C. S. O.

0112

(Formerly) 22/40

0112

1946

SUBJECT :

SEA FISHERIES. Trawling and Control by J. J. Hunt

CONNECTED FILES.

NUMBER AND YEAR.	
22/40	FISHING RESOURCES
135/43	C S O Oct 1940 Fisheries Research.

48

Downing Street,
S.W.1.

FALKLAND ISLANDS

~~April~~, 1946.

NO. 11

11 MAY 1946

Sir,

I have the honour to refer to your despatch No. 14 of the 6th of February, 1945, regarding the possibility of developing the fisheries of the Falkland Islands.

2. In that despatch you referred to the late Mr. E.R. Gunther's investigation of the offshore fisheries. Mr. Gunther's work has been completed by Dr. Hart of the Discovery Committee's staff, and the results form his "Report on Trawling Surveys on the Patagonia Continental Shelf".

This Report is now with the Cambridge University Press for printing, and they have been asked to expedite its publication. In the present state of the printing industry the work on the Report is expected to take some considerable time, and in the meanwhile a note has been prepared by the Discovery Committee's staff giving the principal results of the trawling surveys. Copies of the note are enclosed.

3. It will be seen from the note that while considerable quantities of hake appear to be available on the northern part of the Patagonian shelf, it is doubtful whether this would afford a sound basis for a trawling industry in the absence of available markets. The suggestion that a trawler should occasionally work the hake grounds and fill in the intervals on other work may be worth considering as a means of providing a supply of fresh fish for the Falkland Islands.

4. The other proposals in the enclosed note for developing the inshore and herring fisheries may be more practicable, for example, in combination with other proposals to use the natural resources of the islands, such as sheep by-products and kelp.

But the real problem of developing any form of fishing industry based on the Falkland Islands is presented by the fact that the population of the islands is at present too small to support such an industry and that other markets are too remote to be served by it. You will, therefore, probably wish to await the receipt of a copy of the full Report before considering these proposals.

I have the honour to be,
Sir,
Your most obedient
humble servant,

(sgd) G. H. HALL

GOVERNOR,
SIR ALLAN CARDINALL, K.B.E., C.M.G.,
etc., etc., etc.

(2) 48a

Discovery Committee

DR. HART'S REPORT ON TRAWLING SURVEYS
ON THE PATAGONIAN CONTINENTAL SHELF

This report has now been received, and after a number of minor amendments to the text and illustrations have been attended to it will be ready for the press. There are 223 pages of typescript, and many tables, and text figures. The composition, printing and binding will thus take some time, and some notes in advance on the principle results may therefore be useful.

Attached hereto are copies of certain parts of the text which include (a) the list of contents, (b) the foreword, and (c) the final short section on 'Prospects of commercial development: Conclusions?

The Introduction gives an account of the work done at sea, and a description of the environment of the fish. The greater part of the report is a detailed account of the distribution, habits and general biology of the various species of fish. Scarce and unimportant fish are dealt with briefly, but the principal food fishes are treated comprehensively. The most important is the hake (Merluccius hubbsi), and others include Macruronus magellanicus and Stromateus maculatus, which may be called the 'long-tailed hake' and the 'spotted pomfret' respectively. Notothenias, though sometimes abundant, are too small to be of economic importance.

In summer the hake are distributed over the shelf, and are concentrated nearest to the mainland coast in autumn, but in winter they tend to move offshore to deeper water, and the best catches are obtainable near the edge of the shelf. Catches of hake per hour's trawling ranged up to 1154 fish with an estimated weight of 380 kilos, but such large catches were exceptional. On the northern part of the shelf (north of 46°S) the 'William Scoresby' obtained an average of just over 1 cwt. of hake per hour and it is believed that a commercial vessel, by working as long as possible wherever the fishing seemed best, could take at least twice as much. Catches in the intermediate region (46°-50°S) were relatively poor. In the southern region (50°-55°S) hake were rather less plentiful than in the north but included the largest individuals. Here also the best catches of Macruronus and Stromateus were obtained in summer and early autumn.

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FOREWORD

By N. A. Mackintosh

The Patagonian Continental Shelf extends over a very large area, and its position and physical features are such as to prompt comparison with the major fishing grounds of the northern hemisphere. Prior to the investigations of the Discovery Committee however the nature and magnitude of the population of demersal fishes on the shelf was virtually unknown, and it was therefore decided that the prospects of locating marketable supplies of fish should be explored. Three trawling surveys were carried out, for the most part at different times of year, in 1927, 1928, and 1931-2; and the principal results are set forth in Dr. Hart's report.

The report is based to a considerable extent on the unfinished work of the late Mr. E. R. Gunther, and the circumstances in which it was prepared require a word of explanation. Several members of the Committee's staff took part in the work at sea, but the largest part was played by Mr. Gunther, and he was in charge during the third and most extensive survey. It is very largely owing to his untiring energy and enthusiasm, and his broad conception of the problems involved, that a most comprehensive and thorough investigation was carried out. The surveys have resulted in a very great mass of data, and the preparation of a general report on the results was undertaken by Mr. Gunther. Some delay in the completion of this report was inevitable. A taxonomic account of the fish fauna, and a description of the marine deposits of the shelf, were necessary preliminaries, and these have already been published in the Discovery Reports, together with systematic papers on certain invertebrate groups. In the years before the war however Mr. Gunther had made good progress with the general analysis of the material, though his work was unavoidably interrupted from time to time by other responsibilities. Since he held a commission in the Territorials he was called upon for military service just before the outbreak of war, and further progress was therefore suspended. His death on active service in 1940 was a severe loss to the Discovery Investigations.

Owing to the dispersal of the Committee's staff in wartime no more could be done until 1945, when Dr. Hart's services were again available. He has, I believe, taken pains to follow Mr. Gunther's plans in so far as they were formulated, but the task of picking up the threads and collating the data naturally involved considerable difficulties; and for many aspects of the subject it was necessary to start again from the original data. The substance of the report can be regarded as the combined work of Mr. Gunther and Dr. Hart, but the latter, as he explains below, has written the entire text in its final form.

It will be realized that this report deals mainly with the general biology and ecology of the demersal fish, and with the prospects of commercial trawling. The surveys were planned for this purpose and did not include an investigation of the pelagic fish such as the Falkland herring. Various references to these fish are included in the report, but there is still little information on the prospects of commercial fishing by other means than trawling. The principal conclusion of the report is that hake, and some other edible species, are obtainable in moderate numbers by trawling. Although the shelf has been found to be less rich in trawlable fish than might have been expected, it is possible that enough could be taken to support an industry if markets could be found, and problems of preservation and delivery could be overcome. The report may be regarded as a contribution

I see no means of [illegible] these difficulties.

to our knowledge of the fish faunas of the world and it is hoped that it will be of assistance in any consideration of the future economic development of the Falkland Islands.

PROSPECTS OF COMMERCIAL DEVELOPMENT

Conclusions

In the exploration of natural resources the primary function of the naturalist is to provide fundamental information on the nature, quantity and accessibility of the raw material. Thereafter the administrator and technologist are in a better position to assess the prospects of commercial development. It is felt, however, that a report such as this would be incomplete without some practical suggestions from those who have collected and collated the biological data. In the remarks which follow, I am confident that where our evidence is already good, the opinions expressed are shared by colleagues who were directly engaged in collection of the data at sea. The more tentative suggestions are my own (T.J.H.).

The primary object of these investigations was to provide information, upon which the prospects of carrying on any commercial fishery from the Falkland Islands could be assessed. It must be plainly stated that the results are not encouraging; but this is due to economic and geographical factors, rather than to lack of suitable fish. The best trawling grounds are not very near to the Falkland Islands, but it can be shown with reasonable certainty that on the shelf to the northward, roughly equidistant from the Falkland Islands and the lesser Argentine ports, there is a stock of hake just sufficient to enable a modern trawler to pay its way if there were markets equivalent to the British ones within a few hundred miles.

The population of the Falkland Islands is too small and too scattered (with limited means of communication between the settlements) to enable a large trawler to pay its way on local trade alone. If a considerable part of the catch could be sold in, for example, the Argentine at a reasonable price, a trawler working from Port Stanley might be able to keep the latter supplied with the results of, say, one voyage in four. The possibilities of smoking, drying and dehydration would no doubt be taken into consideration, but it seems doubtful whether the fish could be marketed at an economic price in the Argentine. However, I venture to suggest three possibilities, on the strength of the knowledge of the fish-fauna that we have gained:

There are also political difficulties to be anticipated.

I. Local inshore seining for "mullet" (Eleginops), "smelts" (Austromenidia) and such other species as present themselves. Dr. Kemp informed me shortly before his death that our former colleague Dr. J. E. Hamilton was even then trying to establish some inshore fishery in the Falklands. Much might be done to place such a scheme on a permanent footing if a small-scale canning plant could be established. This could deal with an occasional glut of "herring" (Clupea fuegensis) but might aim primarily at developing a small luxury trade in canned Centolla crab (Lithodes), serving to keep a few hands permanently employed. It is not yet known for certain that these crabs would be accessible in sufficient quantity to small coastal craft, but we found encouraging numbers of them in the trawl on the rough ground round the islands, that would not support ordinary inshore trawling. The main part of this scheme would aim at providing some fresh fish for local consumption (a real need). The canning is a further suggestion to aid in keeping it on a self-supporting basis, which could hardly be hoped for from small-scale seining alone.

I tried to get this done, with D.H. in charge of a 3 year experiment: boat & gear were obtained and services of a professional fisherman secured but the "Economy Cttee" (Roberts, Barton, Luxton, Hardy) turned down the scheme. It was a great mistake for which the Colony will [illegible] - M.C. 31/ H.SD.

It is not a true centolla and not found in sufficient quantities near Stanley but I see no reason why they should not be introduced.

The locals don't think so.

8.

II. Exploitation of Clupea fuegensis possibly by some form of purse-seining, for drift nets or other forms of gill-nets would almost certainly suffer too much from damage by seals and birds, to make them workable in the Falkland area. Such a scheme would depend upon canning, production of fish-meal or other means of processing the product. As already explained the trawl could not provide adequate evidence of the quantities of these small semi-pelagic fish available, so that further, possibly costly investigations would be needed, before one could form an adequate opinion as to the feasibility of such a scheme.

III. Part-time trawling. If a cold store were available in Port Stanley, and if sufficient employment could be found for a suitable vessel (possibly on inter-island communications) during more than half her time, a modern trawler occasionally working the hake grounds we found to the north could easily keep Port Stanley on a full supply of fish; but it is very doubtful whether she would pay her way at this.

The local population is not 'fish-minded' on the whole. Fish are a nuisance to clean & prepare and aren't food anyway!

Fisheries 9. (58)

"DISCOVERY" INVESTIGATIONS.
52, QUEEN ANNE'S CHAMBERS,
DEAN FARRAR STREET,
LONDON, S.W.1.

22nd October, 1946.

Miles Clifford, Esq., C.M.G.,
Colonial Office,
Downing Street, S.W.1.

Dear Mr. Clifford,

Here are one or two reports, etc. which I hope will be of interest. There are many other monographs in the Discovery Reports which you might like to see (e.g. on whales, pack-ice, and oceanography, and general accounts of parts of the Dependencies) but I am afraid even a selection of these would make a very heavy parcel. They are all available in Port Stanley, so I am sending only those which are more directly concerned with marine industries in the Falkland Islands and the Dependencies.

Yours sincerely,

N A Mackintosh

Reply at 59/

HES

Interesting & confirms my earlier conjecture. May an acknowledgement be drafted pl.

MC 27/x.

[illegible] 27/x

17. 5T 56

20th December, 1946.

My Dear Mackintosh,

Read 50

Thank you so much for your letter of the 22nd of October, 1946, and for the reports you sent me, which I have read with much interest.

We only arrived here on the 26th of November and are busy settling in. But I am looking forward to tackling the other monographs you mention as soon as I have time.

Yours Sincerely,

(SGD.) Miles Clifford.

P.S. F.I.D.S. affairs are keeping me pretty busy; I am very sorry about Bingham.

M.C..

Dr. M. A. Mackintosh,
"Discovery" Investigations,
52, Queen Anne's Chambers,
Dean Farrar Street,
London, S.W.1.

DRM.

(b) Fishery. I discussed with Mr. Hickling the proposals of Dr. Hamilton for the inauguration of a fishery and after further enquiry remain of the opinion then expressed and recorded in the pertinent Colonial Office file. I would like a professional fisherman with his family and gear to be brought out on a three years' contract (with a guaranteed income) during which he would thoroughly test the inshore possibilities and train two or three apprentices. From the dietetic point of view

a/

a regular fish supply would confer a great benefit. I shall hope to have a suitable power boat available for the fisherman's use. This is, I feel sure, much the most economical way of conducting the experiment; off-shore possibilities and the development of an external market can be considered later but the Discovery Committee's report is not very encouraging.

VIII. INDUSTRIAL DEVELOPMENT

(a) Refrigerating plant
(b) Fishing industry (inshore)
(c) Spinning mill.
(d) Exploitation of kelp beds.

Notes. (a) Subject to the views of your Advisers and not a first priority; it will be some time, presumably, before equipment of this nature is freely available. Can be provisionally set down for 1949.

Dealt with in 114/39 "Refrigerating Plant"

(b) 1948, 1949 and 1950; a three-year contract. It is hoped to have the "Penguin" commissioned by next year; the hull is in good condition and all that is required is the substitution of a Diesel engine for the present derelict steam installation and consequential re-design of the superstructure and internal accommodation. This is not a major undertaking but it will be necessary to have the craft ready for commission by the time the fisherman is brought out and it will therefore be desirable to put the repairs in hand this year. Should the fishing venture fail to materialise the vessel can be chartered advantageously to the British American Kelp Company.

FALKLAND ISLANDS

NO. 5

Colonial Office,
Downing Street,
S.W.1.

6 February, 1947.

Sir,

I have the honour to refer to my predecessor's Despatch No.11 of the 1st May last on the subject of Dr. Hart's Report on Trawling Surveys on the Patagonian Continental Shelf. The Report has now been published in the series of Discovery Reports, and I understand that a copy has been forwarded to you by the Discovery Committee.

2. My Fisheries Adviser has expressed the opinion, in the light of Dr. Hart's Report, that there are sufficient fish in the deep water off the Falkland Islands to support a substantial trawling industry. In view of the fact that the catches of hake around the United Kingdom have fallen considerably one Milford Haven firm is considering the question of sending ships to West Africa and Northern South America to explore the waters there. It may be, therefore, that as the catches of Hake fall still further, as unfortunately they are likely to do, the British trawling industry may become interested in the possibilities of the Patagonian Continental Shelf. My Fisheries Adviser has, therefore, suggested that the British Trawlers Federation should be furnished with a copy of Dr. Hart's Report,

and/

GOVERNOR,
G. MILES CLIFFORD, ESQ., C.M.G., C.B.E.,
etc., etc., etc.

and a copy has accordingly been sent to the Federation through the Ministry of Agriculture and Fisheries

3. In connection with his trawling surveys of the Patagonian Continental Shelf, Dr. Hart has submitted some valuable notes on the edible Centolla Crab, Lithodes Antarcticus. Two copies of the notes are enclosed for your information. 549

I have the honour to be,
Sir,
Your most obedient,
humble servant,

A. Cardinall Jones

Notes on the Data concerning the Anomuran "Centolla-crab," Lithodes antarcticus Jacquinot and Lucas, obtained during trawling surveys of the Patagonian Continental Shelf, 1927-32.

by T. John Hart.

