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Partial Survey and Critique of Ceylon's Marine Fisheries, 1953-55

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ABSTRACT

THIS is a resume of a 1953-1955 study of Ceylon's fishing gears and fisheries and of records of experimental and commercial fishing operations. Representative catches of edible fish per unit of effort for several of the gears studied are summarized in the table. They are low compared with many countries, indicating low abundance of fish.

Kind of Fishing	*Catch per unit of effort* (*lb.*)	(*lb.*)
Large trawler operation	500-550/hr. of towing	300/man/day at sea
Small-boat trawling	65/hr. of towing	26/man/hr. of towing
Handlining (bottom) Offshore	10-30/line/hr.	10-30
Inshore	<5/ ,,	<5
Bottom longlining Indigenous	30-40/100 hooks set	5/man/hr. on grounds
Motorized	15-30 ,,	10-15+ ,,
Driftlining (mid-water handlining)	2/line/hr.	4 ,,
Surface longlining	10-800/100 hooks set	1-20 ,,
Trolling (Indigenous and mechanized)	1-2·5/line/hr.	2-3·5 ,,
Gill netting (Indigenous and nylon webbing)	5-10/hr./10,000 sq. feet of net set	1-10 ,,
Dolphin (porpoise) hunting	105/boat hr.	26 ,,

Driftlining (mid-water handlining), trolling and mothership operations have inherent features which limit development. Small-boat trawling, purse-seining and several other fishing methods offer some promise and deserve further investigation. Returns from large-trawler operations, mechanized surface and bottom longlining, gill netting and dolphin (porpoise) hunting are encouraging. Recommendations are advanced on how landings by these last-mentioned fisheries may be increased and how the fisheries can be made more profitable.

INTRODUCTION

From April 1953 to April 1955 I assisted in Canadian-Ceylonese Colombo Plan fisheries development projects. During that time I was responsible to the Director of the Ceylon Department of Fisheries through a co-ordinator (Mr. D. M. Haywood in the first year and Mr. A. W. Lantz in the second) whose task it was to oversee the work of Canada's appointees who were working within the Department.

During the first year I served as leader of the Department's research officers and results of our work are partly published (Durairatnam and Medcof, 1954; Canagaratnam and Medcof, 1956; Sivalingam and Medcof, 1957). Survey work went ahead vigorously that year, however, as a co-operative effort by regular departmental staff and guest (Colombo Plan) staff from Canada and the U. K. under the immediate direction of the co-ordinator. This was in compliance with the March 1953 Colombo Plan assignment which called for:

(1) Inspection and study of Ceylon's principal marine fisheries;
(2) Conduction of fishing trials where this seemed necessary to proper assessment of the potentials of these fisheries;
(3) Presentation of recommendations on how Ceylon might increase her fish production;
(4) Preparation of a complete report on the survey.

At the end of my year's work with the fisheries research officers I was asked to lighten the task of the co-ordinator by supervising the fishery survey. My task was to see that the four terms of the assignment were fulfilled. This was not a simple undertaking and credit for what was achieved is due to the Steering Committee and those mentioned in Acknowledgments, who worked with me.

The first and most important task was to devise a sound program for the 1954 survey.

Planning the 1954 Survey

The Steering Committee had been set up in 1953 to guide the survey. It included senior officers of the Department, Mr. D. M. Haywood, the then co-ordinator of the Canadian team, and me. This meant that I was familiar with the first year's survey program and that it was not difficult in 1954 for me to fall in line with the Steering Committee's decisions on how to continue the project.

It decided to limit its interests to marine fisheries as in 1953. It decided to continue close study of routine Wadge Bank fishing operations by the Department's two trawlers but to discontinue programs of exploratory trawling in other areas. The great need was to find ways of increasing the efficiency of trawler operations. Among other projects to be continued were dolphin (porpoise) hunting, gill netting and handlining studies. Mothership operations were not recommended.

The Committee also decided that it lacked context information for assessing results of small-boat fishery surveys. It therefore requested a compilation of the Department's records of small-boat fishing trials, past and current, and a comparison of these records among themselves and with similar records for indigenous craft operated by local fishermen. It felt that comparisons of this sort were the only reliable basis for identifying possible "improvements" which the Department might choose to foster. Improvements in this case meant ways of increasing catches and net incomes to fishermen without detriment to the country as a whole and without jeopardy to fish stocks.

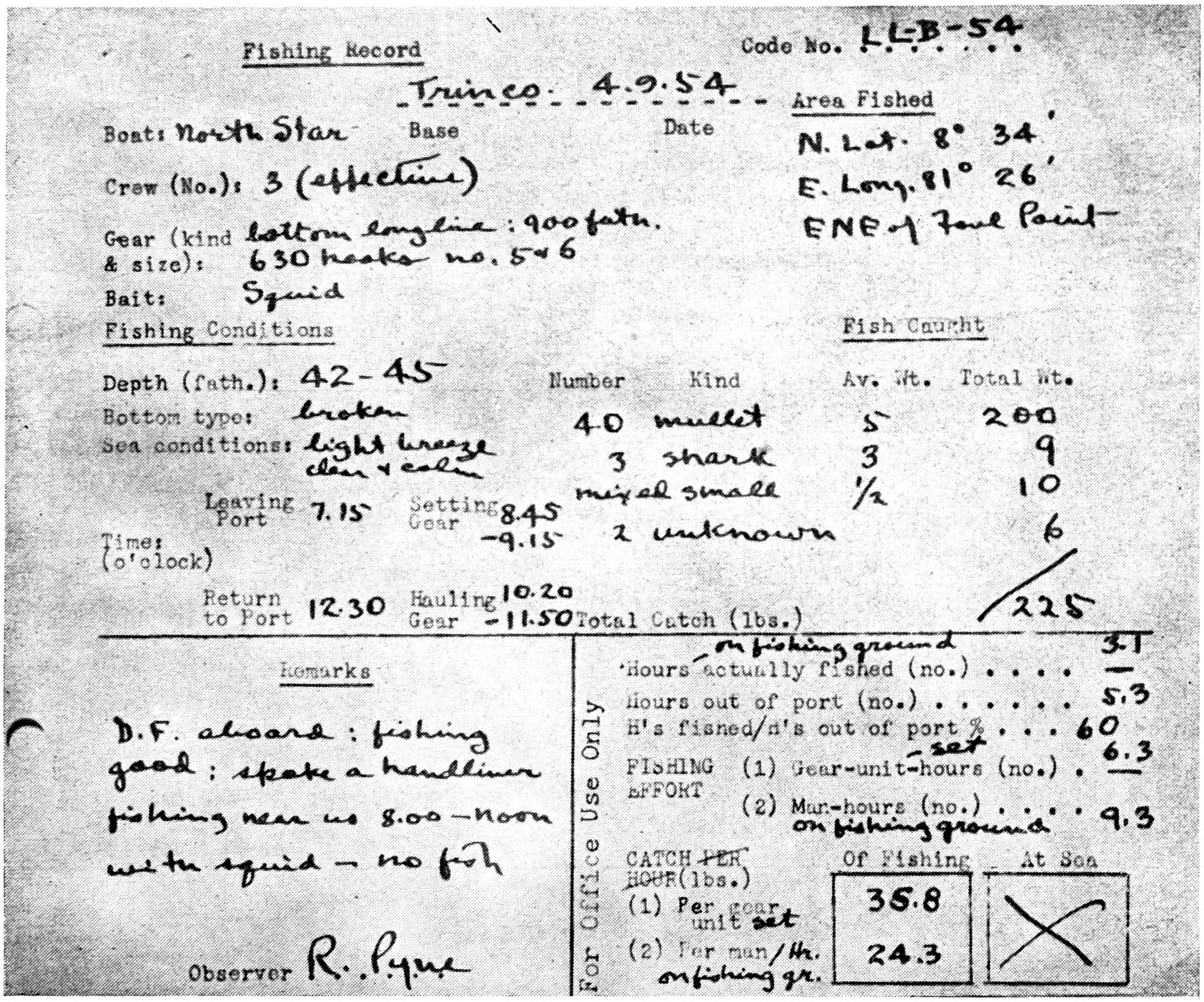
To search intelligently for such improvements required a good knowledge of the indigenous small-boat fisheries, their size and relative importance, the manpower and the gear they used and how efficiently these were used. It was soon apparent that there was little directly pertinent information on these subjects except fisheries statistics. These indicated which were the important indigenous small-boat fisheries but they provided only general ideas of their operational efficiencies and limitations. It was on these two points that quantitative data were required for formulating recommendations for improvement. Accordingly, in organizing the 1954 program, it was found necessary to plan for building up this knowledge simultaneously with work on other 1954 survey projects.

Organizing and conducting the collection of information on the indigenous fisheries was time-consuming. It cut down on the effort that could be expended on trials of new gear, new methods and new boats. It also delayed the study of past records which meant that parts of the 1954 program had to be planned and pursued on the basis of conjecture rather than on well organized conclusions from past experience. The Steering Committee did not relish this way of operating but the only alternative was to call a halt to new work until the information required for better planning was accumulated by field collection and study. Such a course was untenable in the face of the demand to keep going, and we did keep going. In some cases this resulted in too much attention being given to minor and too little to major small-boat fisheries.

Assembling Past Records

Sea trips on both trawlers, BRACONGLEN and MAPLE LEAF, confirmed the conclusion that the Department's long series of records of large trawler operations were well organized and sufficiently detailed to provide the information needed for the study assignment.

Review of the Department's files discovered many hundreds of useful data on small-boat fishing operations, both experimental and industrial—some with motor boats and some with unpowered indigenous craft. Many were complete enough to organize on standardized fishing record forms (Fig. I) and to permit calculation of catch per unit of effort. Many of these back records were summarized in a manuscript report that was submitted to the Department (Medcof, 1955).



Fishing Record — Code No. LL-B-54

Boat: North Star — Base: Trinco. — Date: 4.9.54

Area Fished: N. Lat. 8° 34′ E. Long. 81° 26′ ENE of Foul Point

Crew (No.): 3 (effective)

Gear (kind & size): bottom longline: 900 fath. 630 hooks no. 5 & 6

Bait: Squid

Fishing Conditions

Depth (fath.): 42–45

Bottom type: broken

Sea conditions: light breeze clear & calm

Time: (o'clock) — Leaving Port 7.15 — Setting Gear 8.45–9.15 — Return to Port 12.30 — Hauling Gear 10.20–11.50

Fish Caught

Number	Kind	Av. Wt.	Total Wt.
40	mullet	5	200
3	shark	3	9
	mixed small	½	10
2	unknown		6
	Total Catch (lbs.)		225

Remarks

D.F. aboard: fishing good: spoke a handliner fishing near us 8.00–noon with squid – no fish

Observer R. Pyne

For Office Use Only

Hours actually fished on fishing ground (no.) 3.1

Hours out of port (no.) 5.3

H's fished/H's out of port % ... 60

FISHING EFFORT (1) Gear-unit-set-hours (no.) . 6.3

(2) Man-hours (no.) on fishing ground 9.3

CATCH PER HOUR (lbs.)	On Fishing	At Sea
(1) Per gear unit set	35.8	X
(2) Per man/hr. on fishing gr.	24.3	

Fig. I. Fishing record form used during survey. The sample entry and modifications of original captions show how the form may be adapted to particular needs—in this case to studies of bottom longlining.

The records of 1953 operations by CANADIAN and NORTH STAR, two small boats gifted to Ceylon under Colombo Plan (De Zylva, 1958) were also treated in this way and the same form was used in reporting fishing operations of indigenous craft. Figure I is a sample of the small-boat fishing record form which was devised for general purposes and shows how it was modified in practice to report on one particular fishing operation—bottom longlining.

When assembled, these data occupied many hundreds of fishing record forms. And these had to be summarized for inclusion in the appendices to the report which was called for in the survey assignment. This presented difficulties especially where description of the composition of the catch was concerned. This is a common difficulty in reporting on tropical fisheries, as John (1951) has pointed out, because so many species are generally involved. Finally, for purposes of the survey report, it was decided to describe catch composition according to grade. Edible fish in the catches were divided into groups of species which were assigned grade numbers, 1, 2 and 3 in accordance with their generally recognized quality as food fish. (The first grade was best and the third grade poorest.) The inedible varieties were pooled and reported as grade 4. The accompanying schedule gives fuller meaning to the grade numbers.

SCHEDULE DEFINING THE GRADE NUMBERS USED IN THE APPENDICES OF THIS REPORT TO DESCRIBE THE COMPOSITION OF THE CATCH ACCORDING TO VARIETIES TAKEN. THE COMMON NAMES OF THE FISH IN ENGLISH, SINHALESE AND TAMIL AND THE SCIENTIFIC NAMES OF TYPICAL GENERA ARE GIVEN FOLLOWING MENDIS (1954)

GRADE 1

Common name		*Scientific name*
Seer ..	(E)	Scomberomorus
Thora ..	(S)	
Arekula ..	(T)	
Baracouda ..	(E)	Sphyraena
Theliya ..	(S)	
Jeela ..	(T)	
Mackerel ..	(E)	Caranx
Parawa ..	(S)	
Pareh ..	(T)	
Bonito ..	(E)	Euthynnus
Baleya ..	(S)	
Soora ..	(T)	
Albacore ..	(E)	Thunnus
Kelawalla ..	(S)	
Kelavalai ..	(T)	
Sail fish ..	(E)	Istiophorus
Thalapatha ..	(S)	
Myl meen ..	(T)	
Marlin ..	(E)	Makaira
Koppara ..	(S)	
Kopparan ..	(T)	

GRADE 2

Common name		*Scientific name*
Mullet or Rock fish	(E)	Lutianus
Gal malu ..	(S)	Lethrinus
		Plecotrohynchus
		Epinephalus
Queen fish ..	(E)	Chorinemus
Kattawa ..	(S)	
Katta ..	(T)	
Sprats ..	(E)	Stolephorus
Halmessa ..	(S)	
Netholi ..	(T)	
Herrings and Sardines	(E)	Clupea
Saleya, Hurulla and Sudaya	(S)	
Schudai, Ullam	(T)	
Silver belly ..	(E)	Leiognathus
Karalla ..	(S)	
Karel ..	(T)	

GRADE 3

Common name		*Scientific name*
Sharks ..	(E)	Carcharias
Mora ..	(S)	
Schurai ..	(T)	
Ray ..	(E)	Dasyatis
Maduwa ..	(S)	Rhinoptera
Thirukai ..	(T)	Mylobatus
Goat fish ..	(E)	Parupeneus
Nagareya ..	(S)	
Nakharai ..	(T)	
Spine tail ..	(E)	Acanthurus
Orawa ..	(S)	
Thettan ..	(T)	
rigger ..	(E)	Balistes
Kukulu maha ..	(S)	
lathi ..	(T)	

GRADE 4

Common name		*Scientific name*
Puffers ..	(E)	Diodon
Petheya ..	(S)	Ostracion
Pethai ..	(T)	
Cow fish ..	(E)	Triacanthus
Thunkatuwa ..	(S)	
Klathi ..	(T)	
Purple Leather Jackets ..	(E)	Balistes

Many will quarrel with this system as being vague compared with others such as that adopted by Malpas (1926). However, it was agreed on because it was concise, simple enough to be workable and generally recognized and regularly used by the Ceylonese fish trade.

Collecting 1954 Records

It was considered wise to continue the past method of assembling records of large trawler operations. Printed records forms were in use and the whole task of recording was being well handled by the trawler skippers and other officers of the Department.

And it was decided to compile records of 1954 small-boat operations on the same form as was devised for assembling and analyzing past records (Fig. I). This compilation of current operations was carried out mostly by the writer and the Department's own small-boat fishing skippers during their field work. They documented their own trial fishing operations and industrial fishing operations of indigenous craft in the principal fishing centres.

Many records of the latter sort were also compiled by field officers of the Department in whom the surveyors placed special confidence.

In these records small-boat catches have been reported in pounds. The Department's experimental fishing craft were supplied with scales and weighed their catches or sold them to dealers who weighed them. So their records are precise. But records for many of the indigenous craft are not precise. Their catches were examined as they were being taken out of the boats to be sold by auction at the fish markets without weighing. In such cases the record compiler had to estimate the weights of the fish he saw being unloaded. This can be done with a relatively small error (20-30 per cent.) but it requires experience and good judgment. In order to keep the error of estimates as low as possible we regularly checked our own estimates against weighings. We encouraged those who were working with us to do the same whenever possible.

Procedure

Before trial fishing was undertaken in any area and at critical times in the course of such trials, the writer and the skippers made shore trips to inspect the local fisheries. During these shore trips the Department's field officers were most helpful in supplying information and in acting as interpreters in the many interviews with fishermen. The information gathered was useful to the Steering Committee in planning exactly how, when and where the survey effort should be disposed.

The details of program procedure, results, discussion and recommendation are presented in the several sections of the report which follow.

Limitations of the Survey

A 2-year fisheries survey can be nothing but preliminary. In such a short time it is even difficult to appreciate the problems, say nothing about solving them. As already indicated, this statement has nothing to say about the freshwater fisheries. And even in dealing with those branches of the marine fishery which it has explored, it emphasizes the efficiency of fishermen and their methods. The importance of such an approach as a basis for planned development has been stressed by Amirthalingam (1949). But survey results need supplementary information on fisheries economics, as Firth (1946) points out, to make them fully meaningful in judging the actual and potential importance of fishing operations in any national economy.

There is great need for well organized information on the economics of Ceylon's fisheries and until this can be assembled, it will be difficult to deal wisely with many fisheries problems. But at least some perspective in meeting these problems is needed now and some data on comparative catches are available. For this reason some comparisons are made in this report between poundages of fish landed by Ceylonese fisheries and by similar industrially profitable fisheries of other countries. The sole purpose of these comparisons is to promote sound thinking.

Many more years' work are needed to clarify most of Ceylon's fisheries problems but, on the other hand, many improvements can be effected now on the basis of what has been learned. It is the author's belief that the recommendations made in this report and in the MS report (Medcof, 1955), which preceded it, are well supported by the information available and it is his

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hope that they will be implemented. De Zylva, who was a member of the Steering Committee and Acting Director of the Department of Fisheries while I worked in Ceylon, was a strong proponent of modernization of fishing methods. After 1955 he supervised several fishing experiments. In reporting these (De Zylva, 1958) he makes no mention of our recommendations but his statements clearly show that he had adopted at least some of them and was trying to apply them for the betterment of the fisheries and the country. It has been a pleasure to work toward this end.

CRITIQUE OF WADGE BANK TRAWLING OPERATIONS

The two trawlers, MAPLE LEAF and BRACONGLEN, are the largest single fishing units in Ceylon. It is therefore fitting that their programs should be treated first in this survey report.

In 1954 we had at our disposal what we believe was the best continuous, detailed set of tropical trawling records ever compiled up to that time. They described the operations of trawlers owned both by private fishing companies and by the Ceylon Government. The Fisheries Research Station had already recognized the importance of these records and was using them in biological studies (Sivalingam and Medcof, 1957) when the Steering Committee called for this operational efficiency study of the Wadge Bank trawl fishery. Although MAPLE LEAF'S and BRACONGLEN'S operations were similar, they involved different periods and they have been treated separately. Comparisons lead to useful conclusions.

A. Operations by Maple Leaf

History

The Department of Fisheries had been operating trawlers on the Wadge Bank for 8 years before MAPLE LEAF came to Ceylon in 1953. And for many reasons it had tentatively decided that the new vessel should fish this same ground.

Some experienced Ceylonese seamen were put aboard her to work under the three officers (captain, first mate and chief engineer) who had sailed her out from the United Kingdom. These officers were under Colombo Plan contract with the Government of Canada. They were all experienced in temperate-zone fisheries but they were new to the tropics. Their task was to learn what was new to them as quickly as they could, to direct the vessel's operations and to initiate Ceylonese understudies who should eventually take over from them.

There was an introductory period in 1953 which included some exploratory fishing off the southwest and southeast coast of India on either side of the Wadge Bank. This exploratory fishing discovered no large new stocks of groundfish that would encourage operations beyond the Wadge Bank. But it did show that there were good quantities of prawns off the southeast coast.

The records (Appendices 1 and 2) show that operations settled down quickly and that MAPLE LEAF landed over a million pounds of fish (grades 1, 2 and 3) in the 7-month period June to December 1953 and a million and a half pounds in the full year of 1954.

Condition of Catch

In the opinion of the skipper, Captain William Ellen, the condition of the fish when discharged from the ship was superior to that of catches landed in the United Kingdom by craft out of port for similar periods. This is attributed to the good functioning of the hold refrigeration equipment installed by Canada after purchase of the ship.

Usefulness of Maple Leaf

In summary we can say that during the period reviewed, MAPLE LEAF fulfilled the hopes of Colombo Planners. She contributed substantially to Ceylon's supply of quality fish in good condition. Furthermore, her operations in the hands of the Department appear to have been profitable (Goonewardena, 1956).

38.	Rhabdonema arcuatum Kuetzing	R	R	—	R	F	—	—	—	—	—	—	—
39.	Hemidiscus hardmannianus (Greville) Mann	R	R	—	R	—	—	—	—	—	R	—	—
40.	Licmorpha abbreviata Agardh	—	—	C	—	C	—	—	—	—	—	R	—
41.	Licomorpha littoralis Misra	—	—	—	—	—	R	—	—	C	—	F	R
42.	Climacosphenia moniligera Ehrenberg	C	—	—	—	—	—	—	—	—	—	F	R
43.	Climacosphenia elongata Bailey	C	—	—	—	—	—	—	—	—	—	R	—
44.	Fragilaria oceanica Cleve	—	—	—	—	—	—	—	—	—	—	—	R
45.	Rhaphoneis discoides Subrahmanyan	—	R	C	C	R	—	—	—	—	R	C	—
46.	Synedra closterioides Grunow	—	—	—	—	—	—	—	—	—	—	—	—
47.	Synedra formosa Hantzsch	—	—	—	R	—	R	—	—	—	—	—	—
48.	Thallassionema nitzschioides Grunow	—	—	C	—	F	—	—	—	—	—	R	B
49.	Thallassiothrix longissima Cleve and Grunow	F	—	—	—	—	—	R	R	R	—	R	R
50.	Thallassiothrix frauenfeldii Grunow	C	—	C	C	C	—	—	—	—	F	C	B
51.	Asterionella japonica Cleve	—	—	—	—	B	P	P	C	—	R	R	—
52.	Gyrosigma balticum (Ehrenberg) Rabenhorst	F	F	—	—	—	—	—	—	—	—	—	—
53.	Pleurosigma elongatum W. Smith	C	—	—	C	C	—	—	—	R	—	—	R
54.	Pleurosigma normanii Ralfs	—	—	—	R	R	—	R	R	—	—	—	—
55.	Pleurosigma angulatum (Quekett) W. Smith	—	—	—	—	—	R	—	—	—	—	—	—
56.	Pleurosigma aestuarii Brébisson	C	—	C	—	C	—	—	—	—	—	R	R
57.	Pleurosigma carinatum Donkin	—	—	—	R	—	R	—	—	R	F	—	—
58.	Diploneis weissflogii (A. Schmidt) Cleve	—	—	—	—	R	—	—	—	—	R	—	R
59.	Diploneis robustus Subr.	—	—	—	R	R	—	—	—	—	—	—	—
60.	Navicula hennedyii W. Smith	—	—	—	R	R	—	—	—	—	—	—	—
61.	Navicula longa (Gregory) Ralfs.	—	—	—	F	—	—	—	—	—	—	—	—
62.	Pinnularia directa Smith	R	—	—	—	—	—	—	—	—	—	—	—
63.	Trachyneis aspera Ehrenberg	—	—	—	—	—	R	—	—	—	—	R	R
64.	Cymbella marina Castracane	—	—	R	—	—	—	—	—	—	—	—	—
65.	Bacillaria paradoxa Gmelin	—	—	—	C	C	C	R	R	—	R	R	R
66.	Amphora salina Smith	—	—	R	—	R	—	R	R	—	—	—	—
67.	Nitzschia closterium (Ehrenberg) W. Smith	C	—	—	C	—	—	—	—	—	—	R	—
68.	Nitzschia longissima (Brébisson) Ralfs.	C	—	—	P	F	—	R	F	C	—	F	—
69.	Nitzschia seriata Cleve	R	R	—	—	R	—	—	—	C	R	R	R
70.	Nitzschia sigma (Kuetzing) Smith	R	—	—	R	—	—	F	F	—	—	—	—
	Dinophyceae												
71.	Ceratium trichoceros Kofoid	—	—	R	R	—	—	—	—	—	—	—	R
72.	Ceratium massiliense Gourret	—	R	R	—	—	—	—	—	—	—	R	R
73.	Ceratium tripos Nitzsch	R	R	R	—	—	R	—	—	—	—	—	—
74.	Peridineum sp.	R	R	—	R	R	—	—	—	—	—	—	R

TABL[illegible]—(*contd.*)

PHYTOPLANKTON CALENDAR, PUTT[illegible] LAGOON, JUNE, 1960 TO MAY, 1961

Species	*June* 1960	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Jan.* 1961	*Feb.*	*March*	*April*	*May*
Cyanophyceae												
75. Trichodesmium erythraeum Ehrenberg	P	C	C	R	—	P	—	P	P	C	C	C

* R = Rare 1—10 individuals per C.C.
F = Few 11—25 do.
C = Common 26—75 do.
P = Plenty 76—200 do.
B = Bloom = more than 200 do.

TABLE III

PHYTOPLANKTON CALENDAR, DUTCH BAY, JUNE, 1960 TO MAY, 1961

Species	*June* 1960	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Jan.* 1961	*Feb.*	*March*	*April*	*May*
1. Melosira sulcata (Ehrenberg) Kuetzing	R	R	R	R	—	—	—	—	F	F	F	R
2. Stephanopyxis palmeriana (Greville)	R	R	R	—	—	R	—	—	—	F	F	R
3. Sceletonema costatum (Greville) Cleve	P	P	B	F	P	P	P	—	R	R	—	—
4. Thalassiosira coramandeliana Subr.	R	R	—	—	—	—	—	—	—	—	R	R
5. Thalassiosira decipiens (Grunow) Jorgenson	F	F	R	C	C	C	—	—	R	R	R	C
6. Thalassiosira subtilis (Ostenfeld) Gran	C	R	—	C	—	B	—	R	C	—	R	C
7. Coscinodiscus gigas Ehrenberg	B	B	P	C	C	C	C	F	F	R	C	C
8. Coscinodiscus marginatus Ehrenberg	C	P	P	C	R	F	F	C	C	—	—	R
9. Planktoniella sol (Wallich) Schutt	R	R	R	R	C	R	F	F	F	C	C	C
10. Aulacodiscus orbiculatus Subr.	—	—	—	—	C	—	—	R	R	—	R	—
11. Corethron inerme Karsten	—	—	—	—	—	R	R	—	—	—	—	R
12. Schroederella delicatula (Peragallo) Pavillard	—	—	R	—	—	—	—	—	—	—	—	R
13. Leptocylindricus danicus Cleve	C	R	—	—	—	—	—	R	—	—	R	R
14. Leptocylindricus minimus Gran	C	R	—	—	—	—	—	—	C	—	—	R
15. Guinardia flaccida (Castracane) Peragallo	—	R	—	—	—	—	—	—	R	F	—	—
16. Rhizosolenia cylindrus Cleve	C	R	R	R	—	—	—	—	—	—	R	R
17. Rhizosolenia styliformis Brightwell	R	R	C	R	—	—	R	C	—	R	R	R
18. Rhizosolenia setigera Brightwell	C	F	C	C	P	F	F	C	R	R	R	R
19. Rhizosolenia crassipiana Schroeder	C	F	—	—	C	C	C	F	R	R	F	F
20. Rhizosolenia alata Brightwell	P	F	—	—	P	C	C	F	R	R	F	F
21. Rhizosolenia imbricata Brightwell	R	P	P	R	P	C	C	C	R	B	—	C

Comparison of Wadge Bank and other Fisheries

As a further aid to criticism of MAPLE LEAF's Wadge Bank operations, records were obtained of her last one-and-a-half years of operation (1951 and 1952) out of her former home port, Fleetwood, U. K. These are compiled in Appendices 3 and 4.

At that time she was under commission as the BOSTON ATTACKER and operated on grounds off the west coast of Scotland including the Orkneys and Shetlands. According to Captain Ellen this region is generally considered to be more productive than other " mid-water " grounds like the North Sea, the Faroe Islands and Iceland, which are exploited by United Kingdom trawlers.

Captain Ellen also reports that the gear used by BOSTON ATTACKER off Scotland was the same as that used on the Wadge Banks a 48-foot Granton trawl (total footrope length 116 feet, total headline 80 feet). Besides this, Captain Ellen states that she was then skippered by one of his acquaintances and a close rival with him for first position among the Fleetwood mid-water trawlers.

Thus we have comparable records of a first class mid-water trawler, MAPLE LEAF (BOSTON ATTACKER) using the same gear and skippered by men of comparable skill, while she operated in one of the largest, longest established, temperate-zone trawl fisheries and while she operated in what appears to be a good, well established, tropical trawl fishery. As far as we are aware, these complementary sets of records are unique. They permit confident appraisals of Wadge Bank fish stocks and of the Ceylon Department of Fisheries' methods of trawler operation against a well known standard.

Data summarized in Appendices 5 and 6 permit a less precise comparison of Wadge Bank operations with those on the Canadian Atlantic (International Commission for Northwest Atlantic Fisheries area sub-divisions 4W and 4X) and Canadian Pacific coasts.

TABLE I

COMPARISON OF TRAWLING OPERATIONS BY MAPLE LEAF (BOSTON ATTACKER) OUT OF FLEETWOOD, U. K., ON GROUNDS OFF THE WEST COAST OF SCOTLAND (1951–1952) AND OUT OF COLOMBO, CEYLON, ON THE WADGE BANK OFF THE SOUTH COAST OF INDIA (1953–1954) AND BY 151-500 GROSS-TON TRAWLERS OPERATING OUT OF CENTRAL NOVA SCOTIA PORTS (1953).
(THE VALUES ARE AVERAGES FROM DATA LISTED IN APPENDICES 1 TO 5)

	Boston Attacker off Scotland	*Maple Leaf on Wadge Bank*	*Nova Scotia 151-500 gross ton trawlers*
Length of fishing trip (days)	12·9	10·5	7·3
Catch per trip (lbs.)	81,555	91,457	93,000
Catch per day at sea (lbs.)	6,363	8,578	13,300
Days on grounds/Days at sea	69%	90%	83%
Days in port per month	8·2	14·3	—
Catch/Hour on grounds (lbs.)	380	395	909*
Catch/Hour of actual trawling (lbs.)	—	538	1,239
Number of crew (officers and men combined)	15	28	—
Catch/Man/Day at sea (lbs.)	424	306	—

* Calculated from catch per hour of actual trawling (1,239) by multiplying by 0·734 which is the mean value of the ratio catch/hour on grounds : catch/hour actual trawling, for MAPLE LEAF, 1953 and 1954.

Fishing Time and Sea Time

Table I summarizes the appendices referred to and permit several interesting comparisons. It shows that MAPLE LEAF'S (BOSTON ATTACKER'S) trips out of Fleetwood averaged 2·4 days longer than those out of Colombo. But in spite of this, the average catch per trip was less (81,555 compared with 91,457 pounds). This is attributed largely to differences in distances between home ports and fishing grounds—2 days' steaming out of Fleetwood and only 12 hours out of Colombo. The proportion of her sea time spent in actual fishing was accordingly low for Fleetwood (69%) and high for Colombo (90%).

Abundance of Fish

The relative abundance of fish on the two grounds can be judged from data on catch per hour spent on the fishing grounds (Table I). It seems that fish abundance on the Wadge Bank is about 104% of that off the west coast of Scotland (395 lb. per hr. compared with 380) but only 43% of that on the less heavily exploited Nova Scotia Banks and 62% of that off the Canadian Pacific coast (Appendix 6).

Examples of the few published records of operations on tropical trawling grounds have been reviewed (Sivalingam and Medcof, 1957). These records suggest that the Wadge Bank is as good as the best in the tropics excepting perhaps the Gulf of Thailand where an average of 298 kg. per " catch hour " has been reported by Thiews (1962). This is roughly equivalent to 220 kg. (480 lb.) per hour on the grounds (Table I). These records and handline fishing records for Mauritius and the Seychelles Islands (Wheeler and Ommanney, 1953) also cast doubt on the generally accepted notion that tropical banks are consistently poor producers of bottom fish. Indeed they show that MAPLE LEAF is engaged in a fishery that compares favourably with many that are well known and profitable as Hickling (1951) believed.

Appendices 1 and 2 also show that on Wadge Bank the catch per hour of trawling varies a good deal with season. It is generally heaviest during the southwest monsoon months, May to October. This variation is taken as evidence of seasonal changes in abundance of fish. This subject has been discussed by Sivalingam and Medcof (1957). Sivalingam's records (Goonewardena, 1956) suggest that there may also be year-to-year differences both in abundance and species composition of the stocks.

Efficiency of Crewmen and System of Feeing

Table I shows that the catch per man per day was much higher in the fishery out of Fleetwood than out of Colombo in spite of the fact that MAPLE LEAF caught less fish there than she does here. The reason is that the crew was increased in number from 15 to 28 (officers and men included) even though the amount and difficulty of the work involved did not change appreciably. Those with whom I have discussed this matter say that the extra men are needed in Ceylon for two main reasons:

1. The seamen appear to have a lower work capacity.
2. The terms of employment do not encourage the seamen to work efficiently.

If the first be true, we must expect that more than 15 men will always be needed in Ceylon to operate Maple Leaf. But if the second also be true, we can expect that she could be operated with fewer than 28 men and this might be to the advantage of both the crew and the Department.

The suggestion has often been made that the Department should abandon the wage system of paying its trawler crews and adopt the " lay system " as Kristensen (1953) has recommended for India. Under the wage system seamen receive the same pay regardless of how many fish they land. Under the lay system (which is in effect in most of the world's major industrial fisheries) a fixed proportion of the returns from the sale of catches is set aside as the crew's share and the officers' share.

