FISHERIES DEVELOPMENT

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Summary

The special characteristics of fishery resources likely to affect the study and planning of development are defined and the structure and function of the industry outlined.

To simplify consideration of development, distinction is made between development and growth, the former involving innovation and the latter the addition of units identical to those already employed in the industry. This leads to an examination of the nature of fisheries development, development situations, and the immediate and subsequent consequence of development. The use of indices to measure the real change taking place during development is discussed.

Conditions for development and/or growth include under-exploitation of the resource and/or improved operation. The importance of information, know-how, and finance is also stressed. Leverage by inducing or impelling development in another sector is also suggested. The benefits of such development are then discussed and this leads to a detailed consideration of the respective roles of government and industry in fisheries development.

INTRODUCTION

The great length of the Australian coastline and the vast stretches of ocean surrounding this continent seem to offer such extensive opportunities for fishing that Australia apparently ought to be one of the great fishing countries of the world. Yet the contrary is the case, for the Australian fishing industry is one of the smallest.

To the layman, this situation is perplexing, particularly as foreign vessels are reported from time to time to be fishing these waters. Moreover, this situation does not arise from a lack of demand. Foreign fish products are on sale in retail shops and imports of edible fisheries products exceeded $A29 million in 1966-67. The layman learns that other countries are developing their fisheries and some have already extended their operations to areas thousands of miles away from base. He cannot, therefore, understand why Australian fisheries are not being developed. Why, for instance, does Australia not share with the Japanese the valuable tuna fisheries of the Coral and Tasman Seas? What other resources are being neglected, what should be done to enlarge Australia's fisheries, and what would be gained by doing so?

The Australian Fisheries Development Conference, for which this paper was originally prepared, was convened to examine evidence on such matters. Information relating to the nature and extent of a number of selected fishery

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resources was also considered in an attempt to assess the opportunities offered by these resources. Information on boats and gear, manpower, processing plants, cold-stores, and other equipment, was also made available to permit the Conference to attempt to evaluate the changes in respect of kind and quality that would have to be made to achieve particular modifications in the industry.

The task before the Conference was both wide and complex and although no new lines of action were devised, the Conference achieved its major purpose of bringing industry and government together, and thereby establishing conditions that could significantly influence the future course of the industry. The establishment of an Australian Fishing Industry Council, which represents and can speak for the diverse interests of individual sections of the industry, was an immediate outcome. The Conference also stimulated a new spirit of co-operation between government and industry.

This paper was to provide a general framework for discussions by formulating the basic principles of fishery development, and suggesting a common terminology.

CHARACTERISTICS OF FISHERY RESOURCES

Although fisheries have much in common with other industries, and more especially with other primary industries engaged in the exploitation of natural resources, they have special features which seriously affect the nature and conduct of any study of them. Especial note must be taken of these features in planning the future of these industries. These features are:

(1) The natural resources are living and renewable.

(2) However, with the exception of the still relatively small section concerned with culture, the bulk of the resources are wild and to these man makes no contributions such as are made in agriculture by ploughing, sowing, and so forth.

(3) Because the resources are wild, man cannot control what is to be available for harvesting at any time and his best course of action is to predict (from studies of the resource and its habitat) what will be available and to plan exploitation to make the best use of this opportunity.

(4) Such resources are generally common property and to a large extent international. Because of this the amount of effort applied is not subject to the restraints that govern exploitation of a solely owned resource. Uncontrolled competition thus prevails, unless means are found to control operations by agreement among the fishermen or by regulation imposed by government. Consequently governments have, at least in the primary sector of the industry, a more direct and continuing responsibility than would normally be acceptable for other industries.

(5) Fishing itself is a hazardous occupation calling for special skills and equipment. The circumstances of its operations, which include a high degree of isolation when danger is most pressing, encourage an extreme individualism. Two-way radio may reduce but cannot remove this isolation. The risks in the primary sector are such that governments are generally concerned deeply in matters such as fitness of equipment, the competence of personnel, and the provision of special assistance such as sea-rescue services.

(6) Fishing is an irregular, intermittent occupation which is largely dependent on the weather. But even when this is favourable, the taking of a catch depends on whether the fish are located, prove to be vulnerable to capture, and the gear is successfully operated. In consequence, catches, fishermen's income, and market supplies are subject to marked uncertainty.

(7) Fish is a highly perishable commodity and the agents of spoilage, which are numerous, are difficult to control. Moreover, because fish is a wet commodity consisting of discrete units of various sizes and shapes, its handling presents special technical problems which are particularly acute in respect of transport, refrigeration, and processing.

(8) The problems in handling, storing, and processing are aggravated by the uncertainty of supply. Fishermen cannot give any assurances of when they will make their catches nor of the quantity of fish they will land. Regular supply to processing plants is rarely possible and most fisheries must be organized for seasons which, in some cases, are short but marked by heavy yet irregular supplies.

These characteristics of the resource and its products, and of the circumstances under which the industry's operations are conducted, determine the characteristics of equipment, manpower, and operations, and have a marked influence on the costs and earning of the industry. In turn, investment and action by government, particularly in respect of its responsibility as guardian of these common property resources, are considerably influenced by these characteristics.

STRUCTURE AND FUNCTION OF INDUSTRY

The primary sector of a fishing industry in any country is to be seen as a mosaic of unit fisheries each exploiting one or more resources (see Appendix I: Australian Unit Fisheries). The secondary and tertiary sectors, which consist of a complex network of establishments engaged in the handling, storage, processing, and marketing of fish and fish products, may be divided into geographical units or into segments each associated with one or a group

of unit fisheries. The degree of vertical integration also varies from country to country, and even within a country from one segment of the fisheries to another. Similarly, the degree of horizontal integration is variable and is minimal in countries where subsistence and small scale industrial operations take place. The physical and organizational structure of each sector of fisheries follows the pattern of all industries as can be seen from the table.

This table makes no reference to ancillary industries, such as those concerned with the construction of boats and fishing gear. Some of these industries are largely, or even exclusively devoted to the service of the fishing industry, but their structure and operation is not considered in this paper. Port or shore facilities are frequently reserved exclusively for operating units in the primary sector, which is in strong contrast with the situation of other infrastructural elements which provide common facilities for several industries.

Reservation of equipment and facilities to fishery, so strong in the primary sector, is less marked in the secondary and tertiary sectors. For instance, establishments in the secondary sector may also process raw materials from industries other than fisheries. Similarly, transport and marketing services may be shared with other commodities. Manpower, too, is trained on a general rather than a fishery-oriented basis. This feature of the secondary and tertiary sectors of fisheries has an accountancy as well as a technological significance, and this differentiation of the primary sector from the secondary and tertiary sectors has considerable bearing on planning.

(a) Operational Characteristics

Two features of fish and fishing - the perishability of fish and the very high risk element associated with the industry - exert a very considerable influence on the operations of the industry.

The operations of the primary sector are highly coloured by a considerable element of risk, reflected by the individualism, self-reliance, and resourcefulness of the fishermen. Hazards to life and equipment are ever present and at times lead to loss of both. Industry thus has an obligation to introduce and employ methods and equipment likely to reduce such hazards and, in some countries, special services are maintained for the assistance offishermen. In addition to these hazards, there is a strong element of uncertainty in individual fishing operations.

Because of variation in the distribution and behaviour of fishes, most fisheries have a highly seasonal character. In addition, catches in some fisheries also show a lunar or tidal periodicity and all fisheries are subject to fluctuations in the natural availability of the stock from year to year.

To such natural fluctuations in availability and accessibility of the stock, further fluctuations in the catch are imposed by fish behaviour and external factors such as weather. Landings are almost inevitably liable to a very considerable range in volume from day to day, from month to month, and from

TABLE

THE STRUCTURE OF THE FISHING INDUSTRY

Sector	Operating Units	Components
PRIMARY SECTOR	Fishing units	Boats consisting of hull, engine, navigational and deck equipment, etc.
		Gear consisting of netting, rope, floats, etc.
		Manpower consisting of master, engineer, deckhands, etc.
	Port or shore facilities	Equipment consisting of navigational aids, slips, cranes, etc.
		Structures and Buildings consisting of wharves, jetties, roads, stores, etc.
		Manpower consisting of management, labour, and clerical staff.
SECONDARY (PROCESSING) SECTOR	Processing plants (servicing one or more ports)	Buildings consisting of stores, offices, processing rooms, etc.
		Equipment consisting of retorts, washing, skinning and filleting machines, transport, etc.
		Manpower consisting of management, labour, and clerical staff.
TERTIARY (COMMERCE) SECTOR	Wholesale fish markets and agents (distribution)	Buildings consisting of market premises, retail shops, etc.
		Equipment consisting of transport, refrigerated stores and display cases, etc.
	Retail shops and markets	Manpower consisting of management and sales staff.

NOTE: Although transport is shown only in the secondary and tertiary sectors a fishing boat is used for transport to and from the fishing grounds, and shore transport may also be owned and used by fishermen in connection with their livelihood.

year to year.

Although this strong element of uncertainty is accepted by fishermen as a natural feature of fishing operations its reduction is a major objective in fisheries development. Much of the advance that has taken place in fisheries during the past few decades has been in the development of equipment to reduce searching time and to make fish-location more precise, and methods of fishing more reliable. Uncertainty in the primary sector has important implications in the secondary and tertiary sectors, principally in respect of storage and the organization of operations to accommodate the variation and uncertainty of supply.

The perishability of fish imposes on all sectors of the industry an obligation to adopt methods and to employ equipment to prevent (or at least delay) the changes that take place in fish once they are removed from their natural medium. This means that fishing boats must be fitted with refrigeration or provided with ice, and that proper inboard storage and handling of fish must be recognized as essential elements of fishing operations. Similar methods and equipment are necessary in the secondary and tertiary sectors, but the character of the operations in these sectors is determined by the uses to which the fish is to be put (within the limits imposed by the need to prevent spoilage).

(b) Industrial Organization

Operating units of the primary sector of the industry are generally owner-operated and highly competitive, and this holds true of Australian fisheries. In some countries groups of units are company-owned, or bound by contract, and operate in concert in fishing and in delivery of the catch - a situation which exists in Australia almost only in respect of prawn fishing in Western Australia and, lately, in the Gulf of Carpentaria.

In other instances fishing units are linked into co-operatives for the disposal of their catch, but this connection is often rather tenuous and readily broken by the fishermen. Fishing units may also combine to procure producer supplies through co-operative organizations, but again the individualism of fishermen often makes the connection very insecure.

