# PROSPECTS AND PROBLEMS FOR NEW ZEALAND'S DEMERSAL FISHERIES

## Proceedings of the Demersal Fisheries Conference October 1978

Fisheries Research Division
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# Opening address

by the Hon. J. B. Bolger
*Minister of Fisheries*

THIS, the first New Zealand demersal fisheries conference, is indeed timely. For too long the potential of the New Zealand fishing industry went unrecognised and it is only in recent times that sufficient encouragement has been given to the fishing industry for it to attempt to achieve anything like its ultimate potential.

The rapid expansion of any industry brings with it new problems not previously experienced by those involved. Some of the problems facing the industry will be discussed at this conference. It should be remembered that no industry is without problems, and therefore you should focus your attention on the important issues and leave the little ones to solve themselves.

**Deep-water species**

There are excellent opportunities for expansion by the New Zealand fishing industry, particularly in the use of the previously unexploited deep-water species. Some of these species were virtually unknown until taken by the large foreign fishing vessels operating in very deep waters; for example, southern blue whiting and oreo dory. Other species were known, but not recognised as being abundant; for example, hake and hoki. Still others were known to be abundant, but were not exploited because of lack of market demand; for example, warehou. Now foreign fishing vessels have exposed the stocks of these species and introduced them to their home markets. Our task is to decide the best way for New Zealand to gain benefits from the harvesting of these resources.

At present, New Zealand companies are exploring all avenues: charters, joint ventures, and the purchase of larger, off-shore vessels. Results of these developments will be keenly watched by all interested parties.

**Finite limit**

We must all be aware that fish resources have a finite limit to the level of exploitation that they can support. Foreign vessels licensed to fish in our waters are limited in numbers and they have catch quotas for individual species. In addition, they are permitted to fish only where licensed. As the New Zealand fleet expands foreign vessels can be reduced or ultimately excluded.

Any alteration of future fishing effort depends on whether our present estimates of sustainable yields are accurate or whether they are too generous or too conservative. Only careful monitoring of catches and fishing effort by Ministry of Agriculture and Fisheries staff will show us whether allowable catches can be increased. If increases prove possible, it is hoped that they will be taken up by increases in the catching capacity of the New Zealand fleet.

**Market outlets**

However, a preoccupation with catching fish will not automatically result in a bigger or better fishing industry. Perhaps the most important consideration for companies planning any increase in catching capacity is the question of market outlets for the fish caught. Over the last 6 or 8 months we have seen examples where too little thought has been given to the profitable marketing of our fish and fish products. Because of a downturn in some of our major export fish markets there has been a building up of fish stocks in storage facilities around New Zealand.

Perhaps this should have been expected. Just a few years ago we were catching between 30 000 and 35 000 t of fish; this year our catch will approach 100 000 t. It is logical to expect that these increased landings will result in a greater volume of fish awaiting export. At the end of May this year there was 4640 t of fish in stock in New Zealand. This had dropped by the end of August to 3657 t.

The biggest tonnage of fish in stock was the high value species snapper, which comprised 16% of total stocks. No one expects too much trouble in selling that. Barracouta at 14.5% of stocks and New Zealand sole at 12.7% were the next two species in volume of total stocks.

Although stock holding is higher than normal, this will always happen from time to time. Equally, however, there is no sense in continuing to increase our catch of fish without a comparable effort being directed into marketing. Let it be clear, though, that no matter how much effort is put into marketing, there will always be fluctuations in the market price for fish, as there are with New Zealand's major primary exports.

The approach must be to build a reputation for honouring contracts and meeting agreed specification and delivery dates. Last year when export prices were reaching record heights some companies adopted the practice of breaking contracts to sell on a different market at a higher price. Such a practice reflects a very short-term approach by companies, who gain themselves a reputation as unreliable suppliers.

With the downturn in prices that we have experienced this year, we have seen a different approach to marketing by some fishing companies, who are now indulging in price cutting, with each company quoting lower prices as overseas buyers do the rounds of New Zealand companies. I appreciate that selling fish is a highly competitive business, but such practices do little for the long-term viability of the industry.

Furthermore, we have already learnt from experience that we must not expect to rely on a few large markets for our produce. As there is no export marketing organisation for fish, each company makes its own marketing decisions. However, companies that put all their eggs in one basket are placing themselves at great risk, for, should the market decline, the effect on a company is severe. There is a suggestion that that is what has happened in some instances this year.

Those companies who have gained a reputation for being reliable suppliers and who have gone out and sought new markets in expectation of increased landings have come through the recent months largely unaffected. For every tale I hear of a company having difficulty selling its product, I hear of another who cannot get enough fish for export.

**Legislation**

A few weeks ago I had legislation passed through Parliament to re-structure the membership of the Fishing Industry Board. When the new board is operating it will include two members from the catching sector and two from the processing sector. I hope that the board will then direct its attention, as it is entitled to under its Act, more to providing the industry with additional marketing information—suggesting new markets and new methods of presenting fish for sale.

**Quality**

The quality of the end product also determines how successful New Zealand will be at selling the fish we catch. We are all aware of the very high standards that are demanded for our meat exports. We can expect that similar high standards will be required for fish exports.

It is simply illogical to spend thousands, or even hundreds of thousands, of dollars on fish-catching equipment only to see the fish rejected for export or domestic consumption for want of a few tonnes of frozen water. The whole exercise and a considerable amount of investment have been wasted.

Utilising our demersal fish resources does not only mean catching demersal fish; it also means selling those fish at a profitable price.

**Rapport**

The addresses you will hear during this conference will, I am sure, be of great interest to you all. I am convinced that one of the best things for the New Zealand fishing industry is the close rapport that our researchers have with fishermen.

Compared with that of some nations, our research effort is small and obviously it will take many years before we know all that there is to know about our huge fishing zone. However, the knowledge our scientific staff have obtained is the best we have on which to base future plans. I doubt that any of the speakers at this conference would claim that their comments constitute the final definitive word on the many subjects up for discussion. What this conference will provide is a forum where those involved in the industry can put their findings and discuss their experiences. It constitutes a very good example of the communications necessary to build a sound, viable, long-term future for the New Zealand fishing industry.

It gives me much pleasure to declare this conference open.

# Keynote address

by J. S. Campbell
*Fisheries Consultant, Wellington*

THIS conference on the prospects and problems for New Zealand's demersal fisheries, including squid, has come at a time when important decisions are being made in industry and government about the future development of the New Zealand fishing resources.

The prospects and problems of our demersal fisheries development revolve round a number of important features which I will raise in the course of this paper. These are:

- Size of the fish stocks.
- Location of the fish stocks—in shore, off shore, and species available.
- Commercial acceptability of the species.
- Degree of processing.
- Costs of catching, processing, and marketing.
- Some marketing problems.
- Need for back-up services and trained people.
- Possible extent of resources available to New Zealand and foreign vessels.
- Fisheries management and rationalisation of catching and processing units and co-operation and co-ordination in marketing.

The discussion which follows will not be as clear-cut as these points because every feature exercises considerable influence on the others. In the course of the conference there will be more detailed discussion on the important issues.

### Size of the fish stocks

New Zealand has had its own fishing resources brought forcibly to its attention by foreign fishing activities in New Zealand waters. Foreign fishing began on a fairly modest scale some 15 to 20 years ago, but in the last 3 years it has increased considerably. In certain fisheries there have been quite spectacular developments. For example, in the 7-year period from 1971, when the first eight Japanese squid vessels appeared, to March 1978 annual squid catches have climbed from 0 to almost 100 000 t. Of the 1977 catches of squid, 99.5% were taken by foreign vessels. In 1972, 960 t of whiptail (hoki) were landed; in 1977, 97 500 t were landed by foreign vessels alone.

In 1972 the New Zealand demersal fish catch was 24.5% and the foreign catch 75.5% of the total known catch. Between 1972 and 1977 New Zealand's own demersal catch rose by 39%, but the foreign catch rose by 260%. In 1977 the New Zealand catch of demersal fish and squid totalled 53 000 t and was only 11.1%; the foreign catch of 422 600 t represented 88.9% (Table 1).

It is mainly on the information provided by foreigners that we must now consider the prospects for development of our demersal fisheries. (One of the reasons for including squid in the discussions is that in 1977, 56% of the total squid catch of about 94 000 t was taken in trawls.)

Since it has been necessary for some foreign nations to make agreements and to negotiate for quotas of fish with the New Zealand Government, there has been a greater keenness on their part to disclose their total catch figures. These catch figures seemed to take a sudden upward turn. Perhaps we should put behind us the uneasy suspicion that trawl catches may have been understated in the past to minimise New Zealand's concern about the quantity of fish taken and that more recently these catches could have been fully stated to justify claims for higher quotas.

Whether we are suspicious or not, and whether we think it was morally wrong for some foreign nations to build up fishing effort while the Law of the Sea negotiations were proceeding, we must accept the information provided because it is practically all we have about certain fisheries. We have to make a serious evaluation of the information which is available and which will now be supplemented by more detailed and authenticated catch data.

**TABLE 1: Tonnages taken by three foreign nations and by New Zealand in 1977**

| | catch (t) | % |
|---|---|---|
| Japan | 255 200 | 53.7 |
| Russia | 123 000 | 25.9 |
| South Korea | 44 400 | 9.3 |
| Foreign total | 422 600 | 88.9 |
| New Zealand | 53 000 | 11.1 |
| Total | 475 600 | 100.0 |

These figures do not include Japanese tuna long-line catches estimated to be about 8000 t.

The catch of the Japanese squid-jigging fleet for the 1977–78 season has been included, rather than the catch for the 1976–77 season.

The question has been asked, somewhat critically, why foreign vessels were able to expand their demersal catches by 260% between 1972 and 1977 while New Zealand's catch expanded by only 39%. The main reasons appear to be these:

1. Foreign nations had large research vessels and, at considerable cost, researched special fisheries and off-shore grounds.
2. Their fishing organisations were large enough to stand the costs of moving into new fisheries on a large scale.
3. They already had the vessels, the crews, and techniques.
4. They had access to markets.
5. They had the pressure to find new grounds and to establish a fishing presence because of the expected 200-mile fishing zones.

What does this information indicate to us about the prospects for development? First of all, we must put it in some sort of perspective.

**Location of the fish stocks—in shore, off shore, and species available**

We have the catches of some species in some areas at some depths, in certain parts of the year, by certain fishing methods with various types and sizes of gear, and by many types of vessels manned by three different nationalities. Some of this information, fortunately, has been studied by our own scientists through the valuable co-operation of some foreign nations. Actual fishing activities, both commercial and research, have been witnessed by our scientists. Nevertheless, there are wide gaps in our knowledge of the resources, especially those in deeper and more distant waters which offer apparently more substantial prospects for development than the in-shore waters. These gaps need to be filled quickly, because if we are going to find prospects for development and base investment decisions on them, we need to have more information.

For example, though we know that the foreign vessels caught almost 100 000 t of hoki in 1977, we don't know what the potential is and whether that catch can be sustained or increased. This applies also to other species like southern blue whiting, the oreo dories, and so on.

It seems that there will be a national division of the industry by types of resource, by area and depths to be fished, and by fishing methods and vessel sizes.

There are two main methods of catching demersal fish, namely, bottom-lining and trawling, and the latter method can be used for bottom, mid-water, and near-surface catching. Certain species (such as snapper) are more available on the 200-m shelf, others are found in lower, deeper water down to 1000 m.

There is probably more information available to us on the in-shore fishing resources because of the valuable work done over recent years by our scientists and industry. It seems to be fairly generally accepted that the popular demersal species on the in-shore grounds are already fairly heavily exploited and there may not be much room for further development. Examples of heavily fished species are probably snapper, sole, flounder, gurnard, tarakihi, and hapuku. In-shore species which have been exploited by foreigners are barracouta (1977 catch 45 400 t, of which New Zealand caught 10.4%), jack mackerel (1977 catch 18 800 t, New Zealand catch 10%), the various warehou species including the common warehou (1977 catch 21 700 t, New Zealand catch 5%), red cod (1977 catch 13 300 t, New Zealand catch 17.5%), and tarakihi (1977 catch 7300 t, New Zealand catch 57.5%).

The prospects for development for the New Zealand in-shore fleet fishing on the 200-m shelf will thus be to catch a greater proportion of those fish which are available in this area and which have previously been caught by the foreign fishing vessels. Although some in-shore areas have been designated as closed to foreign fishing vessels (for example, Canterbury Bight and west coast North Island), quota allocations to foreign vessels include some of the in-shore species. So not all the in-shore fish will necessarily be available for New Zealand development.

In deep and more distant waters the potential for development again must be based on those species which have been shown to be available in relatively large quantities. The 1977 catches by trawlers were hoki 97 500 t, southern blue whiting 30 000 t (48 500 t in 1973), warehou species 21 700 t, deep dories 11 500 t, silverside 3800 t, ling 34 000 t, and hake 19 300 t; berycoid fish and other species were also taken. In deep bottom long-line fishing the predominant species would be ling. Squid can be caught by squid-jigging vessels and by trawlers, both in shore and off shore.

**Commercial acceptability of the species**

Now we have some idea of the species which may be available for development, we must turn to the "worth" of these fish. You will note I have not said the "quality" of the fish. Apart from such physical defects as parasite infection or high mercury content, live fish have inherently good quality. It is usually bad handling and/or bad hygiene that affect fish quality. Acceptability to consumers and the appraisal of the market place determine the value of the fish and this varies from species to species. Traditional local preferences determine what is acceptable in different markets. A buyer of fish in these circumstances is likely to class local opinion as a traditional preference and the seller of fish, with some justification, may be inclined to call it prejudice. White, firm-fleshed fish is generally preferred.

It is important in marketing our fish to find out what the preferences are in other markets and the effect these may have on the prices of the fish.

Most New Zealand species are still fairly unknown in the main fish markets of the world and there is a continuing problem of nomenclature. If we assume that the main in-shore species such as snapper, tarakihi, sole, flounder, and gurnard are already fairly heavily exploited and do not offer spectacular prospects for increased catches, we must concentrate on the species which offer significant prospects for catch expansion.

Already the New Zealand industry has considerable experience of the market acceptability in Australia and Japan for jack mackerel, barracouta, warehou, ling, hake, red cod, and other species for which there are prospects of catch expansion. There is little or no experience in marketing hoki, southern blue whiting, and some of the deeper-water species which have been caught by foreign fishermen.

The activities of foreign nations have established, to some extent, the acceptability of many of our fish species. They have also determined in some instances the degree of processing required by the main markets open to the fish. Already hoki is finding a place in the United States in the fillet block trade, to be made into fish fingers and fish portions. A price level has been established below the Atlantic cod fillet block price and above the block made from Alaskan pollack. A few months ago the hoki price was about seven-tenths of the cod price, but it was an acceptable product in block form, provided the fillets had been defatted. There are world price levels established for some of the species being caught in New Zealand waters, but these would be for the more popular and acceptable species, such as the tunas (skipjack, albacore, and southern bluefin), squid, lobster, and other shellfish.

I have classified our fish species into four broad groups according to their acceptability and their price at present (Table 2). Some are on the border line, of course, and prices do vary from time to time. All the demersal species with significant prospects for expansion are in the B and C classifications for value or price.

The demersal species available for development require considerable investigation, not only into their acceptability and the form in which they will be acceptable, but into the economics of catching and processing them.

It is also important to investigate the flesh quality, the use for which it is most suitable,. the recovery rates, and whether or not the fish lends itself to machine processing. Fish have wide differences in flesh colour and texture, shape, bone structure, fat content, type of skin, and so on. All these factors affect the value of the fish, either because of acceptability or because of the costs of preparing the fish to an acceptable form.

There is still a great deal of work to be done in New Zealand, even though we have basic information from the experience of foreign operators.

## Degree of processing

There seems to be a strong feeling in certain government quarters that shore-based processing is better for New Zealand than processing at sea or the selling of products overseas in a form which permits the buyer to process the fish. We will get business where we satisfy the demands of the buyer. If he is in the fish processing business, for example the processing of squid, he is a potential customer for whole squid and we must supply it or lose the market. If he manufactures fish fingers or fish portions, he will want to buy fish blocks.

**TABLE 2: Classification of species according to present acceptability and price**

| Premium | A | B | C |
|---|---|---|---|
| John Dory | Snapper | Gurnard | *Barracouta |
| Hapuku | Tarakihi | N.Z. soles | *Jack mackerel |
| Lobster | Elephant fish | Trevally | *Kahawai |
| Special snapper | Flounder | Southern kingfish | *Southern blue whiting |
| *Bluefin tuna | Lemon soles | Shark | *Silverside |
| Oysters | *Albacore tuna | *Red cod | |
| Scallops | Mussels | *Ling | |
| | Special trevally | *Hoki | |
| | | *Hake | |
| | | *Skipjack | |
| | | *Silver warehou | |
| | | *Common warehou | |
| | | *Squid | |
| | | *Deep dories | |
| | | *Berycoid fish | |

*Species offering prospects for increased catches by New Zealand-based operators.

The degree of processing to be done in New Zealand and condition of entry into foreign markets will determine the type of plant required on vessels and on shore. If full processing of certain species is to be undertaken (for example, squid or surimi), specialised plant must be installed and a continuous supply of fish will be needed to make the plant economic. The principle of maintaining a continuous operation to minimise production costs and to spread overheads applies to all fish processing. Unfortunately, the generally seasonal nature of fishing causes considerable fluctuations in supplies of fish to processing plants.

There are ways in which these fluctuations can be minimised by dressing fish on the vessels, freezing at sea, and reprocessing on shore. Some fish respond well to this treatment and thus enable the processor to get more even use of his labour force and his plant facilities. There is an urgent need for reasonable hygiene regulations to facilitate rather than retard processing or semi-processing at sea.

The Koreans and Russians have been producing dressed hoki in frozen blocks, transporting these blocks to their shore processing plants, thawing, filleting, and then making fillet blocks for export to Europe and the United States. This product has been acceptable to the main United States processing companies, who have applied their own exacting tests for hygiene and other quality aspects.

There is a great variety of processing plant available, some of which is not necessarily specialised for particular fish species. Some plant, such as filleting machines, must be specially built to process our fish species.

The nature of the fish flesh will determine the type of treatment each species will require and the type of product which can be made. This may force the processor to manufacture products not normally supplied to traditional markets. For example, southern blue whiting is a fish which is subject to rapid spoilage after catch. It requires special filleting and skinning machines. The British White Fish Authority and the Torry Research Station have done valuable research work on the northern blue whiting and are now conducting trials on the use of the fish for surimi. They have surprised the Japanese by producing an acceptable product after freezing the fish at sea and then reprocessing on shore.

The manufacture of surimi requires very expensive specialised plant, so that no New Zealand fish processor would want to embark on this type of production without carrying out a thorough investigation.

In setting up fish processing plants care must be taken to ensure that there will be a sufficient supply of fish to make full use of the plant to reduce processing costs. Consideration may have to be given to closer co-operation and rationalisation of processing, because costs must be kept to a minimum if New Zealand is to be competitive in world fish markets.

**Costs of catching, processing, and marketing**

When examining the New Zealand resources and their value, we must take into account the appropriate costs which will apply to catching, processing, and marketing. Many of our in-shore fish have reached foreign markets in small quantities, even though their names are not so well known. They bring a relatively low price and it is difficult to know whether a better price would be obtained if we caught and sold additional quantities. The problem for a developing industry is in trying to increase catches of fish of lower acceptability, but at a higher cost of catching, processing, and marketing.

The distant-water fisheries, which offer the greatest possibilities for expansion in catch weight, will apparently require vessels of greater size and sophistication and a much higher capital cost than those which can operate efficiently in the in-shore fishery. The increased size of vessels, greater distance to the fishing grounds, and the lower value of the fish will all challenge the ingenuity of the industry to mount a profitable operation. If the fish are to be of lower value and are to be caught with vessels of greater capital cost, a level of efficiency must be maintained in catching and processing which will result in a lower overall cost per unit than generally applies in the present in-shore fishing industry.

This raises the question of determining the size of operations and what economies can be achieved by a scale of operations greater than we have ever experienced in the New Zealand industry. Some of the nations who have been taking part in our fisheries do not have the same accounting or costing systems which would apply if New Zealand vessels were undertaking the same work. We must therefore turn to those nations which have a similar economy to our own and which have been operating with relatively highly rewarded labour and using capital equipment built and financed in an economy similar to our own.

Experience of these nations in catching such fish as Atlantic cod, haddock, and other valuable Northern Hemisphere fish will at least qualify them to pass judgment on the economics of catching and processing. I have deliberately linked fishing and processing at this point, because we will need to examine very critically the advantages or disadvantages of a certain amount of processing at sea.

Once we become involved in more distant deep-water fishing, we are faced with a change from the traditional manner of stowing and chilling fish which is brought back for on-shore processing. There are distinct limits on the time fish can be kept in ice, even when they have been headed, gutted, and bled. It is too costly to have large vessels making frequent trips to and from port. These will be fishing vessels, not transports. Therefore there will need to be a considerable amount of processing or preliminary processing at sea. In addition, if this does take place, one-third to one-half the weight of the fish must also be processed at sea into fish meal and fish oil in preference to discarding it at sea.

Northern Hemisphere operators have caught cod, haddock, and other similar fish of higher value than the fish which apparently offer the greatest scope for bottom trawling in our distant waters, namely hoki and blue whiting. However, the cost to European vessels of getting to fishing grounds across the Atlantic will be considerably greater than the cost of operating from New Zealand ports to the deeper waters in the off-shore areas of New Zealand.

As we extend our markets we encounter the problem of inadequate or irregular shipping services and the high cost of freight to some markets. It is difficult to understand why it can cost between 19c and 24c per kilogram (average 21.84c) for fish going to Australia, against 24c to the United Kingdom and 20c to 27.5c to the west coast of the United States. To Japan rates are 20.7c for special lower value fish and 30c for higher value fish. To north European ports the rates are 31.7c, to Genoa 40c, and to Piraeus 58.14c.

These rates are approximate and are subject to periodic revision. They are also subject to special surcharges from time to time to cover currency adjustment factors, congestion surcharge, and bunker surcharge. There are also some problems associated with containerisation and minimum container loads. These freight rates impose severe restrictions on the ability to sell some of the less preferred species. The freight content often exceeds the amount paid to the primary producer and therefore will retard production of these fish.

It is important for everyone to recognise that fishing is a specialised industry and should be treated as such. Too many decisions affecting the fishing industry have been made on the basis of some fancied similarities to the meat industry. Nothing could be more misleading and the attendant costs of decisions made on this basis could seriously affect the development of the fishing industry. Unlike the meat industry, which does enjoy some natural advantages at the producer level over competitive producers, the New Zealand fishing industry suffers serious natural disadvantages compared with its competitors. Those added costs which seriously erode the earnings of the primary producers of livestock could make the expansion of the fishing industry into the less valuable deep and more distant fisheries uneconomic. I refer specifically here to payment by results, hygiene and packaging requirements, restrictions on shipboard processing, shore handling costs, freight costs, and duties in export markets.

The key to developing the resources available to New Zealand is maximum efficiency in production (that is, catching and processing), minimum costs at all stages, and freedom of access to markets.

### Need for back-up services and trained people

The accelerated pace of fishing development which is apparent brings with it some growing pains.

In the short term catching capacity is being increased rapidly by the chartering of fishing vessels and the provision of skilled foreign crews.

This will mean that catching capacity could outstrip other developments such as the provision of cold storage capacity, handling facilities, repair and maintenance facilities, shore processing and packing plants, trained personnel, marketing capacity, financial arrangements, and ancillary services.

I do not propose to cover this in depth, but merely point to the need for parallel development of infrastructure and qualified and experienced personnel.

### Some marketing problems

That there are problems to be overcome in marketing New Zealand fish species is well known to the industry, and we must now accept that most of the expanded fish production will need to go to export. I have already mentioned the problems of identity and nomenclature of our fish. These problems may be met to some extent if we produce enough fish of individual species to find a place in large markets like the United States, Japan, and the European Economic Community in the form those markets require.

There are several factors which will affect our ability to establish and maintain a place in volume markets like the United States fish block trade. These are:

- An acceptable fish species;
- A quality product which meets the buyers' specifications for hygienic, visual, and presentation quality and geometry of blocks;

- Continuity and regularity of supply;
- A reasonable price policy (that is, a steady, competitive price).

Once New Zealand gets its fish products established in this type of market, there will be a need for much greater co-operation and co-ordination in marketing than has applied in the past.

New Zealand fish has traditionally been marketed in the fresh consumer market and the frozen catering market. We now need to recognise that our export market prospects are likely to be enhanced by a more diversified approach.

Our markets could be roughly divided into:

- End user trade; fresh, frozen, smoked, canned, and consumer products.
- Catering trade; hotels, restaurants, etc.
- Institutional trade; hospitals, armed forces, school lunches, etc.
- Manufacturing trade; fish block for fish finger manufacture, surimi for kamaboko or fish sausage manufacture, minced fish for fish cakes, dressed fish for special processing.
- Non-edible trade; fish meal and oil, pet food, fish bait.

The markets will determine the products, and demand is the key to marketing, whether that demand is created by the buyer and the users' preferences or stimulated by creation by the producer of something which meets a need. For example, the fish finger was created by producers seeking a way to stimulate demand for fish by creating a new product and therefore new markets. The field for new products is limited, but the field for meeting the existing preference is wide, provided our industry can learn what all the preferences are and satisfy them. Traditional preferences for local types of fish can also be met by providing matching or near matching species (for example, trevally to West Indians in the United Kingdom, monkfish to France, and grey mullet to Egypt).

There are tariff barriers to many markets, import controls, and other impediments. There are also non-tariff barriers such as certain hygiene, labelling, and packaging requirements. Some restrictions on imports are designed to protect the catching sector of the importing country (for example, duties and import quotas on mackerel to Japan) and others are to protect the processing industry (for example, duties on fish fingers or canned tuna to the United States). Good market research is required to find all the restrictions or obstacles to export trading, and good organisation to meet all the complex and widely differing requirements of the many foreign markets which may be available. A higher degree of specialised export marketing will be needed if large tonnages of New Zealand fish are to be successfully exported.

Fish marketing is competitive on the suitability of species, quality, delivery, packaging, and price. It will probably become more so as the trading pattern changes from the impact of 200-mile zones.

New Zealand's most difficult competition may come from the trading activities of those nations which have been licensed to fish in our waters for the same species which our industry will be selling. The costs to these nations will sometimes be much lower than New Zealand's in wages, hygiene requirements, and overheads. The differences will certainly not be balanced by the licence fees paid for rights to fish in New Zealand waters. In addition, New Zealand exporters will often be paying rates of duties well in excess of the licence fees (which go to government and not to the exporters).

**Possible extent of resources available to New Zealand and foreign vessels**

In 1977 the declared total catch of demersal fish and squid reached 475 000 t. There is no guarantee that this total production could be maintained. In the absence of any better indication of our potential resources we can at least theorise on what sustainable resource totals of 400 000, 500 000, and 600 000 t could mean for New Zealand fishing industry development.

| Demersal fish and squid | tonnes | tonnes | tonnes |
|---|---|---|---|
| Estimated sustainable yields | 400 000 | 500 000 | 600 000 |
| Less 1977 New Zealand in-shore catch | 53 000 | 53 000 | 53 000 |
| | 347 000 | 447 000 | 547 000 |
| Less estimated potential for in-shore catch | 97 000 | 97 000 | 97 000 |
| | 250 000 | 350 000 | 450 000 |
| Less quotas allocated to foreign nations | 209 000 | 209 000 | 209 000 |
| Quantity available for off-shore development by New Zealand vessels, joint ventures, or foreign quotas | 41 000 | 141 000 | 241 000 |

The foreign quotas, which the Minister of Fisheries described as "conservative", are for squid for a September to August year and for trawl fish to 31 March 1979. The Japanese quota for this period of 60 000 t may be increased for a full year.

The potential for New Zealand demersal and squid development could be as follows:

| | tonnes | tonnes | tonnes |
|---|---|---|---|
| In-shore | 97 000 | 97 000 | 97 000 |
| Off-shore | 41 000 | 141 000 | 241 000 |
| | 138 000 | 238 000 | 338 000 |
| Percentage of total allowable catch available to New Zealand | 34.5% | 47.5% | 56.3% |

Some of the foreign quotas granted include some in-shore species with specified limits on tonnages in nominated areas. It is sometimes difficult to make a clear distinction, but it would appear that the following portion of foreign quotas **could** possibly come from areas and depths accessible to New Zealand in-shore vessels:

| | tonnes |
|---|---|
| Barracouta, jack mackerel, red cod, warehou, tarakihi | 22 950 |
| Squid | 33 000 |
| | 55 950 |

If this is so, it would mean that the 97 000 t shown as available to New Zealand in-shore vessels would be reduced by about 56 000 t and the off-shore tonnage available would be increased by 56 000 t.

It would also appear that New Zealand Government policy would be to reduce the foreign quotas of in-shore fish as the New Zealand industry increased its exploitation of those species. If foreign quotas were maintained at the same tonnages, more trawl fish would have to come from the off-shore waters.

If the total allowable catch is in the vicinity of the 1977 actual catch, namely 500 000 t, the Government has several options open to it. First, there is the unique opportunity to ensure that New Zealand domestic or joint ventures set up to exploit the off-shore fishing resources are of sufficient size to achieve economies of scale in catching, processing, and marketing. This would involve the allocation of sufficiently large quotas of fish with an adequate balance of the higher and lower value fish. Second, the Government could opt for more participants each on a smaller scale with less chance of profitable operation and more likelihood of fishing units being too small and effort too fragmented.

In-shore fishing development could proceed on the present lines with a mixture of company- and skipper-owned vessels. In-shore operations naturally include the other fisheries not covered by this conference. For practical operating and economic reasons it is neither wise nor sensible to ignore the fact that there will continue to be considerable intermingling of in-shore fisheries as well as complementary fishing.

For example, there are combination trawler-purse seiners working both demersal and pelagic fisheries in appropriate seasons and combinations of lobster potting and tuna trolling, demersal trawling and shellfish dredging, lobster potting and squid jigging, and possibly also squid jigging and deep drop-lining.

This ability to diversify and to join seasonally complementary fisheries is an advantage in-shore fishing has over off-shore fishing, where there is less chance of mixing fisheries of premium or group A priced fish with lower value fish.

New Zealand trawl fishing development in deep and distant waters also suffers some disadvantages in comparison with foreign trawlers fishing under licences and quotas.

1. Processing or partial processing of fish at sea may be restricted for New Zealand-based companies because of stricter hygiene requirements. Foreign vessels have no such restrictions and can process at sea and still sell the product in the United States without problems (for example, New Zealand hoki).

2. New Zealand-based companies are expected to have or to build shore-based plants, but licensed foreign vessels do not have that capital commitment in New Zealand. The emphasis for the producer and the buyer is on the quality of the product rather than the quality of the surroundings where the fish is processed.

3. New Zealand-based investments in development of off-shore fishing resources are totally committed to those resources. They have no alternatives for the use of their specialised assets of vessels and shore plants. The foreign licensed vessels can go to other fishing grounds if the New Zealand resources prove to be unprofitable.

4. Foreign licensed vessels are usually old, well-depreciated trawlers and the costs will be lower than those which will apply to New Zealand-based companies who acquire newer vessels.

5. Foreign operators in the trawling field will most probably be part of large companies or organisations

which have a wide range of fish products to sell and are thus able to balance the less profitable operations with more lucrative ones. New Zealand deep- and distant-water fishing companies will have all their production in a limited range of species which will be harder to market without a balanced range.

It is not my intention to create a pessimistic attitude to the economic prospects for New Zealand deep and distant fisheries development. I must, however, emphasise that if New Zealand development is to be stimulated, these problems must be understood so that sympathetic and practical help can be provided to overcome or minimise them.

One important way in which Government can help is by making sure that New Zealand-based enterprises can achieve adequate economic catch levels, continuous processing plant throughput, and volume and continuity of supply to export markets.

It has been indicated by Government that quotas allocated to foreign countries will be reduced as New Zealand catches a greater proportion of the total catch. Although this may be the theoretical aim, it may be politically difficult to implement. Where there appears to be a reasonably large resource capable of bearing a substantial total allowable catch (for example, squid), foreign participation on a quota basis may be assured for some time. In other fisheries, however, where a large initial investment is needed in big trawlers and processing plants, Government must provide an adequate and sure reserve for New Zealand's future development. On the other hand, if New Zealand does not catch the "surplus" of the total allowable catch, greater quota allocations may be made to foreigners.

### Fisheries management and rationalisation of catching and processing units and co-operation and co-ordination in marketing

We have now entered the era of managed or controlled fisheries whether we like it or not. The concept of the Law of the Sea Single Negotiating Text is for management of fisheries to ensure the maximum economic use of the resources while maintaining their productive level.

This places a great responsibility for the management of the resources on the coastal states. Already controls are being established on foreign operations and it is inevitable that such controls will also apply to domestic fishing operations.

The important issue is whether, in exercising such controls, the coastal states will ensure that those units which are permitted to operate will catch enough fish to achieve a high level of efficiency and profitability. If this is done, there will be no overcapitalisation with attendant increases in production costs and pressure on operators to overfish.

The question of controlled fisheries is a complex one, and it would justify a conference or seminar of its own. In demersal fishing, particularly where a large investment in vessels and processing plants is required, fisheries management controls need to be influenced as much by economic factors as by biological considerations. The greatest pressure comes on to the biological structure of a fishing resource when there is great economic pressure on the catching sector.

Controlled entry fisheries lead to rationalisation of catching effort. There will still be a need for some rationalisation of fish processing plants to achieve economies in the provision of buildings, modern plant, and equipment and in the use of labour.

There will be a further need for more co-operation and co-ordination in marketing to ensure that New Zealand fish exports achieve the best possible realisations. I do not advocate setting up a marketing board along the lines of other primary product marketing boards because the marketing of fish is a very different proposition from marketing those products which have a clear international identification. A great deal of individual initiative is required for the marketing of fish and this can best be supplied by active traders. The need for co-ordination and co-operation in export marketing is to reduce those elements of competition which lead to price cutting and other practices which reduce the overall realisations.

### Conclusion

Many of the points I have covered will be dealt with in greater detail by following speakers and in the course of conference discussion.

The prospects and problems of accelerated fishing development really offer opportunities to take advantage of those prospects and to attack and solve the problems. Neither will be done without the full co-operation of the various industry sections and all the government agencies and other bodies who exercise some influence over developments.

New Zealand-based enterprises, whether wholly or partly New Zealand owned, start in deep-water fishing with some disadvantages compared with foreign licensed fishing companies. On the other hand, there are now some valuable government incentives available for New Zealand development and there is a strong sense of enterprise and initiative within the industry. The export market situation has been depressed, but some improvement is being forecast.

So the challenge for us now is to solve the problems and take full advantage of the prospects. This conference is focusing a spotlight on the important issues.

# Fish and fishery resources

by G. D. Waugh
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WHAT makes the rock lobster fishermen, the scallop fishermen, the eel fishermen, and the dredge oyster fishermen more responsible and more far-sighted than the finfish fishermen?

All of the other groups have recognised that the resources they are exploiting are finite and, what is more, they are being overfished. They recognise that if the industries based on these resources are to be given any stability, some controls on fishing effort must be introduced. The complaint is mostly that the controls now being introduced are too little and too late. Perhaps this is our fault because we didn't learn enough soon enough to be specific about what type of controls would be desirable.

If these fishermen are correct, and there is little doubt that they are, why should we suppose that some of the finfish stocks are not equally at risk? I don't just mean the fish themselves; some of them will survive. What we have to be concerned about is the fishermen; will they survive as economic operators? We have made observations on some of the stocks, which show that they are already being overfished, but almost invariably any suggestion that fisheries for particular species should be controlled is vigorously resented by the industry.

One possible reason is that the other species (rock lobsters, scallops, etc.) that I have mentioned represent unit stocks or unit fisheries where the fisherman fishes specifically for the one animal for the greater part of the year. On the other hand, the trawlerman fishes for a variety of species fairly indiscriminately. Nevertheless, there are some unit finfish fisheries; for example, snapper in the Hauraki Gulf, elephant fish in the Canterbury Bight and Pegasus Bay, trevally in the Bay of Plenty, and possibly the snapper fishery of the west coast of the North Island.

### Manpower and material resources

In planning for our own work, for advice to government and industry, we obviously have to look at the fish stocks themselves, and for this we need our own scientific, technical, and material resources in terms of people, space, equipment, and vessels, not to mention money. In staff, alone, we face a shortage. We have had to sacrifice some research work to hold this conference because we could not prepare for these talks and carry on new work at the same time. Nevertheless, I hope that our time will have been well spent.

We also have to be concerned about the industry's manpower and material resources. Are there not enough or are there too many people and vessels to utilise the fish stocks wisely and well? Are these resources being used to the best advantage, not only of the fishing sector afloat and ashore, but of New Zealand as a whole?

If controls are necessary, how can they be implemented and supervised? Here we have to look at other manpower and material resources in enforcement officers, inspection vessels, accommodation, etc. We also have to look at the question of communications between all of these. One way of communicating is to hold conferences such as this which will, we hope, make people think about what we would like to do and what we need to do to attain our objective of making best use of the fish stocks.

### Assessment of fish resources

Most of you will be aware that from the late 1930s to 1964 all the fisheries were controlled under a system of restrictive licensing because it was believed that stocks could be readily overfished. In fact, what the system did was to underexploit the fish and protect the livelihood of those fishermen lucky enough to have licences. The advent of foreign fleets and the realisation that we were not making full use of the resources led to the delicensing of the fisheries in 1964 to allow the industry to expand.

The trouble with the theory was that no one knew anything about the fish or the fish stocks and, therefore, no one had any idea of what the desirable, optimum, or ultimate yields. might be. Fisheries Research Division was, in effect, created after the event to answer these questions.

Despite limitations of staff and facilities, we had made substantial progress in assessing the resources of the coastal zone fished by the New Zealand fleet and were beginning to be able to advise government on the status of the fisheries. This we had to do despite the lack of meaningful statistics from some sectors and areas. This has inevitably delayed our work and placed greater pressure on our own manpower resources. Staff have to spend long hours away from more productive work to collect data from fish sheds and fishermen.

However, as I have indicated, we had made progress and were diversifying into fisheries which we believed would be of future use to the industry. We were catching up with the local fisheries problems when the Government's decision to establish the 200-mile Exclusive Economic Zone (EEZ) raised a new series of questions.

This created two problems; first, how to deploy staff who were, until then, working mostly on the coastal fisheries and, second, re-allocation of time on *James Cook* to gain some coverage of the new fisheries.

I would like to acknowledge the willingness of those scientific staff who have undertaken the more distant and much less comfortable studies on the deep-water fisheries. I would also like to express my appreciation to the officers and crew of *James Cook* who have worked in waters and sea conditions for which the vessel was not designed. Compared with some of the foreign trawlers she is only dinghy-sized, and the roaring forties are notorious the world over.

Acknowledgment is due also to the Japanese scientists and to Japan Marine Fishery Resource Research Centre (JAMARC) for the data made available from their commercial and research vessels and from the industry/government vessel *Shinkai Maru*. These data have helped immeasurably in giving us a first appreciation of the standing stocks of fish on most of the deep-water grounds.

A few years ago when the foreign vessels were fishing on our continental shelf and catches by the local fleets began to decline, the foreigners were blamed for overfishing. Foreign vessels have now been generally excluded from the coastal area and they have been replaced by newer medium-sized vessels belonging to New Zealand companies. The combined fishing power of these newly acquired vessels exceeds that of the previous foreign vessels.

Our fishing companies and fishermen "can't have the penny and the bun". If the stocks were being overexploited previously by New Zealand and foreign fleets combined, why should some companies now assume that because only New Zealand vessels are concerned, the situation will be any different?

**Duty of fisheries scientists**

There are not enough fisheries scientists and we do not have all the answers, but we do have accumulated knowledge which is generally not available to individual companies or fishermen.

As a general criticism of scientists, they are seldom prepared to be dogmatic about their ideas and theories because they are often subject to correction. Generally these corrections are in refinement of estimations rather than major changes in the theory. Nevertheless, the scientists' training is such that they like to see every t crossed and every i dotted before committing themselves to positive statements.

In the past there was time to do this. The rate of change of fishing technology was fairly slow; now it is extremely rapid. It is possible to put large vessels, even factory trawlers, into a small area and decimate a stock of fish in a very short time. If these fish are slow growing, as, for example, snapper and tarakihi, their regeneration time is equally slow. A stock of barracouta or mackerel with a life expectancy of 6–8 years will recover about six times as rapidly as a stock of snapper or tarakihi with a life expectancy of 40–50 years. This means we must have some predictive capability to forewarn government or industry of likely declines before they occur and before over-investment in manpower, machinery, and vessels has been made. In other words, it is far more important to manage the fisheries than it is to manage the resources.

Sometimes it is not possible to be absolutely specific about when and by how much a fishery will decline, but there is a certain knowledge, a "gut feeling", that this will happen unless some restraint is exercised. It is our duty to voice these feelings, to issue the warnings; otherwise we are guilty of condoning the waste of our resources. I do not mean just the waste of our fishery resources, but wasteful use of the country's manpower, vessels, fuel, and money.

**Future use of resources**

We need to optimise the limited resources we have available to us as a nation and, in my view, we need to sit back and take stock, to see what we have, where we are heading, what additional facilities we need as a country and as an industry, where we can expand, where we need to exercise restraint, and where we need to retrench. In other words, we must optimise our collective effort before we reach the stage where committed capital investment is dictating policies that could in the long run be ruinous.

I have no wish to paint a gloomy picture, and there is undoubtedly much more room for development of our industry in certain directions, particularly in the deep-water fisheries.

Neither do I wish to pre-empt observations by succeeding speakers, but I would like to reiterate one important point: that it is fairly easy by regulating effort, limiting the size or number of vessels, closing areas, establishing minimum sizes of fish, or limiting mesh sizes to manage or conserve the **fish** resources. Most of the fish species will still be there when fishing is no longer economic. What we have to do is to manage the **fisheries** and perhaps we have to do this, despite the views of some, in the best interests of the country.

Almost every fishery in the world has had a boom situation followed by a bust. I sincerely hope that we will resist the same thing here. Inevitably, the local industry, either on its own or through joint venture partners, will want more. The foreign countries, who would otherwise have vessels lying idle, will also want more. And the Government, aware that its income is derived from licences and levies which in turn are related to quotas, will probably want more. We hope to persuade all parties that what I have suggested is the proper way to proceed to develop the fishery of the EEZ. Although it may take longer, it will cause less hardship to all concerned.

There is, however, one proviso. If the scheme is to succeed, there has to be a continuing commitment on all sides to ensure that the necessary work is done, that adequate data are collected, that they are processed expeditiously, and that staff are available to perform the analyses so that quite specific proposals can be made on the basis of sound assessments and sound principles.

Finally, despite all the problems I have mentioned, there is one which does not affect the deep-water demersal fisheries of the EEZ. We do not have to take into account the recreational fishermen. To the best of my knowledge there are no deep-sea anglers who fish with rod and line at depths of 1000 m!

# Present status of the demersal fishing industry in New Zealand

by R. O. Armitage
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*Fishing Industry Board, Wellington*

A major problem in commenting on the present status of the industry utilising the demersal finfish resources is that it is an industry which is difficult to observe in isolation. There are several fishing industries in New Zealand and there is a considerable amount of commercial interaction between them, in catching to some extent, but particularly in processing.

Yet, though it is not possible to talk of a single fishery without putting it into the context of the total fishing industry, it is also difficult to make generalisations about the total industry, as each area has its unique characteristics and different combination of fisheries.

This is the fishing industry's paradox—separate yet together, individual and competing and yet based on a common resource more communal than many would like to admit. This is, however, being increasingly realised as the need for controlled fisheries gains acceptance.

As well as the economic interaction between the demersal fishery and other fisheries, the demersal fishing industry itself is not homogeneous. It is a multispecies fishery, one of the most complex to manage because of the wide range and interrelationship of variables, and the species mix is different throughout the country, which means that what might apply in one area is not true for another. However, the extent of these differences will probably reduce as the industry expands and vessels from several ports cover a wider area and fish similar resources.

Two other considerations in analysing the status of the demersal fishery are:

1. To what extent the analysis should be qualitative or quantitative;
2. How much emphasis should be given to each of the three sectors—catching, processing, and marketing.

This paper will be confined mainly to quantitative analysis. It will attempt to provide some aggregate data on the industry to give perspective and outline to its current status and structure and expansion intentions. Quantitative data can be useful in helping to provide information about the commercial industry. However, one shortcoming is that aggregate data can obscure particular or individual problems.

Qualitative judgments are subjective and, owing to the nature of the industry, they vary widely depending on the person or company spoken to. Industry members are best able to comment on the present state of the industry and whether its intentions or expectations are wise, profitable, or possible; therefore observations of this sort will be limited in this paper. However, some general comments will be made on aspects that will affect the economics of the industry and its ability to develop. The paper deals almost exclusively with the catching sector, with some brief comments on processing and marketing.

A note of caution should be given on the statistics used in this paper. As averages and aggregates they will probably not relate to any individual situation and therefore may not be agreed with by anybody. In addition, some inadequacies in the source data for both catching and processing have made it impossible to extract refined and complete data on some aspects of the industry.

**Existing catching sector**

The demersal fishery is the largest of the New Zealand fishing industries in terms of capital employed in vessels and weight and value of production, but it is second to the rock lobster industry in terms of the number of fishermen engaged.

The New Zealand fishing industry caught about 78 000 t in 1977 (calendar year) and to see the demersal fishery in perspective it is useful to look at an analysis of the catch by main fisheries (Table 1). The demersal catch was 65% of total fisheries production and 84% of the finfish catch; but it was 42% of total fisheries value in 1977 (at port prices).

Although the official statistics show catches by ports of landing, the amount that has come from each of the main fishing areas around New Zealand can be calculated.

