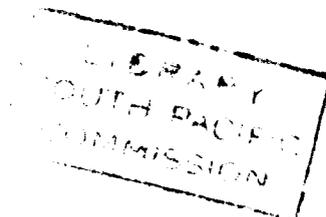


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SOUTH PACIFIC COMMISSION

FISHERIES CONFERENCE

Noumea, 14th - 22nd May, 1952.

R E P O R T

(Revised)

This Report to the South Pacific Commission will be considered by the Commission at its Tenth Session in October, 1952.

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## INTRODUCTION

### Area and Population.

1. The region comprises the territories within the scope of the South Pacific Commission which are shown on the map in Appendix 1.
2. According to recent censuses and estimates, the total population of the region is approximately 3,328,000 people. The territorial distribution and density of the population are given in Appendix 2. The weight of population falls in the western or Melanesian part of the region, particularly in New Guinea, but high densities of population in relation to land area occur in the small island communities of Micronesia and Polynesia.

### Objects of the Conference.

3. The objects of the Conference were described as follows:-
  - (a) To work out a practicable method of bringing together all the relevant information available on fisheries in the region;
  - (b) To suggest the best way of investigating quickly the problems of catching, processing, transporting and marketing, and of inducing people to increase the use of local fisheries products;
  - (c) To make constructive suggestions concerning a statement of the prerequisites for fisheries development in the region;
  - (d) To consider and advise what role the South Pacific Commission could play in the development of the fisheries in the region.

### Fish as a Food.

4. Land animal protein is not a regular item in the diet of the peoples of the region, and in most territories social and economic factors limit the possibility of early or rapid expansion of protein food supplies from livestock. Fish appears to offer for many Pacific people the cheapest and most accessible source of animal protein. In the Micronesian and Polynesian territories fish is already utilised to a considerable extent but in the Melanesian territories, where most of the people live, the present consumption of fish is generally on a lower scale.

5. Apart from dietary needs, there is a general consumer demand for fish as a food.

6. The Conference took as its primary consideration the development of fishing within the area to meet the nutritional needs of the people.

7. The rate of population increase will be speeded up by the measures being taken by administrations to improve health and social and economic conditions. Already some of the Polynesian and Micronesian communities are growing at a very rapid rate. Even the present levels of average fish consumption can only be maintained by increases in the total fish catch. If the future target is to allow for higher levels of fish consumption per head, it is clear that there should be a major effort in fisheries development.

Production for Export.

8. Where in addition to meeting local nutritional needs, the industrialisation of fisheries for export is envisaged, the rate of development of the fishing effort must be very much greater.

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## APPRAISAL OF SOUTH PACIFIC FISHERIES

### RESOURCES

9. Although the documentary evidence available to the Conference is inadequate, the Conference believes that the resources of the region are at present, with certain local exception, under-exploited, and that they will be capable of sustaining without damage the expanded operations which will be required to provide the supplies of fish needed by the populations of the region in the immediate future. (A list of reports relating to the fishing industries in South Pacific territories is given in Appendix 3.)

#### Coral Reef and Atoll.

10. These are the main sources of fish supply in the Commission area and appear to be adequate to sustain present levels of exploitation. However, in general, the reef area of any atoll or island is relatively small and the fish stocks are isolated and are not likely to be replenished by migrations. Consequently each area must have a definite limit of yield. In some localities, in the neighbourhood of concentrations of urban population, these resources appear to have been over-exploited and the current harvest is small. These instances include reefs in the neighbourhood of Rarotonga, Pago Pago, Papeete, Suva and Noumea.

#### Mangrove and Estuarine.

11. These are important in the New Guinea and New Caledonia areas, and are believed to be abundant and relatively unexploited, especially in New Guinea. As far as is known, development is nowhere limited by the resources. It is in mangrove and estuarine areas that the greatest potential for pond-culture exists but in most parts of the region this is not a traditional method of obtaining fish (see Appendix 5).

#### Oceanic (Pelagic).

12. Compared with the resources of coral reefs and atolls, those of the oceanic areas are undoubtedly more extensive, although it is highly probable that the concentrations vary considerably. The pattern of distribution of the principal species in these waters is as yet unknown, but various investigations and commercial operations have indicated some areas as being very favourably endowed. Stocks in sufficient abundance to carry commercial operations have been indicated in equatorial waters north of New Guinea and south of the Caroline Islands and in equatorial waters south of Hawaii, and are known to exist in some quantities in the remainder of the area. Most prominent among these stocks are the tunas, but there are numerous other species of potential commercial value, such as flying fish, half-beaks and mackerels.

Freshwater.

13. New Guinea possesses some large bodies of fresh water which, by analogy with the developments in Indonesia and elsewhere in Asia and in Africa, might be expected to yield substantial quantities of fish. Minor freshwater resources exist on the majority of the high islands.

PRESENT FISHING INDUSTRIES

Catching.

14. Fishing operations are of a subsistence character almost throughout the region. Some market fisheries have been developed in order to meet the requirements of certain urban centres. They have been built up by the improvement of certain of the indigenous methods and, in some cases, by the introduction of new methods. The craft of the region are generally canoes. The number of craft and the number of fishermen are not known. Some powered craft are in use but they are not numerous, despite their advantages in increasing the amount of possible fishing time, increasing the accessibility of grounds and improving the transport to market. In some areas there are social and economic changes causing a drift from fishing as an occupation and creating a reluctance on the part of the local populations to pursue fishing. It would seem that development of fish production will involve the prosecution of socio-economic programmes as well as the provision of new types of craft and fishing gear.

15. Oysters and seaweed are collected in the region for food; resources of the latter are known to be extensive.

Processing.

16. The only methods of processing employed in the region are salting, smoking and drying, mostly by crude and primitive techniques. Only small proportions of the fish caught are processed.

Marketing and Distribution.

17. Facilities for the transport, storage and marketing of locally caught fish are virtually non-existent in the region except that the general markets at the urban centres usually possess a fish stall. The same centres usually have a trade in imported fresh and preserved fish.

Other Marine Industries.

18. Pearl-shell and trochus are collected in some parts of the region and are of economic importance for export and the establishment of overseas credits. From this point of view these industries are of a different character from the fisheries for food supplies.

19. With the exception of the New Guinea area, the industry is unlikely to reach the dimensions which would make the production of by-products such as fish meal, fertiliser and oils an economic proposition.

STATEMENT OF THE PROBLEM

Diet.

20. Evidence available to the Conference indicates that the dietary status of the peoples of the region varies considerably but that in some areas the consumption of animal protein is low. Whilst it is recognised that a completely vegetarian diet is possible and is followed by certain populations of the world, nevertheless, for the greater part of the South Pacific region animal protein is regarded as an essential element of food. The Conference has attempted to assess the potential role of aquatic resources in meeting this need, but has found that the information available is insufficient to permit a reliable assessment to be made. In New Guinea and large islands in Oceania the relatively large tracts of land might be expected, with appropriate social and economic change in the lives of the people, to make a contribution of animal protein on a scale which obviously could not be reached by the smaller islands of the region.

21. The problem is to produce more fish, in order to help in meeting such animal protein deficiencies as exist, and also to meet, where supply is not at present adequate, a consumer demand for fish which is general throughout the region.

General Economic Position.

22. The Conference recognises three general types of situation within the region:-

- (a) Where the population is small and the economy not complex, and where it appears that no need and/or no opportunity exists for immediate action to induce increased fish production, e.g., non-urban areas of Oceania.
- (b) Where there exists a need for increased fish production and where present operations are such that a relatively small-scale programme of administrative action would bring about increased activity by fishermen and ensure the delivery of the catch to the consumer, e.g. urban areas of Oceania.
- (c) Where the need for fish production may be regarded as considerable but the industry is under-developed, and where a quite substantial programme of fisheries development would be required, e.g. Papua and New Guinea.

23. There is no assurance that buoyant markets for the principal exports of the area will be maintained. This uncertainty, and the expanding needs of the increasing populations, make it necessary that alternative economic resources, including marine products, should be developed.

24. For the production of substantially larger market supplies of fish the best opportunity is afforded by the pelagic species such as the tunas and mackerels, in the open ocean outside the reef areas. If still larger production is desired for industrial purposes, special requisites must be considered. (See Appendix 5.)

RECOMMENDATIONS

31. Recommendation 1. Studies should be continued by nutritionists to determine the situation regarding dietary deficiencies in the region, and in particular protein deficiency, with special reference to the place of fish in meeting any such deficiencies.