The secondary sector is by nature a company-organized operation, although the form of integration varies. In Australia, canneries are operated by private companies, public companies, and a co-operative.

Organization in the tertiary sector is complicated and diverse. In Australia, it ranges from total regulation of wholesale fish marketing by government authority, to a completely free system of fish handling. In addition to these general arrangements for disposal of the catch as landed by fishermen, there are wholesalers, many of whom are also engaged in the importation of fish. Only in Queensland and New South Wales is there any real measure of integration.

The South Australian Fishermen's Co-operative Limited is the most notable example in Australia of an integrated fishery enterprise. Share capital is held by fishermen, but it has been government loan finance that has permitted the society to spread into three other States. It is now active in primary, secondary, and tertiary sectors of the industry and thus combines horizontal with vertical integration. However, generally speaking, the organizational condition of the greater part of Australian fisheries contrasts strongly with that of the fisheries of the major fishing countries of the world where both horizontal and vertical integration are well developed. Perhaps one of the most important changes that could take place in Australian fisheries would be the introduction of such integration.

Trade associations within the industry are common, but until recently these were not well organized. Prior to the Australian Development Conference, there were fishermen's co-operatives, associations and societies, and these continue to operate. There were also associations of wholesalers and retailers, but no nation-wide organization which could represent the whole or even a sector of the industry. The formation of the Australian Fishing Industry Council with representatives drawn from all States and sectors of industry has significantly altered this position and has provided industry with a mechanism whereby its views can be presented at State or Federal level.

NATURE OF FISHERIES DEVELOPMENT AND GROWTH

Increased production, which is the change most frequently observed as a consequence of development, is often regarded as the whole of development. But an upward movement on a production graph is not a reliable index of development, since it may reflect no more than changes due to natural fluctuations in the fish stocks. Increased production may be and often is the consequence of development, but the significance of such an increase can be appraised only in terms of the changes by which it has been brought about. In any discussion of development a clear distinction must therefore be made between the changes which take place in the industry and the more obvious consequences of such changes (which might, but do not necessarily, include increased production).

It is also advisable to make a distinction between structural and organizational changes on the one hand and the relatively simple expansion of an industry by increasing the number of operating units on the other. Although economists would probably refer to both as economic growth, we recommend that the term growth be employed to refer to the simple expansion of an industry and that the term development be reserved for more complex structural and organizational changes leading to increased productivity. The value of this distinction largely lies in the fact that whereas "growth" as defined here can be accomplished by industry using savings accruing from increased productivity, "development" can be achieved only by special courses in which Government is generally obliged to participate.

Finally, a distinction should be made between development of the industry and the course of action taken to promote the development; there is evidence

in literature that at times the means by which development has been promoted have been mistaken for the substantive changes.

(a) Industrial Change

A distinction between quantitative and qualitative changes in the industry is important. A qualitative change could include any modification of the structure of any of the physical components of the operating units in the industry, or any alteration in organization of the industry at any level, effected for the purpose of increasing productivity. A quantitative change, however, does not include modification in structure or organization but consists solely of an increase in the number of units through the addition of more units, the same as those already in operation, thus increasing production or throughput.

Qualitative changes can be made of any of the components of industry. In the primary sector these include modifications of hull, engine, fishing gear, and fish-searching and navigational equipment. They also include changes in the skills of the men employed. Similarly, qualitative changes in the secondary and tertiary sectors of the industry consist of changes in processing, storing and handling equipment, and in the techniques of the manpower employed.

Quantitative changes by simple addition of new units usually have only a quantitative effect, although in the early stages of an industry the addition of new units in any sector almost invariably induces qualitative changes. Distinction between qualitative and quantitative change thus may be indefinite at times, but in principle the differences between these kinds of changes are often of considerable significance to those concerned with administration.

(b) Developmental Situations

Developmental opportunities range from those in which an entirely neglected resource can be brought under exploitation, e.g. the striped tuna and jack mackerel resources of Bass Strait, to those where, although the resource is being exploited to its maximum and therefore cannot give increased production, the production costs might be reducible, e.g. the western rock lobster resource.

Where a neglected resource is to be exploited, the fishing units may be, (1) newly constructed, entirely for the purpose thus adding to the total complement of fishing vessels; (2) organized with vessels drawn from other fisheries; or (3) a combination of these procedures. Fisheries which contribute vessels to a new fishery will be affected sometimes with distinct operational improvements; the effort expended in certain Victorian fisheries was reduced during the rapid development of the scallop fishery in Port Phillip Bay. Similarly, production from a new fishery may be handled through existing secondary or tertiary elements, or may require the establishment of entirely new elements. In the former case, the increased throughput is likely to lead to substantial reorganization of processing plant or storage and handling

facilities and to important economies of operation. However, if new elements are provided, there will be some repercussions in the existing industry, not the least of which may be the effect on markets and prices.

An established industry is most likely to change by growth alone, but developmental change can occur if, for example, the fishery has stabilized at a low level of exploitation of the resource. In many areas the introduction of outboard motors has enabled fishermen to exploit resources of more distant (and thus hitherto unexploited) grounds, and at the same time to minimize unproductive travelling time. Developmental changes can also occur where exploitation is at or near the maximum sustainable by the resource and where growth is not possible. For instance, costs can be reduced through the introduction of new materials, equipment, or methods of fishing, or by the use of better navigational or fish-finding equipment. Such changes may reduce the element of risk of the fishing operation. Similar benefits can be obtained by improving inboard handling and storage and the arrangements for discharging the catch. In the secondary sector, development can take place through the introduction of equipment (1) to reduce loss of raw material, (2) to reduce the labour input, or (3) to process raw material which would otherwise be wasted. Such gains are also available at the tertiary level. For instance, the introduction of packaged frozen fillets will reduce losses from deterioration, and may extend and stabilize the market outlet.

In essence, costs can be reduced in any sector of the industry by,

(1) increasing the useful life of the equipment,

(2) reducing time (in terms of labour) required of each operation, and

(3) reducing losses of all kinds.

(c) Consequences of Development

If a special definition of development is accepted, the consequences of development can then be more easily identified and considered. The proposed definition of development is that it is a qualitative change in the physical components of an industry, in its operational techniques or in its organizational forms or in a combination of any or all of these. Such a qualitative change may be but is not necessarily accompanied by quantitative change. For example, the number of operational units may remain unchanged although their characteristics are modified. The primary consequence of such a change is an increase in output, either absolutely (in total catch) or relatively (in catch per unit) or both. The introduction of the Vigneron-Dahl trawl gear in Australia in 1925-26 was an example of such a change, although its very success led to an immediate quantitative change, an entry of more vessels.

The primary consequences of development are generally followed by secondary consequences which, if the development programme is well designed, will foster and provide the means for yet further changes. Increased production should give increased returns to the fishermen (and in an effective developmental

project this increase should not be simply proportional); increased supply to secondary and tertiary sectors should induce changes in these sectors with consequent wider spread of overhead costs and hence better prices to the fishermen. Increased returns to the fishermen should not only improve their lot, but should give them the means to undertake further changes, whether simply to increase their equipment and expand their operations or to introduce further developmental innovations. If this sequence can be established, the developmental operation should be self-promoting, changes being compelled in secondary and tertiary sectors which in turn induce, and provide the means for, further changes in the primary sector, which then compel still more changes in the other sectors.

Any change which takes place in the industry (whether of growth or development) should be represented by indices relating as closely as possible to the real change that has taken place. In the primary sector, the basic index for industry is production per man. This can be expressed either as the value or quantity of fish taken and is usually measured as an annual figure. These indices, however, should also be related to the quantity of equipment employed and ultimately to the return on investment.

An index which receives a lot of attention, and of which considerable use is made by biologists in their study of resources, is the yield per unit effort. This index may have important meaning with regard to the condition of the fishery and thus in management of an industry. The catch per unit effort is likely to fluctuate considerably since, if it is correctly measured, it is sensitive to changes in availability, accessibility and vulnerability of the resource to whose fishery it refers.

An annual value for catch per unit effort of a unit fishery reflects secular trends in the availability of the resource; at the same time it may be considerably influenced by the intensity of exploitation. A fall in catch per unit effort over a fishing season or year certainly represents a fall in the average abundance of the stock, but it does not necessarily signify a change in the population that might have serious economic consequence. Measures to regulate the average size at first capture (by setting legal minimum length or legal minimum mesh size) are normally based upon the growth characteristics of the species to which they apply. At the same time precautions may have to be taken to ensure that the average abundance of mature, reproducing individuals remains at a level to provide sufficient recruitment to maintain the stock. If the average size at first capture is at an age some time after the average age at first sexual maturity, it is likely that the stock between these two ages, plus the residue of fishable stock, will be sufficient to maintain recruitment. This cannot be assumed *a priori*, nor on the other hand can it be assumed that it is necessary to set the average size at first capture at an age older than the size at first maturity. These are matters for separate determination for each species.

However, assuming that recruitment is assured, the principal consequence of a fall in catch per unit effort is to the individual fishermen. In the

absence of arrangements such as licence limitation, a fisherman's normal response to such a fall is to increase the annual total of his effort so as to maintain the level of his total catch in spite of the decline in return per unit effort. He may also seek to evade regulations so as to increase his catch per unit effort illegally. However, if it is an objective of policy that each fisherman should be assured a level of catch sufficient to give adequate return for his effort and investment, a limitation of the number of fishing units exploiting each resource might be found necessary. The result of this action (which is appropriate only where the limits of exploitations are known or have been reached) is similar to a technological development which increases the catch per unit effort, and among other things it gives each fisherman a level of income from which he has some possibility of making savings. If these savings permit him to make other organizational and technological changes it may become possible or even necessary to limit the number of licences further, and in this sense further development can be generated. Thus, management measures, rationally employed, can be effective means of promoting development.

(d) Conditions for Development and Growth

Opportunity for development and/or growth in a fishery exists if either the resource is underexploited (the equivalent in secondary and tertiary industry is under-utilization of catch) or possibilities exist for changing the fishing or production equipment or operational methods so as to obtain an increase in productivity, either directly or by reduction of losses. These are the fundamental opportunities for development and should be distinguished from incentives to effect development or growth, and from the means to produce the industrial changes for which opportunity exists. To these two main categories of opportunity for development should be added a third element, namely, the existence of information about such opportunities, and about the means of and the reasons for development and growth. We deal with this last item first.