**TABLE 1: Fisheries production by principal fisheries for 1977**

| Fisheries | | Production (t) |
|---|---|---|
| Finfish | | |
| Demersal | 50 600 | 60 300 |
| Pelagic* | 9 700 | |
| Rock lobster | | 3 600 |
| Shellfish | | 14 400 |
| Total | | 78 300 |

*Tuna, mackerel, and kahawai have been combined to give a pelagic fishery catch. This figure approximates the catch by pelagic fishing methods.

Table 2 shows the 1977 total finfish and demersal catches by major fishing areas. The landings at those ports which would have received fish from a number of areas have been apportioned according to industry experience. The fishing areas and demersal production from each in 1977 are shown in Fig. 1.

**TABLE 2: Total finfish and demersal production in 1977 by fishing areas**

| Area | All finfish (t) | Demersal (t) |
|---|---|---|
| 1 | 25 800 | 17 600 |
| 2 | 16 300 | 15 500 |
| 3 | 100 | 100 |
| 4 | 8 900 | 8 800 |
| 5 | 7 300 | 6 700 |
| 6 | 1 900 | 1 900 |
| 7, 8, 9 | 0 | 0 |
| Total | 60 300 | 50 600 |

If the catch of the United States charter vessels is removed from total production, the demersal finfish amounts to almost 90% of total finfish production in New Zealand. Therefore, when talking about the demersal fishery in New Zealand from the industry's point of view, we are really talking about the finfish industry.

To compliment this analysis of finfish production by area the total value of all fisheries production by these areas is useful (Table 3). Tables 2 and 3 illustrate what is well known: that the demersal fishery is more highly developed, as is the finfish fishery in general, in the north, and it is the dominant fishery there. In the north the finfish fishery is not much augmented by other fisheries, whereas in the south it becomes comparatively less important and other very profitable fisheries are the basis of the fishing industry there. As well as the need for higher capital cost for vessels to exploit finfish resources in the south, and the lack of easily fished popular finfish species, the presence of the high valued fisheries in the south has forstalled the further development of the demersal resources there.

**TABLE 3: Total value of fisheries production in 1977 by area**

| Area | All finfish ($ million) | All fisheries production ($ million) |
|---|---|---|
| 1 | 7.5 | 11.8 |
| 2 | 5.0 | 6.2 |
| 3 | 0 | 1.4 |
| 4 | 2.8 | 5.0 |
| 5 | 2.1 | 4.9 |
| 6 | 0.7 | 8.3 |
| 7, 8, 9 | 0 | 0 |
| Total | 18.1 | 37.6 |

To understand the catching sector it is important to know how the production is achieved. Table 4 illustrates by what fishing methods the 1977 catch was made.

Trawling and bottom seining produce over 60% of the finfish catch and over 75% of the demersal finfish production (Fig. 2). The industry depends heavily on trawling and therefore a close look at the trawl fleet is essential. Analysis of the registered trawl vessels (vessels with trawling permits) of which there are about 450, shows that less than 200 vessels (those catching more than 50 t of fish in 1977) account for over 90% of the trawl-caught fish and thus 70% of the demersal catch, and that only 54 vessels (those catching over 200 t) produced half the trawl catch (Table 5).

These 200 trawlers have a value at cost of $25 million and have 550 fishermen working on them. Most of this value is contributed by vessels under 10 years old. To replace the existing trawl fleet with basically the same size distribution as at present, but with vessels of improved design and technology (and therefore catching potential) has been estimated to cost about $36 million on 1978 prices.

Vessels engaged in line or net fishing number about 400 (that is, vessels catching over 5 t) and of these about half produce 70% of the 11 414 t of finfish caught by line and net.

## Expansion of the catching sector

The catching capacity of the demersal fleet will be increased by:

- Increases in the efficiency of the existing fleet as vessels become obsolete and are replaced by vessels of improved technology;
- New additions to the fleet through imports and local construction.

Some of the existing fleet is fairly old and this indicates that much replacement could take place

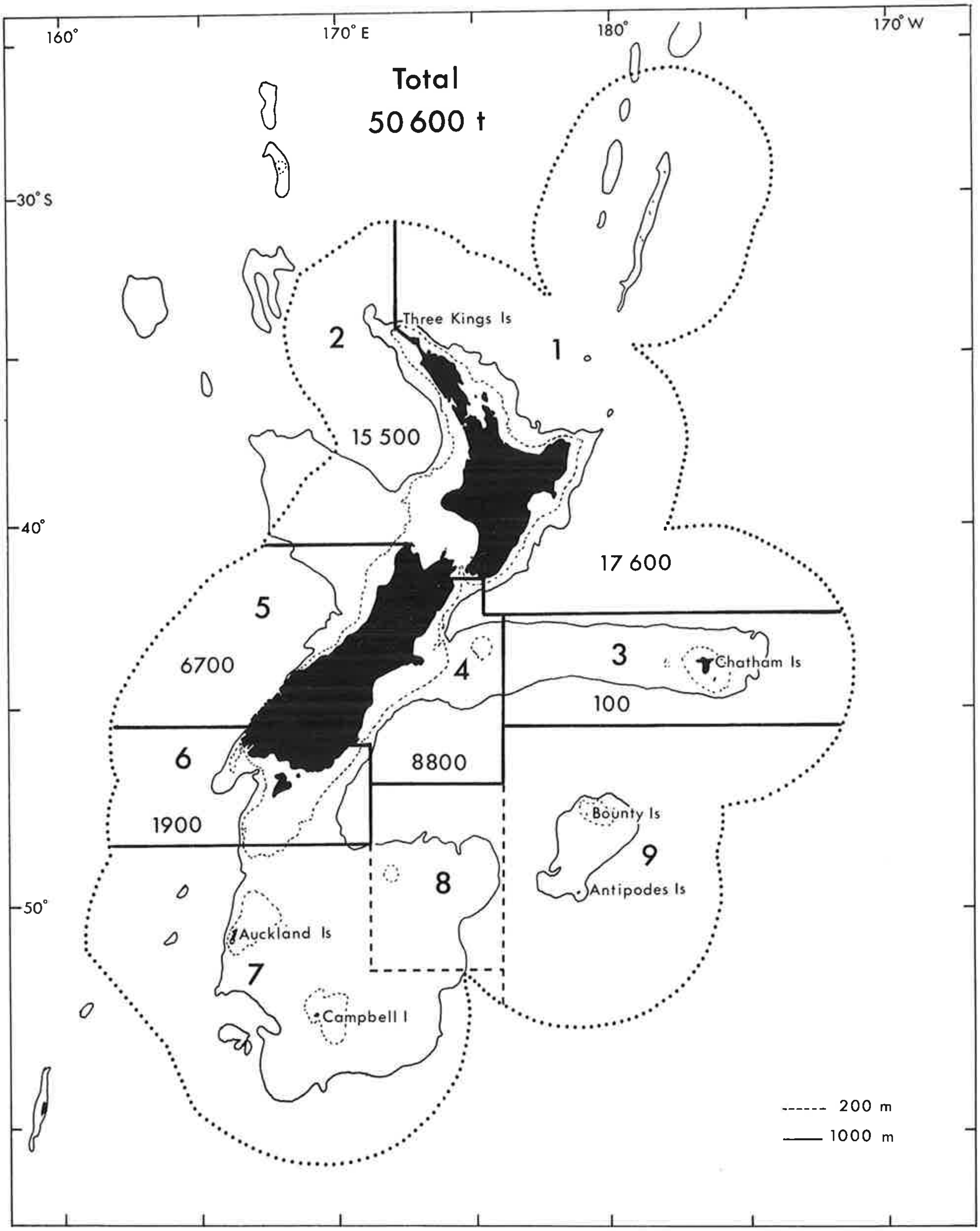


Fig. 1: New Zealand industry's 1977 demersal catch (tonnes) by fishing area.

TABLE 4: Finfish catch for 1977 by fishing methods

| Method | Catch (t) | Totals (t) | Value ($ thousand) | Totals ($ thousand) |
|---|---|---|---|---|
| Trawling, pair | 11 828 | | 3,528 | |
| Trawling, single | 24 043 | | 6,845 | |
| Bottom seining | 2 026 | 37 897 | 974 | 11,347 |
| Set netting | 7 846 | | 2,748 | |
| Lining | 3 568 | 11 414 | 1,394 | 4,142 |
| Purse seining | 9 778 | | 2,122 | |
| Trolling, poling | 551 | 10 329 | 185 | 2,307 |
| Others | | 694 | | 352 |
| | | 60 334 | | 18,148 |

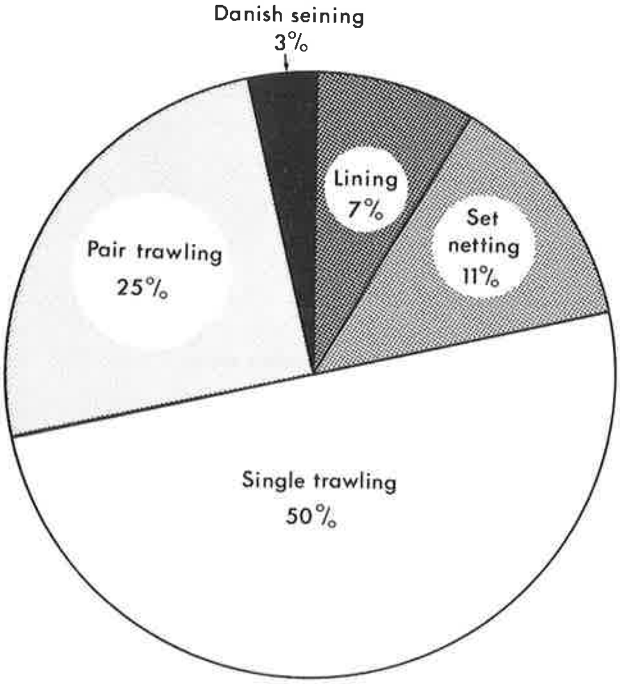


Fig. 2: Analysis of fishing methods by which the 1977 demersal catch was produced.

TABLE 5: Analysis of trawlers and Danish seiners by catch range

| Catch range (t) | No. of vessels | Total catch (t) | Cumulative catch % |
|---|---|---|---|
| 500+ | 6 | 4 400 | 12 |
| 400–500 | 6 | 2 900 | 20 |
| 300–400 | 16 | 5 600 | 35 |
| 200–300 | 26 | 6 250 | 51 |
| 150–200 | 24 | 4 300 | 62 |
| 100–150 | 38 | 4 750 | 75 |
| 50–100 | 80 | 6 020 | 91 |
| 25–50 | 66 | 1 987 | 96 |
| 0–25 | 190 | 1 690 | 100 |
| Total | 452 | 37 897 | |

over the next 5 years. Table 6 gives a broad indication of the age distribution of the total fleet.

There is some evidence that advantage is being taken of the vessel construction incentives available, and increasing numbers of vessels are being replaced with a consequent increase in total catching capacity. It is estimated that if the existing trawl fleet was replaced with vessels of modern design and technology, the average productivity could increase by between 25% and 35%.

A survey of shipyards indicates that the number of smaller vessels planned to be built over the next 2 years to replace obsolete or lost vessels could add a further 10% to the present finfish catch by 1979–80. There is no guarantee, of course, that the vessels they are replacing will actually be withdrawn from commercial activity and therefore this estimate of increased catching capacity due to vessel replacement could be conservative.

As well as this, the importation or construction intentions of major fishing companies and some individual fishermen indicate that by 1979 another 30 vessels (25 over 21 m and the other 5 between 18 and 21 m) could be introduced into the demersal fishery as new catching capacity.

An analysis of the catching expectations of companies and individuals with replacement or new-addition vessels for 1979–80 is given in Table 7 and Fig. 3.

TABLE 6: Analysis of fishing fleet by age

| Age of fleet (years) | Steel % | Wood % | Total % |
|---|---|---|---|
| Under 10 | 70 | 25 | 36 |
| 10–19 | 25 | 22 | 24 |
| 20–29 | 4 | 19 | 14 |
| 30–39 | 1 | 11 | 8 |
| 40+ | 0 | 23 | 18 |

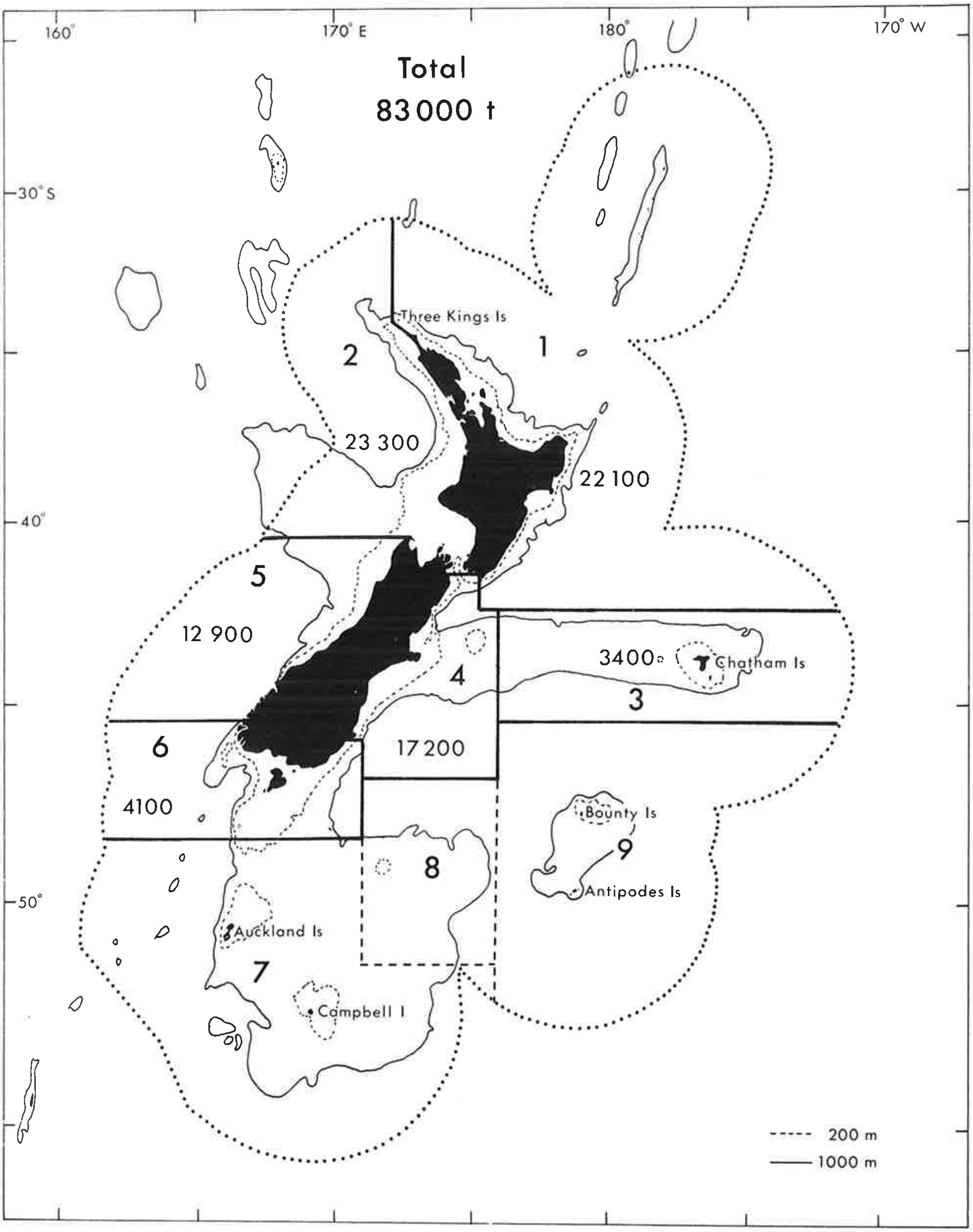


Fig. 3: New Zealand industry's 1979–80 expected demersal catch (tonnes) by fishing area.

**TABLE 7: Expected New Zealand finfish catch for 1979–80 year by area of production**

| Area | 1977 catch (t) | Replacement vessels (about 10% of 1977) (t) | Additional vessels (local construction and imports) (t) | Total (t) |
|---|---|---|---|---|
| 1 | 17 600 | 1 700 | 2 800 | 22 100 |
| 2 | 15 500 | 1 500 | 6 300 | 23 300 |
| 3 | 100 | 0 | 3 300 | 3 400 |
| 4 | 8 800 | 900 | 7 500 | 17 200 |
| 5 | 6 700 | 700 | 5 500 | 12 900 |
| 6 | 1 900 | 200 | 2 000 | 4 100 |
| 7, 8, 9 | 0 | 0 | 0 | 0 |
| Total | 50 600 | 5 000 | 27 400 | 83 000 |

It should be stressed that these increased figures are the sum total of the catch expectations of all the known new investment in fishing vessels. There is no implication that the expectations will be realised. The demersal catch by the New Zealand industry is therefore expected to increase by 65% over the next 2 years as a result of the addition of 30 medium-sized vessels, mainly in the 21–30-m range, and some replacement of the existing fleet.

## Productivity and costs in the catching sector

It is now possible to put together the data relating to the existing trawl industry and those for its projected expansion over the next 2 years (Table 8).

This comparison gives some interesting results, though insufficient research or analysis have been done to test them. The existing trawl fleet, with new investment and technology, could achieve a catch per 1978 investment dollar which is slightly higher than the catch per investment dollar expected by the new additions to the fleet. Nevertheless, the rates of production are surprisingly similar. It appears, therefore, that for every 1978 dollar invested in trawling capacity a production of about 1.1 kg can be expected. The existing fleet would, of course, have a much higher productivity if it was related to the current value of the fleet, but comparison on that basis is not really valid.

The big difference between these two situations is the manpower required. The present trawl fleet employs 550 and has the potential, with new investment, for an average of about 75 t per man per year; whereas the new and larger additions to the fleet are expected to produce about 200 t per man with the 130 crew they will need. These comparisons should be treated with caution, as in many respects like is not being compared with like. The catch of the present fleet is what has been achieved, whereas the catch of the additional vessels is what is expected and reality might be different.

Furthermore, the additions will have the drive and expertise associated with all new investment and will reflect the best that can be achieved by these vessels. The existing fleet contains many vessels fishing well below their capacity, often through choice, and extraction of the results for the top 30 vessels in the present fleet for the purpose of comparison could perhaps give quite a different result. The estimate of the higher catch with new investment could also be conservative. A comparison of operating costs other than crew costs could show a difference between the two categories. In some ways the comparison is pointless, as the size of the vessels in most of the existing fleet and the vessels in the new additions are both within the size range of 16–30 m. This is considered to be the optimum to fish most of the coastal resource for on-shore processing. There is a place for the vessels at the lower end of the range, which are more versatile for fisheries such as tuna trolling and scallop dredging, and those at the upper end with their ability to fish over a wider area for more days a year. The comparison was made to draw attention to the fact that careful consideration must be given to the type of vessel the industry needs to replace the present fleet and to harvest more of the resources available. It also raises some important questions:

- The investment in the new larger vessels appears to be developing a new ratio between capital and labour. Should there be some revision of the

**TABLE 8: Catching sector productivity**

| Fleet | No. of vessels | Value at cost ($ million) | Present catch (t) | Catch per investment dollar (at cost) (kg) | Replacement cost in 1978 ($ million) | Expected catch (t) | Potential catch per 1978 investment (kg) | No. of crew |
|---|---|---|---|---|---|---|---|---|
| Existing | 196 | 25 | 34 000 | 1.36 | 36 | 42 000 | 1.16 | 550 |
| Additions | 30 | 22 | 27 400 | 1.25 | 25 | 27 400 | 1.09 | 130 |

proportions which have traditionally gone to these factors?

- If the existing fleet increases its productivity (as it is doing) will it be possible to direct this capacity to other resources or will there need to be a reduction in the number of vessels and crew working the inshore demersal resources so as not to increase pressure on them?
- If the existing fleet with new investment can achieve the same catch with 25% fewer vessels, there would be about 140 trained fishermen available for new trawlers. Therefore, what are the implications for training?

Another major difference between the present operations of the trawl fishery and those of an expanded fleet will be the earnings per tonne. The demersal catch in 1977 averaged about $315 per tonne at port price level, and a look at averages for each port throughout New Zealand indicates that most areas were reasonably close to this figure (Table 9).

There are variations between ports and these usually reflect some of the differences between areas. For example, there was an above average value in Northland because of the high proportion of line-caught, air-freighted export fish handled there. Wellington had a high average price because only high valued popular species are accepted there and, as the market is exclusively domestic, there are low processing costs and wholesale mark-ups, which result in higher port prices. There was a below average value in Nelson because of the high proportion of lower valued species. Because of the type of resource available for the industry as it expands, it is expected that the average value of the catch will be considerably lower than in the past, at least in the initial stages. However, it has been seen that unit costs in the catching sector will not conveniently reduce to accommodate these lower realisations.

Inspection of a sample of vessel operating costs indicates that, depending on circumstances, a break-even point for an average trawler in 1977 before interest was about $220–$300 per tonne. Vessels concentrating on snapper caught less weight, but achieved much higher unit values; those catching predominantly barracouta and red cod, etc. had higher catches, but much lower unit values. This latter situation is the one applicable to the demersal industry's expansion.

Therefore to be economic the catching sector's demersal expansion has to be based on an **average** unit value which is over $220 per tonne (1977 prices). The average will obviously vary, as will the break-even point, for the reasons outlined earlier. **Average** should be stressed, as, if a vessel is able to augment its catch with higher valued species, it will be able to catch fish which may have a realisation at port level below $220 per tonne.

With interest rates of 10% break-even values would probably increase to between $320 and $380 per tonne, which indicates the high capital cost of the increased investment in the catching sector.

The resource is composite and the decision has to be made on the means of utilising it. Perhaps if new catching capacity is concentrated entirely on less valued species, such operations will not be economic and therefore a large section of the resource will not be able to be harvested by an expanded local industry. If all demersal resources were spread among the expanding industry, resources could be harvested which would not be if the operations of vessels were confined too selectively.

In the end, however, it is the costs of processing fish into a marketable product and the price at which such products can be sold that dictate what can be paid for harvesting them. This is so with all primary industries

**TABLE 9: Landed value of finfish and all fisheries produce**

| Port | Finfish Catch (t) | Finfish Value ($ thousand) | Average dollars per tonne* | All fisheries produce Catch (t) | All fisheries produce Value ($ thousand) |
|---|---|---|---|---|---|
| Whangarei | 2 138 | 997 | 466 | 2 527 | 1,972 |
| Auckland | 12 726 | 4,316 | 339 | 13 791 | 4,470 |
| Coromandel | 2 257 | 730 | 323 | 3 012 | 1,274 |
| Tauranga | 11 286 | 3,002 | 256 | 11 520 | 3,519 |
| Gisborne | 4 005 | 1,135 | 283 | 4 239 | 1,774 |
| Wanganui | 1 323 | 410 | 309 | 1 376 | 433 |
| New Plymouth | 1 425 | 371 | 260 | 1 459 | 458 |
| Napier | 1 702 | 495 | 290 | 1 942 | 1,162 |
| Wellington | 1 412 | 771 | 530 | 2 101 | 1,862 |
| Nelson | 8 964 | 2,094 | 233 | 11 307 | 3,336 |
| Christchurch | 2 926 | 1,093 | 373 | 3 273 | 2,044 |
| Timaru | 2 370 | 691 | 291 | 2 395 | 761 |
| Dunedin | 1 016 | 403 | 396 | 1 356 | 1,443 |
| Bluff | 1 380 | 474 | 343 | 12 245 | 9,006 |
| West Coast | 3 743 | 1,280 | 342 | 3 996 | 1,994 |
| Others | 1 661 | 174 | 104 | 1 702 | 2,135 |
| Total | 60 334 | 18,436 | 301 | 78 241 | 37,643 |

*Average for all finfish, not just demersal.

and the fishing industry is no exception. Primary industries experience price fluctuations which make development difficult and fishing, because of its nature, cannot accommodate or withstand price fluctuations in the same way as farming. This suggests that some special support measures are warranted.

In the past the processing sector has acted as a buffer for the catching sector in price fluctuations, but as the industry expands its capacity to do this will be reduced. The vulnerability of the catching sector to price fluctuations, particularly a sustained period of stagnant prices, is one of its weakest points at present. This is particularly important now when the considerable costs and growing pains of expansion have coincided with a market downturn.

Assistance to the catching sector needs to be more than just aimed at encouraging capital investment, and one of the most important measures that could be considered is a minimum port price guarantee which would provide a degree of stability and encourage the exploitation of lower valued species.

### Processing sector

Although there are many processing establishments in New Zealand—over 120—relatively few handle a high proportion of the finfish production.

Of the 60 000 t of finfish landed in 1977, about 40 000 t or 65% was handled by the 12 largest companies, and of these the 3 largest processing companies (4 factories) handled 33% of the finfish production.

As far as it can be isolated, the finfish processing sector has a total investment in plant, equipment, and buildings of about $12 million and employs 1300 people.

The total value of finfish production in 1977 at wholesale or f.o.b. level was about $40 million (Table 10).

The average export realisation in 1977 for all demersal fish was about $1.18 f.o.b. per exported kilogram, which equates to about an average of $600–$700 per landed tonne. This is reduced if snapper and soles are taken out to about $500–$600.

Processing operations have therefore been based in the last year or more on an ex-factory realisation which equates to between $500 and $700 per green tonne. This varies with the company concerned; some specialising in particular species have had higher average returns, but those handling a high proportion of the lower valued species have been near or below the lower end of this range, a level which is considered to be barely economic. This lower level, however, is the one with which the expanding industry will need to operate because of the species expected to be caught. Processing economics can be improved to accommodate this situation only if:

- Raw material costs are reduced;
- Processing unit costs are reduced;
- The product itself can achieve higher market realisations.

The present and future economics of fishing make it virtually impossible to reduce prices to the catching sector to achieve lower raw material costs unless there is a price guarantee scheme introduced at the same time.

There may be some improvement in processing unit costs if a more regular flow through factories could be achieved. A survey of some plants indicates that capacity is under-utilised by between 30% and 40% over a year, but there are times when capacity is fully committed (Fig. 4). Access to catches of foreign or joint venture vessels can be a way of filling the gaps. However, any savings in this area will probably be offset by the heavy cost incurred in upgrading premises. This will add to costs without any increase in productivity and may amount to $4 million, which is a high figure compared with the total investment in processing facilities.

With the substantial increase expected in demersal landings over the next 2–3 years, and an upsurge in pelagic catches, the processing sector will need to expand its capacity. This capital investment will be additional to upgrading costs. Some expansion can be accommodated in existing facilities with a proportional increase in labour. Taking this into account, additional investment in processing facilities, excluding upgrading, will probably amount to $9 million over the next 2–3 years. Four hundred more people will be needed in processing to handle the greater demersal catch.

**TABLE 10: Wholesale value of finfish production 1977**

| | Exports | | | Domestic | | |
|---|---|---|---|---|---|---|
| Type | Catch green weight (t) | Packed weight (t) | Value f.o.b. ($ million) | Green weight* (t) | Value wholesale ($ million) | Total value ($ million) |
| Demersal | 50 600 | 14 530 | 17.2 | 26 400 | 18.1 | 35.3 |
| Pelagic | 9 700 | 7 950 | 4.2 | 900 | 1.0 | 5.2 |
| Total | 60 300 | 22 480 | 21.4 | 27 300 | 19.1 | 40.5 |

* By use of an average of 60% for demersal and 90% for pelagic for conversion from packed weight to green weight, we can arrive at a domestic consumption figure. This calculation converts exports to a green weight of about 33 000 t, which is 55% of total production.

The New Zealand fishing industry now depends on export markets and will do so increasingly as it expands. The processing sector, being made up of a large number of medium to small companies, is comparatively fragile in relation to the vagaries of primary product export markets and is more exposed to them than most of New Zealand's other primary industries.

Although considerable achievements have been made in exports over the last 2 years, two things need to be stated:

1. The export price index for principal fish species has not increased for about 18 months, and since 1975 it has only increased by 33%, which is less than the accumulated inflation rate.

2. The average realisation has actually decreased because of the higher proportion of lower valued species.

The increased demersal catch, if achieved, could earn a further $2 million in domestic sales, including the promotion of fish preparations, and $17 million in export sales at 1978 prices. As the industry is attempting to develop more of the resources in the zone, special support measures to assist this may be justified. These should be aimed at helping to achieve what is in the national interest, but would otherwise not be considered profitable by individual companies. The industry is using a natural resource and has a very low import input. If its foreign exchange potential was weighted appropriately, any support necessary to maintain the industry's future viability would be justified.

Many of the fish species are not yet known in the export markets, and an optimistic view could be that as they become established prices will increase to a level which will enable catching and processing costs to be covered.

It should be stressed that, as well as returning a lower than average price, many of the new species being caught require more processing to turn them into a marketable product.

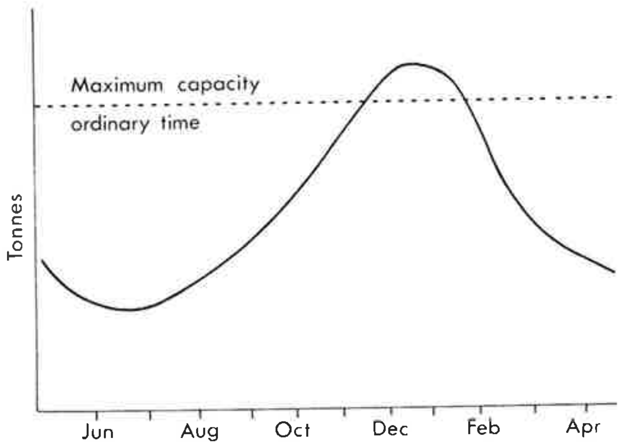

Fig. 4: A typical flow diagram for a New Zealand factory.

**Conclusion**

In this paper I have tried to give some basic data on the present structure of the demersal fishing industry and to put its operations and expansion plans into some perspective. It is not possible in a brief survey to deal with all aspects of the industry or its problems. The intention has been to describe and highlight some of the principal features and issues. Joint ventures and the expected catch from them have not been referred to, as information on these is uncertain.

The demersal fishery has made a considerable contribution to the New Zealand fishing industry. In 1977 there was an estimated $39 million invested in vessels and $21 million in processing facilities for this fishery, which in the previous 5 years produced $52 million in exports and a similar amount in domestic sales (at the wholesale level). In the next 2 years investment in vessels will increase to about $68 million (net) and in processing facilities to about $30 million. This investment will be capable of earning about $34 million in exports and $19 million in domestic sales per year on current prices. In other words, over a 5-year period exports of about $170 million can be achieved—surely a worth-while investment from the national point of view. The industry will have problems in reaching this potential, but having been asked to think big it has committed itself to doing so (see Table 11).

However, it is not possible for the individual companies in the industry to carry the total burden and risk this extensive development programme. The resources are not available from within the industry and the nature and magnitude of the costs involved warrant direct assistance and support from central Government, particularly to cover the costs of the industry establishing itself on a larger scale and in new resources. The fishing industry's development is a national enterprise with national benefits and the costs must be shared appropriately. Big deeds and assistance as well as big words are required from the Government to give the industry the support it needs.

**TABLE 11: Some basic statistics on the New Zealand demersal fishery**

| Year | Catch (t) | Investment ($ million) | | Labour | | Sales ($ million) | | |
|---|---|---|---|---|---|---|---|---|
| | | Vessels | Processing | Catching | Processing | Exports (f.o.b.) | Domestic (wholesale) | Total |
| 1977 | 50 600 | 39 | 21 | 1 200 | 1 300 | 17 | 17 | 34 |
| 1980 (estimate) | 83 000 | 68 | 30 | 1 350 | 1 700 | 34 | 19 | 53 |

# Collisions

by D. Eggleston

*Assistant Director, Fisheries Research Division, Ministry of Agriculture and Fisheries, Wellington*

"WHY don't you look where you're going?" "Where do you think you're going?" These are some of the most widely used expressions after collisions, whether between pedestrians, motorists, or boaties. They emphasise the need both to **look** and to **know** where we are going.

In attempts to reduce collisions on the road and at sea, simple rules have been devised, and if everyone looked where they were going **and** obeyed the rules there would be no more collisions.

By "collision" in this context I mean a conflict of interest or competition between different groups which leads to undesirable damage to one or all of the groups involved. If such collisions happen often enough, we have changes in the rules of the road. At a basic level, measures are introduced such as "drive on the left", "give way to traffic on the right", and "give way to pedestrians on crossings".

There is a long history of collisions in New Zealand fisheries, and they have usually led to changes in the "rules of the road", which in this instance are the Fisheries Act and Regulations. Such changes have usually aimed at reducing the competition, often with the added effect of reducing efficiency. One example is the trawl line in the Bay of Plenty, which was introduced to protect the small in-shore vessels from competition with the Auckland steam trawlers. Another is the old licensing scheme which allowed landings only at home ports and thus protected the vessels of each community from glut landings by vessels from other ports.

More recently, collisions have occurred in the management of the Hauraki Gulf and between fishermen catching rock lobsters by diving and those using pots. On a larger scale, the biggest conflict of interest in recent years has been that between New Zealand and foreign trawlers fishing the continental shelf, that is, coastal waters shallower than 200 m.

New Zealand has sovereign rights over the fish in the 200-mile EEZ, but these fish do not belong to any one person or group of people. They are common property, belonging to the nation as a whole, and the Government has the responsibility, on behalf of the people, of ensuring that the best use is made of this resource. The overriding responsibility is to ensure that supplies of fish will be available for future use. We can consider our stocks of fish as a trust fund, held in trust for New Zealand with the Government as trustees. The trustees are entitled to use the interest in the best way for New Zealand, but are not permitted to squander the capital.

Within the limits set by this primary responsibility there are numerous options available for managing and using the fish resources. These can be policy goals and can, therefore, be used to set appropriate rules. Such options include:

- maximising landings;
- maximising employment;
- maximising recreational opportunities;
- maximising profitability;
- maximising export earnings;
- maintaining cheap food supplies to New Zealand, and so on.

Some of these goals are compatible; others clearly are not, such as maximum employment/maximum profitability, recreational/commercial fishing, or maximum export earnings/cheap local supplies.

Only the Government can assign priorities to each of these goals. From the priorities the rules of the road can be drawn. I am not aware of any clear statement of priorities, but my interpretation of the present situation is that maximisation of export earnings tops the bill, and that maximising the overall economic efficiency of the industry (achievement of maximum economic yield) would also have a high priority.

The rules have been changed recently by the introduction of various export incentive schemes and so that modernisation of our fleet can proceed by easier importation of vessels. The duty-free importing of vessels gives rise to a further conflict of interest by cutting out the New Zealand shipbuilders, and the maintenance of employment must have high priority at present.

The vagueness of the relative importance of the various possible goals probably indicates that we do not know precisely where we are going, but we are going there "full steam ahead"—ideal conditions for future collisions. **Now** is the time to work out what we want from the resource, and then a development plan should be drawn up so that the policy goals can be achieved and the benefits maximised. More appropriate rules of the road could be drafted to reduce the incidence of future collisions and conflicts of interest. This would prevent wastage and inefficient use of capital, manpower, and fish.

I would like to look at one collision which seems imminent in demersal fisheries: that between the smaller boats which made up most of our fleet until 2 years ago and the larger 70- to 100-ft (21- to 30-m) boats being introduced at present. I have already alluded to this in the June issue of *Catch '78.*

The control of foreign trawlers and bottom longliners and their exclusion from closed areas on much of our shelf resulted in optimism that the New Zealand fleet could expand to take what were popularly believed to be massive amounts of fish previously being caught by foreign vessels. Consequently, much development is going on in our shelf demersal fisheries. In this enthusiasm three facts have been lost from sight:

1. The catches of prime species by the foreign vessels plus the New Zealand fleet were not necessarily sustainable, and many were certainly not. Hence, the reason for closing the areas was that the New Zealand fleet at October 1977 was judged to be capable of fully exploiting the prime species in these areas.
2. Foreign vessels have fished on only about half of the shelf, since the deep-water drop off is inside the 12-mile territorial limit for much of the area.
3. Foreign vessels have not taken massive amounts of the species sought by New Zealand fishermen. Over the last few years the catch from the shelf has totalled some 40 000–60 000 t, but of this only 10 000–20 000 t was of prime species, the remainder being mainly barracouta and jack mackerel.

Given these facts, and also that New Zealand fishermen were complaining of falling catch rates almost everywhere, we must question whether it is appropriate to continue to catch the prime species formerly caught by the foreign vessels or whether we should allow stocks to recover. Are we doing the right thing by building up the catching capacity of our trawler fleet fishing depths less than 200 m? I believe that modernisation and increased efficiency are desirable in our in-shore fleet, but not to catch more of the prime species. Modernisation should be by vessel replacement as older boats are phased out of the fishery. One new 75-ft (23-m) boat may be equivalent to, and replace, two or more older and smaller vessels This raises the question of a collision between maintaining employment and increasing profitability.

A check of the fishing plans for the new vessels shows that those already imported, or being considered, plan to take more prime species from the shelf than the Japanese had been taking. Thus we have a collision situation between the newer, larger vessels and the older, generally smaller vessels, both of which are competing for the same resource. Increased catching capacity and fishing effort will result in falls in catch rates, which will be felt by all vessels. Older and smaller vessels will be at a disadvantage because of less flexibility, but new vessels, with large loans to pay off and service, will also suffer from reduced catches of prime species on which much of their income depends. There will be calls for the newer, larger vessels to be banned from certain areas or confined to selective fishing for barracouta and jack mackerel. Unless careful thought is given to what benefits should accrue to the people of New Zealand from the coastal resources, there is a danger of the introduction of a plethora of new regulations, restrictions, and licensing conditions which will restrict the efficiency and economy of the fishery.

I suggest that the situation is serious. Restrictions on efficiency are desirable only if maximum employment opportunity is the main goal of fisheries management. I do not believe that this is so in New Zealand, despite the difficult times being experienced at present. Time is short. The vessels now being brought into the fishery have a working life of 10 to 20 years at least, and overinvestment in vessels **now** will be a continuing problem, affecting catch rates and the economy of fishing for many years. It is important that careful study (but not too prolonged) is given to the development of fisheries policies and the clarification of the goals of fisheries management in New Zealand. Then a management system can be developed which will make best use of the resources and reduce conflicts, collisions, and crises in the industry, and the industry will be able to develop rationally to make best use of the resources, not just for fishermen but for the benefit of all New Zealanders.

## Discussion of preceding five papers

The question of tertiary education in the fishing industry was raised. Mr Bolger said that he was not sure what would be beneficial, but that such education was being considered.

It was agreed that the increase in fuel costs and the eventual scarcity of fuel were major problems for the fishing industry, but that they were outside the scope of the present conference.

The need to regard fisheries as finite was questioned. Salmon fisheries could be enhanced by breeding and releasing programmes, and the questioner wondered whether it would be possible in the future to cultivate species like snapper. In reply, it was pointed out that manpower and finance were problems here. Who would pay? Should the Government provide the money and the fishing companies harvest the fish? However, it was agreed that such programmes would be technically possible.

One speaker warned of the danger of drawing misleading conclusions based on data from elsewhere. He said that we were mainly talking about stocks which we knew to be finite because of limited area and/or long regeneration time.

# Shelf resources: jack mackerel and barracouta

by D. A. Robertson

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and

D. Eggleston

*Assistant Director, Fisheries Research Division, Ministry of Agriculture and Fisheries, Wellington*

CHANGE has been a major feature of fishing in New Zealand waters over the last decade and this has been especially obvious in the fisheries for the two most abundant shelf fishes, jack mackerel (*Trachurus* spp.) and barracouta (*Thyrsites atun*).

Ten years ago the New Zealand landings of these species (460 t of jack mackerel and 230 t of barracouta) were low by 1978 standards. In 1967 the catch of both was larger, but most of it was discarded. Neither was specifically sought by trawlers, though from 1941 to 1962 a diminishing quantity of barracouta was caught by pole and line fishing off the east coast of the South Island.

Because of growing Japanese and New Zealand catches of jack mackerel and barracouta, Fisheries Research Division attention has been focused on them since the early 1970s and much has been learnt about their biology. However, as the theme of this meeting is "Prospects and Problems", we shall talk about jack mackerel and barracouta in this context without going into biological detail.

### Prospects

If we want to look at the immediate future of any fishery, our most useful first step is to look at the past.

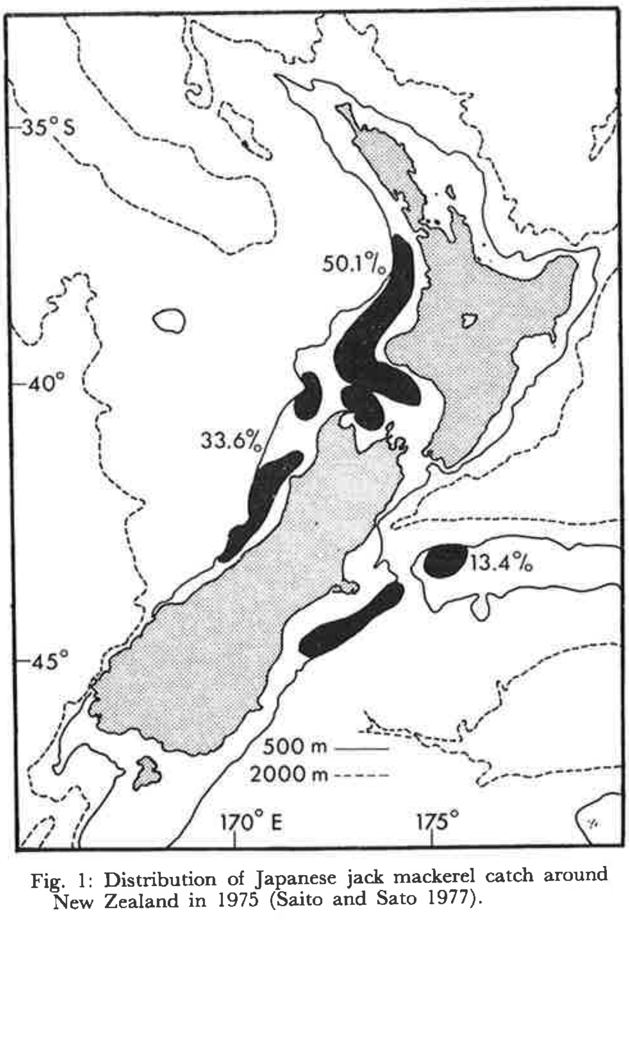


Fig. 1: Distribution of Japanese jack mackerel catch around New Zealand in 1975 (Saito and Sato 1977).

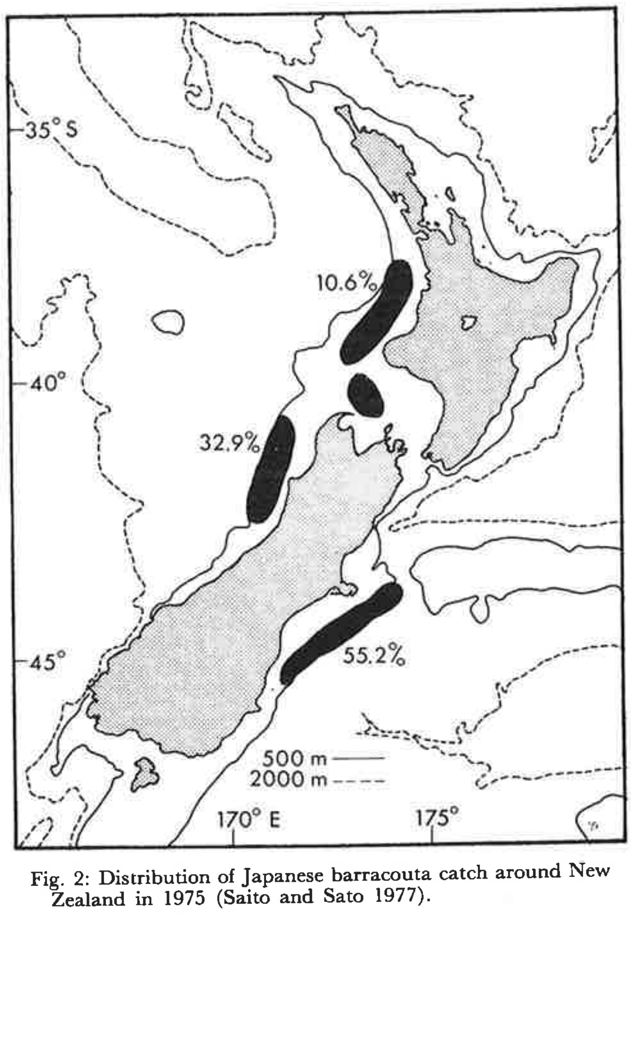


Fig. 2: Distribution of Japanese barracouta catch around New Zealand in 1975 (Saito and Sato 1977).

If we have adequate statistics, the immediate past should be useful in answering questions about where, when, and how much we can expect to catch for a given species. Figures 1 and 2 show the distribution of jack mackerel and barracouta catches by the Japanese fleet in 1975. From catch return data we know that most jack mackerel are taken in July-December off the west coast of the North Island, and most barracouta are taken off the east coast of the South Island in January-March.

Figures 3A and 3B show the total catches of jack mackerel and barracouta around New Zealand over the last 10 years. Both fisheries have undergone rapid growth, with the greatest increase occurring in last year's barracouta landings.

Figure 4 shows that these species have diminished in importance over the same period. The most obvious cause for the decline in their relative importance is the shift to fishing for deeper-water species—especially hoki and hake—and butterfishes, and to trawling for squid.