Seamen are anxious that the crew's share should be as large as possible and they work together hard for the common purpose of landing the heaviest possible catches. Furthermore, each crewman is anxious that his part of the crew's share be as large as possible. His share will be greatest when the crew size is least. He is willing to work as hard as he can so the crew size can be cut down to the minimum required for efficient operation of the ship. For this reason slow or lazy seamen are not welcome aboard. If they cannot learn to work quickly and effectively with their fellows they soon find themselves replaced by those who can and will. The rest of the crew insist on such action.

The lay system has the same stimulating effect on ship's officers as on crewmen. And it offers many other inducements to better ship operation. One of the most important is that it encourages men to be at sea (where they earn their money) as much as possible. "Turn-arounds" are quick.

Needless to say, the lay system is not adaptable to vessels engaged in experimental work or exploration. They are fishing for information, not for fish.

Sea Time

Table I shows that while fishing the Wadge Bank, MAPLE LEAF spent approximately half her time in port—14.3 days per month as compared with 8.2 days when she worked out of Fleetwood. (These averages take in the time required for annual "refits", occasional repairs and general maintenance.)

If she had operated in 1954 as she did in 1951 and '52 she would have been in port 98 days instead of 172 days and at sea 267 instead of 193 days and she might have landed 2,300,000 pounds instead of 1,500,000 pounds of fish; that is, 50% more.

Four main reasons have been advanced why MAPLE LEAF fell so far behind her Fleetwood performance.

1. Shore facilities for discharging catches and servicing trawlers were inadequate. The "turn-around" usually took 4 days as compared with 48 hours in Fleetwood.
2. On-shore arrangements for relief crewing were not efficient. Many times sailings were delayed for want of a substitute for an "AWL" seaman.
3. Too much of the responsibility for conditioning the ship for its next trip was left to the captain who had poor facilities for this work and who needed shore respite from his gruelling 10-day sea trips.
4. The wage system of feeing the crew discouraged efficient performance.

B. Operations by Braconglen

Comparison with Maple Leaf

BRACONGLEN is a slightly larger ship than MAPLE LEAF and considerably more powerful as shown by Table II. These differences are real but in practice they are often less obvious than might be expected.

TABLE II

COMPARISON OF SIZE AND POWER OF TRAWLERS BRACONGLEN AND MAPLE LEAF

(Data taken from Lloyd's Register of Shipping, 1954)

Feature compared	*Braconglen*	*Maple Leaf*
Length over all (feet)	149·1	142·8
Length between perpendiculars (feet)	137·7	130·0
Gross tonnage	338	323
Net tonnage	123	118
Stroke of engine (inches)	27	24
Diameter of Cylinders (inches)		
High pressure	13·5	12·25
Intermediate pressure	23·0	21·0
Low pressure	38·0	34·0
Nominal horse power	91	84
Boiler heating surface (Square feet)	3,064	2,436

Both vessels were owned by the same U. K. fishing company and served as "mid-water" trawlers while they were in the United Kingdom and since they came to Ceylon they have fished exactly the same gear. It would be instructive to obtain BRACONGLEN's U. K. operational records to permit a stricter comparison of the two vessels' potentialities.

BRACONGLEN's Ceylon fishing records were compiled, analyzed and tabulated in the same form as that used in Appendices 1 and 2. Sheer bulk prevents their inclusion in this report. They are summarized in Table III. A comparison of Tables III and I indicates that many statements made about MAPLE LEAF apply equally to BRACONGLEN. But there are other observations that should be made about BRACONGLEN's performance because they provide context for what has already been said and because they are important in themselves for a proper understanding of past and present operations of both trawlers in Ceylon.

Adjustment to Ceylon Fishery

When BRACONGLEN first came her trips were very short (av. 7.1 days, Table III). By 1952, however, it had been shown that it was feasible to make longer (8.6 days) trips which afforded a 25% increase in the proportion of her sea time that was devoted to actual fishing. This change effected a small (2%) increase in the catch per day at sea. This shows up when the July-December (the best fishing months) values are compared (7,867 as compared with 7,723 pounds) but it is masked when the mean value for the 12 months of 1952 (7,570 lb.) is compared with the July-December 1951 value (7,723 lb.).

TABLE III

SUMMARY OF TRAWLER BRACONGLEN'S OPERATIONS ON THE WADGE BANK OFF SOUTHERN INDIA, OUT OF COLOMBO, CEYLON, JULY 1951 TO DECEMBER, 1954

Year	*No. of trips*	*Total days at sea*	*Total catch (lbs.)*	*Average length of trip (days out of port)*	*Average catch (lbs.)* Per trip	*Average catch (lbs.)* Per day at sea
1951 July-December	12	78	602,366	7·1	54,761	7,723
1952 July-December	11	102	802,416	9·3	72,947	7,867
1952 Whole year	20	171	1,294,548	8·6	64,727	7,570
1953 ,,	18	179	1,604,967	9·9	89,165	8,966
1954 ,,	17	152	1,526,860	8·9	89,815	10,045

But it was not until 1953 that the ship's real capacity for catching fish began to be realized. That year the length of trip was increased still further (9.9 days) and hoped-for increases amounting to 25% were realized. The catch per day at sea approximated 9,000 pounds and the year's catch exceeded 1½ million pounds.

In 1954 BRACONGLEN's catch per day at sea rose to 10,045 pounds (Table III) which is by far the best the Department has ever realized from any of its trawlers. But her trips were shorter, her total sea time was down 15% and her year's landings were down 5%.

Reasons for Improvement

Many reasons besides those just outlined have been advanced to explain the substantial improvements in BRACONGLEN's performance since 1951. Of these, there are four which seem most plausible. Even if these were all valid and the only reasons for the change, it would still be impossible to disentangle them and say certainly which was the most important. However, it seems worth mentioning these reasons because there has been so much debate on the "how" and "why" of the improvement.

1. There were mechanical improvements in the operation of the ship after a qualified Chief Engineer (Mr. Grisenthwait, a 1952 Colombo Plan appointee) was engaged to stay with BRACONGLEN.

2. There were improvements in shore services for ship maintenance and in general management of ship operations—the latter under Captain Ellen.

3. Fish seem to have been more abundant during at least part of the later years (Sivalingam, personal communication) and this helped raise total production.

4. Rivalry. This began in 1952 as soon as it became known that another trawler (MAPLE LEAF) was to appear on the scene and it continued after she arrived.

Possibly the last is the most important of the four proposed reasons for the improvement. Susceptibility to rivalry is a healthy human characteristic that involves officers and seamen and is nothing to be ashamed of. Its importance in stimulating fishing effort is widely recognized. It fits in naturally with the " lay " system of paying crews.

C. General Discussion

Trawler Management and Efficiency

Much credit is due Captain William Mitchell, former skipper of BRACONGLEN, for his patient efforts in the developmental period when local personnel were being trained to become competent operators of trawlers; when good engineers were not regularly available and when the Department was developing a full understanding of what trawler operations required. His successor, Captain Neville Mendis maintained and, in some ways, improved BRACONGLEN's performance.

Captain Ellen worked hard and made many splendid catches but his ship, MAPLE LEAF, was a smaller craft and could not be expected to do as well as BRACONGLEN, other factors being equal.

In spite of these advances there is still room for substantial improvement in the performance of both ships. Much can be gained by insuring that all who are responsible for their management are well acquainted with the main features of their performance and willing to co-operate with the management officer. For example, it has been shown (Appendix 2) that fish are most abundant and of better quality (more paraw) on the Wadge Bank during the south-west monsoon (May to October). If they know this, management officers can often avoid refits and other lengthy tie-ups in port at this time when trawling is most rewarding.

When trawlers are well managed they can land fish more economically and in better condition than most other types of fishing craft. They fish day and night and can operate in all weather except severe storms. They insure heavy, regular landings and they stabilize fish marketing.

Questions of Over-fishing and Fleet Expansion

Catch per day at sea in 1954 was lower for MAPLE LEAF (She did not fish during the poor months, January to June, in 1953 as she did in 1954) and higher for BRACONGLEN than in earlier years. When values for the two vessels are averaged, however, the 1953-54 trend (3%) is toward higher catches per day's fishing. Considered separately BRACONGLEN's records, which cover a longer period, show the same trend. This could be taken as evidence of increased abundance of fish or of more efficient performance of the vessels on the fishing grounds but not as evidence that fish stocks were declining. This conclusion validates Blegvad's (1951), John's (1951) and Hickling's (1951) predictions that Ceylon could expand her Wadge Bank trawler fleet without fear of a serious reduction in catch per boat. John suggested three trawlers for the combined exploitation of the Wadge and Pedro Banks. It would seem now that this is an under-estimate and that Blegvad's more ambitious recommendation might be followed.

Even if the catch per boat on the Wadge Bank were to drop substantially from some future over-expansion of the trawler fleet, this need not be disastrous because it is a reversible process. Fish stocks will recover when fishing pressures are reduced. Besides, there are other good trawling areas like the Pedro Bank (Blegvad, 1951) that could be fished to relieve pressure on Wadge Bank fish stocks if this were necessary. At present these other areas are not being exploited at all.

Experience alone can determine the limits to which the fleet may be profitably expanded as Kestevan (1951) rightly points out. But expansion can be undertaken courageously because, as already shown, the Wadge Bank fishery compares favourably with other tropical trawl fisheries and with some of the profitable temperate-zone fisheries.

At the same time, the data assembled here warn against unbridled optimism. There are limits. The Wadge Bank should not be expected to rival areas like the north-west Atlantic which for centuries has tempted fishermen to make trans-ocean crossings to reap its harvests.

When and if fleet expansion is undertaken, it would be well to monitor fishing conditions by analyses such as we have outlined here. This should provide advance warning of overfishing before it becomes an economic problem.

Recommendations

This critique supports the following summary statements and accompanying recommendations which may be useful to the Department of Fisheries:

1. Changing system of feeing crews

If the lay system of feeing were adopted, it should eliminate disinterested and incompetent officers and men. An efficient crew should increase landings even without improvements in management and in shore facilities. It should also reduce the size of crews and consequently the costs of equipping and rationing them.

It is therefore recommended that the Department of Fisheries adopt the " lay " system of feeing its trawler crews.

2. Improving shore servicing

MAPLE LEAF records indicate that her landings could be increased 50% beyond those of 1953-54 if shore services were improved to permit 48-hour " turn-arounds " as in Fleetwood. Presumably the same would apply to BRACONGLEN. In other words, by better shore servicing and management these two trawlers could land as many fish as three trawlers would land under present operating conditions. Costs of increasing fleet size are vastly greater than costs of increasing operating efficiency of ships already under commission.

It is therefore recommended that the Department of Fisheries in the interests of economy should:

1. Improve shore servicing for its trawlers as soon as possible.
2. Defer purchase of additional trawlers until improved services are available.

3. Increasing the trawler fleet

There is good reason to believe that Ceylon can expand its Wadge Bank trawler fleet without overtaxing the fish stocks. Use of trawlers assures steady, large supplies of good quality fish in good condition and stabilizes fish marketing. Considering the volume of fish produced, trawlers are not expensive. They are profitable.

It is recommended that the Department should:

1. Increase its fleet of large trawlers as soon as it has facilities to service them efficiently.
2. Increase the fleet slowly and monitor effects of the increase on fish stocks very carefully so that expansion can be halted before stocks are diminished to levels where exploitation becomes unprofitable.

SMALL BOAT TRAWLING

Otter trawling for groundfish (fish that live at the bottom or close to it) is the backbone of many, if not most, of the major fishing nations of the world. The main producing units are expensive, far-ranging steel vessels more than 100 feet long like the BRACONGLEN and MAPLE LEAF which Ceylon regularly operates on the Wadge Bank 150 miles from Colombo. However, important quantities of fish, especially of the flounder type, are landed the year round in these same countries by smaller trawlers operating on rich shallower-water grounds close to shore.

Appendix 6, listing data for 1948 for the Canadian Pacific coast, shows how important a fleet of small trawlers can be in contributing to total landings. The boats referred to in this appendix averaged 50 feet long and were powered by motors of 90 to 120 brake horsepower. Appendix 7, showing 1954 catches, illustrates this for the Canadian Atlantic coast and a slightly smaller class of boat. These records were assembled by the Fisheries Research Board of Canada and made available through the courtesy of Dr. A. W. H. Needler, Director of the Biological Station at Nanaimo, B. C., and of Dr. J. L. Hart, Director of the Biological Station at St. Andrews, N. B. These data are impressive but the work of the Fisheries Research Institute of Japan (1961) shows that Canadian small trawlers are surpassed in performance by those which Japan operates in the East China Sea.

A. History of Surveys in Ceylon

Southwest Coast

The survey conducted by the Ceylon government trawler LILLA in 1920 and 1921 (Malpas, 1926) indicated that the trawlable grounds off the southwest coast were too small, too rough and too poor in fish to reward commercial trawling with a large steam vessel. But Glanville (unpublished MS Report to Fisheries Research Station), from his work with HALPHA, has stated that there are moderate-sized patches of trawlable bottom off Colombo where small catches of fish can be obtained. He presumed that small commercial otter trawlers could exploit these grounds if their operators learned their positions. But most of the fish he took (Table IV) were third quality and his trials were not extensive enough to convince him that commercial operations would be profitable. Outside these limited areas net tear-ups were so common as certainly to prohibit worthwhile bottom trawling on the southwest coast, no matter how abundant the fish might be.

TABLE IV

AVERAGE FISHING PERFORMANCE OF VARIOUS TRAWLERS ON PEDRO BANK, IN PALK STRAIT AND OFF THE SOUTHWEST COAST OF CEYLON; AND OFF THE EAST AND WEST COASTS OF CANADA. THE VALUES LISTED ARE THE SIMPLE MEANS OF THE SEVERAL ENTRIES FOR THE BOATS, REFERRED TO IN APPENDICES 6 TO 11

Region and Fishing Vessel	*Catch/Day out of Port (lbs.)*	*Catch/Hour of actual trawling (lbs.)*
North-east Coast (Pedro Bank region)		
Lilla	—	185
Bulbul and Tongkol	2,696	285*
Raglan Castle	3,549	407
Halpha	—	0
North Star (1953)	—	79
Canadian (1954)	—	26·5
Northwest Coast (Palk Strait region)		
Lilla	—	285
Halpha	—	403
Northstar (1953)	—	223
Canadian (1954)		
Regular hauls		26·1
Special hauls		
Towing alone		5·0
Tandem towing with " North Star "		10 to 25
Southwest Coast (Galle to Chilaw)		
Lilla	—	46
Halpha	—	100
North Star	—	235
Katumarams (using the Katumaram dela)	—	19·6†
Canada—Small mechanised trawlers		
Atlantic coast	1,416	161
Pacific coast	—	639‡

* Special records kept for Bulbul's last three 1929 trips out of Colombo to the Pedro Bank showed that catch per hour of actual trawling averaged 10·6 per cent. of catch per day out of port. The value 285 equals 10·6 per cent of 2,696, the mean value for Bulbul's and Tongkol's catch per day out of port, 1928 to 1935.

† The mean value for catch per hour fished (i.e. per hour on the grounds) by the katumaram dela is 13·1 (Appendix 11). The value 19·6 is calculated from 13·1 on the assumption that actual trawling occupies two thirds of the fishing time.

‡ This value is catch per hour fished (Appendix 6).

No mechanized trawlers, large or small, have tried to operate commercially in this area in spite of its proximity to the island's best market, Colombo. However, some small-boat trawling is done now off the southwest coast by log rafts (katumarams) working in pairs. Each one is paddled along and hauls one warp of a trawl known to the Sinhalese as " katumaram dela " (Pearson, 1923). This is a primitive version of the modern twin-boat trawl or " Spanish trawl ".

All the handling is manual. Although Malpas demonstrated that the grounds in this region are not suited to large otter trawler operations, the katumaram del regularly take sufficient quantities of fish there to keep their owners interested (Appendix 11 and Table IV).

Northeast Coast

LILLA's fishing survey off the northeast coast indicated that the Pedro Bank should be well worth fishing (Malpas, 1926 and Pearson and Malpas, 1926). Later, commericial trawling by the steam trawlers, BULBUL, TONGKOL (records made available through the courtesy of Ceylon Cold Stores, Ltd.) and RAGLAN CASTLE, showed that this was indeed true. These large craft used Colombo as a base (Appendix 8) and they made good catches of "mullet" (Lutianids) and some coarse fish. However, except for one haul made by HALPHA in 1949, small boats have done no trawling there. The grounds would be readily accessible to them for they need not go beyond the narrow continental shelf (Fig. 2).

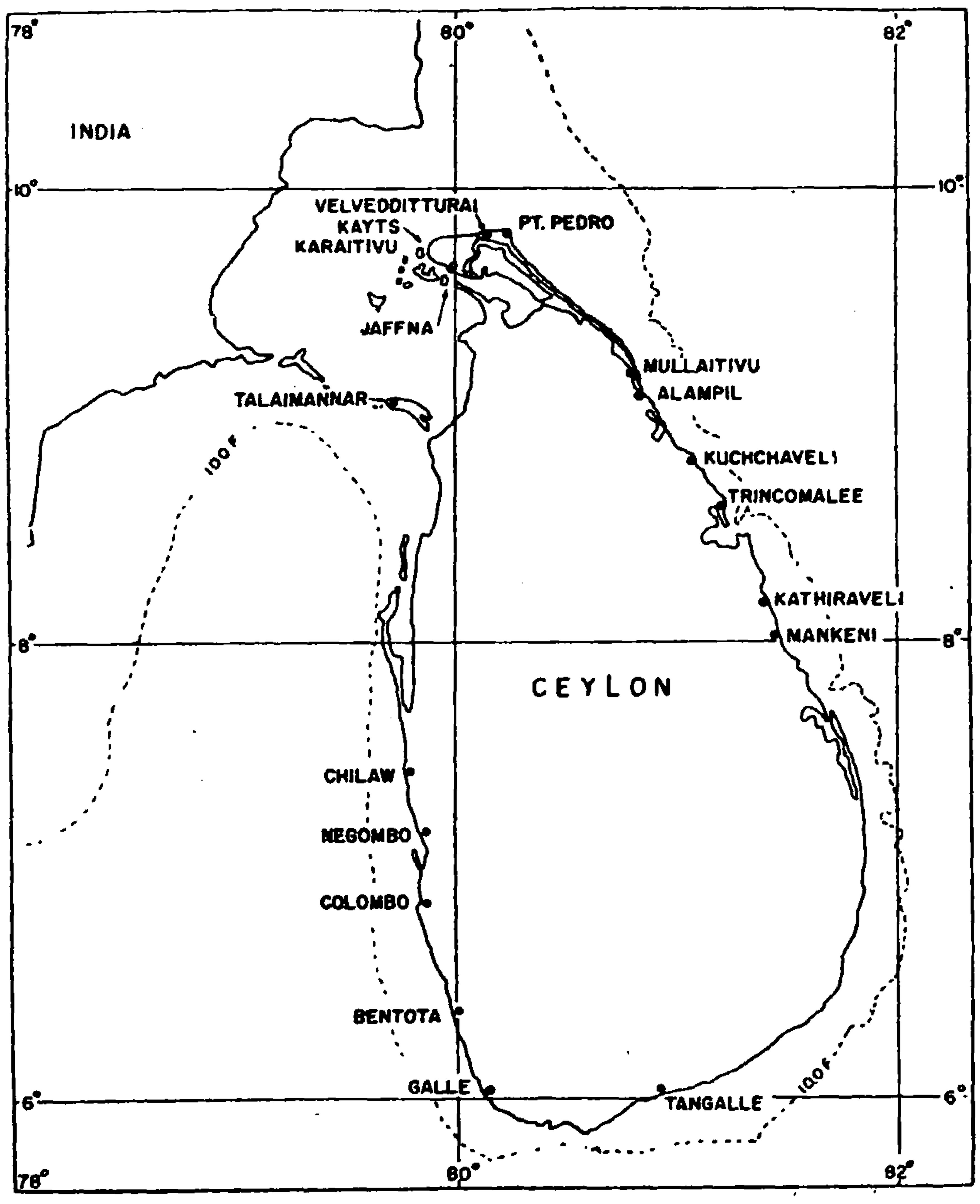

Fig. 2. Map showing positions of several fishing ports mentioned in the survey report and the extent of the continental shelf (sea area inside the 100 fathom contour) over which almost all fishing takes place.

Southeastern Palk Strait

LILLA's work in southeastern parts of the Palk Strait (also readily accessible to small boats) showed that this is a highly productive area of poorer quality fish (Appendix 9 and Table IV). No large trawler has ever tried to operate there commercially but 1952 results reported by Glanville for HALPHA (unpublished MS, Fisheries Research Station) support the conclusion Malpas (1926) reached that this should be rewarding.

HALPHA is 75 feet long, has a gross tonnage of 54 and has two 140 horsepower diesel motors. She could scarcely be referred to as a "small boat" in the regular sense of the term. It is true to say, therefore, that previous to 1953, the only small-boat commercial trawling ever done in Ceylon was with unmechanized boats.

B. 1953 and 1954 Trials

Planning

The knowledge that lucrative catches are made by trawlers of CANADIAN's and NORTH STAR's size-class in places where groundfish are plentiful (Appendices 6 and 7; and Fish. Res. Inst. Japan, 1961) and the promising reports of LILLA's and HALPHA's efforts in areas that are readily accessible to boats of this size were encouraging. It provided all the evidence that was necessary to convince the Steering Committee that it was important for the Canadian team to try out small-boat otter trawling with their Canadian west-coast type gear.

Trawling, as a method of fishing, is not strange to Ceylon and it seemed reasonable that it would be adopted by small boats if this were shown to be worth while. It was thought of as well suited to ports like Jaffna and Kayts whose harbour mouths are too shallow for large trawlers and probably equally well suited to deeper-water ports like Colombo, Talaimannar and Trincomalee.

It was decided that the three areas offering the best prospects for exploration were the southwest and northeast coasts and southeastern Palk Strait.

1953 Trials with Conventional Gear

Mr. H. Pinchin, who had experience in trawling off the Canadian Pacific coast, was one of the first group of three Canadian skippers to come here under the Colombo Plan and he carried out the 1953 otter trawling trials using NORTH STAR. She was equipped with a double-drum winch and "A" frames placed far aft. The trawl was boarded, therefore, over the stern as is the fashion for small boats off the Canadian west coast and off the northwest coast of the United States of America.

The trawl used for most of the work had an 80-foot footrope. Toward the end of the year's work it was thought that it might be too large for NORTH STAR's 80-horsepower diesel motor to haul at an effective speed. Mr. Pinchin therefore reduced the mouth-width until the footrope measured 55 feet. This increased the towing speed somewhat and the hauls made thereafter seemed to be better (Appenidix 10) in that they took more mullet (Lutianids). The catch records are summarized in Table IV, along with those of other boats that have fished the same areas.

Mr. Pinchin's records and general reports support two conclusions:

1. Glanville's reports are well founded and until the positions of trawlable grounds off the southwest coast are charted, it will be impossible to assess them properly.

2. The fish taken on Pedro Bank and in Palk Strait were third quality (many skates, rays, sharks and small fish) and not abundant enough to make otter trawling commercially worthwhile for boats of NORTH STAR's size-class.

This second conclusion seemed incompatible with former records (Appendix 8 and Table IV) which showed the Pedro Bank to be highly productive of second-quality fish. While Mr. Pinchin was unable to offer a generally satisfactory explanation for this disparity, he attributed it to year-to-year differences in abundance of fish on the grounds.

1954 Trials with Conventional Gear

The total number of hauls made in 1953 (69 in all) was not great so the Steering Committee decided to continue the project in 1954 in spite of Mr. Pinchin's findings. Mr. Victor Halliday, one of the second group of Canadian skippers to come here, was put in charge. He had had several years' experience in small-boat flounder and general groundfish trawling in Nova Scotia.

The trawling gear was installed on CANADIAN and the first trials were made in July out of Trincomalee using a new 80-foot otter trawl braught out from Canada in 1953 by Mr. Pinchin. Records of the operations are reported in Appendix 11 and Table IV. Based on these and on his observations on behaviour of local varieties of fish and on the boat's performance, Mr. Halliday came to the following conclusions:

1. The fish here seem to move faster than they do off the Canadian east coast. This he attributed to the much warmer water (80° as compared with 50-60°F) and because of this one might expect that higher trawling speeds would be required to take them.

2. CANADIAN's speed when towing the 80-foot trawl at full throttle was very low—not much over one knot per hour.

3. At this speed the net was capable of taking only the very slowest-moving species of fish like flounders. Any others taken must be regarded as accidentals and their numbers in the catch must not be considered a reliable index to their actual or relative abundance on the grounds.

4. The consistently low catches of flat fishes by the trawl and the low frequency of flat fishes in catches of local craft using other types of gear is good evidence that flat fish are scarce on these grounds as Blegvad (1951) suggested.

5. The scarcity of these slow-moving varieties, which are, in so many cases, the mainstay of small trawler catches in temperate regions, does not augur well for the success of conventional small-boat otter trawling here.

6. CANADIAN was under-powered for trawling with an 80-foot net, even if only slow-moving types of fish were being sought.

7. The smallest, commercial-sized trawl available should be used if a fisheries survey with conventional otter trawls was to be carried out.

Mr. Halliday's third conclusion is consistent with the data compiled by Mr. Pinchin in 1953. Pinchin's catches were often composed almost entirely of large skates and of almost no faster-moving forms such as mullets (Lutianids), until after he reduced the net size. This conclusion is further supported by a comparison of Mr. Halliday's trawl catches (Chundikulam, July 23, Appendix 11) with Mr. Pyne's longline catches made on the same grounds on the same day (Appendix 13). The trawl took poor catches, and of mullets only, whereas the longlines took fair numbers of mullets and some sharks (dogfish) which are fast fish. Sharks must have been on the grounds, even if they were not captured by the trawl. The logical explanation is that they were fast enough to swim out of the path of the slow-moving trawl.

Following these first east coast trials, Mr. Halliday ordered a new trawl. It was a cotton trawl— ¾ of No. 35 Style as described in Catalogue No. 2, 1953, of John Leckie Limited, Halifax. Nova Scotia, Canada. It had a 50-foot footrope. At the same time he reduced the width of the 1953 trawl from 80 to 35 feet and he was able to obtain an old worn net with a 30-foot footrope from the Department's stores. With these two smaller nets, trial hauls were made after July 20 off Mullaitivu and in Palk Strait.

These, however, were little more productive than the 80-foot trawl although they did permit an increase in trawling speed to an estimated two knots per hour. This he considered still too slow for good catches of flat fishes (which were rare) and much too slow for the faster species. Support for this opinion comes from British Columbia trawlermen who consider that, even in their cold waters, speeds of at least two knots are required for flat fish and that three knots are required to take any quantity of faster types along with them. The same opinion is held by Nova Scotia flounder trawlermen who regularly tow at two to three knots (Personal communications from St. Andrews and Nanaimo Biological Stations of the Fisheries Research Board of Canada). The Wadge Bank trawlers usually operate at four knots and it seems likely that the LILLA, TONGKOL, BULBUL and RAGLAN CASTLE all operated at such speeds when they recorded the good Pedro Bank catches listed in Appendix 8 and Table IV.

Special Trials

On October 29, 1954, off Kayts (Appendix 11), Mr. Halliday tested his theory that CANADIAN's poor catches were the result of slow towing. He had NORTH STAR pass him a tow line so the two boats could tow in tandem. In this way the combined power of their 80-horsepower motors was used in hauling the 50-foot trawl and he achieved a towing speed estimated at 2½ to 2¾ knots. Table IV and Appendix 11 show that the catches made in this way were two to five times as great as those made by CANADIAN alone using the same net on the same grounds on the same day. Even this increased catch would not be considered worth while by Canadian east or west-coast standards (Table IV) but it is to be noted that the hauls were not made in a part of Palk Strait designated by Malpas (1926) as worth trawling.

In 1953, Mr. Pinchin explored the possibilities of mid-water trawling with NORTH STAR. On August 19-22, off Trincomalee, he towed the 80-foot otter trawl, complete with doors, on short cables along the 40-fathom contour. By adjusting the cable-length he made tows at various depths estimated at 10, 20 and 30 fathoms (Appendix 10) to see if there were mid-water fish to be captured. The speed achieved was somewhat higher than that of bottom trawling with the same gear. In the course of the fishing he took a few small fish and jelly-fish.[9] This result was not encouraging but the beach seines at that time were doing no better. It did show, however, that even a slow net towed in mid-water can take some fish.

In 1954, Mr. Aubrey Barry and Mr. Halliday, who joined the Canadian team that year, made another test of mid-water trawling. On July 27, off Mullaitivu, CANADIAN and NORTH STAR combined operations for a brief time. Each took a single warp of a square-mouthed box trawl 78 feet on each side (a pseudo-Larsen trawl) and hauled it close to the surface through small schools of pomfret (*Stromateus fiatola* (Bk.)) which appeared to be feeding on jellyfish. The speed was not more than one mile per hour and the boats were about 100 feet apart. They managed to straddle the schools of fish which seemed to be in no way alarmed by the boats or the net but they did not enter the net. They merely avoided it leisurely.

CANADIAN's winch failed when the trawl was being boarded after the first haul and NORTH STAR had to board it by herself. Only one pomfret was taken. It was several days before the winch was back into operation and by that time the pomfret, which are seasonal migrants on this coast, had moved out of the area and no further trials were possible.

This brief test indicated that the method of operation was suited to the capture of this schooling species off Mullaitivu because it will " stand " in the water in spite of local disturbances. How many other local species share this characteristic is not known. Some certainly do not, but it is believed that many which are now regularly taken by beach seines do stand and could be caught by towing small, fast, mid-water trawls. Mr. Saemundsson, the F.A.O. fishing gear technologist who was working in Ceylon in 1954, expressed the view that twin-boat fishing trials using nets of various sizes and designs appropriate to the sizes of the boats available to tow them, should be given a prominent place in fisheries survey work. The two tests and the obervations made by the Canadian team support Mr. Saemundsson's view.

C. Discussion

Importance of Continuing Trials

Because the conventional otter trawl and the conventional methods of operating it from low-powered boats were found unsuitable to conditions in Ceylon, it has been suggested that small-boat trawling trials should be abandoned altogether. This we would consider unwise because the possible benefits of adapting small-boat trawls to local conditions are very great. We regard them as possible successors to beach seines. The beach seine fishery now contributes 40% of the total annual catch but is in economic distress because it requires so much manpower and manpower is becoming increasingly expensive (Canagaratnam and Medcof, 1956).

It is important therefore to continue efforts to adapt small-boat trawling to conditions in Ceylon.

Possibilities of Conventional Otter Trawling

Glanville and others have shown that conventional otter trawls will work in Ceylon's inshore waters. And Pinchin and Halliday have shown some of the problems that face their commercial operation by small boats. One of the ways of increasing the speed of trawling (which seems to be one of the main problems) without changing the type of trawl would be to increase the power of boats. This seems undesirable because it might involve increases in the size of boats which might bar them from ports like Jaffna with shallow harbour mouths. It is also undesirable because it would increase operation costs. But if efforts are to be made to adapt conventional trawls, there are ways of reducing some of the operating costs. Appendices 10 and 11 show that the number of " rip-ups " suffered is very great. These are costly in time and money. Mr. Halliday was of the opinion that " rollers " or " bobbins " should be fitted to the footrope to reduce these and a set of these was turned out for trial. Unfortunately they were made of seasoned, fine-grained wood and never did lose their buoyancy, even when sunk at 40 fathoms for 48 hours. They were therefore unfit for trials. The need for trials with bobbins still stands.

Possibilities of other Trawls

A more promising way of getting around the problem of increasing trawling speeds might be to change the design of trawls and/or methods of trawling. There are many types of trawls and many ways of using them and new types are continually being developed. Much of the power exerted as a forward thrust by the motors of otter trawlers is absorbed by the " doors " which are set at an angle so they will flare sideways and keep the mouth of the trawl open by their sideways pull. There are other ways of keeping the mouth of the net open without this loss of power.

If the doors of the otter trawl were discarded and CANADIAN and NORTH STAR (or any other pair of matched boats) each towed one of the warps of the same trawl, higher speeds should be attainable than those Mr. Halliday achieved by tandem towing. This increase might be great enough to raise both the quantity and quality of catches to commercially profitable levels. This twin-boat method of fishing groundfish is commonly practised by the Japanese " bull trawlers " that fish the China Sea (Fisheries Institute of Japan, 1961) and by trawlers from Spain which cross the Atlantic to fish the Grand Banks off Canada's east coast. It was from them that this method of trawling got its name, " Spanish trawling ", in that region. Twin-boat trawling should work in Ceylon because the weather, which is usually a limiting factor for this type of fishing, is much more favourable here than in the North Atlantic. Nobody has tried it. John (1951) thought the possibilities were good.

If twin-boat trawling with regular types of bottom trawls will not work, or even if it did prove workable, there are still other types of twin-boat trawling that are worth examining.

The conventional groundfish trawl, with its low head-rope, may not be the best gear to use in Ceylon waters where certain types of fish like flounders, that actually live on the bottom, are rare. There are two well recognized ways of fishing under such conditions. In both these methods there is little or no friction between net and bottom and high speeds can be obtained with relatively low power. One is to use a net which need not go to the bottom—a mid-water trawl such as a herring trawl or Larsen trawl. The other is to use a box trawl to skim over the bottom.

The sides of a box trawl are high so that even when the footrope is on bottom the headrope will be well above it, thus enabling fish to enter the net even if they are swimming several feet up in the water. Because fast bottom fish are known to be abundant on close-to-shore areas that are accessible to small boats, e.g., Pedro Bank, it does seem worth conducting trials of this sort.