4.xii.46.

(not published).

~~546.~~

The Centolla Crab
Lithodes antarcticus

Lithodes was found throughout the whole of the region covered by the trawling surveys. Large catches were not common in the trawl, and although a few were occasionally captured in the small beam trawl, it was never taken with other gear. These notes are based entirely on records of the catches obtained in the OTC (commercial otter trawl, 80 ft. headline, 3" cod end mesh). The weights and measurements are interesting and very suggestive, but are hardly sufficient to justify more detailed treatment, such as would be desirable were a published report on them in prospect.

The numbers of Lithodes taken in all roughly comparable hauls of the OTC have been tabulated and charted and this shows that the species was very irregularly distributed and not confined to coastal areas. At least two of the richer hauls were obtained far offshore. In general it may be said that Lithodes was not abundant on the plain of the shelf, and was absent from the deep water of the southern part of the Falkland trough, the only part of the area in which trawling at uniform depths of more than 500m. was possible. On several occasions, however, large numbers of Lithodes were taken actually on the shelf edge, sometimes where the latter runs close to a coast (as to the NE of the Falkland Islands, and also to the west of them, on the edge of the trough referred to above), but sometimes also where the shelf edge lies far from land (as at St. WS772, more than 200 miles from the mainland coast and far to the North of the Falkland Islands). So far as can be judged from these data, it seems that it is where the depth gradient is steepest that Lithodes normally finds optimum conditions, irrespective of the actual depth when the latter does not exceed some 300m. Thus out of twentyfour catches of ten or more Lithodes eight (including two very rich hauls of more than 100 individuals) were obtained within 50 miles of the Falkland Islands where the shelf is narrow (except to the NW). Six more were obtained within 50 miles of the Mainland coast, mostly on the "first-slope,"[1] while the remaining ten considerable hauls of the species were taken far offshore. At half of these offshore stations the trawl was fishing actually on the shelf-edge, where the depth gradient was extreme. It is probable that this fondness for steep slopes explains why our catches of Lithodes on more level ground were for the most part uniformly small, and its absence from many hauls made on the plain of the shelf.

This is the one important fact concerning the distribution of Lithodes that seems clear from this data - the greatest numbers are to be found wherever the depth gradient is steepest.

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[1] The comparatively abrupt decent from the shore-line to a depth of some 80m., mentioned in the published report on trawling surveys. - 'Discovery' Reports, Vol. XXIII.

The wide dispersal of the stations from which both weights and measurements are recorded in detail, the relatively small number of such observations and large apparent anomalies in a few of the weights preclude detailed statistical treatment of this data. It is not clear how far the observations may legitimately be lumped to give adequate sampling, or how far the apparently anomalous weights may be due to local variation (? races) within the species. Some points of practical importance and at least one of great theoretical interest are however, sufficiently illustrated by these observations.

The carapace breadths recorded range from 4 cm. to just over 15 cm., and the weights from 34 gm. to 1850 gm. The breadth/weight ratio seems remarkably constant wherever the samples are large enough for us to place any confidence in the result, suggesting that there is little change in form throughout the post larval life of these crustacea. The largest female recorded was just over 14 cm. across the carapace, but few females exceeded a breadth of 12 cm. Many males over 12 cm. were measured and it is thus evident that they commonly attain to a larger size than do the females. Tentative smoothed breadth/weight curves indicate that at breadths of 6-10 cm. females are very slightly heavier than males of the same breadth, but at breadths greater than 10 cm. the males were the heavier. The smallest of the measured females recorded as being in berry was 7.9 cm. across the carapace.

I do not know at what size or weight these crabs (which are esteemed for food on the mainland) become marketable, but it may be of some practical interest to state that they reach a weight of 1 lb. at carapace breadth of some 9.5 cm. and a weight of 1 kilo. at carapace breadth 12 cm.

One interesting point that may be deduced from the breadth/weight records of Lithodes is that carapace breadth is an extraordinarily good constant of their volume. The densities of large crustacea investigated by Mr. A. G. Lowndes at Plymouth are noticeably constant between about 1.08 (for Maia, one of the lightest, and with some superficial resemblance to Lithodes) and 1.27 (for Cancer, the heaviest). This being so, a rough indication of the efficiency of any given linear measurement as a function of volume may be obtained by a direct log./log. plot of that measurement against weight in grams (since mass is related to volume of water, and so to the linear units, in the metric system). If the measurement is efficient, the slope of the straight line obtained on the graph should give an angle whose tangent slightly exceeds 3 (the cube, or index number of the volume/mass relationship. For Lithodes antarcticus the angle is approximately 72°, and Tan 72 is 3.0777.

The numbers of measurements are inadequate to determine whether there is any significant correlation between size and regional distribution of Lithodes. Large individuals appeared to be almost equally frequent in each of the three arbitrary latitudinal regions into which the area was divided in the published discussion of the results of the trawling surveys. The smallest individuals were all recorded from the southern region, but more data are needed before any

significance can be attached to this observation. Males were more numerous than females throughout; the disparity in numbers between the sexes seemed least in the southern region, but again much more comprehensive data would be needed to show whether this is a constant feature or not.

The number of Lithodes in berry was noted at a few stations. It would seem that nearly all the adult females not parasitised by Rhizocephala were in berry early in summer in the northern region, but we have no indication as yet of the time the eggs are carried (possibly several months). In the southern region most females were in berry after midsummer.

The observations on the incidence of Rhizocephalian parasitism suggest that further work might show:

a) that females are more commonly affected than are males,

b) that a higher proportion of infected crabs are to be found in the southern region than in the northern region.

Some very interesting notes on the epizoic fauna living on Lithodes antarcticus were made by Gunther. He records that besides gymnoblastic hydroids and a marine leach, certain Caprellid amphipods were common upon them. These amphipods seemed able to secrete a kind of crude silk which, with adherent mud particles, forms a sort of crude shelter serving to prevent the younger individuals from being swept off the crabs.

T.J.H.
4.xii.46

Table 1.

Numbers of *Lithodes antarcticus* taken in the OTC at stations of the trawling survey.

71	462	(229)	1	792A	2	(840)	1
(72)	0	(230)	0	792B	6	(841)	1
73	1	(231)	0	793	4	847A	11
74	0	(232)	0	(794)	2	847B	0
75	0	233	1	(795)	1	(848)	0
76	6	234	0	796A	1	849	2
77	1	235	0	796B	2	850	2
78	11	236	0	(797A)	0	851	14
79	0	(237)	12	797B	2	853	10
80	17	(238)	0	797C	0	855	3
81	0	239	4	798	12	857	0
(82)	0	(240)	0	799A	3	858	6
83	6	(241)	0	799B	0	859A	5
(84)	0	242	0	800A	1	859B	8
85	0	243	0	800B	3	860	2
(86)	104	244	34	801	1	862	1
(87)	0	245	0	802A	21	864	0
(88)	1	246	116	802B	10	866	0
89	0	248	14	803	1	868	2
90	1	(250)	3	804A	7	870	1
91	1			804B	3	872	11
92	0			805	3	(874)	0
(93)	"few"	(756A)	0	806	0	875	4
94	2	(756B)	0	807	0		
95	10	(762A)	0	808	0		
96	0	762B	0	809A	0		
97	121	763	0	809B	1		
98	3	(764A)	0	810	9		
(99)	"approx." 15	764B	17	811A	0		
108	11	765	9	811B	0		
109	15	(766)	0	812A	5		
		771	12	812B	6		
		(772)	(x4=132) 33	813	0		
(210)	1	773	0	814	0		
211	1	774	6	815	0		
(212)	0	775	7	816	0		
213	0	776	1	817A	0		
214	1	(777)	0	817B	0		
(215)	1	781	3	818A	0		
216	12	782	5	818B	0		
217	6	(783B)	4	819A	0		
218	57	784	0	819B	0		
219	5	785	4	820	0		
220	0	786	0	(821)	0		
(221)	0	787	13	823	0		
222	0	(788A)	2	824	13		
223	0	788B	0	825	16		
224	0	789	0	833	7		
225	"several"	790A	4	834	1		
(226)	0	790B	"2or" 3	837	0		
(227)	5	791A	0	838	7		
(228)	0	791B	0	839	0		

Table 2.

Lithodes antarcticus

Carapace-breadth frequencies,
all reliable observations, regardless of region.

Carapace-breadth to nearest 0.5cm. below	Males		Females	
	Numbers	Per cent	Numbers	Per cent
4.0	1	1.4	1	1.6
4.5	2	2.7	3	4.9
5.0	1	1.4	0	-
5.5	0	-	0	-
6.0	5	6.9	1	1.6
6.5	3	4.1	6	9.8
7.0	1	1.4	7	11.5
7.5	5	6.9	8	13.1
8.0	4	5.5	2	3.3
8.5	7	9.6	4	6.6
9.0	6	8.2	3	4.9
9.5	1	1.4	4	6.6
10.0	5	6.9	2	3.3
10.5	3	4.1	3	4.9
11.0	4	5.5	5	8.2
11.5	1	1.4	5	8.2
12.0	3	4.1	5	8.2
12.5	6	8.2	1	1.6
13.0	1	1.4	0	-
13.5	5	6.9	0	-
14.0	7	9.6	1	1.6
14.5	1	1.4	0	-
15.0	1	1.4	0	-
	73	100.4	61	99.9

Table 3.

Lithodes antarcticus, Breadth/weight relations, all observations.

Breadth cm.	Weights grams. Males.	Females.
4.3		32.5
4.4	42.5	
4.6		45
4.7		57.5, 60
4.8	60	
4.9	60	
5.0	70	
6.1	115	
6.2	150, 120, 120	150
6.3	130	
6.6		155
6.7	160	185, 200, 165
6.8		175
6.9	185, 190	200
7.0		165, 180
7.1		220, 210, 180, 165
7.3	240	195
7.5		290
7.6	280	270, 220
7.7	245	
7.8	206	290, 270, 200
7.9	410, 280	340, 340
8.1		300
8.2	320, 365	
8.3	330	315
8.4	325	
8.5	310, 275	450, 350
8.6	353	
8.7	290, 350	350
8.8	425	500
8.9	395	
9.0	550	
9.1	380	
9.2	465, 475	460, 410?
9.3	550	
9.4	600	550
9.6		500, 650?
9.8		400?
9.9	625	550
10.0	750	
10.2	500	
10.3	750, 550, 800	800?
10.4		750
10.6		750
10.7	700, 650	650
10.8	500	
10.9		800
11.0	950	775, 850
11.1		725
11.2	900	325
11.3	850, 1000	
11.4		650

Table 3 (continued)

Breadth cm.	Weights grams. Males.	Females.
11.6	1100	
11.7		850, 900, 600
11.8		830
11.9		975
12.0		1000, 850
12.1	950	875
12.2	1150	950
12.3	1150	
12.4		1150
12.5	1200, 990, 1300	
12.6		975
12.7	1150	
12.8	1500, ?1000	
12.9	900	
13.0	1600	
13.6	1525, 1600	
13.8	1450, 1350	
13.9	1375	
14.0	1000, ?1500	
14.1	1500, 1250	1425
14.2	1700, 1850	
14.3	1600	
14.4	1800	
14.5	1500	
15.2	1400	

~~54c.~~

Table 4.

Lithodes antarcticus. Carapace-bredth/weight relations.

Average figures derived from best-fitting curves.

Carapace-breadth to nearest 0.5cm. below	Weights (grams)	
	Males	Females
4.0	34	34
4.5	45	45
5.0	60	67
5.5	83	90
6.0	107	118
6.5	140	150
7.0	187	192
7.5	230	237
8.0	282	290
8.5	340	345
9.0	403	412
9.5	485	490
10.0	585	585
10.5	695	670
11.0	807	760
11.5	930	845
12.0	1053	945
12.5	1185	1055
13.0	1342	1165
13.5	1500	1275
14.0	1665	1380
14.5	1865	1500
15.0	-	-

Appendix I.

Lithodes antarcticus Numbers in berry at various stations

Note, no crab under 7.9 cm. carapace has hitherto been recorded in berry; this presumably is an approximation to the lower size limit at which the species becomes adult.

WS765	17.x.31	Northern region; 3 females of 8.1 upwards all in berry.
WS771	29.x.31	Northern region; 1 female of 11.4 in berry (others below 7.5).
WS772	30.x.31	Northern region; of 17 females all but the smallest (7.8, infected) were in berry (7.9 - 14.2).
WS804	6.i.32	Southern region; 3 females 8.6 - 8.8 all in berry.
WS805	6.i.32	Southern region; 1 female 9.2 in berry.
WS838	5.ii.32	Southern region; 2 out of 3 females in berry (smallest 8.1 was not and there were 2 definitely immature females also at this station, making 5 in all).

The only conclusion these scanty observations permit is that nearly all the adult females not parasitised by Rhizocephala are in berry early in the summer in the northern region and after mid-summer in the southern region but we have no indication as yet of the time for which the eggs are carried (probably several months).

NOTE: No observations on this point were made in the intermediate region.

Appendix II.

Incidence of Rhizocephalian parasitism in Lithodes antarcticus.

WS765 4 males uninfected; 5 females, 2 infected (smallest) (Northern).

WS771 8 males uninfected; 4 females, 1 infected (smallest) (Northern).

WS772 16 males uninfected; 17 females, 1 infected (smallest) (Northern).

WS781 1 male infected; 2 females, 1 infected (Southern).

WS782B 2 females both infected (much larger than any of the above) (Southern).

WS802A 9 males, 2 infected; 12 females, 7 infected (Southern).

	Males		Females	
	Free	Infected	Free	Infected
Northern	28	0	22	4
Southern	7	3	8	8
Totals	35	3	30	12

These numbers are too small to base any definite statements upon them but they suggest that further work might show -

a) that females are more commonly affected than are males,

b) that a higher proportion of infected crabs are to be found in the southern region than in the northern region.

NOTE: No observations on this point were made in the intermediate region.

31

G.M.

You have 135/43 and are preparing a report for H.E. You may find these pp. (wh. I have had tidied up) useful.

[signature]
24.3.47

PA [signature] 23/7

Agricultural Office,

25th October, 1950. 37

Your Excellency,

The attached reply from the Colonial Office Fishery Advisor to inquiries about Centolla puts us back to the Discovery Reports.

In these there is but brief reference to them in Vol. XXIII on pages 387 389 and 390 in abstacted analysis of catches.

However I have been able to trace down an unpublished report by T.John Hart in C.S. File 0112 pages 20-23 which is most interesting and which I attach.

The nearest Centolla taken were within 50 miles of Stanley but this is much too far away to base a local industry on.

Therefore it does not affect the introduction of Lithodes into local waters but may enchance such an introduction by a mixture of 2 strains or races to give the filip of hybrid vigour in years to come.

C/S.

John P. [illegible]
Agricultural Officer.