Among those things needed for development and growth, undoubtedly the most important is information. In the primary sector such information relates to the location, distribution, behaviour, and abundance of resources, and includes predictions as to these characteristics. Inadequacy of information of this kind is one of the major reasons for risk and uncertainty in fisheries. Uncertainty has considerable influence on fishing operations and is a major problem in secondary and tertiary industry. If accurate information could be obtained about each resource, and if fishing could be conducted rationally on the basis of such information, the characteristics of equipment and operations in secondary and tertiary sectors could be stabilized and overhead costs could be reduced. It therefore seems reasonable to argue that a basic condition for promoting development and growth is the availability of this information. It should, however, be noted that the level of information required by different classes of person or even individuals may vary - a research scientist will require a higher level of information than a member of industry, who will take a calculated risk if the incentive is sufficiently attractive.

In addition to this basic requirement there is a need for information on weather (so that fishing risks could be further reduced) and on markets. beyond this, all three sectors of the industry need information on technological matters. From these needs we would argue that training and education must be a major element of any developmental programme, since operatives must not only be trained in various techniques, but must be given an understanding of resources and other matters so as to be able to make good use of information disseminated to them.

Among the means with which to effect development, probably the most important, after possession of know-how, is finance. Presumably the best method of acquiring this is by way of savings from current operations but in most fisheries, where development or growth opportunities are being neglected, the operatives are unable to make any savings by which to seize these opportunities. In these situations many, if not most, governments have set up special arrangements to provide financial assistance. It can be argued that the principal governmental responsibility in this matter, after dealing with the informational aspects discussed above, is to provide such financial assistance as is necessary to establish the initial developmental advance. The increased productivity to which such critical "leverage" assistance should lead, should enable the industry itself to bring about further growth. The forms of such financial assistance are numerous, ranging from direct grants for developmental purposes through loans at reduced interest rates to subsidies, but there is no general rule as to which form could be most appropriate.

Expanding economies should offer little problem about incentive for few individuals are without ambition to improve their lot, but in some societies the drive for improvement seems to be very low and operatives seem to be content with their current condition, sometimes even in the face of considerable evidence that opportunities for expansion exist, and that their own condition could be improved by even small changes. Over the spectrum of situations, from those in which there is virtual stagnation to those in which there is a strong drive for improvement, development may be either induced or impelled, and the energy for such change may come from government or from the community at large. If we think of a fishery as effecting a flow of material from resource to consumer, we may think of changes in the volume of that flow as being either induced by a strengthening of demand or impelled by a change in the productive capacity of the operating units. An effective increase in demand by consumers will cause changes in all operating units that serve to meet that demand. Increase in demand by operating units at lower levels will serve to induce changes in the units below that level and to impel changes in units above it. There may, of course, be reluctance on the part of operatives, below or above a point at which change has been effected, to respond to the increased demand or increased supply, and it is part of the technique of promoting and guiding development to be able to recognize such reluctances, to identify their causes, and if possible to remove the causes.

Since no moves are likely to be made for development unless the contemplated change offers real measurable benefit, no useful assessment can be made

of the need for the prospects of development in a particular case except through some measure of the expected benefits. In the previous subsection we have discussed the conditions under which development is possible; we now enter a discussion of the kinds of benefits that may be looked for but, we must emphasize, the value of such benefits - no matter how attractive - is nil if the conditions for development cannot be met.

(e) The Benefits Arising from Development and Growth

The benefits of fisheries development and consequent growth of the fishing industry can best be evaluated by considering the value of such industries in countries in which such development and growth has occurred. Basically fishing provides a source of protein foodstuffs and the most obvious benefit of development would thus be to countries in which malnutrition is a major problem. Such a benefit is of limited value to Australia, although in some developing countries it is literally a matter of life and death.

In other countries, the importance of the fishing industry is derived from the employment it affords. However, in Australia this, too, is of limited value although its economic worth in other ways is considerable. For instance, the export of marine produce in 1967-68 amounted to $A36.2 million and this will increase very substantially as the development of the northern prawn fisheries proceeds. Further, this benefit is enhanced by the diversification of the industry which accompanied such changes - a diversification of particular value to Australia since the fishing industry is the only primary industry relatively, but not entirely unaffected by droughts. A fishing industry can also make a substantial increase to import saving, a feature of particular importance when the balance of payments is adverse.

Apart from these direct benefits, the fishing industry is an income generator since it supports secondary and ancillary industries including canneries and processing establishments, gear and equipment manufacturing industries, boat yards, and refrigeration and ice-making plants.

Economic benefit may also be achieved by a programme designed to develop the fisheries as a socio-economic measure to improve the status of fishermen. If initial development is achieved, the increase in earnings may permit the fishermen to increase their investment in the industry. Development can thus be self-sustaining.

The fishing industry, with its ports scattered along the coast, also encourage decentralization. The rapid development of the prawn fisheries in north-west and northern Australia could thus be of considerable importance in the general development of these areas.

The value of experienced seamen and the ready availability of small craft is generally recognized. Fishermen also play a major role in search and rescue operations in many countries.

Development may also be of value in the management of a fishery through a

redistribution of fishing power. Concentration of fishing on a specific resource may change the ecological balance. For example, if only one of two competing species in a habitat is subject to exploitation, the unexploited species is likely to benefit, and increase in numbers. It has been suggested that such a sequence can account for the failure of the Californian sardine fishery in which the competing species, the anchovy seems to have replaced the sardine. South Africa, fearing that a similar change may occur in its pilchard fishery, is taking action to encourage exploitation of the anchovy resource.

In Australia, development of a lucrative fishery may draw fishing units from other fisheries in which the effort employed has been excessive and in consequence the returns are falling. This in itself is a remedial measure providing opportunity for licence restriction as a means of holding effort at a desirable level.

All or any of these benefits can be obtained through the development of a fishery. However, even if the opportunity exists and is recognized and if other elements are favourable, development may not take place because finance cannot be found. But investment flows to projects that offer the most promising return, whereas the risks and hazards of fishing undoubtedly limit interest in fishery ventures. Yet the financial risks are less than those of oil exploitation and in Australia no greater than those of farming. The development of the Australian fisheries is outlined in Appendix II.

THE RESPECTIVE ROLES OF GOVERNMENT AND INDUSTRY

Industrial change is a task largely for industry itself, effected for the most part with the assistance of established financial and commercial enterprise. However, it being a feature of modern society that governments participate in development in various ways, the respective roles of government and industry are of considerable importance. In elucidation of these roles the following questions may be asked.

(1) When, under what circumstances, and to what extent should government participate in the decisions and the activities of development and growth?

(2) What role can government play in designing, promoting, and guiding development and growth?

(3) How and in what ways should government collaborate with industry to achieve the objectives respectively of industry and government?

(4) By what principles should a term be set to the participation by government in the development of any particular industry?

The discussion above, of the structure and operations of the industry, has shown that in many respects the primary sector is special in its equipment and

organization, and essentially this means that the equipment and manpower are employed exclusively for the industry. Except on extremely rare occasions, a fishing unit is not employed in operations for other industries in contrast with, for example, road transport units which can be used equally well for transporting fish or other materials. The operations of the primary sector are also special, particularly because of the risks involved in marine operations. Furthermore, other operational characteristics resulting from the perishability of the commodity and variability of its supply, which it shares with the secondary and tertiary industry, are most strongly present in the primary sector.

In consequence of its special character, development of the primary sector requires particular attention. Whereas development in storage, transport, and processing of fish and fish products may be brought about in response to and in company with changes in these facilities for other industries, whatever changes must take place in the primary sector will be exclusively for the fishery. With respect to particular fisheries the effect of this conclusion is not in any way diminished by the fact that fisheries can draw benefit from developments that take place in other industries; for example, from those developments in electronics industries that extend the use of echo-sounding equipment, navigational aids, and so forth.

Finally, opportunities for development and growth in fisheries are largely of three kinds relating respectively to,

(1) use of the resource;

(2) efficiency and productivity of operational units;

(3) raw material and produce use.

Of these opportunities, those of the first kind are exclusively a matter for primary industry whereas those of the second, insofar as they relate to secondary and tertiary industry, are often to be effected in the industry along with other industries. Moreover, the development or growth from opportunity of the first kind is generally a starting point for development and growth in secondary and tertiary industry. Development in primary industry impels development in the other sectors as discussed in an earlier section.

In the ultimate, development consists of,

(1) changing the operational components of one or more categories, or

(2) adding operational components, or

(3) changing operational procedures.

To change an operational component may be either to devise a modification of an existing component or to invent a substitute component, or simply to replace a component of one form by a component of another form. These changes involve

managerial decisions for which information must be available. They also involve the availability of finance for the purchase of components and of skills in the installation and operation of these components. The manipulative operations of change are the task of operatives of the fishery or of ancillary industries, and at this level are not normally a governmental task. In essence, governmental responsibility is managerial. Its task is to obtain and to disseminate information, and as far as possible to ensure that use is made of such information. In addition, government may make use of public finance to meet the costs of implementing managerial decisions for development and growth. Finally, government may enter business.

It may be suggested that in principle, those things needed for development and growth, which will (or could) be used by all the operatives concerned, should be paid for by all of the operatives, but that the community should contribute to the costs of development and growth to the extent that it may benefit from the changes. Such benefits include increased national income, greater availability of food, the advantages of fuller employment, and the reduction of the risk element. The community may benefit in relation to the last item both directly, insofar as public expenditure in dealing with mishaps (for example undertaking sea-rescue work) may be reduced, and indirectly insofar as the reduction of economic losses may increase national productivity.

Because fishery resources are common property, there is an a priori case for governmental action to ensure that they should be well used in the interest of the community, the owner of these resources. Government is usually expected to assume managerial responsibilities for these resources through its promulgation and enforcement of regulations to control exploitation, and its other activities (through extension services and mass media) to educate and persuade fishermen, and the public in general, not only to observe specific regulations, but also to make good use of the resource. At the very least, government thus has an obligation to carry out research on these resources to ascertain the distribution, behaviour, magnitude, and dynamic characteristics of each.

It is only a logical extension that government should also admit an obligation to intervene in other ways to ensure the full and rational use of these resources. In the present context, this implies primarily a role for government in activities to bring about development and growth of the industry, more particularly where such changes are not taking place. Of course, the force of the argument in favour of any particular action depends greatly on the strength of the community need for the benefits expected to flow from the proposed development and growth. In some cases those benefits do not arise direct from the industry itself, but are side effects resulting from the existence of the industry. For example, establishment of fisheries in remote parts of Australia will contribute to development of economic infrastructure, and the benefit of this might outweigh the gains from fishery production.