32. Recommendation 2. Periodical and regular compilation and assessment of quantitative and qualitative information on fishing industries should be recognised as essential prerequisites to rational development.(1)

33. Recommendation 3. Where Administrations are satisfied that the need for increased fish production (for any purpose) is considerable, territorial fisheries services should be established to perform the following functions, as far as may be appropriate:

- (a) improving local fishing methods;
- (b) introducing appropriate non-indigenous types of fishing methods;
- (c) providing or improving facilities and supplies for handling, processing, distribution and marketing, and for the preparation of by-products and utilisation of wastes;
- (d) providing, or arranging the provision of, producer supplies;
- (e) promoting suitable forms of organisation within the industry;
- (f) providing extension services;
- (g) exercising such control over operations as may be proved necessary in the interests of the maintenance of resources.(2)

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(1) A suggested approach to the method of field collection of quantitative data is given in Appendix 7.

(2) Where fisheries services are developed they would presumably take over functions envisaged in Recommendation 2.

34. Recommendation 4. Where a large and urgent development problem exists, action in addition to that comprehended in Recommendation 3 will be necessary. Where the assistance of the Commission is sought in such cases, steps should be taken to submit the project plans to Member Governments for consideration by their respective experts. The Commission should then consider what assistance should be afforded to secure the success of the project.

35. Recommendation 5. In view of the special importance attaching to new gear or the introduction of improved methods of catching fish, and the importance of simple preservation methods, the Commission should disseminate information related to these subjects throughout the region.(3)

36. Recommendation 6. The various institutions within the region engaged on fishery and oceanographic research should be encouraged to continue this work and to develop the fullest co-ordination of their activities in appropriate cases through the Commission and the Indo-Pacific Fisheries Council.(4)

37. Recommendation 7. Where the practice of local fishing methods has declined, or does not expand, because of economic and/or social influences in the life of the people, the promotion of fishing for consumption or sale should be included in programmes of community development.

38. Recommendation 8. (a) The Commission's attention is drawn to:

the usefulness of the courses in technical instruction being offered by various Governments of the Indo-Pacific region with the assistance of the F.A.O. Expanded Programme of Technical Assistance, of which however perhaps only the course in technology (5) to be held at Manila would be immediately suitable; and

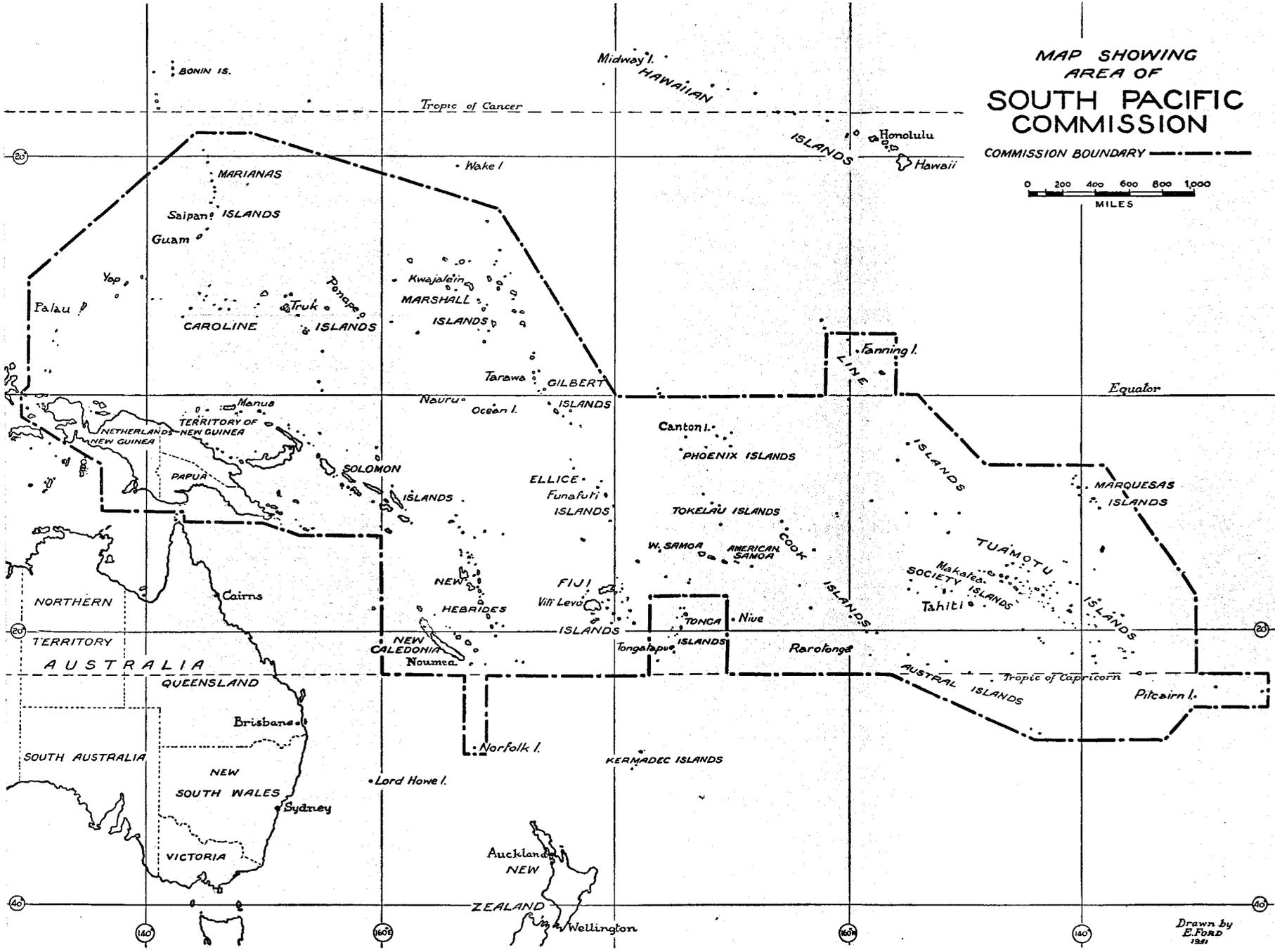
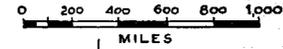
- 
- (3) Some data of this kind are recorded in Appendices 5 and 6.
- (4) A brief account of some of the fisheries research in progress in close relation to the Commission area is given in Appendix 8.
- (5) In the experience of delegates to the Conference these courses are of highly practical value. They may be attended by trainees nominated by any Member Government of F.A.O. The Organisation pays all expenses, including subsistence and a per diem allowance, the only cost to the nominating Government being a fare one way.

APPENDIX 1

See map facing this page.

MAP SHOWING  
AREA OF  
**SOUTH PACIFIC COMMISSION**

COMMISSION BOUNDARY



**MEMBER GOVERNMENTS AND TERRITORIES OF THE SOUTH PACIFIC COMMISSION**

- Australia:**
  - Trust Territory of Nauru
  - Trust Territory of New Guinea
  - Norfolk Island
  - Territory of Papua
- France:**
  - French Establishments in Oceania
  - New Caledonia and Dependencies
- Netherlands:**
  - Netherlands New Guinea
- New Zealand:**
  - Cook Islands
  - Niue Island
  - Tokelau Islands
  - Trust Territory of Western Samoa
- United Kingdom:**
  - British Solomon Islands Protectorate
  - Colony of Fiji
  - Gilbert and Ellice Islands Colony
  - Pitcairn Island
- United States of America:**
  - American Samoa
  - Guam
  - Trust Territory of the Pacific Islands
- Condominium:**
  - Anglo-French Condominium of the New Hebrides

Drawn by  
E. Ford  
1951

APPENDIX 2

POPULATION STATISTICS OF SOUTH PACIFIC TERRITORIES

	<u>Population</u>	<u>Area Sq. Miles</u>	<u>Population Density Per Sq. Mile</u>
<u>AUSTRALIA</u>			
Nauru	3,500	8	437
Norfolk Island	1,140	13	87.6
New Guinea	1,080,000	93,000	11.6
Papua	373,000	90,540	4.1
<u>FRANCE</u>			
French Oceania	56,000	1,449	38.6
New Caledonia and Dependencies	68,000	7,000	9.7
<u>NETHERLANDS</u>			
New Guinea	1,000,000	164,090	6.1
<u>NEW ZEALAND</u>			
Cook Islands inc. Niue	19,200	200	96
Tokelau Islands	1,450	4	362
Western Samoa	84,000	1,130	74.3
<u>UNITED KINGDOM</u>			
British Solomon Islands	95,300	14,600	6.5
Fiji	295,000	7,000	42.1
Gilbert and Ellice Islands	35,600	215	165
Tonga	41,000	269	152
<u>UNITED STATES</u>			
American Samoa	19,000	73	260
Guam	59,000	225	262
Trust Territory of the Pacific Islands	54,000	687	78.6
<u>CONDOMINIUM</u>			
New Hebrides	43,000	3,590	11.9

APPENDIX 3

SELECT LIST OF REPORTS ON FISHING INDUSTRIES

IN SOUTH PACIFIC TERRITORIES

In addition to the Annual Reports of the various territories, information on fisheries industries in the South Pacific region may be obtained from the following sources.