CS — [illegible] 26/10.
AO — [illegible] 4/XI/50

All I have suggested is importing a few into the Colony and putting them down in some suitable creek (which could be staked off possibly to see whether they breed).

The possibility of bringing out a trained fisherman and gear to use with the 'Philomel' should not be lost sight of: one day our people may learn to appreciate the value of fish as a regular [illegible]

MC. 30/

33

COLONIAL OFFICE,
Sanctuary Buildings,
Great Smith Street,
LONDON. S.W.1.

18. August, 1950

Dear Sir,

In reply to your letter about the possibility of importing live centorias crabs from Chile into Falkland Island waters, I should hardly think this necessary. The Discovery reports show that centolla crabs are really abundant in Falkland Island waters and I should be surprised if the centolla is not in fact the same as the centorias.

I should first check over the records of the Discovery before undertaking the costly and difficult job of trying to import live crabs from Chile.

Yours faithfully,

C.F. Hickling

(C.F. Hickling)

THE AGRICULTURAL OFFICER,
DEPARTMENT OF AGRICULTURE,
FALKLAND ISLANDS.

C.O. Ref: 19888/152/52.

DESPATCH

CIRCULAR 118/53.

THE CHURCH HOUSE,

GREAT SMITH STREET,

LONDON.S.W.1.

31st January 1953.

Sir,

FISHERIES LEGISLATION

I have the honour to inform you that the Colonial Fisheries Advisory Committee have had under consideration the effectiveness of legislation designed to conserve stocks of fish. The general feeling of the Committee was that there was a tendency for Governments of the Colonial and Dependent Territories to introduce restrictive legislation without adequate evidence of a genuine decline in the fish population due to over-fishing and that some of the conservation measures proposed or adopted were of doubtful value. They felt that the imposition of restrictions were liable to cause friction between fishermen and the fisheries staff charged with the duty of enforcing them and to divert the attention of the staff from their primary duty of helping fishermen to increase their catches by advice and demonstration of improved methods.

2. The enclosed Memorandum was therefore prepared by my Fisheries Adviser for the consideration of the Committee. The Committee agreed with Dr. Hickling's general thesis that legislation for the control of fishing should only be enacted if it was based on adequate scientific and statistical evidence, and recommended that copies of the Memorandum should be furnished to Colonial Governments for their guidance.

3. In view of the general need to increase the supply of protein foods in the Colonial and Dependent Territories, I am anxious that restrictions should not be imposed on the fishing industry unless they are based on objective evidence that over-fishing is responsible for a decline in catches. I should be grateful therefore if careful consideration could be given to the recommendations in the enclosed Memorandum.

4. This circular has been addressed to all Colonies and Protectorates etc., and to Regional Organisations. It has been sent to the High Commissioner, Federation of Malaya under cover of a separate despatch.

I have the honour to be,
Sir,
Your most obedient,
humble Servant,

Oliver Lyttelton

FALKLAND ISLANDS

35

MEMORANDUM ON FISHERIES LEGISLATION.

For many years past, the regulation of fisheries seems to have had much attraction for the legislator. In the United Kingdom, the corpus of fishery laws had reached a considerable bulk by 1866, when it was reviewed by a Royal Commission. This Commission, which included Professor T.H. Huxley as a Commissioner, had no hesitation in recommending the repeal of all laws professing to regulate fishing in the open sea. The Commissioners also recommended the repeal of all laws professing to regulate fishing in inshore waters, since they were not satisfied, on the evidence brought forward, that fishing had yet made any impression on the stocks of fish in comparison with the natural hazards to which they are exposed. But this Commission foresaw that this attitude might have to be modified if, in the future, fishing increased to the point where it added a hazard to the fish stocks surpassing the natural hazards. They went on to say:- "The existence of such a state of things, however, could only be determined by the examination of trustworthy statistics of the fisheries in question, extending over a considerable number of years". And again; "We think it a matter of great importance that fisheries statistics should be systematically collected. It is only by such means, that the constant recurrence of panics to which the sea fisheries interested have hitherto been subjected can be prevented, and that any trustworthy conclusions can be arrived at regarding the effects of the modes of fishing which are in use."

The present state of most of the fisheries of the Colonial and Dependent Territories is as primitive as the United Kingdom fisheries of 1866; and in the great majority of cases fisheries statistics do not exist, or, where they exist, they are incomplete and inadequate.

2. It is difficult to see on what grounds the United Kingdom Fisheries legislation of the pre-1866 era could have been based. Not only were fisheries statistics lacking, but very little was reliably known about the habits and life histories of fish. Undoubtedly the game laws were the principal model; but it is dangerous to draw analogies between the preservation of game and the preservation of fish. Stocks of game can be watched and even enumerated, and their rate of breeding is slow. Fish stocks on the contrary have an extremely rapid rate of breeding, and they cannot be directly watched, but only indirectly by conclusions drawn from the results of commercial fishing and of biological research. It is possible to exterminate stocks of game, hence the need for game sanctuaries; but it is in fact impossible for man to exterminate stocks of fish except in a few special cases. So great is their rate of breeding that a very few spawners can replenish the stocks. The potential offspring of one mature female cod or hake or eel are to be numbered in millions at each spawning; as to fresh waters, it has been estimated that if only one pair of bream or bass are present per acre of water, they can produce more fish than that acre will support. Lake Rukwa in Tanganyika dried out to a system of mud holes in 1949, yet in the spring of 1952 the lake, then almost refilled, carried a large stock of Tilapia, of nearly as large a size as before.

3. The writer has made a search (admittely not an exhaustive one) in the literature on the subject to find any cases where legislative intervention has had any effect in improving an impoverished fishery. Apart from certain cases which will be discussed later, there seem to be few references in the literature to cases where legislation, based on trustworthy and long continued scientific and statistical evidence, has been studied on the same type of evidence as to its effects on the fishery. It is unsatisfactory to find that fisheries legislation seems to have been in most cases so uncritical; for the thorough enforcement of such legislation is in fact usually impossible, and it is only partially enforceable at considerable costs in money and man power.

4. An American critic is even more forthright in his "Critical Analysis" of practices in the management of warm water fish. He says "Practices in the management of warm water fish consist chiefly of legal restrictions, such as closed seasons and creel and size limits..... the value of such practices seems to be nil. No real scientific evidence has ever been brought forward to substantiate the belief that closed seasons, creel limits and size limits are necessary ..... Louisiana had a closed season for several species of freshwater fish for many years. Not a single bit of evidence was advanced to show that the closed seasons did any good. Those species for which there was no closed season seemed to hold their own", as well as those which had restrictions, and the legislation was withdrawn.

5. A very helpful and well documented review of fisheries legislation has recently been compiled by M. Matagne, of the Directorate of the Fishery Service of the Belgian Congo. He classifies fishery legislation under a large number of heads. But roughly speaking, such legislation can be grouped under two categories, namely (i) legislation dealing with the conduct of the fishing industry, including the regulation of the fishermen and the proper care of the products; and (ii) legislation dealing with the exploitation and conservation of the fish stocks on which the industry is based. The first category need not concern us, as it is common to the regulation of other classes of workers, and to other perishable commodities. It is the biological category of legislation which needs careful scrutiny; such measures as restricting fishing seasons and areas, fishing gear of all types, and the size species, or number of fish to be caught. These measures are designed to protect the stocks of fish, or to build them up where already believed to be depleted.

6. Most of the Colonial and Dependent Territories have fishery laws. These generally provide for the prohibition of dynamiting and poisoning and, of the introduction of exotic species. Where turtles are an important item of commerce, there is usually legislation to protect the turtles during their most vulnerable and helpless stages namely, while ashore for egg-laying, and while still in the egg. For the rest, the fishery laws do not usually go beyond an enabling clause empowering the Executive to make regulations.

7. Wide fluctuations in the abundance of fish, or even their complete disappearance, may occur naturally, and have no connection with man's activity. Such catastrophies might result from changes in climate and rainfall, from landslides blocking rivers, from changes of ocean currents and variation of prevailing winds. Huge unexplained mortality of fish is reported from time to time. The wide variations from year to year of the herring and other fisheries are now in many cases understood, and can even be predicted. But they cannot be regulated by any remedy at present foreseeable. Herring fisheries, such as that which formerly employed a large drifter fleet off Plymouth in the early winter, have become extinct; in that case there was a gradual change in the nature of the sea water at the western entrance to the English Channel, so that successive spawnings failed, until the stock died out. It has never reappeared. No human intervention could have saved this valuable fishery.

8. It would seem to be a wise principle to assume that a fishery is in a sound condition, requiring no regulation, unless the contrary can be proved. Proof should consist of definite statistical evidence, and not the statements of witnesses or hearsay evidence. In both these respects the attitude of the Royal Commissioners of 1866 should be commended. It follows that the collection of statistics, the best that can be devised with the resources available, is essential to wise conservation of fish resources. The evidence of witnesses seems to be often biased; this

must be so, since it is the writer's experience, all over the world, that fishermen and others will readily declare that the fisheries are in decline. It is a genuine rarity to meet anyone who will say that the fisheries are as good as they have been in the past.

9. It is also necessary to distinguish between a real and an apparent decline in a fishery. If the number of fishermen increases, or the number of consumers increases, there may be an apparent decline, due to less fish caught per man, or less fish available per consumer, though the total yield of fish may not have declined at all. To the individual fisherman or consumer, the fishery appears to have become less productive; there is a shortage of fish.

10. Where statistics show a real decline in total yield over a period of years, which is neither due to a natural periodicity nor to any catastrophic change in the environment, it becomes possible that man's activities, chiefly as a fisherman, but also as an industrialist, may be responsible. If we eliminate industrial pollution, as coming under existing laws prohibiting the use of poisons, there remains a possibility that a wise regulation of the fisheries may check a further decline or even bring about a recovery.

11. A stock of fish not subjected to fishing tends mainly to consist of large, old, and usually slow-growing individuals, in balance with the available food-supply on the one hand, and with the activities of predators and competitors on the other. The competition of these older fish suppresses the rate of survival of the younger fish of the same species. The expectation of life is limited wholly by natural causes. But when a new risk is introduced, in the form of mortality due to fishing, this balance is upset. The accumulation of older fish is thinned out, and there is frequently an absolute as well as relative increase in the number of younger fish. The total weight of fish caught will start to fall. This in itself is no cause for alarm. The fishery probably benefits from the elimination of the older and slower-growing fish; more of the younger fish survive, and they grow faster.

12. But when fishing grows more intensive, whether by increasing numbers of fishermen exploiting the fishery, or by the use of more efficient gears, or by both together, until the number of fish removed is a significant part of the whole catchable stock of fish, a new balance is struck. The proportion of small fish to large fish, and therefore the total weight of fish produced, is then determined by the fishing intensity. With greater intensity the expectation of life of the fish is reduced, fewer individuals survive to reach a large size and good weight, and the total weight of fish harvested declines. But the continuance of the stock is not endangered, as few spawners are required to provide all the fry necessary for replenishment. With a lesser intensity, the expectation of life of the fish is increased, more survive to reach large size and weight, and the weight of fish harvested increases. The increase can be very rapid, for a fish may more than double its weight in each year of life, and this increase is compounded with each successive year, until a new balance is struck between fishing intensity and the size of the fish stock. The effect of this on the fisherman still operating at the reduced level of fishing intensity is two-fold. Firstly, he gets more fish because fewer fishermen are harvesting the same crop, and secondly because there are more of the heavier and larger fish.

13. Of the many methods of regulating fisheries which have been tried, only the regulation of fishing intensity has been effective. By this means the decline of the halibut fishery of the North Pacific has been checked and reversed. By the great reduction in fishing intensity due to the two world wars, stocks of marine fish showed a remarkable

recovery in each case, the stocks at the end of each war including a large proportion of older and bigger fish, and therefore a greater weight for capture. Though the mechanism through which the fishing intensity controls the yield of a stock of fish may seem complicated, the proportion itself is very simple and in accord with common sense. Reduce fishing, or stop it altogether, and the fishery will recover. A reduction in fishing intensity may be achieved in a number of ways. For example, all fishermen, fishing craft or fishing gears may be licensed, and only a limited number of licences be issued. Fixed fishing gears such as stakes or weirs may be restricted as to number and as to distance apart. Where more efficient fishing engines are introduced, the more efficient the engine, the fewer the licences. Fishing may be prohibited for a certain proportion of each year, or in certain sections of a fishery in rotation.

14. But it must be recognised that the enforcement of measures to reduce or control fishing intensity is difficult, and may require large and expensive enforcement staffs. Hence the prior necessity of making sure that a fishery needs such protection; that as the profitability of a fishery declines, economic factors may not automatically put a check on fishing; and that the measures proposed can in fact be enforced at a cost substantially less than the improvement in the value of the fishery anticipated. Only accurate statistics, backed by research, can be a reasonably safe guide.

15. Other prospective measures seem to have but doubtful value. They usually consist of (a) a close season; (b) mesh regulation; (c) size regulation. A close season imposed for the purpose of protecting spawning fish would seem unnecessary, except in very special cases, for example where spawning takes place in a narrow or shallow stream. Fish fences put across rivers to capture fish ascending to spawn, are probably in most cases harmless to the stock. If only a small number of fish suffice to replenish the stock, there is no point in allowing an excessive number to spawn, and the capture of the surplus is an economical exploitation. Fish fences are not so effective that some fish cannot pass them. This is proved by the fact that there may be several such weirs one above the other on the same river.

16. As to mesh regulations and size regulations, these have not yet been proved to be generally effective. They are designed to save the smaller fish, in order that a potentially large population of fish may be built up. But intensive fishing may already result in a large absolute increase in the numbers of the smaller fish, due probably to the removal of competition by the larger fish. If the population of small fish is further increased by mesh regulations and size limits, they will press upon the means of subsistence, and their growth will be slowed down. Both in the sea (for example, plaice and haddock) and in freshwater, the rate of growth of young fish has been shewn to be in inverse proportion to the density of the population. After many years of intensive research, it is still a matter of debate whether it is better to allow the accumulation of a large stock of slowly-growing small fish, or to thin them out so as to produce faster growth in the survivors. A strong case can be made out for either of these totally opposed policies. In Australia a conservation scheme was initiated in 1942, to check an apparent depletion in the mullet fishery. The legal minimum length was raised by successive stages. But the catch statistics did not reveal any benefit, and the legal minimum length was restored in 1946, to its previous figure. The investigation showed that no alteration in minimum legal lengths would effect an increase in the mullet stocks, and there was some suggestion that the previously observed decline was due to changes in the environment. In this case the effects of a minimum size regulation were studied, and were found not to result in any recovery of the fishery.

17. Mesh regulations may act in two ways, in both of which the regulations may defeat themselves. Drag nets retain all fish above a certain size, and release through the meshes fish below this size. But the small fish so released alive will add their competition for a limited food-supply to that of the population of small fish still unfished, which owing to the great reproductive powers of the parent fish, are already probably as many as the means of subsistence will support. The result might only be a retarded rate of growth and a stunted population. In the case of gillnets the mesh acts in two ways. For any given mesh size, fish of a rather sharply selected size are retained in the meshes. Fish smaller than this size can pass through uncaught, while fish larger than this size, if caught, are only loosely held and can, in most cases, escape. Mesh regulations which are framed so as to take only the largest category of fish must result in the dysgenic removal, for generation after generation, of the best-growing strains, leaving future breeding more and more to the "bad-doers". As fish are no less subject to heredity than other organisms, the result of attempts to restrict capture only to the larger fish might be fewer and fewer large fish to be caught.

