl are evident from the results of this experiment, no reliable estimates of their differences in the sampling of roundfish were obtained. In view of the possibility of "SCOTIA'S" trawl failing to sample such forms as haddock and whiting as efficiently as "EXPLORER'S", it is recommended that a further experiment be carried out on a population consisting principally of these two forms, and that this should be supplemented by a similar one on a flatfish ground.

2. Consideration should be given to the use of floats on the headline of "SCOTIA'S" trawl.

3. Experiments should be carried out on "EXPLORER" to see whether slight modifications of the existing gear or the adoption of the 48 ft. net would result in more effective flatfish sampling without sacrificing its effectiveness as a roundfish trawl.

4. Experiments should be conducted with "SCOTIA'S" gear to determine the optimum warp/depth ratio and footrope weight for sampling both round and flatfish populations at normal towing speeds. There is a need for one of the new Chernykeef ship's logs to be fitted to "EXPLORER" and "SCOTIA" which can be used to record the ships' speed during actual trawling operations.

5. It is also recommended that consideration be given to the adoption of a larger trawl on "SCOTIA". Apart from the probable increase in fishing capacity that would result, such a trawl would require larger trawlboards and stronger fittings, which would lessen the danger of loss of gear on rough ground.

(Signed) B.B. PARRISH.

TABLE I./

TABLE I.

NUMBERS OF FISH CAUGHT BY "EXPLORER" and "SCOTIA" DURING COMPARATIVE TRAWLING EXPERIMENTS

FEBRUARY, 1949.

(Large mesh and Small mesh combined).

No.	COD		DABS		OTHER FLATS		HERRING AND SPRATS		ANGLERS		SKATES		SMALL GADOIDS		MISCELLANEOUS		TOTAL		TOTAL EXCLUDING SPRATS	
	Ex.	Sc.	Ex.	Sc.	Ex.	Sc.	Ex.	Sc.	Ex.	Sc.	Ex.	Sc.	Ex.	Sc.	Ex.	Sc.	Ex.	Sc.	Ex.	Sc.
1	36	22	40	167	5	13	2292	6	0	2	1	1	212	69	0	12	2586	292	294	286
2	43	18	156	110	5	9	534	10	0	3	0	0	177	53	1	9	916	212	382	202
4	19	28	52	38	5	5	2570	3	0	2	1	1	48	139	2	5	2697	221	127	218
5	90	25	59	38	10	13	1654	2	0	2	1	1	385	44	1	2	2200	127	546	125
6	14	21	30	71	15	12	138	8	0	0	0	11	87	231	1	5	285	359	147	351
7	23	38	63	96	5	10	3838	26	0	0	1	1	116	129	2	9	4048	309	210	283
8	18	58	50	85	2	14	4680	16	0	0	0	0	71	84	3	6	4824	263	144	247
9	11	22	36	88	5	15	6986	9	0	0	0	1	96	48	0	1	7134	184	148	175
TOTAL.	254	232	486	693	52	91	22692	80	0	9	4	16	1192	797	10	49	24690	1967	1998	1887

TABLE II.

WEIGHT OF FISH CAUGHT BY "EXPLORER" and "SCOTIA" DURING COMPARATIVE FISHING TESTS.

FEBRUARY, 1949.

(Large and Small Mesh Combined).

All Weights given in Lbs.

No.	COD		FLATS		ANGLER		SKATE		CLUPEOIDS		MISCELLANEOUS		TOTAL FISH		INVERTEBRATES	
	Ex.	Sc.	Ex.	Sc.	Ex.	Sc.	Ex.	Sc.	Ex.	Sc.	Ex.	Sc.	Ex.	Sc.	Ex.	Sc.
1	135	105	8	25	0	10	7½	28	35	*	8½	19½	194	187½	1½	21
2	176	48	50	15	0	14	0	0	18½	*	14	5	258½	82	5½	8
4	77	75	15½	11	0	41	4	11	62	*	8	11	166½	149	0	7
5	326	100	23½	14	0	5	1	21	44	*	33½	5	428	145	2½	26
6	36½	30	11	14	0	0	0	87	5½	*	5½	8	58½	139	19½	45
7	79	45	14½	15	0	0	3½	3	98	*	8	11	203	74	7½	14
8	61½	49	8½	20	0	0	0	0	110	*	6	11	186	80	1½	26
9	27½	35	11½	15	0	0	0	2	185	*	3	5	227	57	3½	15
TOTAL	918½	487	142½	129	0	70	16	152	558	*	86½	75½	1721½	913½	41½	162

* Included in Miscellaneous.