The recent past indicates several important points:

- A high average catch of jack mackerel and barracouta has been maintained (for example, in 1977 the total of both—49 000 t—exceeded the

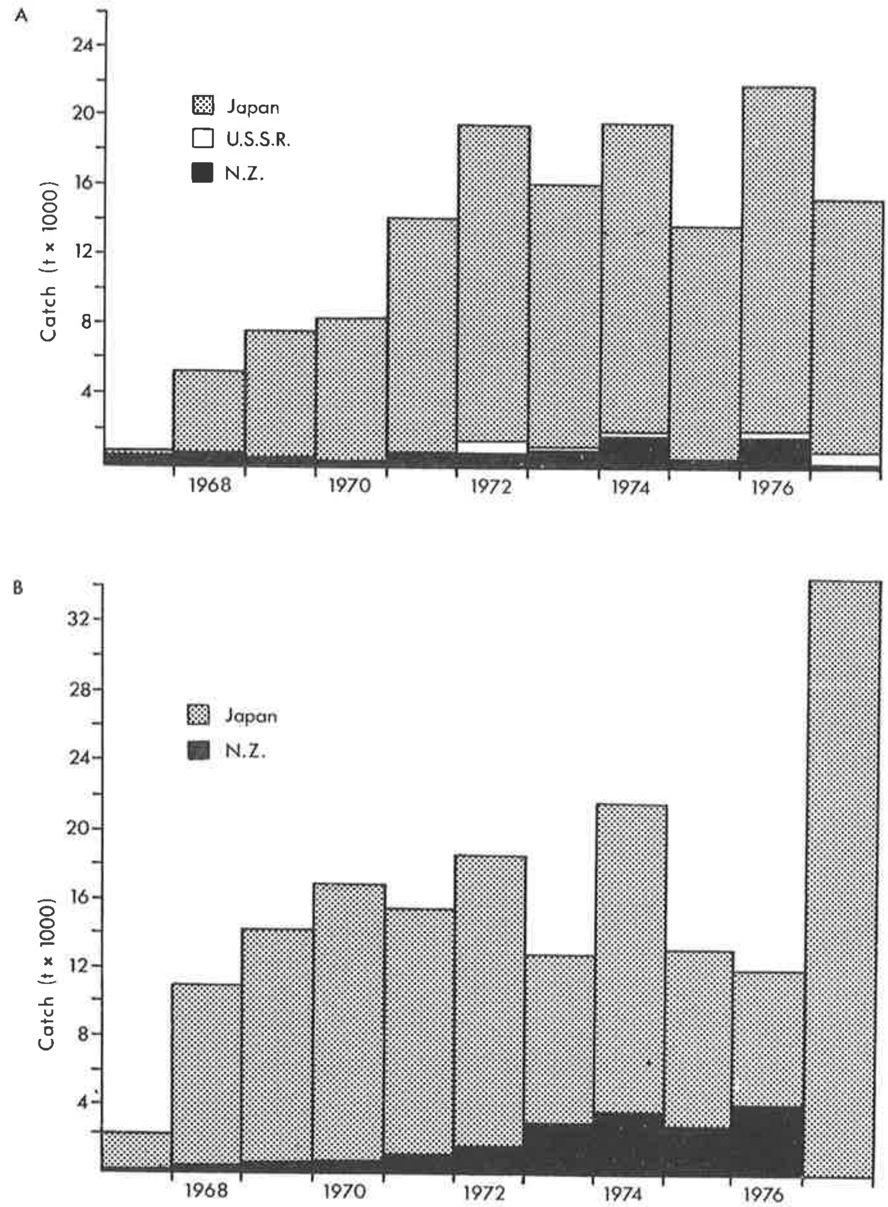


Fig. 3: Total annual catches of jack mackerel (A) and barracouta (B) around New Zealand, 1967–77.

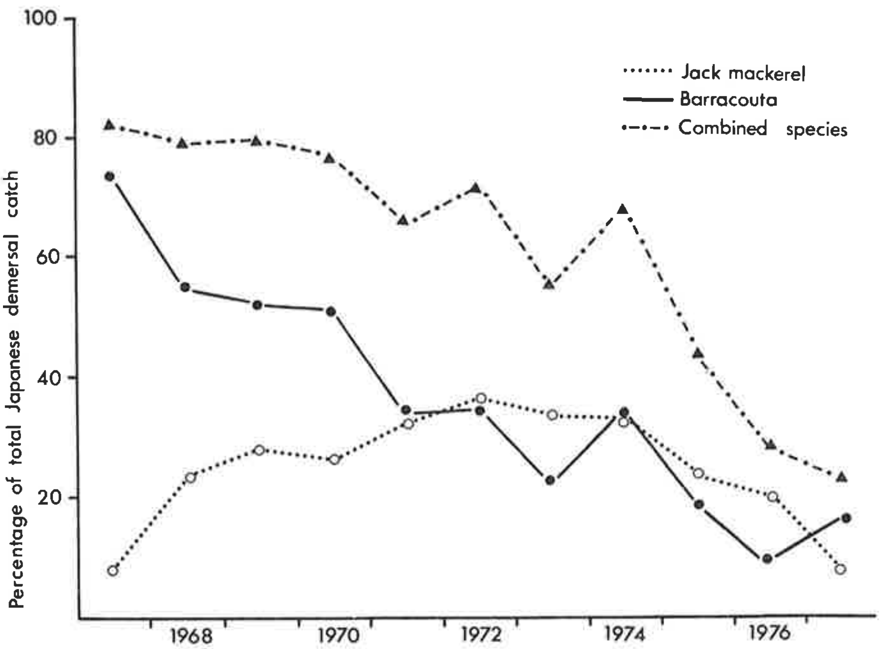


Fig. 4: Percentage composition of jack mackerel and barracouta in bottom trawl catches around New Zealand, 1967–77.

1976 total wetfish landings by the New Zealand fleet).

- This has mostly been taken by the Japanese.
- Markets for both species obviously exist in Japan.
- Both are well within the reach of New Zealand boats.
- Foreign vessels are at present excluded from some barracouta and jack mackerel fishing grounds.

There are two possible ways of satisfying the Japanese markets: by the Japanese coming and catching their own fish; or by New Zealanders (or Koreans) catching the fish and exporting it. **Theoretically** it should be cheaper for us to do it than for the Japanese.

Then there is the question of whether or not it would pay. If we **assume** that New Zealand could catch what the Japanese fleet catches and that we could match their quality, we could, for example, in 1977, at New Zealand export prices of about $550 a tonne for jack mackerel and $500 a tonne for barracouta, have grossed at least NZ$18.5 million instead of NZ$1.1 million for New Zealand exports of these species.* This value would be nearer NZ$30 million if we could fetch the Tokyo market price as at March 1978 of $1,216 a tonne for frozen jack mackerel.†

## Problems

Whoever intends to participate in these prospects in future—Japan, Korea, U.S.S.R., or New Zealand—there are problems that need to be faced.

The most obvious of these is: How sustainable are the existing annual catches? Some clues to the answer to this question can be obtained by looking at recent trends in catch rates and catch per unit of effort (CPUE).

For jack mackerel, the Japanese effort in terms of hours fished apparently trebled on the west coast of the North Island from 1968 to 1975 (Saito and Sato 1977). During that period, annual catches increased by a factor of about 3.5 times and the average catch per hour fluctuated between 1 and 2 t, with some catches of up to 10 t per hour.

For barracouta on the east coast of the South Island, however, though the effort in hours fished increased by a factor of 3 from 1968 to 1975 (Saito and Sato 1977), the average annual catches remained the same, and the catch per hour declined from 2.3 t to 0.5 t. On the basis of these two simple considerations it appears that the jack mackerel fishery is healthy and the barracouta fishery on the east coast, South Island, is in some kind of trouble, or it is at least showing early signs of depletion. Recent catches on the west coast have exceeded 30 t per hour.

If we consider some of the relevant biological characteristics of these two kinds of fish, we see that barracouta has a faster growth rate and dies younger than jack mackerel. This means that if the populations of jack mackerel and barracouta were equal in size, we could expect to safely take more barracouta than jack mackerel because the natural losses in the barracouta population would be much higher than those for jack mackerel.

*Figures from *Report of the Fishing Industry Board for the year ended 31 March 1978.*

†Figures from *Monthly Statistics of Agriculture, Forestry and Fisheries, June, 1978. Statistics and Information Department, Ministry of Agriculture and Forestry, Japan.*

We need to consider the population size and yield estimates that are available and compare these with existing landings to see whether more or less fish are being caught than should be according to these estimates.

## Jack mackerel

The estimates for jack mackerel are shown in Table 1.

Last year at the Pelagic Fisheries Conference in Tauranga a conservative estimate was presented of the possible yield of jack mackerel for the whole of New Zealand of 36 000 t and for the west coast about 22 000 t (Robertson 1978). Both figures are higher than the average annual catch.

However, both Soviet and Japanese biologists have made estimates of the New Zealand jack mackerel population size and the Soviets have gone a step further and estimated a possible yield (Nosov n.d., unpublished estimates from Fishery Agency of Japan).

Some of us at Fisheries Research Division believe that the estimates by both Soviets and Japanese are too high; the Soviets because they assumed 80% of the fish escaped from their trawls and the Japanese because they assumed very high catch rates over large areas.

By scaling down the values by what seemed to be reasonable factors, we have arrived at a yield range for jack mackerel (*T. declivis*) for the whole of New Zealand of between 48 000 and 187 000 t per year. This range is considerably lower than the original Soviet—or implied Japanese—yield estimates, but also considerably higher than total annual catches have been.

In other words, if we take a realistically conservative look at Soviet and Japanese jack mackerel yield estimates, it seems that there is room for up to a tenfold increase in landings without serious harm to the population. **This assumes that the basic premises in the Russian and Japanese estimates are not at fault.**

## Barracouta

We do not have the benefit of a Soviet estimate of barracouta population size; however, the Fishery Agency of Japan has recently provided one. Their total barracouta biomass for the main coastal shelf areas is 2.54 million t and **if** this were used to produce a yield value (a mortality of 0.4 assumed) it would be 508 000 t per year. (We believe these figures are also too high.) However, the scaled down versions of standing stock range from about 500 000 to 1½ million t and would yield 98 000–298 000 t per year for the whole of New Zealand (Table 2).

These figures also suggest some optimistic expansion is possible, but contradict the catch per effort data of the Japanese fleet, which showed a marked decrease in the principal fishing grounds from 1968 to 1975.

**TABLE 1: Standing stock* and annual yield estimates (t) for jack mackerel (*Trachurus* spp.) in New Zealand waters; yields in brackets**

| Area | U.S.S.R. | Japan | Scaled down from U.S.S.R. | Fisheries Research Division N.Z. |
|---|---|---|---|---|
| West coast | | 2 065 000<br>(310 000) | | |
| North Island | 200 000–300 000<br>(30 000–45 000)<br>M† = 0.3 | | 80 000–120 000<br>(12 000–18 000) | 585 000‡<br>(88 000) |
| South Island | ? | | ? | 8 000§<br>(1 200) |
| East coast South Island | ? | 68 000<br>(10 000) | ? | 47 000§<br>(7 000) |
| Whole of New Zealand | 800 000<br>(140 000) | 2 146 000<br>(215 000) | 320 000<br>(48 000) | 716 000§<br>(107 000)<br>1 248 000‡<br>(187 000) |
| | E‖=0.8<br>M=0.18 | E=0<br>M=0.2 | E=0.5<br>M=0.3 | E=0.5<br>M=0.3 |

*Standing stock is total weight of fishable population.
† Mortality.
‡ Scaled down from Japanese estimates.
§ Excludes 0–200-m depth range in all areas except west coast North Island and is therefore conservative (R.C. Francis, pers. comm.).
‖ Escape from trawl.

TABLE 2: Standing stock and annual yield estimates (t) for barracouta (*Thyrsites atun*) in New Zealand waters; yield in brackets

| Area | Japan | Scaled down from Japan* | Fisheries Research Division N.Z. |
|---|---|---|---|
| North Island | | | 76 000 (11 000) |
| West coast | 1 854 000 (185 000) | 282 000 (56 000) | |
| South Island | | | 267 000† (40 000) |
| East coast South Island | 596 000 (60 000) | 261 000 (52 000) | 89 000† (13 000) |
| South coast South Island | 88 000 (9 000) | 52 000 (10 000) | 25 000† (4 000) |
| Whole of New Zealand | 2 562 000 (256 000) | 1 490 000 (298 000) | 492 000† (98 000) |
| | E‡=0 M§=0.2 | E=0 M=0.4 | E=0.5 M=0.4 |

* Scaling factor equals 1976 Japanese commercial catch rate divided by Fishery Agency of Japan's estimated average catch rates.
† Excludes 0–200-m depth range in all areas except west coast North Island and is therefore conservative.
‡ Escape from trawl.
§ Mortality.

## Management aspects

At present the only management forces acting on these two fisheries are:

- Trawl mesh size;
- Total allowable catch quotas;
- Closed areas.

None of these were applied on the basis of adequate biological information about either species:

- The mesh size was chosen largely with other fisheries in mind;
- Total allowable catch quotas were based on a minimal amount of information;
- Closed areas were selected to exclude foreign competition with local fleets for prime species, not for barracouta or jack mackerel.

The apparent protection afforded by these general management criteria may be adequate when the catches are far below sustainable levels, but they will need to be modified as fishing intensity increases. As fishing pressure increases on the more limited stocks of in-shore species (for example, west coast snapper) it is becoming more important that trawlers diversify their target species. Any swing to an increased fishing for jack mackerel or barracouta would be a healthy move if accompanied by a reduction in effort on in-shore fisheries.

If New Zealand does **not** take considerably more jack mackerel and barracouta, we are bound by the principle of sharing any "surplus" yield with foreign fishermen, especially if it can be shown that the foreign fleets are capable of selective or aimed trawling for that species.

## Conclusion

We now have at least a few limited yield estimates to consider, a situation which did not exist a year ago. For both jack mackerel and barracouta the present levels of fishing appear to be safe in terms of these yield estimates. Particular care will be necessary in management decisions regarding some areas which appear to have been heavily fished; for example, east coast South Island barracouta. However, the prospects for these species are bright, provided that an adequate system of statistical return and biological monitoring is maintained, and also that New Zealand fishermen can overcome the problems of market access and quality control.

## REFERENCES


SAITO, T., and SATO, T. 1977: Present and future sources in various waters for Japanese fish supplies. Unpublished proceedings of the Symposium on Fisheries in New Zealand and Japan, 4–5 May 1977.

ROBERTSON, D. A. 1978: The New Zealand jack mackerel fishery. *In* Habib, G., and Roberts, P.E. (Comps.), Proceedings of the Pelagic Fisheries Conference, July 1977, pp. 43–7. *Fisheries Research Division Occasional Publication, N.Z. Ministry of Agriculture and Fisheries, No. 15.*

NOSOV, E. V. n.d.: Some biological aspects of the New Zealand *Trachurus declivis* Jenyns 1842 and its fishery. (Unlabelled translation received from Russian Embassy, held in Fisheries Research Division library.)

# Squid

by P. E. Roberts

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THIS paper will summarise my present knowledge on where and when squid are caught, the quantity caught, and why they are found where they are. Most of my information comes from logbooks from foreign trawlers fishing inside the New Zealand 200-mile EEZ, from jig vessels chartered by Sealord Products Limited, Nelson, from publications by Japanese and Taiwanese far-seas squid associations, and from New Zealand commercial trawl returns. The gaps are filled by hearsay and guesswork. The squid I am talking about is the New Zealand arrow squid, *Nototodarus sloanii.*

### Where?

At present the main trawl fisheries for squid are centred on the Auckland Island shelf to the south of New Zealand, along the south-east coast of the South Island, and off the north-west coast of the South Island. The 1977 New Zealand commercial trawler returns show that squid are landed in most New Zealand ports from Mangonui in the north to Bluff in the south (Fig. 1 and Table 1). Most of the foreign catch is of arrow squid, but I have been told that one Auckland firm's catch in 1977 contained about 40% of broad-finned squid.

The jig fleet works in the central portion of the distribution of squid defined by trawl catches. Figure 2 shows the daily positions of the three vessels chartered by Sealord during the 1977–78 squid-jigging "season". The Japanese and Taiwanese recognise several main "fishing grounds": Egmont, Cook Strait, Westport, Mernoo Bank, and Canterbury, and they would like to recognise Golden Bay and Tasman Bay as well. During the 1977–78 season the three Sealord vessels fished all these areas.

**TABLE 1: New Zealand trawl catches of squid (mainly arrow squid, *Nototodarus sloanii*) in 1977, by port of landing; data from commercial fishing returns**

| North Island Port | Weight (kg) | South Island Port | Weight (kg) |
|---|---|---|---|
| Mangonui | 14 | Golden Bay | 832 |
| Whangaroa | 268 | Motueka | 25 326 |
| Whangarei | 5 027 | Nelson | 46 366 |
| Auckland | 7 555 | Greymouth | 47 860 |
| Coromandel | 3 | Westport | 10 353 |
| Mercury Bay | 622 | Pelorus | 261 |
| Manukau | 2 465 | Picton | 1 275 |
| Raglan | 126 | Blenheim | 27 |
| New Plymouth | 977 | Kaikoura | 110 |
| Wanganui | 9 482 | Lyttelton | 1 991 |
| Paremata | 379 | Akaroa | 1 043 |
| Wellington | 15 064 | Timaru | 5 507 |
| Tauranga | 2 270 | Oamaru | 885 |
| Gisborne | 5 364 | Port Chalmers | 4 339 |
| Napier | 6 655 | Nuggets | 1 |
| | | Waikawa | 68 |
| Total | 56 271 | Bluff | 1 725 |
| | | Total | 147 969 |

The demersal trawl catch is taken in bottom depths of 10–420 m, with best catches between 50 and 250 m. New Zealand trawlers catch squid closer to shore in shallower water (in 10–300-m bottom depths) than do foreign vessels (in 80–420 m), and they have highest catches in depths of 26–50 m (over half of the catch) (Table 2). The jig fishery is located between 40 and 250 m, with highest catches where bottom depths are 80–150 m.

### When?

The Russian trawl fleet, working mainly around the Auckland Islands and along the south-east coast, have found commercial concentrations from February until May-June. The Japanese trawl fleet working the same areas take about 40% of the squid catch in January and 80% by the end of June. Maps of the monthly distribution of tows where squid were landed between April and September 1978 show that six Korean vessels have been trawling for squid only off the north-west coast of the South Island. They have been catching squid in most tows, though catch rates had dropped off in August.

The New Zealand trawlers catch squid throughout the year. Seasonal trends are difficult to detect because little squid is landed (only 205 t in 1977, and only five ports recorded landings of over 10 t). Peak monthly catches were recorded between January and March in Motueka, Westport, and Greymouth, and in June in Nelson and Wellington. For all New Zealand ports combined, about 40% of the catch was landed between January and March and 40% between May and July. There is a suggestion of a trend from a summer peak in southern ports, through a winter peak in central ports, to a spring peak in northern ports. This trend may, however, just reflect variations in fleet operations (such as concentration on the spring snapper fishery) rather than variations in the pattern of squid distribution and abundance.

The jig fleets of Japan and Taiwan have traditionally (that is, since the 1972–73 season) commenced fishing in mid to late December and departed in early or mid April. But daily catch rates from individual vessels chartered to Sealord in the 1977–78 season are just as high in April as at any time between December and April (Fig. 3). Experienced Japanese fishing masters were convinced that this year they could have continued fishing until at least the end of May. Tasman Bay jig fishermen were still landing squid in June and July 1978. In the areas so far investigated (that is, central and southern regions of New Zealand) it seems that the jig season will extend from December to June, 7 months.

There has been little experimental jigging in northern New Zealand waters. Early Japanese research indicated that in the East Cape-Bay of Plenty-North Cape area we have a different situation. There the season may be later, perhaps 6 months out of phase with the southern stocks, because of different breeding and spawning habits. If this is true, and commercial concentrations can be located, we have a potential year-round fishery.

### How much?

The total catch of squid from New Zealand waters in 1977 was about 84 000 t. Of this total, about 57 200 t was taken by trawling (28 500 Russia, 20 000 Japan, 8500 Korea, 200 New Zealand) and about 26 600 t by jigging (24 500 Japan, 1800 Taiwan, 300 New Zealand).

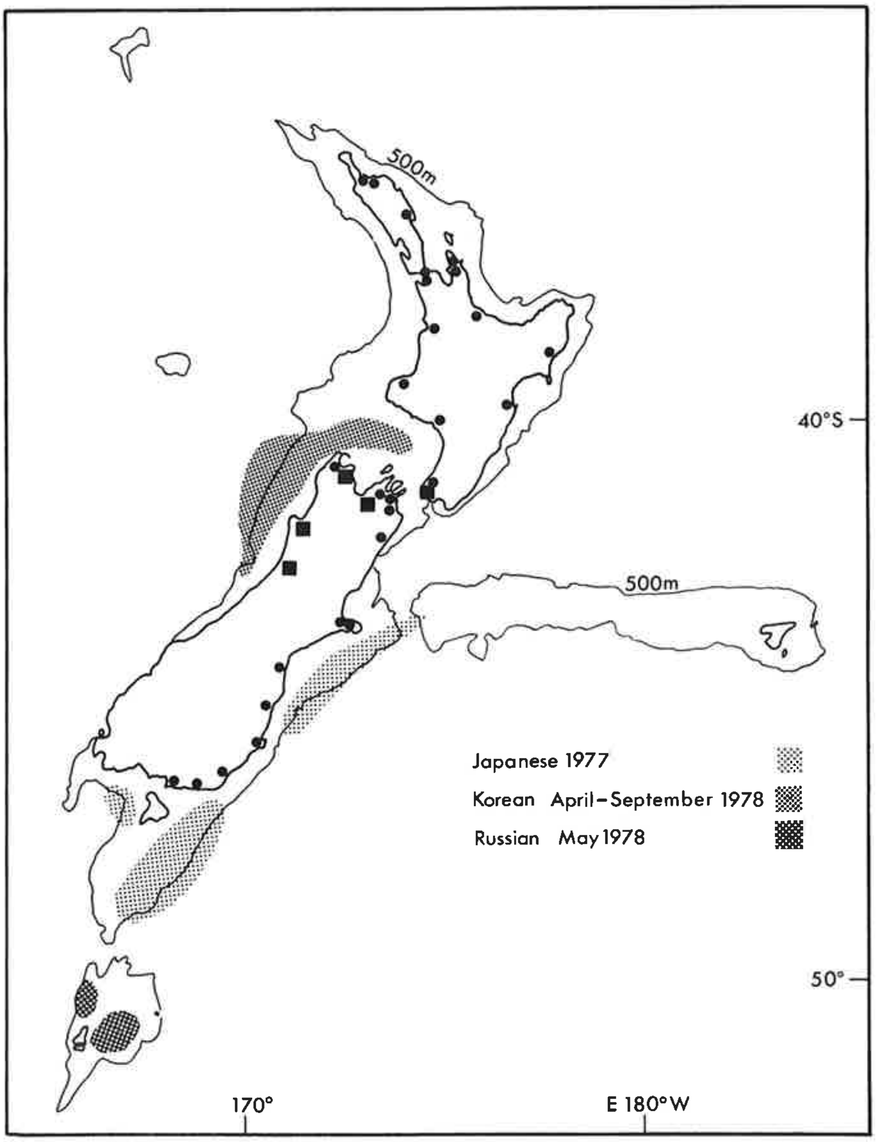


Fig. 1: Approximate fishing areas for arrow squid caught by foreign trawlers; ports at which New Zealand trawl-caught squid (arrow and broad-finned) were landed in 1977 are shown as dots (less than 10 t) and squares (more than 10 t).

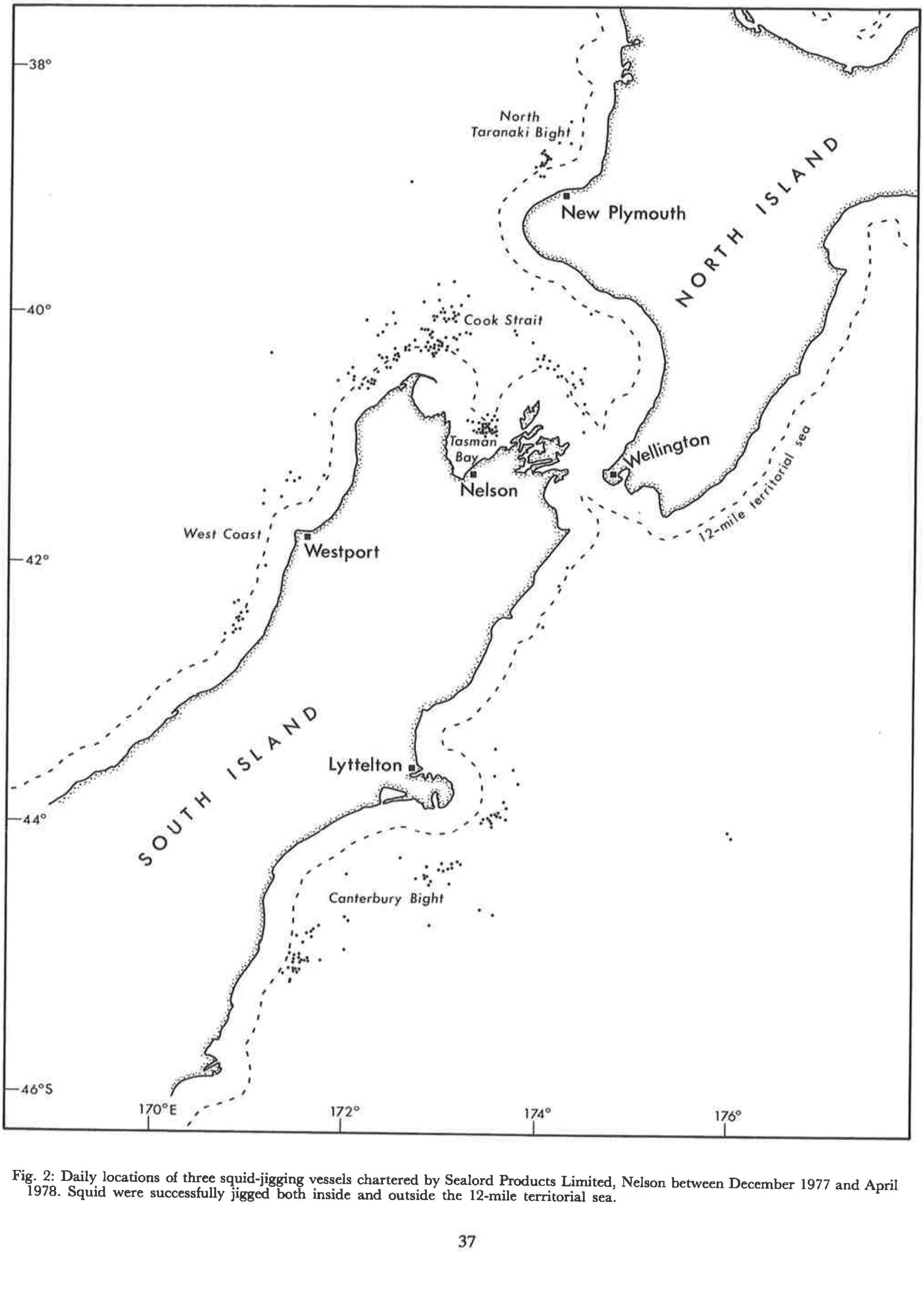


Fig. 2: Daily locations of three squid-jigging vessels chartered by Sealord Products Limited, Nelson between December 1977 and April 1978. Squid were successfully jigged both inside and outside the 12-mile territorial sea.

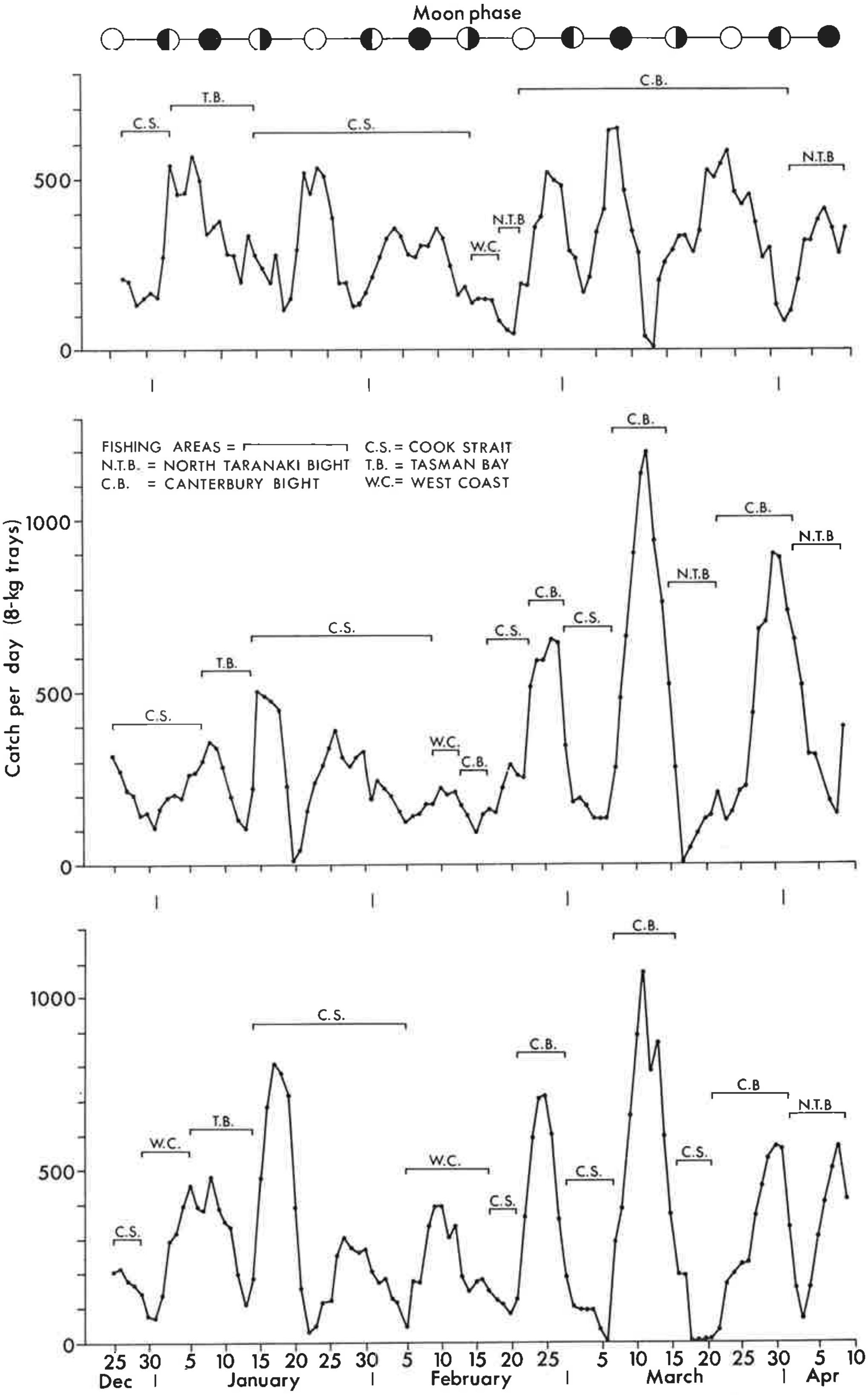


Fig. 3: Fluctuations with time of daily catch rates (shown as 5-day moving averages) of three vessels chartered by Sealord Products Limited, Nelson between December 1977 and April 1978, in relation to fishing areas and moon phase*.

**TABLE 2: New Zealand trawl catches of squid (mainly arrow squid, *Nototodarus sloanii*) by bottom depth; data from commercial fishing returns (depth data were recorded for about 46% of the landings by weight)**

| Depth range (m) | Catch (kg) | % |
|---|---|---|
| 0–25 | 9 867 | 10.5 |
| 26–50 | 49 375 | 52.3 |
| 51–75 | 9 444 | 10.0 |
| 76–100 | 2 738 | 2.9 |
| 101–125 | 6 418 | 6.8 |
| 126–150 | 12 272 | 13.0 |
| 151–175 | 4 107 | 4.4 |
| 176–200 | 132 | 0.1 |
| 201–225 | 8 | –* |
| 226–250 | 8 | – |
| 251–300 | 30 | – |
| Total | 94 399 | |

*Percentage negligible.

(514 t of a total of 3667 t). Figure 4 shows squid catches for all vessels from which data were received during successive 10-day periods between April and September. The vessels averaged about 0.7 t of squid per tow (3.0 t per vessel-day) in mid April, but this had dropped to about 0.01 t per tow (0.3 t per vessel-day) in late September (Table 3). Part of the drop was a result of a change in fishing pattern to catch hoki in deeper water, but vessels which remained in shore also had lowered catch rates of squid.

With all these data in hand I was tempted to make an estimate of the total standing stock of arrow squid off the west coast and in Cook Strait. The Korean vessels have an average towing time on the seafloor of 4 hours at 3.64 knots (6.74 km per hour), and their nets have a mean wingspread of 23.84 m. The mean

**TABLE 3: Catches and catch rates of squid by Korean trawlers off the north-west coast of the South Island and in Cook Strait, April-August 1978, from logbook data received by Fisheries Research Division, Wellington**

| Month | Total squid (t) | % of total catch | No. of vessels | No. of tows | t per tow | t per day |
|---|---|---|---|---|---|---|
| Apr | 118.3 | 32 | 5 | 225 | 0.53 | 2.19 |
| May | 101.0 | 13 | 4 | 242 | 0.42 | 1.66 |
| Jun | 235.4 | 21 | 6 | 434 | 0.54 | 1.84 |
| Jul | 45.3 | 9 | 3 | 155 | 0.29 | 0.87 |
| Aug | 12.7 | 2 | 3 | 241 | 0.05 | 0.14 |
| Sep | 1.6 | 1 | 2 | 93 | 0.02 | 0.04 |
| Totals and means | 514.3 | 14 | 6 | 1390 | 0.37 | 1.22 |

We have only two logbooks from Russian squid trawlers. The vessels worked around the Auckland Islands in May 1978, in 160–310-m bottom depths. During 26 fishing days the 2 vessels made 75 daylight tows (3 tows per day) of 45 minutes to 5 hours in length (mainly 1–3.5 hours), at speeds of 3.1–3.8 knots (5.7–7.0 km per hour). They landed 260.5 t of squid (comprising almost 100% of the catch) at average rates of 3–4 t per tow and 10 t per vessel-day. Highest catches were 15 t per tow.

Most of the Japanese trawl fleet's effort when aiming for squid is in the South Canterbury Bight, on the Stewart Island-Snares Island shelf, and around the Auckland Islands. During 1976, in these areas, they caught 4734 t of squid (of a total for all areas of 5150 t) at an average rate of 12.5 t per vessel-day.

The logbook data from six Korean trawlers working off the north-west of the South Island over the period April-September 1978 show that, though not nominated as a target species, squid made up about one-third of the total catch in April, and about one-seventh of the total catch over the 6-month period

*Highest catch rates were obtained in the Canterbury Bight area. There is a marked correspondence of peaks, probably because the three vessels fished in the same areas. There appears to be little correlation between catch rate and moon phase.

trawling area is 0.643 km$^2$. The total area of the squid's range between North Taranaki Bight and Greymouth and in Cook Strait-Tasman Bay is about 56 800 km$^2$. If a 50% escape from nets and a wide distribution throughout this area are assumed, my biomass estimates are, for April 1978, 117 200 t (about 250 million squid) and for August 1978, 9200 t. These figures imply a massive natural mortality of squid (or mortality plus migration out of the area trawled), especially between July and August, when it reaches 83%. The Korean trawlers are only just scraping the sides of the barrel; they are taking about 0.5% of the total of 117 200 t.

I have also made an estimate of the standing stock of arrow squid around the Auckland Islands. There, Russian vessels have an average towing time of 2.25 hours at 3.37 knots (6.25 km per hour). I have assumed a wingspread of 20 m, which gives an average trawling area of 0.28 km$^2$ per tow. Russian logbook data and Russian publications indicate that squid are mainly located on the shelf between 100- and 400-m bottom depths, an area of 14 000 km$^2$. Again, if a 50% escape and wide distribution of squid over the Auckland Islands shelf are assumed, the estimated biomass for May 1978 is 350 000 t.

If the wide distribution of squid on the shelf is considered, as well as the higher catch rates obtained

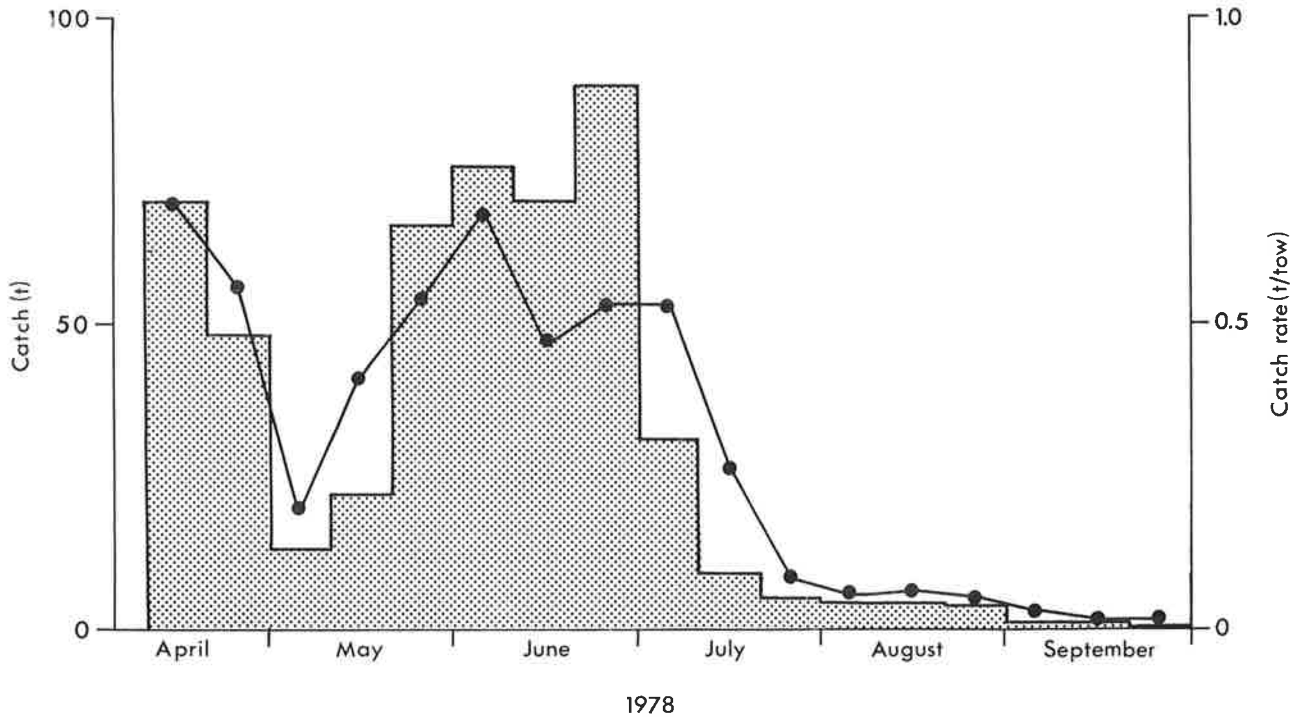


Fig. 4: Squid catches (tonnes) and catch rates (tonnes per tow) of arrow squid by Korean demersal trawlers working off the west coast of the South Island between April and September 1978.

by Russian vessels (10 t per vessel-day) and Japanese vessels (12.5 t per vessel-day) in other southern New Zealand waters, total standing stock estimates by Japanese scientists for New Zealand waters of 300 000 to 900 000 t are beginning to appear quite conceivable. However, it must be borne in mind that estimates based on commercial vessel results will be high because of aimed trawling with echo location techniques to find schools and concentration of activity in areas of highest density.

Japanese and Taiwanese jig vessels have fished here for the last six seasons (1972–73 to 1977–78). Both countries publish well-documented summaries of their annual catch and effort statistics for the New Zealand region; these include maps showing the distribution of catch by ½° squares of latitude and longitude. Individual vessel statistics are not available for the whole fleet (of 128 Japanese and 10 Taiwanese vessels in the 1976–77 season), but average catch per vessel varies between 1.5 t per day in poor years (about 150 t per vessel) and 3.9 t per day in good years (about 400 t per vessel). However, the traditional season has only lasted through 3–4 months, and the expected extension to 6–7 months would allow a total season's catch of 300–800 t per vessel.

## Why?

Last season I asked the New Zealand fishermen on board Sealord chartered jig vessels to record daily sea temperatures and collect samples of surface sea water for salinity analysis. Initial analysis of these data (Table 4) shows that the highest catches (over 1000 trays per day) were made in areas where salinity was

**TABLE 4: Ranges of sea surface temperature and salinity and bottom depth by catch rate for jig vessels chartered by Sealord Products Limited during the 1977–78 season**

| Catch rate (trays/day) | No. of days | Temp. (°C) | Salinity (‰) | Depth (m) |
|---|---|---|---|---|
| 0 | 11 | 14.2–18.6 | 34.72–35.20 | 47–122 |
| 1–9 | 2 | 20.1 | 34.62–34.68 | 104–138 |
| 10–99 | 36 | 14.2–20.1 | 34.12–34.34 | 45–230 |
| 100–999 | 202 | 13.4–20.8 | 34.00–35.52 | 42–250 |
| 1000 + | 22 | 13.6–19.4 | 34.61–34.99 | 80–146 |
| Totals | 273 | 13.4–20.8 | 34.00–35.52 | 42–250 |

between 34.61‰ and 34.99‰ (temperature 13.6°–19.4°C); that is, the squid are concentrating (presumably for feeding and in response to a physiological requirement for mating and spawning) along the boundary between coastal and oceanic water masses. Off the south-east coast of the South Island this boundary coincides with the southern edge of the Subtropical Convergence. Within this range their distribution will be determined by available food. Other regions likely to contain commercially exploitable concentrations are those of high productivity lower in the food chain, areas such as the upwelling regions off the north-west coast of the North Island, near the Three Kings Islands, and off East Cape.

**Future problems?**

Our biological studies at Fisheries Research Division are at present aimed towards establishing a method of determining the age of squid and of testing the hypothesis that they live for 12–18 months, spawn once, and die. If they do prove to be as short lived as Japanese scientists suspect, we must determine the proportion which can safely be taken by commercial fleets without unduly upsetting the rest of the marine system. Probably the greatest problem will be in determining how the allowable catch should be split between the two main fishing methods, trawling and jigging; in most areas they are, unfortunately, competing for the same resource to the detriment of each other.

# A preliminary analysis of the west coast South Island deep-water fishery

by G. J. Patchell

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IN 1975 the Japanese fleet took 7187 t of finfish from the west coast of the South Island. In 1976 there was an almost fivefold increase in total effort from 3129 hours in 1975 to 14 466 hours and a total catch of 38 224 t. The entry of the Republic of Korea into the region in 1977 resulted in an estimated total catch of 122 000 t, which made area G the most important trawl fishery region in the New Zealand 200-mile EEZ. This paper discusses the history and prospects of the deep-water fishery in area G.

## History

The deep-water trawl fishery, in depths of 350–800 m, is based primarily on the two merluccid hakes, *Macruronus novaezelandiae* (hoki) and *Merluccius australis* (hake), but ling, *Genypterus blacodes*, occurs as a 3%–5% by-catch. The fishery is seasonal on concentrations of spawning fish. In past years it has begun in June and extended through to August, when the fish apparently move into mid water and begin to disperse. At this time the trawlers move in shore to fish on concentrations of barracouta, *Thyrsites atun*, and common warehou, *Seriolella brama*.

Japanese data are available for the west coast area from 1972 onwards. However, only hake catches have been recorded continuously through this period; they have increased from only 38 t in 1975 to 4588 t in 1976. Hoki has been recorded separately only since 1976, when 6499 t were landed. However, in the data supplied by the Fishery Agency of Japan some vessels apparently persisted in grouping hoki under gadiforms and the total catch of hoki may have been as high as 18 358 t.

Data from Japan indicate a hake catch of 11 795 t in 1977 and when the South Korean catch of 6011 t is taken into account the catch increased fourfold between 1976 and 1977. South Korea also took 9991 t of hoki during the 1977 season and Japan 43 863 t, a total catch of 53 854 t of hoki on the west coast.

## Catch-effort data

Some detailed catch-effort data are available for the years 1976–78. Mean catch of hake and other gadiforms (predominantly hoki) per hour trawled for the Japanese fleet in 1976 is shown in Table 1. The catch per hour was much higher for the class 6 trawlers, but the data appear to be biased by one vessel with a fishing power much greater than any other.

*Shinkai Maru*, a 3393-t exploratory fishing stern trawler from the Japan Marine Fishery Resource Research Centre (JAMARC), fished the South Island west coast during the winter of 1976 and caught 1492 t of hoki and 417 t of hake. These results provide a good guide to the fishery in 1976.

Mean catch rates for hoki and hake over the periods 6–16 June and 28 June to 23 August are shown in Table 2. The vessel fished with high-opening bottom trawls (one smooth-bottom and one rough-bottom

**TABLE 1: Japanese catches of gadiforms (including hoki and hake) from the west coast, South Island in 1976**

| Month | Tonnage class* | Total catch (t) | Hours fished | t per hour |
|---|---|---|---|---|
| Jun | 4 | 683 | 501 | 1.36 |
| | 5 | 415 | 440 | 0.94 |
| | 6 | 1 193 | 242 | 4.93 |
| | 7 | 480 | 200 | 2.4 |
| | 8 | 421 | 179 | 2.36 |
| Jul | 4 | 2 978 | 1 491 | 2.0 |
| | 5 | 1 051 | 781 | 1.35 |
| | 6 | 2 934 | 389 | 7.54 |
| | 7 | 3 719 | 794 | 4.68 |
| | 8 | 541 | 179 | 3.02 |
| Aug | 4 | 1 616 | 1 011 | 1.6 |
| | 5 | 681 | 958 | 0.71 |
| | 6 | 3 360 | 266 | 12.63 |
| | 7 | 1 250 | 354 | 3.53 |
| | 8 | 1 121 | 397 | 2.82 |
| Sep | 4 | 362 | 660 | 0.55 |
| | 5 | 51 | 646 | 0.08 |
| | 6 | -† | - | - |
| | 7 | 17 | 196 | 0.09 |
| | 8 | 57 | 391 | 0.15 |
| Oct | 4 | 5 | 65 | 0.07 |
| | 5 | 2 | 15 | 0.13 |
| | 7 | 1 | 41 | 0.02 |
| | Total | 22 938 | | |

*Tonnage class: 4 1000–1500 t; 5 1500–2000 t; 6 2000–2500 t; 7 2500–3000 t; 8 3000–4000 t

†No catch.

trawl) with 6–7-m headline height and wingtip to wingtip spread of 39 m. *Shinkai Maru* started fishing on hake in 700–800 m north of the Hokitika Canyon (Fig. 1) during June. At this time catches of hake were low (less than 1 t per hour) in water shallower than 700 m, with small catches of hoki in 600 m. Towards the end of June the hake spread in shore to 600 m and by late July were caught in 460 m, though catches were low, averaging 0.2 t per hour. Throughout this period catches of hake in 700 m were maintained at 2 t per hour.