18. To sum up this memorandum; fishery legislation, in so far as it aims at the conservation of fish stocks, is not a simple matter, but a highly complex one, in which the results of regulations may not only differ from those intended but may even defeat them. Conservation should only be attempted where reliable statistics show, over a period of years, a continued decline in the stocks of fish, which cannot be attributed to changes in the environment, or to natural causes inherent in the fish stocks. This is especially important in view of the cost of enforcing legislation, the general undesirability of having regulations which cannot be effectively enforced, and the importance of good relations between fisheries staff and the fishermen, whom it is their function to assist and encourage.

C. F. HICKLING.

COLONIAL OFFICE.

4th November, 1952.

H.A.O

34-39 f.i.p. W.H. for B.S. 24/2/53

H.C.S

Perused Many Thanks

5. John P. Ellis

40. 16/III/53

C.O./865/152

COLONIAL OFFICE

PRODUCTION OF FISH
IN THE
COLONIAL EMPIRE

(Revised Edition)

LONDON: HER MAJESTY'S STATIONERY OFFICE

1954

NINEPENCE NET

Colonial No. 300

PRODUCTION OF FISH IN THE COLONIAL EMPIRE

A Review by the Fisheries Adviser to the Secretary of State for the Colonies

Revised Edition, 1953

1. In 1949, a small pamphlet with the title " Production of Fish in the Colonial Empire " was produced; since then there has been considerable development of fisheries. The time is therefore ripe for a further review of Colonial fisheries. The departments of the various territories have collaborated by sending brief accounts of their work, and the Directors of the Research Stations have also sent in reports. To all of these I express my thanks. I have exercised an Editor's discretion in selecting from the very comprehensive material supplied.

2. All territories except Fiji, Malta, Cyprus and the lesser islands have or have had specialist Fisheries officers. In North Borneo, Sarawak, Sierra Leone and Gambia fishery work has been reduced or discontinued. The majority of Fishery Officers are graduates of U.K. universities, who have had a special course of training; a minority are locally appointed officers with or without specialist training. The total number of Fishery Officers seems to be stabilising at about 50, and recruitment is now taking place chiefly for replacement purposes. For the few officers now required a course is organised which includes fish preservation, the making and use of fishing gear, the care of diesel engines, general freshwater and marine fisheries work, chart work, survey and organisation of co-operative societies.

3. The duties of these Fishery Officers are similar to those of Agricultural Officers. They survey the existing fishing industries of their territories, become acquainted with the fishermen and their fishing methods, the means of distribution and the markets. They assist the fishermen to get supplies of improved equipment, instruct them in better methods, and organise the collection of statistics. Wherever appropriate, they encourage the use of small and simple motor boats to increase the catch of fish per man-hour. Most territories have one or more demonstration fishing craft, which may, however, be rather larger than those which would be suitable for the local fishermen, since they must also provide some accommodation for the Fishery Officer and Master Fisherman, where one is carried. The Master Fishermen are professional fishermen from the United Kingdom, who take charge of the fisheries experimental and exploratory work.

4. The Fishery Officers tend to be handicapped by the smallness of their number. One officer frequently has to deal with a coastline on lake or sea of hundreds of miles, and with many thousands of fishermen widely scattered in small and often isolated communities. He may be confronted with the choice between concentrating on one particular group of fishermen, thereby having an opportunity to obtain demonstrable results, but neglecting the rest; or of keeping in touch with all groups of fishermen, and so failing to show results, though the long-term benefits may not be small. Fishery development, like agricultural development, is clearly a long-term process of education, propaganda, and demonstration.

The conditions of work of a Fishery Officer are well summarised in the 1952 Report of the Lake Victoria Fisheries Board. " A Fishery Officer must be most adaptable, practical and patient. He must be part scientist, part sailor, a fisherman and an organiser. One Fishery Officer may control up to 10,000 square miles of lake, and have as much as 1,300 miles of coastline to cover. . . .

In many ways a Fishery Officer's life is ideal for the ' open-air ' man, but at the same time it can be a hard life, calling for long hours in uncomfortable surroundings, the ability to cook and fend for oneself, and forego the pleasures of good company."

5. Fishery development work falls under two headings, namely, the development of fisheries in sea and freshwaters, and fish culture or fish farming.

So far as the fisheries of the sea, and of the great lakes, are concerned, much the most important, and indeed the inevitable, line of development is the introduction of motor fishing craft. In many cases, especially in the Far East and in some types of boat in the West Indies, the existing fishing craft may be sturdy enough to carry an inboard or outboard engine with the minimum of modification. To put engines in such craft is a useful intermediate step towards the use of small and inexpensive fishing boats designed, from the start, to take an engine, with or without auxiliary sail. But where, as in most of the African territories, the present fishing unit is the canoe, it may be necessary to proceed in one step to the motor boat.

No other measure can do so much as this to increase the fisherman's output, and so the supply of fish to the territory. It is too obvious to need labouring the point, that an engine will enable a fisherman to increase his output with less effort, and so it has proved wherever it has been tried. For example, the installation of engines in the inshore fishing craft of England proceeded very rapidly in the first decade of this century, since experience soon showed that the sailing craft could not compete with the increased rate of production of the motor boats, even when the latter were equipped with the less reliable engines of that day. Data comparing the catches of power-driven boats with those of hand or sail propelled boats of the same type, and using the same methods, are available only for Mauritius (para. 14), Gold Coast (para. 26), and Hong Kong (para. 48). These show convincingly the superiority of the power-driven boat. But the rapid expansion of the mechanised fleets of Hong Kong, Malaya and Sarawak, is itself sufficient proof that, once mechanisation has begun, the powered boats are recognised by the fishermen to be superior as fish-producing units.

6. The difficulties which Governments must face in considering a policy of mechanisation are twofold, namely, educational and financial. The educational difficulty is the lack of mechanical knowledge which generally prevails among fishing communities. This can only be overcome by experience, but backward communities are not slow in acquiring the minimum mechanical skill needed to run, for example, motor buses and lorries. No greater risk is run in supplying marine engines, provided some simple and practical instruction is given.

The financial difficulty arises from the indebtedness and lack of capital, almost universal among peasant communities. We are concerned at this stage not with large and costly fishing craft, but simple open boats which should cost, complete with engine, from £500 to £1,500, and which could use the existing fishing methods. The cost of such a craft is far beyond the means of most peasant fishermen, but would be a very suitable object for hire-purchase financed by development loans operated as a revolving fund. But hire-purchase, in the ordinary way, involves a deposit or a guarantee. The risk is, that the fisherman may have to go to a professional money-lender for this deposit or guarantee, and that the money-lender may charge such terms that the principal may never be repaid, and in time, the boat would pass automatically into the money-lender's hands. For this reason, motor fishing boats would probably best be made available on hire-purchase without deposit or guarantee, and only to fishermen of known reliability. As, in most territories, fisheries staff have been working for several years, they should know the creditworthy fishermen, and these could set an example to the others.

7. Fish farming, or growing fish in ponds for human consumption, is a valuable technique where there is suitable land and an assured supply of water for the purpose. Moreover, by stocking with suitable species, useful quantities of fish may be grown in flooded rice fields without harm to the rice. Experimental and demonstration work on these lines is going on in many territories. While a full-scale fish farm involves considerable capital outlay, fishponds can usefully form a part of peasant small holdings, as in the Far East.

Fish farming is at present carried on largely on empirical lines; food or fertiliser is put in, and fish are taken out. Provision has, however, been made under the Colonial Development and Welfare Act for a research station which will tackle the fundamental principles underlying the fertility of ponds and the breeding of fish under domesticated conditions. The findings of this research work will undoubtedly put fish farming on a more assured basis and point the way to more economic yields. A geneticist, whose duty it will be to breed strains of fish adapted to pond conditions, has been appointed in advance of the establishment of the research station, in view of the importance of this work, and its long-term character.

8. While the development of fisheries is a matter for the individual territory through its fisheries staff, fisheries research is organised on a regional basis since groups of territories in the same region (e.g. East Africa, West Africa, Malaysia) tend to have the same fundamental problems. The research organisations have the more baffling tasks of prospecting possible new fishing grounds and methods, determining the possible yield of fish, and providing the background of precise and detailed knowledge which is essential to the rational development of any fishery.

A brief account will now be given of fishery development and research in each territory.

9. In *Gibraltar* a commercial fishing venture has been established. Sardines and mackerel are caught by purse seines from April to November, and fish of the tunny family from July to November by means of very large traps or pounds of netting, which intercept these fish on their migration out of the Mediterranean. Most of the fish are canned, and are sold locally, in Italy, and the United Kingdom. A search for further markets continues.

10. In *Cyprus* the fisheries are small and appear to have little prospect of expansion. A small fleet of motor trawlers works the limited fishing grounds around the island, and find that they have to work these grounds in rotation to avoid depletion. The sponge fishing is worked intermittently, and there are no freshwater fisheries. Soon after the war, in 1945 and 1946, the pond-culture of carp was demonstrated, and results got were as good as those got in Palestine, where carp-culture is a major food-producing industry. But lack of abundant water, in competition with the needs of irrigation, and the unacceptability of the carp to local consumers, put an end to this enterprise.

11. *Aden* is traditionally an entrepôt and transhipment centre for fish and fish products from the southern Red Sea, Somaliland, the south coast of Arabia, and the Persian Gulf, to East Africa and Ceylon. The annual export of dried fish to East Africa is of the order of 3,500 tons, representing perhaps three times that weight of fresh fish. The most abundant fish in normal years on the south coast of Arabia, which includes the British Protectorates, is the " sardine ", which occurs in mixed shoals of several species, chiefly *Sardinella*. These fish, caught by beach seines and cast-nets, are thrown out on to the hot sand to dry, and then become an article of commerce which is used locally, and exported, as fodder for beasts and as a fertiliser. In several recent years, this fishery has failed, for reasons unknown, and in consequence the fisheries for the tunnies, and other fish which prey on sardines, have been less productive.

Fishery development has been mainly directed towards increasing fish production for the rapidly expanding population of Aden Colony. A 45-ft. motor fishing vessel is available for exploratory and demonstration work. Among methods being tried are Danish seine-net fishing, long-lining in near and distant waters, experimental purse seining and gill netting, and trapping and trolling. The local fishermen, who use boats and canoes propelled by hand and sail, have been assisted by being towed by the Goverment fishing vessel to the fishing grounds. Several good line-fishing areas have been newly discovered, and good progress is being made in converting the local fishermen to the use of the deep-sea longline; trapping, trolling and deep-sea seining have given spasmodically good results. Probably the greatest single development has been the demand for British twines, hooks, corks and small diesel engines. A loan fund of £2,000 per annum has been set up to encourage fishermen to take short term loans for purchase of this equipment and this policy has been very popular. Two medium-sized local fishing boats are now equipped with engines, and four more are planned in the near future. An attempt is being made to discharge the chronic indebtedness of the fishermen and to set up a marketing organisation and fishermen's co-operative societies.

The fishery resources of the Protectorates, and especially the Eastern Aden Protectorate, may be great; they are at present exploited by primitive means, yet in normal years a large exportable surplus of fish is produced. An Italian firm is attempting to establish a fish canning and fish meal factory here; as to the indigenous fishermen, a small start has been made by equipping a surf-canoe with an outboard engine working through a trunk. This canoe appears to be successful for sardine netting and trolling. There are no freshwater fisheries.

12. The coast of *Somaliland* is well stocked with fish, which appear to be most plentiful towards the east. Nevertheless, the Somalis are not traditionally fishermen, nor have they been consumers of fish. The consumption of fish now appears to be increasing; exploitation of the fisheries is chiefly by migrant Arabs who set up temporary fishing camps and carry their salted and dried fish back to Aden. The Fisheries Officer is now interesting Somalis in the further development of their own fisheries. He has been using a small motor fishing vessel based on Berbera, but has discovered, after many months of trials, that fish are not abundant here, but further east, and to some degree further west also. He is now seeking a larger boat in which he can carry the crew and the supplies necessary to set up mobile fishing camps at which not only the fish, but by-products also, would be produced. He has established a fish market in Berbera, to encourage the local trade, and is assisting in the development of a fresh fish trade with Hargeisa and other inland centres. A system of loans to assist fishermen to buy good fishing gear is being operated by a District Commissioner with advice from the Fisheries Officer. Trade contacts with Ethiopia are being explored.

A canning factory has been established by a private firm at Elayu, at the extreme eastern end of the British Somaliland coast line. It is at present operating on fishes of the tunny type bought from local fishermen.

13. The fishery possibilities of the *Seychelles*, and the island groups and ocean banks within exploitable distance from the Seychelles, have been explored by an expedition financed by Colonial Development and Welfare Research funds, and the results have been published ("Report on the Mauritius-Seychelles Fisheries Survey," by Dr. J. F. G. Wheeler and Dr. F. D. Ommanney. H.M.S.O. 1953). The Colonial Development Corporation set up a fishery company to follow up this work, but the enterprise was unsuccessful. It seems likely that other attempts will be made by private enterprise to exploit these fishing grounds from the Seychelles.

14. In *Mauritius* a company, with Government participation, has fitted out an ex-naval "Flower" class corvette as a refrigerated fishing vessel mother-ship to exploit the same fishing banks, from Mauritius. After failures due to mechanical faults and crew difficulties, the vessel changed hands and personnel, and has since made some productive fishing voyages. But an unexpected difficulty has arisen in selling her refrigerated fish, and at the time of writing the vessel is laid up until the produce of her previous voyages has been sold.

The production of fish by the local fishing fleet is about 2,000 tons a year, partly from lagoon and partly from offshore fishing. The catches of the offshore grounds, are, however, rapidly increasing, due to the installation of small diesel engines in some of the 34 pinnaces which chiefly exploit the offshore deeper water. Some 14 of these boats have been or are being motorised with the assistance of Government loan funds, and the result has been a spectacular increase in the production of fish at the principal deep-sea fishing stations, as may be seen in the table below, for the year 1952.

Boats	Number	Total catch (Kg.)	Average per boat (Kgs.)
Sail pinnaces	20	69,685	3,484
Motor pinnaces	6	67,277	11,213

In terms of catch per fishing day, the comparison is, sail pinnaces, 18.5 kg., motor pinnaces, 142.6 kg.

It seems likely that the continued expansion of a motorised fleet will result in a substantial increase in the supply of fresh fish in Mauritius. Some attention is now being paid to the possibilities of freshwater fisheries and fish culture.

15. No developments can be reported for *St. Helena*, *Ascension*, and the *Falkland Islands* where fishing continues as a small local industry using sail boats. In the case of St. Helena and Ascension, fishing is conditioned by the prevailing trade winds, and in the case of the Falkland Islands the population is so small, and meat is so plentiful, that there is no inducement to develop fisheries.