Similarly, surface and mid-water trawls should be tested for capturing fish that live well up in the water quite independent of the bottom. NORTH STAR's and CANADIAN's preliminary trials at mid-water trawling have already been described. The results were not discouraging. The hope is that systematic trials will discover efficient methods of small-boat trawling that will eventually assume the important roles they now fulfil in other countries. John (1951) had high hopes for this type of operation.

Summary

1. Small-boat otter trawling for groundfish is a highly productive method of fishing in many countries and if practicable here, might be carried on both from deep-water ports and from ports that are too shallow-mouthed to accommodate large trawlers.

2. So far, only small catches have been taken in small-boat trawling trials in Ceylon but several important points have been established that indicate promising directions for further trials.

3. Slow-moving fishes, such as flounders, that sustain conventional small-boat otter trawling in many temperate countries are rare here but faster-moving groundfish abound on some of our close-to-shore banks.

4. An important point is that small-boat trawls must be towed faster than in temperate zones if they are to capture the more abundant fast-moving species. This might be done by using more powerful and faster boats and quite small otter trawls fished in the conventional way. But there are other kinds of trawls and other methods of fast trawling with low-powered boats that have not been adequately tested here; for example, mid-water trawls and twin-boat trawling (Spanish trawling) for pomfret. The possible benefits from adapting these to Ceylon fisheries are great.

Recommendation

Because the possible benefits of small-boat trawling are great and because the Department of Fisheries now has boats that seem capable of testing and adapting at least some of the known methods to local conditions, it is recommended that small-boat trawling trials be continued vigorously.

HANDLINING FOR GROUNDFISH

Handlining is like angling without a rod. It is a very ancient but not necessarily crude form of fishing (Radcliffe, 1921) that is still commonly practised in many countries—usually from boats. Each fisherman tends at least one line and each line carries one or more baited hooks and a sinker fastened close to its lower end. The handliner pays out line until the sinker rests on bottom or is close to it, then he generally raises and lowers it with a seesaw motion of the arm. He believes that moving the baits makes them more attractive. He may also " chum " the fish; that is, periodically he may release bait in the neighbourhood of his hook to attract more fish and improve his chances of catching them. The hook-bait and the chum may be either alive or dead.

Compared with other fishing methods, handlining has the obvious advantage of low cost of equipment, and skill in its use is not too difficult to acquire. Handlining has the further advantage that it can be carried on over bottom that is too rough to permit other types of fishing like trawling or longlining. Its disadvantages are that when currents are strong it is sometimes impossible to prosecute (Grenier, 1954) even when other types of fishing like longlining could be carried on and that it may be unprofitable in deep waters where longlines with power haulers possibly could be operated to advantage. Another disadvantage is that in handlining there is a strict limitation in the amount of gear used. In Ceylon, for example, there are seldom more than two hooks per line and fishermen seldom tend more than one line per man. This means that boat crews must be large if catches are to be kept high. In longlining, by contrast, the amount of gear set can be very great if there are facilities to handle it.

A. Traditional Ceylonese Fishery

The Canadian team's 1953 study of handlining for groundfish in Ceylon was cursory but it showed that the equipment and methods used here are highly refined and some of them most ingenious. An example that illustrates this is the device and use of the chum cone known to the Sinhalese as " eyem cooda " (Fig. 3). It is of open wicker construction, weighted below with a lead ring and fastened above to a line. Live prawns or small fish which the fishermen carry with them are placed under the cone which is then allowed to drop quickly through the water. So long as it sinks freely the chum is held in the upper part of the cone by the stream of water rushing upward through the wicker. When the fisherman clutches the line, the free fall of the cone is checked, the water pressure on the animals ceases and they swim out at whatever depth they happen to be. Glanville (1954, Figure 11) describes the live bait basket, another ingenious device which is used in conjunction with the chum cone.

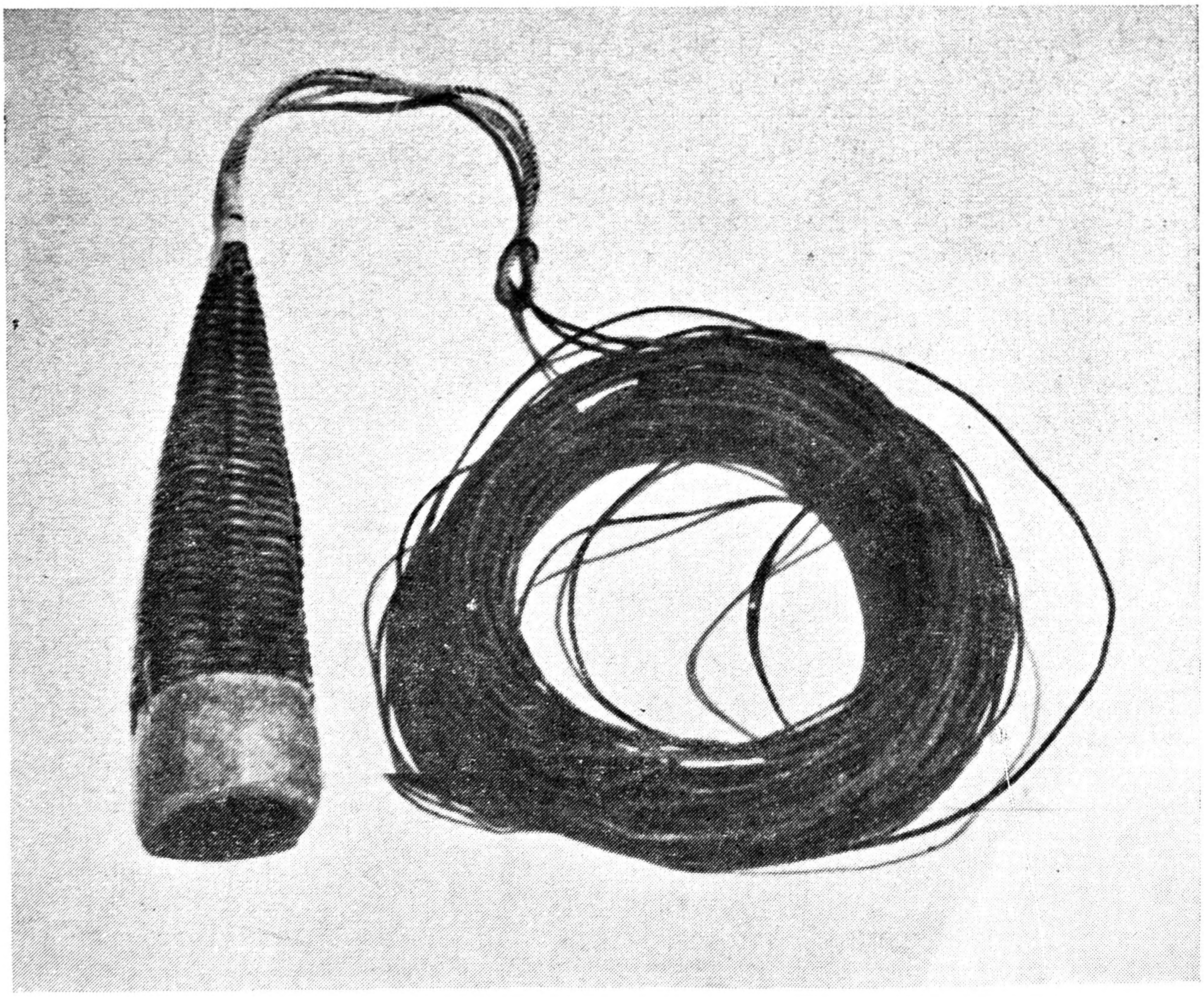

Fig. 3. Chum cone used by handliners to carry down and release live chum (small fish or prawns) at the level of baited hooks to attract large fish and improve catches. The bottom ring is of lead, the cone-proper is of wickerwork.

Traditionally, handlines are hand-laid cotton, dressed with the juice of "timbiri" fruits (*Diospyros atrata and D. albiflora*). The hooks may be factory-made or produced locally by a hooksmith with simple blacksmith's equipment. He uses spring steel wire from such sources as coiled springs of old automobile seats and is able to turn out strong, delicate or sturdy hooks according to the exact pattern prescribed by the fishermen who stand by supervising him as he works.

B. Search for better Gear

Mr. Babcock, more than any other member of the Canadian team, directed his attention to the equipment used in handlining. He strongly advocated replacement of traditional-type lines by colourless, mono-filament nylon which he considered superior. Some fishermen adopted them. He also believed that the fishing efficiency of the popular hand-made spring-steel hooks was low because they corroded so quickly. He advocated tests of hooks made of non-corrosive metal and, through arrangements with the Steering Committee, several small lots of stanless steel hooks were made up at the Government Factory following patterns given to Mr. Babcock by fishermen. These were distributed to fishermen in different ports. Later, inquiries were conducted among these fishermen to get their appraisals. They generally approved of the non-corrosive characteristics of the new hooks but most of them were dissatisfied with the patterns. Almost every man had his own strict views of just how the hook he was to use must be made. He liked to choose the pattern and supervise the manufacture himself.

In 1954 Mr. Babcock continued his efforts along the same lines until he completed his contract and return to Canada. More fishermen tested nylon lines and several more patterns of hooks were tested but with much the same result as in 1953. Finally it was decided that the simplest way to popularize stainless steel hooks would be to place stock material in the hands of village hooksmiths. In 1955, when this report was filed, no suitable stainless steel wire stock had been obtained but this approach to the problem had been approved by fishermen and blacksmiths. Steel of the right malleability and tempering characteristics may not be easy to find.

Preoccupation with other fisheries work prevented the Canadian team from carrying out other field work on handlining for groundfish except that discussed under Mothership Operations and the collection of records of industrial operations by indigenous craft. The latter are treated in the next section.

C. Study of the Fishery

The task of fulfilling the Steering Committee's request for a review of back records was assigned to the writer and it soon became clear that annual landings of groundfish by Ceylon's many handliners are very high in spite of the fact that the catch per man per hour is often low. They are probably exceeded only by landings of beach seiners and gill netters but there were no annual statistics from which the true relative importance of these fisheries could be judged.

The Department's voluminous files describing mothership operations supplied a good deal of bottom handlining catch data for different parts of the coast. They applied to fishermen working from their own craft after being towed to fishing grounds by motorized launches (motherships) operated by the Department of Fisheries. It was agreed that these should be analyzed and that the information gained should be supplemented by assembling records of current industrial handlining operations by local craft that were unassisted by motherships. A quantity of such data was assembled with the help of fisheries officers (Appendix 12). It was also agreed that no further handline fishing trials should be carried out by the Deparment or the Canadian team until the results were available for intelligent direction of any such work.

The data assembled for Ceylon and for some fishing areas outside Ceylon are summarized in Appendix 12 and Table V. The value shown for Nova Scotia in Table V is not a statistic but an estimate of average landings so far as Mr. Pyne and Mr. Halliday could remember from their own experience in fishing those waters.

TABLE V

SUMMARY AND COMPARISONS OF HANDLINE GROUNDFISH CATCHES COMPILED IN APPENDIX 12

Fishing Ground	*Year*	*Months*	*Catch/line/hour fished (lb.)* (*)
Ceylon off:			
Colombo	1954–55	Sept.–March	1·4
Negombo	1954–55	Dec.–Jan.	0·5
Karaitivu Island	1949	April	20·0
Thalaiyadi, Pt. Pedro and Myliddy	1954	September	0·8
Mullaitivu	1951	June–Sept.	11·5
	1952	Aug.-Sept.	5·5
Mankeni	1954	June-July	10·3
Wadge Bank	1949	Feb. and March	33·2
Seychelles Islands near shore	1948–49	April-June	50·6
Seychelles oceanic banks	1948–49	April-June	77·0
Nova Scotia (east coast of Canada)	—	—	40—50 (†)
Gulf of Oman (Western Arabian Sea)	1948	January	8·3

(*) Same as catch per man per hour in most cases.

(†) An estimate by Mr. Pyne and Mr. Halliday from recollections of their own fishing experience.

The data show that in Ceylon the catch is largely composed of " rock fish "—a loose term used here to include a wide variety of grade 2 fishes (mostly Lutianids and Lethrinids that feed about rocky ledges and coral reefs) and some grade 1 and grade 3 fish. The records for unassisted craft and reference to Figure 2 show that in most cases these are taken from grounds close to shore readily accessible to sailing or oared craft and on lines with one hook. And the catches are small—for example, out of Colombo it averaged 1.4 pounds per line per hour (Table V).

The best catches were made from small boats, " vallams ", towed by motherships to fishing grounds that are relatively far from shore, close to the edge of the continental shelf and therefore seldom visited by handliners. Off Karaitivu Island and Mullaitivu, for example, they averaged 20.0 and 11.5 pounds per line per hour.

The records show that catches even by assisted craft are highly seasonal. In some cases at least, this is attributable to the inability of these boats to withstand weather conditions rather than to lack of fish on the grounds. Handlining for groundfish off Mullaitivu, for instance, stopped in September in 1951 and 1952 but trawling records (Appendix 8) show that there is an abundance of groundfish on the Pedro Bank throughout the northeast monsoon season when no line fishing whatever is practised there.

Appendix 12 also indicates that the best catches have been made with multiple-hook lines (usually five-hook) in the hands of Indian fishermen skilled in their use, from boats that are constantly rowed during the fishing operation so as more or less to maintain their positions over the fishing ground instead of drifting over it rapidly with the variable currents that are characteristic of such places. However, Table V shows that even with these refinements the catches were little better than those reported for the Gulf of Oman (Western Arabian Sea) by Bertram (1948). They were much lighter than those realized from 3-or 4-hook lines on the Wadge Bank (Chidambaram and Rajendran, 1951) or from 1-or 2-hook lines on the Canadian east coast or from the 10-hook handlines used in the Seychelles (Wheeler and Ommanney, 1953).

D. Discussion

Four tentative conclusions may be drawn from this study:

(1) Groundfish are probably not as abundant on the grounds oridinarily visited by Ceylon handliners as on many grounds exploited by tropical and temperate-zone fishermen. Accordingly, it would be unrealistic to expect heavy catches there. Nevertheless, returns from handlining in the better areas are so much higher than those from some other types of fishing (e.g. from trolling) that more people might be encouraged to practise it.

(2) Some of the best handlining grounds are near the edge of the continental shelf, relatively far from shore and are therefore almost consistently neglected by our handliners. This could be overcome by using larger, more seaworthy mechanized boats. These could take fishermen safely and quickly from and to their operational bases and permit them to exploit rich fishing grounds regardless of seasonal weather conditions. They could also carry heavy loads of fish. It is still questionable whether such mechanization would be rewarding to commercial fishermen unless they had government patronage of some kind because handlining requires large crews. If it were rewarding then handlining might be greatly expanded and Ceylon's landings of good-quality fish could be increased accordingly and seasonal production stabilized.

At the edge of the continental shelf, deep oceanic water (rich in nutrients) often mixes with shelf water (sometimes poor in nutrients) to produce an abundance of bottom and planktonic fish foods and abundant fish stocks. This may partly explain the heavier catches observed on the shelf edge but so far there is no local hydrographic or biological evidence that this holds true in the areas tested. Their stocks might decline if heavily fished. Investigations might reveal relationships that would be important in assessing these grounds and in discovering new fishing grounds. In the Seychelles (Wheeler, and Ommanney 1953) this relationship does not seem to apply. There, the best fishing is on top of banks—not at their edges.

(3) Better catches might be realized if multiple-hook lines were adopted by Ceylon handliners.

Following from this third conclusion, a suggestion by Mr. J. R. Seemundsson (F. A. O. fishing expert assigned to Ceylon) merits attention. He advocates the use of the " juksasnella " recently introduced in Scandinavian countries. It is a circle of line, an " endless belt " handline, so to speak, equipped with several heavy sinkers and armed with many hooks some of them baited and some bearing artificial lures. In operation, the juksasnella is hauled in continually over one side of the boat, either manually or with a power hauler, and allowed to sink back to the bottom on the other side. The amount of line in the circle and the number of hooks is adjusted to the depth of the water in such a way that several hooks are at all times being dragged over the bottom or close to it.

The part of the line on the bottom and immediately above it acts as a multiple-hook handline for taking groundfish while the parts higher in the water act in much the same way as multiple-hook drift lines or even as trolling lines useful in capturing pelagic species. Its principal disadvantages would seem to be its slightly higher cost and its greater tendency, than conventional handlines, to foul on uneven bottom. However, these disadvantages do not seem serious enough to discourage thorough trials of the device on our grounds.

(4) This study has shown that handlining is one of Ceylon's largest fisheries but that very little is known about it. It would seem that more fishermen should be encouraged to participate in it. Eventually it might be replaced by other fishing methods like bottom longlining but the fact that it is already being practised would simplify its expansion. However, before expansion

of the fishery is encouraged it should be better understood. In other words, investigational programs should take in not only an examination of current-style operations, as heretofore, but also include fishing trials with mechanized boats and new-type gear and possibly biological and hydrographic studies of good handlining grounds.

Recommendation

Handlining for groundfish is a widely practised but little known fishery and has been recognized as important. Prospects are that it could become even more important in the national economy. It is therefore recommended that investigation of the handline fishery for groundfish be continued vigorously and expanded.

BOTTOM LONGLINING

A bottom longline consists of a strong " ground line " usually about 50 fathoms long, to which short side lines called " gangings " or " snoods ", 6 inches (in Ceylon) to 3 feet long, are attached at regular intervals of 1 to 3 fathoms. A hook of any desired size is attached to the free end of each ganging. In fishing operations several lines are usually tied together into one " string " which may be any length up to 3 or 4 miles.

In some sections, especially the northern part of the island, the gear is familiar under its Tamil name, " tundi valai ", but even this term has little or no meaning outside that section. For this reason it seemed necessary to give this description of what is meant by a bottom longline.

A. Review

While the 1954 program of fisheries survey was in the planning stage we made a review of bottom longlining in Ceylon. This was intended to provide the Steering Committee with the information it needed for deciding whether bottom longline fishing trials should be included in the program. The review covered the traditional fishery and its problems, readily accessible information about longlining in other countries, and records of experimental fishing that had been done in Ceylon.

Traditional Ceylonese Fishery

Mr. E. R. A. De Zylva and other officers of the Department provided information on this fishery and the author made a first-hand inspection in company with the Chief Inspector, Mr. A. M. A. Cader. Longlines were in common use in the Jaffna peninsula and occasionally used in Koddiyar Bay. Pearson (1923) described them as in common use about Puttalam but they were not seen there during our field trip.

The Canadian team was impressed with the ingenious devices developed by the local fishermen to overcome the inherent difficulties which limit this kind of fishing.

1. The chief limiting factor was, of course, an adequate fish stock, catchable by this gear. Within the range of their fishing craft, which was not great (their boats were unpowered), the fishermen had learned where and when they could fish profitably.

2. The second limiting factor was a regular and large supply of bait, alive or at least fresh, and attractive to fish. In the Jaffna peninsula, at least, the fishermen had overcome this. There the catching and transporting of bait to longliners was the sole occupation of a group of fishermen who fished a small fish known in Tamil as " kili meen ", apparently in most cases *Cheilinus chlorurus* (Bloch), during the longlining season.

Another and more ingenious solution was the use of longlines of empty chank shells (*Turbinella pyrum*) (Fig. 4) which were set out at convenient points inshore from the longlining grounds by old men or boys. Small juvenile octopus (*Octopus* sp.) which sought shelter in the cavities of these shells were shaken out into the boats when the lines were hauled. Thereafter they were kept alive in floating boxes until they were required as live bait for longlines.

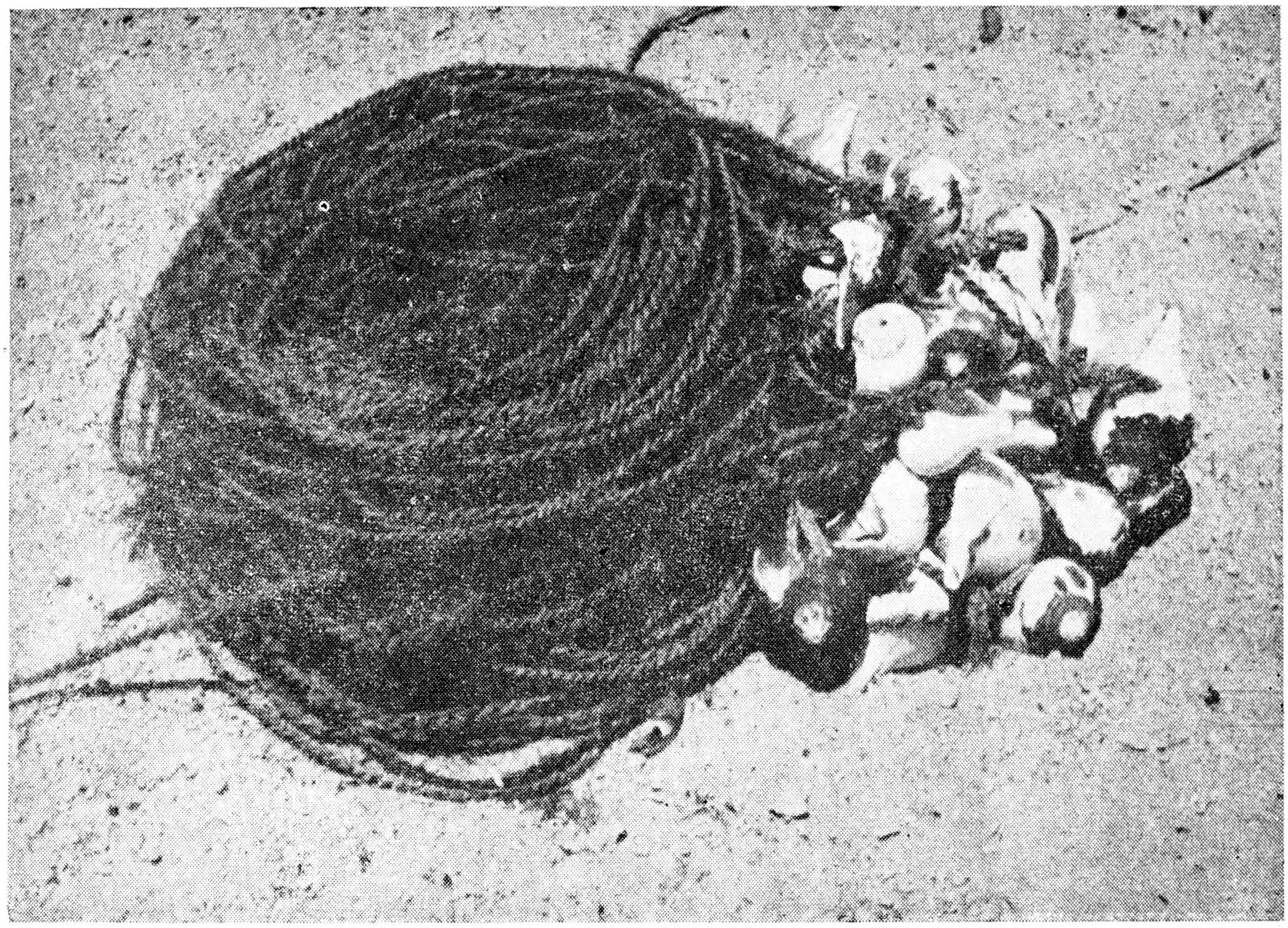

Fig. 4. Coiled longline of chank shells. Set close to shore it catches young octopus which are used alive to baitbottom longlines for groundfish.

3. The third limiting factor was the depth of water in which the lines could be set and hauled manually. Where the depth was much more than 20 fathoms, the physical effort required for hauling was so great that only short strings could be used without exhaustion of the fishermen and short strings meant small catches. Because of this, longlining in Ceylon has been limited to the few shallow-water areas where large fish regularly concentrate in sufficient numbers to be worth fishing.

4. A fourth and seriously limiting factor was the position of productive grounds relative to suitable landing points and the seasonal changes in the direction and strength of the prevailing winds. This was especially important in places like Ceylon where nearly all fishing craft were paddled, rowed or sailed. The fishermen were aware of richer fishing grounds beyond the normal range of their craft but were unable to exploit them. What they needed, they said, were motorboats.

These four factors seemed to be chiefly responsible for the restricted use of longlines in Ceylon and, for that matter, they are the same almost everywhere.

During the brief inspection trip it was impossible to gather enough data on catch to gauge the efficiency of the traditional fishery. But, from what the fishermen told us, bottom longlining seemed to be more rewarding than several of the other fishing operations we had studied. On the other hand, it seemed to have developed as far as it could so long as it depended for power on human muscles and the wind.

Longlining in other countries

In some areas, for instance parts of the Canadian Atlantic coast (Nova Scotia), this method of fishing has been highly developed and is still commonly practised (Templeman and Flemming, 1956). There, a regular bait supply has been assured by organized fishing of bait species (e.g. herring and squid) at seasons when they are abundant, and by storing large stocks of them in the frozen state until they are needed. There too, 30 to 50-foot, two-man or three-man mechanized boats are in use and allow their operators to travel to and from the most productive fishing grounds quickly and in safety. Mechanical power is also used to operate "gurdies" which haul the lines from any depth with relatively little effort on the part of the fishermen. The boats carry ice to preserve the freshness of the catch during trips which regularly last from 12 to 48 hours. Under these conditions heavy and lucrative catches are regularly landed as is shown by 1952 and 1953 data supplied by the Fisheries Research Board of Canada and presented in Appendix 14 and summarized in Table VI.

TABLE VI

SUMMARY OF APPENDICES 13 AND 14 LISTING BOTTOM LONGLINE FISH CATCHES (UNGUTTED WEIGHT)

Craft and port	*Year*	*Hooks set/boat/trip (no.)*	*Catch/trip (lb.)*	*Catch/100 hooks/set (lb.)*	*Catch/man/hr. on fishing grounds (lb.)*
Katumarams (Ceylon)					
Valvedditurai (mothership)	1951	200	—	38·9	—
Mylliddy (unassisted)	1954	225	64	27·0	5·4
Dory (19-foot, mechanized, Ceylon) Colombo	1954	210	6	2·9	1·5
North Star (Ceylon)					
Colombo	1954-55	1,068	135	12·2	9·8
Karaitivu Isl.	1954-55	1,120	134	14·2	9·6
Kayts	1954	504	16	2·8	1·1
Trincomalee and east coast	1954	687	118	24·9	14·9
M. F. R. V. No. 1 (Mauritius-Seychelles)	1948	—	—	111·8	—
Mechanized Longliners (Eastern Canada)					
Liverpool, Nova Scotia	1952-53	5,971	3,47[illegible]	67·4	206·4
Lockeport, Nova Scotia	1952-53	3,685	2,690	4·2	—

There are many other temperate zone bottom longlining fisheries that might have been examined, e.g. the halibut fishery on the United States and Canadian Pacific coasts but data on these were not readily available.

Wheeler (1953) found good fishing grounds in places where tidal currents were too strong to permit handlining for groundfish. The lines would not go to the bottom. But in some of these he was able to use bottom longlines. He has published some of the few records of bottom longlining in the tropics. Some of his catches are described by counts of fish. To make his results comparable, Wheeler's (1953) records have been modified to conform with the system used here to describe our own and Nova Scotia operations and expressed as pounds of fish taken per 100 hooks set. These modifications required estimates of the average weight of the fish taken. The reasonableness of these estimates may be judged by the reader for himself from Wheeler's report.

These Nova Scotia and Indian Ocean data were encouraging. They showed that bottom longlining worked well both in the temperate zone and in the tropics. But they were no more encouraging than the analysis of records of experimental fishing that had been carried out in Ceylon itself.

Early Experimental Bottom Longlining in Ceylon

Blegvad (1951) observed the use of the traditional type bottom longlines by Karaitivu fishermen and in March and April 1949 he fished some he contrived himself, with promising results (Appendix 13 and Table VI).

In 1951 the Department of Fisheries used the motor craft SEER and HALPHA as "motherships" to tow Valvedditurai bottom longline fishermen to and from their established fishing grounds. Records in the Department's files showed that catches on some days approached 70 pounds per 100 hooks set (Appendix 13 and Table VI). But it is true to say that up to 1954 there had been no sustained effort to explore or expand the longline fishery. It had been omitted from the 1953 program of fishery survey.

B. 1954 Program

From this review the Steering Committee decided that bottom longlining should be thoroughly explored in 1954 and that the work should begin on the east and north-east coasts.

Fishing Trials

Following the Steering Committee's decision, NORTH STAR was equipped and Mr. Roy Pyne who had long experience at this kind of fishing in Nova Scotia, was charged with the work. He improvised a small amount of gear for the first trials using whatever materials he could obtain locally. This included a great variety of hooks and lines only a few of which could be considered suitable for power hauling, easy repair and handling.

At the same time an order was placed with the Canadian Colombo Plan authorities for a supply of lines and hooks that should be adequate for the year's trial operations. This included "18-pound" ground lines made of steam-tarred cotton (300 fathoms weigh 18 pounds), "4-pound" gangings, also steam-tarred cotton, and "kirbed" and "straight" large-eyed galvanized hooks mostly of size 6/0 of the Pflueger or size 17 of the Mustad scale of describing hook-size. By most standards this would be considered a small hook for groundfish.

The improvised gear was used in trials off the east coast from mid-July until the end of October 1954 when the local supplies of lines and hooks were exhausted and the lines in use were so worn that they were not worth repairing any longer (Appendix 13 and Table VI).

The Colombo Plan order was filled soon after but not in time to permit this better-type gear to be tested on the east coast. It was used, however, out of Kayts and off the south-west and west coasts in November and December 1954 and in January and February 1955, both from the NORTH STAR and from powered Nova Scotia dories that had been gifted by Canada (Appendix 13 and Table VI). The longlines had to be hauled manually from the dories and for this reason they were obliged to fish in shallow water where catches were light.

Bait Requirements and Costs

In Nova Scotia an average of 4 pounds of herring or 3 pounds of squid is required to bait 100 hooks (Martin and McCracken, 1954). Mr. Pyne found that here the requirement of herring (Sinhalese—" saleya ") is usually only about 3 pounds because the head is small and can be used along with the body instead of being trimmed off. The squid requirement is about the same here as in Nova Scotia.

These statistics on bait consumption are useful not only in calculating bait demands of a bottom longline fishery but also in calculating and comparing operating costs of longlining. Bait costs and boat operating costs must be considered as well as the amount and value of the fish caught in judging whether it is worth while pressing the development of longlining in particular areas. In Nova Scotia the poundage catch of fish is 15 to 20 times that of the bait used (Table VI) and the bait is cheap (equivalent to 15-20 c, Ceylon, per pound). However, the price the Nova Scotia fisherman gets for his catch (equivalent to 20-30 c, Ceylon, per pound of gutted fish) is below that which Ceylon fishermen ordinarily receive for theirs. Taking this into account the poundage catch on good grounds (those averaging 30 or more pounds per 100 hooks per set) which amounts to ten or more times the weight of the bait used, would seem to be high enough to encourage commercial fishing.

Mr. Pyne considered that bait was always expensive in Ceylon. It was expensive because almost every species of fish taken here is acceptable on the market as a food fish, either in the fresh or dried or salted state. Presumably this will always be the case and bait will always be expensive to those who do not find time to catch it themselves.

Kinds of Bait

Mr. Pyne found that several kinds of small fish made satisfactory bait but that molluscan flesh (squid) gave the best catches of fish (Medcof, 1955, Appendix 13). This prompted trials in February 1955, with large mud snails (*Terebralia palustris* Brufiere) because sometimes bait was scarce. These snails abound in the shallow pools behind the barrier beach on Karaitivu Island. Mr. Pyne found that at that season at least, the flesh of these animals is too soft and watery to stay on the hook and that they were useless as bait.

The bait qualities of the terrestrial giant African snail (*Achatina fulica* Feruccac), which is so common as to be a pest in parts of the southwest coast, should also be studied. This animal has a large tough foot and a firm body. Dr. S. W. Ling of the World Food and Agricultural Organization states (personal communication) that it is regularly fed to pond-cultured fish in Indonesia. There is no reason to believe that it would not make an attractive bait for marine fish. A characteristic that recommends it especially is that it can be kept alive, and therefore fresh, for long periods with very little care.

Bait Supplies

Mr. Pyne found that bait species were abundant in and about Trincomalee most of the time but sometimes bait was hard to get. The real problem was to organize regular supplies from the fishermen. If commercial-scale bottom longlining were established the simplest solution would be to maintain supplies of frozen bait in the local cold-storage to meet emergency shortages over a wide section of the coast. Lagoon species of fish could be seined by bait catchers like those in Jaffna. And there are large quantities of squid (*Loligo* sp.) off Trincomalee from June to mid September. Both could be frozen.

Lifetime of Bait and how to measure Fishing Effort

Mr. Pyne's experience shows that the effective life of bait set out in these warm waters is usually not more than two hours and sometimes less. The bait becomes soft and crabs and other small bottom organisms, or fish that are too small to be caught, strip it off the hooks. Thus, providing the lines are left in the water for a minimum period of say an hour and a half, the length of the set is not likely to affect the amount of the catch unless hooked fish are attacked by sharks, which is rare here.

In the traditional fishery and apparently in the 1951 Valvedditurai mothership trials, the baits have usually been exposed for more than two hours. During our review this raised the question of how bottom longline fishing records should be reported to be most meaningful for most purposes. It was finally decided not to describe them in terms of catch per hour the gear was in the water as we had described trawling and handlining records. Instead, they have been expressed in Appendix 13 as catch per 100 hooks set, regardless of the length of the set and number of man-hours of labour involved. This permits direct comparison with catches in different places in spite of other and varying features of the operations.

The catch per hour of labour expended is a useful statistic in many comparisons of fishing operations but the long-lining methods now practised in Ceylon vary so greatly and have been so little studied that it is hard to decide how the human effort should be expressed. That used by Medcof (1955, Appendix 13), catch per man per hour on the fishing ground, may be useful in some instances but is not reported in our Appendix 13 because it can be misleading. In day-fishing, for instance, sets are short and all the time on the grounds is usually filled with activity. In contrast, night fishing is leisurely and the crews are usually able to sleep for several hours. The time they spend on the ground in this case is not a measure of the effort expended in making a set, which is all that really counts. When more has been learned about longlining, catch per man per day at sea (there is usually one set per trip and one trip per day) may prove to be a useful statistic in comparisons of catches by longlines with catches by other gears.