The types of action open to government in connection with development and growth of fishery industries fall roughly under five headings.

(i) Actual operation in which managerial decisions at

industrial level are taken by government servants and are implemented by government servants or the agents of government.

(ii) Information

(1) Collection of information by research.

(2) Dissemination of information through educational, extension, and training programmes.

(3) Promotion, whereby government servants act in consultant capacity and advise industry on developmental changes they might undertake.

(iii) Finance

(1) Provision of capital by grants, loans, subsidies, tax concessions, etc. for capital works and for equipment for communal requirements, e.g. for harbour facilities, navigational aids, markets, etc.; or to meet individual needs, e.g. for construction of boats and gear, canneries, processing establishments, etc.

(2) Reduction of operating costs by duty rebates, subsidies, tax rebates and concessions on vessels, gear, fuel, and other materials used in the industry.

(3) Increased returns by subsidies on catches, price support scheme, tax concessions and exemptions, export incentives, etc.

(4) Special measures such as calamity relief.

(iv) Regulation of fisheries to achieve objectives such as

(1) proper utilization of resources,

(2) maintenance of social and economic standards,

(3) efficient control and administration of the industry,

(4) safety at sea.

(v) Administration, including the provision of

(1) efficient management and control of industry,

(2) administrative support for biological, economic and technological research units, and extension services including technical and vocational training,

(3) fostering the organization of fishermen into co-operatives, etc.,

(4) participation in or control of marketing.

In respect of any particular industry such activities again fall into three principal categories. First, those which affect an industry and its operatives along with all other industries and citizens; second, those undertaken by government with respect to fishery resources because of the international and national status of the resource; third, those undertaken directly in implementation of policy with respect to economic or political objectives.

Most developmental activities fall into the third category, but there is no doubt that activity of particular pace, intensity, or timing in the first or second category might be effective in initiating or encouraging development.

From this brief survey our conclusion is that there is a fundamental case for a wide range of activity by government with respect to the primary sector. Initially, this relates to the discovery and description of fishery resources and subsequently to the regulation of the exploitative activities. Government then being in possession of authoritative information concerning the national fishery resources has responsibility to assess the benefits to be gained by development of industry in use of these resources. Such assessment must, of course, take into consideration a great many economic and political factors but, having made such an assessment, government has responsibility at least to encourage and in various ways to assist the evolution of the industry in accordance with some over-all plan.

(a) The Particular Tasks of Government

For the purposes of this paper, governmental responsibilities have been separated into three groups. The first of these are those which are the normal responsibility of a government in respect of the public as a whole, including persons engaged in the fishing industry. This responsibility relates to matters such as education, public utilities (including water, power, and road and rail communications), medical services, law and order, etc. These services are not without their influence on fisheries and the timing and location of their establishment may play a critical part in the development or growth of a particular industry. For example, the extension of road and rail communications had a profound effect on the British fishing industry. It was also an important factor in the early development of Australian fisheries and in some areas the development of fisheries still awaits the provision of such services and utilities (see Appendix II).

Responsibilities of the second group concern the need to ensure that national resources are properly utilized. This is because fishery resources are common property; this responsibility is of particular importance. Since marine resources as common property lie only partly in the relatively narrow strip of territorial waters subject to the jurisdiction of the coastal State,

both national and international interests are involved. Within national boundaries government must exercise jurisdiction over fishing operations and it must also act as negotiator with regard to the use of high-seas resources. Its actions in this field may have considerable psychological influence on development and a firm stand in negotiations (assuring its nationals of protection) may have a decisive influence on the minds of those contemplating developmental projects.

Government thus has a managerial role in respect of resources and since this necessitates collection of fisheries statistics, upon which management measures (among other things) must be based, government must also accept responsibility for administrative control of the industry. The efficiency with which government carries out these functions has a marked effect on the operation and development of the industry. There is scope for action of this kind in Australia; for example, industry has recently criticized existing licensing procedures as being unnecessarily complex and time-wasting.

The third category of governmental responsibility relates to activities which in general could be carried out by industry, but which are undertaken in some degree or other by government expressly for the purpose of initiating or accelerating some change in the industry.

Such services or measures of assistance include the following.

(i) Research

(1) Resources.- Biological research is necessary not only for the stock assessments required for the managerial responsibility of government but also to furnish detailed resource information which might eliminate at least some part of the uncertainty of fishing operations, and reduce the problems of the secondary and tertiary sectors arising from fluctuations in supply. Therefore, although biological research is a responsibility which government must accept in order to be able to discharge its managerial function, industry has a direct interest in it, and should share some of the responsibility for it. Exploratory fishing is similarly a joint responsibility, but active physical participation by fishermen would probably be of greater value than financial support.

However, research in areas remote from existing fishing ports or grounds (which could comprise offshore waters or the slopes of the continental shelf) presents a special case. The hazardous nature of fishing operations is increased in such situations, for the waters are often inadequately charted, and are often without navigational and shore facilities. Moreover, without knowledge of the available resources, especially with respect to fish behaviour, the uncertainty of operations will be greatly enhanced. Government thus has a special responsibility for research in remote areas, but the potential benefits of development in such areas should greatly exceed those flowing from increased fish production alone and should offset this increased responsibility.

(2) Boats (Their Design and Construction).- A fisherman's isolation from the rest of the community, imposed by his occupation, partly accounts for his conservatism and general resistance to change. Thus most boats are constructed according to traditional designs, and while a new design may be introduced, perhaps from drawings of a successful vessel of another country, modifications for local conditions are carried out by rule of thumb. Few fishermen are in touch with world developments in design or use of new materials but, even if such information were available to them, boats and equipment are too expensive for individual experimentation. This effect becomes more and more acute as larger and more complex vessels are built to meet the needs of particular fisheries.

The need for such research in Australia is emphasized at present by the lack of a suitable bar boat. It is emphasized also by the very variable performance of vessels of approximately similar design, and there is obvious need for analysis of boat design and of the factors determining the efficiency of a fishing unit.

The benefits of such research would include not only greater efficiency and economy of operation, but increased safety at sea. Moreover, larger and better-equipped vessels would extend the range of existing fishing operations whilst reducing operational hazards. Similarly, improved fish finding equipment should reduce the uncertainty of fishing operations.

(3) Gear Design and Fishing Techniques.- In the past, most advances in fishing gear design have resulted from rule of thumb experimentation by fishermen. But this is slow, and a more radical approach for the development of new methods is necessary. In several countries, special institutions or programmes of investigation have been established to improve existing methods and to design new gears. The results from these cannot be used in Australia without modification to suit local conditions which would involve a programme of experimental fishing. Although few individual fishermen have the reserves to undertake considerable periods of experiment, large fishery enterprises should be able to accept such tasks. In Australia however, there are few such interests and in general these are engaged in particular fisheries, and therefore cannot be expected to be of much assistance.

Improvement or innovation in fishing gear, however, could offer benefits as great as those that research into boat design could provide. Moreover, in view of the great variety of fishing methods used, and since there is no other organization or body capable of undertaking this work, government must accept this responsibility if development is to be actively fostered.

(4) Fish Handling and Processing.- Advances in fish handling and processing in the past were pioneered and introduced by industry. But the perishability of the product and the heavy fluctuations in supply create major problems in secondary and tertiary sectors of the industry and thus affect the price received by fishermen. Moreover the growing competition in all sections of the industry, particularly for overseas markets, has led a number of governments (especially of Europe and North America) to undertake programmes, and to establish research units, for the purpose of improving the handling,

storage, preservation, and processing of fish, aboard or on shore. Such measures lead to improved quality and reduced costs. In some countries such activities extend to product development and diversification with a view to overcoming consumer resistance, or to extending the market outlet. The economic benefits are perhaps obvious but for the purposes of this paper we emphasize that improvements in fish processing and handling lead to a wider use of the resultant products and thus induce further development.

In Australia, there is a particular and pressing need for action in this field, although it might be argued that the main Australian problem is of providing an extension and training service to introduce improved practices which are well established elsewhere. There would also seem to be a real need for evaluation of local species for which the market demand is, at present, limited. Presentation in more acceptable forms by product development and diversification offers a solution to the problem presented by fish such as the red gurnard perch and snoek (barracouta).

(5) Economic Aspect.- Economic research can be of particular value for the fishing industry, for the social and economic conditions of this sector are special and as yet relatively little studied. Although only few countries employ professional economists to study the fishing industry, the importance of economic research has been recognized in Australia, as shown by the establishment of an Economic Section in the Fisheries Branch, Commonwealth Department of Primary Industry. Victoria and Tasmania have also obtained the services of economists for particular projects.

While government stands in need of such investigations from which to draw information upon which to base policy, the individualism of fishermen and the dispersed nature of the industry makes the employment of economists by industry somewhat impracticable. Undoubtedly large fishery enterprises cost their operations, but there are few of these in Australia. Government must thus extend this service to industry, if rational development is to be achieved.

Moreover, since these research activities are often interdependent, the conduct of an effective programme normally lies beyond the reach of any but governmental agencies. For example, the determinants of the efficiency of a boat can be fully studied only by a combination of boat, gear, and economic research.

(ii) Promotion of Development

(1) Extension Services Including Vocational Training.- Skill and knowledge, important in any human endeavour, are particularly important in the fishing industry because of the isolated nature of its operation. These factors not only play an important part in fishing operations, but in some circumstances they may determine the safety of the vessel and crew. But the need for skill and knowledge is not confined to the primary industry - it is one of the causes of the general low standard of fish marketing in certain States and for most of the complaints that have been made about fish handling, storage, and transport.

Nevertheless, the dispersed and isolated nature of the primary sector makes its problem particularly acute and pressing. For instance, in many States,

vessels are surveyed to ensure that they are seaworthy, yet standards of competency for the skipper and crew are not required. So an operator with little or no knowledge or practical experience can take a vessel to sea in most Australian States. It is presumed that the main obstacle to the implementation of standards of professional competency, which would reduce the hazards associated with operations at sea, is the lack of facilities for the training of fishermen.

Thus a major industrial need is a system of vocational training to impart such skills to existing operatives and to ensure that recruits to industry have the necessary skills and knowledge. This applies equally to the secondary sector of the industry as to the tertiary, and to the government officials on whom rests the responsibility of guiding and assisting the industry.