16. In *Tristan da Cunha*, a commercial company, in partnership with the Colonial Development Corporation, has been successfully producing frozen and canned crawfish tails. Output is rising, and is now over 24,000 boxes of frozen tails a year.

17. Turning to the Caribbean region, in *British Honduras* there have been developments due to the steady demand for all fish products, and to improved methods of fishing. In 1952, four power-fishing boats from 24 to 45 ft. in length, were put into use. They act as fish carriers and carriers of live crawfish when not themselves fishing. A crawfish pot of similar design to that used in the Bahamas and Florida was introduced, and is now used exclusively in the northern areas of the Colony; some 7,000 are estimated to be in use.

In 1950, a Fishery Officer was appointed to the Colony after completing a course of training in England, and a 34-ft. launch fitted with a power capstan was put at his disposal. His task is to improve fishing methods, increase production, foster co-operation among the fishermen, and carry out experimental work. Many prawn trawling surveys have been made, but have not yet found commercially paying quantities; experiments in deep-sea fishing for red snappers have shown the presence of these fish in many areas of the Colony.

The following table shows the increase in fish marketed :—

Fish	1950		1951		1952	
	Quantity cwt.	Value $	Quantity cwt.	Value $	Quantity cwt.	Value $
Crawfish, whole ..	422	7,276	1,583	30,543	444	10,539
Crawfish, tails ..	685	12,245	1,333	52,399	1,596	79,942
Fresh Fish	975	6,701	228	3,401	479	9,069
Salt Fish	143	1,779	223	2,520	506	9,336

Work will start soon on experimental fishponds.

18. In the *Bahamas*, Nassau, the capital, provides the chief market for fresh fish and is supplied by some 30 sailing boats and six auxiliary-powered boats. It is estimated that these power boats have increased catches for the local market by twenty-five per cent.

In addition to supplying the local market, these and other boats produce crawfish and fish for export to Miami and West Palm Beach in Florida. In 1952, some 94,000 crawfish, weighing some 1,400,000 lbs., and valued at some £76,000 were captured, while other fish exported were about 92 tons valued at £10,600.

Sponges were formerly a valuable fishery in the Bahamas, but the beds were decimated by a disease in the 1930's. The beds have been closed for some years before 1948, and again since 1949, and are showing some recovery.

Other marine products included, in 1952, 3,500 lbs. of turtle shell, 50 tons of turtle meat, ten tons of edible conch (*strombus*), salt, marine curios, and beach shells.

19. In *Jamaica*, the inshore sea fisheries are fairly intensively exploited, but a more recent development has been deep sea fishing by private enterprise on the less exploited Pedro Bank and Morant Cays.

Work is now being done on the freshwater fisheries, and especially on fish ponds. A fishery Officer has been appointed after a tour of training in Africa and the Far East ; he has some experimental and demonstration ponds and is interesting local small farmers in stocking their ponds and in putting up new fishponds. Some 50 acres of such ponds are now in production.

Fish produced in the Cayman Islands, a dependency of Jamaica, are occasionally flown to Kingston. These islands have for long been large producers of turtle meat, and a cannery has recently been established on the islands by the Colonial Development Corporation.

20. A Fishery Officer has been appointed to the *Leeward Islands*. Meanwhile, some fishponds have been started by private enterprise. Uncertainty of rainfall is a handicap, but the results seem encouraging, and all suitable ponds in Antigua have been stocked with fry. It seems probable that these fish may make a useful contribution to the nutrition of the island. Very recently a crawfishing industry for export has developed in Antigua. The Virgin Islands have always produced a small surplus of fish, which is exported to the American Virgin Islands.

21. A Fisheries Adviser has been appointed to the *Windward Islands:* he originally went out to St. Vincent to give expert advice on the production and marketing of oil and other produce of the small " blackfish " (whale) fishery of St. Vincent. The fisheries of the Windward Islands are entering a new phase. Until recently, lack of transport has limited the sale of fresh fish to the points at which it was landed, so that the tendency was towards fishing for family subsistence and for barter. Surplus fish was salted for a wider market,

but compared unfavourably with imported salt fish from North America, which was a long-established and low-priced commodity. As a result, fishing boats and equipment are those best suited to meet the small individual requirements of part-time fishermen ; the boats are frequently ill-found, and with few exceptions unsuitable for fishing in waters beyond the immediate sheltered lee of the islands. The offshore and windward grounds are hardly explored. Yet the development of roads and motor transport, and of ice supplies and cold storage, have opened up wider markets in the islands, and currency exchange rates have moved in favour of locally caught supplies of fish. Present production and organisation are inadequate to meet these wider possibilities, and the Fisheries Adviser is concerned with problems of basic organisation. If organised fishing is to replace part-time, subsistence, or sport fishing, it must provide a reasonable return for labour and must carry the cost of any improved technique or equipment. This could be achieved by increasing the catch per man-hour at costs and prices which would encourage the consuming public to buy freely. The provision of larger and more seaworthy boats, with small engines, is a part of this programme, and this entails education in the use of engines. In Grenada, for example, the Fishery Officer is building boats of modern design, with motors, which are being rented to selected fishermen and used for commercial fishing under the advice of the Fishery Officer. A careful profit and loss account is being kept, which will show the possibilities of further expansion on these lines. In order to provide capital for commercial development, each of the Windward Islands is considering Loan Schemes, and also the centralised purchase of good fishing equipment for sale to the fishermen.

A wider development is the use of schooners for deep sea fishing. Coming from the Windward Islands, these schooners load up to 12 tons of ice in Barbados, and fish the banks off British Guiana. The fish is landed at Martinique, where the price of fish is high, and the venture is still somewhat speculative. But should experience show that costs can be reduced, this deep sea fishing may become a further source of supplies to the Windward Islands markets.

Fish culture in freshwater ponds has been developed on a small scale on estates in St. Lucia, Dominica, and Grenada.

22. The fisheries in *Barbados* had a serious setback when a large proportion of the fishing fleet was destroyed or seriously damaged by heavy seas in December, 1951. Repair and rebuilding was promptly taken in hand, and there are now operating 590 deep-sea flying-fish boats of 20–24 ft. over all, and some 270 smaller boats, chiefly used for fish-pots and the fishing for sea-urchins in season. Some 17 power-driven fishing boats are also in use, with two others about to be launched, and these have on occasions proved more serviceable than the sailing craft and made greater returns both financially and in the quantity of fish caught. It is felt, however, that sailing boats with auxiliary engines are the best type, having in mind the limited experience of Barbadian fishermen in the use of engines.

This increase in power-driven boats has been stimulated by the acquisition by the Government of Barbados of a fishery experimental vessel built locally to a Norwegian design. She is 43 ft. 6 in. long, and has been actively engaged in technical investigations since 1949 ; in particular, she has pioneered the gill net and the " ring gill net " for flying fish, and wire lines for the capture of the " wahoo ", a big mackerel weighing up to 130 lbs., on a commercial scale. The capture of flying fish has been almost doubled by the demonstration and acceptance by the fishermen of these methods, and the 12 boats which now use the wire lines for " wahoo " take fish to the value of over £1,000 during the short season for these fish.

In the spring of 1953, a Scientific Officer was sent to Barbados to do research work on the flying fish fishery.

A most important part in the substantial fishery developments in Barbados has been played by the scheme for loans to fishermen from a revolving fund which is a model scheme, and fully solvent. Repayments total about £17,532 and the balance outstanding is £10,275. Bad debts are rare. The fund is administered by a Fisheries Committee which makes loans on the advice and recommendation of the Fishery Officer, who is well acquainted with the fishermen, and knows their character and reliability. Cash is seldom lent; work is paid by the issue of vouchers which are honoured by the Committee when the work is completed to a high standard and to the fisherman's satisfaction. Repayments are recorded in a pass-book issued to each fisherman receiving loans.

Fish markets are being built at a number of outlying stations.

23. Until very recently, *Trinidad* had no Fishery Officer, but has now engaged two, one for sea fisheries and one for fish culture. The sea fisheries still depend largely on canoes and pirogues, small or medium-sized open boats, which work a variety of fishing gears, including beach seines. Many of these are now propelled by outboard motors.

Shrimp trawling by small diesel-engined boats has recently begun, and seems now to be established. The superiority of the small trawl over the beach seine is evident, and it can be worked by two men, as compared with several for the beach seine.

Recently, there have been at least three attempts to trawl with large decked fishing craft, but only one of these has persisted in spite of great technical difficulties, and the outcome is still uncertain. A Fishery Survey of the Gulf of Paria in 1944 showed promising prospects for trawlers with low running expenses.

Fish culture has good prospects in Trinidad. The newly appointed freshwater fishery officer has taken over the demonstration fishponds at St. Joseph, and has got significant yields of fish. He is starting extension work, including the stocking of flooded ricefields with fish. This development has been helped and pioneered by a private estate firm, which has had fairly good results from fishponds put up to help feed their staff.

The present production of fish falls far below the island's requirements and there is a large import of salt dried fish from North America.

24. There has been no notable development of fisheries in *British Guiana*. It has been estimated that the amount of fish produced in the rural areas both from the sea and from freshwaters is about 18 million lbs.; in addition, on the fish market at Georgetown, the principal market in the territory, the average quantity of fish marketed is just under four million lbs. Yet there is an annual import of five million lbs. of fish products, chiefly salt dried fish, and supplies of locally produced fish, including subsistence fishing in the sea and in freshwaters, have never been equal to the demand for any appreciable period.

Fishing boats of various types number some 530, with some 740 units of fishing gear of various types apart from cast-nets; there are some 58 boats with auxiliary engines, mainly outboard. There is no commercial trawling, though a recent survey conducted by a U.S. trawler showed that fish and prawns are available in quantities sufficient to enable a small trawler to operate successfully. A comprehensive fishery development programme has been drawn up which aims at a self-sufficiency of fish, but this awaits implementation.

Large but unknown quantities of fish are caught in the flood-fallowed sugar-cane fields and the ditches into which these are drained. They already form a substantial supplement to the food of employees on sugar estates and others. There is no doubt that these quantities could be much increased by simple culture and fishing methods. A start has been made with small investigations by the freshwater Fisheries Officer in British Guiana.

By-products of the sea fishing industry include prawn-meal (an average annual production of 26,000 lbs.), and fish bladders for the manufacture of isinglass (10,000 lbs.).

25. Turning to West Africa; no part of the territory of *Gambia* is more than about 10 miles from the sea or from the river, both of which can supply good quantities of edible fish. It is Government policy to encourage the Gambian to extend his fishing in every profitable way. Power craft have been introduced to explore new fishing grounds and new methods. Trials are being made of the use of motor boats to tow the local canoes to and from the more distant fishing grounds, and for the power boat to carry a number of dories, with fishermen to work them, out to distant fishing grounds. The equipment of local canoes with outboard or inboard power units is also being tried, to see whether this will increase their catches and bring them more quickly to market.

In the river, a fishing station has been brought into operation where Africans of the Protectorate are taught methods of fishing new to them; after their course of training they are encouraged, and assisted by small loans, to set themselves up as peasant fishermen.

Fish drying, for sale to the interior, has been subsidised and encouraged on a small scale.

26. The production of sea fish on the *Gold Coast* by the canoe fleets is of the order of 20,000 tons a year. A number of fishing methods are used, including beach seines, which may be of a very large size. The most important fish are the Sardinellas, herring-like fishes which, during their short three-month season, give rise to a highly productive fishery. As with other fisheries for herring-like fish the world over, this fishery is liable to violent annual fluctuations. Over the eight years 1943 to 1950, the average catch per sample canoe per season has varied from nearly 32,000 lbs. in 1946 to only 7,000 lbs. in 1950.

Power-driven surf-boats have been in use for some years by the Gold Coast Fisheries Department, to test the suitability of such boats for fishing. They have proved to have a much superior performance to the fine sailing and hand-propelled surf-canoes, though using no more men; indeed, the catch per man-day is several times that of the non-powered canoes in the sardinella fishery.

In the average season of 1949, one of the motor surf boats caught some 30,000 lbs. of "herrings" during the period when sail and hand-propelled canoes took an average catch of some 11,000 lbs. This was ascribed chiefly to the much greater mobility of the motor-boat; she was able to work on windward grounds accessible only with difficulty by canoes under sail, could easily cover an area up to 20 miles from her base, and could move quickly from one area to another in search of fish. She was able to put in rather more sea time, as her crew was fresher, not having to tire themselves with paddling, and when she had made her catch she could be sure of a quick run home. "In her freedom from the limitations of the canoes" says the Annual Report for 1949 "she possesses the quality that has given power craft their pre-eminence in fishing fleets throughout the world." At first these motor boats used the same type of net as the sailing canoes, but they have now evolved a type of drift net which gives better catches and is less liable to damage. It appears to be the best type of gear to use from power-driven boats for sardinella.

Since the sardinella season is so short, these motor-boats have pioneered inshore trawling as an alternative fishery between the sardinella seasons. Using small light trawls with 40-ft. headline, their catches have averaged 100 lbs. of fish per hour over the whole year. As the running expenses of these small craft are low, such catches are likely to be a paying proposition, and there is great interest among the fishermen in boats of this kind. A boat-building yard is now established at which such boats are being built for sale to local

fishermen and fishing companies. The most serious handicap to rapid expansion is the lack of harbours on the Gold Coast. It is, however, intended to provide accommodation for fishing vessels at the new port of Tema.

Improved preservation methods have been investigated for many years. Canning has proved successful, but produces a relatively costly article : recent experiments with edible fish meal, whereby the entire fresh sardinella is converted to a powder of low moisture content, have proved that this product is acceptable to consumers remote from the sea, especially in the Northern Territories, and its keeping qualities when bagged in paper sacks appears to be adequate.

The most productive freshwater fisheries are those of the River Volta and its tributaries, though their total contribution is small by comparison with the sea fisheries. Investigations by the Gold Coast Fisheries Department have shown that these fisheries are in a fairly stable condition, though some stretches of river could probably yield more fish then they now do if fished more intensively. The Department is now concerned with the establishment of fisheries in the smaller streams of the Northern Territories particularly where they form natural pools or where pools have been created by the weirs built by the Department of Tsetse Control. These have been found to contain excellent stocks of fish, which are replenished each year from the main river. In addition, reservoirs and dams are being stocked with fish, and the local people are being instructed how to catch their fish. They are appreciative of this new source of food.

Unfortunately, a disease of the eye which may lead to blindness (onchoceriosis) is carried by blackflies which live in the streams, and this disease is a deterrent to fisheries development in inland areas. Trials are to be made of a fish from the Congo which seems to feed selectively on simulium (blackfly).

27. *Nigeria* also has few harbours, and the fishery, by hand and sail propelled canoes, has tended to concentrate on the lagoon, creek and river fisheries. Because these waters are probably already being fished as intensively as is practicable, effort is being directed towards a development of the sea fisheries. Teams of Gold Coast fishermen have been engaged to teach their methods to Nigerians, and there are now about 250 Gold Coast circling nets in use for the capture of the shark and sardinellas, and 70 large-meshed shark nets. Canoes are still the fishing craft used, but an improved model with lugsail and leeboards is being demonstrated and also a canoe fitted with an outboard engine. Meanwhile, successful demonstrations of trawling with small motor fishing vessels manned entirely by Africans have been made at Lagos and the Cameroons.