AUSTRALIA

- ANDERSON, K.W. - Primitive New Guinea Fish Processing.  
Australian Fisheries Newsletter, Vol. 10, No. 1, Jan. 1951.  
pp.4, 10.
- MUNRO, I.S.R. and RAPSON, A.M. - Fisheries Survey in New Guinea  
by M.V. "Fairwind" 1948 to 1950. With an appendix on a  
survey of inland fisheries in New Guinea. 1950. Mimeographed.
- RAPSON, A.M. - Fisheries of the Territory of New Guinea.  
Prepared for Report on Territory of Papua and New Guinea  
Resources being published by Department of National  
Development. 1951.
- SCHUSTER, W.E. - A Survey of the Inland Fisheries of the  
Territory of New Guinea and Papua. Australian Journal of  
Marine and Freshwater Research, Vol. 2, No. 2, Oct. 1951.  
pp.226-236.
- THOMPSON, H. - New Guinea Fisheries Survey Report. Regional  
Development Journal, Vol. 2, No. 1, pp. 42-43. Reprinted  
Fisheries Newsletter Vol. 10, No. 5, May 1951. p.10.

FRANCE

- LEGAND, M. - Contribution à l'étude des Méthodes de Pêche dans  
les Territoires Français du Pacifique Sud. Journal de la  
Société des Océanistes, Tôme VI, No. 6, Déc. 1950.  
pp.141-184, 12 pl. Réédition - Musée de l'Homme.
- LEGAND, M. - Etat actuel et Perspectives de l'Industrie du  
Poisson dans les Territoires Français du Pacifique Sud.  
Cybium, Bulletin de l'Association des Amis du Laboratoire  
des Pêches Coloniales, Paris. No. 7, 1952. 23 pp., 8 pl.

New Caledonia

- CATALA, R.L.A. - Etude préliminaire sur les constituants ichtyo-  
faunistiques du cours moyen des rivières néo-calédoniennes,  
sur l'intérêt alimentaire de certains d'entre-eux et sur  
les modes de pêche s'y rapportant. Congrès des Pêches et  
des Pêcheries de l'Union Française d'outre-Mer. Institut  
Colonial de Marseille. Oct. 1950, pp.260-267.

French Oceania

ROPITEAU, A. - La pêche aux Thons à Maupiti. Journal de la Société des Océanistes, Paris. Tôme III, No. 3. Déc.1947. P.12.

VERNIER, A. - Pêches et engins de pêche à Tahiti et aux Iles Sous le Vent. Journal de la Société des Océanistes, Paris. Tôme III, No. 3. Déc. 1947. p.15.

UNITED KINGDOM

Fiji

BAAS BECKING, L.G.M. - Examination of Sites for Fish Ponds. Department of Agriculture, Suva. 1950.

HICKLING, C.F. - Report on the Fisheries of Fiji. Department of Agriculture, Suva. 1947.

HICKLING, C.F. - Fish Raising in Padi Ponds. Department of Agriculture, Suva. 1947.

HORNELL, James - Report on the Fisheries of Fiji. Government Printer, Suva. 1940.

Gilbert Islands

CATALA, R.L.A. - Report on the Gilbert Islands (Chapter on Sea Resources). To be published by the South Pacific Commission.

UNITED STATES

SMITH, Robert O. - Survey of the Fisheries of the Former Japanese Mandated Islands. Fishery Leaflet 273, Fish and Wildlife Service of the United States Department of the Interior. Washington, 1947. 105 pages, 50 illustrations, 21 maps, 5 tables.

APPENDIX 4

STATEMENTS ON FISHERIES PROGRAMMES AND POLICY

AUSTRALIA.

Nutrition surveys have shown that the diet of the inhabitants of Papua and New Guinea is deficient in animal protein.

To help meet this deficiency the Australian Government has decided to establish a fisheries service within the Department of Agriculture, Stock & Fisheries. The determination of the functions of this service is awaiting the appointment of a Director and also the outcome of this Conference. However, one of the first activities of the service will be directed towards the improvement of gear and techniques already in use.

In addition, a project for the development of the industry and the introduction of non-indigenous gear will show whether this type of approach to the problem of fish production is sound. Further, the resulting increase in quantity of fish available should make possible an attack on the problems of distribution and of community or co-operative organisation of the indigenous inhabitants.

The facilities and experience of the Commonwealth Scientific and Industrial Research Organisation and the Commonwealth Fisheries Office are available to assist development in the territory.

FRANCE.

The programme for the development of marine industries is practically in the hands of the French Institute of Oceania (I.F.O.), Noumea. The funds of this Institute are provided by the Office for Overseas Scientific Research. At the same time, official recognition of the relations existing in fact between I.F.O. and the Government departments concerned with fisheries questions in the territories will constitute the establishment of a fisheries service.

The present staff at I.F.O. will shortly be increased by the addition of a physical oceanographer. The purchase and fitting of a small sea-going vessel of about 15 metres will be completed by the end of this year. The personnel will then be further increased by the appointment of a qualified deck officer who, in addition to other duties, will have to deal with practical technology.

The first stage of work of I.F.O. will include the continuation of the appraisal of near-shore resources. Research work already completed elsewhere will be extended to the islands (Isle of Pines, Loyalty Islands, Belep, Chesterfield, New Hebrides). Concurrently, and alternating with near-shore field trips, systematic investigations of pelagic species will be undertaken off-shore in the waters of the New Caledonia-New Hebrides group.

The "Caledonian" programme will be supplemented by a "Tahitian" programme but it cannot yet be said whether this will be carried out in one or in several expeditions. It will start

in 1953 and will include a tentative appraisal of pelagic and near-shore resources (mainly as regards bait fish) of the Society, Leeward, Tuamotu and Marquesas Islands and, if possible, of the Tubuai Islands. Hydrological studies will be carried out in connection with this work on the basis of a programme to be worked out immediately after the arrival of the physical oceanographer.

Any expansion of the fisheries industry will be made primarily through entrepreneurs already interested or likely to be interested in the industry as producers, and through other industrial groups in the community who may provide a market for fisheries products. The object will be to encourage them to find a solution to the problem of distribution.

#### NETHERLANDS.

The programme which the Fisheries Section of the Department of Economic Affairs will carry out in Netherlands New Guinea will consist of two parts:

- (a) Development of the existing indigenous industry with the object of increasing the catch for local consumption and eliminating the import of canned fish from abroad.
- (b) Establishment of a fisheries industry and fish processing industry mainly producing for export markets.

To carry out the first part of the programme, three technologists experienced in the catching, industrial handling and processing of fish, and the construction and preservation of fishing materials are working with the Fisheries Section.

The introduction of non-indigenous fishing gear at this early stage of social and economic development of the indigenous people is not considered desirable. The Government will concentrate upon providing an ample supply of fishing materials and markets for local surpluses of the catch. Special attention is being given to forms of processing such as smoking and dry-salting of fish for distribution within the area. A navigating school will be established where a course for master fishermen will be given at the same time.

To carry out the second part of the programme, two projects are planned, one of which is partly under way. One project will be the establishment of a tuna fishery and tuna canning factory on the north coast of New Guinea. To carry out this project a combined tuna live bait and long-line ship is being constructed in Holland and is awaiting transport to New Guinea. This ship will operate regularly in the equatorial waters north of New Guinea and will deliver the catch to smoke houses until a cannery is established.

The second project will be the establishment of a trawl-fishery on the south coast of New Guinea, eventually leading to a fish meal industry. The first step in carrying out this project has been taken by the construction of a trawler in the Netherlands. This ship will be available to commence work early next year. The main problem is the difficulty of obtaining experienced fisheries officers from the Netherlands. Also the funds for carrying out the necessary oceanographic and hydrographic work are not available. A biologist will be appointed to the staff of the Fisheries Section next year to make a start with research work.