C. Discussion

Interpreting the Records

North Star's catches varied a great deal which is not to be wondered at because she was engaged in exploratory fishing on untested grounds as prescribed by the Steering Committee. These grounds were mostly beyond the range of unpowered indigenous craft but in areas considered as likely to be accessible to these same craft if they were mechanized both for propulsion and for hauling back gear. At no time did she settle down on what appeared to be a really good ground and fish it steadily as a commercial fishing craft would. It is reasonable to assume that her average catch per 100 hooks would have been considerably higher if she had done this. For this reason NORTH STAR's performance should not be compared unreservedly, with those of craft of any description that are engaged in commercial operations. Commercial-type fishing should be carried on as a logical next step in her program because her experimental catches were most encouraging in some places.

Not only should NORTH STAR's rates of catch per 100 hooks be treated with reservation but so also should her catch per trip records. She seldom fished more than 750 hooks per trip (Medcof, 1955, Appendix 13). This is all that is required for exploratory fishing but Appendix 14 shows that this is far below her capacity. Boats of her size-class regularly fish 3,000 to 4,000 hooks per trip in Nova Scotia. Thus, anyone interested in estimating the potentialities of fully mechanized bottom longlining fishing boats in Ceylon should multiply the catches listed for each trip, three or four times. For example, the records suggest that off Trincomalee NORTH STAR could have been landing 750 pounds per trip if she had been fishing 3,000 hooks. Such landings would be equivalent to 250 pounds per man per day at sea (for a 3-man crew) which approaches that for Wadge Bank trawlermen (Table I) and far exceeds catches made in most of the Ceylon fishing operations we have examined.

Prospects

Judging from what has been done so far, the chances for a successful mechanized bottom longline fishery on the central west coast are not promising. And south-eastern Palk Strait, where longlining by local boats is now established, seems to be less rewarding than it should be to justify mechanized operations. In contrast, the chances at depths of 30 to 50 fathoms off the central east and north-east coasts seem bright (Appendix 13) despite the fact that one of Ceylon's most intensely fished stretches of shoal water lies immediately inside it. As Hickling (1954) points out this is not unusual in areas where fishermen have not yet taken to mechanized boats.

The prospects are brightest in the reach from Mullaitivu to Kalkudah and they are brightest of all just off Trincomalee because Trincomalee is a good port and because the edge of the continental shelf is close to shore (Fig. 2) at that point. Very short runs would take fishermen to the best grounds. Weather conditions should permit a long, steady fishing season—probably February to October—and irregular fishing for another two months. Trincomalee could become the most important fishing centre on the east coast. Off open beaches like those at Mankeni, fishing would be possible for shorter but nonetheless worthwhile periods.

Bottom longline catches are lighter off the east coast of Ceylon than in Nova Scotia or in the Mauritius-Seychelles area (Table VI) where fish seem to be more abundant. Nevertheless they compare not unfavourably because the per-pound market price of fish is high in Ceylon.

These east-coast grounds are not fished now because they are outside the range of indigenous craft and too deep for manual hauling of longlines. And it is impossible to say how their fish stocks would react if a mechanized fishery were to develop and they were subjected to steady commercial fishing. But, if the Wadge Bank can be taken as an example, there is no reason for pessimism. In other parts of Ceylon the prospects should be more fully explored before fishermen are encouraged to take up long-lining.

Summary

1. Examination of the indigenous Ceylonese bottom longline fishery shows that it is rewarding in spite of the severe limitations confronting it.
2. By ingenious methods and vigorous effort the fishery seems to have discovered all the important stocks of bottom fish accessible to it and to be harvesting them to the full.
3. The fishermen appreciate this situation and state that mechanization of fishing craft is necessary for any expansion and they earnestly hope for expansion.
4. The survey showed that mechanization is needed not only for propulsion of bottom longline fishing craft but also for hauling back the gear with its catch.
5. Results of the 1954 fishing trials with full mechanization and good bait indicate that fishing off the east coast should be rewarding during most of the year. Other areas were not completely assessed.
6. The potential catch per man per day compared favourably with that of Wadge Bank trawlermen and exceeded that of fishermen with mechanized craft engaged in most other kinds of fishing in Ceylon.

Recommendations

On the basis of the survey results summarized above, it is recommended that the Department should:

1. Immediately encourage bottom longlining off the east coast by all means at its disposal.

This might include arrangement for full mechanization of suitable craft; help in organizing ready supplies of longline fishing gear and bait; advice and help in marketing and possibly some demonstration fishing.

2. Continue exploratory bottom longline fishing trials.

Explorations should cover the whole of Ceylon's continental shelf with emphasis on areas nearest good harbours and major markets.

DRIFTLINING

In reporting their 1953 observations, Captains Babcock and Homer described the traditional driftline fishery in many parts of the east, south and west coasts. They thought it could be improved in some ways but they hesitated to recommend a full-scale program of encouragement because they had gathered only general information and had made no driftline fishing trials themselves. So far as could be learned there had been no study of this fishery up to that time.

The Steering Committee therefore decided that Mr. Cader and I should examine this fishery on the south coast during our tour of inspection. We were to try to obtain information that would enable the Committee to decide whether driftlining deserved a place in the 1954 survey program.

We interviewed many fishermen, discussed their operations and examined their gear and catches. Our review was highly informative but it was so brief that it provided only very general ideas of the importance of driftlining in the fishing industry as a whole.

A. Review

Definition of Driftlining

Driftlining as practised in Ceylon may be described as mid-water handlining and is related to surface longlining (to be described in the next section) in the same way that handlining is related to bottom longlining. Driftlines and handlines are relatively short. They have a single or a few hooks at their ends and are constantly tended by the fishermen using them. In contrast, both types of longlines are long, as their names imply, and have many hooks placed at intervals along them. They are baited once, set, then hauled after some arbitrary period during which they are not tended. But, whereas handlines and bottom longlines usually take bottom fish (grade 2), driftlines and surface longlines usually take grade 1, mid-water fish such as swordfish, sailfish, and seer. They also take some sharks.

Driftlines are sometimes referred to as longlines because they are longer than most handlines but it seems best to avoid this term because of the confusion it involves. The term longline should be used solely to describe bottom and surface longlines as defined elsewhere in this report. Driftlining is also referred to as deep trolling but there is little justification for this term and it also leads to such confusion that it should be avoided. The best descriptive name might be mid-water handlining but this term is not generally understood.

Description of Gear

The driftlines were usually made of close-laid cotton corresponding in thickness to what Canadians call 14-pound steam-tarred line. They were hand-laid and usually dressed with the juice of timbiri fruits (*Diospyros albiflora* or *D. atrata* Alston; identified for me by Dr. B. A. Abeywickrema, Department of Botany, University of Ceylon). This juice acts like tar. It serves as a preservative and a line stiffener and makes for easier handling. Dressed driftlines had a long life, coiled easily and ran out quickly without snarling. They were usually 50 to 75 fathoms long and on each end they usually had a single large, hand-forged hook.

The hooks were of steel or German silver and their size varied somewhat but approximated that of number 1 or 1/0 in the Mustad coding system. The hooks were not connected directly to the line but to the free ends of wire traces or leaders. The leaders were 3 to 6 feet long and fastened at their upper ends to the line. Wire is not easily bitten through by sharp-toothed fish that not infrequently bite off cotton gangings from bottom longlines and escape hook-in-mouth.

The commonest leaders were single strands of German silver wire although double strands were sometimes used depending on the gauge of the wire available and the fisherman's tastes. German silver wire does not corrode in sea water but it does have the disadvantage of easy kinking and becoming weak at the kinks. Sooner or later it must be renewed no matter how carefully it is handled or it will break when a strong fish strikes and the fisherman will lose his fish, his hook and part of his leader. Steel piano wire was occasionally used because it was stronger and less kinky when new but fishermen avoided it because it soon corroded in salt water, became brittle, kinky and weak. Stainless steel combines the advantages of both the other metals without their disadvantages but because of its higher cost and scarcity in local markets, it was not widely used. Sample leaders made of stainless steel distributed by Captains Babcock and Homer in 1953 in the area visited were immensely popular among driftliners and we received many enquiries as to where they could be purchased.

Operation

In operation the driftline was usually held looped close to the middle in the fisherman's hand or tied to the boat at some convenient spot so that its two-baited hooks would fish at almost but not quite the same depth in mid water. Driftlining was sometimes a deep water operation, close to or beyond the edge of the continental shelf. The boat, with its sail furled, was allowed to drift and the driftline trailed out behind.

However, most driftlining was carried on by handliners as a secondary but simultaneous operation while their boats were anchored. Their principal catch was bottom species and their attention was seldom diverted from their handlines because few fish struck driftlines. When a fish was hooked on the driftline, however, it was usually first grade (see Schedule) and large. Thus the catch amply rewarded the small effort involved in setting and tending the line.

In the Batticaloa area handliners regularly took driftlines to sea but set them only if they happened to catch fish on their handlines that made suitable live bait for driftlining. In other places this kind of fishing was more highly rated and handliners regularly carried and used only driftlines. Sometimes handliners worked out into the deep water beyond the handlining grounds and during such parts of their fishing trips they used only driftlines.

B. 1954 Program

After deliberating on the results of the examination made with Mr. Cader and on the skippers' 1953 reports, the Steering Committee decided that a driftlining project should be included in the 1954 program but that it should be given low priority. It was agreed that stainless steel leader wire would be added to the government stores of gear that was kept for sale to fishermen and that the survey effort would be limited to a compilation of records of commercial driftlining operations. This, it was hoped, would provide a sounder basis of information for determining the importance of the fishery, its possibilities for expansion and whether the Department should try to foster it.

Fishing Records

Because driftlining operations were so often combined with handlining and because the total catches were pooled when landed it was not easy to gather records of commercial operations that faithfully described the driftline catch per unit of effort. The entries in Appendix 15 are accordingly few.

C. Discussion

The data assembled indicate that the average commercial catch of driftlines per individual hook per hour of operation was higher than that of Japanese surface longliness (Appendix 16). This seems reasonable because a surface longline hook may remain in the water several hours, and is not rebaited if a fish strikes it, steals the bait and swims off without being caught. In contrast, a driftline hook is kept baited and fishes all the time it is in the water.

Although the catch per hook per hour was higher for driftlines than for surface longlines the catch per man per hour was less because each fisherman usually fishes only two hooks compared with 15 in the small Japanese surface longline boat.

Our records indicated that driftlining is very effective but general observations and fishermen's statements suggested that our records were too few to give a fair idea of average performance. Most of our data were gathered during the seasonal run of sailfish off the southwest coast where and when driftline catches were apparently high by ordinary standards.

The final consensus was:

(1) Under average conditions driftlining gives low total catches.

(2) Driftlining by handliners incidental to their principal operations is probably justified.

(3) Driftlining in deep water during good runs of grade one fish is inefficient because number of hooks fished per man is so very low (see next section on surface longlining).

(4) Fishermen will probably gradually abandon driftlines for economic reasons.

(5) Further study of this fishery might provide information that would be useful in developing the surface longline fishery.

Recommendations

From the results of this study it is recommended that the Department of Fisheries should:

1. Make no effort to encourage driftlining.
2. Make such studies of the driftline fishery as will provide information that might be helpful in developing the surface longline fishery.

SURFACE LONGLINING

So far as the writer has been able to discover, the traditional fisheries of Ceylon never did include surface longlining. The following short description of the gear and how it is used therefore seems necessary.

Description of Surface Longlines

A surface longline is like a bottom longline (see earlier section of this report) except that it is held up in the water by surface floats instead of resting on the bottom. The mainline (corresponds with the groundline in a bottom longline) is generally referred to as the headline and is not ordinarily attached directly to its supporting floats but to floatlines, 2 to 5 fathoms long, which reach down to it from the floats.

As in bottom longlines, the hooks are not attached directly to the mainline but to gangings (also called snoods) of lengths varying from 3 feet to 75 fathoms depending on the design of the gear and the depth-preferences of the species being fished. There may be wire leaders attaching the hooks to the snoods. For open-sea fishing the gangings are attached to the headline at intervals of 20 to 30 fathoms.

The number of floats varies greatly. Sometimes one is attached opposite each ganging in which case the headline is suspended almost horizontally in the water and all the hooks fish at about the same depth if the gangings are of uniform length. Sometimes the floats are attached at wider intervals—up to 500 fathoms. With this arrangement the headline sags deeply between buoys and the hooks fish at correspondingly different depths. The size of the floats varies depending on the number used and the length and weight of the headline and the gangings they support.

From this description it will be seen that reference to this gear as a surface longline is not quite apt because the headline is not at the surface and the hooks may be very deep. The same criticism applies to its other common name, floating longline, but both are useful because they distinguish this gear from bottom longlines. Perhaps mid-water longline would be a more faithfully descriptive name but it has not found favour.

History and Practice of Surface Longlining

Surface longlining is by no means a new method of fishing. In northern European countries it has been practised for many years in the Atlantic fisheries. And in Canada (Newfoundland) fishermen have resorted to it for generations to take cod which move up from the bottom into mid-waters at certain seasons where they feed on capeline (*Mallotus villosus* D. F. Muller) (personal communication from S. N. Tibbo, Fisheries Research Board of Canada), Regardless of who first developed the gear or where it was developed, the Japanese must be credited for refinement and elaboration of it for pelagic fishing in the Pacific. They are still the leaders in this field but in recent years high-seas longlining for tuna has spread to other countries (Murphy and Shomura, 1953).

As a result vast stretches of ocean formerly regarded as fishermen's deserts are now known to be productive of highly prized species. Profitable commercial fishing of these requires, first of all, a knowledge of the hydrographic features and inter-relationships of the great water masses of the open oceans. It also requires a knowledge of the habits of the species sought and the habits of their food organisms in relation to these different water masses. Aboard the larger, modern, Japanese pelagic tuna fishing boats the skill of the technicians in discovering the temperature patterns of the water their ships sail through and in selecting suitable fishing grounds is considered to be as important to the success of fishing trips as the efficiency of the fishermen and the quality of the gear and the bait they use.

A. Surface Longlining in Ceylon

Halpha

The first report of surface longlining in our waters is that of Blegvad (1951). He describes two shallow-water sets made by his colleague, Mr. Myrup, working from HALPHA, off the southwest coast in March 1949. The gear used is incompletely described and the total catch was six small sharks (Appendix 16).

Canadian

The second series of trials was made from CANADIAN, January 25 to February 17, 1954, by Captains Babcock and Homer, of the Canadian Colombo Plan fisheries team. They made eight sets mostly in deep water off the south and southwest coast. Their gear, as described by Captain Babcock, was improvised from materials brought out from Canada for other purposes. The headline was of 40-pound manila, 2,500 to 5,000 fathoms long. The floats were No. 2 " Scotchman " or the standard type made of tarred canvas, attached to the headline by 15-fathom floatlines, adjustable for depth, and placed at intervals of 500 fathoms along the headline. Every third float was flagged to show the position of the longline and thus help the fishermen to keep the boat lined up with the gear while it was being hauled. The gangings were steam-tarred cotton, 3 feet long, attached to the headline at intervals of 18 to 20 fathoms. These were attached without wire leaders to flattened, tinned, kirbed, halibut hooks approximating the size of No. 6283 in the Pflueger and Mustad code systems for hook size. With this arrangement and with floatlines fully extended, the hooks nearest the buoys fished at a depth of 15 fathoms. Those between buoys fished deeper because of the sag in the headline and Mr. Babcock believed that at times some fished as deep as 150 fathoms. By this device a great depth of water was sampled at each setting.

CANADIAN's efforts were no more rewarding than HALPHA's (Appendix 16). In his reports, Captain Homer comments that tidal currents off the southern tip of Ceylon seemed stronger than charts indicate and this made the area especially difficult for fishing trials of this sort.

Some of Captain Homer's log entries are included under " Remarks " in Appendix 16 and show that several times hooks were missing when the line was hauled back. This may have resulted from bottom snags or from large fish biting off the cotton gangings in efforts to escape after being hooked. With wire traces between the hooks and the ends of the gangings, the gear might have given better catches.

Small Japanese Boat

The third series of surface longlining trials was conducted in the interests of a Negombo Fishermen's Co-operative Society by Japanese fishermen working from a 2-man, 6-horsepower motorboat based at Colombo and Negombo in September and October 1954. They reported making 15 sets with a line 1,100 fathoms long. It had 35 hooks and 35 floats and for bait, frozen "samma" (*Colobabis saira*) brought from Japan. The headline was cotton with 2-fathom, cotton floatlines and 9-fathom gangings whose upper 7 fathoms were of cotton and lower 2 fathoms of wire. The fishing reports summarized here with the permission of the Negombo Fishermen's Co-operative Society indicate an average catch rate 50 times that of earlier trials. Approximately 12 % of the hooks took first grade fish, mostly sailfish (*Istiophorus*). This figure approaches that reported by Murphy and Shomura (1953) for the better areas of the central Pacific.

Seer

The Japanese fishermen demonstrated their methods to officers of the Department of Fisheries who were convinced of the value of further trials. As a result, the fourth series of surface longlining trials was undertaken by the Department's SEER in October and November 1954, working out of Colombo harbour and using hurulla (a herring) as bait. Of the six sets reported in Appendix 16, four were made with the conventional shoal-water Japanese gear with hooks set to fish at 5 fathoms. This gear was lost on the fourth trip. The last two sets were with British-type, factory made surface longlines for shark with the hooks set to fish at 7 fathoms. There are too few data to make a good comparison of performance of the two types of gear although the Japanese type seemed better judging from the percentage of hooks that took fish (mostly sailfish). SEER's crew were novices at fishing the surface longlines and their bait may have been less attractive than samma. Whatever the cause, their catch per 100 hooks, including both types of lines, averaged only 13% of those made by the Japanese but were nevertheless 10 to 15 times as high as those by HALPHA and CANADIAN.

North Star

The fifth series of trials was undertaken in January 1955 by Captain Roy Pyne using improvised gear with hooks set to fish at 4 fathoms. This series was incomplete at the time of writing but the two sets reported (Appendix 16) show that improvised surface longlines will catch fair quantities of shark at this season. The records suggest that for fishing shark, mollusc flesh (cuttlefish) makes better bait than fish flesh.

Large Japanese Vessels

Besides these records of operations close to the south and south-west coasts, the Department has confidential records of operations by large steel, ocean-going, Japanese ships (converted trawlers) scouting for tuna with longlines in the near and far open ocean to the southwest and to the east of Ceylon. These indicate that there is good fishing at certain seasons in off-shore areas that are accessible to motorized boats of NORTH STAR's size-class. They also indicate that it might be profitable for Ceylon to imitate Japan and operate longline boats of BRACONGLEN's size-class in mid-ocean fishing.

B. Discussion

Lesson to Learn

This history of surface longlining in Ceylon provides two object lessons in what to avoid in carrying out fishery surveys like ours. The lessons are:

1. Don't use improvised gear if proper gear can be obtained.
2. Don't start fishing trials before carefully reviewing all available information on how, where and when best results can be expected.

Some have rated the surface longlining work by HALPHA and CANADIAN as wasted effort. Actually it may have been worse than that. It was potentially if not actually damaging because the results have discouraged people from making trials with proper surface longlining gear. We ourselves had a poor opinion of the possibilities of this method until the small Japanese boat equipped with proven gear and manned by skilled surface-longline fishermen made sets during the sailfish season in a place where driftliners had demonstrated that these fish were available. The Steering Committee may have been unwise in authorizing Mr. Pyne to initiate the NORTH STAR trials in January and March, 1954. He had improvised gear that could not be used as a yardstick for fisheries survey work unless it were carefully described.

Opportunities Inshore

The work of the small Japanese boat and SEER shows that motorized craft can make good catches (194 pounds per 100 hooks per set) with conventional surface longlines set close to shore during the sailfish run off Colombo and Negombo. And driftline fishermen know that this run is a regular annual event over an even wider stretch of the coast. In other words, small motor craft can carry on profitable inshore surface longlining in Ceylon.

Sailing craft could probably participate in the fishery too because their crews now land sailfish caught with driftlines. They would know when and where to put out the gear and what bait to use and the higher catches would encourage them to abandon driftlines that are inefficient because they carry so few hooks.

Opportunities Offshore

From information given to the Department by the large visiting Japanese vessels it would seem that Ceylon could use motor craft the size of CANADIAN and larger, for fishing tuna from its nearer high-seas areas. To do this the crews would have to master the refined techniques of this fishing method—especially those involving hydrographic observations to determine where and when to make sets.

The possibility of developing a Ceylonese surface long-line fishery is less bright on the high seas than inshore but should not be disregarded.

Recommendations

From the results of this study it is recommended that the Department of Fisheries should:

1. Take appropriate steps to encourage inshore surface longlining.

The Department is well acquainted with different ways of encouraging development—making gear available, compiling information about where and when the fishery may be profitably pursued and demonstration of fishing procedures.

2. Assess the possibilities of surface longlining in the nearer high seas areas about Ceylon.

It is important to start compiling pertinent information now—species of fish, their seasonal occurrence and abundance, their habits and the gear used to capture them in other oceans. There is a vast literature on this subject.

TROLLING

In the old sense "trolling" meant singing or passing a bottle around the table but today it means fishing from a boat by trailing lines with hooks and artificial or real baits attached. Usually the lines are long and the boat's speed keeps the baits relatively close to the surface although special devices are sometimes used for deeper trolling. Trolling is a common method of fishing throughout the world for taking carnivorous types of fish that haunt the surface or mid waters. These are usually fast-moving, migratory types whose abundance varies greatly both from time to time and place to place. Many of these varieties are highly prized, luxury food fish and command such high market prices that the quantity taken need not be great to make trolling a worthwhile method of fishing. Because the fish are valuable, trollers usually take good care of their catches and this enhances their attractiveness to consumers.

The effort involved in trolling is relatively slight compared with that required for handlining or trawling so in most trolling operations only small crews are carried. On the whole it is a relatively pleasant and exciting method of fishing as the derivation of its name imlies.

A. Trolling in other countries

Some idea of the catch rates and the lucrative total yields that may be realized from trolling may be had from Appendix 17 which includes data on salmon trolling assembled by the Fisheries Research Board of Canada and made available to the writer by the Director of the Pacific Biological Station. These show that good catches are realized over a several-month period every year and that an important industry has been built up. The catch rates correspond closely with those published for the Mauritius-Seychelles area (Wheeler and Ommanney, 1953, table 1, page 87). Their catches of mixed tropical species averaged 4.0 pounds per line-hour from 586 hours of experimental trolling conducted throughout the years 1948 and 1949 in shelf areas (water less than 100 fathoms deep). In a few small areas it was considerably higher. The literature cited by Murphy and Shomura (1953) shows that trolling is also an effective method for taking tuna in the central Pacific where catch rates averaging three to five times those quoted above have been recorded for several successive months.

B. Trolling in Ceylon

Traditional Fishery

Trolling has long been an important method of fishing all around the coast of Ceylon but particularly toward the south where orus are popular craft. Their manoeuverability and speed suit them particularly to this method of fishing and their 2- to 4-man crews annually spend thousands of man-hours in trolling and nothing else. They seem to do most of their fishing over the contintental shelf. John (1951) and others have indicated the importance of this fishery but in spite of this it has never been properly studied. So far as the writer is aware the few data in Appendix 18 are the only systematic catch-per-effort Ceylon trolling records assembled so far.

Traditional Gear

The lines regularly used by Ceylon fishermen are like those used in driftlining (see section of this report on driftlining). In fact, the same lines, leaders (traces) and hooks are often used interchangeably for both types of fishing. In trolling, however, the line is never looped in the middle. It is always tied at one end to some part of the boat and fished in one straight piece with a single lure or bait on the end (Fig. 5A). The lure is made of shreds of the inner bark of " ahatuwa ", which according to Dr. Abeywickrema of the Department of Botany, University of Ceylon, is the Sinhalese name for epiphytic figs such as *Ficus parasitica* and *F. heterophylla*. These strong lacy bark shreds with the consistency of fine silk, may be dyed blue or left in their natural glistening white colour and tied to the wire leader close to its connection with the hook. They stream out in the water partly obscuring the hook and are believed to be attractive to fish.

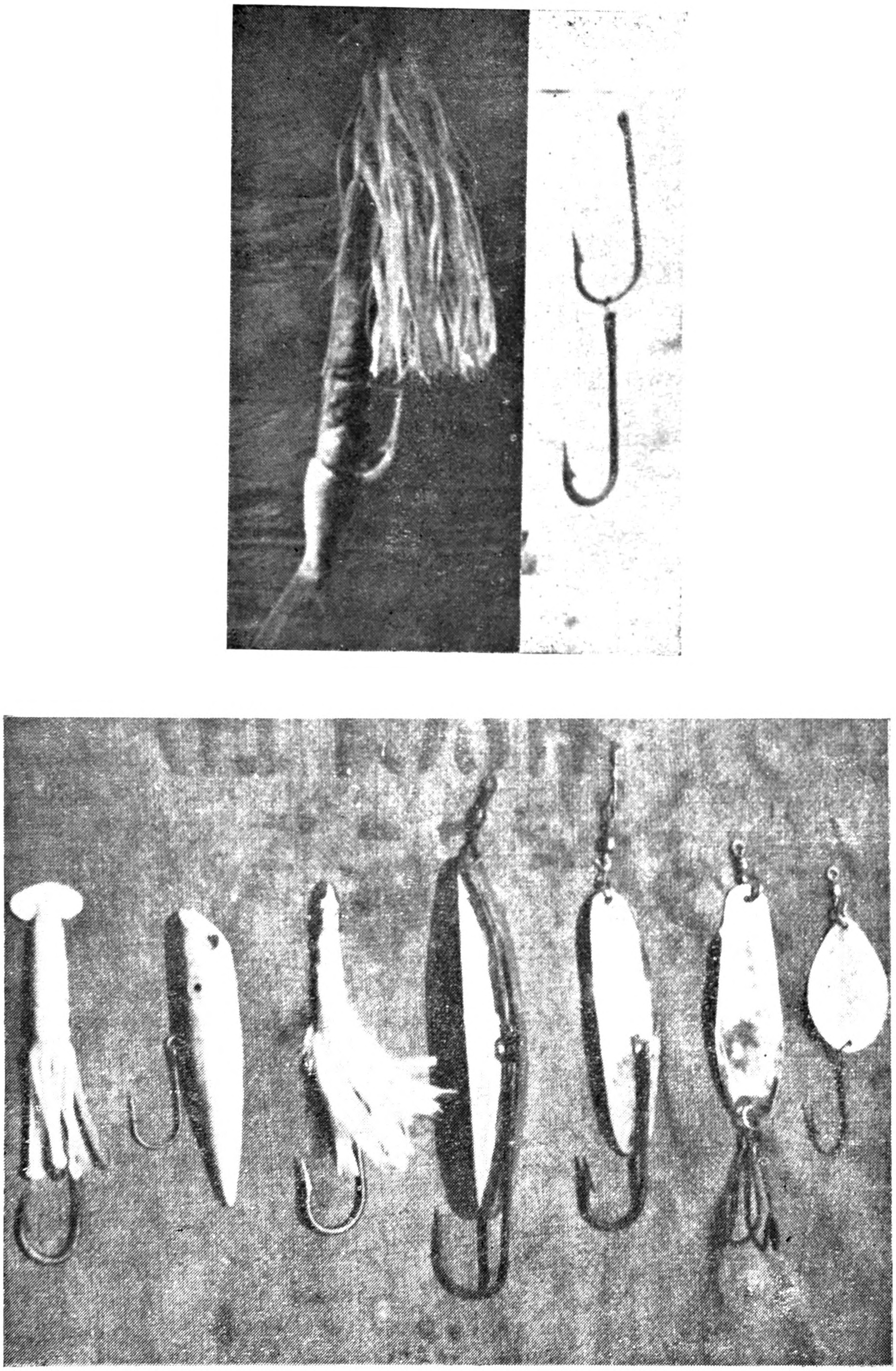

Fig. 5. Trolling lures whose performance was studied. A. Two common indigenous types—ahatuwa bark lure, baited with split fish tied on by thread, and tandem hooks as they appear before baiting. B. Commercially manufactured lures (Photo from jean, 1957) left to right—rubber squid ; wooden plug ; Japanese feather jig ; $7\frac{1}{2}''$ and $5''$ chromium-plated spoons ; brass spoon ; egg wobbler.

The lured hook is always baited, sometimes with a small fish (Fig. 5) either dried or fresh. " Hurulla ", a kind of herring, is a favourite. If fish is not available a long narrow slice of ripe coconut meat is often substituted. On the south-west coast the bark is often omitted and sometimes tandem hooks are used (Fig. 5A). In this arrangement a " trailer hook " of a size approximating number 4 or 5 (Mustad size scale) is fastened by its eye to the bow of the main hook. Whether the hook is single or double, the bait is tied on with thread so as to obscure the metal as much as possible.

Experimental Trolling 1953

Captain Homer, of the Canadian team, had many years' experience in trolling both for salmon and for tuna off the Canadian and United States Pacific coasts. He equipped CANADIAN with bamboo poles in the conventional North American Pacific-coast style (Anderson *et al*, 1953) and spent approximately 400 hours in 1953 trolling with a great variety of American and Japanese lures (Fig. 5B) cruising at 3 to 6 knots. He continued the work for a short time in 1954 and was joined in it part-time by Captain Pinchin in NORTH STAR (Appendix 18).

C. The 1954 Program

As a basis for planning the 1954 program, the Steering Committee called for a review of 1953 trolling records. The skippers' log book entries were compiled on fishing record forms (Fig. 1) and studied. From a quick review the catch per hour of trolling seemed low for all types of lures used (Appendix 18) and there were no data on the performance of traditional gear. The Committee decided to continue the project but to assign it a lower priority in the fisheries survey program. The main purpose of continuing was to establish a basis for comparing the performance of the various lures used by CANADIAN and NORTH STAR with that of the traditional lures used by local craft. Without this, the 1953 records had limited meaning.

As far as possible the trolling was to be carried out as an incidental operation during trips to and from fishing grounds where other kinds of fishing were being carried on and during the more lengthy trips from Colombo to parts of Ceylon where fishing experiments were to be conducted. The bamboo poles and other special devices used by Captain Homer were not to be installed on the boats because they interfered with the other types of fishing operations.

To permit the comparison of different lures, it was decided to introduce several refinements in methods of keeping records and to have CANADIAN and NORTH STAR include local-type lures with the other lures they trolled. Assistance in conducting the trials was to be obtained from another Department boat, SEER. Besides this, some western-type lures were distributed to oru fishermen to fish along with their own lures with the understanding that they should supply records of relative performance. And members of the Department's inspectorate service were to assist the writer in assembling records of operations by oru trollers using local gear.

Records were assembled covering 945 hours of commercial and experimental trolling in 1954 and the same scheme was continued to the end of March 1955 (Appendix 18 and Table VII). Unfortunately the records obtained from the local fishermen who used western-type lures were few and not precise enough to warrant analysis. This was partly because our field work was too discursive to permit regular interviews with the oru fishermen to whom the gear had been distributed.

TABLE VII

SUMMARY OF AVAILABLE RECORDS OF TROLLING OPERATIONS IN CEYLON WATERS BY MOTORIZED CRAFT ALONE IN 1953 AND 1955 AND BY MOTORIZED AND SAILING CRAFT (ORUS) COMBINED IN 1954. BRACKETED VALUES UNDER 1954 ARE FOR SAILING CRAFT TREATED SEPARATELY. FOR COMPARISON DATA ARE LISTED FOR CANADIAN PACIFIC COAST TROLLING FOR SALMON AND MAURITIUS-SEYCHELLES TROLLING FOR TROPICAL SPECIES

	Ceylon			*Canada*	*Mauritius-Seychelles*
	1953 May-December	*1954 January-December*	*1955 January-March*	*1949 February-October*	*1948 and 1949*
Hours of trolling	380	945 (219)	294	29,596	586
Total catch (lb.)	3,612	5,415 (569)	2,995	—	2,357
Trolling Time/Time out of port	83%	69% (72)	87%	—	—
Catch/lure/hour (lb.) (Av. of means for trips)	1·1	0·9 (0·8)	2·5	5·7	4·0
Catch/man/hour (lb.) (Av. of means for trips)	2·6	0·5 (0·8)	3·3	20·1	—

C. Discussion

General

1. A great many of the 1954 experimental trolling catches were obtained incidentally, as prescribed by the Steering Committee, and these draw attention to the value of encouraging trolling wherever possible among fishermen who do not regard it as their main fishing occupation. It need not interfere with other fishing operations when it is carried on during trips to and from fishing grounds. Catches made at such times are clear profit.

2. A review of Appendix 18 summarized in Table VII shows that compared with other fisheries (see Tables I, V and VI), a very high proportion of a troller's time out of port is spent in actual fishing. In this sense, trolling is an efficient fishing method.

3. The quality (grade) and market value per pound were very high.

4. On the average the catch per unit of effort was low. In experimental fishing the average for 1953 and 1954 was 1.0 lb. per lure-hour fished and one trip out of every three gave a zero catch (Table VIII). Only on three occasions in 1953 did the catch per lure per hour reach 4.5 pounds, which is less than the means for commercial trolling on the Canadian Pacific coast for salmon and about the same as that for experimental trolling in the Mauritius-Seychelles for tropical varieties. In 1954 the catch per hour reached 4.5 pounds on five trips and the average was 0.8 pound. Toward the end of March 1955, catches were relatively high for Ceylon because the boats were in Palk Strait during the best trolling season.

5. The highest experimental trolling catches off the north-west coast were obtained in March and off the north-east coast in August.