While these efforts are resulting in substantially increased catches of fish, Nigeria still depends to a large degree on imports of dried fish from Europe, and from the freshwater fisheries of the Niger and Chad. To assist in increased local production, some 97 freshwater reservoirs have been investigated and some 38 stocked with fish. On one of these there are 60 licensed fishermen landing some 30 tons of fish per year. Moreover, about 30 acres of fishponds have been set up as demonstration units, and are attracting much interest. On the Jos Plateau, remote from natural sources of fish, a large commercial fish farm of some 400 acres has been almost completed, and will start production during the next year. It should ultimately produce about 300 tons of fish per year.

28. Fisheries research in British West Africa is catered for by the *West African Fisheries Research Institute* situated at Freetown, Sierra Leone, with a Director and a scientific staff of six. There are marine and shore staff, and African assistants and labour. Constructional work is well advanced or complete on laboratory block, stores and staff quarters, and a Library is being provided. The large 110-ft. research trawler *Cape St. Mary* has had a

series of mechanical breakdowns, but has made 17 exploratory trips from the Gambia, Sierra Leone, Gold Coast and Nigeria, extending as much as 120 miles seawards. From the trawling records obtained, it seems the bulk of fish are caught in depths of 6 to 10 fathoms ; larger fish are found in depths of 18 to 25 fathoms, and the same species in greatly reduced numbers in depths of 50 fathoms. There is as yet no evidence of discontinuity of species from east to west along the coasts of British West Africa.

A study of estuarine fish in the Sierra Leone River has been made over a 12-month period with the two smaller research launches, using light trawls. About 40 species of fish have been caught, of which 5 species constitute regularly over 80 per cent. of the catch. The seasonal changes in the abundance of the fish, and in the feeding and breeding conditions, have been followed. The fishing was consistently better in the estuary well above Freetown than in the lower estuary ; in the upper estuary the catch has averaged nearly 60 lbs. per hour. Catches were smaller in the rainy season than in the dry season.

Research is also being started on the chemical changes in sea and estuarine water, on bottom muds and on mangrove swamp.

29. In Central Africa, *Nyasaland* has now established the collection of comprehensive fishery statistics at a number of the more important fishing beaches on Lake Nyasa. A start has been made in providing the African fisherman with proper planked boats to replace their present dug-out canoes, and this can be expected to improve their output of fish, which can be estimated at about 4,000 short tons a year for the whole of Lake Nyasa. It has not yet been possible to try powered fishing boats nor new fishing methods for Africans. The non-African fishing firms are now three in number, producing some 2,000 short tons of fish annually. They are using some 10 power-driven fishing craft, which fish purse-seines and heavy long-lines, and also act as fish carriers. As the estimated fish potential of the lake is of the order of some 20,000 tons annually, there appears to be scope for considerable development. Though there are no fish farms as yet in Nyasaland, a large number of farm dams have been stocked, and experiments are to be begun in association with an agricultural experimental station.

30. In *Northern Rhodesia*, the fisheries remain the jealously-guarded preserve of the African population, with the single exception of a European commercial fishing enterprise at the southern end of Lake Tanganyika, which yields some 200 to 300 tons of dried fish per annum.

The fisheries are therefore still prosecuted with simple gear, chiefly gill nets, seine nets, and fish traps and weirs, from dug-out canoes, which have serious limitations as fishing craft, chiefly instability and small carrying capacity. Nevertheless, the fisheries of the lower Luapula River and Lake Mweru alone produce between 5,000 and 6,000 tons of fish annually ; and it is estimated that the annual value of fish caught in the territory is of the order of £400,000. But there is a need for better fishing equipment ; for example, nylon nets are being introduced to the fishermen, and efforts are being made to secure steady supplies at reasonable prices. It is proposed to establish a Fisheries Development Board, with the primary objects of encouraging production, facilitating marketing and eliminating waste ; and the necessary legislation is pending.

Fish farming is being advocated by demonstration and advice, and in the Government Fish Farm yields of fish (chiefly *Tilapia* species) of the order of more than one ton per acre per annum have been achieved. While the acreage of fishponds is still small, considerable progress has been made with the stocking of farm dams. Expansion of fish farming awaits the finding of economic fertilising and feeding technique.

31. Fisheries Research for *Northern Rhodesia* and *Nyasaland* is provided for by a joint Fisheries Research Organisation, which is still in the formative stage,

with accommodation under construction at Samfya on Lake Bangweulu and a laboratory as yet only in plan. In the autumn of 1953, it is hoped to begin a two-year survey of Lake Nyasa. Meanwhile, some 7 acres of fishponds have been built between Samfya and Fort Rosebery in Northern Rhodesia, and some preliminary experiments made on the combined growing of fish and rice.

32. *Tanganyika* has both a sea fishery and lake fisheries. Lake Tanganyika has a large population of sprat- or whitebait-like fishes called " dagaa ", of which some 1,200 to 1,500 tons of dried material (equivalent to about 3,600 to 4,500 tons of fresh fish) are caught annually by the local canoe fishermen. Though this is the most important fish of Lake Tanganyika, there are substantial catches of other species by beach seine, trap, and lines. A 45-ft. motor fishing vessel is doing experimental fishing on the lake. Lake Rukwa, which nearly dried up in 1948/49, has now refilled and the stock of fish has made a rapid recovery. The fisheries of the lake provided some 320 tons of fish in 1952, caught by African fishermen, and by one European licensee. African fishermen operate traps and lines along the rivers and in the swamps ; in the big Malagarasi Swamp a European Company buys and markets some of the fish caught by Africans, and some 200 tons of fish are produced. Experimental gill-netting, and Dutch fyke-nets, which are fixed traps used in marshes, are being tried.

The marine fisheries of Tanganyika are still on the small scale, and operated by African fishermen using outrigger canoes. But here also, experimental fishing by a 50-ft. motor fishing vessel has begun, to see to what extent catches could be increased by mechanised methods of fishing.

Fish farming has a prominent place in plans for fishery development, and there are already some 15 demonstration fishponds and farm dams set up in all parts of the territory, in addition to an experimental fish farm on the Pagani River. Yields of over 1,000 lbs. per acre and per annum have been obtained. In two stations work is being done on fish culture in flooded rice fields, and varieties of Malayan rice with a long growth period have been imported for this purpose.

33. At *Zanzibar*, a Scottish shipwright has built a 68-ft. motor fishing vessel for the use of the Fishery Officer, and this vessel has already begun experimental and exploratory fishing cruises. Multiple trolling for the big surface fishes, heavy longlines for sharks, and deep water handlining by mechanical methods, are being tried ; also surface longlines or " flaglines " of Japanese type. For the possible use of local fishermen, a smaller 40-ft. craft has been built ; it has a 30 h.p. diesel and a small belt-driven capstan for the economical hauling of fishing gear. Tests will be made of the running costs, fishing capacity and performance at sea of this smaller vessel. It is estimated that, in Zanzibar, some 5,000 fishermen landed, in 1951, some 4¼ million pounds of fish.

34. In *Kenya*, much work has been done on the development of the sea fisheries, and the tonnage of fish landed has risen every year, until, at present, production has tended to outstrip the existing means of distribution, which are now receiving scrutiny. New marketing rules have come into effect to attempt to bring order into the selling of fish.

The native fishermen have been induced to work together, and are being assisted by the provision of cheaper fishing gear. Nylon thread has been introduced for making shark tangle nets, and has resulted in an estimated improvement of 60 per cent. in catches. For vegetable fibres, net preservatives have been adopted by the native fishermen, resulting in a longer life and so in lower fishing costs. All fishing craft on the coast are now registered.

Meanwhile, and looking to a future offshore expansion of fisheries, the exploratory 45-ft. motor fishing craft has proved two areas suitable for trawling

by vessels of 50-ft. to 75-ft. with low running expenses. A yield of 700 lbs. of saleable fish per trawling hour holds out promising prospects. Some successful results have also been got by surface trolling, and a rate of 35 lbs. of fish per line per hour has been observed.

A large fishery for Green Snail, the shells of which are used for buttons and fancy work, has developed in the past two years at lucrative prices. The oyster fishery has increased to the point where legislation has had to be introduced to protect the beds.

Freshwater fisheries have been or are being developed in several lakes, from small lakes in the Drift Valley to Lake Rudolf, which is believed to have a potential output of 1,500 tons per annum. In the case of Lake Rudolf, special attention is being given to the problems of marketing.

A fish culture experimental farm has started work, to obtain accurate data of the yields of fish to be got in fish ponds with different treatments. The life history is being worked out of the two most promising species (*Tilapia nigra* and *Tilapia Melanopleura*) and combinations of these and other species are being grown in the same pond to secure maximum use of all available food, and simultaneously to control the breeding of mosquitoes and snails, which are responsible respectively for the transmission of malaria and bilharzia. Very large numbers of small lakes and dams have been stocked with fish and the natives taught how to fish them.

The development and control of trout fisheries in the upland streams has always been in the forefront of Kenya's fishery work. A special research station has been running for four years, and much fundamental and practical research has been done. As an uncovenanted benefit from this work has been the discovery that adult Blackfly larvae (which carry onchocerciasis, responsible for much blindness) breed parasitically on mayfly nymphs ; this knowledge may help in the control of this serious disease.

35. *Uganda* has extensive gill-net, beach seine, and long-line fisheries in all its rivers and lakes, including Lakes Victoria, Kyoga, Edward, Albert and George. It is estimated that, in 1952, 10,000 tons of fish were produced from the Uganda waters of Lake Victoria, and 13,000 tons from other lakes. The total value was in excess of £1 million. There is a considerable export trade to the Belgian Congo ; some 8,000 tons of dried fish, worth £400,000 were so exported in 1952.

The general policy is to increase production in any waters where this is possible, and protect against excessive fishing waters already fully exploited. The deeper waters of the lakes are being explored for new sources of fish, new fishing methods and gear are being introduced to the African fishermen and their marketing facilities are being improved. Nylon gill-nets have been introduced and have proved popular and effective. Work continues at the Kampala technical schools to develop a boat acceptable to the Africans as an improved substitute for their sewn or dug out canoes.

36. Progress since fisheries work began in 1946 has been steady. For example, on Lake Albert, the number of fishing canoes has increased from some 50 before the war to 550 in 1952 ; on Lake Kyoga in the last five years the fishery has changed from one of a primitive nature producing very little fish to a flourishing industry, chiefly with gill-nets, which produce 2,500 tons of fresh fish, worth £100,000, for Uganda consumption. The Dutch fyke-net is now being tried in the swamps of this and other lakes. Everywhere the fisheries appear to be flourishing, and the African fisherman is one of the more prosperous members of his community. Co-operative societies are being encouraged, and through these societies better equipment will be bought more cheaply, and it will be possible later even to acquire power-driven fishing boats, where these can be used to advantage.

37. While most fish marketing in the Uganda Protectorate is done by African fishmongers using bicycles or hired lorry transport, the fishery on Lake George is operated on modern lines by a public utility corporation now under the control of the Uganda Development Corporation. The fish are caught by licensed African fishermen, and are collected by refrigerated motor fish carrying boats and brought to a base at Kasenyi, where there are ice factory, blast freezers, cold storage, and processing and drying sheds. Landings average about 8 tons of wet fish per day, mostly *Tilapia Nilotica*. While most of the catch is split, salted, dried, and exported to the Belgian Congo, an increasing amount is refrigerated and sold fresh in Kampala.

38. A considerable number of dams, minor lakes, and reservoirs have been successfully stocked with various species of Tilapia, and are now producing appreciable quantities of fish for local consumption. A Fish Farming Officer is now establishing an experimental and demonstration fish farm.

39. In recent years a considerable crocodile trapping industry has been encouraged, the monthly average catch being over 500 crocodiles per month. The skins are mostly wet-salted for export to the U.S.A.: it is believed that a reduction in the number of these reptiles may result in an extension of the areas in which gill-nets can be used. Crocodiles cause much damage to gill-nets, by tearing out fish caught in them.

40. Lake Victoria, though nowhere deeper than some 45 fathoms, and, over much of its area, much shallower, is as large as Ireland, and its coastline is shared by the three territories of Kenya, Uganda and Tanganyika. Hence the fisheries of this Lake are administered by an Inter-territorial *Lake Victoria Fisheries Service*. Though this service has to enforce legislation, it has always aimed to be the friend and adviser of the fisherfolk of the lake, and not a body of uniformed officials waiting to catch them out in illegal acts. With headquarters at Kisumu, in Kenya, it has officers, with subordinate staff, in each of the three territories. At headquarters there is a slipway, and complete repair and refitting facilities. Each officer has a 45-ft. motor fishing vessel, in which he tours his district, supervising the work of the subordinate officers, and collecting statistics. The motor fishing vessel is also used for experimental and demonstration fishing. Echo-sounders are now being fitted to these vessels, especially for the detection of fish shoals; all three carry radio and are in daily contact with headquarters.

The number of fresh Tilapia exported from Kisumu by rail has increased, in the last four years, from 1.8 million to 2.3 million, weighing about 1,500 tons. Experimental work includes fishing with nets of various mesh sizes in a wide variety of localities, the introduction of better materials for fishing, including nylon, and propaganda and demonstration to ensure better care of nets. Nylon gill-nets appear to have between 25 and 50 per cent. superiority over flax nets in fishing performance, and may last three times as long. Their use among these cautious and conservative fishermen seems to be increasing, and a large demand is anticipated. Two 30-ft. steel fishing dhows, designed by the Chief Fishery Officer of the Lake Victoria Fisheries Board, are now being built for trial use by African fishermen. They have small auxiliary diesel engines, as well as sails, and are being produced for about £800 each.

Recently a programme of marking Tilapia fish in order to discover their migrations and growth rate, has been started. The results of recaptures of these fish will be examined in collaboration with the Jinja Research Station (see below).

41. At Jinja, on the Uganda shore of Lake Victoria, there is the freshwater station of the *East African Fisheries Research Organisation*. The establishment of this station consists of a Director, four Scientific Officers, two Field Officers, a Secretary, and Assistant Secretary, and subordinate staff. There are two

motor launches, and a mobile laboratory for detached field work. This research station has now been functioning for four years, and already it is achieving a considerable reputation as a research centre of high standing.

Several important advances have been made in knowledge regarding both the factors which determine fertility in tropical lakes, and the fish which live in them. For example, it seems that sulphur, which is one of the elements essential to plant growth, and which is normally present in sufficient quantity in natural waters, is in short supply in East African waters, and may act as a limiting factor on the production of plant life, and therefore of animal life (including fish). In the future, it may be possible to remedy this deficit, in waters of limited extent, by the use of sulphur-containing by-products of copper smelting and of super-phosphate manufacture.

Further, the fertility of a shallow tropical lake may depend on the number of animals, and especially plant-consuming animals, present. This is because plants decay but slowly, whereas they decay more rapidly after consumption by animals; and animals themselves disintegrate rapidly when dead, thus releasing manurial salts for the further use of plants. Thus, the turnover of nutrient materials is much more rapid in a lake well stocked with animals than in one in which animals are few. In this light, the hippopotamus becomes a valuable factor, and even the crocodile appears to have a respectable place. The difference in productivity between superficially similar swamps may be due to the paucity of plant-eating fish in the less fertile swamps, and the introduction of such fish might improve their productivity.