NEW ZEALAND.

Fish and other marine produce are an essential part of the diet of the people. Their needs, generally, are met from local resources, except where the combined effects of concentrations of population and increasing money economies encourage some consumption of imported supplies. In two of the smaller islands fish appear to be naturally not plentiful. Fuller information on the existing position, and on possible avenues of investigation and assistance, is given in the documentation of the Conference.

The people of the islands for which New Zealand is responsible number three per cent of the total within the South Pacific Commission area. There are no fisheries services, except strict controls for conservation. In the Cook Islands the taking of fish for sale other than for domestic consumption in the Islands is forbidden; the taking of pearl shell in northern lagoons is regulated by measures which maintain supplies while allowing exploitation which is high in proportion to the populations engaged in the trade.

No attention has been given to pelagic fish production for export because of

- (a) lack of evidence of resources and economic factors favourable to development of such a trade, and
- (b) the comparative attraction for the people of agricultural resources.

New Zealand will be most interested in recommendations of the Conference that may promote wider development of fisheries.

UNITED KINGDOM.

The United Kingdom Government, through the Secretary of State for the Colonies, has given consideration to the general provision of adequate protein supplies in the diet of rapidly increasing populations. The potential of aquatic resources is recognised as a fertile field for exploitation and the Government is considering both long range and immediate programmes for this purpose.

Her Majesty's Government, being a signatory to the Agreement establishing the South Pacific Commission, awaits the deliberations of the South Pacific Commission Fisheries Conference and the acceptance or otherwise of the recommendations of that Conference before defining a programme.

UNITED STATES.

The Governments of Guam, American Samoa and the Trust Territory of the Pacific Islands feel the need of and are interested in the development of the fisheries of these territories. The institution of programmes in fisheries, however, awaits the provision of the necessary funds.

A programme of investigating the high seas fishing resources of the territories and island possessions of the United States and intervening areas is being conducted by the Pacific Oceanic Fishery Investigations of the U.S. Fish and Wildlife Service.

This organisation has its headquarters at Honolulu and its areas of investigation lie both within and without the South Pacific Commission area. The type of programme and some of its results are given in Appendix 8.

Food and Agriculture Organisation and Indo-Pacific Fisheries Council.

The activities of the Food and Agriculture Organisation in respect of fisheries in the Indo-Pacific region fall into three sections: the continuing programme of its permanent staff, the co-ordinating and other activities of the Indo-Pacific Council, and the contributions to economic development of the Expanded Programme of Technical Assistance (EPTA).

The Organisation's continuing programme operates to furnish a world service in the formulation of fishery problems, the compilation of information on fishery industries and the co-ordination of national fishery activities. The programme makes expert advice in fishery matters available to Member Governments and such a service may be made use of by the Member Governments of the Commission (all of whom are members of FAO) either individually or through the Commission. The experts at present on the Organisation's staff include technologists in food and gear work, a naval architect, economists and biologists.

The Indo-Pacific Fisheries Council is a regional body established at the instance of the Organisation and financed, in respect of its Secretariat and meetings of its Executive Committee, from funds of the Organisation. The Council meets regularly to receive and review information on the fisheries of the region and on governmental programmes in connection therewith. The experts of which it is composed work in a series of technical committees and sub-committees to formulate problems and propose courses of action by Member Governments, the Council and the Secretariat. The Council has sub-committees covering almost all aspects of fisheries work; among the most important of the contributions of these committees are the preparation of programmes in hydrology, statistics and certain special fields of biology. The Council has a fairly extensive publications programme, which includes the preparation of handbooks. It has contributed to the development of plans for technical instruction for this industry.

The Expanded Programme of Technical Assistance provides specialist personnel for particular projects of economic development, conducts schools for fishermen and governmental fisheries officers, and provides fellowships for overseas travel. Projects have been initiated in various fields, including mechanisation of fishing operations, the establishment of fishery harbours, and the improvement of inland fisheries. The projects of this kind could be established for the individual Governments of the Commission area and for the Commission itself on their behalf. The schools are listed briefly in documentation of the Conference but the final schedule will probably be somewhat different from this list. These schools of course are open to the Member Governments of the Commission.

APPENDIX 5

FISHING GEAR AND METHODS RECOMMENDED FOR TRIAL

GEAR SUITABLE FOR REEF FISHING.

For the development of fisheries on coral reefs, portable traps should be used. These traps should be made of local materials as far as possible.

Set lines with multiple baited hooks may be used. The lines should be set about four feet six (1.5 metres) from the bottom; the hooks should be six feet apart (2 metres). The snoods should be two feet (75 cms.) long. Hooks should be size 6-8.

Where there are larger crustacea, baited lobster pots should be used.

Where the "fish drive" (Fijian "vutu vutu" or Hawaiian "hukelau") is traditionally practised with the use of a bag net and a long scare line, it may be encouraged. This method is not considered to be too selective.

Fixed traps, with not more than one enclosure per trap, should be built on the top of reefs. Such traps should not be built closer than half a mile apart. Local materials should be used for building such traps.

Where possible trolling just outside reefs on the leeward side of islands should be promoted.

For all the above methods of fishing, motorisation may be encouraged to provide both longer fishing areas and to extend potential fishing areas. Outboard engines, while often popular, are basically uneconomical. The small hull motor (5 h.p. - 10 h.p.) inboard diesel craft designed to take on the sea and in which the propeller is protected, may be encouraged. It can be used both as a tug and fish carrier. The construction of live-fish wells can be adopted to facilitate transport. Pockets holding live fish can also be towed.

TRAPPING OF SPAWNING FLYING FISH.

This type of fishing depends upon being able to locate the spawning schools of flying fish. If these schools cannot be found relatively close inshore, canoes could not be used and powered boats would be necessary.

It is an important fishery in Macassar. From about mid-April till mid-August large spawning schools of flying fish migrate through the Straits of Macassar in a northerly direction. For generations Macassar fishermen have caught fish from these schools, using the knowledge that flying fish deposit their eggs upon floating seaweed, drift wood, etc.

Fishing stations traversing the equatorial current system yielded very high catches in and near the plankton-rich band of water as compared with adjacent waters north and south of this band. On one traverse the yield was in excess of seven fish per hundred hooks, and in another it was over thirteen per hundred hooks. The catch consisted mainly of yellowfin tuna and the size of individuals was large, the average being in the neighbourhood of 110 to 125 pounds each.

According to the studies of the circulation by the Investigation's oceanographer, Mr. Townsend Cromwell, the enrichment system depends on sustained winds with a component from the east and should be well developed by winds from the south-east which usually prevail from June to February. In the period from March to May, when there is a tendency for the north-east trades to reach as far south as the equator, the system should shift southward and become weaker. These theoretically expected changes in location and intensity were found to have taken place according to the fishing results of a recent set of cruises. It may, therefore, be concluded that the concentrations of tuna are definitely controlled by the circulatory system and are not fixed by latitude or by the presence of islands.

The oceanographic studies have been under the direction of Mr. Townsend Cromwell, whose manuscript treating with the circulation system will go to press shortly. The plankton work, under Mr. Joseph E. King, is treated in a manuscript now going to press, while the fishing results are under preparation for publication by Mr. Garth I. Murphy.

Among the other activities of the Pacific Oceanic Fisheries Investigations which are of general interest to the South Pacific Commission region are: the assembling in specially constructed tanks of a reference collection of the various tunas, whose taxonomy is presently in a confused state; the investigation, by arrangement with the University of Hawaii, of reactions of tunas to stimuli such as chemicals, light, sound and electricity, under the direction of Dr. Albert Tester; and the translation of scientific and other reports, mainly of Japanese origin, by Mr. Wilvang Van Campen.

#### A TECHNIQUE FOR MEASURING ABUNDANCE OF REEF FISHES.

A scheme of measuring the abundance of reef fishes, developed by Dr. V.E. Brock, Director of Fish and Game, Territory of Hawaii, holds some promise of providing essential quantitative biological information.

The method involves the use of two divers, equipped with self-contained compressed air diving apparatus, who, guided by a 500 yard line, swim along the sea floor counting the fishes on a path extending some twenty feet on either side of the line. The counts are made separately by species and in five lots for each of five 100 yard sections into which the line is divided. The counts are made thus over an area of some 60,000 square feet.

The record is kept on white frosted plastic sheets some 6" x 9" x 1/16" in size by means of an ordinary pencil wrapped with string in order to prevent its disintegration. The plastic

Baskets about three feet in length and two feet high, built like traps with two entrances, are used. The baskets are cylindrical and made of bamboo. Around the circular entrances a ring of coconut leaves is fastened. In the middle of the basket are two carrying handles made of rattan. Eight of these traps are made into a float.