**TABLE 2: *Shinkai Maru* catch rates, 1976**

| Period | Species | Mean catch rate (t per hour) | Range |
|---|---|---|---|
| 6–16 Jun | hake | 2.11 | 0.18–4.2 |
| | hoki | 0.53 | 0.01–2.16 |
| 28 Jun–23 Aug | hake | 0.6 | 0.02–2.25 |
| | hoki | 4.99 | 0.03–33.59 |

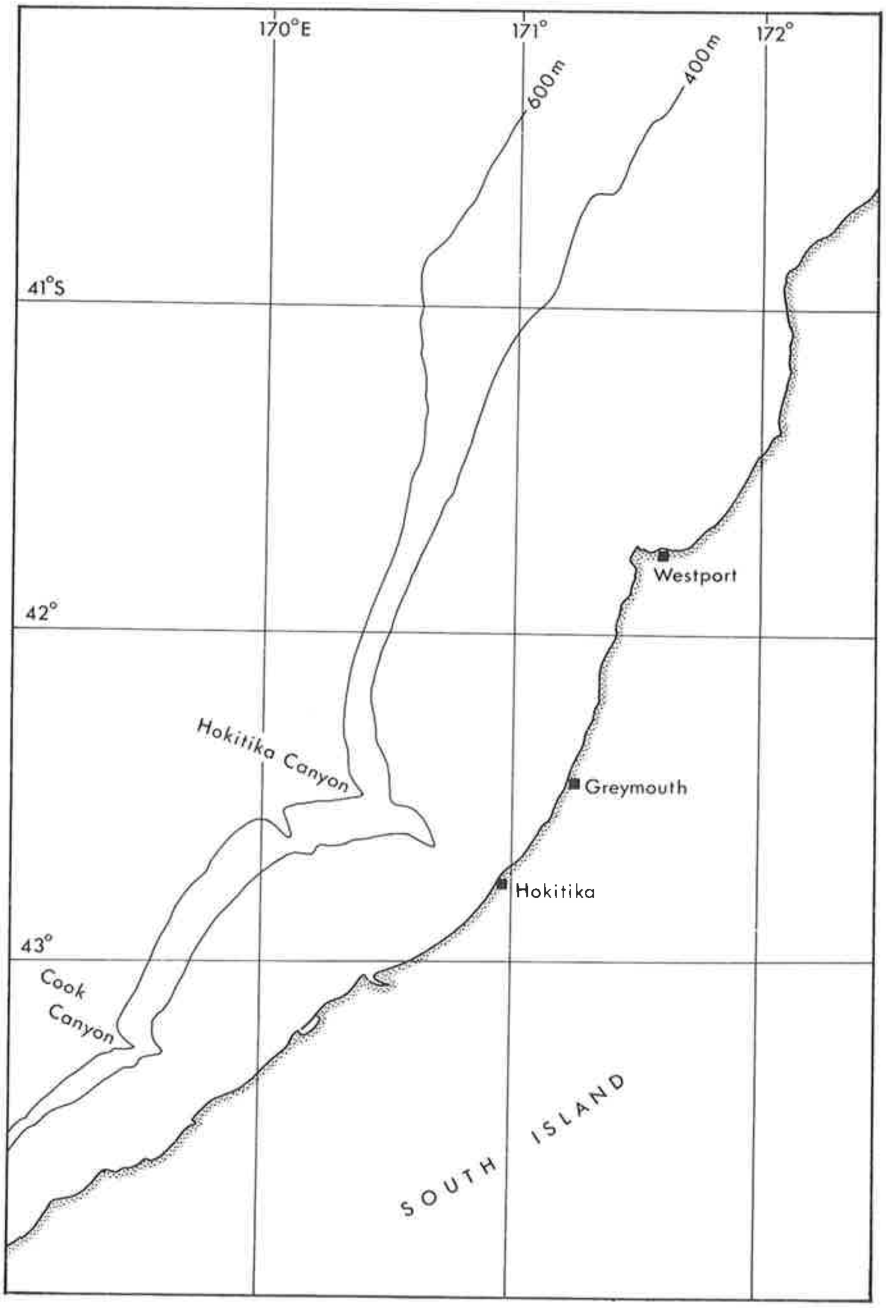


Fig. 1: West coast South Island trawl grounds.

During July and August the vessel target fished on concentrations of hoki. Initially these were in 600 m, but according to JAMARC they moved northwards from 42° S to 41° S and in shore from 600 m to 450 m as the winter progressed. The greatest catch, of 61 t in 1.8 hours, was made in late August in 500 m.

Data gathered by *Shinkai Maru* were transmitted to both the Japanese and Korean fleets and resulted in a massive increase in effort for 1977. Only some catch-effort data, from South Korea, are available so far. Catch rates for a 3000-t trawler (A) and a 5300-t trawler (B) are shown in Table 3. Both vessels were fishing with "jumbo" trawls during this period and the dimensions of these nets are shown in Table 4. The vessels began fishing in early June in 600–700 m. Catches were low for both vessels at first (1–2 t per hour), but increased to 2–5 t per hour for trawler A and 2–8 t per hour for trawler B during late June. Catch rates at night were up to 50% lower than during the day in this period. At the end of June and through early July catches increased considerably, with rates up to 20 t per hour being attained by trawler B. The catch composition was variable, with both hoki and hake being taken in quantity (95% of the catch). Catch rates at night dropped to less than 0.5 t per hour during this period, compared with 10–40 t per hour during the day, and the vessels stopped fishing at night.

Through July, hoki began to make up a greater proportion of the catch as the vessels fished in 550–600 m, and by late July catch rates soared, the greatest catch being 120 t in 35 minutes by trawler B. Catch rates were still high during August, with 100 t of hoki being caught in 50 minutes on the 10th, but during this early part of August the vessels moved in shore to fish on concentrations of barracouta and common warehou.

Catch data for 1978 are also available for trawler A. She began fishing in deep water 2 weeks later this year (1 July), but spent some time during June searching for concentrations of hoki and hake. Through the 1978 season hoki has been the dominant species, with only 103 t of hake being caught. The fishing patterns have been similar to those of 1977, the vessel moving from a mean fishing depth of 582 m in July to 475 m in mid August. Comparative catch rates by 7-day periods between 1977 and 1978 for trawler A are shown in Fig. 2. The total catch of 2758 t this year is 18% down on 1977 figures and the catch per hour is significantly lower. However, this does not necessarily reflect a decrease in stock size because the vessel used a 90-mm double cod-end in 1977, whereas this year she used a 100-mm single cod-end under New Zealand EEZ regulations. Also shown in Fig. 2 are catch rates for *Shinkai Maru* in 1976 and trawler B in 1977. The graphs for the vessels in 1976 and 1977 all show a peak in early July and then a decline in catch per hour during the middle of the month. A breakdown of the catch composition indicates that hake catches peaked during this early part of July. The high catch rates achieved at the end of July for the Korean boats and in August for *Shinkai Maru* were due to catches of 95% hoki.

A comparison between 1977 and 1978 catches indicates that the peak fishing for hoki occurred a month later this year. The mean bottom temperature in late July 1977 was 10°–12°C, but only 7°–8°C this year (trawler A data). Ichthyoplankton surveys have indicated that spawning of hoki began in late July this year and probably the colder conditions have led to a later spawning season in 1978.

**TABLE 3: Catch rates for two Korean trawlers in 1977, by 7-day periods**

| Period | Trawler A: Mean catch rate (t per hour) | Trawler A: Range | Trawler B: Mean catch rate (t per hour) | Trawler B: Range |
|---|---|---|---|---|
| 12–15 Jun | –* | – | 2.31 | 0.84–8.57 |
| 16–22 Jun | 1.65 | 0.24–4.53 | 2.79 | 0.46–11.76 |
| 23–29 Jun | 2.22 | 0.65–11.49 | 7.08 | 1.04–20.57 |
| 30 Jun–6 Jul | 14.34 | 1.37–37.29 | 12.35 | 2.07–26.11 |
| 7–13 Jul | 17.34 | 1.91–40.0 | 18.89 | 0.47–41.35 |
| 14–20 Jul | 13.01 | 0.49–33.6 | 8.78 | 0.24–27.69 |
| 21–27 Jul | 43.17 | 0.71–72.29 | 25.86 | 4.74–85.72 |
| 28 Jul–3 Aug | 40.28 | 7.29–145.28 | 42.32 | 0.24–205.72 |
| 4–10 Aug | – | – | 32.85 | 1.31–120.0 |
| 11–12 Aug | – | – | 15.28 | 1.54–28.8 |

*No catch.

**TABLE 4: Net dimensions of Korean trawlers**

| | Horsepower | Headline height (m) | Ground rope length (m) | Head rope length (m) |
|---|---|---|---|---|
| Trawler A | 3800 | 25 | 84.8 | 60.2 |
| Trawler B | 5800 | 32 | 104.9 | 74 |

Most of the fluctuations in catches by these vessels are probably due to the spawning behaviour of hoki and hake, as preliminary evidence indicates that both species move off the bottom to spawn. This view is supported by observations by foreign trawler skippers.

Smaller Korean trawlers fishing the South Island west coast area this year have achieved low catch rates (Fig. 3) while fishing in deep water on hoki. One 500-t trawler (C) achieved a maximum catch rate of 7.7 t per hour, but averaged only 1–2 t per hour. In the 6 months to 6 October 1978 she has caught 685 t of wetfish, and of this 111 t were hoki and 11 t hake. This trawler has been fishing with a net of 4.5-m headline height.

A 900-t trawler (D) has caught 1197 t of fish so far and has been fishing with a "semi-jumbo" net of 12-m headline height. Her catch rates have been higher than those of trawler C, with a maximum catch rate of 13.6 t per hour in a 30-t haul. Available data indicate that hoki tend to be in greatest concentrations from 5 to 30 m off the bottom and that they often escape in large numbers over the top of low headline nets. This is evidenced by the far greater catch rates achieved by vessels fishing with "jumbo" trawls beside those with standard trawls.

## Potential production

There have now been 4 years of fishing in deep water off the west coast of the South Island. Hoki catches have risen through the years 1975–77, but declined in 1978 with the absence of the Japanese fleet. Catch per hour for hoki in 1978 is down on 1977 levels, but this is to be expected with the introduction of a new mesh size this season.

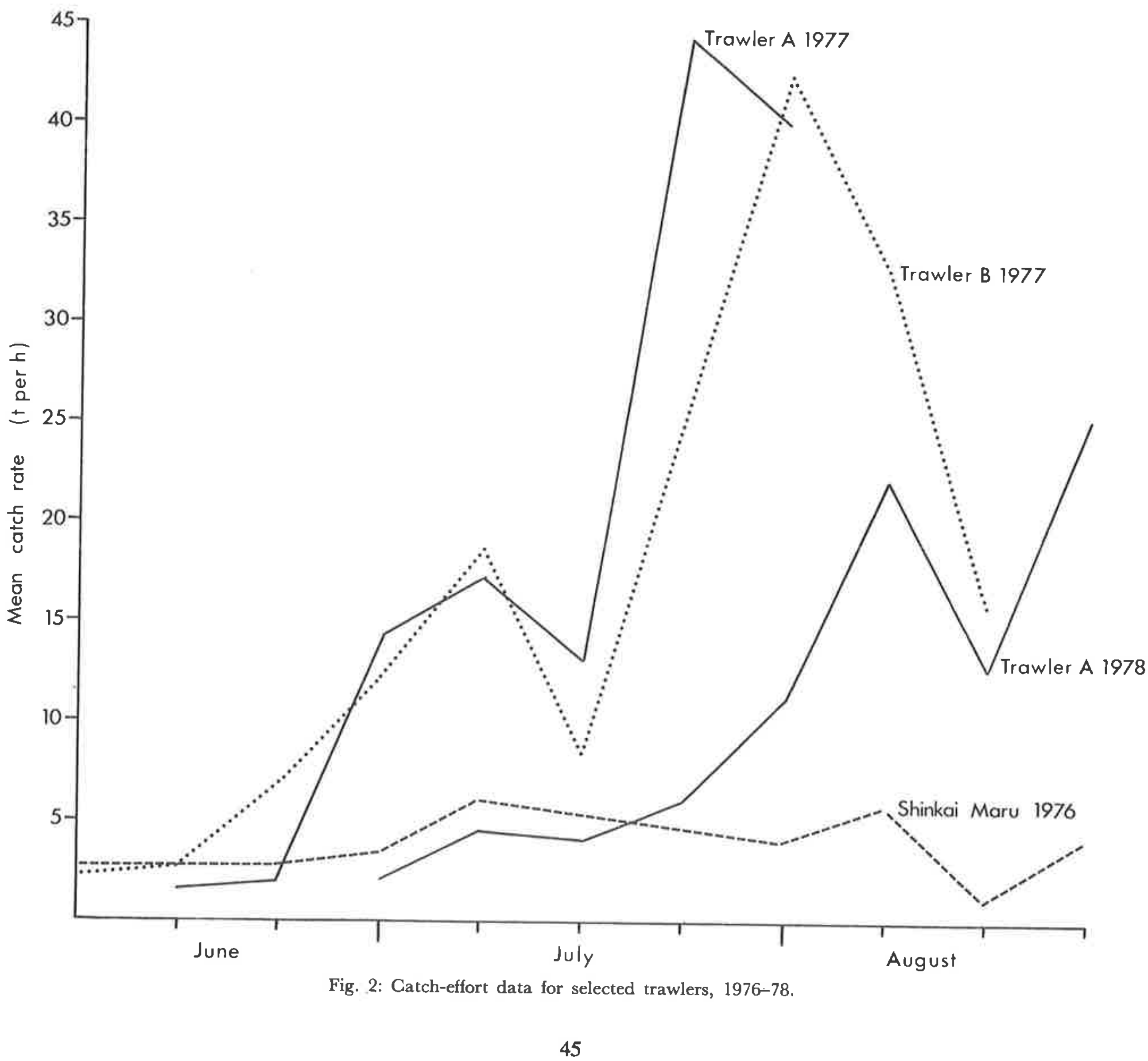


Fig. 2: Catch-effort data for selected trawlers, 1976–78.

Fisheries Research Division's optimistic estimates of total standing stock of hoki on the west coast are 295 000 t. These contrast with the Japanese estimates of 962 000 t, which appears to be a grossly inflated figure, since both sets of estimates used the same data base. Estimates of maximum sustainable yield by New Zealand range from a conservative figure of 10 000 t to a maximum of 42 000 t. There are dangers in applying a philosophy of "maximising the yield" from a fishery (Larkin 1977) and a policy of using conservative estimates in determining total allowable catches (TAC) has been used by Fisheries Research Division in the past. Thus a TAC of 20 000 t of hoki was allocated for the 1978–79 season on the west coast. In my opinion there are no data available so far to justify increasing the fishing pressure on the spawning stocks of hoki on the west coast, especially since in 1977 almost 54 000 t of hoki were caught.

The validity of exercising conservative options in management of a stock becomes apparent when the stocks of hake off the west coast are considered. Estimates of hake standing stocks from New Zealand and Japan are much more in agreement than those for hoki, with figures of 98 000 and 43 000 t respectively. However, the 1977 catch of hake was 17 806 t, or 18% of the New Zealand estimate and 43% of Japan's estimate. Even if the larger of the two stock size estimates is taken, it is most unlikely that the hake can support such heavy fishing, as the species reaches maturity at 60–70 cm in length and lives to 25–30 years.

The total hake catch for 1978 has been only 225 t. Whereas in 1977 trawler A caught 870 t of hake, in 1978, fishing the same area and depths, she caught only 103 t.

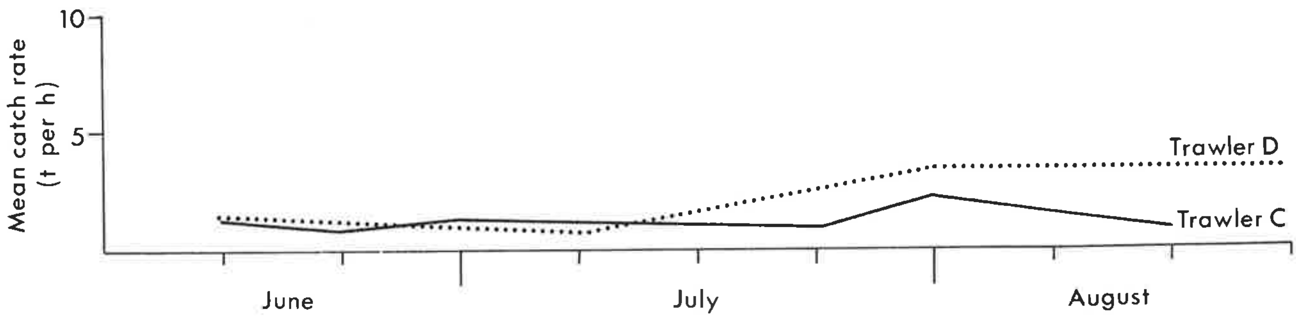


Fig. 3: Catch-effort data for two Korean trawlers, 1978.

Thus there has been a major drop in the hake catch on the west coast this year and whether this is due to serious overfishing of the stock or simply to behavioural changes affecting distribution with the colder conditions is not yet clear. However, it would seem wise to limit hake to a by-catch for the 1979–80 year until Fisheries Research Division's programme of stock assessment provides a more detailed picture on the condition of the hake stocks. Evidence from tow-by-tow data on the west coast indicates that vessels can target fish for hoki or hake, and limiting the hake to just a by-catch should not interfere with the hoki fishery excessively.

## REFERENCE


LARKIN, P. A. 1977: An epitaph for the concept of maximum sustained yield. *Transactions of the American Fisheries Society 106*: 1–11.

# Resource prospects on the Campbell Plateau

by M. W. Cawthorn

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SINCE the early 1970s New Zealand's off-shore areas have undergone a sharp increase in fishing activities. This is particularly so in the southern part of the 200-mile EEZ, where the trawl fishery concentrates on the two most abundant species, hoki (*Macruronus novaezelandiae*) and southern blue whiting (*Micromesistius australis*).

Foreign nations, especially the Soviet Union and Republic of Korea, have operated large trawler-factory ships (up to 5000 t) in the southern part of the EEZ for almost a decade. These highly efficient vessels process the bulk of their catch on board, freezing the preferred species and converting the less preferred species into fish meal and oil.

Most significantly, these vessels use fleet fishing tactics to work an area most efficiently. Fleet fishing operations require that when catch rates begin to fall one or more vessels from the fleet move off and fish exploratorily in an effort to relocate schools. Once fish are found, the exploratory vessel is rejoined by the other ships of the fleet and the schools are systematically cleaned up.

The New Zealand industry has only just begun to appreciate the extent of the area and the resources in it. Until the New Zealand fishing industry operates large vessels of similar size to those of foreign nations, joint ventures and similar arrangements will be the most effective means of exploiting the considerable resources of the region.

To fully understand why this area has such potential it is helpful to consider first the bathymetry and hydrography, features which are essential contributors to the productivity of the region.

**Bathymetry**

The Campbell Plateau is an extensive submarine platform, extending 500 km to the south of the New Zealand mainland (Fig. 1). Within the 1000-m depth isobath lie the shelf areas of the Auckland Islands, Campbell Island, and the Pukaki Rise. Separated from this plateau by a saddle or depression is the Bounty Platform, which, for the sake of this discussion, will be included within the greater area of the Campbell Plateau.

Traditionally, all trawling in these areas has been carried out over the approximately 281 200 km$^2$ available between the 200- and 800-m depth isobaths.

**Hydrography and production**

The circulation of water masses, movements of currents, and the distribution of mixing zones and fronts are greatly influenced by the submarine topography of the Campbell Plateau.

The major current across the area is the Circum Polar Current, which flows from west to east. The moving water mass is constricted as it meets the western edge of the plateau and is forced to the south and east round the Campbell Island Rise. This diversion leads to the development of complex circulation within the area of the Campbell Plateau. A prominent feature developed is the Bounty-Campbell gyral, a large eddy circulating anticlockwise over the area of the plateau (Fig. 2). The regular mixing of the water column in winter results in large-scale nutrient replenishment (J. Bradford pers. comm.). The circulatory effects of the Bounty-Campbell gyral may combine to contribute to the high productivity in the region of the Pukaki and Campbell Island Rises and hence to substantial demersal fish production.

By use of data drawn from Japanese operations, R. C. Francis of Fisheries Research Division estimated the potential production for the area at 666 000 t, broken down as follows: southern blue whiting 382 000 t, hoki 191 000 t, silverside 36 000 t, and other species 57 000 t.

**Species**

The predominant species available to the trawl fishery are southern blue whiting, hoki, ling, hake, silverside, and javelin fishes. Although javelin fishes are among the most abundant, they are less preferred species and generally form a principal constituent of fish meal.

Whiting and hoki constitute about 75% of the total catches, but of the two species whiting has the greater potential and is by far the more important, at times constituting over 97% of the total catches. For this reason, this paper is primarily concerned with southern blue whiting. The total whiting catch to foreign vessels in the New Zealand EEZ has been estimated at about 50 000 t.

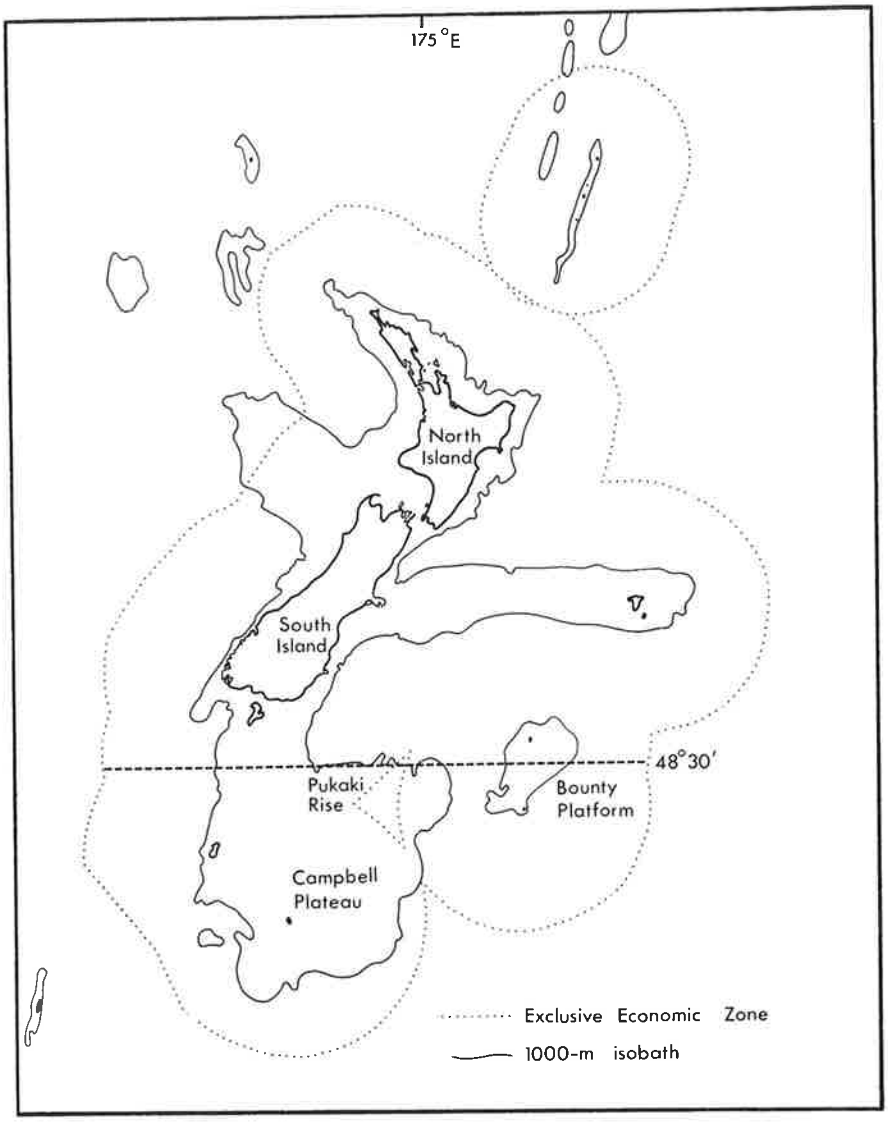


Fig. 1: New Zealand's Exclusive Economic Zone.

In the Northern Hemisphere whiting has been an important commercial species, researched thoroughly over the last century. In the south-west Pacific research into the species began about 10 years ago. Soviet scientists recognised the potential importance of whiting in the early 1970s and have researched age and growth, distribution, and behaviour in some detail.

Soviet scientists observed young whiting 3–5 years old over the Bounty Platform, where this age class constituted at least 86% of their catch. Further south, on the Campbell Plateau, fish in the 5–7-year class predominate (greater than 84%) and considerably further east, out of the New Zealand 200-mile EEZ on the South Pacific Rise, old 9–13-year class fish form 86% of the catch.

The Soviets believe the main spawning area is on the Bounty Platform and the influence of the strong anticlockwise Bounty-Campbell gyral helps keep eggs and larvae contained over the north-eastern part of the Campbell Plateau. In summer the whiting occupy the greater part of the Campbell Plateau. With the onset of autumn they gather in spawning concentrations over the Bounty Platform and accumulate through the winter months. Spawning takes place at depths of 200–300 m with water temperature at about 7.5°C. After spawning the fish move south-west, passing over the Pukaki Rise in August-September on to the Campbell Rise.

Southern blue whiting have a strong diurnal movement; they rise off the bottom at sunset and return to the bottom just before sunrise. During the day, though fish can be distributed throughout the water column, greatest concentrations appear 10–50 m off the bottom.

This species appears to travel quite rapidly and has been observed moving about 128 km in 4 days over the Campbell Plateau.

Whiting are typically a fast-growing, short-lived species. According to Soviet data they reach one-third of their maximum size (about 15 cm) in the first year. They are considered mature at 3 years, at a length of about 28–30 cm. Maximum growth is attained at 40–45 cm.

Abundance of the species apparently fluctuates considerably with rapid water temperature changes.

### Management

As with other species at present being exploited by large-scale commercial operations, management of whiting stocks over the Campbell Plateau-Pukaki Rise-Bounty Platform areas will require careful monitoring of catch and effort and particularly net selectivity. At present, north of latitude 48° 30′ S, 100-mm stretched mesh measurement is enforced. South

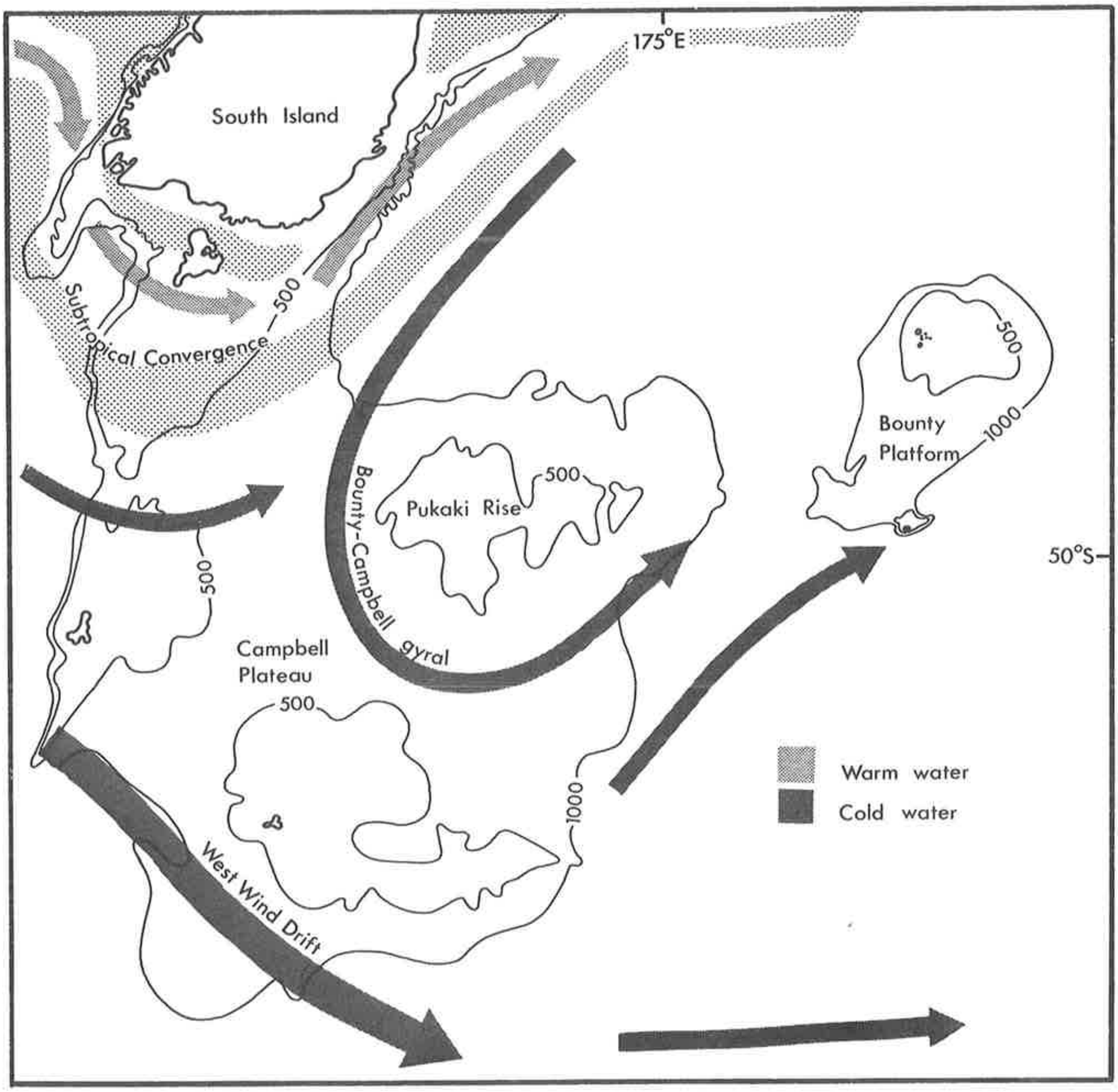


Fig. 2: Current movement and major bathymetric features of the Campbell Plateau area.

of 48° 30′ S, 60-mm mesh is permissible and the Soviets have asked that this be reduced to 40 mm.

Analyses by K. A. Fisher, of Fisheries Research Division, of net selectivity data collected on a recent cruise of the research vessel *Kaiyo Maru* showed that the optimum stretched mesh measurement for nets used in the whiting fishery lies between 71 and 77 mm.

It is possible that present estimates of the standing stock of southern blue whiting in the New Zealand area are conservative. If this is correct, the 60-mm mesh size, as currently enforced, will not be too small and may in fact prove to be the optimum for catching whiting and silverside (a fish of potential desirability to the Japanese, which is caught in association with whiting). Meshes of this size will, however, have a detrimental effect on the stock of hoki, the second most important species taken in the area, for which the optimum mesh size is over 104 mm.

Depending on results from monitoring of future catches in the area, it may be desirable, as a management and conservation measure, to extend the 104-mm stretched mesh requirement over the whole of the 200-mile EEZ.

### Recent observations and research

Research by Fisheries Research Division has been limited in the Campbell Plateau area for two reasons: the size and availability of the research vessel *James Cook* and the limited numbers of personnel. The best current observational data available are provided by official observers travelling on foreign trawlers.

A recent report from one such observer after a trip aboard a Soviet trawler gave perhaps the best indication of prospects for vessels target fishing for southern blue whiting on the Campbell Plateau. He reported that catch rates were about 15–20 t per hour in "good areas". Catches were composed of 95% whiting and the remaining 5% silverside, hoki, ling, and hake. The whiting were all adults in the 32–45-cm size class.

The vessel's sounder recorded dense shoals of whiting extending from the surface to the bottom with aggregations within the shoals estimated at 300–400 t. While trawling through one of these aggregations the gear parted and the entire net was lost. On leaving the grounds 64 km north-east of Campbell Island for Wellington, the vessel steamed through continuous concentrations of whiting to a point east of Stewart Island.

Probably the best estimates of standing stock will be derived from the research-exploratory fishing conducted aboard the German trawler *Wesermünde,* due to begin operations in the area in January of 1979. The entire area will be systematically explored for 12 months, during which the vessel will be continuously manned by a scientific staff as well as its usual complement.

### A cautionary note

Although the time Fisheries Research Division has spent working over the Campbell Plateau has been limited to a few voyages on the 500-t *James Cook* and even less time aboard the 3500-t Japanese research ship *Kaiyo Maru,* two fundamental features of the area are quickly recognised. First, the swells produced by the West Wind Drift and the prevailing westerly winds are high, with a mean interval of about 10 seconds (Table 1). Second, weather in the area is notoriously fickle. Deep depressions make up very rapidly between 45° S and 60° S (for example, the 946 millibars recently recorded at Macquarie Island) and wind velocities ahead of these fronts increase considerably (Fig. 3). Harbours are few and all are liable to very strong winds.

A vessel the size of *James Cook* is too small to work the off-shore area of the Campbell Plateau efficiently and discussions with experienced off-shore fishing masters confirmed our impressions that vessels of 1000–1500 t, with a trawling capacity to at least 1500 m, would be a more suitable size.

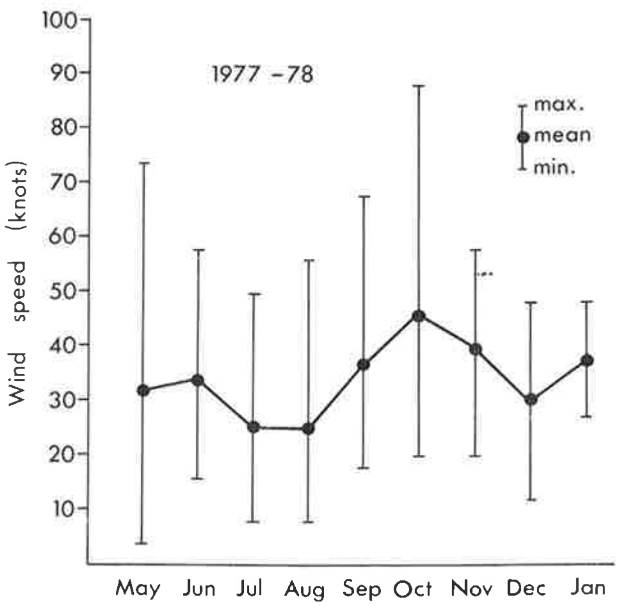

Fig. 3: Monthly wind speeds at Penrod Rig (49° S 169° E), 1977–78.

**TABLE 1: Sea states recorded at Penrod Rig (lat. 49° S long. 169° E) (data by courtesy of Ministry of Energy)**

| | | Wave height (ft) | | | Swell height (ft) | | | Swell period |
|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Mean | Max. | Min. | Mean | (mean secs) |
| 1977 | May | 25 | 0 | 11.0 | 30 | 0 | 16 | 9.16 |
| | Jun | 22 | 5 | 9.3 | 28 | 6 | 18.26 | 8.8 |
| | Jul | 15 | 3 | 7.9 | 24 | 10 | 13.93 | 9.03 |
| | Aug | 17 | 3 | 5.9 | 20 | 10 | 14.03 | 8.84 |
| | Sep | 25 | 4 | 11.27 | 30 | 8 | 17.4 | 10.47 |
| | Oct | 26 | 11 | 11.93 | 50 | 12 | 21.03 | 10.26 |
| | Nov | 20 | 8 | 12.5 | 22 | 12 | 15.73 | 9.6 |
| | Dec | 12 | 4 | 6.86 | 22 | 8 | 12.55 | 17.16 |
| 1978 | Jan | 12 | 6 | 8.6 | 18 | 12 | 14.4 | 8.0 |

## Conclusion

The Campbell Plateau is a productive region with a very large potential resource. Particular care will be necessary when monitoring catches and estimating quotas to maintain stocks which could easily be overfished by fleet tactics. The most appropriate method for New Zealand to enter this off-shore fishery is by joint ventures, until the local industry is able to provide vessels and crews to work the area.

If New Zealand does not develop a fishery for prime species in the area, species allocations will be lost to foreign interests.

# Deep-water fish resources off the south-east coast of New Zealand

by L. J. Paul

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THE south-eastern off-shore fishing ground extends from the deeper water off Banks Peninsula east to the Chatham Islands and south-west along the continental slope to south of the Snares Islands. South and east again is the large Campbell Plateau, physically part of the same region, but described as a separate fishing ground in this conference [see M. W. Cawthorn's paper on page 47].

The ground being described here covers about 50 000 square nautical miles. This is about 20 times larger than the Hauraki Gulf, a well-known and heavily fished area which produces about $1.5 million worth of fish per year. Could this new ground be worth $30 million per year? For a variety of reasons, probably not. It is unrealistic to compare two areas with such different characteristics. But this south-eastern gound does have considerable resources of several fish species, most of which are still quite poorly known.

These resources and their recent exploitation by various foreign fleets are described briefly in this paper. Our information comes from research and exploratory fishing cruises of the Japanese vessels *Kaiyo Maru* and *Shinkai Maru,* 2 years of commercial fishing (1975 and 1976) by the Japanese trawler fleet (1977 data were not available at the time of writing), and some data, variably complete, from other fishing fleets [see Appendix by L. J. Paul and D. A. Robertson on page 117]. This information has been correlated with the scientific results from several cruises to parts of the region by our own research vessel *James Cook.*

This paper refers only to the off-shore grounds, deeper than 200 m, and not to the coastal Canterbury, Otago, and Stewart Island grounds. And it attempts only to describe the resource; it makes no judgment on whether it would be **profitable** for New Zealanders or joint venture groups to fish in this region. It must be remembered that much of the recent fishing activity by foreign fleets around New Zealand has been exploratory fishing to find new grounds, establish a political presence, and maintain fish supplies, rather than make large profits.

## Bathymetry and hydrology

It is necessary to understand the bottom topography of this region and the main ocean currents, because these have important effects on the distribution pattern of the fish.

The Chatham Rise has a large surface area at a depth of 400–500 m (Fig. 1); it drops steeply into deep water along its northern edge and more gradually to the south. The rise is separated from the South Island shelf by the Mernoo Gap. It has several small banks, including Mernoo Bank at the western end, which attract fishing activity.

The remainder of the south-eastern fishing ground lies along the rather steep continental slope and drops from 200 m to 1000 m and more. Fishing activity is concentrated in depths of 300–600 m east of Banks Peninsula and east of Stewart and Snares Islands. The slope off South Canterbury and North Otago is too steep for conventional bottom trawling, though it is probably suitable for aimed off-bottom and mid-water trawling.

The entire fishing ground lies under the Subtropical Convergence, a major boundary between ocean currents (Fig. 2). The northern Chatham Rise and much of the South Island shelf are covered by warm Subtropical water. The southern Chatham Rise and the deeper parts of the continental slope are covered by cold Subantarctic water. Interactions between these two different waters and between these current systems and the bottom topography can provide favourable feeding grounds for some fish species. However, it is a boundary region, rather than a sharply defined zone. In addition, annual as well as seasonal changes can occur in the position of this boundary, with resulting changes in fish concentrations. The more migratory species will not remain in, or even return to, the same geographical positions.

## Subregions

This large region can be divided into five subregions (see Fig. 1)—Stewart, Otago, Banks, Mernoo, and Chatham—which have clear differences in fishing activity, catch rate, and species composition.

## Recent foreign catches

The catch figures given here are rounded or average values. [For more detailed (though still inadequate) statistics, see Appendix by L. J. Paul and D. A. Robertson on page 117.]

**Russian trawl fishery.** Until the fishing logbook scheme began in April 1978, we have had no information on the catch rate or composition by region, let alone subregion, but this south-east area has certainly been a major fishing ground. The main species taken in this fishery has undoubtedly been hoki, with significant catches of "silver" and oreo dories, jack mackerels, warehou, roughies, and red cod. Tarakihi has probably been a by-catch, though significant quantities could have been caught. From April 1978 black oreo dories comprised virtually the entire catch, with a by-catch of orange roughies.

**Korean line fishery.** We have information from 7 months, April to October 1977. The boats worked from Mernoo Bank across to the Chatham Islands. Of the total catch of 3000 t, 80% was ling. Catch per boat-day averaged 11.5 t.

**Korean trawl fishery.** Parts of this ground were worked during 1977, but no catch information is available. We only have total New Zealand figures.

**Japanese line fishery.** Japanese line vessels have worked the area for some years. Data for 1975–77 show a total catch increase from 11 000 to 26 000 t, two-thirds coming from the Chatham Rise and one-third from Mernoo Bank and Canterbury coast. Seventy-five percent of the catch was ling, about 15% deep-sea cod (presumably ribaldo), 5% sea perch, and 5% gropers and bluenose. Catch per boat-day was reported at 6–10 t.

**Japanese trawl fishery.** This has been the major foreign fishery in the region. In 1975 some 30 000 t of fish were caught and in 1976, 42 000 t. The two principal fishing areas were Banks (52% of the catch in 1975, 31% in 1976) and Stewart (24% in 1975, 39% in 1976). Total catch per effort, however, was more uniform over the whole area (Fig. 3).

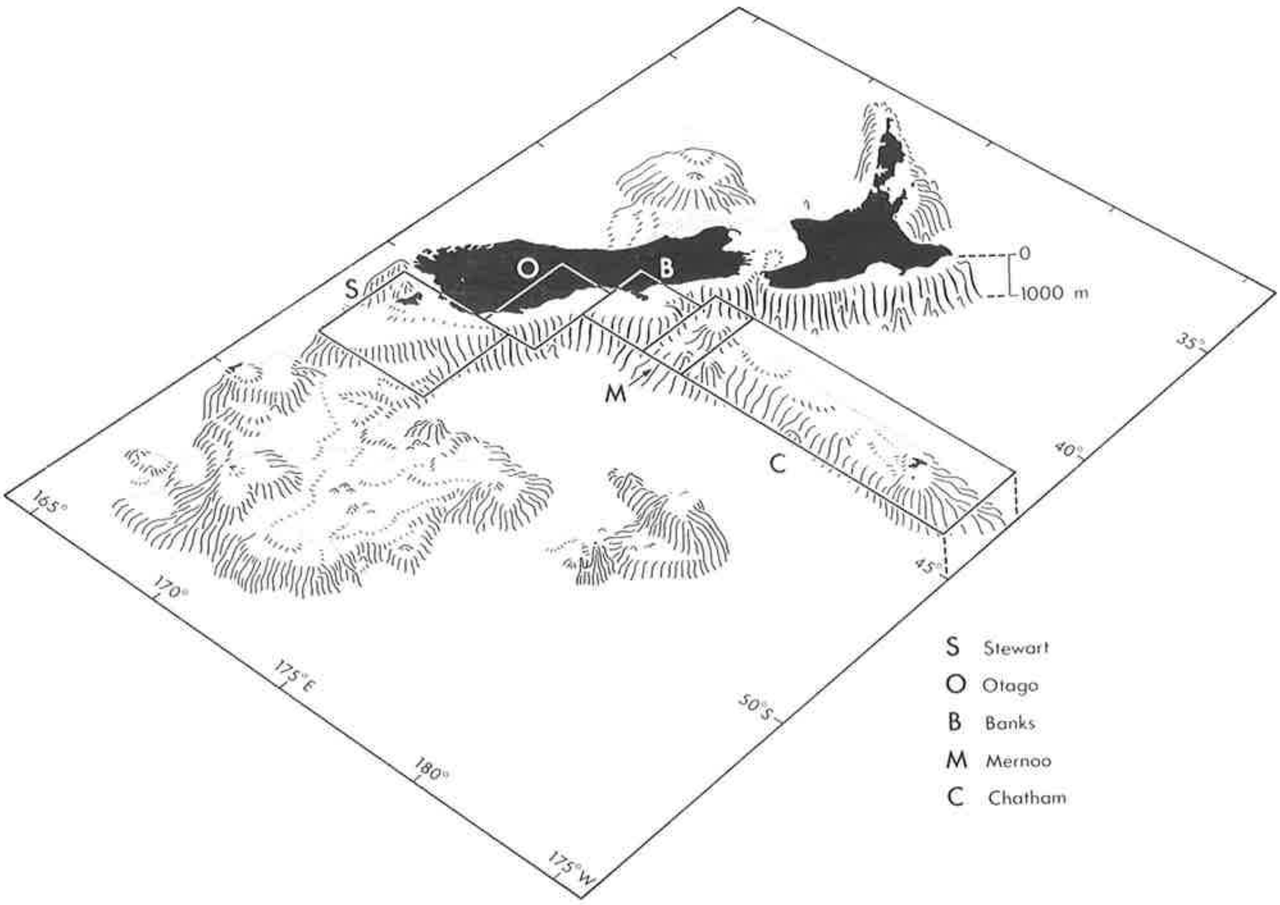


Fig. 1: The off-shore fishing grounds around New Zealand viewed from the south-east. Traditional charts are intended more for navigation than visual appreciation of bottom topography; so this illustration was prepared to show more clearly the size and shape of New Zealand's off-shore fishing grounds.