6. Catches by local craft were recorded only in 1954. They are somewhat sketchily illustrated in Appendix 18 but they accord with those for motor craft being only slightly lower per lure-hour and slightly higher per man-hour than the general averages for both types of boats combined (Table VII). This observation will come as a surprise to many fishermen who assured the skippers that motor noise frightens fish and that catches per lure-hour of the experimental craft (motor boats) must always fall far below those for sailing craft.

The local sailing craft usually carry a 4-man crew and seldom if ever fish more than six lines. Their fishing potential per man is therefore quite low. When CANADIAN was rigged for trolling she regularly trolled ten lines and her effective crew was the same.

7. The records on catch per lure per hour show that trolling is a poor way to add to the nation's suplpy of fish. Even when allowance is made for the higher per-pound value of the catch, the troll fisherman's earnings are low. Wheeler and Ommanney considered that in the Mauritius-Seychelles region catches of 4.0 pounds per lure per hour were too low to justify trolling for tropical species with motorized craft as a full-time operation. With catches such as those recorded in Ceylon the same conclusion seems more than justified. Trolling as we now know it apparently cannot be relied on as an important source of income for fishermen or for large supplies of protein food for the nation. It is expected that the trolling fishery as it is known today will eventually disappear except perhaps for limited times in a few places. Fishermen are conservative and it is to be expected that they will not accommodate readily to this change and they may suffer a period of economic distress. But there are more productive methods of fishing.

8. A more general conclusion seems to follow from the records. Mid-water carnivorous fish seem less abundant in Ceylon waters that in some other parts of the world, both tropical and temperate, where trolling is considered industrially worth while.

9. Under these conditions expansion of trolling as a full-time occupation of motorized craft is a vain hope.

Efficiency of Different Lures

Gathering pertinent data. By themselves the data assembled in 1953 are of little value in deciding what is the best type of lure to use in trolling but many of those gathered in 1954 and 1955 are sufficiently complete to bear critical analysis. These apply to 122 trips by motorized craft (Table VIII) and involve almost 600 boat-hours of trolling. In compiling these 2 years' records the skippers listed the number and kinds of lures they trolled, the number of fish they caught and the number of strikes they had on each lure as well as the regular information called for in the fishing record form (Fig. 1).

TABLE VIII

DESCRIPTION OF 122 TROLLING TRIPS MADE IN 1954 AND 1955 BY NORTH STAR, CANADIAN AND SEER TO TEST THE RELATIVE EFFICIENCY OF DIFFERENT TYPES OF LURES

Conditions of fishing	*No. of fish caught per trip*	*No. of trips made*	*No. of hours fished*
Very poor	0	54	144
Poor	1—5	52	324
Fairly good	6—15	9	62
Good	16—25	3	19
Very good	2 +	4	32
Totals	—	122	581

A variety of lures was usually trolled but a green rubber squid with a single barbed hook (approximating size 3, Mustad scale) was always included as a standard for comparisons. This is a popular lure on the Canadian Pacific coast. Besides this there were yellow and white squids with the same hook arrangement; three sizes of oval, concave, bowed, chromium-plated spoons, 4½, 5½ and 7 inches long, each with a single barbed hook hung from the centre of the spoon and of sizes 2, 2 and 1 respectively; six-sided, oblong, flat, brass spoons 4 inches long with a single, terminal, barbed hook, size 3; "hoochie koochies", which are cylindrical plugs one inch long and one inch thick, trailing coloured plastic frills which conceal a single barbed hook, size 3; Japanese feather lures which are lead-weighted, size 3, barbed hooks concealed by a dressing of red feathers; egg wobblers 2-inch, oval, flat, brass or nickle spoons with single terminal, barbed hooks, size 3; and finally, baited "ahatuwa" bark lures and baited tandem hooks without "ahatuwa" bark frills as used by the Ceylonese fishermen and as described earlier in this report (Fig. 5A and 5B).

Experience shows that the length of line on which a lure is fished affects its efficiency but motorized craft usually fish long, intermediate and short lines to avoid tangling. This practice was continued in the experimental fishing but the lures on the lines were changed each trip. Having taken this precaution it is assumed that line-length effects need not be regarded as a source of error in the results.

The 122 trips for which complete records were compiled are summarily described in Table VIII. From this it appears that no fish at all were caught on about one third of the trips. Thus, data useful in judging the relative efficiency of lures emerged from only 68 trips during which 437 boat-hours of trolling were put in.

Analysis of data. In preparation for analysis, these trip data were first grouped into classes according to the number of fish caught regardless of the length of the trips (Table VIII). In a rough way this is a classification according to conditions of fishing and permits study of relative efficiencies of different lures when fishing was poor, fairly good, good and very good, by Ceylon standards.

Several conventions have been adopted in treating the grouped data. Whenever a lure of any kind was put in the water, fish are considered to have been offered one " chance " to be caught. If two of the same or of different kinds were set, fish had two chances. When there were three lures, there were three chances, etc. When two lures of the same kind were set at the same time the fish are considered to have had double the chances of being caught by that type of lure. Once a fish is caught, or if one only strikes (bites on the hook) without being caught, it is considered to have made a " selection ". After this has happened a new setting is considered to have begun (even though only one of the lines has been hauled or partly hauled) and the next fish is considered to have the same number of chances as were offered to the first. Thus, the total number of selections made during any fishing trip is equal to the number of fish caught plus the number of unsuccessful strikes. Similarly, the total number of settings (chances offered) is equal to the number of lures set multiplied by the number of selections. We found no great between-lure differences in the ratio of unsuccessful strikes and actual catches.

If the numbers and kinds of lures set had been uniform throughout the experiment the results could have been pooled and the efficiency of any type of lure could have been judged from its selection rate, i.e. the total number of times it was selected expressed as a percentage of the total number of times it was set. The attractiveness of the lure is not the only thing that affects this percentage value, however. Under identical fishing conditions it will vary inversely with the number of lures trolled and directly with the abundance of fish. In this experiment the number of lures varied greatly from trip to trip as Appendix 18 shows and such an efficiency value for any lure, if derived from pooled data, would therefore be meaningless in itself. It is not meaningless, however, if compared with a similar value calculated for the green squid lure which was always trolled with it regardless of the number of kinds of other lures trolled with them.

For example, if in 200 joint settings of lure " x " and the green squid, the former got 10 strikes (selection rate 5%) and the latter 40 strikes (selection rate 20%) it is reasonable to say that lure " x " has an efficiency relative to that of the green squid as 5% is to 20%, i.e. it is only one quarter as good. Relative efficiency measured in this way has real meaning and should be relatively stable. For convenience in description, the green squid is considered as always having an efficiency of 100 and all other lures are assigned efficiency ratings accordingly. The efficiency rating for lure " x " in the above example, for instance, would be 25. Lures that are more efficient than the green squid would have ratings exceeding 100.

Results and Discussion. Efficiency ratings were calculated in this way for 11 of the types of lures used in the experiments for four different conditions of fishing, poor to very good, and for all conditions of fishing combined. These values are presented in Table IX in which the lures are arranged in order of their efficiency rating. Some of the ratings listed are based on relatively few data and must be considered as less reliable than others where more settings and more selections were involved. To give some idea of the relative reliability of the different efficiency ratings listed, the corresponding number of times each lure was set along with the green squid lure are listed in Table IX.

TABLE IX

ELEVEN DIFFERENT LURES USED IN TROLLING EXPERIMENT ARRANGED IN DESCENDING ORDER OF RELATIVE EFFICIENCY RATING UNDER DIFFERENT CONDITIONS OF FISHING. THE RELIABILITY OF EACH EFFICIENCY RATING IS INDICATED BY THE NUMBER OF SETS IN WHICH IT WAS USED ALONG WITH THE GREEN RUBBER SQUID. THE GREEN SQUID WAS TAKEN AS THE STARDARD FOR REFERENCE AND HAS BEEN ASSIGNED AN EFFICIENCY RATING OF 100. "α" MEANS INFINITELY BETTER THAN GREEN SQUID.

Poor (Average)			*Fairly good*			*Good*			*Very Good*			*Ratings based on records for all fishing conditions combined*		
Lure	*Sets (no.)*	*Effic. rating*	*Lure*	*Sets (no.)*	*Effic rating*	*Lure*	*Sets (no.)*	*Effic rating*	*Lure*	*Sets (no.)*	*Effic. rating*	*Lure*	*Sets (no.)*	*Effic. rating*
Tandem baited hooks	22	246	Tandem baited hooks	21	α	—	—	—	—	—	—	Tandem baited hooks	43	429
5½" Spoon	92	175	Ahatuwa bark	38	α	Japanese feather	22	α	4½ spoon	170	420	4½ spoon	333	350
4½" spoon	58	157	4½" spoon	63	513	4½" spoon	42	900	Japanese feather	27	200	5½" spoon	431	191
Green squid	—	100	5½" spoon	77	300	5½" spoon	63	210	5½" spoon	199	162	Japanese feather	136	133
Yellow squid	100	100	Japanese feather	25	120	Hoochie koochie	21	207	Green squid	—	100	Green squid	—	100
Japanese feather	62	93	Green squid	—	100	Yellow squid	63	180	Yellow squid	127	69	Yellow squid	361	100
Hoochie koochie	58	91	Yellow squid	71	71	Green squid	—	100	Hoochie koochie	58	50	Hoochie koochie	145	86
Ahatuwa bark	44	88	Hoochie koochie	8	40	Ahatuwa bark	41	77	Brass spoon	27	36	Ahatuwa bark	178	79
Brass spoon	19	24	Brass spoon	9	0	Brass spoon	—	—	Ahatuwa bark	55	29	Brass spoon	55	22
White squid	23	0	—	—	—	—	—	—	—	—	—	White squid	23	0
Egg wobbler	7	0	—	—	—	—	—	—	—	—	—	Egg wobbler	7	0

The average fishing conditions (i.e. the conditions under which most trolling was done) were poor (Table VIII). And Table IX shows that under these conditions tandem baited hooks (efficiency rating 246) gave the best results bringing in more than twice as many fish or strikes as the green squid. The 5½-and 4½-inch chromium-plated spoons came next. The ahatuwa bark lure gave low catches and the white squid and egg wobbler were poorest of all. Data for the 7-inch, chromium-plated spoon are not listed. They were few and its catches were poor. The number of settings of the tandem hooks and of the last three lures listed in Table IX are too few to provide as reliable estimates of their efficiency ratings as seem desirable.

Under better fishing conditions there are departures (Table IX) from the order of rating worked out for average conditions. In most cases, however, these departures are not well supported by large numbers of data and there is some doubt of their validity. It will be noted that so far there has been no experimental fishing with baited tandem hooks under good or very good fishing conditions. This is desirable considering that this lure performed so well under average and fairly good conditions.

The order of efficiency ratings based on the combination of all records for all conditions of fishing is essentially the same as that for fishing under poor (average) conditions and it seems reasonable to use the former in dealing with most problems in selecting lures.

From discussions of these results with the skippers and from reviews of the original fishing records, it appears that deductions from the study should not be applied to all problems without reservation. Many species of fish were recorded in the catches and the order of efficiency worked out applies to catches of mixed species. There are indications that some species had different preferences. If trolling were done under special conditions where only one species is taken then the order of efficiency might be different. Furthermore, on the few occasions when fishing was particularly good, fish seemed to take any lure at all, i.e. the order of efficiency seemed to break down completely. This might be considered a weakness but not a serious weakness because our principal deductions apply to average or near-average conditions of fishing.

In discussing these results with local fishermen some were inclined to disregard them all together. They were more than happy to learn that their tandem hooks performed so well and they were willing to believe that differences in efficiency existed, which is a point that Wheeler and Ommanney (1953) apparently disregarded for all their trials were made with only one type of lure. However, the fishermen claimed that since all the experimental fishing was done from motor boats, the results would not apply to their operations from sailing craft. They were unshakeably of the opinion that motor noise frightened fish and that the order of efficiency worked out in the experiment had no meaning for them. Table VII shows that the catch per line-hour was approximately the same for sailing and motor craft. This discounts the idea that motor noise frightens fish seriously and that the established order of relative efficiency of lures would be different if the experiment had been conducted from sailing craft.

It must be admitted, however, that the experiment was out of balance in not comprehending observations made from orus using different kinds of lures as originally planned. How serious this weakness may be can be determined only by actual trials. It would appear to be small.

Acknowledgment. The writer wishes to thank his colleague, Mr. J. E. Paloheimo, Statistician of the Biological Station, Fisheries Research Board of Canada. St. Andrews, *N. B.*, for assistance in analyzing the result of the trolling experiment, and Mrs. E. I. Lord, Laboratory Technician, of the same institution, for her patient work in arranging the data of study.

Practical implications. Regardless of public opinion, results of the trolling experiment are pertinent to trolling problems and the Department's efforts to solve them. Several western-type lures, e.g. rubber squid, have been shown to have low efficiencies when fished in Ceylon waters and further trials of them seem pointless. Besides this it has been shown that fishermen are now using one type of lure (baited tandem hooks) that has a high efficiency rating under poor (average) and fairly good fishing conditions. It may be equally good under better fishing conditions but this has yet to be established. In some ways it would seem wise to encourage wider use of this gear but at the same time it would be unreasonable to expect revolutionary improvements in trolling catches to result from such a change. As pointed out earlier in this report trolling is a branch of the Ceylon fishing industry that seems to have limited possibilities.

Baited tandem hooks are manifestly good but they have one important handicap which was not fully considered in working out the efficiency rating—they require baiting. For fishermen who carry on trolling as a major operation, this is a real drawback but they have established ways of coping with this and use the gear extensively. They spend a considerable amount of time before each trip looking up bait (sometimes they have to buy it) or catching it on the way to the fishing grounds. Besides this they must often interrupt trolling operations to rebait their hooks In all these ways they suffer time losses that would not occur if they used $4\frac{1}{2}$-or $5\frac{1}{2}$-inch spoons that are only slightly less efficient. It is more than likely that they would be better off if they adopted spoons. These are always ready to go into the water. The only preparation required is to put them into the boat before sailing.

In campaigning for wider use of baited tandem hooks it would seem pointless to try to encourage their use by fishermen for whom trolling is an incidental operation. A number of handliners told us, for instance, that they seldom find it worth while to spend time and possibly money, looking up suitable bait for short trolling runs into their handlining grounds. However, some, and perhaps many, would fish spoons if they were available and this kind of trolling is something well worth encouraging. Even small catches would help these fishermen whose total landings are low. But again, general adoption of spoons should not be expected to bring about great changes in the country's total fish landings.

One disadvantage of spoons is often pointed out and grossly exaggerated by fishermen, by agents of the Department and by many others with whom our trolling experiment results have been discussed—spoons are expensive compared with the traditional gear. There is no denying that their initial cost is higher and that their lifetime is no longer. When lures have to be replaced it is usually because they have been lost—not because they are worn out. The wire leader breaks at a kink or the line parts under the strain of catching a heavy fish. The important point that these people overlook is that the initial cost of a spoon is its total cost—there is no operating cost. In contrast, baited tandem hooks have a low initial cost but a relatively high operating cost in terms of fishing time that is lost. It takes time to catch bait and time to bait the hook everytime it is set and reset. And bait sometimes has to be bought. It was hard to judge from what the fishermen told us but it appeared that in the normal lifetime of a set of tandem hooks, this operating cost far exceeded the difference between their initial cost and the cost of a spoon lure. In other words, the tandem hook is not an inexpensive fishing device. Even if spoons do cost more than tandem hooks the cost of either is trivial. It is less than the value of one good fish that either lure may catch. Thus, to suggest that cost is a serious objection to the use of spoons is hardly logical.

Spoons have been shown to be effective over a wide range of fishing conditions and their use offers advantages to fishermen even though trolling may seem worth while only as an incidental fishing operation. In 1955 spoons were available at only one or two tackle shops in Colombo and only a few fishermen, e.g. those at Nayaru, were acquainted with them through Mr. Glanville, the F. A. O. Fisheries Engineer, who worked there for some time. Presumably other groups would adopt spoons if properly acquainted with them.

Summary

1. Trolling is one of the major branches of Ceylon's indigenous fishing industry and has been little studied.

2. Catches are light but most of the fish taken are first grade and large and their per per pound value is high.

3. Boat crews are large in proportion to the number of lines towed and catch per man-hour is very low.

4. Indigenous baited lures are highly attractive to fish but using them involves much loss of potential fishing time and this detracts from their superiority.

5. Two of the spoon lures tested seem to be as good as or better than indigenous lures when all factors are considered.

6. In spite of motor noise, the catch per line per hour by motor boats was slightly higher than that for sailing craft but nevertheless low compared with that in the world's better known trolling fisheries. From this it would seem that, on the average, fish that take trolling lures are not abundant here.
7. The general conclusion is that catches by any craft (indigenous or mechanized) engaged full-time in trolling are too low to be economic. And it is expected that Ceylon's full-time troll fishery, as it is known today, will disappear. The fishermen will find more profitable ways of spending their time.
8. Fishermen engaged in trolling may suffer economic distress during the period of adjustment.
9. In contrast trolling catches made incidentally during other fishing operations can be worth while. For example, craft travelling to and from bottom longlining grounds can troll, with little expense and no loss of fishing time, and thereby add to their income.

Recommendations

On the basis of the results just summarized it is recommended that the Department of Fisheries should:

1. Turn down proposals for encouraging full-time industrial trolling operations unless they are supported by convincing new information.
2. Encourage mechanized craft to carry on trolling as an incidental operation while they are travelling to and from grounds where they pursue more lucrative types of fishing.
3. Make trolling spoons, of the type we found most effective, more readily available to fishermen by including them in fisheries stores and encouraging commercial dealers to stock them.
4. Carry out further studies of the indigenous troll fishery with emphasis on its economic aspects to see what can be done to ease the plight of fishermen who may be seriously affected by the expected decline in this fishery.

GILL NETTING

The gill net is an ancient fish-catching device (Radcliffe, 1921) but it is still widely and effectively used. Essentially it is an open-meshed curtain of twine which hangs vertically in the water. It snares fish, usually by their gill covers, when they try to poke their hands through the mesh. To make sure that the net presents a flat wall in the water it must be supported and almost all nets are supplied with floats along their upper edges for this purpose. Usually the floats are strung at intervals along a horizontal supporting headrope to which the upper edge of the curtain is bound.

If the floats are sufficiently numerous and buoyant they will stay at the surface and the net hangs below them by gravity. Such a net is termed a " surface net ".

If the floats are not sufficiently buoyant, the whole net sinks until its lower edge and sometimes a considerable amount of its lower part rests on the bottom. The submerged floats lift as much of the curtain off the bottom as will just counterbalance their buoyancy. The net may be carried downward by its weight alone in which case the number and size of the floats must be nicely adjusted so that the net will sink without too much of it lying folded on the bottom where it cannot fish. More often the lower edge is bound to a heavy footrope which helps sink the net. This rope may or may not be weighted with various devices. Compared with nets that lack footropes, this arrangement requires less precise adjustment of buoyancy (no. of floats attached to headrope) to permit sinking of the net and still insure its fullest possible upward extension from the bottom. Both these types are referred to as " sunk nets ".

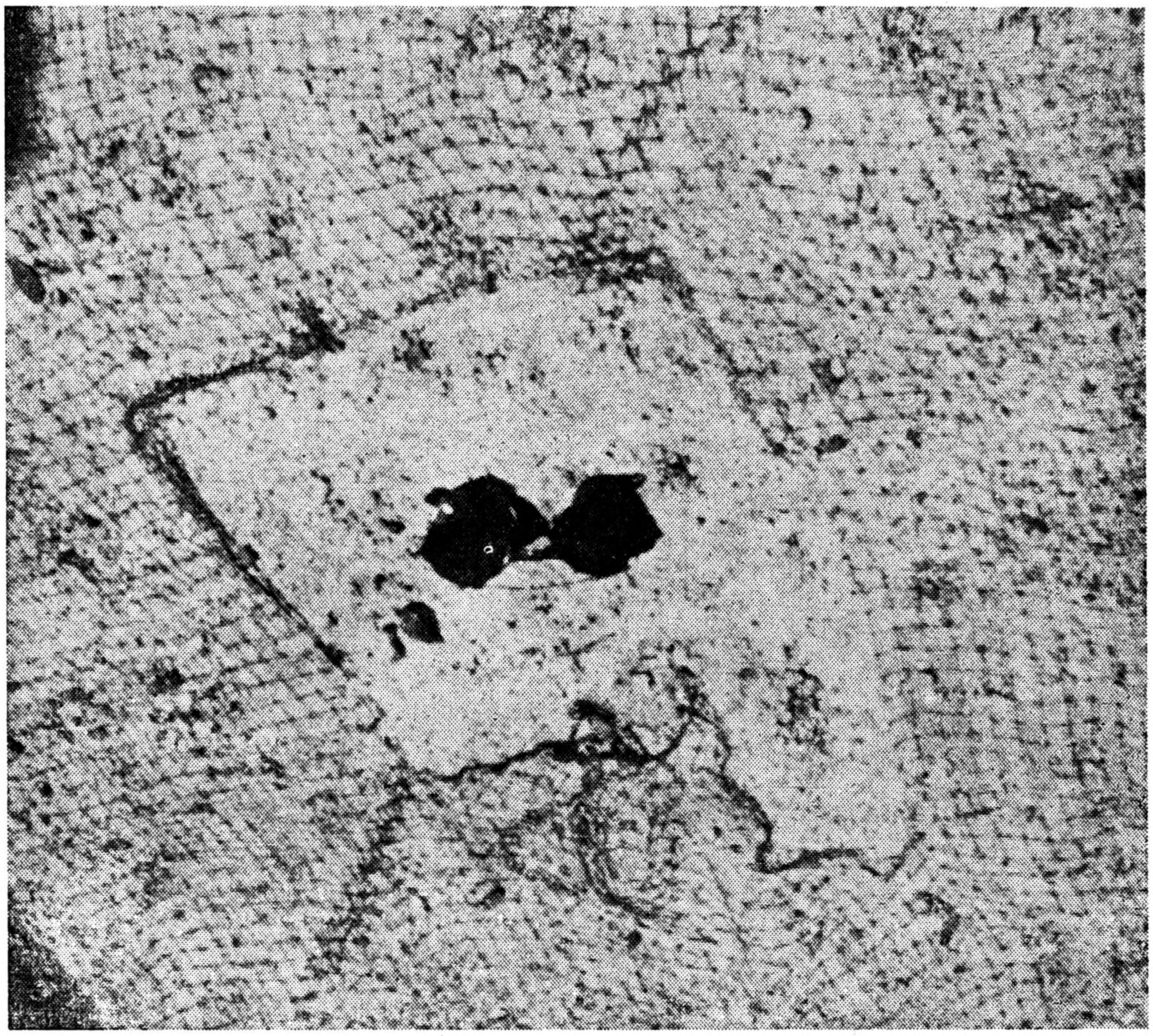

Fig. 6. Damage to Negombo fisherman's gill net caused by dolphins when they stole netted fish. The size of the rent may be judged from the sunglasses in the picture.

Gill nets may also be suspended in mid water by float lines of adjustable length attached to their headropes and passing upward to supporting surface buoys. These may be referred to as " mid-water nets ".

Most gill nets—surface, mid-water and sunk nets—have footropes (generally weighted) to spread the curtain to its fullest extent.

When nets are put in the water they are often made fast either individually or as a " fleet " (tied together end-to-end) to fixed supports such as stakes, anchors or buoys in which case they are termed " set nets ". Often they have no fixed support. Instead, single nets, or several in a fleet, are trailed out behind an unanchored boat. While the nets are exposed they and the boat may drift small or great distances depending on winds and currents. Used in this way they are usually referred to as " drift nets ".

Surface, mid-water and sunk nets may be used as set nets. And surface and mid-water nets are often used as drift nets but sunk nets are seldom used in this way. In the North Sea, however, sunk nets are sometimes used for drift netting over smooth bottom when herring concentrate low in the water. This same practice has been observed off the north coast of Ceylon where drift nets without footropes are employed.

A. Early Studies of Ceylon Gill Netting

Pearson's 1923 description of indigenous fishing gear indicates that gill netting is the most highly developed and diversified of Ceylon's major fisheries. Hickling (1951), Blegvad (1951) and John (1951) all examined the gill-net fishery and recommended searches for improvements, but this is no simple task. It requires comparison of performance of new kinds of nets with that of kinds that are now in use and a searcher cannot undertake this without a great deal of preliminary information. Considering the great variety of nets now in use in Ceylon and the bewildering number of new types that are constantly being invented all over the world, it will be appreciated that the planning, execution and interpretation of results of netting trials can be very involved. Nevertheless, following Hickling's, Blegvad's and John's recommendations the Department purchased a variety of nets and conducted fishing trials. Records of some of these are on file but they never have been properly examined and interpreted.

The Canadian team agreed to extend the Department's program with Mr. Babcock in charge and working from CANADIAN. He began with night drift-netting trials off the north and east coasts in August 1953 using the Department's 1,200 x 18-foot, 6½-inch mesh, tarred cotton nets He continued these trials in late October and early November out of Colombo.

Detailed records of his 13 sets are included in the writer's manuscript report to the Department (Medcof, 1955) and they are summarized here in Appendix 19. He worked both inshore and offshore where water depths varied from 4 to 200 fathoms and sometimes he drifted 10 miles or more during the night. The results were not rewarding.

From the beginning Mr. Babcock was not satisfied with his gear, so nylon webbing was requested from Canada as part of Colombo Plan Capital Aid. It arrived late in 1953 and he made it up into what he considered to be suitable nets for fishing trials. But he had no opportunity to test these nets before he completed his contract. We have records of only three of his 1954 sets (March 3-5) and they were all with the tarred cotton nets used as set, sunk nets off Colombo. These were fruitless (Appendix 19).

B. The 1954 Program

Early in 1954 the Steering Committee reviewed Mr. Babcock's program. The Committee appreciated the limitations under which he worked and the desirability of testing the nylon nets he had made up. It decided to continue gill netting studies as a low-priority project. Emphasis was to be shifted from merely carrying out fishing trials to developing better background information for planning trials and interpreting results. I was asked to review the Department's records of early experimental netting; Mr. Barry, who had many years of experience in gill netting on the Canadian Atlantic coast, was asked to conduct what experimental fishing he could along with his other work on CANADIAN and both of us were asked to assemble records of commercial gill netting operations by local craft.

The review of records was never completed but from July 1954 to March 1955, a great deal of potentially useful information on gill netting was assembled (Appendix 19) as well as general information on the gill net fishery.

General Observations

Our observations of the indigenous fishery indicated that although some new types of nets and methods of constructing them had been adopted, the general picture was much the same as in Pearson's day. Cotton and hemp were the commonest twines used. Some of the webbing was factory-made but most seemed to be hand knitted. Almost everywhere fishermen and women were to be seen occupied in some phase of net manufacture. The time so occupied seemed enormous.

Almost every type of net and method of operation mentioned in the introduction to this section of the fisheries survey report was encountered. Some were very ingenious and the quality of workmanship was generally high. Day and night fishing were both common and the duration and frequency of sets and the amount of gear operated per man varied greatly. In some cases gill netting was carried on as a side line with other kinds of fishing; e.g. in taking bait for handlining. In other cases it was a major operation.

Standards for Comparative Studies

With this complexity of nets and special ways of using them it was hard to know how to organize the records we gathered. The available literature suggested no generally recognized international standard way of compiling, analyzing and reporting them. And there was no single type of net and method of operating it that was in island-wide use and therefore suitable as a standard. But we wanted to be able to compare efficiencies of different kinds of industrial netting among themselves and with experimental netting. We also wanted to compare the efficiency of netting (catch per man per hour) with the efficiency of other kinds of fishing like longlining. We therefore set up an arbitrary system based on a local fishery.

In the important drift net fishery in the northern end of the island the katumarams carry approximately 10,000 square feet of sun-hemp netting per crew member. This area of net was adopted as the standard unit of gear and 10,000 square feet of netting set for one hour was adopted as the standard unit of netting effort. To describe the amount of human effort that went into any netting operation, it was decided to use the number of crew multiplied by the number of hours the net was in the water and express it in man-hours.

We realized that this description of human effort associated with gill netting was unrealistic in certain instances. It seemed reasonable enough in most cases such as in day fishing of drift nets which are constantly tended but it was poor for describing the effort expended in tending fixed nets that were set close to shore and tended only a few brief times every 24 hours by men who paddled out for that purpose. Similarly it was poor for describing night fishing of drift nets where the crew usually manages to get some rest during the set. However, these inaccuracies and others like them were not considered too serious to discourage their use when the need for some description of effort was so great.

As a basis for comparing Ceylon operations with those of other countries Mr. Noel Tibbo of the Fisheries Research Board of Canada supplied information on the herring drift net fishery in the North Sea (Europe) and in the Gulf of St. Lawrence off the Canadian east coast. The former is one of the world's best known gill-net fisheries. A typical British herring drifter carries a crew of 14 men. In the evening it sets a fleet of about 100 mid-water drift nets, each 110 to 115 feet long and 50 feet deep, and hauls them in the morning. On the average it is 10 hours from the time the nets are set until they are back in the boat again and the catch per net averages about 100 pounds per net per night. This is equivalent to 17 pounds per unit area of net (10,000 square feet) per hour of set or 70 pounds per man per hour of fishing. Catches in the Gulf of St. Lawrence under the same conditions average 2 to $2\frac{1}{2}$ times as heavy. Data on other well known gill net fisheries for other species seemed desirable as standards for comparison but these were not available.

Organizing Records

All our 1954 observations were compiled on the regular fishing record form (Fig. 1) including mesh-size, length and depth of nets, method of fishing (surface, mid-water or sunk netting; drift or set netting) as well as the other standardized data the form calls for. The catch per unit of gear and of human effort was calculated as indicated above. Records of 1953 operations, already discussed, were similarly treated for listing in Appendix 19.

Fishing Trials 1954

Mr. Barry made 13 sets in 1954 and 43 in 1955 up to the third week of March—the end of the period covered by this report. These included two mesh-sizes of nylon and several mesh-sizes of tarred cotton nets. In most trials were used as surface drift nets. When they were used as set nets some were usually surface and some sunk.

Indigenous Gear Studies

Whenever possible, Mr. Barry recorded industrial catches by local fishermen in the areas where his experimental fishing was done. Other records of local-type net operations were assembled by the writer. These applied largely to the Colombo district and in their compilation he occasionally had assistance from Fisheries Inspectors and a laboratory attendant.

C. Discussion

1. Field observations confirmed the view of earlier investigators. Gill netting is probably the most highly developed and diversified of Ceylon's major fisheries. Because of this our work on gill netting turned out to be the most involved of all our fisheries survey projects. Because there had been so little previous work, much of our effort was consumed in establishing a basis for study. Some baseline information was assembled (Appendix 19) which shows great variability in catch per unit of effort. For this and for other reasons much more of this work is needed to provide the perspective necessary for sound comparisons and recommendations. But even from what has been learned to date we can delineate some of the main characteristics of the net fisheries.

2. Comparison with herring catches by the North Sea commercial drift net fishery (17 pounds per gear-unit-hour) shows that Ceylon gillnet catches, both commercial and experimental, are low most of the time (usually less than 5 lb.). Off the southwest coast, however, in the period September to March when sprat are running, catches are very good indeed—more than 100 pounds per gear-unit hour.

3. The amount of gear used by the Ceylon fishery is small, averaging less than one unit per man as compared with more than 4 units per man in the North Sea herring fishery. Ceylon landings could be greatly increased by increasing the numbers of nets used but, as Blegvad (1951) suggested, changes of this sort are limited by the low net-carrying capacity of local craft. The writer's impression is that over-crewing of some of the boats is another contributing cause. Until larger boats are available to carry more gear it is unreasonable to expect important improvements in total catches by gill netters.

4. As might be expected from (2) and (3), the catch per man per hour of commercial fishing effort is usually less than 5 pounds as compared with 70 for North Sea herring drifters. If the amount of gear set per man was raised to North Sea standards, the catch per man per hour might be increased four or five times but even then it would be low by comparison, most of the time.

5. A great deal of manual effort is expended in most fishing districts in net-making. Even if part of this work, e.g. the yarn twisting, were done machanically, fishermen could then make more gear, spend more time fishing and thus increase landings.

6. The catch per hour per unit area of gear used was about the same in experimental and commercial fishing. From this we deduce that nettable varieties of fish were either scarce or able to avoid the kinds of nets used. What evidence we have supports the latter deduction. Several times (Appendix 19) nets took nothing in places where there was an abundance of surfacing fish If net-avoidance by fish is a sight reaction, nylon netting, being more transparent, should give better catches than cotton. Mr. Barry believed that this was the case but his records do not always separate catches by cotton and nylon nets to demonstrate this point as clearly as seems desirable. If net transparency is important then the new monofilament netting which is recently coming into use in some countries should give even better results than nylon in Ceylon because monofilament is highly transparent, durable and requires little maintenance.

7. The gillnet study is still in a preliminary stage. Our data do not show where, when and how the best catches can be made or what advantages new development like monofilament twines may have in tropical waters. Such information could be increasingly useful as mechanized boats that can handle large amounts of gear become more common. But it could also be useful

in present small-scale operations because setting a few gill nets can be and often is combined with other types of fishing like longlining. Improved methods of gill netting could be important in raising Ceylon's fish landings with little extra effort.

Recommendations

The study of the Ceylon gillnet fishery is in its infancy but it has already shown the importance of the industry and some ways in which it can be improved.

It is therefore recommended that the Department of Fisheries should—

1. Continue studies of the commercial gillnet fishery to discover its limitations and potentialities.
2. Continue experimental gillnet fishing trials including tests of newly developed materials and techniques of using them.

MISCELLANEOUS NETTING TRIALS

Trammel Netting

A trammel net is really a pair of nets, one fine-meshed and the other very coarse-meshed, hung face-to-face as a single net would be. Fish striking the fine-meshed net force a pocket of it through one of the meshes of the large-meshed net behind it and in struggling so entwine themselves that they cannot escape. Obviously trammel nets fish in only one direction, i.e. they catch only fish that approach them from the side on which the fine-meshed curtain is spread. Hickling (1951) believed they would work well in Ceylon.