The Macassar fishing grounds are 50-80 miles off-shore, so that powered boats are used. The boats are about 30 feet in length, carry 4-5 floats of traps and can hold 2 - 3 tons of fish. The hold is divided into two sections, one for the storage of salt and the other for fish.

Before the boats set out to sea a quantity of seaweed is gathered and next to the coconut leaves on the traps a ring of seaweed is fastened. When the boats arrive at the fishing grounds, the floats are set overboard, fastened to each other and to the fishing boat by cables.

The fishing is done during the S.E. monsoon, mostly in rough seas, the boat drifting on the leeward side of the float at a pace of  $1\frac{1}{2}$  - 2 miles an hour.

The fish come to rest and play under and between the floats, deposit their eggs on the weed and swim into the basket, where they are trapped. Sometimes, mostly during the night, when fish are abundant they can be scooped up between the floats.

The eggs are torn off by the fishermen, the fish are lifted out of the baskets, and after being properly washed, are stored in the fish-hold and salted there, 1 lb. of salt to 2 lbs. of fish. After about 6 days, 2 - 3 tons of fish are caught and the boat sails back to Macassar, where the fish are discharged, washed and sometimes resalted for 24 hours in saturated brine. The fish are spread out on bamboo mats and are thoroughly dried during 3- 4 days.

About 3,500 tons of fish are caught annually. If properly dried and stored the fish can be kept for 2 - 3 months. During the early part of the season the fish are not dried, being too fat, but sold wet salted on the local markets. Drying commences in June.

Spawn is sold in vinegar and spices, mostly to the local markets, or is dried and baked in coconut oil.

#### METHOD OF TUNA FISHING FROM SMALL NATIVE CRAFT USED IN NETHERLANDS NEW GUINEA.

A very effective method of catching the small scombroids, of which family many species occur near the mainland of New Guinea and most of the other island groups in the Western Pacific, was introduced from Indonesia to Netherlands New Guinea. This fishing method can be carried out with native fishing craft and requires no great capital investment.

The boats used are slender, round bottom craft with sharp upward pointed bows, 25 - 36 feet long. A square latin sail is used on the one mast. The technique employed is the live bait, pole and line method as used by the Japanese and U.S. West Coast fishermen. Only a small amount of live bait is required.

It is caught at night under a lamp with dip nets or with a small beach seine. The bait is kept alive in the boat, the bottom of which is perforated so that seawater flows in and out with the movements of the boat. If no bait has to be kept, the holes are plugged with wood.

Early in the morning the boats set out to sea and tuna is indicated by birds flying over the school. There is a crew of 11; one man throws the bait over the after end of the boat, four men row the boat slowly around the school, and the fishing is done by the remaining six men.

The pole and line are identical to the gear used for large scale tuna live bait fishing, except that the lines are somewhat longer. When the tuna do not bite readily, live bait is used on a barbless hook. Otherwise small type barbless hooks with henfeathers attached to the shank are used.

The fish are thrown into the boats of which the fore and after part are separated by boards from the part in which the bait swims.

These boats can be used with outboard motors to reduce the time required for finding the school and to enable more schools to be fished in the same period. This method could be introduced in all places where suitable boats can be built and small tunas are found. The species caught in the New Guinea area are;

Katsuwonis pelamis (Kishinouye)  
Euthynnus alliteratus affinis (Cant.)  
Kishinouella tonggol  
Auxis maru (Kishinouye)  
Sarda orientalis

#### MOTHER-OF-PEARL LURE FOR TUNA OR BONITO USED IN TAHITI.

This method is usually employed from small powered boats at Papeete, but can be practised from canoes manned by two or three men.

The lure is cut from mother-of-pearl shell, shaped vaguely like a fish and trimmed with a bunch of feather barbs or cattle hair, forming a sort of brush. The hook, which is bound on the lure, is usually a mere metal hook, often made of brass, without barb and very open. The whole is tied on a metal or cotton leader. The success of the lure probably depends on the particular shell - not all lures catch fish and apparently only trial will tell.

As soon as the canoe arrives in a school of fish, the short bamboo poles which are carried are brought into use. The poles are 6 - 12 feet long. If necessary two poles will be used, held by two men and rigged on the same line. A short cotton line, securely fastened, trolls the mother-of-pearl bait immediately astern on the surface, and the fishermen wait for bites. The fish is immediately lifted, thrown into the canoe or boat where, owing to the open curve of the hook and the back of the barb, the fish unhooks itself. It is killed and gutted and the gills taken off.

JAPANESE LONG LINE OR FLAG LINE METHOD FOR THE TAKING OF PELAGIC FISH.

A modification of the Japanese method of flag line or long line fishing can doubtless be effectively employed in many parts of the South Pacific region for the capture of the larger pelagic species, such as tunas and the spear fishes. Such a modification, which is essentially a simpler, more primitive version, is at present used in the Territory of Hawaii. In its simplest form the operation of the gear requires a powered vessel of moderate size (25 - 50 feet overall), with working space both forward and aft. The size of the vessel will be determined largely by the average sea conditions on the fishing grounds and if advisable the gear can be set and hauled entirely by hand.

The Hawaiian long line fishery is described, with complete details of the construction of the gear, in:

June, Fred C. Preliminary Fisheries Survey of the Hawaiian-Line Islands Area. Part I.  
- The Hawaiian Long-line Fishery.

Commercial Fisheries Review. Vol.12, No. I.  
Fish and Wildlife Service, Washington, D.C.

PRE-REQUISITES FOR LARGE-SCALE INDUSTRIAL DEVELOPMENT OF TUNA FISHING.

In going from a market fishery to the large-scale industrial use of tunas for export, there are several very important requisites which present problems which are not immediately soluble. Among these are:

- (a) reliable indications that sufficient stocks of tuna are in existence within fishing distance;
- (b) knowledge of the seasonal or periodic fluctuations in abundance of such stocks and the causes thereof;
- (c) practical methods of fishing them to produce economic quantities;
- (d) the capital resources needed for fishing craft and shore factories;
- (e) a labour supply with the necessary skills; and
- (f) an assured export market.

METHODS OF FISH CULTURE IN PONDS.

Fish culture may occur in three forms:

- (a) the intensive culture of fish in ponds in large fish farms. Production up to 6,500 lbs. per acre per annum.
- (b) the incorporation of one or two ponds in the mixed agricultural small-holding of a peasant economy. Production 600 to 1,200 lbs. per acre per annum.

- (c) the culture of fish as a catch crop in areas which are irrigated for the purpose of production of a major agricultural crop, such as rice or aroids. Production 60 to 100 lbs. per acre per annum.

Fish culture in ponds may entail either a process of heavy and perpetual fertilisation or the management of ponds so that a dynamic balance is maintained in the aquatic environment between the animal and plant population, and regular annual yield of fish ensured. The latter condition obtains particularly in the culture of Chanos Chanos (Forsk) in brackish-water ponds.

Although fish culture is carried out at a traditional level in a number of places in the region, it is not considered to be a means appropriate for major production of fish at present. On the other hand, a detailed study of traditional practice should be made so that, as and when occasion for development arises, improved methods may be dovetailed into traditional practice in a way which will neither upset this practice nor offend social custom.

APPENDIX 6

FISH PRESERVATION METHODS  
IN PAPUA AND NEW GUINEA

The following information and recommendations arise from a survey of indigenous methods of fish preservation carried out in Papua and New Guinea during April, May and June, 1950, by Mr. K.W. Anderson of the Food Preservation and Transport Division, Commonwealth Scientific and Industrial Research Organisation, Homebush, New South Wales.

OBSERVATIONS ON EXISTING PRESERVATION METHODS.

As far as could be ascertained the sole method of preservation of fish used throughout the territory was a simple crude-drying over a hot fire.

The extent to which the fish is dried varies somewhat within uncontrolled limits but can broadly be classified into two groups:

- (a) Short term, partial drying, with or without prior cleaning of the fish, giving a product that is relatively soft, probably has a moisture content in the range of 40-60% and a storage life of 1 to 7 days. This is the technique used in the greater portion of the territory.
- (b) A more complete drying of cleaned and split large fish or whole uncleaned small fish, down to a moisture content of about 20% where it is hard and dark in colour but, when protected from attack by insects, probably has an indefinite storage life even under tropical conditions. This latter technique seems confined to the Sepik river area.