The Japanese trawlers ranged in size from 1000 to over 3500 t. In 1975 there was an even distribution of fishing time from five size classes within this range; in 1976 there were relatively more 1000–1500-t vessels, mainly working off Stewart Island for warehou.

In general, 1000–2000-t vessels caught 1 t of fish per hour, and 2000–4000-t vessels caught 2–2.5 t per hour. Hauls averaged 3 hours in length.

It is difficult to use the detailed catch figures provided by the Japanese trawler fleet to understand the natural distribution of fish in this area or seasonal migrations of the major species. Each vessel, or perhaps group of vessels, target fishes for certain species in different areas and depth ranges. Different companies may have different fishing strategies. Within the same area, small and large vessels often have different catch compositions. The reported catches, therefore, do not necessarily reflect the natural abundance of fish in each subregion.

However, by combining data from all subregions, the whole fleet, and both 1975 and 1976 catches, some idea of the resource being fished can be obtained. The principal species taken were: warehou species 26%, barracouta 17%, hoki 12%, red cod 9%, squid 8%, jack mackerels 7%, and ling 7%. "Other finfish" made up the remaining 14%.

The relatively small catch in the Chatham and Mernoo subregions was mainly hoki, with some warehou, ling, and jack mackerels. At Banks and Otago barracouta was the main species, with red cod, jack mackerels, and some hoki. At Stewart warehou (mostly silver warehou) comprised half to two-thirds of the catch, with ling and hoki as subsidiary species.

### The major species

We are still working up our biological information on these species, but some generalisations can already be made.

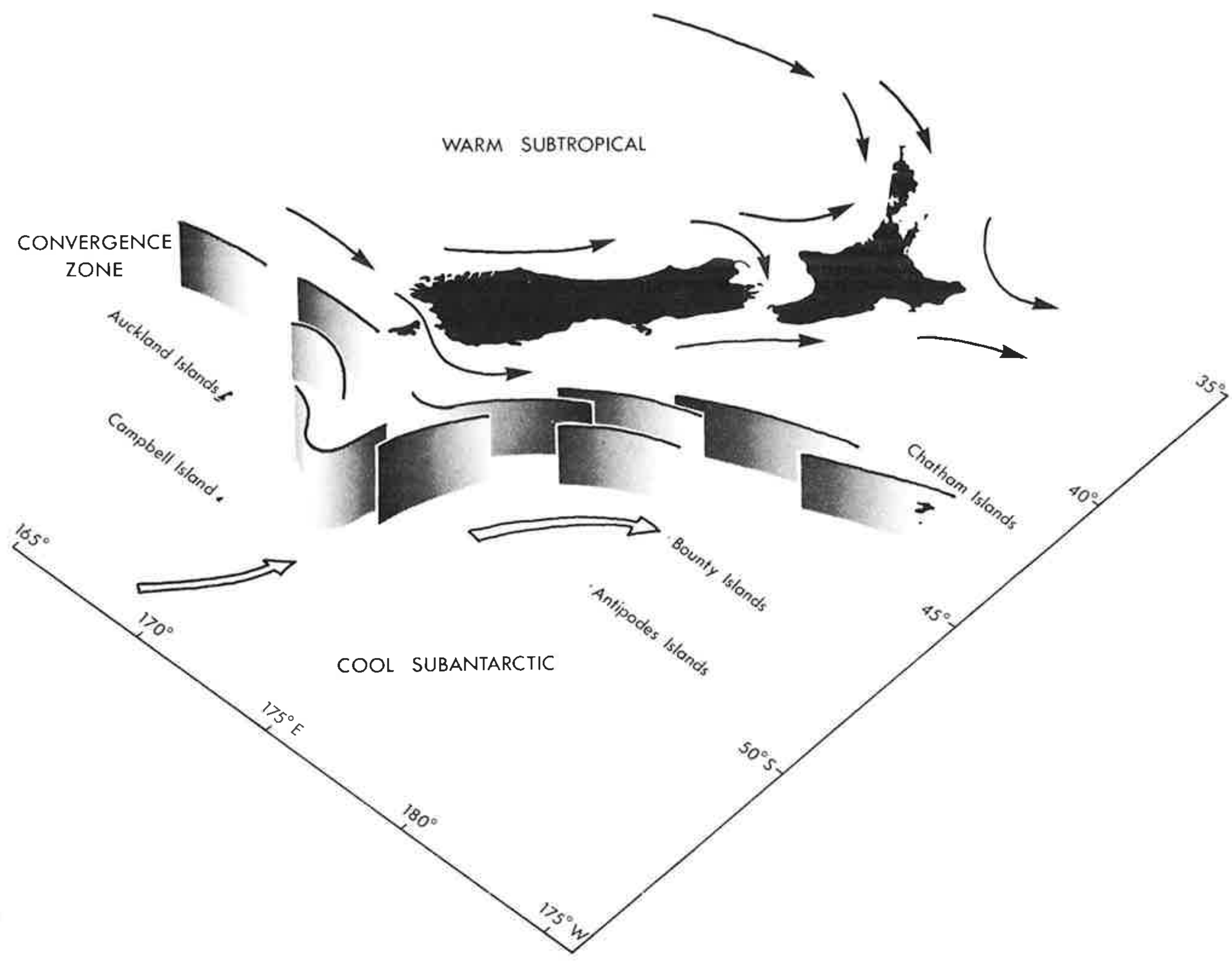


Fig. 2: The principal oceanic and coastal currents around southern New Zealand and the position of the Subtropical Convergence.

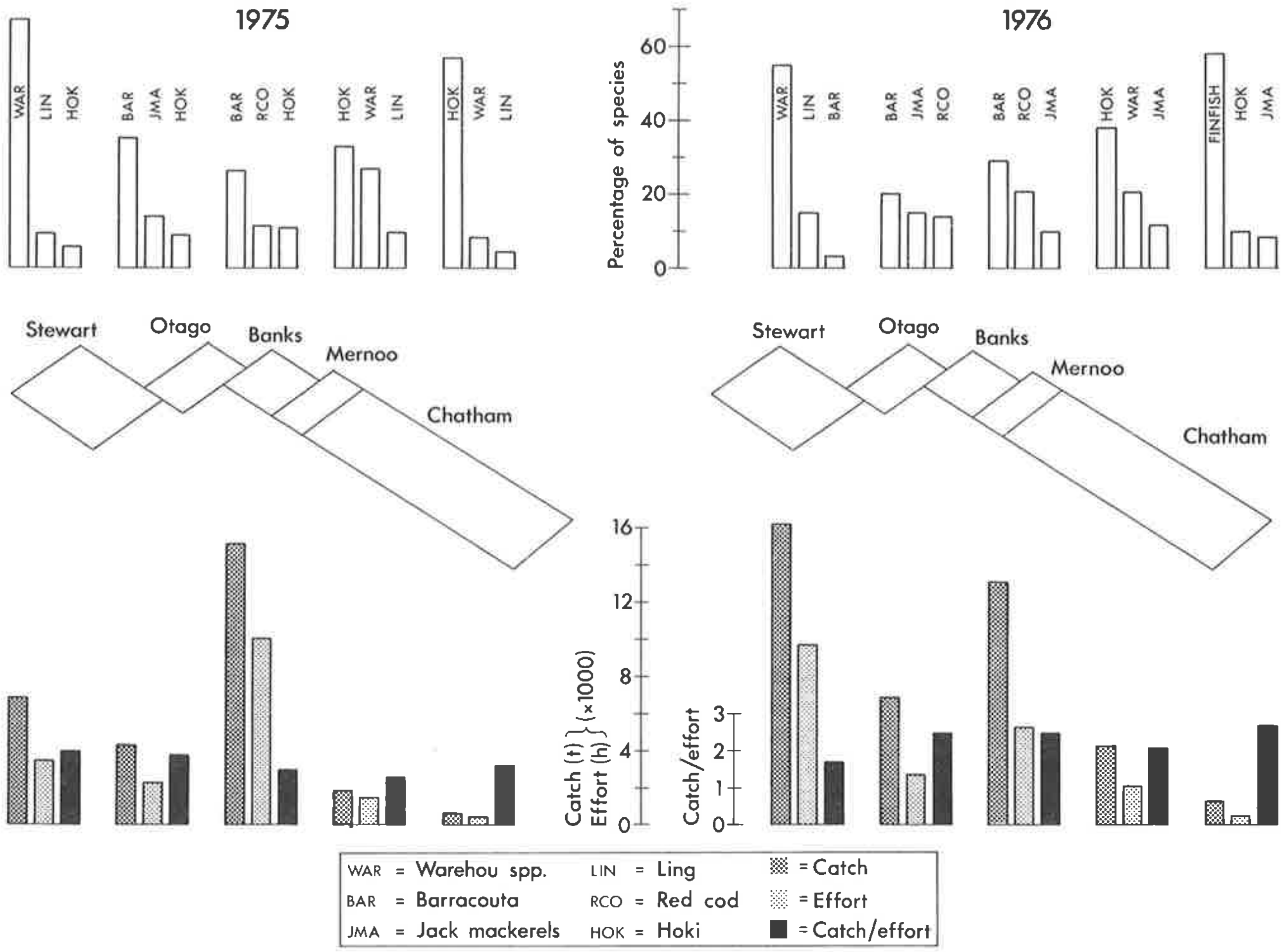


Fig. 3: Species composition (top) and catch, effort, and catch per effort (bottom) from the Japanese trawl fishery off south-eastern New Zealand in 1975 and 1976.

**Warehou.** This is mainly the silver warehou, though white warehou and perhaps a few common warehou are also taken. The silver warehou occurs between 300 and 700 m in the entire south-east region. It seems to be less common on the west coast of the South Island and occurs only sporadically on the Campbell Plateau. It feeds on planktonic organisms such as salps and other small "jellyfish", and it appears to be closely associated with the Subtropical Convergence. Changes in the strength and position of this oceanographic feature will alter the location of fishing grounds and the timing of peak catches. There is a spring spawning near Mernoo Bank and then a southward migration to a summer feeding ground east of Stewart Island, where the main fishery occurs. Although the silver warehou has a fast growth rate and a relatively short life, its habit of concentrating within a small area could encourage and allow overfishing.

The large catches of silver warehou made by Japanese trawlers in the Stewart subregion in 1975, at a high catch rate, encouraged the fleet to return there in 1976 and expend even more effort (see Fig. 3). Catch rates were, however, poorer and silver warehou made up a lower percentage of the total. (Data for 1977 show a lower catch rate and percentage of catch again.) Silver warehou is markedly seasonal in this southern subregion and is taken mainly from October to March. The high catch rates of the 1975–76 summer, averaging 2 t per hour, have apparently not occurred again. The two possible explanations—a change in oceanographic conditions and overfishing of a concentrated stock—deserve serious investigation.

Less is known of the in-shore common or blue warehou and the off-shore white warehou, but they will similarly be prone to overfishing. The price for warehou is currently (late 1978) very high in Tokyo, which suggests that when Japanese trawlers return to the 200-mile zone they will target fish for these species. It is clearly desirable to have quotas or an effort limitation on warehou.

**Barracouta.** This is a fish of the shelf edge, 200–400 m, though concentrations do sometimes move in on to the shelf. Dr Robertson has already dealt with this species [page 30]; so I need only say that the main grounds are off Banks Peninsula and the South Canterbury Bight. Barracouta are not abundant on Chatham Rise, apart from spawning concentrations on Mernoo Bank, and in the Stewart Island area they occur with spiny dogfish in fairly shallow water on the shelf itself, rather than along the shelf edge.

**Hoki.** Although only third in Japanese trawl catches, this species may be the most abundant and important in the area, at depths of 200–600 m. Juveniles occur in dense concentrations along the continental shelf edge, 100–300 m. Adult concentrations vary considerably within their area of distribution and depend on: regular seasonal spawning and feeding migrations, the Banks Peninsula area and Mernoo Bank often having large schools; irregular migrations caused by warm and cold years; and variations in spawning and year-class strength and in subsequent recruitment to the commercial stock.

**Red cod.** This species is apparently restricted, in a commercial sense, to the outer shelf and upper slope around Banks Peninsula. It also appears, at least seasonally or in some years, on Mernoo Bank. In international terms, it is a limited resource.

**Squid.** There are important squid fisheries, both trawling and jigging, already described by Mr Roberts [page 35]. The distribution and concentration of squid may vary with changes in the Subtropical Convergence.

**Jack mackerels.** These are migratory species, varying in abundance seasonally and from year to year. Japanese trawl catches are made along the South Island east coast in summer and autumn, from January to June, and on Mernoo Bank and Chatham Rise in winter and spring, from July to December. Presumably this represents a southern migration for summer feeding.

**Ling.** This is an important species, particularly for line vessels. We know little of its biology, but suspect that it may be long lived, and so present high catch rates will not be sustained. Although widely distributed, it appears to congregate for spawning, which makes it prone to overfishing when these concentrations are discovered by a fleet of large trawlers.

**Oreo dories.** These were little known until recently, when the Russians virtually filled their 1978 quota of 20 000 t from area C (South Island east coast plus Mernoo) with one or two oreo species, mainly caught south-east of Banks Peninsula. Oreo dories are apparently quite common in 1000 m, but little is known of their biology.

### Other species

Other commercial or potentially commercial species in this region include orange roughies, which are not uncommon on the western Chatham Rise; two species of ghost shark, one along the shelf edge and one in deeper—probably Subantarctic—water; gropers and sea perch; and the well-known spiny dogfish, for which a use may one day be found. The semi-pelagic Ray's bream is not uncommon. There is a sizeable trawler by-catch of other species, notably small grenadiers or rattails.

I have one final comment. Much of the exploratory fishing has been within the depth range 300–600 m. Catch rates for several important species, for example hoki, are still high at 600 m. We still do not know the outer limits, and hence the total size, of these new grounds, and of course there are many other aspects of this large region, with its diversity of fish resources, which remain to be studied.

# Exploitation, marketing, and economics: Fishing Industry Board involvement

by N. E. Jarman
*General Manager, Fishing Industry Board, Wellington*

THE Fishing Industry Board was established by Act of Parliament in 1963 and was charged with a number of responsibilities relating to the development of the New Zealand fishing industry. These include such functions as:

- Promoting the New Zealand fishing industry;
- Promoting means of expanding the fishing industry and ensuring that full use is made of the fish resources of New Zealand;
- Promoting the sale of fish and fish products in domestic and export markets;
- Promoting quality standards;
- Co-ordinating domestic and export marketing;
- Licensing fish exporters;
- Promoting co-ordination within the industry;
- Advising the Minister of Fisheries of aspects where development can occur;
- Advising the Minister of overseas marketing trends and prospects;
- Advising the Minister of factors affecting or likely to affect the economic stability of the fishing industry.

To discharge these functions the Board employs staff who are expert in a variety of areas; for example, economics, market research, promotion, home economics, food technology, aquaculture, fishing methods and gear technology, training, publicity, and so on.

The industry is represented on the Fishing Industry Board at present by one member from each of the catching, processing, and retailing sectors.

An amendment to the Fishing Industry Board Act passed by Parliament at the end of the present session now provides for further industry representation. From 1 January 1979 industry representation will be increased to five members out of a total of eight, two being from the processing sector (nominated by the New Zealand Seafood Processors' Association Inc.), two from the catching sector (one nominated by the New Zealand Federation of Commercial Fishermen Inc. and one by the New Zealand Share Fishermen's Association Inc.), and one from the retailing sector.

The role of the Fishing Industry Board with regard to exploitation, marketing, and economics must be flexible to take into account the changing needs of the industry. Additionally, until recently the Board was limited in its ability to fulfil totally its wide range of responsibilities because of inadequate funding. Government has finally acceded to the long-standing request of the Board and the industry to increase its funding to match more exactly the income provided by the industry through the levy system on fish. Government will match the levy paid by the industry dollar for dollar, up to a maximum of $400,000. The Board is most grateful for this practical recognition. This year our total income from industry and Government will be approaching $1 million, a threefold increase from that available only 3 years ago. In addition, we expect our income to continue to increase as fish prices appreciate (partly because of inflation) and also as landings of fish increase because of development of the New Zealand industry and the growing number of mixed fishing operations being permitted by Government.

The lack of funds available to the Board in the past limited our ability to assist the industry to exploit, process, and market the previously less popular species. Despite this lack of income, considerable work has been done by the Board on specific projects, such as the prawn project in the 1960s, the initial squid fishing operation early in the 1970s, the development of the wide-mesh lateral trawl net, and the light-weight purse-seine exercise operated for 2 years off Nelson.

**Industry involvement**

The Board has always preferred in these types of fishing operations to charter vessels from the industry. This reduced our costs, since we did not have the expense of maintaining a vessel. Our vessel requirements are variable, and there is no suitable multi-purpose vessel. In addition, the involvement by the industry was valuable to us and, we hope, to them. We have found that having the industry work with us helps us to gain their support for our projects. The establishment by Government of the Industry Development Grant Fund has provided for the first time some financial assistance which will encourage the industry to do work itself on newer forms of exploitation. Our role will be to assist them in every way possible and perhaps limit our direct involvement. Although the policy has not been spelt out in complete detail, we understand that the Board is not eligible for money through the Industry Development Grant Fund.

We believe that the principle of encouraging the industry to become involved in such exploratory measures is sound, and we hope that this will continue to grow and be increasingly well funded. We understand that there are discussions being held within the Ministry of Agriculture and Fisheries about the future of *W. J. Scott*, particularly in regard to developmental fishing. If the activities of this vessel or its replacement are to be concentrated on transect fishing and on resource assessment, we believe that the savings that will accrue to Government should be diverted into the Industry Development Grant Fund to expand its financial base. In particular, the fund could provide money for exploratory fishing in appropriate instances, with less requirement for industry to match the Government contribution.

In our developmental work we have concentrated on those types of fishing which we think have great potential, but which have appeared too risky for industry to put money into. In this and in other areas the Board believes it has a responsibility to consider and plan for the changing requirements of the future. It is easy to move along radical lines and, if sufficient judgment is not applied, to move into areas which the industry will not support. Our strength depends on the confidence with which the industry regards us, and it is most important that in considering forward requirements we are able to maintain this confidence. As an example, we are proceeding cautiously with our investigations of alternative means of fishing which are less energy dependent than our more traditional ways. Some of the proposed solutions to a problem which is not yet an absolute reality are very radical. We feel the need to define the problem in great detail so that we can convince the industry that a revolutionary approach may be necessary.

**Processing**

The Board has responsibilities covering all sectors of the industry, including processing, and we have long been concerned about quality. We recognise that there are many fishermen, processors, retailers, and exporters in this country who are equally aware of the necessity of producing the highest quality fish. However, there are some people within our industry who, through ignorance or laziness, do not take the required care with the product. One area of major concern to the Board is the uneven handling of fish at sea. All of our work done in conjunction with Massey University, and all information from overseas, indicates that there is no excuse for not bringing the temperature of fish down to 0°C as soon as possible after catching. Despite this awareness, there are still too many vessels in New Zealand without any form of temperature control and too many processors who have accepted this state of affairs without working to do something about it.

On a recent visit to Japan and Korea I was told that they would be interested in buying species of fish which we are having difficulty in selling if they were of a higher quality. In particular, these countries have referred to the need to freeze at sea. This needs to be looked at in greater detail. The cost may be substantial, and I hope that some other developments I saw in Japan may obviate the need for it. The comment made in Korea and Japan was that the quality of fish frozen at sea was so superior to the quality of fish adequately or inadequately iced and then frozen on land that there was no option but to do the whole operation at sea.

However, I am aware of other processing options. Two years ago when the Board was operating its light-weight purse-seine exercise we had the advantage of a very efficient brine chilling unit. Jack mackerel caught by this technique and rapidly chilled to 0°C, and then landed promptly and immediately blast frozen, was worth two to three times as much on the Japanese market as our more traditionally handled product. The price received related to the price being obtained on that market for fresh product caught by Japanese domestic fishermen.

While in Japan I spent time with a government research scientist who for the last 15 years has been looking at more effective means of preserving the quality of the fish once it was caught. He has demonstrated that fish held at −3°C has a much greater shelf life than fish iced in the traditional manner. He achieved these lower temperatures not by complex refrigeration equipment, but merely by ensuring that 1.6% by weight of salt was added to the ice used aboard the vessels. Salt in water depresses the freezing point, and that proportion will maintain the ice and hence the fish at −3°C. I think it is important that we look at this technique in New Zealand, partly because it could extend the shelf life of our chilled product and so enable us to expand the markets to which we supply chilled fish, and also because it could do much to reduce the quality gap between fish frozen at sea and fish frozen on land.

**Marketing**

The Board's role here is to assist the industry in every way possible. Over the years there have been suggestions that the Board should take a much more active part to ensure that the industry's marketing effort became more co-ordinated. Few people within the industry do not believe that some form of rationalisation is desirable, but most would be as opposed as I am personally, and my Board is, to the concept of the Board becoming a statutory marketing authority. We believe that marketing must be done by the people who own the product and have a financial stake in it. The sure way to limit marketing initiative is to take the marketing role away from the industry and place it in the hands of quasi-bureaucrats.

This in no way diminishes the view held by the Board that greater co-ordination of our marketing effort is necessary. We believe that the move for this and the means of achieving it must come from within the industry, and that the Board and the industry must have much discussion to ensure that the right steps are taken.

Our further role is to undertake the varying types of marketing research which could more precisely identify market opportunities for the industry. Some of this can be done from New Zealand by identification of people overseas who can provide us with the appropriate information. However, there is no doubt that as the industry expands and its catching capacity increases a considerably greater effort must be put into marketing, marketing research, and the development of new markets.

The Board has agreed that we should form a marketing advisory committee, with representation not only from the processors, but also from the fishermen and particularly from those exporters with no processing capacity. There has been a tendency in the past to exclude the exporters from much of our discussion, since they were regarded as outsiders with little or no investment in the industry. However, in any one year between a third and a half of New Zealand's fish exports are handled by this group, and so they must be well represented. This committee, which I hope will be meeting shortly, will be charged with the prime responsibility of putting before the Board, on behalf of the industry, those matters which should be concentrated on to assist the industry's marketing development.

All that is needed is that we identify the markets showing the greatest potential for profitable trading, find out more about the way in which fish are handled and distributed in those markets, determine the exact nature of their needs, establish contact with potential buyers, bring together our industry and those potential buyers, promote the New Zealand fish which we believe can be sold, and ensure that there is adequate follow-up to meet developing demand.

When new markets need to be developed and exploited, and at times such as these when there are problems with existing markets, there is a renewed interest in the possibility of some form of co-ordinated marketing. Our suggestion for the industry to consider is the possibility of establishing something like the Meat Exporters' Council or the Meat Export Development Company, which could exercise some control over individual marketing activities at some times or on some markets. These particular examples may not suit the requirements of the industry, but the principle needs to be looked at. The industry must itself combine its activities to maximise the benefits which should be available to the industry as a whole. While we have many small organisations and some big ones competing on the same market place with fish not currently in high demand, there remains the possibility of absolute chaos.

**Economic analysis**

This is a key part of the Board's activities. Our responsibilities are towards the commercial fishing industry, and their success or failure is measured in economic terms. If we are looking at fishing, processing, or marketing, the only criterion which we can adopt is that changes or developments must lead to increasing profitability, if not in the short term, then certainly in the long term. Our consideration of the possible impact of future energy cost increases, our need to consider exploiting those resources which we have not previously exploited, our assessment of new market possibilities, the possibility of processing in greater depth in New Zealand—all require in their planning stages an accurate perception of economic implications. Board staff have increasingly been involved in this work, and this section of the Board has grown substantially over the last 2 or 3 years.

Two other major exercises being undertaken by the Board involve an in-depth study of the economics of the industry. The first is the collection of data required to establish an industry development plan, which we hope will enable the industry to take advantage of certain incentives offered by Government in its 1976 budget. We have almost completed data gathering and over the next few months we will need to have many discussions with members of the industry, both individually and in groups, to pinpoint areas where some rationalisation will be needed. This need for rationalisation applies particularly to aspects where some form of Government assistance may be required; for example, the upgrading of fishing ports, rationalisation of transport, regional development implications, and manpower training requirements.

The second exercise is the economic analysis of the accounts of fishermen operating in fisheries which will shortly be controlled under the new Controlled Fisheries legislation. The basic philosophy of this legislation was that some of the fish resources of New Zealand needed to be protected, not only in biological terms, but more particularly because of the need to protect the economic status of those participating in the fisheries.

**Co-ordination**

Possibly the most important aspect of our duties is promoting co-ordination within the industry. We see our role as that of an honest broker, with a duty to bring together the various sectors of the industry so that the industry can speak on most matters with a united voice. We must encourage the coming together of the catching, processing, and retail and export sectors and all groups or individuals in the fishing industry. This requirement for co-ordination extends into individual sectors and as a Board we try to bring together the different groups who are active in each of these sectors. We fully recognise that with an industry as diverse as the New Zealand fishing industry there will never be complete uniformity of views. However, we believe the interests of each group are so similar and some of the problems are so large, that it is only when we can talk together and find a common approach that we are likely to overcome these problems and fully realise the potential which is there to be exploited.

# Joint ventures and charters: Do they provide a short cut for fishing industry advancement?

by C. C. Hufflett
*Managing Director,*
*Sealord Products Limited, Nelson*

THE intention of this paper is not to support or condemn joint venture and charter arrangements, but merely to relate them to the present New Zealand scene. I intend to draw some conclusions, but it must be emphasised that these are my own personal comments and they do not necessarily represent the view of the companies or organisations I work for.

## Joint ventures

First, it is necessary to define precisely what joint ventures and charters are. It is generally assumed that a joint venture involves an equity shareholding in a New Zealand company. This, of course, is not necessarily so. A joint venture can be a "one-off" arrangement between a New Zealand and an overseas company to investigate or exploit a particular resource or technique, and it need not involve any equity partnership at all.

My own company had an arrangement to investigate the southern spider crab resource which involved chartering both a New Zealand flag fishing vessel and a Japanese one. The exercise included processing investigation as well as catching techniques. This was quite different from any equity arrangements we have and was intended to prove the viability of the resource and market acceptability of the product. It was a one-off deal which was to terminate after the initial period, after which a separate joint venture company was to be set up. Any spoils from the investigatory period were to be divided between the joint venture partners. Unfortunately, there were no spoils, and I think that the crab meat caught on this venture would probably rate as the most expensive ever landed. All that resulted was a well written report and a few cartons of crab claw meat which remained unsold on the Sydney market 5 years later. This non-equity joint venture "self destructed" and is generally talked about in hushed terms by executives on both sides.

So it is possible to set up a joint venture or a business arrangement between a group of companies of different nationalities without its being a permanent arrangement, and it can well be the proving ground for later development. Often when the overseas partner is unsure of the true economic or political climate in the host country this is a good arrangement for him, as it provides a let out and a similar escape route for the host partners.

Clearly these are simple arrangements and can be set up with comparative ease. They should be under strict control, however, and such arrangements should be only of a temporary nature to test a particular resource or technique. The danger is that if they are not properly controlled, such schemes can be seen by entrepreneurs as the way to circumvent some of the establishment costs which are normally borne in New Zealand, not for the purpose of long-term development, but with the intention of lining the pockets of those immediately concerned.

## Overseas shareholder

Regardless of the foregoing, we usually think of a joint venture in terms of equity shareholding, and there are different reasons for wanting an overseas shareholder. I do not hold the view that an overseas shareholder is necessary to obtain technical expertise in either fishing or processing methods. This information can generally be purchased either from the manufacturer of proprietary plant and equipment or from consultants who are available throughout the world and who cover the complete range of fishery science.

The more justifiable reason for a joint venture is that the foreign partner has:

- The capital available for investment in a risk industry;
- The plant and equipment which could be used in New Zealand today (perhaps secondhand, but in any case at a far cheaper cost than establishing on a first-off basis);
- Access to markets.

It is this last attribute which is the most important because the major restraint placed on the New Zealand fishing industry today is market accessibility.

## New markets

I believe that, with the right equipment, New Zealand is capable of catching and processing the resource, but to move the volumes of fish now available within the EEZ, firm marketing arrangements such as can be obtained through a joint venture set-up are necessary. I personally am extremely interested in the proposed West German venture. (Let me make it quite clear that my company has no involvement with the New Zealand company which is making the arrangements.) I am interested, not because of the fishing techniques they will use, but because it is a new nation being involved and one which has access into the European Economic Community. If that joint venture can open up markets for New Zealand fish in this area, we must all benefit. If they will do the initial marketing preparation at their cost and risk, this can only be to the advantage of other New Zealand companies.

I think that most people at this conference will agree that it is of utmost necessity that New Zealand finds markets away from Australia and Japan as soon as possible. Our reliance on these two markets is the cause of the temporary economic ill which is now facing the industry. I wish this particular venture all success, and so should all New Zealanders whether they are proponents of joint ventures or not, because once that market access is opened, we can all take advantage of it. Certainly my company will be there, as today we could not logistically mount such an exercise or meet the establishment cost of entering that new market.

Clearly the first and major consideration in any joint venture arrangement must be: what does New Zealand get out of it; what does New Zealand earn; what is the net benefit to New Zealand after all expenses have been paid?

I do not subscribe to the view that joint ventures should be allowed only to those nations which have habitually fished in New Zealand waters. If that were the criterion, we would find ourselves wedded to that volatile Japanese market. Let us bring in, under strict control, people from different nations who, as a result of their work in New Zealand, can open up new markets for all of us to enjoy. At present the squid caught in New Zealand is mainly taken by jigging and is destined for the Japanese market. There are other fishing methods and there are other markets. It would do no harm if these were investigated by a Mediterranean country, or by some group holding access to a different market.

**Bargaining power**

The guidelines and controls established for joint ventures and charters are of New Zealand's making, and it is essential that these are stringent and have due regard to the domestic industry and the overall benefit of New Zealand. I have been told by the Minister of Foreign Affairs that under the Law of the Sea we do not have the right in negotiations with foreign nations to allow their access on the basis that they must not sell in third countries against our own industry. I find this incongruous, as it appears we can use the Law of the Sea to negotiate agricultural access, but cannot use the same legislation to protect our own industry. If this is so, joint venture or charter arrangements which we control are infinitely preferable to the balance of the total sustainable yield of the EEZ being taken by the Japanese, Russians, and Koreans. The Russians and Koreans are not providing an alternative market for New Zealand marine products, but are merely competing against our own.

New Zealand is tardy in using the EEZ for the removal of trade restrictions and barriers against its own domestic industry, but it is noticeable that a bill at present before the United States Senate by Senator Warren G. Magnuson, which deals with the setting up of off-shore processing arrangements in the United States zone, clearly states that: "Nations that impose artificial trade barriers on U.S. fish exports will not be able to take part in the program." There is surely an example here for New Zealand.

Nations involved in joint ventures in this country should concurrently remove any trade restrictions against the New Zealand industry. The Magnuson bill specifically refers to the establishment of off-shore processing ships and the trade barriers referred to are those against United States processors wishing to gain access into the markets of those nations operating processing vessels off the United States coast. A parallel to this in the New Zealand situation would be that before Japan could engage in joint venture squid fishing arrangements in this country, import duty against New Zealand squid would have to be removed. Likewise, before the United States could fish tuna in our waters under joint venture or charter arrangements, there should be free access of our processed product into the market.

I believe that if the Government of the day has the will, joint ventures and charters could provide bargaining power for the overall benefit of the New Zealand industry.

**Charters**

In referring specifically to charter arrangements, the term "charter" has become confused, as there are differing degrees of chartering relative to the risk taken. The Union Steam Ship Company charters many of its cargo vessels and these, without exception, are "bare-boat charters". As the name implies, a bare ship is leased and the chartering company provides the crew, fuel, victualling, etc., maintains the vessel, and takes the total risk of the venture. It is not easy to do the same with fishing vessels because of the sophistication of plant and equipment on board and different accommodation standards, which usually result in the charter of a vessel plus all or part of her crew. With the exception of vessels built under Lloyd's or a similar European or American classification society rules, few overseas vessels are suitable for manning by New Zealanders.

Clearly there is no case for chartering vessels for operation in the in-shore fishery. Charters should be used to exploit the off-shore areas and areas where a proportion, if not all, of the catch can be processed in New Zealand so that we can achieve the economies of scale in processing needed to compete on world markets.

It should be made clear that though a small plant with a 10-t freezer can be economic in packing whole snapper for the Japanese market, it would not be suitable in the processing of the less preferred species such as barracouta, hoki, southern blue whiting, red cod, and so on. This type of processing requires volume throughput of a magnitude not seen in New Zealand before. Fish processing plants in South Africa, Canada, Norway, and elsewhere often handle 240 t of fish a day, or about 60 000 t a year.

Although New Zealand may not overnight have plants of such capacity, we need to be thinking in these terms if we are to compete with less preferred species on the world market, and it is here that charters of off-shore demersal trawlers can provide the initial volume required, without conflict with the existing New Zealand wetfish industry.

There is nothing new in this type of arrangement and almost without exception the world's leading fish processing countries have a foreign fish input into their plants. In the United Kingdom, even after the Icelandic cod war, factory ships from that nation land fish into Hull and Grimsby for further processing. This is accepted by the fishing sector of the industry there because they know that the large plants on Humberside need a guaranteed supply of fish to survive.

Thus charter vessels in New Zealand waters can benefit the New Zealand industry by ensuring that our shore production costs are contained by economy of scale and that we are competitive on world markets. Unless these charters proceed, there is no doubt that New Zealand's expansion into the less preferred species will be slow to the point of not taking place.

Clearly a New Zealand fishing venture which is 100% owned in New Zealand, both in the catching and processing sectors, gives the highest net return to this country. I do not believe, however, that the off-shore resources are going to be developed fast enough by totally New Zealand-owned and operated arrangements. It would take too long and the foreign fishing fleets will take too much. I do not know if this could ever be achieved by New Zealand-only ventures, but I do not believe in a proliferation of joint ventures. The choice of which ones should proceed should be made (and I believe is made) only after very careful selection. The criterion of selection is simple: "Which one provides the best return to New Zealand?" This is a simple guideline and a competitive one. All proposals should be viewed in this light, and it should be remembered that though they can provide a short cut to fishing industry development, once established they are here for good, and this means that a proportion of the profits (if any) must be remitted overseas.

# Why 30-m vessels for the New Zealand deep-sea fishery?

by N. L. Mills
*General Manager,*
*Sanford Limited, Auckland*

I have been asked to tell you why New Zealand fishing companies decided on 30-m vessels to develop New Zealand's deep-water fishery. Each company must make its own decision; so I am only qualified to tell you how Sanford Limited made its decision. However, it is significant that Charles Hufflett of Sealord Products Limited and Cliff Skeggs of Skeggs Foods Limited arrived at the same size completely independently.

Being asked to speak on this subject to some extent implies that the organisers of this conference, like many people both in and out of the industry, consider 30-m vessels too small to fish the deep water adequately. However, we in the winterless north do not see it that way.

**Planning**

Let me make it clear that the planning of these vessels involved a large number of people from each section of our business, especially the fishermen. Engineers, factory executives, marketers, and accountants were also much involved. When you talk to four or five experienced fishermen and then try to blend what they require with the opinions of all the other people mentioned, you begin to realise that fishing vessels, like cars, are largely the preference of the people who drive them.

After all the discussion it finally had to be a management decision. However, to be fair, I feel we did arrive at the type of vessel that satisfied most people on our staff. Certainly our fishermen are very happy with the two new vessels and we are ordering a further two vessels with only minor alterations. The matters that we took into account in deciding the size of the vessels are, briefly:

1. How the catch is to be stowed on the vessel.
2. Where the vessels are going to work, the depth of water, and the distance from their home port.
3. Prevailing weather conditions.
4. The method of fishing and the consideration that it may be necessary at some stage in the future to change that method.
5. The number of crew necessary to operate the size of vessel we decide on and how they are to be remunerated.

As we sell 40% to 50% of our production to the local market and our factories are set up to process fresh fish, not to reprocess frozen fish, we had little difficulty in arriving at a decision to stow the fish in ice in the normal way that our present fleet does. We did study a 90-ft (27.5-m) factory vessel with processing and freezing capabilities as well as provision for stowing a part of the catch in ice. However, our fishermen did not favour the stern ramp necessary in this vessel to give the room, and they could see major difficulties in handling the very large bags of fish sometimes caught by pair trawlers up a narrow stern ramp. These vessels were too high-wooded to lift over the side satisfactorily and it was impossible to maintain the room in the vessel without its being so high-wooded.

Therefore, we decided to build the typical style of North Island trawler with the wheelhouse forward and a reasonably low-wooded large deck area aft. To handle the deeper-water species that generally sink when they are hauled to the surface a very powerful net roller was situated aft.

We considered that these vessels would mainly work from Cape Egmont to North Cape on the west coast and East Cape to North Cape on the east coast, with occasional trips to the west coast of the South Island. Obviously, steaming time to the South Island would be such that it would limit fishing time because of the storage of fish in ice, but our company only wants experience in that area to validate the general opinion that it offers the greatest scope for expansion. The vessels were certainly not built to fish there regularly.

**Depth**

The vessels were designed with the correct horsepower and winches to fish up to 250 fathoms (457 m). By far the greatest resource in the fishing area I described is in the 50- to 150-fathom (91- to 274-m) depth, and so we had a good reserve if we needed to shift our area of operation into deeper water.

**Weather**

Our fishermen were not keen to see the size go much above 90 ft (27.5 m), as their experience was that this size of vessel could work as long and in as bad weather as vessels three or four times that size.

Moreover, a larger vessel would inevitably involve a much larger crew and experience shows that a larger vessel does not necessarily produce increased quantities of fish.

These vessels pair fish and therefore cannot work as long in worsening weather conditions as single fishing boats. They have proved extremely good sea boats and I have not heard one complaint about their sea keeping ability from any of the skippers or crews.

**Methods**

The vessels are laid out so they can pair trawl as well as single trawl if required. This changeover can be made very rapidly and they are also designed so that, should we wish to change to purse seining, the hull shape and stability are suitable for that method. We would naturally need to change the method of stowing fish and that would be a major cost. It was not our intention to have a multi-purpose vessel, as I believe that is too much of a compromise. Any change would be costly and would need to be of a permanent nature.

**Crew**

Crewing of these vessels is most important. We work all our vessels on a share basis and any additions to our fleet must be vessels on which the crews can earn better incomes, otherwise they would not take up new appointments. Because of the capital involved we must get the best crews possible if there is to be a profit in the operation for the company, and the safest way to ensure this is to give the skipper, firstly, a good, comfortable, and reliable unit laid out as he desires and, secondly, a unit that has the capabilities of catching sufficient fish to ensure that his and his crew's incomes are increased or at least maintained as they change vessels.

I believe these vessels have proved to be what the company, the fishermen, and our planning committee expected, to the extent that we are now ordering two more at a cost in excess of $2 million, and as our factory capacity is extended I am sure we will be trying to get further import licences for additional units to further expand our fishing base.

# Marketing and government assistance, the key to development of the trawling industry

by R. T. MacKay

*President, N.Z. Seafood Processors Association and Managing Director, Nelson Fisheries Limited*

THE strength and survival of any business depend on its ability to recognise and cultivate a demand and to give the right products at the right price to the right people at the right place at the right time.

There are more profound definitions of marketing, but this is adequate for our purposes. Skilful marketing provides the soundest foundation on which to build a successful business. If we accept this premise, what factors affect our decision on whether to go ahead and produce and sell a particular product or commodity? We need to know what people want, what form and price it should take, how often they want it, and therefore what its potential is.

We need to diminish the amount of guesswork and assemble as many facts as possible. This information will allow us to spot any market "gaps" and allow us to capitalise on opportunities for improving existing products. Only then is it sensible or possible to make a judgment decision. These remarks are an attempt to set the stage for the questions that are being asked by everyone connected with the fishing industry:

- What is wrong with the demersal fishing industry?
- What can be done to rectify the situation?

The fishing industry is orientated towards production rather than marketing and until a concerted effort is made to analyse the market and set up marketing and distribution organisations (thus moving towards a fundamental marketing policy) no progress is likely. Only by relating supply to demand, and not just catching fish and then trying to sell it, can there be any immediate solution to the present situation.

Therefore, the future of New Zealand's fishing industry is closely linked with its ability to sell overseas at a profit, and no market has been left wide open by the creation of the 200-mile economic zone. Access to foreign markets is an essential pre-requisite to fishery development and use of resources; without these markets one cannot have a profitable and expanding industry. In addition to marketing, the other two important facets are catching and processing, and both of these must be profitable in their own right before the industry can develop and expand.

**Cost structure**

Our industry is having to adjust to a different cost structure as it moves into the less preferred and lower priced species. If catching the fish and turning it into a salable product costs x and we can sell it only at $x-10$, the resource from New Zealand's point of view is valueless. This can be overcome by Government's providing help and relief to the catching and or processing sectors of our industry to enable us to compete on overseas markets. The Government must make up its mind whether it requires overseas funds, and if it does, to what extent it is prepared to help our industry.

Commonly, whenever fisheries development is under consideration, great emphasis is placed on catching and insufficient emphasis on processing and marketing. I do feel that development means more than an increased catch. It means earning the greatest yield possible from use of a resource. The main objective of developing the industry is to earn foreign exchange. Therefore, products must be designed and produced that will interest overseas consumers and satisfy their demands.

The question of the size, both in physical volume and monetary terms, to which the New Zealand industry can expand must be considered before realistic planning can be carried out. I recommend, therefore, that planning for development be undertaken in a series of rather modest steps.

**Resources**

Fishery resources are similar to any other natural resources in that they have limited size and they can be harvested with varying degrees of efficiency. However, unlike agricultural science, most fishery science has not reached the stage where the natural reproduction can be artificially augmented. Supplies of fish now and in the next few years will continue to depend on the interaction between natural changes in the size of resources and the efficiency of the catching sector.

Knowledge of the success of spawning provides a basis for looking forward a few years, the depth of focus depending on the age at which fish reach a commercially interesting and takable size. It is not possible to forecast near-water demersal fisheries more than 3 or 4 years ahead, for a forecast depends on the knowledge of the future supply of young fish and of how old the fish are when they make their contribution to the landings. It is obvious that prime fish as we know them in New Zealand, for example, snapper, tarakihi, and elephant fish, are showing downward trends. Fish such as red cod, barracouta, whiptail, and mackerel are increasing, but these species return low market realisations, and I believe they will continue to do so in the immediate future. This affects the economics of all operations.

Research into both the known and unknown resources is also important. With unknown resources the object is to find what new species are present which may offer opportunity for commercial exploitation.

**Marketing**

On the subject of marketing, several questions arise:

- Where are the potential markets and what size are they?
- What products are required?
- What is the price situation as a basis for profits?
- What is the competition, and how expensive would it be to win a share of a given market?

It is extremely important that appropriate studies be made to find answers to these questions.

There is a further consideration and that is that certain species of fish in New Zealand bear unusual names which are quite unknown in many areas of the world. One wonders if this could be an obstacle to acceptance in certain markets.

**Transport**

In consideration of markets, transport must be taken into account. It is a fact of life that transport costs, internally and externally, are at high levels. It would be interesting to know what percentage of New Zealand's gross national product is spent on all forms of transport, and what shipping freights are costing the country as a percentage of our total export earnings. These costs also reduce our competitiveness in overseas markets.

**Technical education**

I think there is a need for upgrading technical education not only in catching, but also in processing, to improve the quality and presentation of seafood products.

There is sufficient evidence to indicate that many areas in the waters surrounding New Zealand are capable of producing large quantitites of seafood products. There are many misconceptions about the suitability of various seafood products for commercial use. Reports of huge quantities of fish schooling in various areas are taken by many to indicate that it is only a question of catching the product to make it a commercial proposition. It is accepted that there are large quantities of seafoods easy to catch, but many of the species of fish are unacceptable to the market. This is not because of their unsuitability as an edible product, but rather because of people's traditional eating habits or because there has been insufficient effort in developing and converting the new material into a suitable form to make it more acceptable to the market.

The Fishing Industry Board could play a major and important part in assisting product development as well as market investigation and research. Perhaps it could develop, with industry, a national marketing policy regarding some of the less preferred species of fish. When the fish has been caught and the best methods of processing and marketing have been ascertained, it is then a question of being able to assess whether the financial involvement is justified and whether the resource can be classified as a commercial proposition.

**Subsidies**

Over recent years the Government has helped the industry to expand by providing funds for development of both catching and processing. I believe they must complete the "second leg of the double" by providing additional financial support in the form of subsidies to enable us to compete with Third World and less affluent countries, whose production costs are very low and who are able to offer seafood products at prices well below our costs of production.

Before money is spent on developing the fishing industry, it is necessary to establish that there is a market for the particular product at an economic price. Therefore neither the Fishing Industry Board nor the Government should spend large sums of money to develop fish which cannot be sold at a profit; their funds should be used in developing fisheries to land the types of fish for which there is already a suitable, expanding, and profitable market, for example, tuna and squid.

**Economic considerations**

Operating and capital costs of vessels will continue to increase, and therefore it is important to decide what levels of fishing are likely to give most benefit to fishermen and to the overall economy, not only in the short term, but also in the long term.

Fishing pressure on our prime species will be maintained and it is obvious that fish stocks which are already decreasing will continue to decline. This leaves the present economics of operating large vessels very much in doubt if they are fishing only the cheaper varieties such as barracouta, jack mackerel, and red cod. In consideration of the development opportunities for the New Zealand industry it must be recognised that there are considerable stocks of these less preferred species to be caught.

I think that encouragement for the industry to develop further will need to be restricted to much larger vessels capable of exploring the deeper-water resources or to vessels fishing under-utilised pelagic species, particularly tuna and squid. However, if this issue is not faced and resolved now, it could lead to economic disasters, as many of the companies will not be able to subsidise their vessels from previous high profits from prime species of fish.