It has also been found that the nature of the minute blue-green algae which are frequently abundant in East African freshwaters may vary with the chemical composition of the water in which they live. Where, as in Lake Rudolf, there is a high ratio of sodium to calcium in the water, the blue-greens assume a form in which they can be digested by the very important Tilapia fish; these fish reach a great size and weight (exceeding 12 lbs.) in Lake Rudolf. It appears, however, that in Lake Victoria the same blue-greens, though devoured by Tilapia, cannot be digested by them.

Considerable advances have been made in our knowledge of the life-history, distribution, and classification of the Tilapias, and also of the related Haplochromis, of which many species, of widely varying habits, inhabit Lake Victoria. Some of these are selective feeders on snails, and may therefore help to control the snail-borne human disease Bilharzia. The study of freshwater snails is an important part of the work of the Jinja station, and a fine type collection is housed in the laboratory. A number of new species have been proved to be vectors of bilharzia; conversely, it has been possible to prove that certain other common species are probably safe in this respect.

Much work has been done on the lake-flies, which are the principal food for the elephant-snouted fish Mormyrus. These flies tend to swarm at monthly or two monthly intervals, and this swarming has some reflection in the catches of the fish. Moreover, the breeding habits of these fish have recently been discovered with the aid of the echo-sounder. They spawn in deep water, where rocks emerge from the mud. Ripe fish have been caught, and the eggs artificially fertilised.

Work has been done in other lakes than Victoria, for example, Lakes George, Edward, Albert, Bunyoni, and Tanganyika, and in rivers and swamps in all three territories.

42. Marine research on behalf of the East African territories is done at the *Zanzibar* station of the East African Fisheries Research Organisation. This station has a 70-ft. wooden motor-drifter as temporary research vessel (the same vessel as carried out the Mauritius-Seychelles Fisheries Survey in 1948-9), and has taken over a number of marine fishponds from the Zanzibar Department of Agriculture.

The station was started in temporary quarters in September 1950, and the first two years were necessarily occupied by the exacting work of refitting the ship, ordering gear and scientific equipment, and building staff quarters and laboratory. By the end of 1952, this preparatory phase had almost ended ; the laboratory was officially opened by His Highness the Sultan of Zanzibar in April, 1953. The present staff consists of a Director and two scientific officers ; there are two vacancies to be filled.

Nevertheless, in spite of these initial handicaps, the research vessel made 10 cruises in 1951 and 26 cruises in 1952, covering a total distance of 7,000 miles in the latter year. The cruises extended from the Kenya-Somali border in the north to the Tanganyika-Mozambique border in the south. The vessel is fitted with echo-sounder and two-way radio.

Having regard to the vessel available, and the small staff at present at work, it was decided by the Fisheries Advisory Committee of the East African High Commission that the first task of the marine research station should be to conduct a two-year's survey of the fishery resources of the East African coast. Study and trial of fishing methods, of the classification, life history, size, feeding habits, breeding habits, and migration of the more important species of fish, has now well begun. Very shortly the work will be extended to include a study of the plankton, which is the starting point for all life in the sea ; and of the biochemistry of the sea, and of marine swamps ; and a study of the biochemistry of by-products of fish such as liver oils and isinglass.

43. *Malaya* has a very long tradition of fishery development work, and this is reflected in the great advances which have been made in recent years, largely through the agency of the strong and active Fisheries staff. The staff has taken a lead by building, or purchasing overseas, prototype fishing craft, and giving demonstration and instruction in their use. This has been followed up by two major schemes for the provision of loans to the industry, and a number of minor schemes for the purchase of fishermen's requirements. The use of ice for the preservation of fish at sea, and its distribution ashore, is now widespread, and a far larger proportion of the fish is now eaten fresh. The total number of fishing craft with outboard or inboard engines increased from 327 in 1949 to 1,228 in 1952, though even this number represents less than 10 per cent. of a total fleet of some 16,000 to 20,000 fishing craft of all kinds.

No accurate comparison is available of the catching capacities of mechanised and non-mechanised vessels. It is known, however, that the mechanised fishing craft catches several times as much fish as the unmechanised, and the very rapid rate of increase in the number of mechanically propelled fishing craft is proof of this. Further indirect evidence is afforded by the fact that, whereas the average output of fish per fisherman per year for the whole of Malaya was about 2,200 lbs. (as given in the Fisheries Department's report of 1949), the average output in Perak State, where mechanisation of the fishing fleets was highest, was about 5,700 lbs., and in Trengganu, where mechanisation was lowest, about 700 lbs.

In spite of the great difficulties of rehabilitating an industry shattered by the war, and in spite of additional recent difficulties due to banditry, the total weight of fish produced in the Federation of Malaya was 134,000 tons in 1952, as compared with an average of 85,000 tons per annum in the five years 1936–1940 inclusive.

Experiments in the cultivation of cockles in 1947 were followed by demonstrations and encouragement, and now large areas of foreshore are under cockle cultivation. The retail price of cockles has fallen by 80 per cent. in the five years 1947–1952, and they make a useful contribution to Malaya's food supplies.

Work is now proceeding on the value of nylon as a netting material under tropical conditions, the use of copper soaps as preservatives of fish nets, and the use of the echo-sounder for the detection of shoals of surface- and midwater-

swimming fish. The fishing efficiency of the great fixed traps, or Kelongs, is also being studied.

There has been great development of the freshwater fisheries. Wherever new land has been brought under controlled irrigation for rice cultivation, provision for fish cultivation has been made. There has been a widespread increase in fish culture among the Malay peasantry, as an element in a mixed agricultural economy, and more than 1,800 new fish cultivators have begun to reap a harvest in 1952. This work has been fostered by demonstrations, instructional pamphlets, and financial loans.

The cultivation of fish in irrigated padi fields has continued to expand, and it is estimated that there are 450,000 acres of irrigated padi land producing fish as catch crop.

The Chinese traditional system of fish culture has been hampered both by the resettlement programme, and by the increased difficulty in obtaining fish fry from China. Nevertheless here, as in the sea fisheries, what has been lost by the emergency operations has been made up by further development, and the production of freshwater fish remains about 25,000 tons per annum.

A new form of fish farming, combined with pig raising has been devised under the supervision and guidance of the Fisheries Department. The production of fruit, pigs, and vegetables is integrated with the production of fish, resulting in economy of man-power, land, and raw materials. Yields have been consistently high at 5.16 tons of live-weight protein per acre annually, of which fish comprised over 2½ tons. This successful combination of fish farming with pig raising is now being propagated in the new Chinese resettlement villages.

44. The fisheries of *Singapore* show a rapid expansion. The number of licensed fishing boats equipped with inboard engines increased from 174 to 205, and those with outboard engines from 80 to 377 between 1951 and 1952 ; at the same time, non-powered fishing boats increased from 1,933 to 2,047 in the same short period. The increase in the powered fleet contributed to a rise in the production of locally caught fish, since many of these vessels are large and powerful, and include pair-trawlers formerly based on Hong Kong. Excluding trash fish landed for pig-feeding or as manure (an average of about 2,000 tons a year) the local production of fish increased from 3,481 tons in 1950 to 5,513 tons in 1952 ; almost the whole increase was due to the exploitation of the offshore fishing grounds by the mechanised fleet. Including imports (less exports), the total availability of fish in Singapore increased from 18,050 tons in 1950 to 20,786 tons in 1952. Moreover, the trade in salted dried fish is rapidly recovering to its pre-war value ; in 1952 exports were at a rate of 51,000 tons, as compared with some 15,000 tons in 1950.

Other important fishery products are bêche-de-mer, prawn paste, edible seaweed, isinglass, sharks' fins, green snail and trochus shells, and canned fish of various types.

This expansion of the fisheries and increase of production has been helped in a large degree by a Fisheries Loans Fund administered by the Fisheries Department. This Fund started at $250,000 (£28,700) and was later increased by a further $150,000 (£17,500) as a result of its manifestly successful working. These loans were partly used for the bulk purchase, for resale to the fishermen, of all their requirements including fishing gear, pressure lamps, and items of food ; but they are chiefly used to assist fishermen to purchase outboard and inboard engines, and to build larger and more powerful fishing craft.

A Fisheries Control Point has been set up on the premises of the Fisheries Department, at which the larger off-shore fishing craft can get Customs and port clearance with the minimum of delay, ensuring a quick turn-round ; a water supply, ice chutes and an ice crusher have been installed. Nylon netting has been introduced and has been found extremely effective, though its use is limited by its high price.

The demand for fish in Singapore, and the compactness of the market, permit most fish to be retailed in the fresh state. The local private manufacturers produce some 400 tons of ice per day, and cold storage facilities are extensive. Nevertheless, there have been occasions when very heavy landings by trawlers and long-line units have depressed the markets to a level where production was barely economic.

The fishing methods employed by the inshore fishermen are palisade traps or fish fences, beach seines, drift-nets and fish traps ; of these, the palisade traps are most productive. The main methods employed in the off-shore fisheries are pair-trawling, long-lining, and trolling, which produced, in 1952, respectively 10·4, 8·3 and 6·1 per cent. of the total catches made by Singapore operators.

The limited area of the Colony restricts the island fisheries. However, some 300 acres of fishponds produce about 200 tons of freshwater fish annually, and the valuable brackish water prawn ponds, built in cleared mangrove swamp, produce about 240 tons of prawns annually from some 900 acres of ponds.

45. A Marine Fisheries Research Station is being established at *Singapore* to conduct research into the fishing potentialities of the South East Asian region. A Director and staff have been appointed, and it is hoped that the station will be in full operation, with research vessel, research launch, and laboratory, in 1954.

46. A general survey of *Sarawak's* sea fisheries was carried out from 1948 to 1950. Experiments were made by a motor fishing vessel on the use of Western types of fishing gear, with only moderate success. In 1950, however, good results were got with deep-sea traps. The collection of fishery statistics was begun, in order to assess accurately the production of local marine fishery resources.

This was followed up, in 1950–52, by a short-term scheme, designed to bring about better distribution of fresh fish, and so reduce its price to the consumer, and this work continues. A further 3-year scheme, 1953–55, is now in operation, to demonstrate improved types of fishing gear, such as purse seines and drift-nets, together with mechanical means of hauling the nets, which are at present hauled by hand. Work on the deep-sea fish traps for bottom-living species of fish is being continued and expanded. Enquiries are being made for small fish-reduction plant able to produce fish meal for human and animal use, and for fertiliser, from low-grade fish.

Meanwhile, development of the local fishing industry continues, especially in the acquisition of power-driven fishing boats, and also fish carriers, which collect the fish for market, and assist by towing non-powered boats to the fishing grounds. The average gross tonnage of the carriers is increasing, since newer boats tend to be larger. The progress in the fishing fleet at Kuching can be seen in the table below.

Type of Fishing Craft	1949	1950	1951	1952
1. Sailing drifters	185	228	243	198
2. Motor drifters	—	—	3	62
3. Motor Fish carriers	40	84	88	140
4. Motor Fish carriers, average tonnage	6.8	7.6	7.3	8.8

The motor fishing boats have given better results than the sailers, as may be inferred from their rapid increase in numbers. Motor boats are working more nets, besides having the advantage of a greater independence of wind and weather.

As to inland fisheries, fish farming continues to develop, especially round Kuching, and it is obvious that very high yields of fish can be obtained in well-

managed fishponds. *Tilapia mossambica* was introduced in 1950, and are breeding and growing well in local fishponds.

47. In *North Borneo*, development work on the sea fisheries has ended, but is continuing on the development of fish culture, and the cultivation of fish in ricefields. Progress is encouraging and a great many enquiries are being received.

48. *Hong Kong* is unique in its fishery development schemes, for, since the war, a Fish Marketing Organisation has been established which is highly successful, and a much quoted and visited example. This organisation has established fish collecting depots and posts in the main fishing villages, from which fish is brought to four wholesale markets in the urban areas. Fishermen may collect the proceeds of the sale of their fish directly after auction ; buyers are allowed 48 hours credit. The scheme is self-supporting, and all expenses are covered by a 6 per cent. commission on the fish sold. The organisation operates a loan fund from which fishermen get cheap credit facilities, either short-term, for the repair of gear and boats, or longer-term, for the mechanisation of their fishing craft. At the collecting depots fishermens' requisites are sold at wholesale prices ; the organisation has also subsidised schools for fishermens' children.

In connection with a programme of mechanisation a very successful exhibition was held in 1933, and over 20,000 persons attended. The number of fishing craft equipped with engines increased from two in 1949 to 145 in 1952 ; courses of training in the care and maintenance of engines, and in navigation and seamanship up to the standard of the Certificate of Competency as Masters of powered vessels issued by the Marine Department, are being conducted by the Fishery Officer.

The superior performance of power-driven fishing boats is shown by careful records of the catches of power-driven and sail-propelled small junk purse-seiners during the 1952/53 seasons. The power-driven boats put in an average of 179 days' fishing, the sailers 144 days ; the average catch per day was 774 lbs. by the power-driven boats, and 584 by the sailers. The average catch for the season was 184,608 lbs. by the power-driven boats, and 112,200 lbs. by the sailers, a superiority of some 80 per cent. This superiority was due to a greater number of fishing days, as well as to a higher rate of capture per day ; moreover, the power-driven boats were able to use a wider range of fishing grounds. No doubt this superiority will become even greater when additional experience allows them to put in a greater number of fishing operations (shots of the net) per day.

The quantity of fish landed in the Colony has increased from 14,500 tons in 1946 to 34,500 tons in 1952. Formerly, over 60 per cent. of the fish was salted for export to China ; this salting was in any case rendered necessary by the long voyages made by the sailing junk long-liners. Nowadays, with increasing mechanisation, it is possible to bring the fish fresh, or on ice, to market. Moreover, the political situation in Communist China has made the salt fish trade less attractive, at the same time as the demand for fresh fish in the Colony itself has increased.

The fishing fleet of Hong Kong is the largest of any port in the Colonial Empire, and indeed is one of the largest in the world. It comprises some 5,880 fishing craft of all types, with a fishing community of some 52,000 souls. Mechanisation, though growing rapidly, has barely started, since only some 145 out of 5,880 vessels are powered. Yet mechanisation approximately doubles the catches of the fishing boats, and a rapid increase in the production of fish in Hong Kong can be expected as mechanisation proceeds. It can be predicted that, in the future, there will be a swing over from the existing junks provided with engines, to types of vessels especially designed to take engines ; indeed, a

scheme, financed from Colonial Development and Welfare Funds, provides for the design of such vessels and the building of demonstration prototypes.

Fish farming, both in fresh and brackish water, is expanding in the Colony and there are some 584 acres of fish ponds in the New Territories. The output consists mainly of mullets and various species of Chinese Carp.

C. F. HICKLING.

December, 1953.

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cf 2

SAVING TELEGRAM.

From: The Officer Administering the Government of the Falkland Islands.

To: The Secretary of State for the Colonies.

Date: 19th February, 1959.

No. 40. SAVING. COLONY.

15 - D/1/59

Your Savingram No. 2 of the 14th January, 1959. Trawling in Falkland Islands waters.