Vocational training can be given in many ways. The most satisfactory is through a residential course, but training can also be given by short courses for working fishermen, evening classes, seasonal courses timed to avoid major fishing seasons, correspondence courses, and film, radio, or television media. Practical demonstrations are an integral part of such training and must be included, when and wherever possible.

Knowledge is also provided in a less formal way by other branches of the extension services. The monthly Australian Fisheries is perhaps the most effective of these since it is issued free to every licensed commercial fisherman. Commonwealth and States also provide advisory services on boat and gear technology, the care and handling of fish, the biology of the fisheries and in some cases, advice on problems in food technology. In the past such advice has been given on an ad hoc basis as there is no organized fisheries extension service in Australia. This is not surprising considering that in most countries, including Australia, there is a very marked contrast between extension services for agriculture and those available to the fishing industry.

Government has already accepted responsibility for some extension services and at this stage industry can do little to assist. But both government and industry should note that "the ultimate aim is the development of the people. Unless people are changed, no permanent improvement can be achieved" (Chang 1963*). Increased services to industry are thus essential if the abilities of Australian fishermen are to be developed to the full.

(2) Finance.- While capital is required for development and growth in all sectors of industry, the problem in the primary sector is aggravated by the characteristics peculiar to fisheries. Fishermen cannot mortgage their fishing grounds, their equipment is subject to unusual risk, and catches cannot be predicted with certainty. In consequence, the financial security required is often much greater than would be required from a land-based operator. This situation particularly affects younger fishermen (on whom the future of the industry depends) for they lack the capital to buy a boat, and the security to obtain a loan for this purpose. Even relatively small, short-term loans

* Chang, C.W. (1963).- "Extension Education for Agricultural and Rural Development." (FAO: Rome)

can be got only with difficulty since the "crop" cannot be offered as security.

Since, as is obvious, capital is necessary for development, if government considers development desirable, it must encourage investment in the industry in one way or another. This is particularly necessary at present to the primary sector of the Australian industry which is neither subsidized nor protected against imports from countries in which grants, long-term loans, and subsidies are readily available.

(3) Organization and Management of Enterprises (Chiefly Co-operatives).-

In many countries, the formation of co-operatives has been encouraged to offset the problems arising from the individualism that characterizes the primary sector of the industry. The co-operative system permits small scale producers to organize and operate services which individually they could not afford. The measure and government support varies from supervision to direct financial aid, but the success of a co-operative depends almost entirely on the managerial talent available. The difficulty of finding such talent possibly accounts in part for the fact that with certain notable exceptions such as Japan and Norway, co-operatives have played only a minor part in fishery development in advanced fishing countries. Nevertheless, the value of such organizations in developing countries can be considerable.

(4) Marketing.- Government has a responsibility to the public to ensure that adequate supplies of good quality fish are readily available and, in pursuance of this objective, it may either act passively or intervene directly in market operations, the establishment of marketing premises, public supervision of sales, etc. Direct intervention ranges from the use of official auctioneers to a control of the entire marketing operation.

In Australia, government participation in marketing varies from State to State. At one extreme the entire wholesale marketing system is subject to official control whereas, at the other, the system is virtually free.

Marketing of fish is further complicated by changing consumer preference and particularly by the increasing popularity of ready-to-cook packs of frozen fillets. This is reflected in the enormous growth of imports of frozen fish in recent years. In 1966-67 over 42 million lb of frozen fish valued at $A10.5 million were imported.

The future of at least some Australian fisheries is threatened by this competition, and the threat could be removed only by a major change in marketing technique. However, such development is beyond the technical ability of most co-operatives and certainly requires finance on a scale beyond their means. Official intervention may, in fact, be necessary but the nature and extent of this will depend on the policy of the Government.

(b) The Joint Role of Government and Industry

Undoubtedly, the first two responsibilities of government (to protect public interest and to manage and administer industry) cannot be shared with

industry. But there are strong grounds for believing, with equal conviction, that industry should contribute in finance and/or effort towards at least some of the special services described above. For example, research undertaken to furnish detailed resource may be at least partly charged to the fishermen and other operatives by whom the main benefit is reaped.

On the same principle, industry may be expected to contribute towards research into boat and gear design and into fish processing. On the other hand, some improvements in fish handling and marketing would be of most benefit to the consumer, research to discover those improvements would be a governmental responsibility.

Economic research is necessary to government as it furnishes information essential for the proper management and control of industry. Such information is of equal importance to industry and should be made available through the extension services.

Extension services are, in fact, one of the most important activities of government, yet such services for fisheries are generally ill-organized and under-staffed. In Australia, such services are, with the notable exception of Australian Fisheries, inadequate for the needs of industry, particularly in the field of vocational training. Yet Japan, one of the largest and most advanced fishing countries in the world, maintains six high schools, two colleges and two universities to provide vocational training in fisheries and fisheries science. Each year, 4,900 students representing about 2% of all fishermen complete advanced courses. But in Australia the only training course given to fishermen is in Papua and New Guinea, which gives initial training to 10-26 local fishermen each year. A fisheries school operated at Cronulla immediately after World War II, which suggests that vocational training is an acknowledged responsibility of the government. Industry however, would be required to assist in any apprentice scheme introduced to meet the need for trained manpower.

Finance of course, remains a major problem. In developed countries, capital for industrial growth and development is theoretically available from three main sources. These are,

(1) from within the industry in the form of profits, depreciation funding, capital contribution by owners (including initial share capital, etc.);

(2) from outside the industry in the form of share capital by investors;

(3) from outside the industry in the form of loan capital from private or institutional investors (this is almost invariably subject to provision of security).

In recent years, the flow of capital from such sources has often been insufficient for the increasing needs of developing industries. This is particularly noteworthy in Europe where replacement of vessels lost during the war or necessitated by developing technology (which has quickened the rate of

obsolence) could not be financed from normal resources. Some governments have thus found it necessary to augment the flow of capital by providing loans, grants, or operational subsidies. Other devices, including governmental guarantees, taxation rebates, etc. have been used to encourage the flow of private capital into the industry.

In Australia development followed by growth is occurring in the tuna and prawn fisheries. Construction of a stern trawler (the first in Australia) also suggests that the trawl fisheries may be further developed. There are also numerous other opportunities for development and subsequent growth, but special measures must be introduced to make finance more readily available to industry if these opportunities are to be taken. At present trading banks consider loans for development purposes and for working capital on a par with those rural and export producers (saving that conditions for servicing the loans are "related to the special circumstances of the industry"). However, the estimate of physical and economic risk in the industry is often reflected by the type and amount of security required. If development is to be accelerated, therefore, the availability of finance to the industry, on terms consistent with its special needs, must be increased. In the meanwhile, industrial assistance in the planning, financing, and implementation of such special services will be limited to specific services rendered to particular fisheries, such as the financing of rock lobster research in Tasmania by an increase in licence fees and the licensing of processing establishments in Western Australia to provide funds for research and development.

(c) The Duration of Government Participation in Development

No definite principles for setting a limit to the length of time government should participate in the development of an industry (or of any part of it) have yet been established. However, the competing claims of other industries for assistance suggest that participation must be limited to that minimum of finance and manpower, necessary for achievement of an initial "breakthrough". Thereafter government participation can be withdrawn until it can be ascertained whether development will become self-generating or need further stimulus.

Practical policy, however, must be determined by the nature of government participation. It is unlikely that industry can ever meet its own needs of biological, technical, and economic research, or of extension services. Moreover, these services are required by government to fulfil its responsibility for the management and control of the industry. Limited specialized services for particular sections of the industry are provided in some countries by industrial organizations but, since this is not yet possible in Australia, government departure from these fields would leave a vacuum which could lead ultimately to industrial stagnation.

The setting of limits to a programme of government participation in exploratory or experimental fishing is a major problem. Once involved in an operation of this kind, government must maintain the operation until the objectives are achieved and/or evidence that a new course of action might be more rewarding presents itself. Unfortunately, government finance is often not managed

for this type of operation and exhaustion of approved funds may lead to the project being shortened or the objectives modified. Similarly, in some projects, the objectives were not clearly defined and this led to misunderstandings and recrimination.

Exploratory fishing in a remote and little known area presents special problems since it requires considerable finance and is subject to risk. Continued support for such projects, until the operation becomes economically viable, is perhaps desirable but the form of government participation may change from exploratory operations to the construction of port facilities, or to other measures such as transport subsidies, or tax concessions.

But, in any event, and in principle, major government participation in development should be reserved (as is normal investment) for projects which have solid commercial prospects. For example, the apparent failure of purse-seining in Australia after World War II was due to the failure of the market outlet. Since a prerequisite to the use of this method for the capture of pelagic fishes, other than tuna, is a processing outlet capable of accepting very large quantities of fish; and since such an outlet did not exist, the government should not have participated.

Rigorous limitations such as these do not apply, however, to minor projects in the primary sector. For example, the introduction of new gear can be achieved through the extension service, by demonstration and dissemination of information, and once such a project is successful in one area, the activity should be moved to another leaving the growth of the innovation to normal industrial processes. In some cases, government participation may consist of a loan of gear or equipment. An arrangement of this kind led to the introduction of machine-made netting into the Jamaican fishing industry in spite of strong, traditional prejudice.

Governmental encouragement of industrial growth can be defined more simply. The principal need is for finance (or in time of war for scarce materials) and this should be made available to those sections of the industry in which growth is required. For example, growth should not be fostered in fisheries in which the resource is fully exploited. On the other hand, subsidies to encourage new vessel construction in the tuna fishery to permit operations to be extended would have developmental value. But in such a case governmental participation is indirect and is a service to the individual rather than to the industry. Nevertheless, promotion of such growth would undoubtedly impel growth and development changes in the secondary and tertiary sectors of industry.

The speed of growth and development is influenced by the extent and duration of government participation, but other factors, such as the degree of isolation of the element involved and the likely effect on the operation of other sectors, are involved.