With the limited means of transport at their disposal it is natural that there is little interest shown by coastal natives in the preservation of fish when there is no ready market within easy access. However, there are many areas where such a market should be available and is not being satisfied either because of the lack of fish or efficient catching gear and methods.

The primitive techniques of the natives and their poor knowledge of hygiene mean that any curing work on a higher level than that at present used would need to be thoroughly supervised for some time.

#### GENERAL RECOMMENDATIONS.

In the absence of controllable pond fisheries, it is clear that the preservation of coastal fish, as a means of smoothing out seasonal fluctuations in supply and of distributing inland to protein deficient communities with a poor system of communication, will initially best be done by the traditional process of salting, drying and smoking in suitable combination rather than by adopting elaborate processes such as freezing, canning and controlled smoking.

As a preliminary it would be pertinent to test the acceptability of the hard dried fish of the Sepik River area amongst natives in other parts of the territory.

Any simple techniques which represent an advance on this primitive fire drying will necessitate the use of salt. This salt will either have to be imported from Australia or obtained by setting up plant for its recovery from sea water within the territory itself. The only area where this might be feasible, using solar evaporation, is in the immediate vicinity of Port Moresby - Kairuku to Beagle Bay, an area of rain shadow with an annual fall of 40" to 50".

If it is desired to proceed with some simple experimental work the two areas which show most promise are Abau on the South Coast of Papua and the Sepik River on the North Coast of New Guinea. At these two points supplies of fish are available; the natives are interested in the project and keen to improve their techniques; and both places are within easy reach of potential inland sources of trade.

It is considered advisable to concentrate initially on preparing a good quality salt-cured fish rather than attempt to introduce some of the more complicated methods for the preparation of fish concentrates and condiments.

#### DESCRIPTION OF SUITABLE PRESERVATION METHODS.

A brief scheme is suggested outlining the fundamental approach to these simple cures but it must be emphasised that no great progress will be made towards developing other than stop gap techniques in any of this fisheries work unless arrangements are made for proper supervision. This should be given by trained personnel who are able to devote their full time to the study and application of the various techniques in the field under the particular existing conditions.

#### Control of the Lag Period between Catching and Landing on Shore.

Fish should not be roughly handled when being taken out of nets or in the boat. If they are piled in heaps, walked on or forked roughly, they will spoil much more rapidly. In the absence of ice it is essential that they be cleaned and "prepared" as soon as possible after catching. The delay should not exceed four hours and should preferably be much less. Fish should not be left under the direct rays of the sun in an open boat but protected by a canvas awning.

Method of Preparation.

The techniques for the preparation of fish for dry salting can briefly be generalised thus:

- (a) Round fish, that is garfish and those of similar shape must be scaled, preferably beheaded or at least the gills removed, split and opened out, thus exposing a large surface of flesh for penetration of salt.
- (b) Flat, deep fish such as mullet, trevally, Spanish mackerel may or may not need to be scaled but must be split: viz. a knife is run down the backbone or the belly towards the tail and the fish opened out into a flat single piece. In some cases it is preferable to cut down both sides of the backbone, subsequently removing the backbone by breaking it off near the tail.
- (c) It is essential that the fish be thoroughly cleaned and eviscerated, all blood and black skin from the belly cavity being removed with a stiff brush.
- (d) A final wash in a dilute salt solution (2 lb. per 5 gallons water) will be found to be helpful in "cutting" slime and traces of blood. Sea water from around a fish house, dock or near shore should never be used. It is invariably contaminated and increases the likelihood of spoilage.
- (e) It is tentatively recommended that the maximum thickness of a split fish or a fillet should not exceed 1/2" but good results could be expected by scoring the flesh of larger fish with a knife in longitudinal slashes thus exposing a greater area of cut flesh. In any case excessively large fish should always be reduced in size.

Salting.

The salting vessel should be thoroughly clean, watertight and preferably of wood, or some non-corrosive material. A small native canoe would probably be very satisfactory. The salt, which should be fairly fine and dry, is poured into a shallow box. Each fish is dredged in this salt, being rolled two or three times and salt being rubbed into the slashes. It is picked up with as much salt as will stick to it. A thin layer of salt is scattered on the bottom of the salting vessel and the fish are laid evenly, flesh side up. No two pieces of fish touch each other without salt between. A thin layer of salt is scattered on top and another layer of fish laid at right angles to the preceding one. This procedure is continued until all the fish are in salt. The top layer is packed skin side up and if necessary weighted down to keep the fish under the surface of any brine that is formed. The amount of salt required will be found by experience but should be approximately one part of salt per three parts of fish. The salting vessel must be protected from rain and kept in as cool a place as possible.

The time required for the fish to become "struck" i.e. absorb sufficient salt to effect a cure, will vary, dependent on climatic conditions, the species (oily or non oily), dimensions and bulk of the fish in the container, and may extend from several days to several weeks.

At the end of this time the fish are taken out of the salt and scrubbed in a brine (the same strength as used for cleaning) until no trace of salt is visible on the surface. They are drained for 15 minutes and placed on the drying racks. These are frames of wood covered with chicken wire and standing on logs 3 or 4 feet high.

#### Drying.

The racks are placed out on dry ground. It is preferable for them not to be in the direct rays of the sun, as this tends to accelerate the oxidation of fats. Under the general climatic conditions existing in the territory exposure to the sun will probably be found necessary in order to obtain a reasonable rate of drying. The fish are laid out skin side down and turned three or four times the first day. Drying may take from a few hours to a few days and can roughly be judged as complete when the surface looks dry and hard and the thumb pressed into the thick part of the flesh leaves no impression. The fish are gathered up and placed under shelter at night or in the event of rain to prevent spoilage through dampness.

A technique which has been described in the literature, but not tried in these laboratories, and is said to be suitable in weather where air drying is impossible or in climates where the relative humidity is high, is as follows: "After the fish have been removed from the salt and scrubbed in brine they are piled in stacks, flesh side down. The stacks are then heavily weighted in order to press moisture out of the fish. After 10 to 18 hours in the stack the fish should be repacked in dry salt with the top weighted down and stores in a cool dry place."

#### Storage.

76. Fish so cured should have a storage life of several weeks. They should be stored in wooden boxes lined with waxed paper. A little salt (about 1 lb. of salt to 10 lbs. of fish) should be scattered between each layer and the fish stored in as cool and dry a place as possible. If signs of mould growth appear, the fish should be scrubbed in brine and dried in the air for a day or two.

Within our limited experience of this dry-salt cure in tropical climates, two significant observations may be made upon storage.

#### The development of a yellow stain on the surface of the fish.

It was thought at first that this was due to oxidation of the fats; however the off-flavours and odours usually associated with such rancidity could not be detected. Some recent work has shown that yellow stains such as these can generally be traced to iron present as an impurity in the salt used for curing. As little

as 40 parts per million of iron in the salt will produce the stain. It should have no ill effect on the consumer.

Surface moisture developing on the fish during storage.

When heavily salted fish is stored in contact with air of high relative humidity and temperature, water from the surrounding air can be deposited on the fish surface because of the difference between the aqueous vapour pressure of the salt solution on the fish surface and that of the surrounding air. It has also been claimed that such surface moisture comes from the interior of the fish flesh by capillary action under conditions of high temperature and humidity. Whatever its source, and the point is rather contentious at the moment, the phenomena may well prove a troublesome factor in storage and handling.

The conditions of storage previously outlined involving a light sprinkling of salt may be used to advantage but some experimental packs would need to be prepared before a definite conclusion could be drawn.

Although most bacteria will not grow and multiply in foodstuffs containing less than 40% moisture, one of the most common sources of spoilage in salted fish is due to a family of organisms known as halophiles. Some members of this family can grow in fairly concentrated solutions of salt, and these conditions will apply to the aqueous phase of the dry-salted fish. The source of the halophiles is usually the salt used in curing. The salt most apt to be contaminated is that obtained from sea water by evaporation. Spoilage due to halophiles shows up as a pink to reddish stain accompanied by softening of the fish flesh. If reddening appears at any time, the fish should be removed from storage, washed thoroughly in a pure salt brine, given a few hours drying and repacked in pure dry salt using 10 - 15 lbs. salt per 100 lbs. fish. All tables and equipment used in salting should be thoroughly disinfected and the salt heated and thoroughly baked to sterilise it.

Smoking.

Although no significant extension of storage life can be expected by smoking this dry salt cured fish, a considerable enhancement of the flavour is obtained. The natives, through the use of fire drying technique, have acquired a taste for this smoked flavour in fish and it was noticed that they did prefer a product which had been smoked rather than sun dried after salting.