Mr. Barry made several trial sets with a trammel net. These sets are described in Appendix 19 with the results of gill netting. The catches were low but good on the average compared with those of gill nets. Certainly they deserve further trials.

Lift Netting

Lift nets are fine-meshed curtains that are spread out on the bottom or deep in the water, and raised periodically by their corners or sides when fish swim over them. Often they are baited about the middle to improve catches. Lift nets are successfully used in shoal water in many parts of the world—often in rivers where it is possible to set up some system of hoisting levers on the bank which makes the use of a boat unnecessary. A modified form of lift net, used from boats in conjunction with ring seines, is now in use on the south coast of Ceylon for catching small fish for use as bait by hook-and-line fishermen.

Mr. Barry got the idea that a small form of lift net might be used in shallow waters and about wharves and in coves where cast-net fishermen and old men who angle, are often seen at work. He made several trials at the China Bay anchorage near Trincomalee. None of these was successful. The fish carefully avoided swimming over the net even when it was baited, as if they feared it. He believed that if he had had access to different types of webbing and could have dyed it the right colour, as the south-coast Ceylonese fishermen dye theirs, he might have had more success.

The idea has merit and might be used for fishing in freshwater irrigation reservoirs as well as in the sea. It would be worth pursuing this experiment as a side issue when occasion permits.

Lampara Seining

A lampara seine is a long, deep, fine-meshed wall of webbing with floats on the headrope and weights on the footrope. It can be set around a school of fish in shoal water and hauled back into the boat. It is most effective in taking slow-moving fish that " stand " in compact groups without being too easily frightened by the netting operation. Lampara seining should be done quickly, otherwise the fish are likely to be frightened and escape.

A lampara seine was brought out from Canada as part of the equipment of CANADIAN and NORTH STAR but it was so heavily treated with net preservative that it was too stiff and clumsy to be properly handled. Mr. Pinchin made several sets with it. All were failures but they did show that several species of fish common in Ceylon waters will " stand " in the water while they are being surrounded by a net set from a motor boat. Hickling (1951) recommended trials with lampara seines and the skippers believed from what they saw that lampara seining with a proper net would be rewarding. The trials made by Mr. Pinchin should not be considered effective and their failure should not discourage further efforts.

Purse Seining and Ring Seining

In these operations a long, deep wall of fine or coarse-meshed netting (mesh-size depends on the size of fish taken) is set in a circle about a school of fish. After this, the bottom of the net is closed (pursed) by a draw string so the animals cannot escape. When they have once been closed in, in this fashion, they may be taken into the boat more or less leisurely. In many countries this is a highly productive method of fishing and sonic depth metres are regularly used to locate sizable schools of fish at convenient depths before sets are made. Several tons of fish are often taken at a single setting.

Both CANADIAN and NORTH STAR were equipped with sonic metres and it was thought that such fish as the highly prized pomfret, which schools off the northeast coast of Ceylon in July and August, might be taken in purse seines. A purse seine was accordingly included as part of the equipment of these two boats when they were sent to Ceylon. It was actually a little too large and too fine-meshed for conveninent handling from boats of this size class and it was so stiff from heavy treatment with net preservative that it could not be used. Eventually it and the lampara seine were torn down and built over into mid-water trawls for use in trawl fishing for the same species.

Mr. Barry was convinced from his general observations that some of the fish about Ceylon could be taken in purse seines. He found that schools of pomfret and queen fish would " stand " in the water while he ran around them with a motor boat but being acquainted with the history of the first purse seine he was hesitant to recommend purchase of such an expensive piece of equipment without some further evidence of its probable usefulness. He therefore joined two pieces of $6\frac{1}{4}$-inch mesh nylon netting, 90 by 4 fathoms, along their edges to produce a 90 by 8-fathom wall and equipped it with rings and a purse line along the lower edge and floats along the upper edge. He set this around part of a school of queen fish (Katta) in 5 fathoms of water over smooth sandy bottom off Karaitivu Island at 9.30 a.m., March 1, 1955. He caught 14 fish with an average weight of 10 pounds each. This operation was complete within an hour. Under " Remarks " on his record form he commented that a longer net would have made it possible to take many times this quantity of fish because turning in such a small circle (diameter less than 150 feet) frightened fish within it.

Further trials with this kind of net, especially, with pomfret, seem desirable. If they were at all successful it would seem wise to obtain a coarse-meshed purse seine for full-scale trials of this type of gear for taking such valuable types of fish.

Fishing with Night Lights

Fishermen on the Canadian east coast know that shoals of sardine herring will follow a night light on a small boat and can be led right into a weir from which then can be seined at some conveninent later time. Japanese fishermen take advantage of this behaviour of fish in another way. Schools of fish will come to a boat shining a strong light down into the water and they stay there while they are surrounded by a purse seine or ring seine set by another boat. When a school is thus surrounded and the net pursed, the boat with the light sails outside the circle of net and the fish are drawn up conveniently. The same principle has been used elsewhere from a single boat with a generator and lead wires running to a powerful electric light supported on a buoy around which a purse seine can be set.

Mr. Pinchin discovered that several species of sprats common on the northwest coast of Ceylon react strongly to night lights even of relatively low intensity and urged night-light fishing trials. Accordingly a powerful buoyed lamp and generator were requested from Canada as part of Colombo Plan Capital Aid. The expectation was that it could be used with the fine-meshed lampara seine or the purse seine from CANADIAN or NORTH STAR.

For reasons explained earlier, it was never possible to make such trials during my term as Fisheries Biologist. The nets were not suitable and no trials were made with the light. Even if nets are not available it would be valuable to examine the night-light reactions of other fish common about Ceylon. Pomfret might be found to behave like sprat and might be taken in Mr. Barry's improvised ring seine. The Ceylonese fishermen do some night fishing with oil lamps and no doubt could supply a great deal of helpful information to anyone who undertook to study this subject. Exploratory trials would be well worth while and could be conveniently carried on from either NORTH STAR or CANADIAN.

Beach Seining Experiments

Mr. Barry was associated for a time with the F.A.O. Fisheries Engineer, Mr. E. Kvaran, in efforts to develop a mechanical hauler for beach seines. This work and the writer's participation in it in association with one of the Department's Research Officers are described elsewhere (Canagaratnam and Medcof, 1956).

DOLPHIN (PORPOISE) HUNTING

Vermin of the Sea

The dolphins referred to here are marine mammals of the family Delphinidae, not the fish *Coryphaena*. Dolphins are often confused with porpoises, which belong to the same family. But dolphins have long narrow jaws that project from the head like the beak of a bird (Norman and Fraser, 1938), whereas porpoises have blunt rounded snouts. This shows up nicely in Figure 1 of the Research Station's Bulletin on commercial utilization of dolphins (Lantz and Gunasekera, 1955). We found two species in Ceylon waters and they were identified by Dr. P. E. P. Deraniyagala, Director of National Museums, Ceylon, as the common dolphin (*Delphinus delphinis* L.), and the bottle-nosed dolphin (*Tursiops* sp.).

To fishermen, both species are vermin of the sea. Early in his stay in Ceylon Captain Wm. Mitchell carried on a good deal of fish inspection and experimental fishing for the Department from HALPHA. In the manuscript report he filed with the Department of Fisheries in 1950, he described how some kinds of hook-and-line fishing suddenly come to an end when groups of dolphins appear on the scene. They frighten and drive off the schools of fish.

Dolphins are generally seen in the deep water along the edge of the continental shelf chasing schools of the small fish they feed on. However, when the fish schools move inshore, dolphins sometimes follow and get caught in beach seines along with the fish in quite shoal water. In 1953 I collected the skulls of several bottle-nosed dolphins taken in this way on the central west coast about Karaitivu Island and discussed my finding with the Steering Committee. Dolphins will attack netted fish and I often saw Negombo fishermen repairing gill nets torn by dolphins (Fig. 6). Captains Homer and Babcock reported damage to their drift nets set at night off the east coast in August 1953. At first they believed this was caused by sharks but later attributed it to dolphins which abounded there then. They reported sighting schools of hundreds of these animals in places where " feed " patches (presumably small fish) showed up on the recording tape of their sonic depth meter.

Dolphin and Porpoise Hunting in other Countries

According to Dr. H. D. Fisher, of the Arctic Unit of the Fisheries Research Board of Canada, dolphins and their close relatives, the porpoises, are hunted commercially in several countries. Norway has a sporadic fishery for the striped dolphin, *Lagenorhynchus* sp., and there are established fisheries for two species off the Canadian east coast—for the black fish, *Globicephala melaena* (Traill), and the beluga, *Delphinapterus leucas* (Pallas). These are used as food and in preparing oil and " fish " meal. On the Canadian Pacific coast, efforts have been made to popularize the flesh of another species which has been marketed under the trade name, " porp ". However, Japan prosecutes by far the greatest of all such fisheries. It depends largely on a combination of shot-gun shooting and harpooning of three species by 20-30 ton motor craft with crews of about 10 (Wilke *et al*, 1953). The annual movements of these animals have been studied and there are well recognized winter and summer fishing grounds. These authors list no records of catch per unit of effort that would be helpful in judging what might be expected from similar operations conducted about Ceylon. But, their description is that of a vigorous industry.

Use of Dolphins in Ceylon

When I collected the skulls I learned that dolphin flesh is eaten in fishing communities on the central west coast of Ceylon where these animals are occasionally taken in beach seines. It is not regarded as high-quality meat but it is considered wholesome and acceptable by the many who use it in either the fresh or dried state. Captain Homer was intrigued with the idea of developing a fishery and believed that considerable quantities of the meat might be marketed regularly if it were properly handled and processed.

From all this, the Steering Committee decided to carry out a preliminary survey of possibilities of exploiting Ceylon's dolphin stocks and methods of processing. The work was shared by several but it was Captain Homer's interest and enthusiasm, vigorously supported by Mr. Lantz, which were largely responsible for whatever success was achieved.

Fishing Trials

Captain Homer's first trials were in October 1953. He rigged standard-type, east-coast, North American swordfish harpoons and built a forward-projecting " pulpit " into the bow of CANADIAN for the harpooner to stand on while thrusting or casting his harpoon. This was necessary because dolphins seldom come alongside a boat (They usually swim just ahead of it.) and because it is awkward to handle the long-shafted harpoon from the boat proper. The mast, stays and other boat rigging are in the way. This gear and method of fishing are described by Lantz and Gunasekera (1955).

The October 1953 operations described by Lantz and Gunasekera were encouraging and Captain Homer rigged more harpoons and put them aboard two other Department boats—NORTH STAR and SEER. Besides this, several harpoons were distributed in the Negombo district to oru fishermen who had become interested during demonstration cruises on CANADIAN.

Most of this harpooning was combined with other types of fishing. In some cases (e.g. when netting) it was impossible to break away for dolphin hunting for long periods but when a school was sighted the boat gave chase for an hour or two. In other cases (e.g. when trolling) it was possible to search steadily for long periods ready at all times to haul the gear and go dolphin hunting for as long as this proved rewarding. As a result our records (Appendix 20) provide rather inconsistent ideas of catch per unit of effort that might be expected for a boat engaged in dolphin hunting only. Partly to offset this, a good many of the skipper's log book comments have been entered in the appendix.

The 1953 records were encouraging so the Steering Committee decided that the work should be continued on this same basis in 1954.

For some time the skippers did not realize that both species of dolphins were common about Ceylon because only the common dolphin was taken in the early trials. However, several bottle-nosed dolphins were captured in January 1954. They are large animals. Many weighed more than 200 pounds and some were judged to weigh more than 400 pounds. The more handsome, black-and-white, common dolphins were much smaller with average weights of about 80 pound. This is a low weight for the species (Norman and Fraser, 1938) and we wondered whether our animals were immature or a small variety of the species.

Although many of the weights reported in Appendix 20 are estimates only, it is nevertheless possible to make shrewd guesses as to which species was taken on the various hunting trips. The highest number captured in one day's operation was 28. These were taken off Colombo on December 2, 1953. The heaviest day's catch (3,260 lb.) included only 20 animals but comprised a higher proportion of the larger bottle-nosed dolphins. This catch was taken January 14, 1954, between Colombo and Barberyn.

The oru fishermen to whom harpoons were given had no success but their efforts were not very determined. They reported that their sailing craft were not sufficiently manoeuverable for effective harpooning. And it must be admitted that dolphin hunting demands nice control of boat movements.

Scaring Dolphins from Fishing Areas

After he had been harpooning for several days out of Colombo in December 1953 Captain Homer reported that the schools of dolphins were harder to approach than at first. He believed that the animals had learned to fear the boat. This, he argued, made harpooning less rewarding because the animals could swim faster than CANADIAN could travel even at full throttle, and because the most successful hunting is done at slower, quieter cruising speeds.

Although this was discouraging to Captain Homer whose interest was in harpooning, his observation was encouraging from another point of view. It suggested that dolphins can be frightened away from a fishing area and thus relieve harassed gillnetters and other fishermen. Insufficient work was done to encourage serious hopes that this can be an effective remedy for the " vermin of the sea " problem. But this idea deserves closer examination. It may be that the animals naturally travel faster and are harder to approach at some seasons than at others. They may not have been frightened by the boat and the harpooning.

Prospects for Industrial Development

The records show that once dolphins had been sighted and the hunt had begun, the poundage catch per hour of boat operation (105 lb.) and per man-hour of fishing effort (26 lb.) was higher than that in several other fisheries in which trials were carried out. Besides this, general observations showed that during the normal fishing seasons off the east, central-west, south-west and south coasts, large numbers of these animals are regularly encountered. Schools of 500 or more were sighted on numerous occasions. This means that dolphin hunting might be possible the year round as it is in Japan.

The fishing done so far does not permit a proper assessment of the possibilities. It is only an encouraging beginning. Before abandoning the idea that harpooning may be done from orus an experienced harpooner should make several trips on these boats and carry out determined and exhaustive trials. Beginners in any fishery often fail even under the very best fishing conditions. Besides this, it should be remembered that in Ceylon there has so far been no test of using guns as well as harpoons to increase the catch. Dolphin hunting deserves further attention. It may be that Ceylon's heavy imports of fish could be cut down by developing this resource. If dolphin hunting is practicable here it seems likely, from what has been done, that it should be combined with some other fishing operation like gill netting to be economic.

If the potentialities are great it would be worth while to make a sustained effort to develop a market. Consumer acceptance of a new product is not easily generated and much depends on how the product is processed and presented. It might be best to make marketing trials on the central-west coast where dolphin flesh is already used to some extent.

Recommendation

In view of the encouraging results of preliminary trials it is recommended that the Department continue this survey of possibilities of a dolphin fishery.

" MOTHERSHIP " OPERATIONS

The term " mothership fishing " implies different operations in different places. In Ceylon the term was apparently devised by Dr. John in the late 1940's when he held office in the Department of Fisheries, and later used by Kesteven (1951). Both referred to the use of motorized craft, usually of small size, for towing sailing and oared boats to fishing grounds that are otherwise accessible only to mechanized craft.

Early Trials

Mothership operations in this sense have been extensively tested by the Department using its own motor craft such as HALPHA and SEER and even the trawler, RAGLAN CASTLE. The fishermen involved have usually been handliners but sometimes bottom long-liners. In some cases they were employees of the person who engaged the mechanized boats and in other cases, members of co-operative societies that rented them. Occasionally catches have been good or very good (Appendices 12 and 13) but on the average the catches per unit of total effort have not been phenomenal if the long slow hauls to and from the fishing grounds are taken into account. This discouraging feature of the operations is not represented by the appendix entries which describe only on-the-grounds results or by the glowing public accounts in support of mothership fishing (Anon, 1953).

1953 Trials

In October 1953 the Steering Committee decided to conduct mothership trials off Negombo and Captain Homer undertook the work with CANADIAN. His report on the operation, which involved 2-man teppams, reads very much like those filed with the Department by Captain Mitchell and others who carried out similar earlier assignments towing various kinds of local craft—vallams, katumarams and teppams. An excerpt from Captain Homer's report describes what is actually involved—

" At 0100 hours, October 9, five teppams put out from the beach and came alongside us. We made them fast to our towline and got under way at 0130 hours and proceeded in a WSW direction. We experienced considerable difficulty and delays with broken lines by which the teppams had attached themselves to our towline.

" At 0415 hours we stopped in a position approximately 8 miles W × S of Negombo, the depth being 13½ fathoms. The teppams then put out their drift nets for the purpose of catching bait. At daylight they hauled their nets and started handlining operations. At 0700 hours one teppam caught two sailfish, weighing approximately 20 pounds each, the other boats getting little or nothing. At 0730 hours the five teppams requested to be moved two or three miles to the westward, which was accomplished by 0820 hours. We noticed a few schools of porpoise in the vicinity and rigged a hand harpoon and took 2 of them.

" At 1040 hours the five teppams wished to return to Negombo and we arrived there at 1330 hours and anchored and the teppams went ashore. The catch was—1 teppam (2 sailfish) 40 pounds; 4 teppams, average catch, 10 pounds each; total weight—80 pounds.

"That night the weather conditions were still good, but the ground swell had increased considerably. At 0200 hours, October 10, we were approached by 11 teppams and at 0240 hours left Negombo with them in tow and proceeded at slow speed (2 or 3 knots) in a WSW direction, experiencing much difficulty with breaking lines, due to the heavy swell. Shortly after leaving, 4 teppams gave up the struggle and dropped astern.

"At 0635 hours we arrived at a position about $5\frac{1}{2}$ miles WSW of Negombo and the 7 teppams threw out their nets as before and started handlining operations at daylight. CANADIAN started trolling with surface jigs, with no success. At 0740 hours we moved 4 of the teppams a few miles to the north, and at 11.30 hours picked up the 7 teppams and started towing them towards Negombo, again experiencing considerable difficulty with the heavy ground swell, two fishermen being thrown entirely clear of their teppams and swimming back to them when we stopped. By 1400 hours we were within 1 mile of Negombo and the sea breeze having freshened we cast off the teppams which proceeded to the beach under sail. The catch, as on the previous day, was very small, possibly averaging 10 or 15 pounds per boat.

"Comments and recommendations. Captain Babcock and I would like to point out that in our opinion even if the amount of fish caught warranted the services of a comparatively large and powerful vessel, it is very doubtful if the amount of boats necessary to the success of such an operation could be towed under average open-ocean conditions. It would appear that the only feasible operation would entail the rigging out of a large vessel (65' or more) with standard-type, one or two-man dories. The vessel, with the dories nested on deck, would then be able to proceed to more distant and possibly more lucrative grounds than the shore-based or "day" fishermen are now able to reach."

Critique of Mothership Operations

The Steering Committee asked for the critique of mothership operations which follows.

Economics. Analysis of Captain Homer's report shows that only about 30% of the time at sea was spent in actual fishing (handlining). The catch per hour of actual handlining was approximately 2 pounds per line. If the catch is expressed as pounds per man per hour at sea, it amounts to slightly more or slightly less than a half pound depending on whether or not the time of the crew of the "mothership" is included in estimating the effort involved. These rates are low but many handliners operating independently fish at about this rate as Appendix 12 shows.

The obvious conclusion from this and similar operations in Ceylon is that oridinarily mothership operations have not paid. This would seem to account for industry's lack of interest in private ownership of motherships. The trouble seems to be that fish were not abundant on the grounds visited and that towing speeds are too low to permit visits to better-stocked areas which are still further from shore. Mothership operations do not provide the solution to the difficulty. Captain Homer's suggestion that dory fishing be adopted to increase the range of operations is in effect a recommendation that mothership operations be dropped. If a fishing ground were extraordinarily rich and close to shore it might be economic to carry on with the present scheme but it has not been clearly shown that such areas exist. This picture may alter if present trials of surface and bottom longlining are fruitful.

Even under ideal fishing conditions the scheme will not work unless there is good co-ordination of efforts by operators of motherships and crews of fishing craft. This was achieved at the fishing village of Negombo during the two trips made by Captain Homer but in some of the operations described in earlier reports filed with the Department, fishermen have had to assemble from wider areas and co-ordination was difficult. This sometimes resulted in long and irritating delays both in port and on the fishing grounds that cancelled out the advantages of motorization and the higher catch-rates realized on the distant grounds.

It is pointless to say that this should not discourage development of the scheme. It does. Fishermen the world over are instrinsically independent. They are unlikely to be co-operative with motherships operated by other people and if they own a motor boat or if they are paying rent for one they will want to sail in it—not be towed by it

Industrial leaders have shown little interest in buying mothercraft of their own although many of them are financially able to do so. The long continuation of these trials by the Department is regarded in some quarters as foolish or patronizing to fishermen, or both. There is justification for these views because the cost to the Department of operating the mothercraft has generally exceeded the rental fee levied on the fishermen and because some of the fishermen have stated that it would not pay them to engage Departmental mothercraft if the service fee were increased.

Another and important reason for questioning the wisdom of continuing these trials is that many fishermen are likely to own motorized craft of their own before many years. When this comes about they will no longer be interested in motherships. When there are so many useful tasks that could be undertaken it would be better for the Department to try to produce results of more lasting economic value than mothership operations seem likely to provide.

Hazards. A feature of the whole operation to which the Department has not given just weight, is the safety factor. Whether fishermen and Departmental officers are conscious of it or not, a fisherman assumes, when he makes fast to the mothership tow line, that the Department is accepting responsibility for his safe passage to and from the fishing area. This assumption persists regardless of the terms of any contract under which the operation may be conducted. Fortunately there have been no fatalities so far but there have been several accidents such as that reported by Mr. Homer. In one case (March 1950) a boatload of fish was lost and the boat and crew almost lost. How easy it would be for a fisherman or several fishermen to be washed overboard and drowned in the dark of night on a rough sea with the mothership motor creating such a noise that cries for help could not be heard! Legally and morally, the Department of Fisheries could scarcely evade responsibility for such happenings. And by carrying on regular mothership operations it is constantly exposing itself to possible incrimination for loss of life through sea accidents that keep recurring. One fatal accident could so damage public relations as to jeopardize not only mothership schemes but many other departmental programs as well.

Realizing, this, fishermen have sometimes been taken aboard the mothership during the trip to and from the fishing grounds. But there is not always room to accommodate them.

Psychology. Another weakness of this operation and certain others that the Department has undertaken, is its tendency to destroy the sturdy independence which is a necessary characteristic of any successful fisherman. Some are inclined to scoff when this is suggested as a serious consideration but in the long run it is not trivial. Cultivation of a healthy psychological attitude among fishermen is as important as keeping them supplied with up-to-date information about fishing methods. Keeping them standing about on beaches waiting for tows to fishing grounds that may not be of their own choosing is not the way to encourage the spirit of enterprise that is necessary to the full development of Ceylon's fishery resources.

Summary

1. The Department of Fisheries has engaged in mothership operations since the late 1940's.

2. Maximum towing speeds of most indigenous fising craft are low, and co-ordinating operations of several craft is difficult. These two factors involve such great time losses that the really good off-shore fishing grounds are often inaccessible to the fishermen involved in the operations.

3. In most cases, costs to the Department of mothership operations have exceeded the service charges it has levied and industry feels that it cannot afford to pay the full operation costs. Furthermore, industry has shown little interest in purchasing motherships of its own.

4. There is not always room for all the fishermen to go aboard the mothership and towing operations are hazardous to the lives of fishermen who travel on the boats being towed.

5. Mothership operations are patronizing to fishermen and not likely to stimulate the enterprise and resourcefulness which is needed for vigorous development of this nation's fisheries.

6. Mothership trials have been carried on long enough to show their severe limitations and it seems pointless for the Department to continue using its boats in this way unless better reasons can be found for continuing the effort.

Recommendation

From results of 1953 and earlier trials and from points raised in this critique, it is reccmmended that the Department engage in no further mothership operations.

GENERAL DISCUSSION

A New View

This fisheries survey has provided a semi-quantitative description of some of Ceylon's fisheries. It is not a complete description and it cannot be completed without several more years' work. Nevertheless it does permit sound comparisons between our operations and well-known fisheries of other countries. The comparisons provide much needed perspective for critical thinking about the potentialities of Ceylon's fisheries and this may prove to be the most useful result of the survey. Without such a background it is impossible to weigh the possible importance of undertakings that are proposed or to judge the worth of results of projects that have been completed.

From this background we can now see the positive value of much advice given by earlier visitors. Hickling (1951) and Kesteven (1951) suggested that analysis of Wadge Bank trawling records would discover ways of improving and developing the trawl fishery. This was a most useful suggestion as the section, " Critique of the Wadge Bank trawl fishery ", clearly shows. It also shows that some earlier advice was not so useful; e.g. advice favouring mothership operations and advice against bottom longlining (John, 1951). From the fishery survey results the Steering Committee decided on opposite courses.

Recommendations

Besides providing orderly descriptions of the industry, comparisons with other fisheries and assessments of earlier advice, the survey has brought forth new recommendations on how some fisheries may be improved and on why efforts to improve others do not seem worth while. These recommendations, which are presented at the close of each section of the report, are better founded than many of those Ceylon has received previously. This is because, from the very beginning, the Canadian team had as a guide the information and advice proffered by former visitors to the Island, advice from the Steering Committee and constant help in experimental fishing from well-informed fisheries officers, research officers, departmental boatmen and F. A. O. workers. The Canadian team had another important advantage. It was able to work and think for a much longer period in Ceylon than most earlier advisers. This gave them access to more information about the industry and opportunity to test and mature opinions before advancing them as recommendations. It is hoped that these recommendations will be useful.

Generalizations

In the course of the survey the Canadian team arrived at certain general conclusions about Ceylon's fishing and fisheries. These deserve a place in this report because they may be useful in dealing with problems of the industry and the Department, especially where expansion is being considered.

Fish abundance. The first conclusion is that Ceylon's inshore waters are not everywhere " teaming with fish " that await all fishermen who acquire mechanized boats. This is supported not only by the generally low catches per unit of fishing effort but also by other indicators of fish scarcity frequently remarked on by the skippers. One was the scarcity of fish-eating birds on Ceylon's marine fishing grounds. In northern areas fishermen, especially net men, watch the behaviour of flocks of birds like gulls and terns, to determine where to fish. The theory behind their thinking is " no birds, no fish ". The skippers believed that this theory applies not only to Canadian waters but to Ceylonese as well. And in Ceylon, birds are scarce. They believed the scarcity of birds indicated a general scarcity of fish about the Island except perhaps in lagoons.

Another subject of comment was the remarkable clarity of the water at most times. This generally accompanies a scarcity of small mid-water plant and animal organisms (plankton) which serve as fish food. Where these are scarce, heavy fish production is usually not realized.

From these considerations it appears that Ceylon's shoal-water fishing grounds are not only limited in extent as John (1951) has stressed, but that they are also scant producers of fish. Accordingly, those responsible for guiding fisheries development must not expect too much from the inshore marine areas in arranging programs for expanded production. We believe, although John (1951) did not, that they should direct a considerable part of their attention to waters beyond the continental shelf and possibly to the inland fresh waters.

Fishery regulations. Another conclusion of importance to administrators is that at this stage it would be unwise to introduce legislation such as specification of minimum mesh-size of fishing nets, with the object of conserving breeding stocks of marine species. This is especially true for migrant species taken by beach seines because only a small percentage of their stocks is vulnerable to attack by Ceylon fishermen. Contrary to a belief (Roughley, 1951. see p. 147.) that is popular here, there is usually nothing wrong, either theoretically or practically, with catching juvenile fish (fish that have not spawned) if they are not wasted. In Ceylon even the smallest fish in the catches are normally carefully collected and used as food. So far there is insufficient information to justify regulations restricting their use. Experience in other countries has shown that when regulations are introduced without proper study, they usually do more harm than good.

Essential work of the Department. Many people, including fisheries officers, expressed the opinion that the Department has involved itself too much in the fishing business. It buys and sells fish and fishing equipment, salt, rice and a number of other commodities and engages extensively in actual fishing, e.g. in trawling and pearl fishing. Much of the Department's thinking is occupied with these matters thus reducing its opportunities to cope with the essential problems of fisheries management and development. Much is being done but more is needed. The simplest way to increase usefulness without increasing staff is to curtail non-essential programs.

To decide where energy should be directed it is important to discover what it is that fishermen need most to become better fishermen. In other words, it is as important to study fishermen as it is to study fish because the fisheries depend on both. A development program should be as clearly related to fishermen's practices, needs and philosophies as it is to fish migration cycles and gear efficiency problems.

Modernizing Thinking. The Department's staff needs fuller opportunity for self education in the theory and practice of management and for the vital work of liaison with industry if it is to be effective in fostering development. Modernized ways of thinking are needed just as much as modernized ways of fishing. Ideas can aid development but they can also impede it if they are not challenged. Most people think, for instance, that when the south-west monsoon is blowing fishing is automatically poor on the coasts exposed to it and that it is not worth while fishing on the north-east coast when the north-east monsoon is blowing. This idea seems to hold for the beach seine fishery and for fisheries conducted by indigenous craft. But the fisheries are changing rapidly with mechanization and it would be wrong not to change our thinking to keep pace. Traditional thinking on all aspects of fishing should be challenged. Many of the generally accepted ideas will prove to be well grounded. But others, like that about monsoons, will be found weak. Trawling records demonstrated that during the north-east monsoon it is possible to make good catches on the Pedro Bank off the north-east coast and that catches on the Wadge Bank are best during the south-west monsoon It is quite possible that other types of fishing like bottom longlining from mechanized craft could be equally successful in many areas during what are now considered to be the " off " seasons.

A further example of how traditional thinking limits vigorous development is the tendency of many fishermen to consider themselves specialists. They participate in one or a few branches of the fisheries and disregard opportunities for increasing earnings by diversifying their activities. Whole communities consider themselves teppam men. They use handlines and certain types of gill nets but they will not venture to do other types of fishing. Other communities are weir fishermen and feel they can do nothing else. They can learn to diversify their activities so as to make full use of every resource available to them. Indeed with popular education they are diversifying and the Department can and is hastening this process by its publications and training programs so that fishermen may achieve their greatest usefulness in national life. It might be hastened still more if government were to abandon the kind of patronizing assistance that keeps old fishing and marketing methods alive long after they have outlived their usefulness. This might seem cruel, but clear thinking tells that in the long run it would be kind.

Appraisal of Survey Results

The survey has accomplished much considering that it extended over only two years. These were two years of persistent work often in the face of difficulties—lack of experience and information, inability to converse with fishermen in their own language, delays in obtaining needed equipment and, in some projects, lack of sympathy (understanding). The survey has been criticized in some quarters, as over-empirical and in others, as over-studious. Some critics argued, for instance, that the program should have included much more demonstration to and instruction of fishermen. It must be pointed out, however, that any survey must go on for some time before the potential industrial usefulness of any new method or device can be sufficiently established to justify its demonstration to industry. This stage is just being reached in bottom longlining and it is hoped that demonstrations and instruction will be properly executed in this and other kinds of fishing in due time. In the meantime, investigations must continue. The approach we took to our work not only made good sense to us but it was what was called for in our contracts—a broad approach to the fisheries problems including a mixture of trial fishing and research that would lead to useful recommendations for development.

Some persons with whom I have discussed the survey results were inclined to belittle them as " more advice from visiting experts that are putting in time ". From lack of serious thought they expected to see a full-blown, modern fishing industry in Ceylon after our two years' work.

Science has been able to create dramatic changes in fields like radio and television communication through the activities of small numbers of highly trained people. We take important advantage of these changes but they are mysterious to most of us and science is often regarded as a modern-day witchcraft capable of working similar changes in any field including the fisheries. Science will bring about great changes in the fisheries of Ceylon but there will be nothing mysterious about them when they come and they will be slow coming. The reason is that the changes must be comprehensible, at every stage, to unschooled fishermen. And the pace of science in leading the developments must be regulated by the rate at which the every-day habits of thousands of people can be changed by hard work on the part of those who undertake to change them. Bertram (1948) has nicely expressed this in his sober but optimistic advice to South-East Arabia, that " ....very slow returns in genuine development, result from extensive, and expensive, years of demonstration and urging of new and improved methods of fishing and cultivation, but under wise guidance, the changes do come in the end ".

Fortunately, many who are guiding Ceylon's fisheries development appreciate Bertram's point of view. They must see to it that it is more generally appreciated and address themselves to the task ahead.

The Task Ahead

It must appear from preceding sections of this report that many of Ceylon's fishermen are not " pulling their own weight " as citizens of the country. Blegvad (1951) commented on their very low catches. According to his estimate the catch per man per day in a 365-day year averages between 4 and 5 pounds. If correct, this is a very low value even when compared with catches in poor fishing areas like the western Arabian Sea (Bertram, 1948). The records assembled during the fisheries survey suggest that Blegvad was not far wrong.

It appears that a man on a trawler on the Bear Island fishing grounds of northern Europe catches more fish in one day than the average Ceylonese fisherman catches in a whole year. The Ceylonese fisherman is not to be blamed. He is in a dilemma not of his own creation. But no reasoning person would suggest that this meagre service to the nation by 50,000 fishermen is a reasonable exchange for costly and elaborate public services the Ceylon fisherman expects and gets—good roads, cheap public transportation, police protection and schooling and health services for his children. No country can afford such a waste of man power as that which is going on now in Ceylon's fishing industry. Fishermen must become independent, not dependent.

Administrators must be awake to the enormity of this problem and vigorously attack it. Their first task is to clarify their own thinking. They must have a clearly recognized aim. Again, Bertram (1948) has probably described what this aim should be, better than anyone else, when he said the " important objective in any fishery development is the emergence of the fisherman, as an individual and as a class, as an active, contented and independent member of the community. So, ultimately, will his efforts help in the attainment of higher standards for all ".

Administrators will not attain this goal quickly or easily. Importing a few boat engines will not take them far towards it. Real progress requires the severest criticism and modification of present policies and programs and redirection of effort. Continuing with the present set-up, patching it up here and there to keep it in operation, will never do. There must be straight-line thinking, drastic decisions and drastic action, sometimes with disregard for present comforts of fishermen in the interest of their long-term betterment.