APPENDIX I

AUSTRALIAN UNIT FISHERIES

1. Molluscs

Sydney rock oyster fishery
Abalone fishery
Southern scallop fishery
Queensland scallop fishery
Victorian mussel fishery
Squid and octopus fishery
Pearl shell fishery

2. Crustacea

Western rock lobster fishery
Southern rock lobster fishery
West coast prawn fishery
East coast prawn fishery
N.S.W. east coast inshore prawn fishery
N.S.W. set pocket net prawn fishery
Northern prawn fisheries
Southern prawn fishery
Mud crab fishery
Sand or swimming crab fishery

3. Pisces

Marine
Southern bluefin tuna fishery
Skipjack tuna fishery
East coast 'trawl' fishery
Snoek (barracouta) fishery
Victorian estuary and inlet fishery and beach fishery
Queensland estuary, inlet, and beach fishery
W.A. estuary, inlet, beach fishery
Tasmanian estuary, inlet, beach fishery
Queensland reef fishery
Queensland mackerel fishery
Giant perch (barramundi) fishery
W.A. mackerel fishery
Australian salmon fishery
Australian snapper fishery
W.A. deep sea hand-lining fishery
W.A. deep sea mesh-netting and longline fishery
South-east edible shark fishery
S.A. whiting fishery
Pilchard and anchovy fisheries

Freshwater
River and lake fisheries
Eel fishery
Whitebait fishery
S.A. River Murray Reach fishery

4. Reptilia

Turtle fishery

APPENDIX II

WORLD FISHERIES - AN AUSTRALIAN PERSPECTIVE

FAO's 1965 Yearbook of Fishery Statistics presents some striking facts about events in the fisheries world. Although the figures in this article are taken in the main from FAO publications, that organization has no responsibility for any of the conclusions drawn. Years quoted are calendar years. It shows that since World War II the recorded catch of all kinds, from all countries, has more than doubled. In 1948 it was estimated to be nearly 20 million metric tons and by 1965 had risen to 53.4 million metric tons - an increase of 32.8 million metric tons or about 164%. Human population increase in the same period was about 38%.

On the basis of these figures, one might be inclined to think that fisheries were hurrying now to take a major role in providing human food, and might in time take over the job of feeding mankind. Certainly the position of fisheries in world food economy is better now than it was some 20 years ago.

But, before we come to a conclusion on this point we should have to ask a few specific questions about the meaning of the statistics in FAO's Yearbook. We should want to know how the total increase had been achieved. From what kinds of resources were the catches taken? In what parts of the world? And by what methods? We should also want to know whether the additional catch was suitable for human food or was largely used for animal food. We should want to know, too, something of the economics of the additional food - is it becoming increasingly expensive to enlarge the fish catch? And we in Australia, looking at the world picture, would be prompted to ask some questions about Australia's part in these developments.

In fact, the increase was chiefly in Asian and South American catches, from marine fishes, and, to an important extent, from the herring, sardine, anchovy group. Of the 32.8 million m.t. increase, 25.7 million m.t. or 78% came from marine fishes; 21.6 million m.t. of 66% was taken by Asian and Latin American countries; and 12.7 million m.t. or 38% was from the herring, sardine, anchovy group.

Most countries of the world participated in the increased catch. But, while some (for example Peru) had a remarkable increase, and many countries doubled or trebled their catch, there were others whose increase was only minor and still others which suffered a decline. As shown in Table 1 about 65% of the increase was affected by only 12 of the 223 countries and territories listed by FAO.

The increases achieved by these countries are significant for more than just the amount and rate of change, remarkable as these may be. Most of the countries listed in Table 1, except the top four, increased their catch by

By G.L. Kesteven This article was first published in Australian Fisheries Newsletter, January 1967

TABLE 1

TWELVE COUNTRIES WITH MAJOR INCREASE IN FISH CATCH BETWEEN 1948 AND 1965

Country	Catch (m.t. x 10^3) 1948	1965	Increase
Japan	2,519	6,879	
USSR	1,485	4,980	
Spain	409	1,339	9,036
Poland	47	298	
Peru	84	7,462	8,010
Chile	77	709	
Norway	409	1,339	
Iceland	478	1,199	2,266
Denmark	226	841	
South Africa	176	664	1,154
South-West Africa	13	679	
Thailand	161	615	945
Philippines	195	686	
	6,279	27,690	21,411

exploiting resources close to, or not far distant from their own shores, and in the important cases in South America and Africa these were previously neglected resources. Much of the increase achieved by the four countries at the head of Table 1 came from exploitation of distant, neglected resources. Thus, what this table shows is that a great deal of the increase in world fish catch has been obtained by fishing neglected resources.

This development, moreover, is even more widespread than the table shows, for there are some countries which have maintained the level of their catch (or achieved some small increase) by moving to other resources to make up for decline in catches from resources near to them.

That is, this table emphasizes that most of the increase in the world catch of fish in the past two decades has been got from establishment of fisheries on resources which hitherto had been neglected - either little fished or not fished at all.

But the matter is not as simple as this. The changes in a country's catch from year to year can be of many kinds. Basically, of course, there are the annual fluctuations that take place in all natural resources. At the same time, however, underlying these annual fluctuations there may be trends of decrease or increase. A country's catch may decrease from over-exploitation of a resource, or because, in competition with other countries, the equipment has not been maintained and developed in the ways that other countries have maintained and developed theirs.

Increase in catch can be got by increasing the exploitation of the resource, either by increasing the amount of equipment or by improving its efficiency, or by both. If a country is the sole exploiter of a resource, an increase of this kind will have no effect on any other country's catch, but if a resource is shared with other countries the increase by one country may be at the expense of others, or lead eventually to decrease in everybody's catch. Increase also can be got by the introduction of management measures to allow a resource to recover its capacity for maintenance so that the catch can be brought back to sustainable levels.

Finally, increase can be got by the opening of "new fisheries". This category includes the important increases discussed above obtained by bringing neglected resources under exploitation. It also includes the case of fish farming where in fact completely new fisheries are created.

The point of Table 1 is that, it shows a very large part of the increase in world catch to have been got by the opening up of new fisheries, whilst the catches of other countries have changed in one or other of the ways listed above, it directs our attention upon the question: How many neglected resources are there yet remaining in the world? This is a question which later we shall show to be very relevant to the Australian situation.

Examples of development

Before attempting to examine the last question, whose answer would be a forecast of the future of world fisheries, we should look at some outstanding

cases of development of the fisheries of individual countries in the past two decades.

Our first example is the Union of South Africa whose total catch in 1947 was about 80,000 m.t. The development of South Africa's fisheries has taken place in two phases. In the five years from 1947 to 1952 production was increased to 403,000 m.t. but then remained at about this level until 1958, when the catch was about 419,000 m.t. In the next three years the catch was further increased to 658,000 m.t. and since then the fishery has been maintained at more or less this level. Most of this increase was a result of development of a pilchard fishery.

A similar pattern occurred in the development of the fisheries of South-West Africa, also on pilchard stocks. From a catch of 18,000 m.t. in 1948 there was growth to 275,000 m.t. in 1953. Then, after a lapse of seven years, the catch grew from 290,000 m.t. in 1960 to 679,000 m.t. in 1965.

The most startling instance of fisheries development in the whole of the history of fisheries is that which took place in Peru, and this, too, occurred in two phases. The catch was 84,000 m.t. in 1949 and grew to 196,000 m.t. in 1954 - about 27% each year. Then, in the next 10 years it grew at the rate of about 46% each year to 9,117,000 m.t. Practically the whole of this total is taken from the anchovetta stocks, and practically all of this is used for the manufacture of oils, meals, and fertilizers.

Another interesting case is that of Thailand, whose catch grew in four years from 306,000 tons in 1961 to 615,000 tons in 1965. The increase has been got almost entirely from development of the trawl fishery in the Gulf of Thailand. This resulted from a demonstration by German experts of ways in which the trawl gear could be improved in design and operation. The German expert principally concerned estimated that similar development could take place throughout South-East Asia and give a catch of about $6\frac{1}{2}$ million m.t. Other experts are not as optimistic, but are agreed that the South-East Asian trawl catch could be in excess of 2 million m.t. A large proportion of this catch would be used for meals and fertilizers.

The case of Japan and of the USSR differs in important respects from the preceding four examples. The Japanese catch 1948 was 2,519,000 m.t. and by 1962 had been increased to 6,887,000 m.t. The average rate of increase was about 12% per year, but the increase was not steady. In some years there was decline, and since 1962 there is evidence of a sustained downward trend. However, the increase from 1948 to 1962 was achieved by developments in craft and gear and by extension of Japanese operations into all the oceans of the world. The Russian catch was 1,485,000 m.t. in 1948, and has been increasing ever since, reaching 4,980,000 m.t. in 1965, an average rate of increase of 14%. The Russian increase has been achieved by methods similar to those adopted by the Japanese, with the construction of entire new fleets including large factory trawlers, and extension to all the oceans of the world. The fisheries development of these two countries has been achieved by massive programmes of education, research, and governmental support, and by closely integrated management of operations.

TABLE 2

FIRST 50 FISHING COUNTRIES OF THE WORLD

Country	Population ($\times 10^3$)	Total Catch (m.t. $\times 10^3$)	Catch/Head of Population (kg)
1. Peru	11,650	7,462	641
2. Japan	97,960	6,879	70
3. China	764,000	(5,000)	6.5
4. USSR	230,683	4,980	22
5. USA	194,583	2,701	14
6. Norway	3,723	2,280	61
7. Spain	31,604	1,339	42
8. India	482,945	1,331	3
9. Canada	19,604	1,259	64
10. Iceland	192	1,199	6,245
11. U.K.	54,616	1,047	19
12. Indonesia	105,230	(936)	9
13. Denmark	4,792	841	176
14. France	48,920	768	16
15. Chile	8,567	709	83
16. Philippines	32,345	686	21
17. S.W. Africa	574	679	1,183
18. S. Africa	17,892	664	37
19. Germany	56,777	632	11
20. Thailand	30,591	615	20
21. S.Korea	28,353	(563)	20
22. Portugal	9,167	554	60
23. Taiwan	12,429	382	31
24. Pakistan	113,105	379	3
25. Netherlands	12,290	377	31
26. Vietnam	16,124	375	23
27. Sweden	7,734	365	47
28. Burma	24,733	360	15
29. Brazil	81,451	(331)	4
30. Italy	51,558	317	6
31. Poland	31,420	298	10
32. Angola	5,154	257	50
33. Mexico	40,913	256	6
34. Malaysia	9,386	253	27
35. E. Germany	15,980	225	14
36. Morocco	13,260	215	16
37. Argentina	22,352	205	2
38. Cambodia	6,300	166	26
39. Faroes	37	145	3,919
40. Senegal	3,475	131	38
41. Greece	8,565	124	14
42. Turkey	32,005	(122)	4
43. Venezuela	8,722	119	14

TABLE 2 (Cont'd...)