83. Fish are ready to smoke after removal from the salting vessel followed by washing and draining. At this stage it is impossible to say what type of kiln might be most suitable but since its main purpose is to flavour the fish, rather than to cure it, some very simple construction will probably be adequate.

The essentials are:

- (a) Smoking should be carried out at as low a temperature as possible in order to promote some drying but avoid any tendency to cook and hence toughen the flesh.

- (b) To obtain uniform deposition of smoke constituents it is preferable if the fish are hung vertically on tenters in the kiln rather than laid horizontally on a rack.
- (c) The kiln should be equipped with some simple mechanism for adjusting the draught into the fire and the rate of escape of smoke from the top so that an even flow can be maintained and the temperature of smoking can be controlled.
- (d) The fire should smoulder without bursting into flame. Where available, sawdust from non-resinous softwoods and some hardwoods is preferable, but driftwood and green coconut husks are reasonably satisfactory as fuel. The time of smoking will vary with the degree of smoke flavour required but will most likely need to be at least 12 hours. Storage conditions will be the same as before.

#### Reconstitution.

This is accomplished by freshening in several cold waters overnight or, should further leaching of salt be required, by parboiling. Prolonged boiling tends to toughen the flesh.

#### Native Palates and Hygiene.

There is a widespread belief that natives can eat spoiled fish apparently without harmful effects. In the writer's experience they are extremely observant of fish spoilage if they intend to consume the product themselves. There seems no reason why the toxins produced by certain bacteria in decomposing fish should not be as harmful to a native as to a European. Therefore, in the above or any other cure, some degree of latitude in the texture and flavour quality of the final product can be allowed owing to the wider range of acceptance of the native palate but the same conditions as are necessary to prevent bacterial spoilage in a European's food must be strictly observed.

APPENDIX 7

SUGGESTED APPROACH TO THE PROBLEM OF COLLECTING  
FISHERIES STATISTICS.

STATISTICS OF FISH CATCH.

The problems of obtaining dependable information on the weight of fish caught in the area with which the South Pacific Commission is concerned is a most difficult one. In general, the statistics of fish caught are obtained through markets or canneries, or other processing plants and the fish which does not enter these channels represents such a small part of the whole catch that it can be neglected. In this area, however, fish markets are the exception rather than the rule and the proportion of the total catch which enters the so-called commercial channels is much the lesser part.

In view of this situation the usual approach of market records will not provide the necessary statistical information. Hence a somewhat different approach is proposed here, that of a periodic survey of landings of fish at selected places which, together with information of the number of fishermen, fishing boats, and fishing gear, can be extrapolated to give an estimate of the total catch. It is not, however, suggested that the market records be neglected; wherever available, they should be collected.

For any clear understanding of the fisheries the importance of information on the weight of fish caught cannot be exaggerated, for such statistics serve to measure the magnitude of the fishery resources and progressive changes in the catch as shown by statistics are often, if carefully considered, the best indication of the wealth of the resources.

INSTRUCTIONS FOR SURVEY REPORT OF FISH CATCH.

This report is intended to provide a means of estimating the fish catch of an island or region. The method of securing that estimate is to obtain the catch of some part of the fishery for a fixed period, such as a day, and similarly to obtain the number of fishermen, fishing boats and gear required to take it. Then an estimate is made of the total number of fishermen, fishing boats and gear for the island or region under review. In very simple terms, the observed catch would then need to be multiplied by the ratio which the number of fishermen, boats and gear required to take that catch bears to the total number of fishermen, boats and gear of the whole area. The accuracy of the results will depend, of course, on whether that part of the fish catch observed bears the same relationship to the men and apparatus used in taking it, as that between the total catch and the total number of men and fishing apparatus used in taking it.





The section of the form headed by Survey Detail is to be used in obtaining the fish catch of that part of the fisheries which can, in view of practical considerations, be observed. The catches of fish should be properly associated with the fishermen, boats and apparatus required to take it, and where a number of separate fisheries are pursued, each more or less distinctive in the methods used, kinds of fish taken and weight of fish landed, it would be most desirable to make surveys for each separately. The entries in the columns should be as follows: Date: give the date of the pertinent set of observations. Kinds of fish: give the kinds as they are locally known, making a proper distinction as to species as far as possible. If the scientific names are known, give them, together with the local vernacular equivalents. The weights of fish should also be given separately by kinds and the units of weight used specified. The origin of the fish is to be taken from the listing given at the bottom of the section and, if the catch is derived from several of these sources, they should if possible be given, together with an indication of their relative importance. In the column headed "Fishery" should be entered the local general term used for the method of capture of the fish. The entries in this column and those following (No. of fishermen, No. and kinds of boats, and No. and kinds of fishing gear) must apply to the particular catches reported under the first three columns.

The section of the form headed General Information is to be used to report the extent of the island or regional fishing industry. Here the entries are classified by fisheries, and the entries which follow should be properly associated with a given fishery and the information should be as complete as it is practicable to give for the island or region concerned. The final entry is concerned with the fishing rate since many fisheries produce a daily catch while others may be productive at various time intervals which may be irregular, or weekly, monthly or even as infrequently as once a year.

The foregoing account is given simply as presenting the main features of a statistical collection system. In operation in each locality, modification of this system will probably be required to meet particular circumstances. It is suggested that any Member Government already possessing experience in this field should communicate advice on this to other Governments, through the Commission. Further, it is considered that Governments proposing the introduction of a system such as this might avail themselves of the services of a statistical officer, preferably one who has had experience in fishery work. It is emphasised that the use of sampling methods such as described here involves a logic whose particular form will depend upon the physical and economic details of the field being studied.

APPENDIX 8

FISHERIES RESEARCH IN PROGRESS IN CLOSE RELATION  
TO THE AREA OF THE SOUTH PACIFIC COMMISSION

RESEARCH PROGRAMME OF THE OCEANOGRAPHIC LABORATORY OF THE  
FRENCH INSTITUTE OF OCEANIA, NOUMEA.

The oceanographic laboratory of the French Institute of Oceania was established in January 1948 in Noumea. Its staff consists of one research worker, M. Legand, and with technical assistants, and it has been solely concerned with ichthyology. The appointment of a physicist-oceanographer can however be expected in the near future.

The French Institute of Oceania is entirely dependent on the Office for Overseas Scientific Research. The objective of this body is to promote, in French overseas territories, any research work which may have a practical bearing on the economy of the territories concerned.

In addition to purely scientific equipment, the laboratory has fishing equipment including approximately 500 metres of beach seines, throw nets, traps, lines, fishing punts and camping equipment.

Research trips were made in 1949-50, with an American war surplus power launch, later lost at sea, and a utility truck. The possibility of purchasing a research vessel is under careful consideration and this question will probably be settled during this year.

In conformity with the equipment available, investigations have so far been concentrated on the coast and adjacent islets.

The technique involved the fishing team of the laboratory camping on an islet, or on the shore, in the neighbourhood of the selected working grounds. When a boat was available, it was anchored near the camping ground. At each period of favourable tides, the Chief of the Laboratory and part of the remaining staff came to the working area and spent from six to eight days in the field, returning to Noumea during the neap tide periods to carry on at the Institute the study of materials gathered. The camp was gradually moved along the coast. In 1949-50, investigations were carried out from twelve such stations and covered most of the coastal areas of New Caledonia.

In each catch, lots were selected and the fish measured. Numerous catches and studies were conducted of post-larval stages. The aims were:

- (a) to establish a qualitative and quantitative inventory of the coastal ichthyological resources;
- (b) to lay the foundations for an adequate zoological identification of the fauna components;

- (c) to establish the basis for a proper study of growth, since all problems raised by the biology of the species are related to growth.

Approximately 350 species were collected and over 200 were identified. Important series of mensurations now make it possible to undertake specific studies of several genera largely represented in local catches (Sillago, Leiognathus, Gerres, Sparus, Stolephorus, Engraulis, Lutjanus, Pomadasys).

At the same time, important efforts were made in the matter of iconography and approximately 80 original plates will be published at a later date, together with the new data on the ichthyological fauna of New Caledonia.

A three months mission was also carried out in French Oceania (Tahiti, Leeward Islands and Tuamotu) in order to study fishing techniques. The part taken in the activities of the Oceanographic Committee on Coastal Studies should also be mentioned. Plans for hydrographic research were elaborated and undertaken by this body at the request of the laboratory. The field work of the committee is carried out by the sloop "Tiaré" of the French Navy. This research concerns the bays and estuaries of the south-west region of New Caledonia.