2. The only investigation of any importance into the possibilities of trawling in these waters and the establishment of a fishing industry was that undertaken by the Discovery Committee, and I can do no better than suggest that Sir David Robertson's attention should be drawn to the Report on Trawling Surveys on the Patagonian Continental Shelf compiled by E.R. Gunther, M.A., and T. John Hart, D.Sc. (Discovery Reports Vol. XXIII pp. 223-408 - printed and published by the Cambridge University Press).

3. The Report concluded "It must be plainly stated that the results are not encouraging; but this is due to economic and geographical factors, rather than to lack of suitable fish. The best trawling grounds are not very near to the Falkland Islands, but it can be shown with reasonable certainty that on the shelf to the northward, roughly equidistant from the Falkland Islands and the lesser Argentine ports, there is a stock of hake just sufficient to enable a modern trawler to pay its way if there were markets equivalent to the British ones within a few hundred miles.

The population of the Falkland Islands is too small and too scattered (with limited means of communication between the settlements) to enable a large trawler to pay its way on local trade alone. If a considerable part of the catch could be sold in, for example, the Argentine at a reasonable price, a trawler working from Port Stanley might be able to keep the latter supplied with the results of, say, one voyage in four. The possibilities of smoking, drying and dehydration would no doubt be taken into consideration, but it seems doubtful whether the fish could be marketed at an economic price in the Argentine."

4. To the economic difficulties would have to be added the political difficulties if any part of the enterprise were to be based in any way on the Falkland Islands, and with considerable reluctance I am compelled to admit that the conclusions of the Report seem to me to be entirely sound.

5. The only comment I would add is that mullet do abound in the many creeks of the Colony during the summer months but it would seem very doubtful whether it would be an economic proposition to catch, preserve and transport them to a central freezer.

6. Mr. Lawrence will naturally be given all the information available and every assistance to see the Ajax Bay plant and assess for himself the possibilities of its use when he arrives here.

GOVERNOR.

AMW/LJH.

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COLONIAL OFFICE
GREAT SMITH STREET
LONDON S.W.1

FST 72/1/01

31st July, 1962.

Dear Arrow,

44-46 I enclose copies of self-explanatory correspondence with the Ministry of Agriculture which sounds distinctly interesting.

If you agree, will you give me a ring as soon as possible so that we can fix a meeting with Engholm (I go on leave on 20th August).

Yours ever,

A.R. Thomas

(A.R.Thomas)

This shd be filed with my letter to Markham about Japanese plans.

Sir Edwin Arrowsmith, K.C.M.G.

Copy of letter from Mr. B.G.Engholm of Ministry of Agriculture, Fisheries and Food dated 25.7.62 to Mr. A.R.Thomas.

(My dear Thomas,)

It is a very long time since we had any official contacts and I am glad to have this opportunity of renewing them by writing to you about a problem in connection with fisheries, on which I hope that you may be able to give us some help.

Very briefly the position is this. As a result of the loss of certain of our traditional fishing grounds in the North Atlantic, together with the general problem of over fishing in that area, we think that it may well be necessary for our fishing industry to go much further afield some time during the next five to ten years. In this connection we have been giving careful consideration to the possibilities of fishing in the South Atlantic. We know there are plenty of fish to be caught down there, but we do not know how economic it would be for our vessels to fish in this area, bearing in mind the distanc it is from our shores. Clearly any fish caught in the South Atlantic could only be brought back to this country for marketing if they were frozen, either at sea or at a land base in the area. One possibility would be for us to fish in the South Atlantic with large freezer trawlers or alternatively by means of expedition fishing, i.e. a mother ship capable of freezing fish with attendant trawler catchers. Another possibility might be, however, to base a fleet of trawlers on a port somewhere in the South Atlantic which had freezing facilities and to transport the fish back to this country by refrigerated cargo ships. It s on this latter possibility that it occurred to us that the Falkland Islands might perhaps be worth considering as a possible land base. None of th foreign countries bordering the South Atlantic would be likely to welcome a fishery base established by us in their countries, but in the Falkland Islands it might well be of material help from the point of view of their economy.

I understand that Sir Edwin Arrowsmith, Governor of the Falkland Islands is over here at the moment and my purpose in writing to you is to suggest that it might

/be

45 46

be very helpful to us if we could have a chat with you and him some time in the coming weeks. I would, if possible, like to arrange for this before the end of August because I am leaving my present post on the 1st September, and taking up another one on the Agricultural side of the Department. As I have been dealing with this matter over the past few months, it might be simpler if the talk could take place before my departure. Perhaps you would be good enough to let me know what would be possible.

Yours sincerely,
(sgd) Basil Engholm.

Reply at 46

46 47

FST 72/1/01

31st July, 1962.

44 Many thanks for your letter of the 25th July. It was very nice to reopen official contact after so many years! I am particularly glad it was over Fisheries since - as you may or may not recall - my first six months in the Service were spent in the Fisheries Department!

As regards your letter, we should certainly be very interested if there were any possibility of beginning a fishing industry from the Falkland Islands and I am certain that Sir Edwin Arrowsmith would be happy to discuss this with you in August. Arrowsmith is home on leave, at present in Ireland, and he will be in Scotland, rather out of touch, until about the 7th August. He is then returning to London, and I suggest, if we are able to contact the Governor in time, that we have a meeting towards the end of the week following August bank holiday, or the following week. If we hold a meeting after the 20th I am afraid I shall have to miss it as I am on leave then.

If you agree we will give you a ring when we are next in touch with the Governor.

(A.R.Thomas)

G. Engholm, Esq.,
Ministry of Agriculture, Fisheries and Food.

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November 16, 1963.

(Dear John,)

.63 in J/3/60/1 refers.

I enclose a copy of a letter I have received from Coleman about Japanese activities at South Georgia, and this is of particular interest on their future plans. You will see that a man called Miyata, who is apparently very well known in the whaling and fishing world, intends visiting the Falklands in January.

When I was in England in 1962, we had a meeting in Ambler Thomas's room with representatives of the Ministry of Agriculture, on fishing possibilities in this area (your file FST. 72/1/01 refers). I have no note of this meeting but I should think there is one in your file. I believe the Japanese are just as interested in fishing as in whaling at South Georgia, and they might quite possibly be interested in the Freezer at Ajax Bay if they contemplate applying for permission to operate around the Falklands. I would, of course, very much rather see a British enterprise here, but unless something is done pretty quickly it may be too late.

Would you please let me know by telegram whether you have heard anything further from the Ministry of Agriculture. We have a long gap between DARWIN's arrival here on December 17 from Montevideo and her next from there on January 31, but there will be an inward mail opportunity by KISTA DAN which is due to leave Montevideo about December 31.

(Yours ever,

Arrow)

(E. P. ARROWSMITH)

J.E.MARNHAM, ESQ. CMG, MC, TD.

30 ~~11.63~~

~~3.1.64~~

" 3.2.64

48

DECODE.

No.8

TELEGRAM SENT.

From SECRETARY OF STATE *to* GOVERNOR

Despatched: 13.1.64 *Time:* 1200 *Received:* 14.1.64 *Time:* 0900

47 3. Your letter to Marnham of November 16. Fishery base.

No immediate prospect of establishment of a British base and we can see no British interest in opposing establishment of base by Japanese.

Grateful to know outcome of visit.

Secer.

49

GTC: ER

We shall be too late, as usual.

BU 10.2.64 (arrive Miyata)

14.1.64

BU

H.C.S.

47 Letter to Marnham was a personal one from H.E. and is filed on the G.H. file. The visit referred to is one by Miyata.

48

Private Secretary.
14.1.64.

DECODE.

No. 31

50

TELEGRAM SENT.

From SECRETARY OF STATE *to* GOVERNOR

Despatched: 10.3.64 *Time:* 2340 *Received:* 11.3.64 *Time:* 0900

IN CONFIDENCE

48

No. 16. My telegram No. 3 Fishery Base.

Frank Robb a large and reputable South African firm of shipping interests who have applied to establish Tuna fishing industry in Saint Helena have now indicated that they are tentatively exploring the possibility of establishing fishing industry based at the Falkland Islands (and would buy C.D.C. Cold Store) operating with freezing ship and trawler in the Patagonia Shelf. We have offered to supply all available information on fish conditions in your seas while representative is in England over the next 3 weeks. Records here and in M.A.F.F. being searched but grateful for suggestions for suitable material we might miss.

Secer

GTC : ER

Reply at 51

51

DECODE.

TELEGRAM SENT.

D1

From GOVERNOR to SECRETARY OF STATE

Despatched: 11.3.64 Time: 1430 Received: Time: pm.

IN CONFIDENCE

50
48

No.25. Your telegram No.16 Fishery Base.

This is most interesting. Reference your telegram No.3 Captain Miyata Managing Director of Nippon Suisan Kaisha Ltd. visited Colony end February. He is interested fishing vicinity Falklands and plans to make survey with Japanese fishing vessel next southern summer. Not interested in cold store at present but said he might be later. Robb therefore has no time to lose. Discovery Reports Volume XXIII pages 223-408 are relevant.

EPA/ER

GTC.

52

DECODE.
No. 30

TELEGRAM SENT.

From SECRETARY OF STATE *to* GOVERNOR

Despatched: 25.3.64 *Time:* 1320 *Received:* 25.3.64 *Time:* 1230

IN CONFIDENCE

51 No. 28. Your telegram No. 25. Fishery Base.

Further background is in Marnham's letter of March 20th. Ellwood called again today March 25th. He will study Discovery Report. Next move would probably be visit to you by member of firm about October to study possibilities on the spot. Meanwhile he will keep in touch and let us know if he needs more information.

Secer.

GTC : ER

53

COLONIAL OFFICE
GREAT SMITH STREET, LONDON S.W.1
Telephone: ABBey 1266, *ext.*

20 March 1964

Our reference: FST 72/1/01
Your reference:

My dear Arrows

53/A

50

As there's a mail just going, I thought I would send you the enclosed copy of the minute by Garth Pettitt on which our telegram No.16 about Robb's interest in fishing was based. It gives the story in more detail than we could put into a telegram and you may find it useful to have on record.

2. I gather that Ellwood may call again soon. If so we will show him the Discovery report (we have told him about it and advised him to get a copy for himself), plus anything M.A.F.F. may be able to produce and such local colour as I can add.

Yours ever
John
(J.E. Marnham)

Sir Edwin Arrowsmith, K.C.M.G.,
Government House,
Port Stanley,
Falkland Islands

Copy

53/A

Mr. A Ellwood of Frank Robb and Associates came to see me today the 10th March about their application for a fishing concession in St.Helena. Mr. Ellwood explained that he was here buying trawlers and was simply taking advantage of the visit to London to enquire what progress was being made.

I explained that the Governor of St. Helena was unable to process his application because a prior applicant was in the field who had produced some proposals which were sensible but not fully worked out and the Governor felt it necessary to give him until April to produce alternative proposals. If he did not the Governor would return to dealing with Frank Robb. Mr. Ellwood then revealed that he knew all about this and had made confidential enquiries about Mr. Knipe and had discovered that he had no finance and was unlikely to get some. I advised Mr. Ellwood that if this were the case for his own planning purposes he should assume that the Government of St. Helena would be favourably disposed towards his proposals.

Mr. Ellwood said that for the St. Helena venture he does not require any assistance from Government except co-operation in the introduction of training in the appropriate trades in school for potential fishermen. The company would be prepared to help in this matter as much as possible but their plans would rely on Government encouraging young St. Helenians to make their career in fishing and navigation. He also explained that his company intended to operate on the basis of providing boats for fishermen who would eventually buy them from their share of the profits and that he hoped that Government would guarantee the repayment of loans by fishermen. Apparently he had discussed this with the Governor. He mentioned that it was not only the intention to set up a factory on St. Helena but that they hoped to establish a small fishmeal factory on Ascension Island which will be manned during part of the year.

I undertook to try to provide for him any published information on fishery research in the eastern part of the South Atlantic. He already had the Coleman report.

It later came out that Mr. Ellwood was also interested in establishing a fishing industry in the Falkland Islands. He had done some considerable reading on the Falkland Islands and has become quite knowledgeable but was apparently completely lacking in any information on the fishing potential of the area although he knew that the Patagonian Shelf was supposed to have had good fish. His company had in mind the setting up of a fishy base in the Falkland Islands to exploit craw fish if they existed and the fish in the Patagonian shelf using trawlers and a freezing vessel. This would be second in priority to St. Helena but did not necessarily conflict as the company had access to capital but he could not pursue the idea until he had more information on the fish which were in the sea around the Falkland Islands. He knew about the cold store which has been put up by the CDC and had not yet been sold and he said that his company were considering buying it though nobody in the Falkland Islands knew this yet. I mentioned to him that many countries were now showing an interest in the Patagonian Shelf and it was even possible that Britain would be showing an interest over the next ten years or so. One country which had shown interest was Japan and very recently the Manager of the Japanese Whaling Company at present operating the station at Leith Harbour had visited the Falkland Islands with a view to establishing a shore base for a fishing fleet there. I also mentioned that the Governor of the Falkland Islands had consulted us on whether there were UK reasons for refusing an application for a Japanese company to set up a base there and that we had advised them that this decision should be taken solely in the interest of the Falkland Islands since we knew of no immediate prospect of a British company wishing to establish a base there. If Mr. Ellwood thought that there was any strong possibility of his firm wishing to establish themselves there he should make sure that the Falkland Islands Government knew about this at the earliest opportunity. Mr. Ellwood said that as soon as he had the basic information on the fish in the area he could get a decision from his firm whether it was worth going in or not and could arrange a visit to the Falkland Islands, though this could not be before June.

/I tried

I tried to draw him on the extent of the investment in the Falkland Islands. Clearly however he did not have a very exact idea of the size of the shore base population or of the installations until he had more information on the fish of the area but the base would be around the old CDC freezing station. I explained that conditions of the Falkland Islands would be quite different from St. Helena and Robb's could not expect to find a local fishing population or indeed local labour for anything and they would have to import labour. I also briefly explained the position of the Falkland Islands over the Argentine claims, our desire to maintain the population in the islands and to increase the wealth and facilities there, the Falkland Islanders desire for more people for this reason and also because it might allow the development of the amenities of the island including roads, and the doubts which would be expressed to bringing in labour from the South American continent. Mr. Ellwood said that he envisaged that the crews of the fishing vessels would be from the Portuguese islands such as are used in fishing off Tristan da Cunha. He hoped however that he might be able to interest British companies in a joint venture and so would have British crews. For shore labour he might be reduced to using labour from Hong Kong on one year contracts. However all these matters he would discuss with the Governor if it were decided to pursue with the idea.

In the meantime I understood to provide him with as much information as I could on the fish of the Falkland Islands area and the Patagonian Shelf and send it to him at the address he will be staying at for the next 3 weeks c/o Fairmile Construction Company, Cobham, Surrey. Mr. Ellwood will be going to the continent next week but will be here the following week. If I am on leave I have asked him to get in touch with Mr. Teegan who will be able to talk to him about St. Helena and if he is still interested in the Falkland Islands I would be grateful if he would arrange that he sees Mr. Marnham.

(R. G. Pettitt)
11th March, 1964