Country	Population ($\times 10^3$)	Total Catch (m.t. $\times 10^3$)	Catch/Head of Population (kg)
44. U.A.R.	29,720	(104)	4
45. Muscat and Oman	686	(100)	146
46. Chad	3,353	100	30
47. Ceylon	11,250	94	8
48. Hong Kong	3,804	84	22
49. Australia	11,360	79	7
50. Tanzania	10,520	(74)	7

The Australian case

The Australian fish catch in 1965 was 79,000 m.t. In 1965/66 it reached about 88,000 m.t., but our comparisons here are based on the FAO tables for 1965, which placed it 49th in the world fishing league for that year (see Table 2). Australia's 1965 position is 11 places further down the list than its 1964 position. Since 1948 the Australian catch has doubled, chiefly by expansion of crayfish, prawn, and scallop fisheries and establishment of the southern bluefin tuna fishery. But doubling the catch is a rate of increase less than that which prevailed in the rest of the world; moreover, in absolute figures, the increase is very small - about 40,000 m.t. or 0.08% of the 1965 world catch.

One is bound to ask why this is so. The smallness of our population is no answer. There are 17 countries with population less than Australia's which take a greater catch, and, with the exception of Ceylon, a greater catch per head of population. Moreover, the country with greatest fish production, Peru, has a population only slightly greater than Australia's. Nor is the answer to be found in either the resource or competition from other countries. Australia has extensive coastline and access to great oceans. The Japanese have shown that there are substantial resources of tunas and other pelagic fishes to the east and to the west of Australia; it is byond question that there are important resources of striped tuna, jack mackerel, pilchards and anchovies, and snoek off Australia's southern shores; and there are important resources of prawns and bottom fish in the north. Whether there are important resources on our continental slope is an entirely open question. Until recently Australia had an unchallenged opportunity with regard to these resources. Since the war the Japanese have moved onto the tuna resources and lately they and the Russians have shown interest in the resources closer to Australia's shores.

Neglected resources

Most of the world fish catch is taken from the floor of the continental shelf and the waters above the shelf, the chief exception being the tunas and related species. There is not a great deal of continental shelf and coastal water remaining to be exploited. There is certainly not much left in the North Atlantic and North Pacific. In South-East Asia there remains on the trawl grounds an important relatively neglected resource from which something more than 2 million tons could be taken. In the southern hemisphere the important remaining possibilities are those of New Zealand and Australia, and the Patagonian shelf on the east coast of South America.

From the oceanic waters of the world there still remains an important possibility for striped tuna, but it seems unlikely that the tuna group will support much further increase in catch after the possibility of striped tuna is realized. There remain possibilities in the Antarctic. The possibility of there being resources in the midwaters of the oceans cannot yet be ruled out.

Of the kinds of fish taken at present, available evidence suggests that the remaining possibilities are rapidly dwindling, and some observers believe that the total catch might eventually lie between 80 and 120 million m.t. FAO

is working at present, in its Indicative World Plan, to assemble and assess the evidence on these matters.

Beyond the prospects with regard to the kinds of fishes taken at present for fresh fish trade, for canning and other methods of processing for human food, and for the production of oils, meals, and fertilizers, there remain possibilities with regard to fish which at present are thought to be useless. There is certainly a very large catch of "trash" fish yet to be landed and utilized. A large proportion of the increased catch by Thailand consists of species which are used for duck food, and there is certainly a large catch of such species to be taken in the northern waters of Australia. Still further there are the possibilities in the use of plankton, especially from the Antarctic. Apart from these possibilities are those of fish farming whose dimensions no one could measure at present.

Conditions for development

The primary requirements for fishery development are intention and information. All fishery resources are now accessible - new boats, especially factory trawlers, make it possible to traverse the world in search of fish, and the economics of the situation make it worth while to do so. New fishing gear and new fish-searching equipment are reducing the risk element of fishing, and as information accumulates on the distribution, migrations, and behaviour of fish, the taking of this harvest becomes an organized campaign. New boats and new equipment have made all the fishery resources of the world accessible and are making all of them vulnerable to exploitation. Those countries of the world that have resolved to exploit marine resources are developing their operations to take whatever they want wherever it lies.

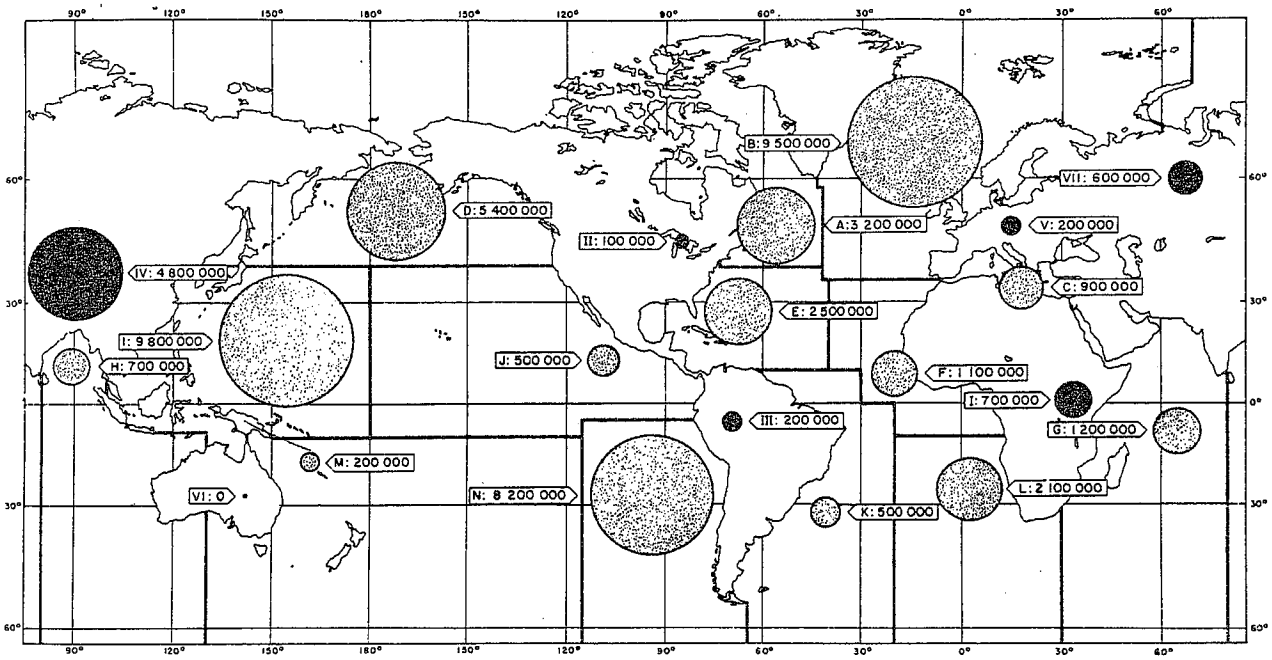

Fig. 1.- World catch by major fishing areas - 1965. Catches are live weight in metric tons. (Reproduced from FAO's Yearbook of Fisheries Statistics.)

Marine areas

A, Atlantic, north-western
B, Atlantic, north-eastern
C, Mediterranean and Black Sea
D, Pacific, northern
E, Atlantic, western-central
F, Atlantic, eastern-central
G, Indian Ocean, western
H, Indian Ocean, eastern
I, Pacific, western-central
J, Pacific, eastern-central
K, Atlantic, south-western
L, Atlantic, south-eastern
M, Pacific, south-western
N, Pacific, south-eastern

Inland waters

I, Africa
II, America, north
III, America, south
IV, Asia
V, Europe
VI, Oceania
VII, U.S.S.R.

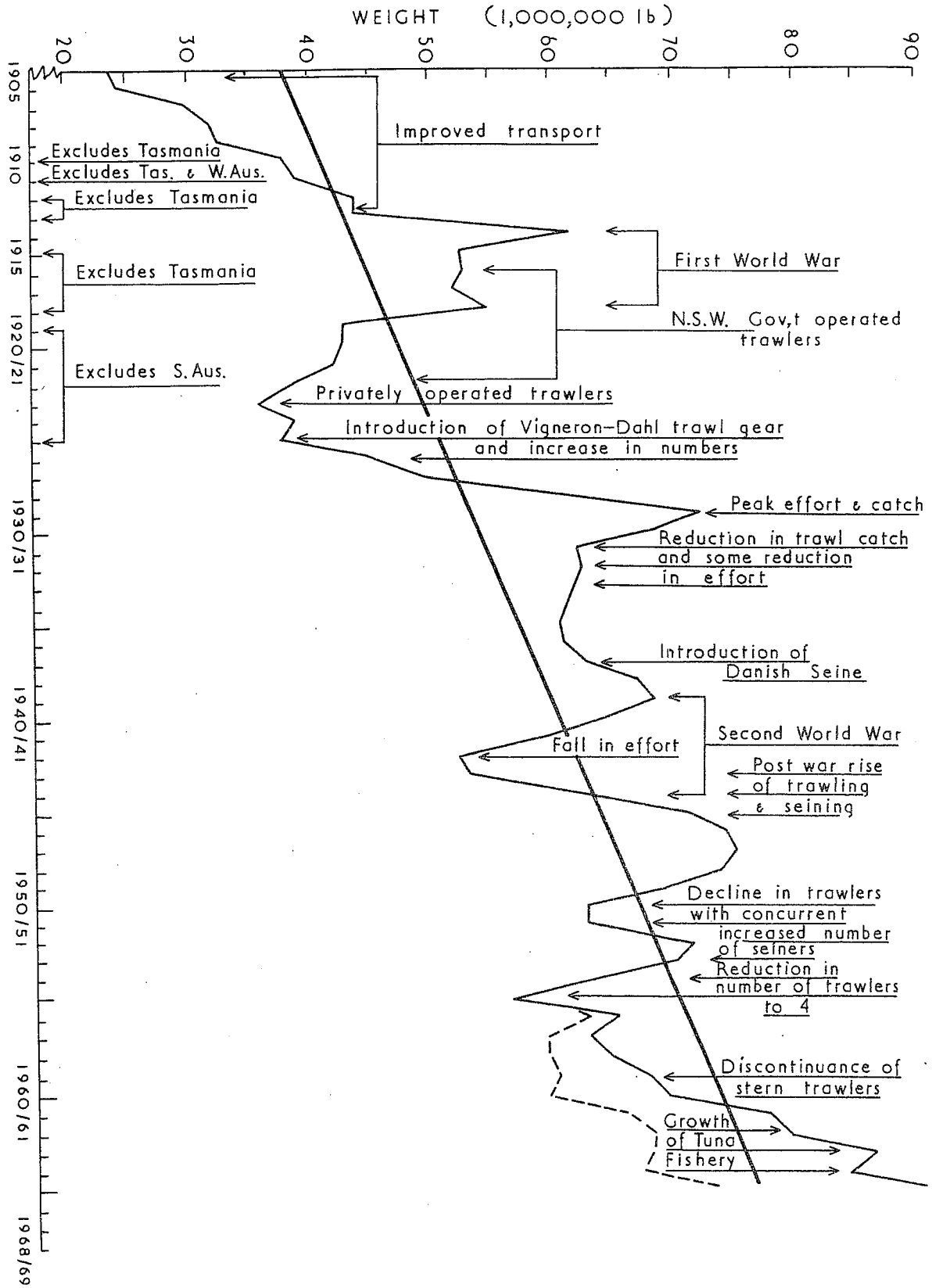

Fig. 1.- Australian production of scale fish 1905 to 1964-65.