During the absence of the Chief of Laboratory on leave in France (1951), the work was entirely suspended in Noumea. On the other hand, considerable efforts were made to assemble the elements of a library on ichthyology. At this date, most of the books and microfilms have arrived and the laboratory is now able to carry out almost all its identification work.

As soon as the question of sea transport is settled, the efforts of the laboratory will be directed to deep sea areas.

In fact, practically nothing is known in this country of what happens beyond the reef, and we have therefore very little data, for instance, on the economic possibilities concerning Scombridae. In this field, the work will have to start from scratch.

When equipped for deep sea research the laboratory will also undertake plankton and water sampling, and temperature recording, in parallel with similar work to be undertaken by the Oceanographic Committee on Coastal Studies.

The research work on the lagoon fauna will of course be continued on the lines previously adopted, but will have only second priority.

The evaluation of banks, identification of species and their migrations, measurements, and eventually tagging, stomach contents, technological studies, for instance on the use of surface nets, selection and preservation of bait and the eventual use of small trawls, will be part of the programme.

From the geographic point of view, the work will be extended to include the islands : Belep and Yandé, Isle of Pines, Loyalty Islands, as well as the New Hebrides, the Chesterfield Reef, and if possible the French Establishments of Oceania.

Liaison with operatives, tradesmen and fishermen will be maintained as previously, since the whole benefit of our efforts and of their results will be intended for private enterprise, with the already very active help of organisations such as the Navy, the Department of Economic Affairs, the Maritime Registry Services and the Native Affairs Service.

#### PACIFIC OCEANIC FISHERY INVESTIGATIONS.

The Pacific Oceanic Fishery Investigations of the United States Fish and Wild Life Service, under the direction of Mr. O.E. Sette, is concerned with developing the high-seas fishing resources of the territories and island possessions of the United States and intervening areas of the tropical and sub-tropical Pacific Ocean. The investigations are based on Honolulu where a laboratory has been constructed on the University of Hawaii campus and where docking facilities for the three sea-going vessels of the investigations are provided at Pearl Harbor by the Navy.

The initial sea-going investigations, which have been under way for two and a half years, are directed mainly towards study of the tuna stocks in the area of the Hawaiian Archipelago, westward as far as Midway Island and southward to a few degrees below the Equator.

The design of investigation is to study the oceanic current systems, with particular attention to situations favourable to high productivity of sea life in general, it being considered that in such situations the probability of finding concentrated tuna stocks is much greater than would be true for the general average of mid-Pacific conditions.

Meridional oceanographic sections traversing the equatorial current system have verified the existence of a divergence at the equator which depends on sustained easterly winds for its maintenance. This divergence is fed from below by waters rich in nutrient salts. As these are introduced into the lighted surface layer, organisms capable of photosynthetic activity multiply and form the support of zooplankton. This process takes place as the water drifts north from the equator under the influence of the prevailing south-east trade wind. The dynamics of wind-driven currents near the equator demands that there be convergence near the southern margin of the equatorial counter-current with an accompanying downward movement of the water and, finally, a return towards the equator at subsurface levels. Since the zooplankton organisms resist the downward movement, they accumulate to form a band of zooplankton rich water paralleling the equator.

Surveys of abundance of tunas by the conventional Californian fishing methods proved impractical owing to lack of sufficient live bait sources for the tuna-clipper type of fishing and to the prevalence of rough seas and "wild" schools in case of the purse-seine type of fishing. On the other hand, the conventional tuna long-line method, such as practised by Japanese fishermen, proved satisfactory.

sheets are ruled vertically into some five spaces corresponding to each of the five 100 yard divisions of the guide line laid on the sea floor, and horizontally into about 30 lines, with names of the species of fish commonly expected to be seen entered on the left margin. Additionally some of the sheets are ruled with fewer horizontal lines, and these sheets are used for notes on the salient features of the sea floor such as the abundance and species of coral and sea weeds, the proportion of sand and the depth of the water. This latter observation is readily obtained from a small depth gauge worn on the wrist.

The divers are accompanied by a skiff which follows their progress by means of the ascending column of air bubbles.

The transect lines are positioned on the sea floor after consulting either aerial photographs or charts so that a suitable range in depth and a suitable average of bottom conditions will be covered. Compressed air sickness and the use of stage decompression to avoid it is by-passed by having one portion of the deeper transect lines end in shallow water. The survey procedure is then to begin the transect at the deeper end of the line, so that decompression is, in effect, accomplished as the diver swims into the shallow end of the transect. The depths and gradients of the transect are selected so that this effect is assured. Depths from 80 to 6 feet have been covered so far.

This method of making estimates of the abundance of fish through direct submarine observations has not been employed for a sufficient length of time to evaluate its effectiveness properly, and the method is quite possibly not yet in final form and hence is likely to be improved. However, when a sufficient number of transects have been completed, the data will be analysed by appropriate statistical methods (analysis of variance) in order to measure the variability and hence the reliability of the method.

If successful, submarine transects may prove to be a valuable tool in evaluating changes in species composition and/or abundance of fishes in reef areas, and thus in the proper management of coral reef fisheries.

The development of this scheme is only one of the many aspects of the work being undertaken by the Division of Fish and Game of the Territory of Hawaii.

#### POISONOUS FISHES.

Dr. Bruce Halstead, Medical Zoologist of the School of Tropical and Preventive Medicine of the College of Medical Evangelists, California, is conducting research on poisonous fishes. His work has been sponsored by the Office of Naval Research and the United States Public Health Service, and he has received specimens from various parts of the world, including a number of islands in the South Pacific region. Specimens are put under refrigeration as promptly as possible and carried to the laboratory at Loma Linda, California, in a frozen state.

Dr. Halstead has made both chemical and biological assays of the specimens he has collected; he hopes to go on to experimental work dealing with the occasional appearance of poisonous individuals among populations of a species.

For the past five years Dr. Halstead has been engaged in compiling an extensive bibliography on poisonous and venomous fishes. The literature is being abstracted in preparation for the publication of an exhaustive review and annotated bibliography on the problem of ichthyotoxism. The bibliography will contain about 1000 references.

It is understood that Dr. Halstead would be glad to co-operate with any other workers interested in this field of research.

APPENDIX C

MEMBERS OF THE CONFERENCE

DELEGATIONS:

Australia

Mr. C.G. Setter                      Second in Charge of Commonwealth Fisheries Office, Department of Commerce and Agriculture.

Mr. W.A. Empey                      Principal Research Officer, Division of Food Preservation, Commonwealth Scientific and Industrial Research Organisation.

Mr. E.N. Kruger                      Officer-in-Charge of the South Pacific Commission Section, Department of Territories.

France

M. M. Legand                      Acting Director of the French Institute of Oceania, Noumea.

M. M. Jacquier                      Chief of Maritime Registry Service, New Caledonia.

M. P. Sarlin                      Chief of Agriculture and Forestry Services, New Caledonia.

Netherlands

Mr. H.W. Leiding                      Fisheries Adviser, Department of Economic Affairs, Netherlands New Guinea.

Mr. D.C. Zwollo                      Head of Fisheries Section, Department of Economic Affairs, Netherlands New Guinea.

New Zealand

Mr. C.G.R. McKay                      Senior Commissioner for New Zealand on the South Pacific Commission. (Formerly Secretary of the Department of Island Territories.

United Kingdom

Mr. D.W. Le Mare

Director of Fisheries, Federation of  
Malaya and Singapore.

Mr. A.F.S. Ohman

Senior Veterinary Officer, Government  
of Fiji.

United States

Mr. O.E. Sette

Director of the Pacific Oceanic  
Fisheries Investigations, U.S. Fish  
and Wildlife Service, Honolulu.

Mr. Vernon Brock

Director of Division of Fish and Game,  
Board of Commissioners of Agriculture  
and Forestry, Territory of Hawaii.

OBSERVER:

Dr. G.L. Kesteven

Regional Fisheries Officer for Asia  
and the Far East, Food and Agriculture  
Organisation, and Secretary, Indo-  
Pacific Fisheries Council.

COMMISSION:

Dr. E.M. Ojala

Deputy Chairman of the Research Council.

Mr. R.N. Hancock

Conference Secretary.

Also present at some of the meetings were M. G. Pisier, Chief of  
the Department of Economic Affairs, New Caledonia, and Dr. and  
Mme. R.L. Catala, French Institute of Oceania, Noumea.