Many people, including some administrators, are guilty of thinking in circles. They praise mechanization of fishing craft and in the same breath say that every step must be taken to avoid throwing fishermen out of work. If progress is worth striving for, all must be willing to suffer the pains of progress. If administrators practise straight-line thinking they must come to the conclusion that no more people should engage in the fishing industry than can earn a good living at it so that each man's contribution is significant and that fishermen should not continue to be wards of the state as some maintain they are today. Ceylon probably has at least twice as many fishermen as it should have even under the present condition of the fisheries. After mechanization of fishing craft gets under way and fishing becomes a more competitive business, many fishermen will find it impossible to maintain their present positions in their profession. Unless large numbers of them find new niches in undeveloped sections of the fisheries, like fishing in tanks (irrigation reservoirs) they will be thrown out of work. They will have to leave fishing all together as, indeed, many are leaving right now—a healthful sign. As this goes on, administrators must cease to think of these people as " poor fishermen " requiring patronage which would maintain them indefinitely in an impoverished state. Instead, administrators should think of them as potentially important contributors to the development of other industries.

If this clear view is adopted, attention can then be intelligently directed to the proper development of the fishing industry. Partial answers to how this can be achieved (sufficient to serve as a working basis) are given in earlier sections of this report. There is no need for recapitulation here.

Implementation of this advice would be relatively easy under the ideal system postulated by Hickling (1954) where people—all people—earnestly desire the change which in the overall picture seems necessary. The change in Ceylon's particular case is the industrial revolution of the fishing industry and the conditions under which it must take place are not of the ideal sort Hickling referred to. There are indications that parts of Ceylon's fishing industry will offer short-sighted opposition to innovations. They may like motors but they will not like to handle more gear and many who do not get motors will not take kindly to entering other industries when they find they cannot compete with those fishermen who do mechanize their operations.

Opposition may also come from some "middle-men"—net and boat owners and fish dealers—who may fear that they will be forced out of their business which now requires an abundance of low-paid labour. Middlemen are quite indispensible to a vigorous fishing industry and the competent ones should be able to adjust their methods and maintain their positions and interests. The Department will be wise to cultivate the closest liaison with middle-men and win their sympathy so as to have their support, step by step, in bringing about the needed changes. At the same time administration must create an atmosphere that will encourage that ambition among fishermen by which they will improve their performance as fishermen or find other employment that will provide them a better livelihood.

Guiding the fishing industry through this trying transition period will not be an easy task. The difficulties are not decreasing. They are increasing year-by-year because Ceylon's rapid population growth creates that vicious circle of problems such as De Castro (1952) and others have described as common to large sections of the world today. Even maintenance of present standards will require a supreme effort and betterment will demand the most careful co-ordination of every ounce of energy that can be brought to bear on the problems of development and developmental research.

Some outside assistance may be counted on but it is easy to over-estimate its value. In the long haul, progress will be proportionate to the extent to which the Department's own staff devote themselves to that task of constantly acquiring and applying new knowledge, skill and self-reliant working philosophies. The work of fisheries development will never end.

Judging from the physical results of this fisheries survey, the outlook for Ceylon's fisheries development need not be dismal. But under almost any conditions it will be dismal unless the open-minded, far-sighted, honest and unselfish members of the Department and industry co-operate vigorously.

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APPENDIX 1

SUMMARY OF 1953 TRAWLING OPERATIONS BY MAPLE LEAF (BOSTON ATTACKER) ON WADGE BANK OFF SOUTH COAST OF INDIA

Year and Trip No.	*Dates* Sailing—Landing	*Days in Port (no.)*	*Days at sea (no.)*	*Days fished (no.)*	*Days fished/ Days at sea %*	*Hours trawl was towed*	*Catch/ Trip (lbs.)*	*Catch/ Day at sea (lbs.)*	*Catch/ Man/Day at sea (lbs.) (1)*	*Catch/Hr. fished (lbs.)*	*Catch/Hr. towed (lbs.)*
1953											
1	June 10—June 22		12	11	92	202	131,177	10,931	390	497	649
		8									
2	June 30—July 10		11	10	91	148	99,911	9,083	324	416	675
		4									
3	July 14—July 24		10	9	90	158	87,020	8,702	311	403	551
		5									
4	July 29—Aug. 10		12	11	92	146	169,496	14,125	504	642	1,061
		9									
5	Aug. 19—Aug. 28		9	8	89	120	72,555	8,062	288	378	605
		20									
6	Sept. 17—Sept. 29		12	11	92	205	96,717	8,060	288	366	472
		6									
7	Oct. 5—Oct. 16		11	10	91	177	102,039	9,276	331	425	577
		5									
8	Oct. 21—Oct. 30		9	8	89	148	47,977	5,331	190	250	324
		8									
9	Nov. 7—Nov. 17		10	9	90	158	55,968	5,597	200	259	354
		4									
10	Nov. 21—Dec. 2		11	10	91	161	121,406	11,037	394	506	754
		6									
11	Dec. 8—Dec. 21		13	12	92	220	77,503	5,962	213	269	352
		10									
	Total (6·7 months)	85	120	109	—	1,843	1,061,769	—	—	—	—
	Average/month	12·8	17·8	16·2	—	275	158,473	—	—	—	—
	Average/trip (from pooled data)	7·7	10·9	9·9	91%	168	96,524	8,849	316	405	576

(1) Total crew of MAPLE LEAF (Officers and men) 28.

APPENDIX 2

SUMMARY OF 1954 TRAWLING OPERATIONS BY MAPLE LEAF (BOSTON ATTACKER) ON WADGE BANK

Year and Trip No.	*Dates* *Sailing*	*Dates* *Landing*	*Days in Port (no.)*	*Days at sea (no.)*	*Days fished (no.)*	*Days fished/ Days at sea %*	*Hours trawl was towed*	*Catch/ Trip (lbs.)*	*Catch/ Day at sea (lbs.)*	*Catch/ Man/Day at sea (lbs.)*	*Catch/Hr. fished (lbs.)*	*Catch/Hr. towed (lbs.)*
1954			14									
1	Jan. 15	Jan. 27		12	11	92	206	70,237	5,853	209	266	341
			6									
2	Feb. 2	Feb. 12		10	9	90	174	91,072	9,107	325	422	523
			27									
3	Mar. 11	Mar. 22		11	10	91	187	61,170	5,561	199	255	327
			7									
4	Mar. 29	Apr. 5		7	6	86	114	37,796	5,399	193	262	332
			10									
5	Apr. 15	Apr. 26		11	10	91	184	98,236	8,931	319	409	534
			7									
6	May 3	May 12		9	8	89	147	74,869	8,319	297	390	509
			26									
7	June 7	June 12		5	4	80	64	50,006	10,001	357	521	781
			4									
8	June 16	June 28		12	11	92	204	127,752	10,646	380	484	626
			4									
9	July 2	July 10		8	7	88	122	88,995	11,124	397	530	729
			5									
10	July 15	July 26		11	10	91	188	121,475	11,043	394	506	646
			7									
11	Aug. 2	Aug. 13		11	10	91	182	158,106	14,373	513	659	869
			7									
12	Aug. 20	Aug. 31		11	10	91	165	141,385	12,853	459	589	857
			10									
13	Sep. 10	Sep. 22		12	11	92	194	132,655	11,055	394	502	684
			33									
14	Oct. 25	Nov. 5		11	10	91	175	47,144	4,286	153	196	269
			5									
15	Nov. 10	Nov. 22		12	11	92	179	43,485	3,624	129	165	243
			4									
16	Nov. 26	Dec. 6		10	9	90	162	36,839	3,684	132	171	227
			5									
17	Dec. 11	Dec. 23		12	11	92	210	87,410	7,284	260	331	416
			9									
	Total (12 months)		190	175	158	—	2,857	1,468,632	—	—	—	—
	Average/month		15·8	14·6	13·2	—	238	122,386	—	—	—	—
	Average/trip (from pooled data)		11·2	10·0	9·3	90%	169	86,390	8,392	300	387	514

APPENDIX 3

SUMMARY OF 1951 TRAWLING OPERATIONS BY (BOSTON ATTACKER) MAPLE LEAF OFF THE WEST COAST OF SCOTLAND

Year and Trip No.	Dates: Sailing—Landing	Days in port (no.)	Days at sea (no.)	Days fished (no.) (1)	Days fished/days at sea %	Catch/trip (lbs.)	Catch/day at sea (lbs.)	Catch/Man/day at sea (lbs.) (2)	Catch/hour fished (lbs.)
1951									
1	June 1—June 13		12	8	75	35,980	2,998	200	188
		18							
2	July 1—July 16		15	11	73	137,620	9,175	612	521
		2							
3	July 18—July 23		5	1	20	119,700	23,940	1,800	4,988
		2							
4	July 25—August 1		7	3	43	104,160	14,880	992	1,450
		2							
5	Aug. 3—Aug. 13		10	6	60	97,440	9,744	650	676
		3							
6	Aug. 16—Aug. 27		11	7	64	52,640	4,785	319	313
		3							
7	Aug. 30—Sept. 15		16	12	75	62,160	3,885	259	216
		3							
8	Sept. 18—Oct. 2		14	10	71	68,880	4,920	328	286
		29							
9	Nov. 1—Nov. 14		14	10	71	76,860	5,490	366	318
		3							
10	Nov. 17—Nov. 29		12	8	75	72,940	6,078	405	379
		2							
11	Dec. 1—Dec. 15		14	10	71	55,300	3,950	263	231
		3							
12	Dec. 18—Dec. 31		13	9	69	44,100	3,397	226	204
	Total (7 months)	70	143	95	—	927,780	—	—	—
	Average/month	10·0	20·4	13·6	—	132,540	—	—	—
	Average/trip (from pooled data)	5·8	11·9	7·9	67%	77,315	6,488	433	407

(1) Actually these are days on the fishing grounds but they are treated here as identical with days fished.
(2) Total crew of " Boston Attacker " (officers and men) 15.

APPENDIX 4

SUMMARY OF 1952 TRAWLING OPERATIONS BY BOSTON ATTACHED (MAPLE LEAF) OFF THE WEST COAST OF SCOTLAND

Year and Trip No.	*Dates* *Sailing*—*Landing*	*Days in port* (*no.*)	*Days at sea* (*no.*)	*Days fished* (*no.*)	*Days fished/days at sea* %	*Catch/trip* (*lbs.*)	*Catch/day at sea* (*lbs.*)	*Catch/Man/day at sea* (*lbs.*)	*Catch/hour fished*
1952									
1	Jan. 5–Jan. 21	5	16	12	75	31,640	1,880	125	110
2	Jan. 24–Feb. 6	3	13	9	69	133,840	10,290	686	619
3	Feb. 9–Feb. 23	3	14	10	72	141,820	10,130	675	591
4	Feb. 28–March 15	5	16	12	75	128,380	8,025	535	446
5	March 25–April 7	10	13	9	69	82,880	6,360	425	383
6	April 9–April 23	2	14	10	72	67,620	4,830	322	282
7	April 27–May 10	4	13	9	69	93,660	7,205	480	433
8	May 13–May 28	3	15	11	73	92,540	6,170	411	351
9	May 31–June 14	3	14	10	72	105,420	7,530	502	438
10	June 19–July 3	5	14	10	72	60,480	4,320	288	252
11	July 6–July 19	3	13	9	69	62,020	4,771	318	287
12	July 22–Aug. 4	3	13	9	69	55,300	4,254	284	256
13	Aug. 7–Aug. 20	3	13	9	69	78,540	6,042	403	364
14	Aug. 22–Sept. 6	2	15	11	73	58,800	3,920	261	223
15	Sept. 10–Sept. 24	4	14	10	72	79,940	5,720	380	332
16	Sept. 28–Oct. 8	4	10	6	60	81,200	8,120	541	562
17	Oct. 10–Oct. 25	2	15	11	73	104,440	6,963	464	396
	Total (9·8 months)	64	235	167	—	1,458,520	—	—	—
	Average/month	6·5	24·0	17·0	—	148,829	—	—	—
	Average/trip (from pooled data)	3·8	13·8	9·8	71%	85,795	6,206	414	364

APPENDIX 5

GROUNDFISH LANDINGS OF OTTER TRAWLERS OPERATING OFF THE CANADIAN ATLANTIC COAST, JANUARY 1 TO DECEMBER 31, 1953, ACCORDING TO VESSEL-SIZE AND AREA FISHED. DATA COMPILED AND MADE AVAILABLE BY THE FISHERIES RESEARCH BOARD OF CANADA

Area fished and size of trawler (gross tons)	*Effort*								*Landings (thousands of pounds)*								*Catch/ Trip (lbs.)*	*Catch/ Days at sea (lbs.)*	*Catch/ Hour trawl was towed (lbs.)*
	No. of craft	*No. of trips*	*Days absent from port*	*Days on grounds*	*Days fishing*	*Hours trawled*	*Length of trip (days)*	*Days on grounds/ Days out of port*	*Cod*	*Haddock*	*Pollock*	*Halibut*	*Red fish*	*Flounders*	*All other species combined*	*Total*			
Central Nova Scotia (ICNAF Sub-Division 4 W)																			
Over 500	1	1·45	12·5	10	10	81	8·6	80%	30	72	2	1	—	13	16	134	94,800	10,700	1,654
151—500	23	184·1	1,337·5	1,108	1,084	14,338	7·3	83%	4,676	9,089	674	142	149	2,013	1,013	17,756	93,000	13,300	1,239
51—150	6	48·2	323·3	282	269	2,910	6·7	87%	528	1,742	158	13	73	172	163	2,849	59,300	8,830	979·5
26— 50	13	56	—	—	—	1,350	—	—	100	651	2	—	17	95	17	882	15,700	—	653·3
Up to 25	—	—	—	—	—	—	—	—	47	253	—	—	3	252	52	607	—	—	—
Western Nova Scotia (ICNAF Sub-Division 4 X)																			
151—500	1	4·1	16·7	14	14	113·1	4·1	84%	6	98	—	—	—	4	14	122	29,800	7,300	1,041
51—150	3	44·4	154·7	138	138	693	3·5	89%	95	388	230	—	14	35	17	788	17,800	5,080	1,132
26—50	6	84	—	—	—	—	—	—	157	390	445	—	5	20	51	1,068	12,700	—	—
Up to 25	54	772 Weeks	—	—	—	—	—	—	48	1,525	62	—	13	1,089	260	2,997	—	—	—

APPENDIX 6

SUMMARY OF RECORDS OF LANDING (POUNDS) BY SMALL OTTER TRAWLERS (AVERAGE LENGTH 50 FEET) FISHING OUT OF BRITISH COLUMBIA PORTS (CANADIAN PACIFIC COAST) IN THE YEAR BEGINNING NOVEMBER 1, 1948
(DATA COMPILED AND MADE AVAILABLE BY FISHERIES RESEARCH BOARD OF CANADA)

Month	*Hours Fished*	*Misc. Soles*	*Lemon Sole*	*Rock Sole*	*Brill*	*Flounders*	*Grey Cod*	*Lingcod Cod.*	*Rock fish (Sebastodes)*	*Skate*	*Perch*	*Dog-fish Liver*	*Total Catch ((Excluding Liver)*	*Catch /Hour fished (excluding Liver)*
1948														
November	549	2,800	34,338	900	208,450	7,000	59,598	9,953 L 284	15,165	1,033	534	29,058	339,771	619
December	494	240	52,519	70	61,833	315	21,054 L 53	17,434 L 616	4,122	2,866	275	10,771	160,728	325
1949														
January	983	17,761	109,897	16,985	3,710	13,174	201,639 L 3,090	21,412 L 4,405	11,283	7,089 L 49	560	3,710	403,510	410
February	764½	6,575	60,015	12,968	1,000	55,648	76,974 L 20	3,845 L 19	4,064	1,856	350	1,711	223,295	292
March	1,637	23,756	396,430	9,808	35,910	34,499	103,083 L 610	53,159 L 688	5,911	5,179 L 63	789	3,081	668,524	408
April	1,282	4,384	179,955	8,001	44,888	5,332	123,889 L 289	30,483 L 312	4,871	4,872 L 878	40	65,601	406,715	317
May	1,729½	1,319	66,207	53,640	176,355	5,579	188,367	133,968 L 1,357½	2,149	8,560 L 89	123	155,170	636,267	368
June	1,444	2,608	17,228	367,824	457,394	11,657	42,189	206,936 L 1,597	6,881	4,701	—	110,941	1,117,418	774
July	2,028½	18,574	28,485	480,035	599,794	562	59,759	444,184 L 7,677	3,964	1,788	—	38,961	1,637,145	807
August	1,383	67,612	24,537	276,624	413,342	1,149	33,821	388,060 L 4,155	825	4,825	—	41,095	1,210,795	815
September	392½	118,455	28,430	35,243	318,635	1,799	66,560	231,051 L 3,153	8,402	2,530	20	39,381	811,125	206
October	1,116½	33,946	75,501	11,382	105,309	12,480	163,328	29,516 L 311	18,155 L 182	2,104	178	31,993	451,899	405
Total	13,803	298,030	1,073,542	1,273,480	2,426,620	149,194	1,140,261 L 4,062	1,570,001 L 20,214	85,792 L 182	47,403 L 1,219	2,869	531,473	8,067,192	Av. 639

Misc. Soles :—Sole 10,175, Sand 10,080, Rex 94,756, Dover 121,810, Butter 17,634, C-O Sole 460, Longjaw flounder 43,007, Flathead 100.

Misc. Fish :—Crab 65,952½, Black cod 27,353, Hake 7,000, Turbot 3,000, Ratfish 4,600, Bass 3,119, Herring 1,000, Pompano 125, Shad 106, Sturgeon 78, Eels 40 Devilfish 5,855, Squid 13½, Scrap liver 2,369, Rat liver 649, Turbot liver 378, Black cod liver 245, Mink feed 16,142, Squpfin liver 8, Mixed viscera 193, Lingcod viscera 203, Dogfish carcasses 13,000.

L. = Liver

APPENDIX 7

GROUND FISH LANDINGS, JANUARY 1 TO DECEMBER 31, 1954, BY SMALL OTTER TRAWLERS OF LESS THAN 26 GROSS TONS OPERATING IN WESTERN NOVA SCOTIA (ICNAF SUB-DIVISION 4X, CANADIAN ATLANTIC COAST). DATA COMPILED AND MADE AVAILABLE BY THE FISHERIES RESEARCH BOARD OF CANADA.

Month	*Effort*				*Landings (lbs.)*										*Catch/ Day out of port (= day fished)*	*Catch/ Hour trawled (lbs.)*
	Boats (No.)	*Trips (No.)*	*Days fished*	*Hours trawled*	*Cod*	*Haddock*	*Halibut*	*Pollock*	*Hake*	*Cat fish*	*Winter Flounders*	*Silver Hake*	*Scales*	*Total*		
January	2	15	16	161	300	8,927	—	—	—	300	16,975	—	—	26,502	1,659	164
February	3	26	26	298	3,440	8,500	—	—	—	—	28,605	—	—	40,545	1,560	136
March	2	22	22	308	800	—	—	—	—	300	42,400	—	—	43,500	1,977	141
April	14	86	95	1,099	3,460	2,900	40	1,290	—	44,528	108,623	—	—	160,841	1,693	146
May	27	232	267	2,232	8,675	63,685	115	190	—	68,078	219,045	—	—	359,788	1,348	161
June	33	361	372	3,260	9,874	171,035	40	5,465	330	44,195	291,666	—	—	522,605	1,410	160
July	30	285	285	2,092	835	72,072	—	1,400	2,205	7,318	229,074	3,000	—	315,904	1,110	151
August	29	246	246	1,731	684	71,808	322	—	14,823	1,260	185,863	9,999	—	284,759	1,157	164
September	25	193	193	2,023	16,446	72,141	—	100	9,608	—	146,718	29,239	16,239	290,252	1,509	143
October	17	101	102	1,122	2,139	51,362	—	—	853	—	32,812	16,474	26,600	130,240	1,277	116
November	13	68	76	577	6,142	142,594	—	—	3,370	—	3,585	11,755	23,800	191,246	2,520	332
December	7	40	44	431	7,361	37,189	—	100	255	—	6,500	9,345	33,600	93,410	2,123	217
Totals	45	1,675	1,744	15,314	60,156	702,213	517	8,545	31,444	165,979	1,311,926	79,812	100,000	2,459,592	Av. 1,416	Av. 161

APPENDIX 8

SUMMARY OF EARLY PEDRO BANK FISHING OPERATIONS BY OTTER TRAWLERS

Fishing Vessels	Year	Trip dates	Days out of Port (No.)	Position (Approximate) N.Lat. : E.Long.	Depths (fathoms)	Total catch (lbs.)	Catch/Day out of port (lbs.)	Catch/Hour trawl was towed (lbs.)	Quality of catch
	1920								
LILLA	Aug.	14–Aug. 29	—	9–15 : 81–58	6—33	1,256	—	129	2
	1921								
	Aug.	9–Aug. 10	—	9–15 : 81–58	13—22	482	—	241	2
	1928								
BULBUL	June	15–June 30	15	—	—	39,750	2,650	—	2
Do.	July	5–July 19	14	—	—	49,287	3,521	—	2
Do.	July	24–Aug. 8	15	—	—	78,251	5,217	—	2
Do.	Aug.	19–Sept. 2	14	—	—	35,813	2,558	—	2
Do.	Oct.	1–Oct. 14	13	—	—	42,715	3,286	—	2
Do.	Oct.	18–Nov. 1	14	—	—	21,570	1,541	—	2
	1929								
BULBUL	Feb.	15–Feb. 25	10	—	—	31,242	3,124	—	2
TONGKOL	Feb.	27–March 9	10	—	—	24,870	2,487	—	2
BULBUL	March	1–March 14	13	—	—	40,580	3,122	—	2
TONGKOL	March	12–March 23	11	—	—	28,750	2,432	—	2
BULBUL	March	18–March 31	13	—	—	31,310	2,408	—	2
Do.	April	25–May 11	16	—	—	29,820	1,864	—	2
TONGKOL	May	14–May 27	13	—	—	24,640	1,895	—	2
Do.	Aug.	21–Sept. 3	13	—	—	29,184	2,245	—	2
BULBUL	Aug.	28–Sept. 14	17	—	—	45,850	2,697	255	2
Do.	Sept.	17–Oct. 2	15	—	—	38,097	2,540	241	2
Do.	Oct.	9–Oct. 19	10	—	—	27,483	2,748	259	2
	1930								
BULBUL	March	6–March 18	12	—	—	37,546	3,129	—	2
Do.	April	7–April 22	15	—	—	42,609	2,841	—	2
Do.	April	25–May 8	13	—	—	23,166	1,782	—	2
Do.	July	23–Aug. 8	16	—	—	42,530	2,658	—	2
Do.	Oct.	21–Nov. 5	15	—	—	32,123	2,142	—	2
	1932								
BULBUL	Aug.	11–Aug. 26	15	—	—	53,896	3,593	—	2
	1935								
BULBUL	March	30–April 18	19	—	—	42,020	2,212	—	2
	1949								
HALPHA	Aug.	15– —	—	9–36 : 80–31	8	0	0	0	—
RAGLAN CASTLE	April	6–April 16	10	9–36 : 80–45	19–20	14,500	1,450	392	2
	1950								
RAGLAN CASTLE	June	15–June 21	6	9–37 : 80–45	18–21	33,383	5,564	423	2
Do.	June	30–July 7*	7	9–48 : 80–38	20–26	25,425	3,632	446	2

LILLA records ex Malpas (1926); BULBUL and TONGKOL records courtesy, Ceylon Fisheries Ltd.; RAGLAN CASTLE and HALPHA records ex files of Department of Fisheries, Ceylon.

* Sailing and landing time estimated from log record of fishing time.

APPENDIX 9

SUMMARY OF EARLY OTTER TRAWLING IN SOUTH EASTERN PALK STRAIT AND OFF SOUTHWEST COAST (GALLE TO CHILAW).

Area and Fishing Vessel	*Year and fishing dates*	*Position (approximate) N. Lat. : E. Long.* °–' : °–'	*Depth (fathoms)*	*Total catch*	*Catch/Hour trawl was towed (lbs.)*	*Quality of catch*	*Source of Records*
Palk Strait							
LILLA	1920—July–Sept.	9–35 : 79–50	4–7	717	80	3	Malpas (1926) (page 26)
	Do.	9–18 : 79–50	6–8	2,737	456	3	do.
	Do.	9–50 : 79–30	5–7	1,669	238	3	do.
HALPHA	1952—May 2	9–09 : 79–44	3–4	1,470	490	2—3	Glanville's report May 2–26, 1952
	May 3	9–08 : 79–43	3–4	4,110	822	2—3	Department of Fisheries files (data incomplete)
	May 7	Talaimannar	—	1,200	300	2—3	do.
	May 13	do.	—	950	238	2—3	do.
	May 14	do.	—	435	145	2—3	do.
	May 19	do.	—	1,020	510	2—3	do.
	May 20	do.	—	2,850	570	3	do.
	May 21	9–20 : 79–56	4	490	245	3	do.
	May 26	9–44 : 79–49	3–5	140	140	2	do.
Southwest Coast							
LILLA	1920—May 6–7	7–50 : 79–38	7–8	113	28	—	Malpas (1926)
	1921—Dec. 22–27 1923—April 5–12	7–20 : 79–38	6–14	539	90	—	do.
	1921—Dec. 22–27	6–58 : 79–38	8–25	317	26	—	do.
	1923—April 5–12	6–41 : 79–39	24–32	457	76	—	do.
	1920—Dec. 20 1923—April 5–12	6–29 : 79–40	27–31	57	11	—	do.
HALPHA	1952—March 10	Mutwal	6–8	1,000	100	2—3	Dept. Fish. files

APPENDIX 10

SUMMARY OF 1953 RECORDS OF SMALL-BOAT OTTER TRAWLING BY NORTH STAR.

Base	*Date*	*Position* N. Lat. °–'	*Position* E. Long °–'	*Depth (fathoms)*	*Description of trawl*	*Length of haul (hours)*	*Catch (lbs.)*	*Grade of catch*	*Catch/ Hour towed (lbs.)*	*Catch/ Man/ Hour (lbs.)**	*References and Remarks*
	1953										
Colombo	22·5	6–49	79–46	22–26	ground fish trawl 80′ footrope: towed on bottom	0·75	440	3	588	196·0	
	16·6	6–47	79–41	26–27	do.	3·0	100	3	33	11·0	4 three-quarter-hour tows combined.
	19·6	6–54	79–50	10	do.	1·0	1000	3	1000	250·0	
		6–54	79–50	10	do.	1·0	0	—	0	0	Tore net.
	22·6	6–55 6–52 6–49	79–49 79–45 79–44	10–12 26 29	do.	3·0	75	3	25	6·3	3 one-hour tows combined
	23·6	6–46 6–45	79–41 79–41	11–31 12–33	do.	1·0	0	—	0	0	2 half-hour tows combined
	24·6	6–39	79–51	18	do.	2·0	0	—	0	0	2 one-hour tows combined: poor bottom
Talaimannar	17·7	9–11	79–39	7	do.	1·0	200	3	200	50·0	2 half-hour tows combined: bottom soft: doors burying
	18·7	9–11	79–39	7	do.	0·5	35	—	70	17·5	
	do.	9–21	79–33	6	do.	1·0	400	3	400	100·0	
Mullaitivu	2·8	9–31 9–31 9–31	80–50 80–49 80–49	20 18 16	do.	3·0	600	3	200	50·0	3 one-hour tows combined
	7·8	9–30	80–46	8	do.	1·0	50	3	50	12·5	
	8·8	9–35	80–39	8–9	do.	6·0	1600	3	266	66·5	3 two-hour tows combined
	8·8	9–35	80–39	8–9	do.	1·0	0	—	0	0	Net fouled with weed.
	9·8	9–35	80–39	6–7	do.	4·0	60	3	15	3·8	2 two-hour tows.
	10·8	9–11	80–53	8–9	do.	2·0	120	—	60	20·0	

APPENDIX 10—*contd.*

SUMMARY OF 1953 RECORDS OF SMALL-BOAT OTTER TRAWLING BY NORTH STAR—*contd.*

Base	*Date*	*Position* N. Lat. °–1	*Position* E. Long °–1	*Depth (fathoms)*	*Description of trawl*	*Length of haul (hours)*	*Catch (lbs.)*	*Grade of catch*	*Catch/Hour towed (lbs.)*	*Catch/Man/Hour (lbs.)**	*References and Remarks*
	1953										
Trincomalee	19·8 to 22·8	8–32	81–18	10	80 ft. otter trawl: towed at different depths on short cable along 40 fathom contour	1·0	5†	3	5	1·2	Many jelly fish
	,,			20		1·0	5†	3	5	1·2	do.
	,,			30		1·0	0	—	0	0	do.
	,,	8–37	81–15	10	do.	1·0	few	3	0	0	do.
	,,			20	do.	1·0	,,	3	0	0	do.
	,,			30	do.	1·0	few	3	0	0	do.
Point Pedro	30·8	10–07	80–16	22	80′ foot-rope: on bottom	2	250	3	125	31·3	Sea fans and ray fish
	,,	10–07	80–16	18–19	do.	2	20	3	10	2·5	Rough
	,,	9–58	80–29	21	do.	2	0	—	0	0	Tore net
	31·8	9–56	80–23	7–9	do.	66	100	3	150	35·7	Rough
	,,	9–56	80–23	7–9	do.	2	200	3	100	25·0	2 one-hour tows; ray fish
Mullaitivu	1–9	9–20 9–20 9–20	80–53 80–54 80–55	12 15 18	do.	6	890	3	148	37·1	3 two-hour tows; smooth bottom
	2–9	9–20	80–53	11–12	do.	6	90	3	15	3·7	Sharks and rays
	,,			—	do.	4	180	2&3	45	11·2	2 two-hour tows cat-fish and small paraw
do.	16·9	9–34	80–48	22	80 foot net on bottom	2	0	—	0	0	Rough
	,,	9–27	80–51	12	do.	2	230	3	115	28·8	Ray fish
	,,	9–20	80–53	11	do.	2	180	3	90	22·5	Small fish
	17·9	9–16	80–57	22	do.	2	110	3	55	13·8	Ray fish
	,,	9–21	80–55	21	do.	2	80	3	40	10·0	
	,,	9–25	80–53	21	do.	0·2	0	—	0	0	
	,,	9–29	80–52	22	do.	1·5	0	—	0	0	

APPENDIX 10—*contd.*

SUMMARY OF 1953 RECORDS OF SMALL-BOAT OTTER TRAWLING BY NORTH STAR—*contd.*

Base	*Date*	*Position* N. Lat. °–'	*Position* E. Long °–'	*Depth (fathoms)*	*Description of trawl*	*Length of haul (hours)*	*Catch (lbs.)*	*Grade of catch*	*Catch/Hour towed (lbs.)*	*Catch/Man/Hour (lbs.)**	*References and Remarks*
Mullaitivu	18·9	9–14	80–53	11	80 foot net on bottom	2·0	240	3	120	30·0	Small fish
	,,	9–17	80–53	11		3·0	360	3	120	30·0	Heavy rain
	19·9	9–11	80–54	9–10–11	do.	3·0	1,260	3	420	105·0	2 very large sharks
	20·9	9–13	80–53	10	do.	1·5	390	1·5	260	65·0	
	1·10	9–35	80–48	25	55′ footrope	3·0	360	3	120	30·0	Equal quantities small and large fish
	,,	9–35	80–48	25	do.	2·0	290	3	145	36·3	—
	2·10	9–35	80–52	30	do.	3·0	345	3	115	28·7	
	,,	9–35	80–52	33	do.	3·0	540	3	180	45·0	
	3·10	9–35	80–52	33	do.	3·0	120	2	40	10·0	Sea anemones
	,,	9–39	80–49	30	do.	3·0	0		0	0	—
	4·10	9–35	80–51	31	do.	3·0	110	3	37	9·2	
	5·10	9–35	80–46	18	do.	2·0	12	1	6	1·3	Shells and mud
	,,	9–13	80–53	11	do.	2·5	60	3	24	6·0	1 large sea snake
	6·10	9–18	80–59	33	do.	1·3	30	2	20·3	5·8	Dead coral in net ; stuck in mud
	,,	9–19	80–59	42	do.	1·5	90	2	60	15·0	loose coral; dirty bottom

* The catch/man/hour is calculated on the basis of a 4-man crew. Actually more men were aboard but only 4 were required to operate the gear.
† Estimated.