The processing sector also has problems. Production costs in handling demersal fish, whether snapper or barracouta, are much the same. Labour used in unloading, processing, and packaging, packing material costs, and cold storage charges are almost identical for each kilogram of fish handled. However, with the less preferred species market realisations are considerably lower, and they are not sufficient to cover overheads and allow companies to make a profit. Export prices would need to improve by 50% to give a marginal profit. The ability of the companies to maintain prices to fishermen at their present level is in question, but fishing companies also realise that if prices were heavily reduced, the viability of the catching sector would be further seriously eroded. Once there are economic problems in catching, the whole industry is in jeopardy, as it relies on the profitable fishing fleet for its supplies. Without it we do not have an industry.

**Future of the industry**

The fortunes of the fishing industry will continue to fluctuate until an orderly, well-defined marketing strategy is established. There must also be a genuine effort by members of all sections to see the fishing industry as a single entity and to discuss and adopt a united front in making recommendations to Government to overcome our problems; a fragmented body will achieve very little. Product development must be encouraged and expanded, as it has been in other frozen food industries, and we must find out exactly what consumers want and can afford.

Fishing is a means, not an end. The end object is to provide the consumer with seafood and in the whole chain of events the product is the all-important consideration. The most important person is the customer, since it is his money that is being sought.

The future of the fishing industry represents a challenge. This is basically a marketing challenge and if accepted it can provide wealth and prosperity for the industry and the country as a whole, but to succeed it must have the continued financial support and help of Government.

## General discussion of the day's papers

### Foreign catch data

Concern was expressed at the paucity of catch and effort data from Russians fishing in New Zealand waters, despite repeated requests from Fisheries Research Division, which had only resulted in release of total annual catch by species. Although catch totals given by foreign countries could have been falsified, there was no reason to believe this was so. For example, the totals also included prime species and catch figures for these species appeared to be reasonable. The total allowable catch quotas were set at conservative levels to allow time to carry out further biological studies.

### Prices

Mr Armitage was asked what effect the removal of snapper prices would have on the average f.o.b. values quoted in his paper. He replied that the prices would drop by about $100 per tonne without snapper.

### Licensing

Mr Waugh was warned of the need to consider the negative aspects of licensing demersal fishing effort. He repeated that he was talking of control rather than licensing in the pre-1964 sense; there was still a need for restraint which perhaps would include some system of licensing, but he was fully aware of the danger of stagnation associated with licensing.

### The need for and problems of foreign vessels

Mr Hufflett was asked about crewing of joint venture vessels; at what rate were fishermen paid, and if, for example, there was a Japanese crew, what union or association would they come under?

He replied that all Japanese crew members on vessels under charter to Sealord Products Limited were members of the New Zealand Federation of Commercial Fishermen. They were paid Japanese standard rates, which were often higher than New Zealand rates. The Americans on tuna purse seiners were also paid at higher rates than New Zealanders.

The questioner also asked if, as expected from the start of joint venture or charter operations, foreigners were being gradually phased out of purse seining.

He was told that one super seiner was entirely New Zealand owned, and New Zealand crew members worked on other chartered purse-seine vessels.

Mr Cunningham commented that joint ventures should not be regarded as a backdoor licensing method for a New Zealand company to employ (on a long-term basis) foreign vessels and crews under conditions not normally applying in New Zealand. The joint venture proposals were covered by the New Zealand Shipping and Seamen Act and only short-term (1 year) exemptions were given. After this the vessels must comply with normal New Zealand survey and crewing requirements.

Co-operative purchasing arrangements were also legally possible; that is, purchasing fish from a foreign vessel licensed to operate in our waters. There were conditions of sale, such as that landed prices must not depress local port price and crews should belong to relevant New Zealand unions. No one had yet suggested such a purchasing agreement.

Mr Anderson asked if companies envisaged any marketing problems for non-preferred species, for example, during 1979 when charter and joint venture vessels begin to land considerable quantities of such species. Mr MacKay said an answer was not possible. For example, the Japanese market was oversupplied until at least September 1979. Prices for barracouta in Japan at present were 18c per kilogram ($180 per tonne), well below the figure of $240 given by Mr Armitage as the minimum required for economic operation of larger vessels around New Zealand.

With regard to operations by foreign trawlers, especially the length of tow mentioned by Mr Roberts, Mr Kenton wanted to know about the quality of squid or barracouta after 5 hours or more in the net. A reply was not given here; but in the afternoon session on Friday a MAF fisheries officer observed that overtowed fish came up in bad condition and were frozen immediately. He commented that the condition of foreign catches was not necessarily good.

### Future fish composition

Mr Griffiths asked Mr Armitage about the expected species composition of the projected 1979–80 North Island catch of about 55 000 t (up from the present 32 000 t). Mr Armitage replied that he had no idea; the projections were based on average catch rates associated with the expected increased fleet size.

### European market potential

Mr Hinds pointed out that about 40 million tourists passed through Italy each year, eagerly looking for traditional Italian dishes, but because the Mediterranean Sea was more or less fished out, Italy would need large future fish supplies. He wondered how much effort was being put into expanding into the European market and what success there had been.

Mr Mills replied that his company exported a small quantity to the European market, but because

Argentina could supply snapper, squid, tuna, and crayfish at much lower prices, the market was limited. Greece was a likely market, but there was considerable difficulty because of regulations about certifying fish.

### Harmful effects of foreign vessels with small-meshed nets

Mr Stevens suggested that earlier operations by large foreign trawlers using fine-meshed nets and nets with fine-meshed cod-end liners would have depleted quantities of juvenile fish (barracouta, hoki, and hake, for example) which would now have become adult fish. For instance, hake were now no longer caught in Cook Strait.

Dr Colman pointed out that there was a high natural mortality of young fish anyway. (He implied that if they had not been caught by foreign trawlers, they would have died through natural causes.)

### Less preferred species

Mr Hinds asked for comments on why some species were less preferred than others. He wanted to know the characteristics that made them less acceptable and whether these characteristics could be altered.

Mr Jarman replied that they were less preferred because they were just not wanted as much on a particular market. The main characteristic was that they were unfamiliar species and this was often tied up with tradition. Some markets, such as Japan, had many traditional dishes. He said that the Koreans were much more flexible in their tastes. For example, Alaskan pollack was recently introduced on the Korean market and had now become highly preferred.

Marketing less preferred species was partly a promotional problem and partly to do with whether a market was willing to change its requirements. Evidence for such a change was seen by Mr Jarman on a recent trip to Japan. In one supermarket which supplied a middle-class Tokyo suburb, less preferred species were being sold because they could be made available at a lower price than traditional species.

### Catching hoki

Mr Hufflett pointed out that the graphs showing catch rates of hoki by Korean trawlers indicated that higher catches were related to greater headline height. His company did not have vessels capable of towing such gear, and he wanted comments on the possibility of using mid-water trawl gear for hoki.

Captain King (FRV *James Cook*) agreed that a high-opening bottom trawl was essential for demersal fishing for hoki and that echo traces regularly showed that hoki were off the bottom, but it had not been possible for *James Cook* to trawl for them because of winch troubles. Mr Patchell commented that when spawning the fish were at a depth of 250 m where the bottom depth was 500 m or more. Dr Francis pointed out that the 3500-t West German vessel coming to New Zealand this summer would be using both mid-water and demersal trawls for southern blue whiting and hoki on the southern plateau.

### Marketing

The representatives of the Development Finance Corporation (DFC) were asked if they ever considered market potential for fish species when evaluating loans for fishing vessels.

Mr Taylor replied that though the DFC had not been greatly involved in financing larger vessels over the last 18 months (because the Rural Bank was now able to do so), there was great concern that New Zealand was too production-orientated rather than market-orientated; it was most important to get a consumer for the fish caught.

### International competition

A question was raised about future planning of opposition countries who exported fish to our markets (Australia and Japan).

Nothing was known of such planning. According to some sources, said Mr Mills, Argentina had the largest untapped fish resource in the world today. For example, in 1977 New Zealand exported about 3000 t of snapper to Japan, of a total of 7000 t imported by them. Argentina had exported 1000 t per month for the last 7 months, and it had flooded the Japanese market. Other competition was recognised, such as the sale of fish by Russia through Singapore to Japan; and the sale by the Japanese of fish, caught in New New Zealand waters, to Australia, which must be having a detrimental effect on New Zealand sales, but nothing was being done about it.

Mr Mills suggested that the New Zealand strategy must be to move out of these areas (Japan and Australia) and enter new markets. It should be taken into consideration that every foreign nation was using New Zealand fish to buy currency; they were interested primarily in profits and New Zealand must compete against subsidised fleets.

### Overexploitation?

Mr Donaghue referred to a concluding comment by Mr MacKay that as prime species declined we would be obliged to fish for other species, and he asked if it was accepted as inevitable that we were overexploiting our limited resource of prime species; and if so, why we were allowing further pressure on the stocks by bringing more fishing vessels into the coastal zone.

Mr MacKay agreed that we were overexploiting coastal species in order to obtain overseas earnings. He continued that he was unhappy that farmers received a subsidy (of $300 million last year) for similar reasons (bringing in overseas capital) and it was time that the fishing industry received similar incentives.

**International trading**

Mr Cunningham and Mr Jarman were asked if they had any contact with the opposition Southern Hemisphere countries (Australia, Argentina, Chile, and South Africa) to ensure that we were not being played off against one another by Northern Hemisphere countries.

Mr Cunningham replied that there was regular contact by exchange of scientific information between these countries and New Zealand, but that perhaps there was little discussion of economic matters.

Mr Jarman said that the Fishing Industry Board had contact with Australian interests, though they did not have an equivalent body there. There was no contact with Argentina or Chile, but the Board had asked for information from our trading post in Argentina about joint venture proposals between Argentina and Japan. It was understood that they allowed joint ventures only if the foreign country would agree not to supply markets traditionally supplied by Argentina (for instance, Mediterranean countries). The large quantity of hake which appeared on the Australian market last year, at prices of $0.95–$1.50 per kilogram, was believed to be caught off Argentina, processed in Japan, and sent to Australia. So far this year hake had not reappeared on the Australian market.

Australia has not traditionally had a major trawling industry, but it was expanding at about 15% per year. We could only expect our major share of the Australian market to decrease with the expansion of their own fleet. The need to diversify our markets was reiterated.

Another speaker pointed out that we had expanded our exports from $28 million in 1976 to $50 million last year and expected to reach $70 million this year. Our first exports of snapper to Japan were made in 1967. With our own rapid expansion we must expect a few initial setbacks in marketing.

**30-m vessels**

Dr Elder commented that, in his view, the 30-m vessels newly imported to New Zealand were not really being aimed at deep-water species, but at the already heavily exploited coastal stocks. He wondered whether subsidies had been put on the wrong type of vessel.

Mr Hufflett replied that 75% of the catch of these larger vessels was of less preferred species. He also pointed out that the so-called subsidy on these vessels was in fact just a removal of the import duty.

Mr Kenton further noted that steel, electronic equipment, and engines were all duty free for vessels built in New Zealand, so that there was really no difference between them and imported vessels. He also stated that vessels much larger than 30 m were needed for fishing the southern plateau, but his company could certainly not afford to buy the 300-t vessels essential for that area.

Captain King pointed out that Korean catches already showed that even 800-t vessels could not fish effectively in deeper water (in contrast to the Korean 1500–3000-t vessels). He suggested that the 30-m vessels could be used for mid-water trawling; anything to keep them out of the tarakihi nursery grounds in Tasman Bay, where there had been four 30-m vessels working throughout the previous week.

Mr Mills accepted that the 30-m vessels could be used for other types of fishing, such as deep-water prawn trawling in the Bay of Plenty, if gear could be designed to fish there.

Mr Waugh agreed that the 30-m vessels would not be able to fish the deep-water resources, but he suggested that they should be used in coastal areas to replace smaller vessels which might not be so efficient.

The general feeling of those present seemed to be that the 30-m vessels were not replacing anything, but simply adding to the current fleet size.

# Why do fisheries collapse?

by R. C. Francis
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WHAT causes fisheries to collapse? The answer is simple: we don't know. Most drastic declines in fishery yields have occurred under conditions of heavy fishing, what might be termed "overfishing". However, the combined effects of both living and non-living components of the marine environment (an environment of which we are virtually ignorant) seem to have as much effect on fishery dynamics as the fishery itself, if not more.

In the traditional paradigm of fishery population dynamics (perhaps better termed population "statics", since, as a science, it appears to be useful in describing fishery behaviour only under a limited range of low or moderate stress levels) two types of fishery-induced declines in the productivity of a stock of fish can occur. In the first, referred to as growth overfishing, if moderate or heavy fishing is allowed too early in the life of the target fish, a maximum harvest is prohibited. If, on average, fish are caught at an older age and allowed to reach some optimal size, the yield from the stock would be larger. In Fig. 1 the large outside circles represent the total weight of a cohort (age group of fish) as it grows older, and the smaller inner circles represent the number and average weight of individual fish in the cohort. The total biomass of an age group starts off being divided among a large number of small fish. As the cohort grows older more and more biomass is concentrated into a diminishing number of larger fish. The cohort reaches its maximum biomass at some intermediate age (A). This is the age at which the theory of growth fishing indicates that optimal exploitation should take place.

Growth overfishing has traditionally been approached as purely an economic problem. The main concern is with low yields rather than the biological effects of fishing on the stock. It is fairly easy to detect and is rapidly remedied by implementation of such controls as mesh size limits, minimum fish size limits, and closed fishing areas.

If fishing is heavy enough and directed in such a way to impair the ability of a stock to reproduce, a second type of overfishing—recruitment overfishing—is said to occur. The biological productivity of a stock is significantly affected and the result is a fishery collapse of one form or another. This type of overfishing is very difficult to detect while it is happening and has proved to be virtually impossible to predict. In the scientific post mortems which follow most fishery collapses, great debates have taken place in attributing the causes to heavy fishing or to "the environment".

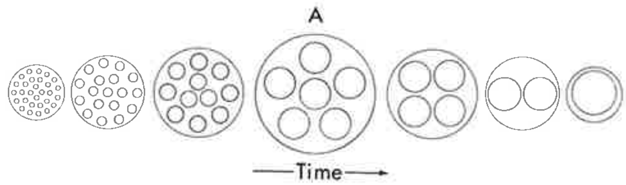


Fig. 1: Changes in a cohort "energy" system with time (from Alverson and Carney 1975).

**Pacific sardine fishery**

The Pacific sardine (*Sardinops sagax*) fishery of the North American west coast was once the largest fishery in the United States in tonnage of fish landed. The catch (Fig. 2) rose during a period of 20 years to over 700 000 short tons in the late 1930s and averaged over 500 000 tons per year between 1935 and 1945. It then declined precipitously to a low of 120 000 tons in 1947, recovered slightly between 1949 and 1952, and then declined again to virtually nothing in the late 1950s. What happened to the stock and fishery is still being debated today. Several things are worth noting.

1. Sardines are short-lived fish whose populations exhibit large-scale fluctuations in productivity; this makes them particularly vulnerable to catastrophic fishery collapses. Sardine fisheries depend heavily on recruitment (new year classes) for their sustenance. Recruitment, in turn, is susceptible to large-scale fluctuations due to variability in environmental and other ecological conditions.

2. Sardines are surface-schooling fish exploited by highly specialised purse seiners. During the period of high catches, when the stock was apparently already on the decline, catch rates in the fishery did not decline in accordance. The area that the stock inhabited was reduced as the stock size dropped. However, inside the range of the stock, and

particularly in the fishing area, both the size and density of schools remained quite high.

3. Sardines and anchovies *Engraulis mordax* are thought to be competitive species. Anchovies spawn at a lower temperature than sardines. Thus they are capable of spawning earlier in the year as the water warms, and they have a greater reproductive success in generally colder years. They both appear to occupy the same ecological niche. Anchovies have since replaced sardines in the food web of the California Current. Perhaps the decline of one species and the increase of the other are linked.

4. The sardine fishing industry was well organised and, in the face of a drastic reduction in fishing success, wished to continue fishing at high levels regardless of the consequences. Even when landings were at their lowest in 1962, fresh-fish market operators who sold sardines for bait pressured strenuously to keep the fishery open. They were paying fishermen up to $500 per ton of fish landed and, in turn, retailing the bait for $1,500 to $2,000 per ton.

## Pacific halibut fishery

The Pacific halibut (*Hippoglasius stenolepis*), unlike the sardine, is a long-lived fish whose populations have a low rate of production. Whereas, under ideal conditions, a sardine population might double its mass in 1 year, a halibut population could at best increase at a rate of about 5% per year. In this sense, halibut are similar to the snapper and trevally of New Zealand coastal waters. Halibut have an uncomplicated life history and, until 1960, were exploited along the north-west coast of North America by a single type of gear, set-line. Since the early 1960s the fishery has become a multi-gear fishery employing the traditional set-line as well as the newer, more adaptable snap-on branch-lines (sometimes used on salmon trollers and drum seiners in the off season for salmon). This opened the fishery up to a wide variety of smaller boats.

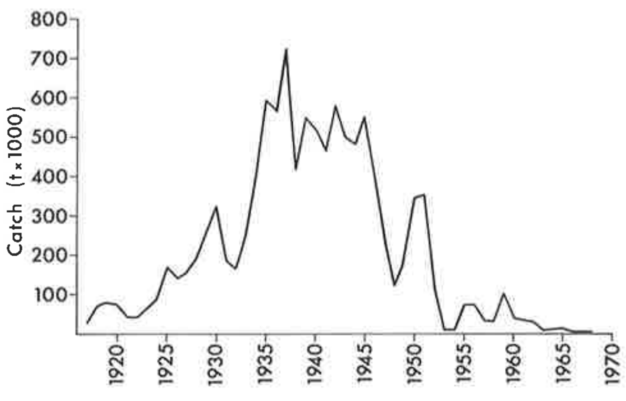


Fig. 2: Sardine catches in short tons from California waters for the years 1917 to 1968, plotted by year at end of season. Data from California Co-operative Oceanic Fisheries Investigations, Reports VIII, X, and XIII (from Talbot 1973).

In addition, large Japanese trawlers have intensively fished the traditional halibut grounds since the early 1960s and have recorded a significant incidental catch of small halibut before their recruitment into the set-line fishery. In those 15 years the fishery has shown a significant decline in both catch and catch per unit of effort (CPUE). According to the International Pacific Halibut Commission's (IPHC) 1976 annual report (Fig. 3) the production of young halibut has declined from an estimated high of 18 million 3-year-olds in 1945, which provided an estimated 9 million recruits to the set-line fishery 5 years later and led to a CPUE of 120 lb per skate in 1955, to only 4 million 3-year-olds in 1975, which might be expected to provide only 2 million recruits to the set-line fishery in 1980 and perhaps a CPUE in 1985 of only 40 lb per skate, a 75% reduction from 20 years ago.

The biological reasons for this decline are unknown. Those most likely are either an increase in larval or juvenile mortality due to changes in environmental conditions or a reduction in the size of the spawning stock by heavy fishing pressure. However, IPHC reports that there is no evidence of a long-term change in the environment and that the abundance of spawners was high until long after the decline in young halibut started. Until more is known about environmental factors and spawning stocks the cause of the reduced abundance of young halibut will remain in doubt. Nevertheless, IPHC claims that the decline need not have taken place if there had been early understanding of the effects of the new types of gear as they entered the fishery. The commission, responsible for managing the fishery, lost control, and because of a lack of basic information on catch and effort of the new gear entering the fishery, it was unable to determine the precise level of catch necessary to halt the decline. A combination of a high price paid for halibut, overcapitalisation of the north-east Pacific coastal salmon fisheries, and the low capital investment of using snap-on gear on a small boat has resulted in hundreds of small boats and new fishermen entering the halibut fishery in recent years and thus greatly enlarging the management problems.

## Basic problems

The basic problems associated with fishery collapses can be summarised as follows. Many recruitment failures seem to be caused by a combination of heavy fishing and environmental changes. Particularly vulnerable are stocks which are exploited in dense schools of either feeding or spawning concentrations. However, the direct causes of most collapses are poorly understood and virtually impossible to predict. When they happen they require quick, decisive corrective actions which excess capacity can make impossible to achieve.

What is required to overcome the problem is an improved understanding of the mechanisms which cause fisheries to fluctuate. Two things which will help facilitate this are:

- Better fishery and environmental data for study. Detailed information is needed on when and where catches are made, how much effort is exerted in taking these catches, and the age structures of the catch (and populations being fished).
- Understanding of the total marine environment in which fish resources live. This will involve studies of the structure and dynamics of marine ecosystems in which certain types of fisheries exist.

Finally, the days of open access exploitation of fishery resources are over. The sooner this is realised the better. To maintain the productivity of fish stocks and avoid fishery collapses, effort must be limited. Advice on management will be given in light of uncertainties about stock levels and dynamics. The fishery scientist must be prepared to give advice not only on the most likely occurrences, but on other possible events. According to Gulland (1978) "management will have to be based on well-informed common sense, "well-informed" meaning, for the biologist, that he gives advice not only on the most likely occurrence, but also on other possible events, particularly the unpleasant ones. If he has this advice, common sense, and a close familiarity with the fishery, then management can hope to be successful".

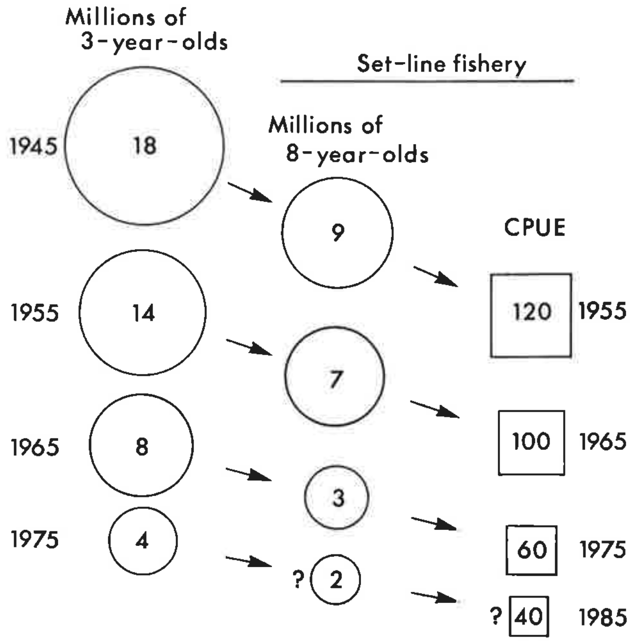


Fig. 3: Effect of reduced abundance of young halibut on recruitment and CPUE in the set-line fishery in the Gulf of Alaska (from International Pacific Halibut Commission 1977).

## REFERENCES


ALVERSON, D. L., and CARNEY, M. J. 1975: A graphic review of the growth and decay of population cohorts. *Journal du Conseil International pour l'Exploration de la Mer 36*: 133–43.

GULLAND, J. A. 1978: Fishery management: new strategies for new conditions. *Transactions of the American Fisheries Society 107*: 1–11.

INTERNATIONAL PACIFIC HALIBUT COMMISSION. 1977: Annual Report 1976. 40 pp.

TALBOT, G. B. 1973: The California sardine-anchovy fisheries. *Transactions of the American Fisheries Society 102*: 178–87.

## Discussion

Dr Francis was asked if the sardine stock was fished while it occurred in spawning concentrations, what level of effort was put into fishing the stock, and the extent of the area fished. He replied that the stock was not fished in spawning concentrations. Scientists do not really know what happened to the Pacific sardine fishery; the basic feeling now is that the fish were going to disappear anyway. Some people believe that if fishing effort had been relaxed when the fishery was still quite productive, the collapse may not have occurred so fast.

Dr Francis believes that basically there was a natural change from sardines to another species and there happened to be an intensive fishery operating on the sardines at the same time. They are the type of fish that school normally, not just in spawning concentrations. Nobody knows the cause of the collapse and a great debate still continues, but it is generally thought that a combination of heavy fishing and adverse environmental conditions led to the collapse of the fishery.

Dr Francis was asked, in the light of his comments on the Pacific halibut fishery, his opinion on what may happen to the ling fishery on the Chatham Rise and Mernoo Bank, especially with the influence of Korean and Japanese long-liners that have been fishing there during the last 2 or 3 years. He was also asked whether sufficient monitoring is taking place now.

He replied that in the long term the fishery shows a lot of potential, and it is an energy-conservative fishery. Now we are getting the catch information required, especially since April 1978. It would be valuable to have back-up information from the Japanese, as this is one fishery from which we do not have much Japanese historical information. We know that in 1977 they caught about 35 000 t of fish by bottom long-lining and about 75% of this was ling. In 1976 they took 30 000 t and in 1975, 15 000 t by bottom long-lining.

The literature on the halibut fishery shows that long-line fisheries are not as easy to assess as one would expect. Measures of effort are difficult to assess; hook spacing, soak time, bait, and the way the gear is set must all be considered. The halibut commission thought they had all the information necessary to manage the fishery, but they did not and the debate continues.

The ling fishery is an important fishery and we should demand the information before we allow anyone else to fish it.

# The Hauraki Gulf snapper fishery

by L. J. Paul and R. D. Elder
*Scientists, Fisheries Research Division, Ministry of Agriculture and Fisheries, Wellington*

THE Hauraki Gulf snapper fishery, one of the most important demersal fisheries in the country, is appropriately discussed in this session on problems because:

- It has had a long history of problems. Some, but not all, of these have resulted from overfishing;
- The difficult question "Who owns the resource?" is clearly involved;
- Despite, or perhaps resulting from, these problems, there is now sufficient information available on the snapper and its fishery to allow the development of several alternative management strategies.

**Present problem**

This fishery has been regulated by closed areas since 1902. Over the years a complex set of regulations defining the areas closed to trawlers and Danish seiners has evolved. These regulations are based on a desire to protect spawning and nursery grounds and on the need to separate physically the fishing grounds of different groups of fishermen (Paul 1977). In 1972 these regulations were simplified, though the closed areas remained essentially the same (Paul 1974). At this time the Ministry of Agriculture and Fisheries decided to investigate relevant aspects of the fishery to find a more rational management plan, which would come into operation when the regulations automatically lapsed in 1976 (extended to 1977). During the early 1970s some signs of overexploitation appeared (Paul 1974, Elder in press).

Although the Fisheries Amendment Act 1977 allowed declaration of certain "Controlled Fisheries", there was considerable opposition within the fishing industry to any fishery for marine finfish (as opposed to molluscs, lobsters, and freshwater eels) being brought under such control. After a series of meetings with the Auckland industry in 1976 and 1977 the Ministry decided to avoid the problems inherent in declaring the Hauraki Gulf a controlled fishery in which effort could be limited. Instead, a total catch quota was introduced for snapper taken by trawl and Danish seine, and there was some rearrangement of closed areas (Fig. 1), with a mesh size increase for trawl nets.

This quota, based on the best scientific evidence available at the time, remains our best estimate of sustainable yield (Elder in press). The catch quota for the first 6 summer months of the 1977–78 quota period was not achieved. In view of the reported fishing effort that was applied in the Gulf during this period, the shortfall in landings confirms that the area has been overfished.

The problem now facing the fishery is how to reduce fishing effort to that which will allow the stock to recover to a level capable of sustaining the allowed quota. It is a socio-economic problem. Further biological studies may refine the sustained yield estimate or the effort required to achieve the yield, but they will not solve the basic problems: too many fishermen for the available fish and a conflict between fishing methods. It is going to take the co-operation of the local fishermen and industry to solve these

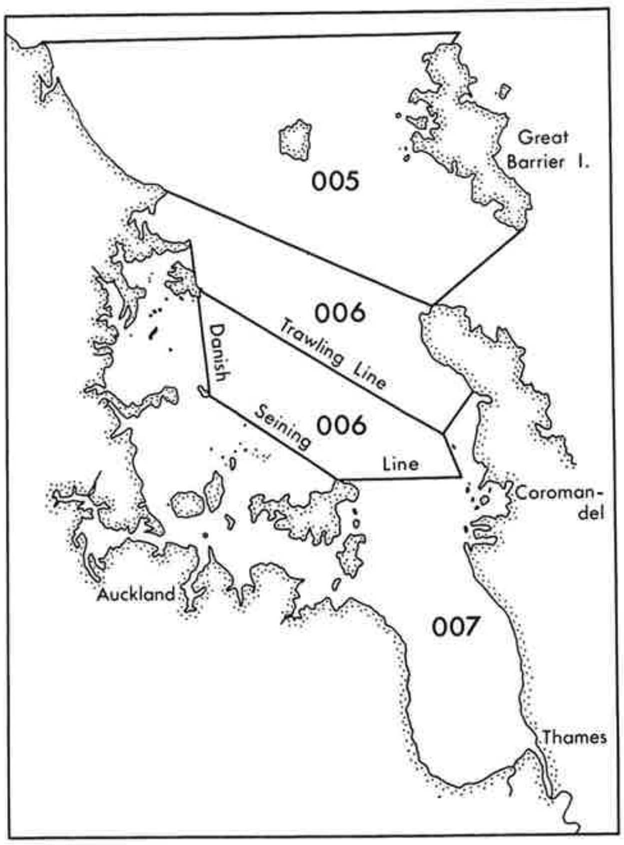


Fig. 1: The Auckland fisheries management area, showing fishing areas 005, 006, and 007 and trawling and Danish seining lines.

problems and brave men to recommend solutions. A Hauraki Gulf Snapper Advisory Committee has recently been set up by the Fishing Industry Board. This committee has had one meeting so far, at which many of the old socio-economic problems were raised. It voted to retain the status quo until further information became available. The Fisheries Management Division of the Ministry of Agriculture and Fisheries is preparing a paper for submission to the next meeting of the committee, which sets out the pros and cons of declaring the Auckland snapper fishery, and its associated fisheries, fully controlled.

## Snapper biology

There is no evidence for more than one stock of snapper in the Gulf, and this stock may be part of a single population unit extending along the north-east coast of the North Island.

The snapper is slow growing and long lived. The large numbers of old fish in commercial catches from the Gulf represent survivors from earlier years when fishing pressure was lower. They also indicate a slow movement on to clear-bottom Gulf grounds of fish which have been protected from heavy commercial fishing for much of their lives, either by regulations or natural cover.

Recruitment of young fish into the catch occurs at about age 4–6 years. The strength of year classes (numbers of fish of one age) varies considerably from year to year. Large numbers hatch and survive in warm springs (presumably because they find a good food supply); few survive hatching in cold springs.

Increasing the minimum cod-end mesh size to 125 mm (5 in.) for trawl as well as seine nets will be beneficial to the fishery, as it will allow more juveniles to escape and grow, but will not significantly affect the catch of adult snapper.

Although juveniles are certainly more abundant in certain areas, it is difficult to define nursery grounds which do not also contain large numbers of adults. The ratio of juveniles to adults is remarkably constant over much of the Gulf. Only the Firth of Thames contains a high density of adults without a similar abundance of juveniles.

## The fishery

All available catch and effort information on the commercial fishery has been examined. Before 1968 fluctuations in snapper landings were largely due to economic factors within the industry (Fig. 2). However, the marked decline in the early 1950s did result from a series of poor recruitment years, and it also followed several years of very heavy post-war fishing. [The tendency for a decline in catch rate to occur after a combination of increased fishing pressure and an environmental change—in this instance a sequence of cold springs—was pointed out by R. C. Francis in his paper on fishery collapses, page 72.] The 1968 to 1971 increase in catch was due partly to an increased abundance of fish (that is, good recruitment) and partly to improved fishing techniques and more fishing vessels, which resulted in heavier fishing pressure.

An analysis of the catch and effort data for the years 1960 to 1974 showed that a maximum sustainable yield of about 3800 t per year, from 4500 standard days fishing, at a catch rate of 840 kg per standard day, could be expected at present levels of recruitment and natural mortality (Elder in press). (A decline or an increase in recruitment brings about a corresponding decline or increase in yield. If natural mortality declines, the yield will increase, and vice versa.)

The analysis suggested that the high landings from the Gulf in recent years had overexploited the snapper stock, and it indicated that the fishery would not recover for some years unless management action was taken.

## Management options

The four management strategies for the Gulf fishery, with our comments, are listed below:

1. The industry could have been **advised** to curtail any plans for expansion of fishing effort. However, in view of the fragmented and competitive nature of the industry this approach was considered to be unrealistic.

2. The **closed fishing area** could have been extended further out into the central Gulf to provide a sanctuary for sufficient snapper to maintain the stock regardless of fishing pressure on the adjacent outer trawling and seining grounds. This extension of closed areas has been the traditional approach to overfishing problems in New Zealand, and it is favoured by several groups in the Hauraki Gulf area, certainly by the politically significant amateur fishermen.

- The absence of other controls maintains free enterprise. The strong fishermen or companies survive; the weaker ones fail. New Zealanders hold strongly to the freedom to go into business, make a living, make a fortune, or go bankrupt.
- This system succeeds at the expense of efficiency. By restriction of trawlers and seiners to the poorer grounds, costs to these vessels are increased. There must be greater capital investment in large vessels, and the cost to the consumer (who, in the final analysis, always pays) will be higher.

- The resource—the fish stock—will be inefficiently exploited. The part of the resource on open ground will be overfished; the part in the closed areas will be underfished and will suffer the various biological consequences of overcrowding.

3. **Fishing effort** could be **controlled** by regulation, that is, limited licensing. The number of vessels could be set to give optimum individual returns, with a capacity to take on average 3800 t per year. The actual catch would vary around this figure, with higher catches in years when snapper were naturally more abundant and lower catches in naturally poor years.

- In a scientific sense this approach is the rational one; it tends to stabilise a stock of fish by taking a fairly constant proportion of it, and its success depends less on accurate scientific assessments of stock size.
- In a practical sense it is easier to administer than a quota system.
- However, because the Act establishing controlled fisheries does not cover marine finfish, such a limit on effort in the Hauraki Gulf snapper fishery is not possible at present.

4. A **catch quota** system could be introduced. After much discussion and certain dissension this approach was adopted. Catch quotas for trawl and Danish-seine vessels have been introduced for the Hauraki Gulf snapper fishery. In addition, there was some rearrangement of closed fishing areas, and a mesh size increase for trawlers. Line and net boats were assumed to catch a rather small and constant quantity of snapper and were not restricted. These measures have been operating for about 1 year and some comment is now appropriate:

- In a scientific sense catch quotas are less rational than effort quotas. When stock size decreases a greater proportion is caught. Conversely, when the fish become more abundant through increased recruitment, a smaller proportion of the stock is caught. This is the reverse of the desirable situation, and it has the effect of increasing natural fluctuations in stock size.
- In a practical sense a quota system is difficult to administer. It requires a greater bureaucracy to monitor catches and offences are more difficult to detect. (These can be summarised as the under-reporting of catches from the quota area.)
- It can have an adverse psychological effect on fishermen. When catches are poor there is a resentment that the quota cannot be reached and a feeling that the stock is badly overfished. When catches are good and the quota is reached early there will inevitably be an outcry that it has been set too low and that good profits are being lost.

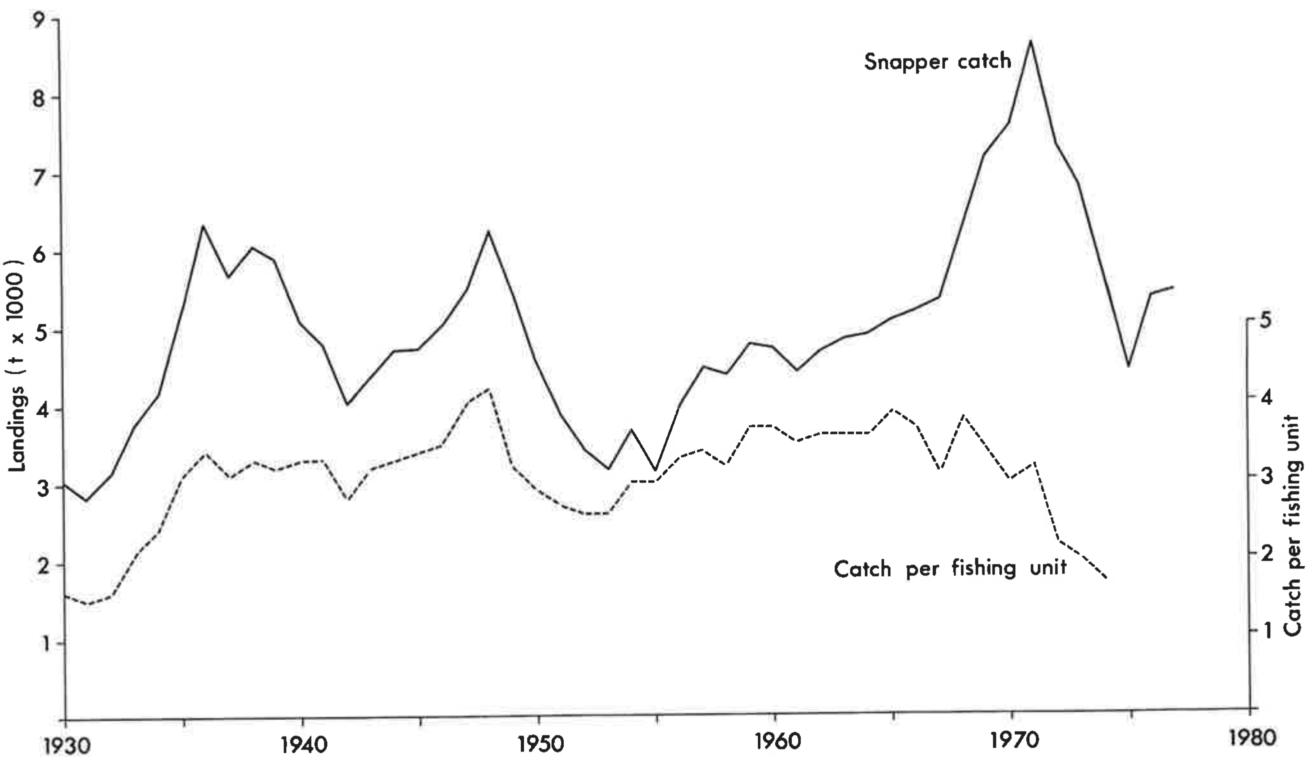


Fig. 2: Auckland snapper catch and catch per fishing unit.

- Although unrestricted entry into the fishery maintains some aspect of free enterprise, a quota system cannot prevent overcapitalisation.

**Efficiency and resource ownership**

In the Hauraki Gulf snapper fishery what is efficiency? Is it one set of large pair trawlers working without restriction in the inner Gulf and landing Auckland's total requirement of fish at minimum cost, with all other fishermen out of work? Or is it 1000 fishermen in small boats? How "efficient" is a line-fishing vessel or small seiner compared with a set of large pair trawlers, not in catch per day, but relative to capital invested and energy requirements, including overseas funds?

We said earlier there were two basic problems in the Hauraki Gulf: too many fishermen and a conflict between fishing methods. In this paper we have commented on the first of these. We leave the second problem for others to debate, because we believe it must be resolved on economic and social, rather than scientific, grounds.

Does the fishing industry "own" the resource? Does it have the right to set levels of exploitation based on financial return to itself? If the New Zealand public owns the resource, do individuals have the right to uncontrolled exploitation, or does the Government have an obligation to regulate the use of resources for whatever it decides to be the overall good?

As scientists we have no special expertise or authority to answer such questions on efficiency and resource ownership. We can contribute scientific data, and we will argue our case strongly if we believe a resource is being threatened or unwisely used. But we respect the rights of those who actually use the resource, and who have a social and economic stake in its future, to participate in management decisions.

REFERENCES

ELDER, R. D. (in press): An estimate of sustainable yield for the Hauraki Gulf snapper fishery from an analysis of catch and effort figures, 1960–74. *N.Z. Journal of Marine and Freshwater Research.*

PAUL, L. J. 1974: Hauraki Gulf snapper fishery, 1972 and 1973: Some evidence for a declining catch-rate. *N.Z. Journal of Marine and Freshwater Research 8*: 569–87.

——1977: The commercial fishery for snapper, *Chrysophrys auratus* (Forster), in the Auckland region, New Zealand, from 1900 to 1971. *Fisheries Research Bulletin, N.Z. Ministry of Agriculture and Fisheries, No. 15.* 84 pp.

## Discussion

When the quota was first put on to the Hauraki Gulf snapper fishery it included fish taken from area 005 and pair trawlers were excluded from this area. The Whangarei pair trawlers protested and were subsequently allowed to fish area 005. The quota was then put on to area 006 alone. Area 005 is bigger than area 006 and is a great snapper-producing area during winter. The questioner felt that the idea of monitoring area 005 was abandoned and he wondered why this was done.

He was told that it was a management decision based on the amount of political and social pressure put on the Ministry of Agriculture and Fisheries by the various interested groups. The present management of the Hauraki Gulf largely reflects the amount of pressure various groups have brought to bear on the Ministry.

The questioner commented that this did not answer the question of why the quota was put on only half of the original area. He believed that if the quota had been left on area 005 as well, it would have been filled in 4 months.

The chairman, Mr Waugh, replied that the quota relates to the total stock in the area. The basic assumption is that the fish are moving through the area and it does not matter where they are taken from; if they are taken, the stock is reduced. The area is really the whole of the Hauraki Gulf and the aim is to reduce the total catch from the Gulf. The present regulations have resulted from lobbying by various pressure groups.

Mr Cunningham said that scientific and socio-economic conflicts always make the formulation of management regulations very difficult.

# The west coast snapper fishery

by K. J. Sullivan and D. J. Gilbert
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THE north-west coast of the North Island from Cape Egmont to North Cape is assumed to contain a single stock of snapper. The fishery is seasonal by nature and 60% of the yearly snapper catch is taken from October to December, which is the recognised schooling season for this species.

**Development**

For many years it was customary for trawlers fishing on the east coast to "fill up" along Ninety Mile Beach before returning to Auckland at the end of a trip. The west coast was long known to contain an underexploited resource of snapper, but fishermen preferred to fish the more sheltered grounds of the Hauraki Gulf and the north-east coast.

On the west coast many days can be lost because of rough seas or because the bar of the Manukau Harbour is impassable. Despite these difficulties, a trawl fishery developed at Onehunga in the 1950s and supplemented the small fleets already working out of New Plymouth, Kawhia, and Raglan.

In 1959 Japanese trawlers, and later some Japanese bottom long-liners, began fishing for snapper off the west coast. Unfortunately no data are available on the total annual snapper catch by Japanese boats. It may have been as high as 1000 t for a few years, but with the introduction of the 12-mile zone Japanese fishing effort for snapper tapered off. Japanese trawlers resumed fishing off the west coast in 1968, but now were trawling primarily for other species outside the 12-mile zone. Official Japanese statistics give total trawl catches between 1968 and 1976, and only in 1972 was the catch greater than 1000 t. Bottom long-liners also appeared again in 1973 and an accurate breakdown of catch by species is available for 1976 data. Snapper made up 2% of the catch.

We can assume that the total catch of west coast snapper by Japanese and New Zealand vessels did not exceed 2000 t per year until 1969 (see Fig. 1). About 1972, as the Hauraki Gulf snapper fishery declined, much trawl effort was diverted to the west coast. The New Zealand catch jumped to over 3000 t in 1973. From 1973–74 pair trawling was introduced in the fishery. The increase in catch rates quickly showed that this method was more efficient for catching snapper than the traditional single trawl. The reason for this is that pair boats catch more large fish.

By the end of 1975 most of the vessels were teamed into pairs. By comparison of catch rates during 1974 and 1975 the relative fishing power of single and pair trawlers was calculated. The fishing power of each vessel of a pair was three times that of a single trawler. The total landings by New Zealand trawlers reached a peak in 1976, when 5400 t of snapper were caught on the west coast. Combined with the Japanese catch this made a total of almost 7000 t, over three times what it had been in the 1960s. In 1977 the yearly landings dropped, mainly as a result of poor weather during the crucial schooling season. It is also apparent that a gradual drop in abundance of snapper has occurred as the accumulated stock of large fish is being reduced year by year.

The exclusion of foreign fishing vessels from this area in 1978 would have reduced the total fishing effort had this loss not been offset by an increase in the New Zealand trawl effort and the commencement of fishing by a pair of 29-m vessels. These are the largest vessels in the fishery at Onehunga at present and they should have greater fishing power than the smaller boats. Hence the 1978 total fishing effort will be similar to the 1976 and 1977 levels. With the expected

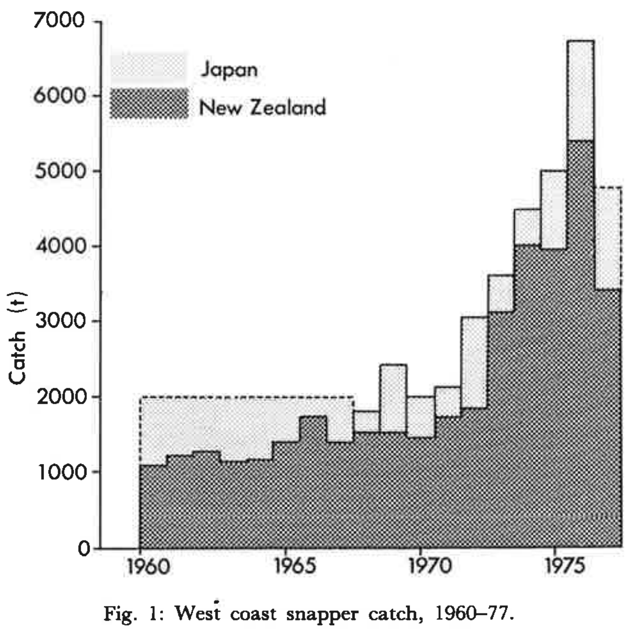


Fig. 1: West coast snapper catch, 1960–77.

introduction of a further pair of vessels in 1979 the level of effort will increase further.

It is, however, the relationship between catch and effort that is of interest both to fishermen and to fisheries scientists.

### Catch per unit of effort (CPUE)

Changes in CPUE (kilograms per day) are commonly used by fisheries scientists as an indication of changes in abundance of fish. As the abundance of fish declines the catch for each day's fishing also declines.