APPENDIX III

THE DEVELOPMENT OF AUSTRALIAN FISHERIES

In 1915, over 52 million lb of fish other than crustacea and molluscs were landed in Australia. Fifty years later, 1964-65, landings had risen by 63.5% to 85 million lb whereas the population during the same period rose from 4,931,988 to 11,250,708 - an increase of 127.8%. The population thus increased twice as fast as did local fish supplies. These supplies have, in fact, risen by less than 1.3% per annum on the average over the last 50 years. The scale-fish sector of the fishing industry lagged behind the general development of Australian industries and is virtually stagnant. Figure 1, which represents graphically the landings of fish other than crustacea and molluscs for the period from 1905 to 1965-66, shows that these landings increased in three distinct stages.

The first stage, the time span of which extended beyond World War I, and the remarkable rise in 1914, must be treated with reserve as it included production from all States whereas the preceding and subsequent years did not. Part of the over-all increase was due to improvement in the collection of statistics, but there appears to have been a very real increase in landings from 1905 to 1915 which would seem to be due, at least in some measure, to improved transport.

The next stage started in the mid 1920's and was the consequence of the introduction of steam trawlers by the Government of New South Wales in 1916. However, these trawlers were of little significance until the Vigneron-Dahl trawl gear was introduced in 1925 or 1926. This modification increased the fishing power of the trawlers by 30% and the improved returns soon led to a rise in the number of trawlers employed.

By 1929, the catch from steam trawlers alone exceeded 15 million lb, but the subsequent decline in the catches, which led to and was aggravated by a reduction in effort, partly accounts for the fall in Australian production thereafter. This was halted about 1956 by the introduction of Danish-seine units which exploited the same demersal stocks and landings once more rose. However, the outbreak of World War II, which led to the requisitioning first of the steam trawlers and later of the Danish-seine boats, resulted in a very considerable fall in both effort and landings during the period 1941 to 1944. The return of these vessels at the end of the war resulted in an equally dramatic rise in effort and landings. Falling catches led subsequently to the reduction in numbers and ultimate disappearance of the steam trawlers.

This decline in catches continued until 1955-56 when landings of southern bluefin tuna initiated a third stage of development. Recent increases in Australian landings of scale fish are largely attributable to the development

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of this fishery (see Fig. 1).

The fluctuations in landings cannot, however, be fully accounted for by these factors. As previously mentioned, the over-all trend reflects, to some extent, changes in the scope and efficiency of the system of collection of statistical data. For example, Figure 1 is somewhat misleading in that it does not include Tasmanian and/or South Australian landings for the years between 1910 to 1925-26 excepting for the "peak" year 1914. Consequently the subsequent over-all improvement in landings since 1905 is less than these statistics suggest and the ratio between the growth of the population and the production of fish is thus more unfavourable than the gross statistics suggest.

The development of single unit fisheries is consistent with development elsewhere in the world. For instance, Norway's increased production after World War II reflects more intensive exploitation of the winter herring stocks. Similarly, Iceland increased production of cod and is now exploiting the previously neglected redfish resource. Further, the spectacular increase in Peruvian landings, which rose from 84 thousand metric tons in 1948 to 7 million metric tons in 1962, relates almost entirely to the landings of "anchoveta".

In Australia the development of single molluscan and crustacean unit fisheries have also been remarkable since World War II. Landings of the western and southern rock lobster, in particular, have risen very considerably. The catch of the western rock lobster soared from just over half a million lb in 1944-45 to nearly 22 million lb in 1962-63. The catch subsequently dropped to just over 16 million lb in 1964-65, but recovered in 1966-67 when 19 million lb were landed. This fishery, together with the smaller fishery for the southern rock lobster which provided over 12 million lb of rock lobster, brought over $A18 million in export earnings during 1966-67.

The development of the prawn fishery is also noteworthy. Australian production, which amounted to just over 1.4 million lb valued at $A176,848 in 1946-47, exceeded 14 million lb in 1966-67 and exports alone were valued at $A2,529,000. This spectacular and continuing increase has largely been achieved by extension of the area of operations.

The most spectacular examples of rapid development however, relate to the abalone and Victorian scallop fisheries. Abalone was first taken commercially in Victoria in January 1964 but the fishery rapidly expanded into all the States in south-east Australia and exports were valued at $A1.6 million in 1966-67. In 1962-63 production of scallops in Tasmania and Queensland amounted to 6.5 million lb live weight, but the establishment of a commercial fishery in Port Phillip Bay in September 1963 boosted Australian landings to 15.4 million lb in 1963-64. In the next year, this fishery provided over 19 million lb live weight, and exports from Victoria alone were valued at $A769,000. By 1966-67 exports from this fishery were valued at $A1.5 million.

The development of these fisheries, and particularly of the rock lobster fisheries, is thus largely responsible for the marked increase in the value

of exports of marine products which rose from $A793,154 in 1947-67 to $A26,832,000 in 1966-67 - an increase of 3,410%.

The benefit accruing to Australia from the development of these four fisheries can be estimated in terms of increased value of exports. This has averaged $A1.2 million a year since 1946-47 and totalled $A24.0 million in 1966-67 alone.

It is more difficult to estimate the value of the tuna fishery to the Australian economy. In 1951-52 only 259,000 lb of tuna were landed, but by 1966-67 the catch amounted to approximately 12.5 million lb. The value of the catch to the fishermen is now estimated to be in excess of $A1 million but its value, in terms of the resultant canned tuna at the retail outlet, is of the order of $A5 million.

Most of the tuna taken are southern bluefin and it is estimated that landings of this fish could be increased to 25 million lb per annum if improved methods of capture and location could be introduced. Striped tuna resources which are virtually unexploited, but which are present in considerable quantities off the Tasmanian coast and in Bass Strait, are estimated to be ten times this amount, i.e. 250 million lb. A fishery from Lakes Entrance was developed during 1962-63 and over 100,000 lb were taken in the first season, from January to May, with peak production in the last two months. Nylon monofilament gill nets were used; net reels and power hauling were developed. However, these fish were small in comparison with other tuna, averaging about 7 lb weight, and the "meat recovery" was lower. The price offered was low and when it was discovered that the gear could be used effectively to catch edible shark, the units transferred to shark fishing.

Nevertheless, the price then offered for striped tuna would be a very strong incentive to fishermen if a more efficient method of capture could be introduced. In fact, the successful introduction and adoption of purse-seining in northern waters, including those off the coasts of Iceland and Norway suggests that this gear could be used to exploit the striped tuna and other pelagic fisheries in the waters off southern Australia.

The potential increase in landings in these two tuna fisheries alone is estimated to be approximately 250 million lb with a possible additional 25 million lb of northern bluefin tuna.

The potential value to the fishermen at the lowest price offered in the past would be approximately $A14 million and marketing offers no problems since these fish have a world market and any surplus to Australian processing capacity could be exported profitably.

It has also been estimated that the unexploited jack mackerel resource could provide landings of the order of 2,500 million lb. These fish are sighted fairly regularly and occasionally occur in very large numbers. During a survey of the waters off the coast of Tasmania and in the Bass Strait on March 5, 1966, the quantities seen off the east and west coasts of Tasmania were estimated by experienced fish spotters as being in the order of 100,000 tons.

Similarly it is estimated that the catch from the snoek (barracouta) resources which are only partly exploited, be raised to 15 million lb. But the problem in this fishery relates to the nature of the fish. Product development and market promotion are needed if the catches of existing units are to be increased.

Substantial resources of pilchards and anchovies are also known to occur in southern waters and off the coasts of Western Australia and New South Wales. There are believed to be untapped demersal fisheries in both Bass Strait and the Bight and the opportunity proffered by the tropical rock lobster resource, for which development of an efficient method of capture is a prerequisite to its commercial exploitation, may be of considerable value. However the prawn fishery is worthy of particular mention since it not only offers a very considerable financial benefit to the economy of the country, but could also play an important part in developing remote areas of Australia.

For instance the Gulf of Carpentaria exceeds 100,000 square miles in extent and prawns are known to occur in some areas at least. If only one quarter of the area is as productive as the grounds off the east coast of Queensland, the Gulf alone would provide catches of about 25 million lb of prawns. Moreover, if this sub-area was as productive as some of the grounds in Western Australia, the catch would be double this.

The opportunities for further development are thus very considerable, but as development proceeds, problems of increasing complexity are likely to be encountered. For instance, development of prawn fishing by extension of known grounds is relatively simple compared to the opening of new fisheries in remote areas where common services and basic shore facilities are not available. In other cases, the cost of research and exploratory work needed to exploit a resource may be too high for individual action, and development must thus await the intervention of large fishery enterprises. The common property nature of the resources and high element of risk does little to encourage investment in the industry until the potential value of a resource can be accurately estimated.

Meanwhile, the primary sector of the industry has benefited from the development of the rock lobster, shrimp, scallop, abalone, and tuna fisheries, and as these fisheries provide raw material for processing, the benefits extend into the secondary and tertiary sectors. The resultant increase in the volume and value of exports of these marine products has also been of significant economic benefit to this country. The continued development of the fishing industry in Australia thus seems fully justified on economic grounds alone.