APPENDIX II

SUMMARY OF 1954 RECORDS OF SMALL-BOAT TRAWLING (MOSTLY BY CANADIAN)

Base	Year and Date 1954	Position (Approximate) N. Lat. °–'	Position (Approximate) E. Long. °–'	Depth (fathoms)	Description of trawl	Length of haul (hours)	Catch (lbs.)	Grade of Catch	Catch/hour towed (lbs.)	Catch/man/hour towed (lbs.)*	References and Remarks
Trincomalee	13·7	8–33	81–49	13	80' footrope	0·5	60	2	120	30·0	Many jellyfish; tore net badly
Do.	13·7	8–33	81–48	17	do.	0·7	0	—	0	0	
Do.	16·7	80–36	81–45	12–14	do.	2·0	8	2	4·0	1·0	—
Do.	16·7	80–33	81–49	—	do.	1·5	0	—	0	0	Tore net
Mullaitivu	21·7	9–42	80–48	30	30' footrope FAO	1·0	0	—	0	0	Bottom good, Star fish, sponges and shells
Do.	21·7	9–41	80–46	28–22	do.	1·0	0	—	0	0	Good bottom
Do.	21·7	9–39	80–44	22–14	do.	1·0	0	—	0	0	do.
Do.	21·7	9–37	80–41	14–11	do.	0·8	4	3	5.0	1·2	1 Shark
Alampil	22·7	9–11	80–54	7–12	do.	1·0	0	—	0	0	Good bottom
Do.	22·7	9–11	80–55	12–15	80' footrope	1·0	25	2	25·0	6·3	—
Do.	22·7	9–11	80–56	15	do.	1·0	25	2	25·0	6·3	—
Do.	22·7	9–11	80–57	20–14	do.	2·0	0	—	0	0	Tore net
Chundikulam	23·7	9–36	80–44	15	do.	1·5	75	2	50·0	12·5	—
Do.	23·7	9–39	80–46	20	do.	1·0	45	2	45·0	11·2	Net badly torn. Catch must have been very good for fish to remain in net
Do.	23·7	9–38	80–42	14	do.	1·6	0	—	0	0	—
Alampil	24·7	9–11	80–54	11	do.	1·5	75	2	50·0	12·5	—
Do.	24·7	9–11	80–57	15	do.	2·0	120	2	60·0	15·0	—
Do.	24·7	9–11	80–56	13	do.	2·0	45	2	22·5	5·7	—
Do.	24·7	9–11	80–55	12	do.	2·1	40	2	20·0	4·8	—
Do.	24·7	9–11	80–57	15	do.	2·0	60	2	30·0	7·5	—
Do.	26·7	9–13	80–58	18–25	do.	2·0	25	2	12·5	3·2	Net Torn
Mullaitivu	26·7	9–16	80–58	25	do.	0	—	—	—	—	Net torn. Door damaged

APPENDIX 11—*contd.*

SUMMARY OF 1954 RECORDS OF SMALL-BOAT TRAWLING (MOSTLY BY CANADIAN)

Base	*Year and Date 1954*	*Position (Approximate) N. Lat. °–′ : E. Long °–′*	*Depth (fathoms)*	*Description of trawl*	*Length of haul (hours)*	*Catch (lbs.)*	*Grade of catch*	*Catch/Hour towed (lbs.)*	*Catch/Man/Hour towed (lbs.)**	*References and Remarks*
Trincomalee	11·8	8–46 : 81–12	23	35′ footrope	2·0	22	2	11·0	2·8	This in the 80′ trawl cut down
Do.	11·8	8–48 : 81–13	30	do.	2·5	0	—	0	0	—
Do.	5·10	8–44 : 81–15	35	¾ of No. 35 (50′ footrope) small doors	1·8	5	2	2·8	0·7	Caught on bottom; Net and doors fouled
Do.	5·10	8–42 : 81–14	12	do.	2·0	8	3	4·0	1·0	—
Do.	5·10	8–42 : 81–12	10	¾ of No. 35 large doors	1·5	0	—	0	0	Sounder not working
Do.	7·10	8–45 : 81–13	30	do.	2·0	27	2	13·5	3·4	Net badly torn
Do.	7·10	8–46 : 81–12	20	do.	2·0	4	—	2·0	1·0	—
Do.	8·10	8–46 : 81–13	35	do.	5·0	5	2	1·0	0·3	Net and doors caught: NORTH STAR helped to haul
Kayts	18·10	9–47 : 79–44	5	¾ of No. 35 small doors	1·0	0	—	0	0	—
Do.	18·10	9–47 : 79–44	5	do.	1·0	24	2	24·0	6·0	—
Do.	18·10	9–44 : 79–48	4	do.	1·0	0	—	0	0	—
Do.	19·10	9–44 : 79–25	8	do.	2·0	14	3	7·0	1·7	—
Do.	19·10	9–44 : 79–37	7	do.	2·0	6	1&3	3·0	0·8	—
Do.	19·10	9–44 : 79–39	7–6	do.	2·0	9	2	4·5	1·1	—
Do.	19·10	9–44 : 79–43	5–4	do.	1·5	0	—	0	0	Net full of weeds
Do.	29·10	9–44 : 79–45	7	Large doors ¾ of No. 35	1·0	20	2	20·0	5·0	CANADIAN alone towing at 1,500 R. P. M.
Do.	29·10	9–40 : 79–37	7	do.	1·5	80	2	53·0	13·4	CANADIAN & NORTH STAR tandem towing 1,400 R. P. M.
Do.	29·10	9–37 : 79–31	4–5	do.	1·3	55	2	41·3	10·3	do.
Do.	29·10	9–38 : 79–33	7	do.	1·5	150	2	100·0	25·0	do.
Do.	1·11	9–50 : 79–55	6	do.	1·8	20	3	11·1	2·8	CANADIAN alone
Do.	1·11	9–38 : 79–55	4	do.	1·8	20	3	11·1	2·8	Bottom very soft
Do.	1·11	9–47 : 79–46	3–4	do.	1·8	60	3	33·4	8·3	Towed at 1,400 R. P. M.

APPENDIX 11—*contd.*

SUMMARY OF 1954 RECORDS OF SMALL-BOAT TRAWLING (MOSTLY BY CANADIAN)

Base	*Year and Date 1954*	*Position (Approximate)* *N. Lat.* °–1	*E. Long* °–1	*Depth (fathoms)*	*Description of trawl*	*Length of haul (hours)*	*Catch (lbs.)*	*Grade of catch*	*Catch/ Hour towed (lbs.)*	*Catch/ Man/ Hour towed (lbs.)**	*References and Remarks*
Kayts	2·11	9–36	79–37	7–8	Large doors ¾ of No. 35	1·5	26	3	17·4	4·3	—
Do.	2·11	9–45	79–42	2–3	do.	1·0	50	2	50·0	12·5	—
Do.	2·11	9–44	79–44	3–4	do.	1·0	49	2	49·0	12·2	—
Do.	8·11	9–36	79–36	8	Old net cut down 35' footrope	1·8	10	3	5·6	1·4	—
Do.	8·11	9–28	79–34	9	do.	1·8	22	3	12·2	3·1	—
Do.	8·11	9–28	79–34	9	do.	1·0	5	3	5·0	1·3	—
Do.	8·11	9–39	79–41	6	do.	1·5	34	1 & 3	22·3	5·7	—
Colombo	8·9	7–0	79–51	—	Katumaran dela 25' footrope	5·0	55	2	11·0	2·2	—
Do.	2·11	—	—	—	do.	5·0	25	3	5·0	1·0	—
	1955										
Do.	25·1	—	—	—	do.	6·0	40	3	6·8	1·3	—
Do.	25·1	—	—	—	do.	6·0	60	3	10·0	2·0	—
Do.	25·1	—	—	—	do.	6·3	90	3	14·3	2·9	—
Do.	26·1	—	—	—	do.	5·5	130	2 & 3	23·6	4·7	—
Do.	26·1	—	—	—	do.	5·5	90	3	16·4	3·3	—
Do.	26·1	—	—	—	do.	6·0	150	3	25·0	5·0	—
Do.	11·3	—	—	—	do.	7·0	80	2 & 3	11·4	2·3	—
Do.	11·3	—	—	—	do.	7·3	40	3	5.5	1·1	—
Do.	11·3	—	—	—	do.	7·2	50	3	7·0	1·4	—
Do.	11·3	—	—	—	do.	5·5	115	2 & 3	21·0	4·2	—

* The catch/man/hour is calculated on the basis of a 4-man crew. Actually more men were aboard but only four were required to operate the gear.

APPENDIX 12

SUMMARY OF 171 FISHING RECORDS OF GROUNDFISH HANDLINING FISHING TRIPS. THE DETAILED RECORDS APPEAR IN A MANUSCRIPT REPORT (MEDCOF, 1955) FILED WITH THE FISHERIES RESEARCH STATION, CEYLON.

Fishing area	*Month(s)*	*Depth (fath.)*	*Boats (No.)*	*Catch (lb.)*	*Catch/line/hr. fished (1) (lb.)*	*Remarks and references*
1948						
Gulf of Oman	January	—	40	4,000	—	Catch/man/hr. was 8·3 lb. (Bertram, 1948)
1949						
Wadge Bank	Feb. and March	40–65	1	19,312	33·2	3- and 4-hook lines; research boat (Chidambaram, 1951)
Karativu	August	13–22	1	600*	20·0	*Estimate from HALPHA log
1950						
Karativu	March and April	15–23	19	13,714	21·5	1- and 5-hook lines; in vallams; 2/3 of crew fished (2); HALPA mothership
Karativu	Oct.-Dec.	13–20	15	13,844	32·8	5-hook lines (2); HALPA mothership
1951						
Mullaitivu	June	13–40	98	42,477	13·5	5-hook lines (2); HALPHA mothership
Mullaitivu	July	5–10	120	58,798	13·8	5-hook lines (2); HALPHA mothership
Mullaitivu	August	—	79	20,288	8·4	5-hook lines (2); HALPHA mothership
Mullaitivu	September	—	63	9,825	6·5	5-hook lines (2); HALPHA mothership
1952						
Mullaitivu	August	—	123	16,360	6·0	1-hook lines; HALPHA mothership
Mullaitivu	September	—	84	10,530	4·9	1-hook lines; HALPHA mothership
1954						
Batticaloa	May	—	2	77	—	1-hook lines; unassisted orus
Mankeni	June	15–30	66	2,384	10·3	1-hook lines; teppams; ADE MARE mothership
Valaichchenai	August	—	1	50	7·2	Vallam with outboard motor; 2 lines
Trincomalee	September	42–45	1	0	0	Oru; 5 lines
Colombo	September	—	15	1,073	2·6	1-hook lines; orus; 5 lines each
Chilaw	September	18	1	38	1·3	1-hook lines; oru; 4 lines
Thalaiyadi	September	3–10	2	19	0·6	Kattumarams
Pt. Pedro	September	4–7	3	42	0·3	Kattumarams
Mylliddy	September	—	1	6	3·0	
Colombo	September	18	1	6	1·2	Motor boat SEER
Colombo	Nov. and Dec.	—	13	458	1·0	Orus unassisted
Negombo	December	14	2	30	0·8	1-hook lines; orus; 3 lines each
Colombo	December	8–40	9	77	0·4	2-hook lines; orus; 6 lines each
1955						
Colombo	January	10–20	20	683	1·2	1-hook lines

(1) This is the average of the values for the various trips.

(2) Four men in each vallam rowed the boat to maintain position on the fishing ground and could not fish.

APPENDIX 13

SUMMARY OF RECORDS OF BOTTOM LONGLINING IN THE MAURITIUS-SEYCHELLES IN 1948, AND ABOUT CEYLON 1949—1954 (DETAILS ON INDIVIDUAL SETS REPORTED IN APPENDIX 13 BY MEDCOF (MS 1955).* ME'NS WEIGHTS ESTIMATED. CATCH PER MAN PER HOUR ON THE FISHING GROUND FOR NS IS BASED ON A 3-MAN CREW. NS MEANS NORTH STAR)

Year and base	*Date*	*Boat(s)*	*Sets (No.)*	*Hooks per set (No.)*	*Catch/ 100 hooks lb.*	*Catch/ man/hr. on grounds lb.*	*References and remarks by skipper*
1948							
Mauritius-Seychelles	Feb.-June	MFRV No. 1	12	16—150	112*	—	Wheeler (1953)
1949 (Ceylon)							
Colombo	3.3	HALPHA	1	500	0	—	Blegvad (1951)
Chilaw	7.3	HALPHA	1	200	10.0*	—	
Galle	22.3	HALPHA	1	500	20.0*	—	
Wadge Bank	29.3	RAGLAN CASTLE	1	1,000	8.0	—	
Karativu	8.4	HALPHA		1,000 (500)	55.0*	—	Lost 500 hooks
1951							
Velvedditurai	30.3–27.4	KATTUMARAMS	8	700—1,100	38.9	—	HALPHA and SEER served as mother-ships
1954							
Trincomalee	13.7–16-7	NS	4	700—900	21.8	10.6	
Chundikulam	21.7	NS	1	1,200	1.6	1.5	
Alampil	22.7	NS	1	1,000	15.2	13.0	
Chundikulam	23.7	NS	1	900	24.3	18.3	Squid bait took best catches
Mullaitivu	27.7	NS	1	900	44·4	33·4	
Trincomalee	29.7–16.9	NS	23	350—900	29.1	15.1	
Mankeni	18.9	NS	1	840	37.5	30.1	Good fishing
Trincomalee	22.9–24.9	NS	4	560—840	15.0	12.5	
Mylliddy	27.9–28.9	KATTUMARAM	2	200—250	42.9	5.4	
Trincomalee	27.9–12.10	NS	5	490—840	16.9	10.9	Gear badly worn; lost some
Kayts	29.10–8.11	NS	5	210—840	2.9	1.9	Poor bait and bottom; local boats caught little
Colombo	3.12–31.12	NS	13	1,120—1,400	13.4	12.5	Some conditions poor
1955							
Colombo	17.1–20.1	NS	4	560—1,400	16.3	12.4	Poor weather
Negombo	20.1	DORY	2	175—185	6.9	3.8	Poor bait and windy
	22.1	DORY	1	280	1.8	1.5	Lost part of gear; heavy weather
Karativu	4.2	DORY	1	280	3.6	5.0	Most bait untouched
Colombo	21.1	NS	1	840	4.8	4.3	
Colombo	24.1–29.1	NS	3	980—1,400	4.9	4.7	
Karaitivu	5.2–15.2	NS	3	840—1,120	13.8	9.9	
Colombo	22.2	NS	1	1,400	15.6	14.6	
Karaitivu	25.2–2.3	NS	3	1,120—1,400	14.6	9.3	

APPENDIX 14

SUMMARY OF FISHING RECORDS OF YEAR-ROUND, BOTTOM LONGLINING OUT OF TWO NOVA SCOTIAN PORTS (CANADIAN ATLANTIC COAST) IN 1952 AND 1953. COMPILED BY THE FISHERIES RESEARCH BOARD OF CANADA. EXCEPT FOR THE LAST COLUMN ALL WEIGHINGS ARE OF FRESH, GUTTED FISH. GUTTED WEIGHT IS APPROXIMATELY 87% OF UNGUTTED ('ROUND') WEIGHT FOR THESE SPECIES

Port and year	*Hooks set (No.)*	*Trips (No.)*	*Hooks set/ Trip (No.)*	*Man-hours expended (1)*	*Total catch (lbs.) (2)*	*Catch/Trip (lbs.)*	*Catch/Man Hour out of port (3) (lbs.)*	*Catch/100 hooks/set (lbs.)*	
								Gutted	*Ungutted equivalent*
Liverpool									
1952	2,353,815	398	5,912	—	1,459,817	3,668	—	62.0	71.4
1953	1,542,420	256	6,029	8,240	850,060	3,321	103.2	55.0	63.3
Lockeport									
1952	4,920,850	1,402	3,510	—	3,669,313	2,617	—	74.6	85.8
1953	4,740,450	1,228	3,860	—	3,391,669	2,762	—	71.6	82.5

(1) Man-hours=Time absent from port × number of fishermen involved.

(2) 35—50% cod ; 18—27% haddock ; rest is a mixture of several species of bottom fish. The catches reported here constitute approximately 50% of the total landings in these ports from longliners.

(3) For a crude conversion of this to catch per man per hour on the fishing ground multiply by 2.0.

APPENDIX 15

1954 RECORDS OF DRIFTLINE FISHING AT 15 FATHOMS OUT OF COLOMBO, CEYLON, BY 3-MAN ORUS FISHING 6 HOOKS WITH SQUID FOR BAIT ON 25-FATHOM LINES (ACTUALLY 50-FATHOM LINES WITH A HOOK ON EACH END) AND BY NORTH STAR AT 100-FATHOMS, OUT OF TRINCOMALEE ; 3 MEN WITH 4 HOOKS AND KELAWALLA FOR BAIT.

Date	*Hours fished*	*Catch (lb.)*	*Catch/hook/hour (lb.)*	*Catch/man/hour (lb.)*
ORUS :				
September 9	6·5	72	1·8	3·7
11	7·0	130	3·1	6·2
13	6·0	45	1·3	2·5
13	6·0	0	0	0
15	7·0	90	2·2	4·3
15	8·0	180	3·8	7·5
Average	—	—	2·0	4·0
NORTH STAR :				
August 26	5·9	0	0	0

APPENDIX 16

SURFACE LONGLINING IN CEYLON 1949-1955. SUMMARY OF DATA FROM MEDCOF (MS REPT. 1955)

Craft and base	*Date*	*Depth of water (fm.)*	*Hooks (No.)*	*Hooks taking fish (%)*	*Catch (lb.)*	*Catch/100 hooks set (lb.)*	*Catch/man/hr. on grounds† (lb.)*	*Remarks and references*
1949								
HALPHA (gear improvised)								
Colombo	3·3	18	50	0	0	0	0	Gear improvised (Blegvad, 1951)
	4·3	23	200	3	25*	12·5	4·2	*estimated
1954								
CANADIAN (gear improvised ; effective crew, 4)								
Colombo	25—26·1	500—700	240	0	0	0	0	Gear improvised
Mt. Lavinia	26—27·1	17	120	0	0	0	0	
Bentota	27—28·1	16	144	0·7	20	14·0	0·8	8 hooks gone
Galle	2·2	100	240	1·3	51	21·3	2·0	Bait untouched
Galle	2—3·2	31	240	0·4	20	8·3	0·4	Bait all gone
Barberyn	3—4·2	20	120	1·7	40	33·3	0·7	Bait all gone
Tangalle	16·2	1,100	240	0	0	0	0	
Do.	16—17·2	1,200	240	—	—	—	—	Lines parted ; lost all gear ; shark ?
SMALL JAPANESE BOAT (Japanese gear)								
Colombo & Negombo	27·9–16·10	—	35	12*	4,000	760	—	*from incomplete report ; 15 sets
SEER (Japanese gear)								
Colombo	29·10	18	103	4·9	186	180	13·3	
	30·10	18	40	0	0	0	0	
	30·10	20	40	7·5	68	170	21·3	Bait hurulla
	4·11	18	93	4·3	116	125	11·6	Bait hurulla
(U. K. shark lines)								
	18·11	200	75	1·3	92	123	8·7	
	18·11	75	75	0	0	0	0	
1955								
NORTH STAR (gear improvised)								
Colombo	19·1	22	50	2·0	62	124	5·7	Bait cuttlefish
	2—3·3	100	50	2·0	35	70	2·9	Bait kumbala

† calculations based on a 4-man crew.

APPENDIX 17

Trolling.—RECORDS OF 1949 TROLLING BY THE VANCOUVER, B.C., FLEET OF "ICE BOATS" SHOWING HOW THEIR 1,000,000-POUND ("ROUND" WEIGHT) SALMON CATCH, COHO AND SPRINGS COMBINED, WAS DISTRIBUTED SEASONALLY AND ACCORDING TO EFFORT. COMPILED BY THE FISHERIES RESEARCH BOARD OF CANADA FROM TRIP REPORTS.

Month 1949	*Fishing effort*		*Catch/Boat*		*Catch/Line/Hour (lb.)*	*Catch/Man/Hour (lb.)*
	Total boat-days fished	*Hours/boat/day (Av.)*	*Day (lb.)*	*Hour (lb.)*		
February	10	6·8	106	15·5	2·6	9·1
March	12	4·7	148	31·3	5·2	18·4
April	22	12·0	241	40·1	3·4	11·8
May	188	11·7	279	23·9	4·0	14·0
June	264	14·2	380	26·8	4·5	15·8
July	475	15·4	570	37·0	6·2	21·8
August	677	13·9	580	41·8	7·0	24·6
September	473	13·4	383	28·6	4·8	16·8
October	28	11·6	181	15·6	2·6	9·4
Total	2,149	29,596 Hrs. Fished				
Averages for year's data pooled	239 Days/Month	13·8 Hrs./Day	465*	34·2	5·7*	20·1*

APPENDIX 18

SUMMARY OF CEYLON TROLLING RECORDS, 1953–55, REPORTED IN DETAIL BY MEDCOF (MS, 1955) CATCH/MAN/HOUR CALCULATED FOR 4-MAN CREWS FOR CANADIAN (C), NOTRH STAR (NS) AND SEER

Year and Base	*Dates (day, month)*	*Craft*	*Trips (No.)*	*Lures per trip*		*Catch per hour of trolling*	
				No. (total)	*Kinds*	*Lure/hr. (lb.)*	*Man/hr. (lb.)*
1953							
Colombo	4.5—30.6	C	9	10	rubber squid and plugs	0·2	0·6
Galle	1.7	C	1	10	rubber squid	0·4	1·0
Colombo	2.7—2.8	C	4		do.	0	0
Pamban	2.8	C	1		do.	0·4	0·9
Trincomalee	3—20.8	C	8		do.	2·5	3·7
Do.	28.8	C	1	10	Japanese feathered	0·4	1·1
Do.	29—31.8	C	3	10	rubber squid	2·5	6·4
Do.	1—11.9	C	6		do.	1·5	3·6
Colombo	25.9—13.12	C	11		do.	0·3	0·7
1954							
Colombo	4.1—22.3	C	10	10	rubber squid	0·3	0·6
Do.	22—25.3	NS	4	6	spoons 5½″	12·5	18·8
Do.	23.3	C	1	10	spoons 7½″	0	0
Palk Strait	24.3	C	2	10	rubber squid	0·6	1·7
Colombo	26.3	C	1		do.	0·9	2·3
Gulf of Manaar	27.3	C	1		do.	4·7	11·7
Colombo	21.6	NS	1	4	rubber squid	0	0
Colombo	21—22.6	C	2		do.	0·3	0·3
Pamban	22.6	NS	1		do.	0	0
Mullaitivu	24.6	C	1		do.	0	0
Trincomalee	9—14.7	NS	3		do.	0·7	0·7
Mullaitivu	21—29.7	NS	6	1—5	rubber squid	0·5	0·4
Trincomalee	3—5.8	NS	3	2—6	various	0·3	0·5
Trincomalee	4—5.8	C	2	4—8	various	0·2	0·2
Nai Aru	6.8	orus (12)	12	3	ahatuwa bark ; baited	0·6	0·6

APPENDIX 18—*contd.*

SUMMARY OF CEYLON TROLLING RECORDS, 1953–55 REPORTED IN DETAIL BY MEDCOF (MS, 1955) CATCH/MAN/HOUR CALCULATED FOR 4-MAN CREWS FOR CANADIAN (C), NORTH STAR (NS) AND SEER—*contd.*

Year and Base	*Dates (day, month)*	*Craft*	*Trips (No.)*	*Lures per trip*		*Catch per hour of trolling*	
				No. (total)	*Kinds*	*Lure/hr. (lb.)*	*Man/hr. (lb.)*
Mullaitivu	6—7.8	C	2	7	various	0·3	0·7
Mullaitivu	6—7.8	NS	2	5—6	various	0·1	0·1
Trincomalee	9—19.8	C	4	4—7	various	0	0
Trincomalee	10—19.8	NS	3	3—6	various	1·5	1·2
Negombo	11.8	Orus (3)	3	18	tandem hooks; baited	0·2	0·3
Negombo	12.8	Orus (2)	2	6	tandem hooks; baited	2·1	2·3
Trincomalee	20—23.8	C & NS	6	2—5	various	0·3	0·3
Negombo	24—27.8	Orus	7	3—6	tandem hooks; baited	0·7	1·4
Kal Kuda	25.8	C	1	6	various	1·5	2·3
Trincomalee	27.8—6.9	C & NS	7	3—5	various	0·1	0·1
Colombo	9—11.9	Orus	6	2—4	tandem hooks	1·7	1·5
Colombo	13—15.9	Orus	6	3—4	tandem hooks	0·9	0·9
Trincomalee	10—22.9	NS	5	3—6	various	0·8	0.7
Nai Aru	23.9	Orus (6)	6	3	ahatuwa bark; baited	0·1	0·1
Trincomalee	23.9—7.10	C & NS	7	3—4	various	0·1	0·1
Batticaloa	24.9	C	1	4	do.	0	0
Colombo	28—29.9	SEER	2	8	do.	0·3	0·6
Negombo	30.9	SEER	1	8	do.	0·2	0·4
Trincomalee	8—16.10	C & NS	6	4—8	do.	0·4	0·4
Kayts	16—29.10	C & NS	9	3—6	do.	0·1	0·1
Colombo	29—30.10	SEER	2	3—6	tandem hooks; baited	0·6	0·7
Kayts	1—8.11	C & NS	7	4—6	various	2·1	2·9
Pamban	10.11	C & NS	2	4	do.	1·0	1·0
Colombo	11.11—15.12	C & NS	11	3—8	do.	0·5	0·7
Negombo	22.12	Orus	1	3	tandem hooks; baited	0·8	1·2
1955							
Colombo	1—2.2	C & NS	3	2—8	various	0·6	0·9
Karaitivu	2—9.2	C	5	2—3	do.	2·4	1·5
Karaitivu	3—16.2	NS	9	6—8	do.	1·6	3·5
Colombo	13—24.2	C & NS	5	5—8	do.	0·5	0·8
Karaitivu	25—28.2	C & NS	5	5—8	do.	2·9	4·0
Karaitivu	1.3	C	1	5	do.	32·8	41·0
Karaitivu	1—16.3	C & NS	8	4—6	do.	2·1	2·7
Kachchtivu	16—19.3	C & NS	4	5—6	do.	3·7	4·9
Trincomalee	17.3	Dory	1	3	do.	0	0
Kayts	19—24·3	C & NS	4	5—6	do.	1·4	2·3

APPENDIX 19

SUMMARY OF CEYLON GILL NETTING OPERATIONS, 1953-55, REPORTED IN DETAIL BY MEDCOF (MS, 1955). CATCH/MAN/HOUR FOR CANADIAN (C), AND NORTH STAR (NS) CALCULATED FOR 4-MAN CREW. DR.=DRIFT NET; SET=SET NET; SUR.=SURFACE NET; SUN.=SUNK NET; TAR.=TARRED; COT.=COTTON; NYL.=NYLON; MESH MEASUREMENT INSIDE. STRETCHED (INCHES)

Year and Base	*Dates (day, month)*	*Craft*	*Sets (No.)*	*Type of net*	*Catch per hour of set*	
					Per unit area of net (lb.)	*Per man (lb.)*
1953						
Point Pedro	2—3·8 (night set)	C	1	Dr; Sur; Tar; Cot; 6½	2·3	0·1
Trincomalee	3—31·8	C	6	Dr; Sur; Tar; Cot; 6½	0·5	0·3
Colombo	15·10—10·11	C	6	Dr; Sur; Tar; Cot; 6½	3·3	1·8
1954						
Colombo	2—5·3	C	3	Set; Sun; Cot; 6½	0	0
Kathiraveli	6·7	Teppam	1	Set; Sur; Cot; 2	0	0
Kathiraveli	7·7	Teppam	1	Set; Sur; Cot; 3½ and 4	5·3	9·0
Kathiraveli	7·7	Teppam	2	Set; Sun; Hemp; 3½	1·9	0·6
Trincomalee	18—20·8	C	2	Dr; Sur; Nyl; 5¼	0	0
Negombo	23·8	Teppams	2	Dr; Sur; Cot; 2	1·8	1·6
Batticaloa Light	24·8	C	1	Dr; Sur; Nyl; 5¼ and Cot; 1½	0	0
Kal Kuda	24·8	C	1	Dr; Sur; Nyl; 5¼ and Cot; 1½	11·0	7·7
Trincomalee	26·8	C	1	Dr; Sur; Nyl; 5¼	6·3	3·4
Vandeloos Bay	25—26·8	C	1	Set; Sun; Tar Cot; 8 (shark net)	0	0
Colombo	8·9	Orus	8	Dr; Sur; Cot; ½ (sprat nets)	73·0	6·5
Colombo	9—15·9	Orus	8	Dr; Sur; Cot; ½ (sprat nets)	100·9	12·6
Point Pedro	24—25·9	Katumarams	4	Dr; Sun; Hemp; 5½ and 6	2·8	2·2
Mylliddy	26—27·9	Katumarams	7	Dr; Sun; Hemp; 5½ and 6	4·7	5·6
Colombo	28—30·9	SEER	2	Dr; Sur; Cot; 2½, 3½, 4 and 5	4·5	—
Colombo	14—15·12	C	1	Dr; Sur; Nyl; 5¼	2·6	1·7
Colombo	21·12	Orus	4	Dr; Sur; Cot; ?	7·0	2·8
Colombo	21—22·12	Katumarams	4	Dr; Sur; Cot; ?	8·0	2·8
Colombo	21—22·12	C	1	Set; Sun; Tar Cot; 8 (shark net)	0	0
Colombo	22.12	Orus	8	Dr; Sur; Cot; ?	4·5	1·8
Colombo	22—27·12	Katumarams	8	Dr; Sur; Cot; ?	6·7	1·8
Colombo	24·12	Orus	2	Dr; Sur; Cot; ?	0·7	2·6
Colombo	28—31·12	C	3	Set; Sun; Tar Cot; 8	0·2	0·1
Colombo	28—31·12	C	2	Dr; Sur; Nyl; 5¼	0·3	0·2
1955						
Colombo	18—25·1	C	1	Dr; Sur; Nyl; 5¼ and Dr; Cot; 3 and 18 (trammel); nets torn; shark ?	2·8	0·8
Colombo	24—25·1	C	1	do.	16·2	2·6
Colombo	25—28·1	C	3	do.	1·9	0·9
Colombo	20—21·1	C	1	Set; Sur; Nyl; 5¼	4·0	0·4
Colombo	21—22·1	C	1	Set; Sun; Nyl; 5¼ and 6¼	4·8	0·5
Colombo	20—22·1	C	2	Dr; Sur; Cot; 3 and 18 (trammel)	0	0
Colombo	20—25·1	C	3	Dr; Sun; Nyl; 5¼ and 6¼	7·0	4·4
Colombo	25—29·1	Orus	10	—	6·7	3·4
Mampuri	1—2·2	C	1	Set; Sun; Cot; 3 and 18 (trammel)	4·6	0·1
Karaitivu	2—26·2	C	4	Set; Sun ; Cot; 3 and 18 (trammel)	15·8	0·9
Karaitivu	4—5·2	Dory	1	Dr; Sur; Nyl; 5¼	7·6	4·1
Karaitivu	2·2-2·3	C	6	Set; Sur; Nyl; 5¼	3·7	1·6
Karaitivu	8·2—2·3	C	5	Set; Sun; Nyl; 5¼	8·7	1·1
Karaitivu	2—24·2	C	4	Set; Sur; Cot; 3 and 5	0·8	0·2
Karaitivu	25—26·2	C	1	Set; Sun; Cot; 3 and 5	1·0	0·1
Colombo	8·3	Orus	3	Dr; Sur; Cot; mesh ?	4·4	1·7
Colombo	9·3	Orus	2	Dr; Sur; Cot; mesh ?	0·5	0·2
Colombo	10·3	Orus	5	Dr; Sur; Cot; mesh ?	2·5	1·0
Colombo	11·3	Orus	4	Dr; Sur; Cot; mesh ?	0·9	0·4
Colombo	12·3	Orus	4	Dr; Sur; Cot; mesh ?	24·6	9·6
Kachchtivu	17—19·3	C	2	Set; Sun; Cot; 5	0	0
Kachchtivu	17—19·3	C	2	Set; Sun; Nyl; 5¼	6·2	1·0
Kachchtivu	17—19·3	C	2	Set; Sur; Nyl; 5¼	1·6	0·9
Kayts	21—26·3	C	5	Set; Sur; Nyl; 5¼	1·4	0·4
Kayts	22—26·3	C	4	Set; Sun; Nyl; 5¼	0·7	0·1
Kayts	22—24·3	C	2	Set; Sun; Cot; 3 and 5	0	0

APPENDIX 20

HARPOONINGS OF SMALL (C) MOSTLY COMMON, AND LARGE (BN) MOSTLY BOTTLE-NOSED DOLPHINS IN CEYLON WATERS BY CANADIAN 1953–54. (WEIGHTS SOMETIMES ESTIMATED. CATCH-MAN-HOUR IS BASED ON A 4-MAN CREW.)

Base	*Date*	*Hours hunted (No.)*	Catch *No. and kind*	Catch *Total weight (lb.)*	Catch */hour fished (lb.)*	Catch */man /hour (lb.)*	*Remarks by skippers*
	1953						
Trincomalee	28.8	—					Large schools sighted
Colombo	1.10	12·0	1C	80	7	2	Trolling most of time
Negombo	9.10	1·0	2C	179	179	45	Working as " mothership " ; schools common
Colombo	15.10	5·3	3C	240	45	11	Stopped trolling to harpoon
,,	16.10	3·0	10C	800	267	67	Trolling most of time
,,	17.10	1·5	3C	240	160	40	,,
,,	18.10	8·0	5C	400	50	13	,,
,,	29.10	1·0	1C	80	80	20	Combined with trolling and netting ; nets damaged
,,	6.11	1·5	5C	400	267	67	Demonstration cruise
,,	7.11	1·8	3C	240	133	33	,,
,,	11.11	5·0	1C	80	16	4	Combined with netting
,,	2.12	10·0	28C	2,240	224	56	Mackerel schools around
,,	3.12	7·0	10C	800	112	29	Combined with trolling
Marawila	12.12	7·0	6C	480	68	17	Demonstration cruise
,,	14.12	11·0	23C	1,840	176	41	Large schools swimming north ; wild, frightened (?)
	1954						
Colombo	5.1	6·5	2C	160	25	6	Combined with trolling ; schools wild, heading south
,,	12.1	8·0	14C	1,120	142	35	Combined with trolling ; all schools wild
,,	13.1	12·0	0	0	0	0	Trolling ; no dolphins seen
,,	14.1	12·5	13BN } 7C }	3,260	260	65	Combined with trolling
,,	21.1	7·0	3C	240	34	9	Demonstration cruise ; also harpooned large shark—escaped
,,	19.3	7·8	3C	240	31	8	Combined with trolling ; chased 3 wild schools
Trincomalee	9.8	8·5	2BN	400	48	12	Combined with trolling
Colombo	18.11	6·5	2BN	200	31	8	Chased school of 100
,,	20.11	5·0	1BN	244	49	12	
				Average	105	26	