The data given here were from pair trawlers from Onehunga and Auckland, which catch 75% of the west coast North Island snapper landings. The winter and summer catches of snapper between 1974 and 1978 were divided by the number of days at sea as recorded in the fishing returns. This gives the CPUE, the values of which are shown in Fig. 2.

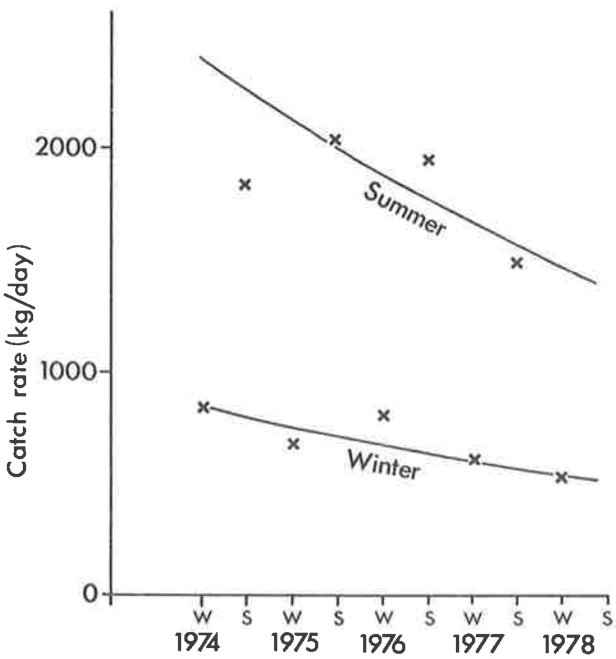


Fig. 2: Average winter and summer snapper catch rates for west coast pair trawlers, 1974–78.

Each year the highest CPUE occurs during the schooling season, when the fish congregate to spawn. During this period fishermen depend on good weather and consequently large fluctuations in summer CPUE occur from one year to the next. During winter CPUE is much lower, but less variable. Therefore changes in winter CPUE are considered to be a better indication of changes in abundance. Both, however, show a downward trend, which is expected to continue. If the fishing effort is increased the decline will accelerate, but if it remains constant the CPUE will stabilise after a few years.

This decline in catch rates is the result of a decline in the abundance of older fish, which have been fished down from a relatively unexploited state since 1974. Before 1974 only a small proportion of the older fish was taken by single trawlers, but with the advent of pair trawlers the old snapper formed a much greater proportion of the catch.

### Size of fish

Samples were taken from the Auckland fish sheds during 1974 and 1975 and have also been taken this year. In 1974 and 1975 they showed that the average fish caught by a pair trawler was about 40% heavier than that caught by a single trawler. It was also found that the size of fish caught by pair trawlers varied seasonally. The catch rate of large fish in the schooling season was about four times that for the winter period.

It is possible to discern a decline in the proportion of large fish in catches since 1974 (Table 1). As the accumulated stock of large fish is gradually reduced by pair trawling the fishery comes to depend on the younger year classes. This is to be expected and does not in itself indicate overfishing. What has to be considered is the total mortality of fish and the size of the spawning stock.

### Fishing mortality

By examination of the growth rate and the natural mortality of the fish it is possible to calculate an optimum fishing mortality. Fishing at a higher level than the optimum results in too many small fish being caught. It also results in a smaller total catch being

**TABLE 1: Size of fish in catches sampled from Auckland fish sheds**

| | % over 12 years | | % by weight over 12 years | | Average weight of whole catch (kg) | |
|---|---|---|---|---|---|---|
| Year | winter | summer | winter | summer | winter | summer |
| 1974 | 26 | 34 | 45 | 59 | 1.2 | 1.7 |
| 1975 | 15 | 51 | 30 | 72 | 1.1 | 2.3 |
| 1978 | 9 | | 26 | | 1.0 | |

shared among more boats, thereby reducing the economic return to each boat.

A theoretical optimum level of fishing mortality was calculated at 30% per year from a yield per recruit model. At present the fishing mortality in this population is estimated to be between 30% and 40% per year. This suggests that the stocks are being overfished.

Members of the fishing industry may feel that they prefer to risk overcapitalisation in the hope that this analysis is too pessimistic. They should realise, however, in their economic calculations that a decline from present catch rates of snapper is certain to occur even if present fishing effort is not increased. In a long-lived species such as snapper the long-term effects of heavy exploitation are not immediately apparent.

## Discussion

It was noted that 75% of the west coast snapper catch was taken by New Zealand pair trawlers and the question was asked whether the other 25% was taken by foreign vessels or other New Zealand vessels.

Mr Sullivan replied that he was considering only the New Zealand catch. The 1978 catch would all be New Zealand caught.

He was then asked what percentage of the fishing effort now put into the area is by foreign vessels, and he replied that the 20-mile line in the area is designed to exclude foreign vessels from taking snapper. In any case, the snapper allocation to foreign vessels on the west coast is no more than 30 t.

# Trevally

by G. D. James

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TREVALLY are an important part of the North Island in-shore wetfish catch; in terms of tonnage they are second only to snapper. Although the same species is found in southern Australia, it is only in New Zealand that trevally form the basis for important trawl and purse-seine fisheries.

They have assumed considerable commercial importance in New Zealand in recent years, mainly because of increased export trade (up from 550 t in 1975 to 2400 t in 1977). Landings increased significantly during the early 1970s and again in 1977, though we do not have accurate landings statistics after 1974 (Fig. 1).

Trevally are caught by a variety of fishing methods, the most important being bottom trawling, which accounts for between half and two-thirds of the total catch. Purse seining, which is used for taking surface-schooling fish, has grown considerably in importance in the last 3 years and now accounts for between quarter and half of the total catch. The rest is taken by a variety of other types of gear, including set nets, Danish seines, drag nets, and box nets. The purse-seine fleet alone has grown from one to seven vessels during the last 4 years, which emphasises the considerable increase in effort that has occurred.

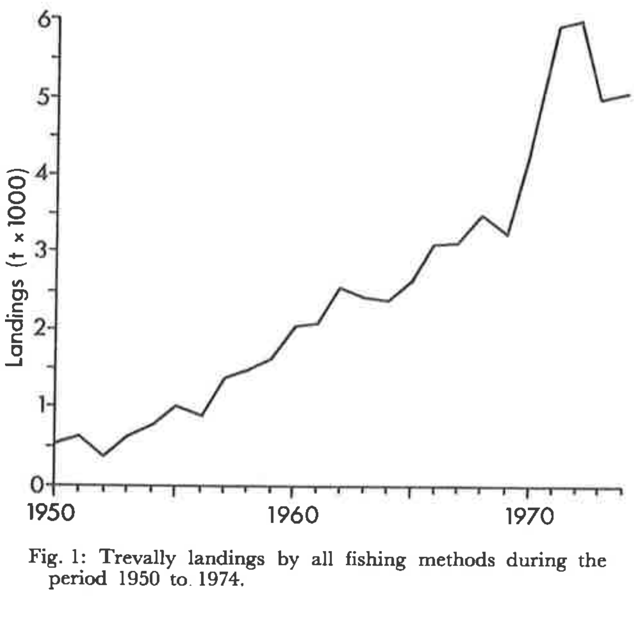


Fig. 1: Trevally landings by all fishing methods during the period 1950 to 1974.

Trevally are caught around the North Island and the northern part of the South Island. Areas that have contributed most to the total trevally catch in recent years have been (in decreasing order of importance): Bay of Plenty, Manukau to Reef Point, Hauraki Gulf, Egmont to Manukau, Ninety Mile Beach, East Cape, and east Northland.

Most of the research effort on trevally has been directed at the demersal or trawlable part of the population, principally in the Bay of Plenty, with some additional work along the west coast of the North Island. Sampling has been carried out from research vessels, supplemented by market sampling of commercial catches. Information has also been collected from purse-seine vessels since 1972.

## BIOLOGY

### Tagging

During 1973 we tagged 2676 trevally caught by bottom trawling in the Bay of Plenty and the Hauraki Gulf. Of these, 121 fish (4.5%) were recaptured. Of those for which we have received detailed recapture data, 1% had moved more than 60 nautical miles, 11% between 30 and 60, 28% between 10 and 30, and 60% less than 10 nautical miles. Although most fish moved fairly short distances, there is sufficient movement to regard fish from the Bay of Plenty, and probably from the Hauraki Gulf as well, as one stock.

During May and June 1977 we were able to tag about 3000 trevally caught by purse seine in the Bay of Plenty. The aim of this tagging was to determine whether these fish remained in schools where they could be taken only by purse seine, or whether they moved away from the schools and became vulnerable to other methods such as trawls, set nets, or box nets. During the year since this tagging was carried out, we have had 612 tags (about 20%) returned, mostly from purse-seine vessels, but also from trawlers and set netters; this confirms that all three methods are fishing on the same stock of trevally in the Bay of Plenty. During the 3 months after tagging the purse seiners recaptured about 300 tagged fish (or 10% of those tagged) and at the same time took some 1700 t of trevally. We were able, therefore, to make a good estimate of stock size in this area at that time—a quantity of some 17 000 t of trevally.

Of particular interest are three trevally tagged at Motiti in 1977 and recaptured further south on the east coast. Two were taken by trawl, one in Hawke Bay and one north of Tolaga Bay, in February and April 1978. The other was taken by set net south of Hawke Bay in August 1978.

### Growth

Trevally grow at a moderate rate during the first few years, but thereafter the growth rate slows markedly (Fig. 2). This pattern is typical of those fishes such as trevally, snapper, and tarakihi which constitute our major in-shore fisheries in New Zealand. These species have fairly slow growth rates and can live to relatively old ages of over 35 years. Such species cannot be harvested as heavily as some of our important off-shore fishes, such as the cods and tunas, which have much faster growth rates.

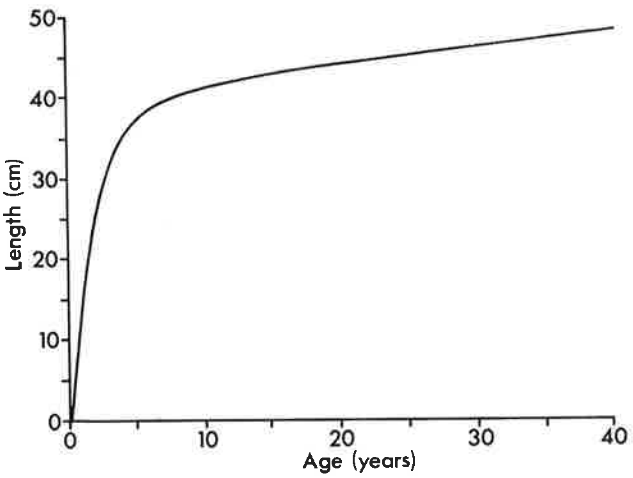


Fig. 2: Growth in length of trevally from the Bay of Plenty.

### Spawning and early life history

Trevally mature first at lengths of 32 to 37 cm (some 10 cm above the minimum legal length of 25 cm), though they do not produce large numbers of eggs until they reach lengths of over 40 cm. Although trevally spawn during summer, no large concentrations of spawning fish have been found. Certainly they do not school to spawn, as only occasional ripe fish have been found in purse-seine catches.

## FISHERIES

### Population structure

The length and age compositions of the catches taken by trawl and purse seine in the Bay of Plenty have been studied (Fig. 3). Purse-seine catches of school fish are composed almost entirely of mature adult fish, greater than about 38 cm in length and between 4 and 30 years old. Schools are fairly similar in both length and age composition. Trevally taken in the trawl fisheries include young fish between 25 and 37 cm and 2 to 5 years of age, as well as considerable numbers of adult fish.

It is apparent, therefore, that young fish first enter the demersal stocks, where they are vulnerable to trawling, and later, at about the age of maturity, many move into the school stocks. We have established from our recent tag returns that there is some return movement.

Because of this relationship, overfishing either the school or demersal stocks could considerably reduce catches of the other stock through a decrease in recruitment. The full effects of this would probably not become apparent for at least 10 years, because trevally are relatively long lived, and for similar reasons it could take at least another 10 years for the fisheries to recover. You can see that talking about the trawl fishery without considering its possible implications for the purse-seine fishery, or vice versa, is quite unrealistic.

### Future of Bay of Plenty fisheries

The information we have on the trevally trawl and purse-seine fisheries in the Bay of Plenty has recently been analysed in greater detail. This work shows that the present total catch by purse seine, trawl, and set net is greater than can be maintained on a long-term basis. Certainly good catches can be made now and over the next few years, particularly by purse seine, but only at the expense of reducing the number of spawning fish to dangerously low levels and lowering the annual catch considerably in years to come.

If attempts are made to maintain the 1977 catch of about 4000 t, the effort that will need to be expended will increase fourfold over 10 years (Fig. 4). If effort does increase like this, the number of spawning fish will be reduced to dangerously low levels. On the other hand, if total fishing effort is not increased over the 1977 level, the total Bay of Plenty catch will decrease over 10–15 years to about 2000 t (about half the 1977 catch) (Fig. 5). Under these conditions the number of spawning fish should remain at acceptable levels.

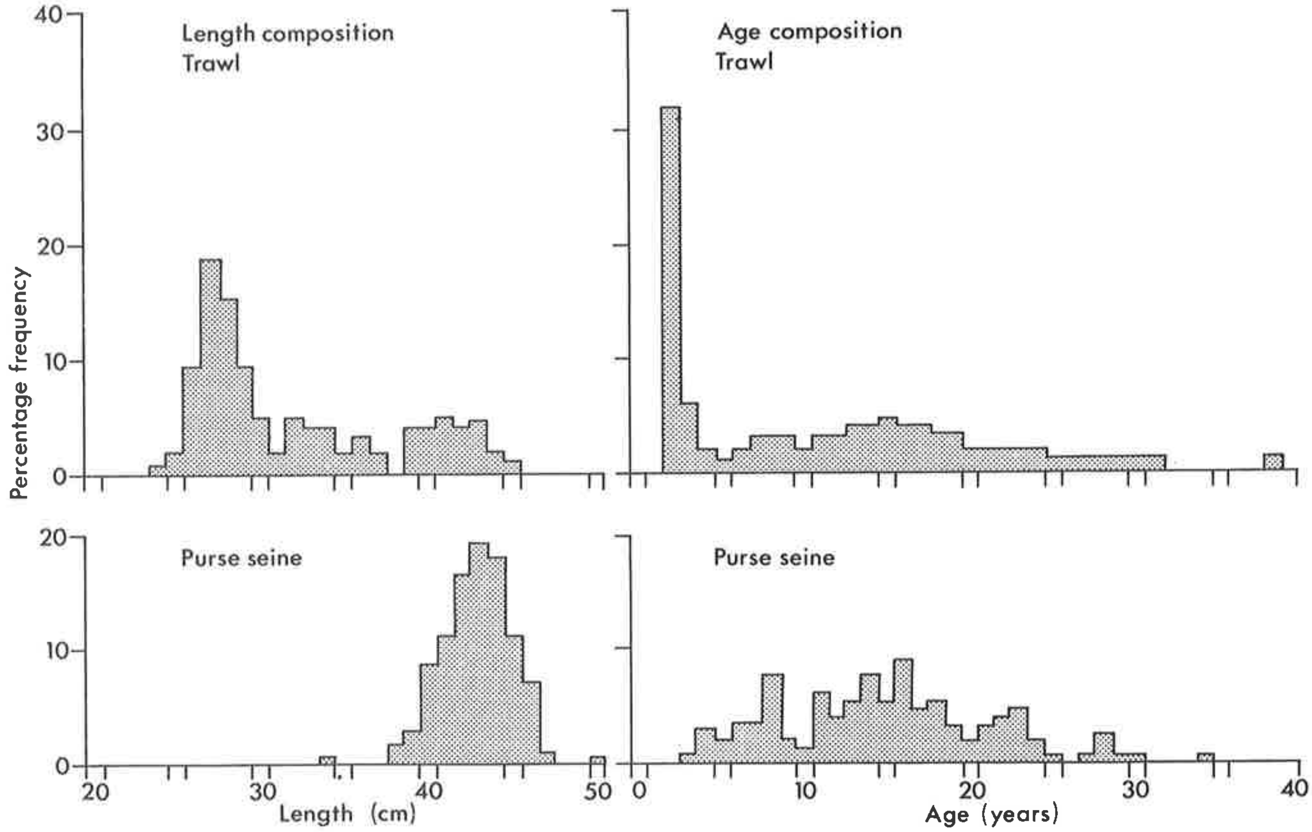

Fig. 3: Length and age compositions of typical trevally catches made by bottom trawl and purse seine in the Bay of Plenty.

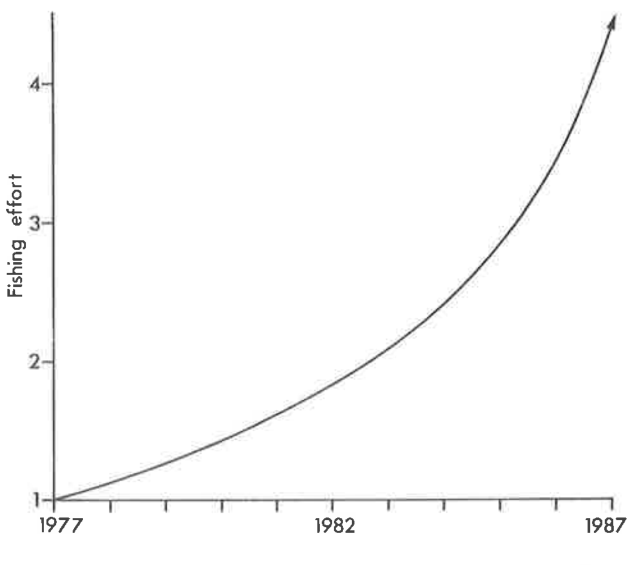

Fig. 4: Fishing effort required to maintain the 1977 trevally catch in the Bay of Plenty.

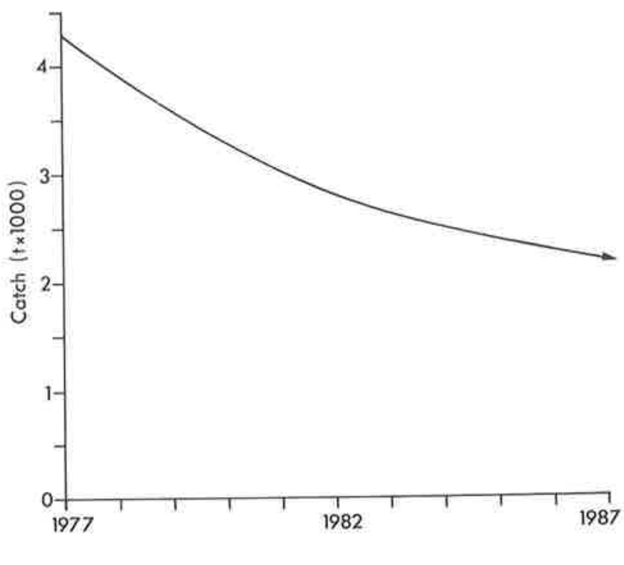

Fig. 5: Future Bay of Plenty trevally catch if fishing effort remains at the 1977 level.

Of particular concern are the considerable numbers of 2-year-old fish taken in the trawl catches. These fish have not spawned and are less valuable to the industry than larger fish. If these young fish were left to grow for another year or two before being caught, the annual sustainable catch would be increased, but, perhaps more significantly, the catch per unit of effort (CPUE) or the catching efficiency would increase by about 20%. These young fish could be largely excluded from the catches by increasing the mesh size. All of these results indicate that to obtain the greatest sustainable trevally catches from the Bay of Plenty and to maintain the number of spawning fish at more than one-third of the unexploited numbers, two things need to happen:

1. Annual total catch of trevally from the Bay of Plenty should not exceed 2000 t. This is about half the 1977 catch.

2. Mesh size in the trawl fishery should be increased to prevent the capture of 2-year-old fish.

**West coast North Island trawl fishery**

There is no trevally purse-seine fishery on this coast, as trevally school only rarely at the surface. Most trevally here are taken by pair trawl.

Figures obtained for three sets of pair trawlers working on the west coast north of Cape Egmont over the last 4 years show an increase in CPUE for trevally over this period. This information, combined with data on the age composition of catches, suggests that trawl effort on west coast trevally is at present within acceptable limits. However, problems will arise if catch rates of snapper decline further and more trawl effort is diverted into catching trevally.

**Conclusion**

Trawl effort for trevally on the west coast of the North Island appears to be within acceptable limits at present. In the Bay of Plenty, on the other hand, some management measures need to be introduced if we are not to see a boom and bust situation occurring there.

## Discussion

Mr James was asked for confirmation that the paper was based on the 1977 tagging programme in the Bay of Plenty and he affirmed this.

It was then suggested that the tags were returned over a 3-week period and that some fish were recaptured the same day, which meant that adequate mixing of the tagged fish was not possible.

Mr James replied that the analysis was made on the number of tags returned over a 3-month period. Purse seiners may have caught tagged fish only over a 3-week period within the 3 months, but the calculations were based on returns from various fishing methods over a 3-month period. The tagged fish were initially caught by various fishing methods. Tags from fish taken in an unknown number of purse-seine sets (say 10 to 12) were returned and up to 70 were returned from 1 set. However, from each of the sets there was a fairly good spread of tags released at each of the places where fish had been tagged; this suggests that fish were mixing well fairly soon after being tagged. The suggestion that tags were all scooped up the day after release was wrong.

A purse-seine fisherman claimed that 99% of the tags taken came from his vessel and were taken in an area with a radius of 4½ miles (7.2 km), and they were returned within a short time of release. The speaker disputed Mr James's claim that he was talking of a Bay of Plenty stock and suggested that he was really talking of a Motiti Island stock.

# The tarakihi fishery: Is there a problem?

by L. J. Tong

*Scientist, Fisheries Research Division,
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THE problems in the tarakihi fisheries are different from those in the snapper and trevally fisheries, and they also vary from one fishery to another.

### East Cape fishery

Our initial research efforts were directed at the tarakihi stocks in the Bay of Plenty and at East Cape (see Fig. 1). Since 40% of the New Zealand tarakihi catch comes from the area between Cape Runaway and Mahia Peninsula, it was important to understand that fishery and to be able to predict its future. Figure 2 shows what has happened there since 1940: the catches rose steeply until 1966, after which there was a sharp fall. The problem was to find out what caused the fall in catches, and whether it would continue or whether it could be halted.

Surveys of the exploited stock at East Cape and an unexploited stock at Kaikoura were carried out to obtain measurements of growth and death rates. By use of this information and the catch data from the industry, Vooren (1973) made a tentative analysis of the history of the East Cape tarakihi fishery. The decline of this fishery since 1966 was found to be of the type that can be expected in the normal development of a fishery on an unexploited stock. Vooren predicted that, provided the effort stayed at the same level, the yield from the fishery should remain steady. He further stated that this yield would not be increased greatly by increasing the effort. The yield of tarakihi that could be sustained by the East Cape stock was between 1000 and 1500 t a year.

Figure 2 shows that Vooren was correct. The industry exploiting the fishery was advised not to increase its effort, and as far as we know it did not. There were no legislation or controls, just good advice. At present I do not know of any problems in that fishery.

### Other tarakihi fisheries

Age-frequency distribution samples taken in the East Cape survey are shown in Fig. 3A. The point to be emphasised is that there are few fish over 10 years of age; 7.8%, which represents only 12.6% of the catch by weight. The older fish in the stock were taken during the period of heavy exploitation. Despite this, and we are assuming that recruitment is about the same each year, the fishery is still healthy.

Figure 3B shows the age distribution of tarakihi from the Cape Campbell area surveyed in March 1978. Over 20% of the catch was aged over 10 years, which represents 30% of the catch weight. In some individual trawls off Cape Campbell itself the older fish contributed over 50% of the catch by weight. If our theories are correct, this stock is still very healthy and can withstand heavier exploitation.

An example of the same situation occurs in Pegasus Bay. Figures 4A and 4B show the age-frequency distributions of the research samples taken in surveys

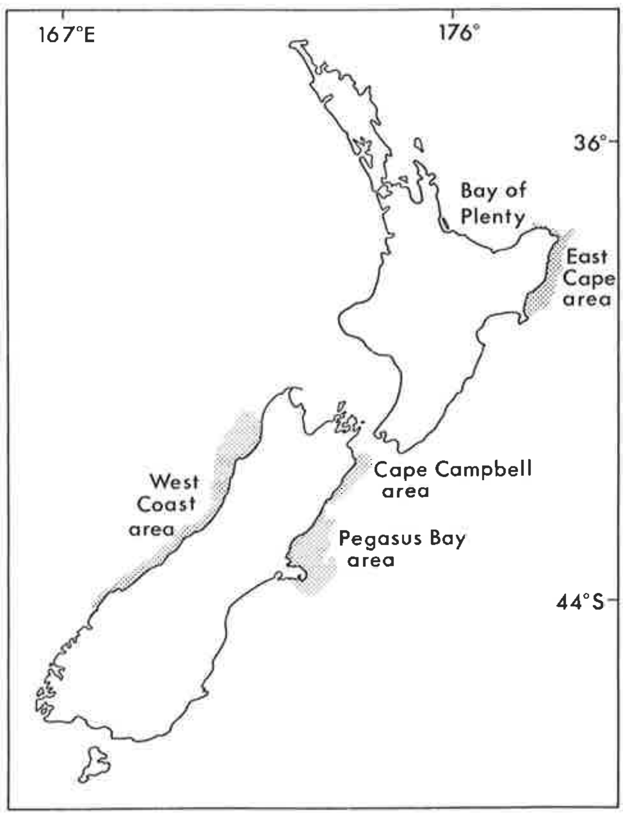


Fig. 1: Locations referred to in the text.

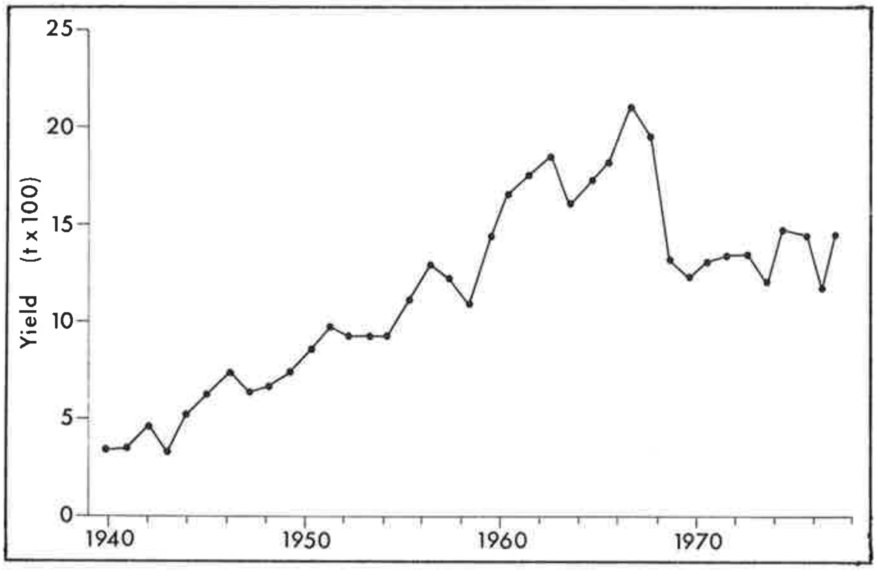


Fig. 2: Tarakihi landings at the port of Gisborne, 1940 to 1977.

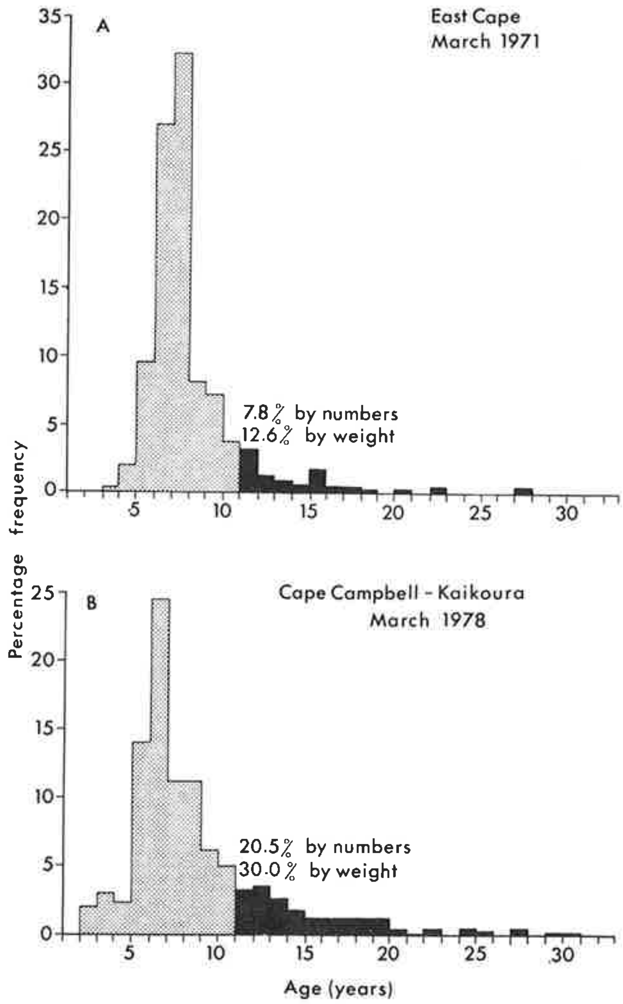


Fig. 3: Age-frequency distributions of tarakihi from *James Cook* surveys at East Cape and the Cape Campbell area. Black shading indicates fish over 10 years old.

in 1970 and 1978 respectively. We described the Pegasus Bay stock as unexploited in the early 1970s and the picture is identical today. Twenty percent of the fish are over 10 years, which represents 33% of the weight of the catch. The stock is not exploited and this is confirmed by looking at the landings of tarakihi for the port of Lyttelton—85 t in 1976. In the early 1970s landings were always over 250 t. This drop is not due to a lack of fish.

### West coast, South Island

Vooren (1977) showed that the tarakihi stock in this area was also lightly exploited. The age-frequency distribution of his samples is reproduced in Fig. 5A. Fifty-four percent of the fish were aged over 10 years and contributed 66% of the catch by weight. The age-frequency distribution of samples taken from the west coast in 1977 is shown in Fig. 5B. The picture has changed; 28% of the catch is over 10 years. This still represents, by weight, a large proportion of the catch. The west coast is an area that has received more attention from the foreign fishing nations, and I understand that local boats are also increasing their effort. If our theories are correct, the tarakihi stock on the west coast is still healthy, but developments will need careful watching. We have good data from the foreign ships which enable us to monitor catch rates and any changes. We lack this information from our own industry.

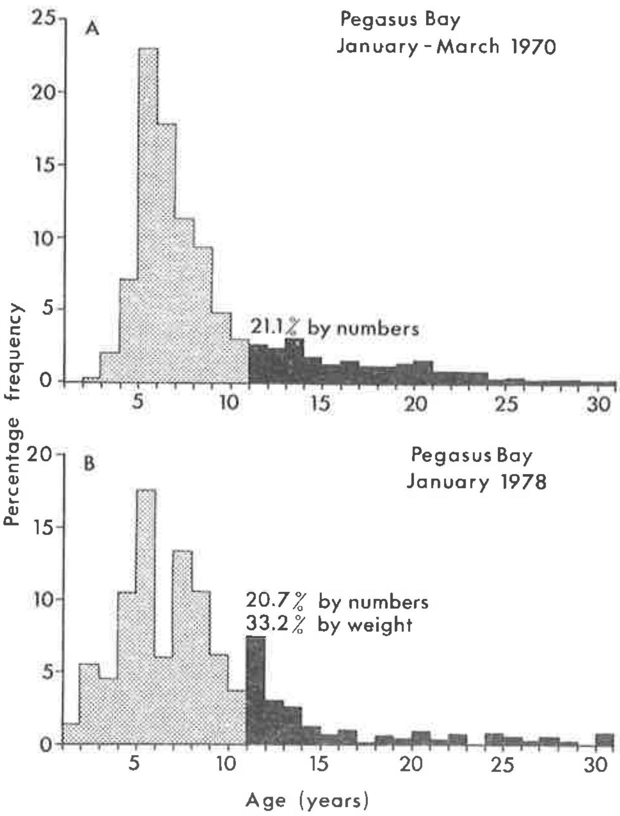


Fig. 4: Age-frequency distributions of tarakihi from *James Cook* surveys in Pegasus Bay. Black shading indicates fish over 10 years old.

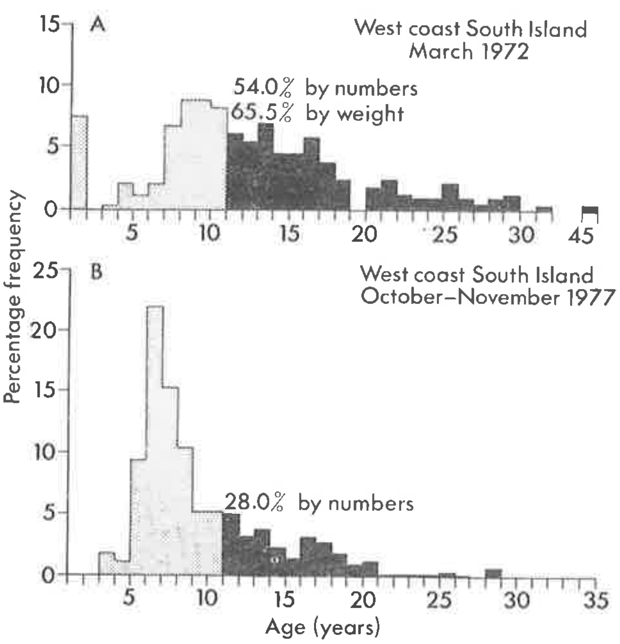


Fig. 5: Age-frequency distributions of tarakihi from *James Cook* surveys on the west coast of the South Island. Black shading indicates fish over 10 years old.

## More data

By use of Fisheries Research Division data and fairly primitive statistics from the industry, Vooren made a prediction for one tarakihi fishery, which, up to 1977, was correct. For some of the other tarakihi fisheries we can make predictions only from the data that **we** collect. Age-frequency and growth-rate data are only part of the model for studying a fishery. Catch and effort data are also essential. The only catch-effort figures that I can use are those from *James Cook*. For example, catch rates in the Cape Campbell and Kaikoura areas this year were nearly 20% higher than at East Cape in the 1971 survey. Both surveys were carried out close to the spawning period, when densities of fish on the grounds are high. Therefore the indications are that for Cape Campbell, Pegasus Bay, and the west coast of the South Island the stocks are underexploited and can stand an increase in fishing effort.

The major problem, and you will hear this many times during the conference, is the lack of data on where New Zealand vessels fish and the amount of effort put into catching the fish. New Zealand commercial data with our own research cruise data would enable us to predict the yields of tarakihi and perhaps avoid the rapid increase and sudden decline in catches that occurred at East Cape. Perhaps we can also achieve this without controls and legislation.

## REFERENCES


VOOREN, C. M. 1973: The population dynamics of the New Zealand tarakihi, *Cheilodactylus macropterus* (Bloch and Schneider), and changes due to fishing: an exploration. *In* Fraser, R. (Comp.), "Oceanography of the South Pacific 1972", pp. 493–502. N.Z. National Commission for UNESCO, Wellington.

——1977: Growth and mortality of tarakihi (Pisces: Cheilodactylidae) in lightly exploited populations. *N.Z. Journal of Marine and Freshwater Research 11*: 1–22.

## Discussion

It was stated that extending the Wellington tarakihi fishery into the Cape Campbell area does not seem practicable. Cape Campbell is a seasonal ground and for 9 months of the year there is very little tarakihi available. What is available is uneconomic for New Zealand vessels to fish. Further south, off Kaikoura, in October small fish are plentiful, but there are rarely any large ones. Pegasus Bay was a winter fishery, but with the advent of foreign fishing fleets in our waters it became uneconomic to steam there from Wellington.

Dr Tong replied that he was unqualified to comment on the economics and he agreed it was a long way to steam from Wellington. However, from *James Cook* catch rates, the grounds south of Kaikoura appear to have a lot of fish; these catch rates are 20% higher than in the East Cape area.

Dr Tong received confirmation that the Wellington fleet fishes south of Wellington and then showed that landings of tarakihi in Wellington have increased from 374 t in 1975 to 492 t in 1976 and to 620 t in 1977. This drew the comment from a Wellington fisherman that he thought a lot of fish came in from Gisborne. Dr Tong responded that the fishermen are apparently not giving the correct information on catch and the area it comes from. Fisheries scientists base their work on the information they get from fishermen and if the information is wrong, reliable results cannot be expected.

Mr Waugh commented that *James Cook* is equipped with trawl gear that can take fish which are off the bottom, and perhaps commercial vessels' gear is not so high-opening and so their catch rates of larger fish are reduced. If this is so, the information that both the scientists and fishermen base their opinions on is valid, but it differs because of their different fishing gear.

He went on to say that Mr James had suggested a management strategy based on his studies, and Dr Tong's paper showed how advice to the Gisborne fishing fleet was heeded and the East Cape tarakihi fishery remained under control. He wondered whether advice given by fisheries scientists, if heeded, could obviate licence limitation.

# Ownership or stewardship? The abiding dilemma of resource management

by Philip S. Corbet
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IN this paper I discuss the related subjects of resource ownership and resource management. This will involve my examining the responsibilities and dilemmas of ownership and their implications for resource management. But first I offer definitions of three concepts which are central to my theme.

Outside the legal profession **ownership** is not easily defined; but where natural resources are concerned the point at issue is presumably whether ownership constitutes the right to enjoy all the benefits from a resource oneself—now—or whether it contains an element of stewardship, namely the obligation to keep the resource in good heart for future users. This point is succinctly expressed in the Audubon Society's description of a true conservationist as *a man who knows that the world is not given by his fathers but borrowed from his children.*

**Resource management** may be defined as *the science, and perhaps also the art, of devising strategies for using resources that preserve or enhance environmental quality.*

**Environmental quality** I regard as *the continuing capacity of an environment:*

- *to support human populations in comfort and health, both mental and physical;*
- *to provide scope for a variety of preferred activities;*
- *to allow planners a wide range of options in respect of resource use.*

All these definitions, it may be noted, give primacy to man's interests; that is, they reflect concern for the quality of the human environment.

## The approach

I shall begin by placing the concepts of resource ownership and resource management in temporal perspective. I say "temporal" rather than "historical" perspective because much of that perspective is in fact prehistorical. My purpose in doing this will be to discover what, if anything, such an exercise tells us about our likely futures. In particular I hope that it will help us to predict, on the evidence available, the main consequences of adopting different criteria for setting management goals.

Though fisheries have unique features and though their management is complex and specialised, I believe that the general principles I shall be examining apply as well to fisheries as they do to most other resources; and I want particularly to attempt a broad perspective here. So I shall not focus on demersal fisheries or even on fisheries in general. Let it be said also that I am not an expert on any aspect of demersal fisheries, though I was employed during 1954 to 1957 as a scientist in a fisheries research laboratory on Lake Victoria in East Africa. During that time I saw political pressures override the recommendations of the research organisation and relax the licensing and mesh-size regulations which had been introduced some years earlier to protect the continuity of the *Tilapia* fishery, a fishery which I understand is now no longer viable.

## A temporal perspective

The question I am trying to answer here is: How did we come to acquire our present attitudes towards ownership and management of resources?

I have heard it said that experience is a harsh teacher, but that fools will learn from no other master. This dictum has been expressed more gently in this form: those who don't learn from history are condemned to repeat it. I believe this statement to be true in so far as man has certain behavioural traits which remain the same. But, because man's cultural and physical environment is continually changing—largely as a result of his own activities—I think it more correct to say that those who do not learn from history are more likely to become prisoners of existing trends. Thus they may not **repeat** history so much as continue to be swept passively along in the direction of recent changes. Those who do not learn from the past commit themselves to a future that has already been made highly probable (though not necessarily inevitable) by the nature of past events. Such considerations bear closely on the future of resource management.

The cultural and technological environment in which we have to make decisions is changing all the time. The decisions we make depend on our preconceptions—about resources and other things.

Some of these preconceptions we recognise; others we don't. To remind ourselves sometimes of how our present attitudes to resources came about may help us to be more discriminating and to see which of our assumptions offer useful prescriptions for resource management in the last two decades of the twentieth century, that exciting time when the oil begins to run out!

Most biologists and many scientists hold the view that, as products of organic evolution, we were moulded in the uncompromising forge of natural selection over a period of 2–4 million years. They tell us that for more than 99% of this immensely long time we lived as gatherers of plants and as intermittent hunters; and that for much of this time we existed in small, nomadic groups. We lived then in balance with our surroundings, as integral parts of an ecosystem, being regulated by it and having negligible impact on it. Biologically, it seems that we still retain most of the characteristics of this Pleistocene gatherer and hunter; but owing to certain important, and relatively recent, **cultural** developments, the environment in which we have to put into practice our assumptions about the ownership and management of resources has changed beyond all recognition. The developments which have had a major and lasting effect in this regard are not numerous: here I nominate only five for special attention. All were made possible because our Pleistocene forebear had already acquired a hyper-developed brain, enabling him to rationalise and communicate what he experienced and then to use such knowledge to change his environment.

These five developments are:

1. The development of more effective methods for hunting in the late Pleistocene, especially by the capture and control of fire and by the use of hafted weapons. These enabled hunters to obtain the strongest rather than the weakest animals as prey, and also, beginning about 15 000 years ago, to bring to extinction certain species of large land mammals.

2. The development, beginning about 10 000 years ago, of agriculture, which involved the conversion of ecosystems from natural to artificial productivity. This greatly increased the proportion of food energy in them that was available to man and also greatly improved the energy gain from food gathering. Agriculture facilitated the production of surplus food, and thus also settlement, social stability, improved technology, and barter.

3. The development of trade and especially, beginning about 2000 years ago, the use of tokens (for example, coins) as a medium for exchange. This fostered the notion that such tokens were valuable in themselves; it encouraged the accumulation of wealth and progressively unequal resource allocation; it provided the incentive to consume resources more and more rapidly; and it led to establishment of the science of economics as we know it today.

4. The development 100–200 years ago of effective hygiene and preventive medicine. This reduced the death rate but not the birth rate, and so it permitted the most recent exponential increase in human numbers.

5. The development, beginning about 70 years ago, of a high-energy technology, and especially its application to food gathering. (Food "gathering", not food "production": we hardly ever **make** food, but still merely collect it from the land or sea where sunlight and nutrients have permitted living organisms to synthesise it.)

These five developments have had some far-reaching consequences as far as our attitudes to resource management are concerned. Three consequences deserve special mention.

**A growing sense of power and independence from nature.** Each of the five developments I have listed, especially perhaps the last, will have increased man's sense of power over his organic and physical environment. And this expanded sense of power may have led to the current concept of ownership—the bizarre notion that one species, man, can "own" all the others—and also to the now widespread idea that man is independent of the natural world and that, merely by exercising his technological ingenuity, he can escape the consequences of placing growing demands on finite resources. Indeed there are now many people who have become so committed to the idea that growth in population and resource consumption are prerequisites for prosperity that they explicitly deny that resources are effectively finite.

**The accelerating rate of resource consumption.** The fourth development ensures that there is a growing number of consumers. But, apart from this, the application of traditional economic criteria to resource management makes it almost inevitable that prime resources will be consumed, and therefore depleted, at an ever-increasing rate (see Ophuls 1977). In the first place, depreciation of currency requires that, merely to remain economically viable, a resource extractor must make a **larger** profit in each successive year. In the second place, the "need" to obtain a high internal rate of return on an initial investment ensures that, when an operation is capital-intensive (for example, oil extraction), the pressure to consume the resource quickly becomes virtually irresistible, even though other considerations support a policy of using it very slowly.

There is another, quite different, source of pressure which leads to resource depletion—the so-called "Tragedy of the Commons" (Hardin 1968): that inexorable tendency of humans who enjoy unrestricted access to a common resource to destroy or contaminate that resource. This relentless principle, which applies to pollution as well as to depletion of resources, results from the fact that it is in each user's **short-term** interest to place increasing demands on a common resource, even though that user's return per unit of effort may decline as a result. In this way the resource is destroyed. Belated acceptance of the universality of this principle led to land enclosure in medieval western Europe and, more recently, to the declaration by coastal states of their right to administer a 200-mile exclusive economic zone. But it should be emphasised that, though such measures make it easier to resist the temptation to deplete a resource, they do not ensure that this temptation will indeed be resisted.

**Consolidation of the status quo and resistance to change.** In most societies where economic criteria and market forces determine resource allocation, there is a strong tendency for the rich to become richer and fewer and for the poor to become poorer and more numerous. Moreover, because wealth brings power, the rich are well placed to consolidate their position. This they do by extolling the alleged virtues of the system which has enabled them to become wealthy. In such an enterprise they command ready allies among traditional economists who for other reasons do not wish to see the conventional wisdom of their discipline challenged. So it comes about that those who counsel that we should use finite resources very slowly, at least until we have developed a tried system for doing without them, are advised: first, that the price of a resource will continually change as the resource becomes scarcer and in this way its exhaustion will be prevented; and second, that, even if the resource does become exhausted, man's traditional technological ingenuity will by that time have developed an effective substitute. (One is reminded of the defending counsel who asserted that his client wasn't at the scene of the crime at the hour in question, but that, even if he was there, he was innocent!)

It is obvious that this third consequence of our five developments is the most formidable because it stands squarely in the way of any significant change in prevailing assumptions regarding resource management. It encourages the comforting notion that we need not be concerned about present trends of resource depletion and contamination, and thus we can avoid or postpone the immensely difficult task of formulating strategies that will enable us to set a course towards stability and sustainability.

To list these three consequences is to show why, in today's society, few accept the proposal that prime resources (especially non-renewable ones) should be conserved or used more slowly in order to protect options that future generations may wish to exercise. Circumstances have pushed us far from the attitude of the pre-industrial peasant farmer whose goal was to minimise risk. Now the almost universal aim is to maximise profit, even though to do so may often be to **increase** risk.

I hope that this brief analysis will have made it easier to identify some of the origins of prevailing attitudes towards the ownership and management of resources. Let us now examine these two concepts more closely.

## Resource ownership

In a legal sense, "ownership" comprises four constituent parts, or "rights", which are:

1. The right to exclude anyone or everyone else from exercising any influence over the thing owned.
2. The right to use and take all the benefits flowing from the thing owned.
3. The right to transfer, give, or rent any or all of the rights of ownership (including this right) to someone else.
4. The right to destroy the thing owned.

It is instructive to note how these rights may be exercised by coastal states in respect of marine fisheries (Insall 1978).

In its 12-mile territorial sea a coastal state is able to exercise all four ownership rights, and so it may be said to "own" the fisheries there in the fullest sense. (The fact that a coastal state has the legal right to destroy living resources in its territorial sea tells us much about prevailing attitudes towards the rights of our descendants.) In its exclusive economic zone a coastal state has the first and third ownership rights, that is, exclusive control and the right to sell, give, or rent ownership rights over fish in the zone; the state has the second right, that is, to take all the benefits of the resources, but subject to the condition that if it is unable or unwilling to harvest the total yield from the fisheries in the zone, it must allow other states to harvest the surplus. Thus the coastal state in practice has the right to take what it can, and other states have the right to take the rest. No coastal state has the fourth ownership right, that is, no state is entitled to **destroy** fisheries in the zone; this follows from the duty imposed on a coastal state to conserve the living resources of its zone.

Having regard to the Audubon Society's definition of a true conservationist, one may take heart from the existence of this last sanction because it recognises (by implication) the rights of future generations, at least as far as living resources are concerned.

I suspect that the nub of the matter is whether the prescriptions of ownership are in themselves unrealistic, in the sense of being either contradictory or impossible to observe with confidence. Can the coastal state exercise the restraint needed to resist the economic pressures to deplete and eventually destroy the resource? And can the coastal state (be it ever so conscientious) really tell when a resource is endangered?

If it can, is it able to detect this and to impose the necessary restrictions soon enough for the resource to recover its viability? Only if the answer to each of these questions is "yes" can we expect the ownership of living resources in the exclusive economic zone to comply with the basic requisites of stewardship. (Is it ominous that this rich assemblage of living systems should have been termed an "economic" rather than an "ecological" zone?)

## Resource management

For purposes of this paper, and at the risk of oversimplifying a complex and difficult subject, I will distinguish three categories of inputs to resource-management decisions. All are interrelated; so the order in which I list them has no significance.

**Socio-political inputs**. These inputs derive from human behaviour, prevailing attitudes, and institutional arrangements. They are evident in attitudes adopted towards, for example, ownership, conservation, lead-times, profit, risk, democratic process, and the relative merits of rational *versus* incremental planning. Scope for change lies mainly in the field of education and in modifying institutional arrangements.

**Economic inputs**. These inputs come from pressures generated by, for example, the international market place, and they depend on the extent to which accounting, and especially discounting, allow for "external" costs resulting from resource depletion and contamination. For example, estimates of maximum net economic yield from a fishery would differ greatly depending on the extent to which such external costs were taken into account. Opportunities for change are limited by the fact that New Zealand is a very small participant in a world economic system; domestically such opportunities may lie in the economic value we assign to certain prime resources (human health is a useful example to keep in mind) and in the degree of economic independence we can acquire (for example, by reducing our dependence on imported energy).

**Ecological inputs**. These inputs are provided by factual knowledge derived from observation and experiment; that is, derived from application of the scientific method. Such knowledge includes, among other things, our understanding of the properties of living organisms in general and of demersal fishes in particular, of the capability of existing technology, of the resource requirements of existing technology, and of the impact on demersal fisheries of different kinds and intensities of fishing effort. Opportunities for change are probably confined to our willingness to obtain the information that is most useful and then to interpret it correctly, and also perhaps to the extent to which we are willing to focus research effort on problems of high relevance and then to interpret the results objectively. An example of such a problem might be the application of modern technology to the development of sailing vessels.

## Conclusion

Some years ago the eminent Australian scientist Sir Macfarlane Burnet remarked that modern man suffers from a surfeit of knowledge and a deficiency of understanding. This aphorism applies neatly to the situation I have described. Already we know enough, quantitatively and qualitatively, about the main components of these three types of inputs to be able to predict, qualitatively at least, the probable outcome if different management policies are adopted in respect of fisheries. Clearly there is a pressing need for more research, especially research focused on prime or threatened resources and on their ability to withstand different levels of fishing effort. Nevertheless, I do not believe that it is lack of knowledge that now forms the key constraint to rational management of fisheries. This I see as being a lack of **understanding**—at both public and governmental levels—of the implications of a few central notions:

- That man's continued survival depends on the integrity of living systems.
- That, using existing technology, man can cause irreversible damage to such systems.
- That the conventional wisdom of economics calls for resources to be consumed rapidly, rather than slowly, and is therefore fundamentally opposed to the conventional wisdom of ecology.
- That, because such conflict can be irreconcilable, ecological goals will sometimes have to be followed **instead of** economic goals.
- That to make current attitudes and practices responsive to the needs of resource management will require a concerted, systematic programme of public education.

Reflecting on the way in which resource-management policies are made in Canada, and the likely long-term consequences of such policies, Professor Kenneth Hare (1977) summarised his position in these words: "Prolonged exposure to these issues has left me a cautious, pragmatic conservationist. Common sense suggests to me that we should use our resources as slowly as possible, and that we should regard all renewable resources as entailed upon subsequent generations—which means that we should use them only to the extent that they fully and promptly replace themselves."

I expect that most of us would acknowledge the wisdom of these sentiments. The dilemma we face is how to put such common sense into practice in the world of today and tomorrow. In this paper I have tried to show where in the decision-making process opportunities exist for resolving or overcoming this dilemma and (more importantly) where they do not. If there is indeed a solution to this problem it would seem to lie in educating and legislating—not for prohibition, which is relatively easy, but for temperance, which is notoriously difficult!


## Acknowledgments

I thank Mr Rodney Insall and Mr Bill Vant for helpful suggestions.


## REFERENCES


HARDIN, G. 1968: The Tragedy of the Commons. *Science, N.Y. 162*: 1243–8.

HARE, F. K. 1977: Resources: will there be enough? *Ontario Naturalist 17 (1)*: 31–5.

INSALL, R. L. 1978: The management of foreign fishing in New Zealand's exclusive economic zone. (M.Sc. dissertation, Joint Centre for Environmental Sciences, University of Canterbury and Lincoln College. 141 pp.)

OPHULS, W. 1977: "Ecology and the Politics of Scarcity." Freeman, San Francisco. 303 pp.

# Utilisation of the resources of the EEZ in New Zealand's interests

by G. D. Waugh
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LET us accept that the total annual crop of fish protein from the 200-mile EEZ is finite. Let us also recognise that, within the mix of fish which makes up the resource, some will be more valuable than others. One species may be half as abundant as another, but have a unit value three times as great. In monetary terms it will be the more valuable resource.

However, it may be more difficult, perhaps twice as expensive, to catch. It may be too deep or too distant, so that the capital costs in vessels to trawl deep enough or energy costs to travel far enough to catch it may outweigh the added value for the New Zealand operator who has a living standard to maintain and capital investment to service.

Here, the lower valued, but more readily catchable species may be the better economic option; that is, the better target species to aim for. It may also be the better fish to take because on-shore facilities demand a regular volume of throughput which will make processing less costly (provided, of course, there is a market available).

This suggests the sort of pragmatic approach one might make to the utilisation of the resources of the zone.

### Principles

In declaring a 200-mile EEZ, New Zealand has followed the concepts laid down in the Draft Law of the Sea Convention and has assumed certain responsibilities. Basically, the draft says that the coastal state, New Zealand in this instance, can declare an exclusive economic zone out to 200 miles from base lines drawn around the mainland territory and off-shore islands. Within this zone the state must assume total responsibility for supervising and managing the exploitation of the resources. However, in the interests of mankind the coastal state cannot adopt a dog-in-the-manger attitude and exclude other countries from exploiting the resources unless it can utilise them itself. In other words, on moral grounds we cannot arbitrarily cut off part of the supply of protein on which mankind is becoming increasingly dependent. However, the coastal state is under no obligation to allow increased foreign fishing to the extent that it adversely affects the economics of the local industry.

The Law of the Sea also says that countries and industries which have traditionally fished the area and therefore depend on it for their own economic survival must be given an opportunity to continue to fish. Where our deep-water demersal fisheries have been exploited by foreign vessels for less than about 8 years, the issue of traditional fishing rights does not arise.

Nevertheless, it will be apparent that we have assumed certain moral as well as managerial responsibilities which, as a law abiding member of the United Nations, we should be seen to observe.

### A philosophy and options

The pragmatic approach to evaluating our resources may be being undertaken already by companies and individuals, but if so, I have not heard it expressed in just this form; that is, a cold economic appraisal of the species, their unit value, their likely abundance, and the costs of catching, processing, and marketing them. In any case, what of the species which make up the balance of the resource? If the fish populations are mixed, we may want to harvest only one of the less abundant, but more valuable, species. How can we ensure that this is available for us to exploit without at the same time denying others the opportunity to catch the less preferred species which are also a protein source? Can we develop or encourage target fishing techniques? If so, how can they be directed or controlled?

We have a dilemma which faces most fisheries; the need to ensure full use of the total resource on one hand and the need to protect the economics of the local industry on the other. How does a research group such as ours order its priorities to help the local industry to use the resources to New Zealand's best advantage? How do we advise or persuade Government of the need to consider these various views?

These are all problems for which we are seeking solutions, but obviously they are not going to be resolved overnight. However, we have made some attempts at part answers. For example, sub-quotas have been established for particular species. On the east coast of the South Island, though a country may have been allocated a total quota of 40 000 t, only 50 t of these may be tarakihi. Once this sub-quota in the by-catch has been reached, the vessels must either fish elsewhere or improve their target fishing for other species.

With the need to deploy some staff in the deep-water fisheries, I am concerned that there could be insufficient attention paid to the coastal demersal fisheries on which so much of our own industry depends at the moment. This illustrates another problem which we face within Fisheries Research Division. The country has assumed additional responsibilities as a manager of an EEZ, but I do not believe that we can now lose sight of our immediate responsibilities to the coastal fishermen. At present it is through them that we utilise our part of the resources of the EEZ.

There is one other philosophical point to consider: How do we use, or how do we encourage others to use, the fish that are caught?

Under the Law of the Sea concept the available protein should be used as food for mankind. Therefore, if there is any chance that a particular fish can be used directly for food, I believe that we should actively discourage its being used for other purposes, for example as fish meal and oil.

There are some species for which no alternative uses have yet been found. But for others which are of sufficient size and quantity and are of suitable quality for processing, I believe that in allocating quotas to foreign fleets New Zealand should, as a matter of principle, consider the ultimate purpose for which the fish are destined.

We have to be realistic. We do not have sufficient people to man large vessels or sufficient capital to purchase craft costing several millions of dollars that would enable us to make full use of the resources of the zone ourselves. On the other hand, we want to reap the maximum economic benefit.

For some types of fishing we may be better off as landlords, leasing the resource to others because they can use it more effectively or more economically than we can. In other types we may be able to do the job better ourselves, and so we should gear our manpower and equipment for this.

Alternatively, we may seek partnerships with others who have the vessels, the technology, and the entries to markets. However, we have to recognise that such joint ventures can also give the foreign partners an opportunity for permanent access to the zone. This in turn means that for some fisheries we can never expect to claim exclusive New Zealand rights to the resource. On the other hand, it may not be politically desirable to totally exclude some countries from the zone even if we could build up our own catching capacity.

In theory, therefore, there is a series of options which we can look at before finally deciding how we could use the resources of the zone in New Zealand's best interest. However, I believe we should look at these options in far more depth and in a much more calculating way.

There seems to be a belief in some quarters that the fishing industry could become big enough, or we could at least make enough from the fish stocks, to pay off the national debt next year! This is certainly not so and though I'm sure we can help, it will take time and some predetermined plans.

We have already had some discussion on what happens if a fishery becomes overcapitalised and overexploited. Inevitably the stocks decline, more and more effort is expended, and more and more money is spent catching fewer or, at the best, no more fish than before. The situation is eventually reached when, to maintain profitability, vessels have to be withdrawn from the fishery or companies fold and their vessels are automatically out of business.

In the EEZ we have what amounts to almost a virgin stock. It is not as big as a lot of people believe, but it is probably bigger than our preliminary estimates suggest. How should we seek to use it?

**Controlled development**

We have a unique opportunity in New Zealand to plan to develop the fishery to an optimum level, whatever that might be. To do this we obviously need precise data on the catches and landings and the effort expended in catching the fish, possibly over the average lifespan of the fish. We need to know how the age structure of the population is changing with time and with fishing pressure. We need more data on the distribution of the fishes and, in particular, we need to know whether we are dealing with one or more stocks of particular species occurring in different parts of the zone.

In other words, we need a preliminary estimate of the size of the resource as a figure to work with. If we are to develop the fishery, this figure needs to be below what we believe to be the optimum yield but, of course, reasonably close to it.

A preliminary estimate has been made of the maximum sustainable yield or total allowable catch in terms of the information available at the time. That is, the estimates were based partly on data from research cruises and partly on the catches and what we knew of effort up to the end of 1976, the last year for which we then had data. Having made this preliminary assessment, the team then suggested that two-thirds of this, which was defined as a "safe biological yield", should be the basis for quota allocations.

We have now learned that the recommended quotas are substantially less than the actual catches in 1977. However, this does not invalidate the decision, though it has resulted in representations from foreign fishermen and foreign governments for bigger quotas and allocations. I do not believe that we should increase the quotas until we know that such increases are biologically acceptable and, therefore, have the best chance of being economical.

Therefore, I suggest that we should plan to develop towards an optimum yield which will give us and everyone else the best possible deal—a stable fishery. You may think that this is a pious hope, but I should be glad to hear from anyone who has a more appropriate objective at this time. It will, inevitably, take several years to achieve. Nevertheless, I am sure that it would be improper to encourage New Zealanders, or anyone else, to seek to develop this fishery simply to make a "quick quid", particularly as the recovery of the fishery from overexploitation is likely to be protracted.

# Open access

by N. L. Mills
*General Manager,*
*Sanford Limited, Auckland*

I am pleased to have the opportunity to speak to you because I take a much more liberal and competitive view of fisheries management than most of the staff in the Fisheries Research Division and also many fishermen. The reason I take this more liberal view is that I do not believe that New Zealand researchers at present have sufficient information to correctly assess the maximum sustainable yield of any particular demersal species, and therefore they take a grossly over-protective attitude. The country at large is entitled to have the resource harvested for its benefit. Fifty years ago scientists and fishermen said the Hauraki Gulf was being overfished. The total snapper catch for all New Zealand in 1932 was 2100 t. The Gulf alone now produces 4000 t. Fifty years later we still have a viable fishery; the scientists were wrong.

### Harvesting the resource

There is a major point on which I think we all agree and that is that the fish resource belongs to all New Zealanders equally and is not the property of those who commercially fish it. However, it does raise the question of how all New Zealanders can benefit from that resource. As I see it, there are only two main ways:

1. The resource is harvested by the most efficient means possible and sold to the public at the cheapest possible price. I think that price and efficiency are the most important points here because most of the owners of the fish do not work or make a living in the fishing industry.

2. The fish is harvested and exported for the highest possible price return so that all New Zealanders benefit from the foreign exchange earned to provide a better standard of living for them.

Government must make fisheries regulations that provide for both of these. Therefore, they must try to have the fish resource harvested as efficiently as possible so that local prices can be kept to a minimum, and to co-ordinate exporting to produce the best possible return in foreign currency.

I am sure that licensing and, especially, controlling entry into any demersal or pelagic fishery will not achieve these aims unless the resource is to be fished to its maximum sustainable yield with modern, efficient vessels. Both of these types of fishery are hunting operations and, as such, must not have competition removed by restriction of entry, or efficiency will be lost. I am not against controls in fisheries, provided there is conclusive proof that they are necessary, they are based on proper and sound information, and they are implemented in a way that does not cause the commercial industry to stagnate. I submit that in the past this has not occurred.

### Past legislation

I believe there is a lesson to be learned from the past. There are not many people here who were in the industry before 1964, when commercial fishing was a licensed industry; therefore, most people present have not had the experience of such restrictive legislation. Many people now promoting the theory of controlled fisheries were not in touch with industry in those days and certainly have no background knowledge of what went on in the industry through that period. It is interesting to note that after 14 years of free enterprise the industry has grown to some standing on the economic ladder and still offers scope to become really important to the economy of New Zealand in the future.

This growth should have occurred in the late 1940s after the war years. Had restrictive legislation not been instituted, I am sure that we would not now be faced with the present situation of selling our country's fisheries resource to foreigners who, because they have not been so severely controlled by their own countries, have been able to expand their fishing industries to such an extent that they can afford to fish in other countries' waters.

I claim that the supporters of controlled fisheries legislation cannot point out one benefit from the restrictive licensing that was finally abolished in 1964. Once the controls were removed, increasing business came to the boatbuilding industry and to a wide range of industries involved in the construction and engineering of processing plant; there was also a large increase in jobs for New Zealanders on fishing vessels and in shore-based processing plants. I do not think anyone can contest that the growth in the fishing industry since restrictive licensing was repealed has been to the benefit of the country.

As a New Zealander I want to see our finfish industry grow to give the maximum benefit to the country and not just to a few people who may benefit from a licensed situation to the detriment of the rest of the people. I favour managing a resource on a practical system rather than on what scientists say might or might not happen from the very limited information that is available. Reports from scientists in the 1928 to 1936 era said that if fishermen did not stop fishing snapper in the Hauraki Gulf, it would be fished out and the resource would be wiped out for ever. It was that sort of talk over the years that brought the 1936 Labour Government to license all commercial fishing under the Industrial Efficiency Act.

**West coast snapper**

To prove my point that researchers in New Zealand do not have the information to calculate the maximum sustainable yield, I would like to refer to snapper and, in particular, the west coast snapper resource. This is an area where I have had experience since 1954. I refer to an article in the July issue of *Catch '78*, which clearly shows the possibility of decisions being made in the fishery on wrongly based information. A short discussion I have had with members of the Fisheries Research Division brings home to me that they are not prepared to listen to experienced people in industry as other researchers have not been prepared to listen to experienced industry members in the past. I would like to go through this article and point out the inaccuracies.

The article states that there is a 17% decline in catch rate calculated on the days at sea. Before this was published it was pointed out to the writers that the days-at-sea returns from the Auckland companies who make up the main part of that fishery are not connected with fishing days, but are merely used to calculate the crews' share. In November 1977, the month showing the greatest decline, the weather was bad and many vessels provisioned but could not sail because of the bad bar conditions at Onehunga. Thus days at sea were logged up, though vessels were tied at the wharf. We pointed out that fuel usage was the only measure that could be accurate and their figures were wrongly based, but in spite of this they went ahead and have given the general public a completely wrong impression.

Another inaccuracy is the statement that the resource on the west coast was unexploited before 1970. This is quite wrong. A large steam trawler worked that coast in 1936 and Sanford Limited had several vessels working there since the early 1950s. For probably 20 years our west coast vessels have produced a greater catch than our east coast vessels. Moreover, my skippers advise me that there have been foreign trawlers there since 1957, with very intensive snapper fishing in those early years up until the 12-mile zone was declared. The Japanese trawled 1444 t of snapper in 1972 and 922 t in 1975. As these are the only figures that I have, I cannot comment on their early tonnages accurately except to say that there were large, 1500-t trawlers working in the area and the catches must have been substantial.

Apart from this, there were long-line snapper fishing vessels on the coast in fairly substantial numbers before the declaration of the 12-mile zone, and over the last 3 or 4 years there have been at least two and sometimes three snapper long-line vessels working our coast. I estimate that these two or three vessels would catch between them at least 800 to 1000 t. Thus there was heavy presence of foreign vessels before 1970 and some presence since.

One of the other items that our experience shows is incorrect is the average weight of fish. It is obvious to us that the figures are incorrect, as we pack our whole snapper and must, for marketing reasons, note the number of fish per 10-kg carton. Our average, including east coast fish, which are smaller than those from the west coast, is much greater than the 0.89 kg shown for 1978. Our factory managers say from their practical experience that the average size of west coast fish being caught is well above 1 kg and that double this would be a fair estimate. Moreover, they are also adamant that the size of the west coast fish is not decreasing. It is clear to me that the Ministry's sampling has been insufficient and possibly at the wrong times to give a true answer.

A graph of the snapper catch per litre of fuel for four sets of our west coast pair trawlers for the last year shows an increase for three sets and a reduction for one set. There are reasons for the reduction of that pair and these were explained to the writers of the article, but, in any case, the average was a slight increase in catch per litre of fuel for that year and this certainly does not indicate a 17% decline in the fishery. I submit that fuel usage is the only true measure of effort available at present.

The most disturbing feature is that in spite of the writers' being advised of their inaccuracies, they had the article printed, rather than taking the time to do a proper study to get the right answer. Moreover, probably 80% of the west coast snapper are caught by two companies' vessels and both have agreed to co-operate with more detailed information. For this reason I believe the writers are losing not only their own credibility, but the credibility of their department. To be fair, the information they have had from fishing returns has not been sufficient to arrive at the correct answer. However, I feel that as soon as there was some doubt as to the correctness of their observations they should have studied their results more deeply before rushing to have them printed.

My company has offered its assistance to prepare an accurate study in this fishery and we hope that the research scientists will take this offer and come up with the correct answer, because this is what the industry deserves if it is to prosper.

I believe a fishery should be restricted only when it is clear that the resource is being fished to its maximum sustainable yield. In pelagic and demersal fishing the resource should be worked to a stage where it shows a decline, as this is the only way to assess the resource volume.

**Evidence from industry**

We in industry are long-term investors aiming to maximise the catch over a long period. The financial risks are high and we are very conscious of the size of the resource we are fishing. We are also well aware, and apparently this is overlooked by some scientists, that some fisheries improve with hard fishing, and there is clear evidence of areas stagnating when power fishing has been stopped on them.

Licensing or controlling a fishery should be used only to protect a resource; too often people are talking of licensing a fishery to protect the investors or fishermen. Fishing is a hunting operation and a high-risk investment industry. If a fisherman wants to be self-employed he should face the competition other self-employed people do, and it is no business of research scientists to promote legislation to give investors protection.

There is a need by industry for scientists, but they must stop being suspicious of the sound practical advice that they can get from industry members. They must also give up what appear to us to be preconceived ideas and get closer to the practical side of the industry. If this is not possible, I believe members of the industry must seriously look at employing their own qualified people to study the fisheries in which they operate to counteract the incorrect answers being arrived at by some researchers.

**In-shore and deep-water resources**

In view of the depressing reports that are being published about the depletion of the in-shore fishery resource around New Zealand, it is certainly heartening to read in the June issue of *Catch '78* the report by Dr R. C. Francis of the very large tonnage of fish that is available in the deep-water fishery. His estimates range from 600 000 to 1 400 000 t. These estimates are like a breath of fresh air when compared with the reports on the in-shore fishery.

However, I have figures supplied by the Japanese Embassy that show that in 1970 their deep-water trawl fish catch from New Zealand was 3.17 t per gross tonne of vessel in the New Zealand fishery, but by 1975 that had reduced to 1.55 t per gross tonne of vessel. This is more than a 50% reduction in catch over a 5-year period. I have discussed this with people in the Japanese fishing industry who say that this is quite normal and that the fishery is in no danger of depletion and is, in fact, in a very healthy state. What disturbs me is that when comparing articles written on the in-shore fishery with that of Dr Francis, it appears to us in industry that Fisheries Research Division is trying to restrict catches of trevally and snapper in the in-shore fishery with nothing like that sort of percentage reduction in catch to support such a move.

I apologise for quoting particular examples, but only in doing so can I make my point that there must be free access into a fishery until it is well and truly shown that it is being worked to its maximum, and only then should controls be introduced. Moreover, if it is not clearly pointed out that the articles are incorrect, people in the future will assume that they show the correct situation.

**Effects of controls**

Now, let us assume the researchers have proved and industry has accepted that controls are necessary. I firmly believe that restricting access for any reason is the start to stagnation. It happened in 1936, and though that may have avoided overcapitalisation afloat, it had the reverse effect ashore. Each two or three fishermen who could not expand their operations afloat became wholesalers and processors by duplicating factories, and serious under-utilisation of shore plants was created. If restricted access is used to manage a fishery, there must be some way to tie each fishing licence to a shore plant to stop duplication. This, I believe, would not be acceptable to the fisherman, who would be restricted in bargaining for the price of his catch. Moreover, fishermen and vessels get older and as the years go by, with no modern vessels and younger crews to compare catch rates, researchers will come up with the answer that the resource is being depleted because of the drop in the effort of older men and vessels, when in fact the resource may be improving.

There are many methods of regulating a fishery, such as quotas, open or closed seasons or areas, and, probably the best, that has been in use for many years, regulations on mesh size that allow sufficient escape.

If the competition is taken out of fishing, the resource is certain to be under-utilised and to stagnate, and the public will be forced to pay more than they should to support such inefficiencies.

Finally, we should all be taking a more positive approach by studying how we can increase each fishery, perhaps by breeding and releasing programmes, rather than the negative approach of restrictions.

# Reasons for controlling fisheries

by R. D. Elder

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HISTORY has shown that fisheries which are not controlled in some way become overexploited and, in industrial societies like our own, overcapitalised.

It is well known and generally accepted that renewable resources such as fish stocks have a finite limit to the level of exploitation that they can sustain. This limit depends on the initial size of the stock, its reproductive capacity, the growth rate of individuals in the stock, and the natural mortality rate of individuals. These factors are in a state of dynamic balance which depends on the physical effects of the environment and competition from other animals, including man. It is the enormous effect of man's fishing activities on this balance that seems inevitably to lead to fish stocks becoming overexploited.

Fishing increases mortality in the stock. Within limits the increased mortality due to fishing can be compensated by reduced natural mortality, increased reproductive success (recruitment), and increased rate of growth in individuals. These compensatory changes result in the surplus yield that can be safely taken from the stock by fishing. The changes, and hence the safe biological yield that can be taken from the stock, are unique to each stock. When this safe biological yield is exceeded the stock becomes biologically overexploited.

In societies where man's ability to range is limited, the overexploitation is generally local. In industrial societies where his range now includes all the oceans, the overexploitation can be on a huge scale, so that recovery of a stock may be extremely long term or even impossible. Fortunately, the effects of overexploitation may usually be reversed simply by reducing or removing fishing pressure.

However, man's preference for certain species of fish means that the preferred species become heavily exploited in relation to less preferred species, which may even be ignored. Thus the dynamic balance of the ecosystem may be seriously upset. The less preferred or lower value species may compete with the preferred species. Overexploitation of the higher value preferred species may create the opportunity for expansion by the lower value species into the niche originally occupied by the preferred species. This additional stress on the preferred species may permanently prevent recovery of stock, even if fishing is curtailed. This is why, today, we hear talk of the importance of fishing "across the ecosystem".

### Controls

Some controls on fishing become inevitable when fishing pressure reaches even moderate levels. The first one usually implemented is the introduction of minimum sizes. This is an attempt to protect sexually immature fish from exploitation and thereby protect the reproductive capability of the stock. Minimum sizes may be combined with mesh size regulations to ensure some growth beyond sexual maturity and to maximise the growth-mortality balance. Closed areas and/or seasons may be introduced to protect spawning fish or nursery grounds. These controls may be followed by quotas on the landings of species to ensure that total stocks are not reduced to levels below those which support the safe biological yield, maximum sustainable yield, optimum sustainable yield, or whatever objective is the aim of management measures.

It is important to note that none of these control measures prevents overcapitalisation in the commercial fishing industry. This is because the available catch is always worth much more than the total costs of the minimum effort necessary to catch it. Therefore there is great incentive for individuals and companies to take as big a portion of the available catch as they can. Hence more, larger, faster, or more sophisticated vessels enter the fishery and more people are employed. However, at the same time the real efficiency in harvesting the available catch is declining and the super-profit or net economic yield that could have been derived from rational exploitation of the stocks is being dissipated in excess capacity—catching and processing.

### Net economic yield

A sound management objective therefore seems to be to maximise the net economic yield available from exploitation of fisheries resources. The maximum net economic yield occurs at a level of fishing effort where the total value of the catch exceeds the necessary costs of production (including operating costs and "normal" returns to labour and invested capital) by the greatest absolute amount (Copes 1976). This maximum net economic yield is illustrated in Fig. 1.

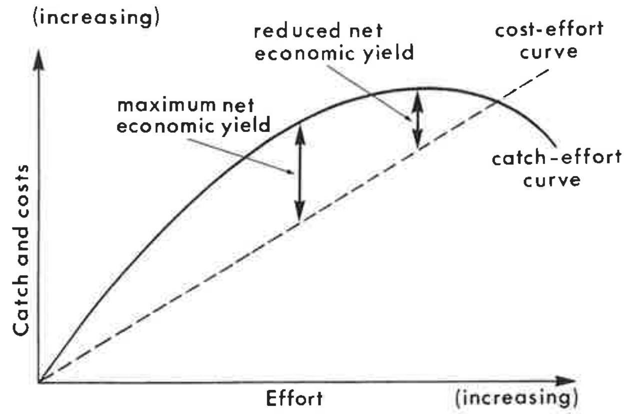


Fig. 1: The concept of maximum net economic yield as the maximum margin between the cost-effort curve and the catch-effort curve.

All costs involved in fishing are contained in the cost-effort curve, including vessel operation costs, labour, return on invested capital, necessary margins for vessel replacement, and entrepreneurs' margins.

It is therefore logical to look at control measures which affect economic yield. Clearly, the control measure necessary for maximising net economic yield is a control on effort. The only sure way of controlling effort is by limiting access to the fishery (licence limitation), but it must be used in combination with quotas, minimum sizes, closed areas, etc. to truly manage the fishery.

**Resource ownership and use of potential yield**

It is widely accepted, and confirmed by changes in the Law of the Sea which have resulted in most sea fisheries falling within the jurisdiction of coastal states, that marine fisheries resources are "common property" resources. This means, for New Zealand's coastal resources, that they are "owned" by the people of New Zealand and held in trust for them by the Government. The Government, at the will of the people it represents, can then allocate the privilege of exploiting these resources and in so doing should gain some "benefits" for the public in return. What these benefits might be should be widely discussed, but they could include the following:

- Increased revenue paid direct to government funds from increased licence fees or royalties on catch for use in or outside the fishing industry;
- Increased overseas earnings, that is, income, for the country as a whole;
- Increased marine recreational facilities;
- Employment;
- Funding of marine management programmes;
- Environmental restoration or enhancement.

These benefits would be paid from the net economic yield generated in a fishery that is being managed to maximise this net economic yield.

This payment has been termed "economic rent" or "resource rent". It is important to remember that the rent comes from the economic surplus that results from the difference between the value of the catch and **all** of the costs involved in taking that catch, and it varies according to the richness of different fish stocks.

It is also important to realise that this economic surplus will amount to large sums of money if the fishery is managed to maximise the net economic yield, and it would be unreasonable to allow this money to accrue entirely to those privileged fishermen who are licensed to exploit the resource. If it did, and they were not controlled by an allocated quota system, they would, naturally, increase capital in their vessels to take an ever larger share of the catch.

Of course there are problems with limited access and allocated quota systems. Most obvious are:

- How many fishing permits should be issued and who should have them?
- What should the permits be worth?
- How may permits be transferred or re-allocated?
- What would be the status of companies as opposed to individuals?
- How should the "rent" be collected—as substantial licence fees or royalties on catch?

These are all problems that can and must be faced and overcome; there is ample previous overseas experience and literature to consult.

Ultimately, most fisheries will have to adopt some sort of allocated quota scheme, with quotas adjusted periodically as stock and economic conditions dictate.

Finally, I believe that the fishing industry and the public should be calling for controlled, limited-access fisheries now. In the developing fisheries it is of utmost importance to avoid overcapitalisation, which not only means losses to the industry, but also to the country or the community as a whole. Where fisheries are overcapitalised it is important to face the problem of reducing excess capacity or redeploying it as soon as possible to avoid the misery and wastage generated. Our deep-sea fishery has room for carefully planned expansion, and foreign vessels can be excluded as our own catching capacity increases, but we must not allow it to become overcapitalised, as some of our in-shore fisheries already are.

## REFERENCE

Copes, P. 1976: Review of South Australian fisheries. Fisheries Green Paper 1, January 1976, South Australian Department of Agriculture and Fisheries. 35 pp.

## Discussion of preceding four papers

At conferences throughout the world, the situation arises where the scientist or the academic is pressing for caution which the businessman does not want. Perhaps in New Zealand we could come up with a formula whereby scientific controls and the economic situation could be reconciled. If a young scientist believes a resource is in danger, in pressing for controls he may be placing his own professional integrity in question. The manager of a fishing organisation may have responsibility for the jobs of up to 450 people, which makes it more difficult for him to accept controls.

If controls have to be placed on a fishery, we must look at ways of providing financial assistance to change to another fishery, since we are apparently using only a small part of the total resource. The cost of freight to overseas markets seems to be one of the main barriers to fishing for the less preferred species.

There was some, largely unresolved, discussion on the discrepancies between the figures which the fishing companies regard as reliable and those which are published. Apparently catch returns and information obtained from fishing companies do not always agree, but it was stressed that catch per litre of fuel should be used as the measure of effort.

It was suggested that the attitude to conservation should be total and that individual aspects, such as fisheries and fuel, should not be isolated. There is a conflict between the interests of present and future generations. The application of high-energy technology to food gathering has given access to accumulated resources which will now be depleted. The warning was given that the carrying capacity of countries using such technology has been temporarily artificially raised and cannot continue at the present level.

In a comment on the effects of licensing, it was stated that from 1936 to 1964, when fishing was a licensed industry, old boats were kept in use to such an extent that licences were not available for new boats.

# A case for conservation: A strategy for the north-east coast snapper fishery

by L. D. Ritchie

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CONSERVATION is a total concept popularly defined as wise or best use of a resource. Too often in the past "best use" has been interpreted as maximum yield, a concept in fisheries where maximum economic return has been the major criterion. Optimum yield, ". . . consideration of recreational, social, ecological and economic as well as biological factors in the determination of allowable catches within every fishery under management" (Carlton 1976), holds much greater promise for biologically healthy seas and rational resource use. Optimum yield may be considerably below the point of maximum yield.

The reaction against heavy exploitation of a fish stock (as given in Hardy 1959) has been considerable in recent years. It is easy to see the need to curb further growth in fishing effort in such heavily fished snapper stocks as in the Hauraki Gulf and north-west coast fisheries, where quotas have been set for the former and the latter is thought to be overfished by some 33⅓% or 1000 t (Sullivan quoted by Young 1978). We are warned of the dangers of overfishing such species as tarakihi, trevally, and snapper by Vooren (1974), Waugh (1977), Brebner (Anon. 1978), and other writers.

It is less easy to assess other biological changes related to these fisheries. There has been urgent warning given and notable movement in recent fisheries literature towards consideration of fisheries as environmental systems rather than as single-species exploitable stocks (Dickie 1973, Andersen 1978, Loftus, Johnson, and Regier 1978, Sinclair 1978, Gulland 1978).

**Equivalence of conservation with best use**

As a proposed starting point, a fish stock should not be exploited to a point where its virgin characteristics of a wide age-size population structure are much altered or reduced. Simply stated, if a virgin stock age-size structure approximates a normal curve (or any other distribution), the exploited stock age-size structure should approximate a similar curve or distribution. However, the amount of stock size structure alteration that is consistent with the maintenance of good biological health of a fishery environment is arguable.

This advocacy of the maintenance of virgin stock characteristics raises the type of question: "What value does the elephant fish have other than as a prime commercial species, and of what particular value are old elephant fish?" Our contacts with elephant fish (as with many other species) outside the commercial fishery are few and we cannot answer such a question. At best, if we seriously deplete such a resource, only the fishery will suffer.

In the north the sea receives high recreational use and its kindly physical and climatic qualities allow use and study of many coastal marine organisms *in situ*. The rest of this paper deals with the north-east coast snapper fishery, the desirability of keeping commercial exploitation at its present adequate and not excessive level, and the means for achieving this.

## THE SNAPPER FISHERY

**The commercial fishery**

The fishery extends from North Cape south to Cape Rodney, east to the vicinity of the Mokohinau Islands, and generally not much beyond the 100-m contour. It is the least heavily exploited snapper stock in the country and has a commercial catch in the order of 1200–1400 t per year. There are about 100 full-time commercial boats, including long-liners based at Houhora, Mangonui, Opua, and Tutukaka, 14 or so pairs of pair trawlers working mainly from Whangarei and Whangaroa, and a few Danish seiners, gill netters, and drag netters.

In winter pair trawlers operate in the southern zone—from Ocean Beach south into area 005—and the long-liners tend to be reduced in numbers by about 50% in the northern zone—North Cape to Berghan Point. From September the pair trawlers fish north from Takou Bay-Whangaroa, and they fish much of the summer in the Cape Karikari-Great Exhibition Bay-North Cape area. Long-liners operating in these northern waters reach about 30 in number between October and February.

## The recreational fishery

There is a considerable recreational or amateur fishery for snapper throughout the three zones (southern, middle, and northern), including all the harbours, most of the open coast, and the off-shore islands—all within 1 hour of haven for small craft. Northland Travel Promotion Inc. estimates that almost a third of Northlanders fish recreationally (30 000+) and that this figure at least doubles over the summer. These fishermen, the numerous fishing clubs, and a dozen or so summer snapper fishing contests contribute to a recreational fishery of several hundred tonnes, perhaps up to 500 t, annually.

## Monitoring the commercial fishery

Fisheries Management Division staff have recently (August 1978) started to monitor the main components of the north-east coast snapper fishery, including pair trawling in the southern, middle, and northern zones and long-lining in the northern zone. Other fisheries, particularly those based at Opua and Tutukaka, will be monitored as time and staff permit. All physical and catch data are recorded and sampling for length-frequency distribution data is carried out.

## Results of catch sampling

Figure 1 illustrates length-frequency distribution data available from long-line and Danish seine catches in the northern zone and pair trawl catches in the southern zone. For long-line-caught fish the mode is at the 42–43-cm fork length size class and almost half the fish are 40 cm or larger. Danish seine-caught fish have a mode at the 32–33-cm size class with 90% of the sample at 30 cm or larger. Trawl-caught fish in the southern zone have a mode of 26–27 cm with 76% of the sample in this or larger size classes.

Paul (1976) outlines the problems associated with interpretation of length-frequency data without aged samples and when the data are of mixed origin and from different sampling mesh size, and hence different selectivity. Tables 1 and 2 compare similar data from the Hauraki Gulf and the north-east coast snapper fishery. Although direct comparison is not possible, it is obvious that the northern zone long-line-caught sample indicates a high modal size (the largest percentage of fish at 40 cm fork length or larger that has been recorded from such a large random sample of snapper in New Zealand waters).

Similarly, the Danish seine-caught fish have a larger modal size than any given by Paul (1976) for the Hauraki Gulf (Table 2). The pair trawl sample (Fig. 1) has a similar size distribution to those given by Paul for outer Hauraki Gulf fish between 1949 and 1971. The southern zone of this survey is an extension of the Hauraki Gulf fishery and the whole area out to at least 100 m receives considerable fishing pressure. Significant differences in population structure would not be expected.

## The health of the fishery

This snapper fishery probably exhibits such good population characteristics because about 46% of the total area is foul bottom and unavailable to present bulk fishing methods. Long-line fishing pressure on this foul bottom is insignificant over all.

Table 3 gives approximate areas and percentages of foul and trawlable sea floor for the fishery. The large fish evident in the long-line fishery (and trawl catches of up to 1000 baskets of large fish in the northern zone) are probably contributed to by "spill over" from the extensive foul bottom which represents a natural refuge from present exploitation.

## Licensing the fishery

It is highly desirable to maintain this snapper fishery at its present level of exploitation. This contention is held by Fisheries Management Division in Northland, most of the commercial fishermen with whom it has been discussed, and most interested Northlanders (as evidenced by media comments). This can be done most simply by the introduction of licensing as soon as possible.

**Social considerations.** Present levels of exploitation enable a good living for many hundreds of people directly involved. The finished product, mainly iced and frozen snapper for export to Japan, is a valuable contribution to the economy of Northland and New Zealand.

**Biological considerations**. Present exploitation levels enable maintenance of a snapper population with a size distribution as natural as possible with the concomitant "good biological health" of the whole in-shore marine environment. One example of how changes to the snapper population structure can affect this environment can be seen in the predator-prey relationship which exists between snapper and kina and the kelp forest (pers. obs.). This is being investigated by Auckland University marine scientists. Large snapper (40 cm fork length and bigger) feed extensively on kina *Evechinus chloroticus* in in-shore shallow rocky areas; for example, at North Cape. In areas where the snapper size distribution is significantly depressed by fishing pressures (much of the Hauraki Gulf, extending north to Tutukaka and beyond) there are large populations of kina which

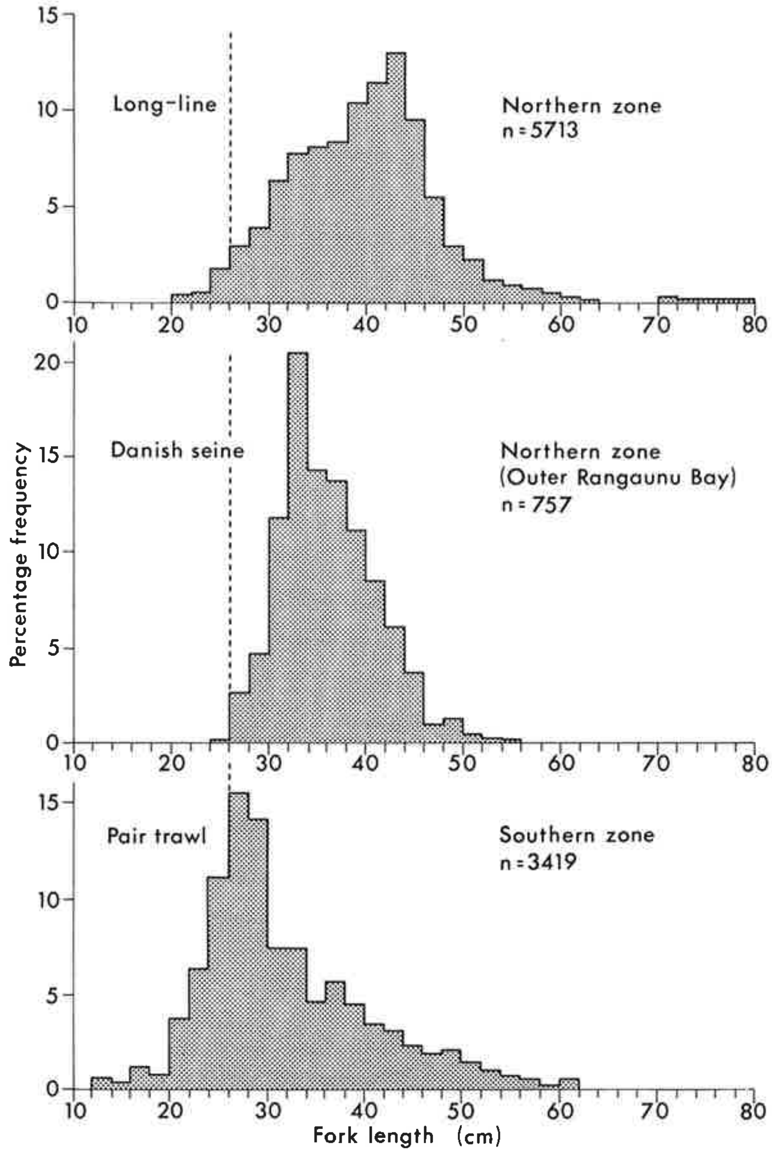


Fig. 1: Length-frequency distribution data for snapper in the north-east coast fishery, August-September 1978.

place heavy pressure on the kelp forest and associated fauna and flora.

The situation is aggravated in areas where red moki are also fished extensively by spear fishermen and gill netters. Red moki feed heavily on juvenile kina (my unpublished data). Modification of the kelp forest community, including reduction of area and recruitment of species palatable to kina, has far-reaching consequences for a wide range of organisms, including many in-shore fish species. In extreme cases accelerated sublittoral, littoral, and foreshore erosion can result from reduction of the kelp forest.

**Recreational considerations.** Recreationally the snapper resources of Northland are important. This fishery will be monitored and investigated by Fisheries Management Division staff in the near future. It can be argued that the high probability of catching snapper 20–30+ years old is a luxury in a fish-hungry world; however, it can be done on the north-east coast with a higher likelihood of success than almost anywhere else and it is a luxury that can be afforded by any local or tourist. It is a luxury well worth protecting.

### Methods for controlling the fishery

Within the present legislative framework there are several methods for retaining the present good health of this fishery and for limiting further growth.

**Controlled fishery.** In-shore snapper stocks (or the trawl fishery) could be included as soon as

**TABLE 1: Long-line-caught snapper length-frequency distribution data**

| Year | Area | Length-frequency distribution sample n | Mode | %≥40 cm |
|---|---|---|---|---|
| 1929* | Hauraki Gulf | 2728 | 35 cm | 30† |
| 1978‡ | North Cape-Berghan Point | 5713 | 42–43 cm | 49.5 |

*Hefford's data *in* Paul (1976).
†Extrapolated from Paul (1976).
‡Data from present survey.

**TABLE 2: Danish seine-caught snapper length-frequency distribution data**

| Year | Area | Length-frequency distribution sample n | Mode | %≥30 cm |
|---|---|---|---|---|
| 1929* | Hauraki Gulf | 26 446 | 30–31 cm | 70† |
| 1970‡ | Inner Hauraki Gulf | 1 478 | 30–32 cm | 90† |
| 1978§ | Outer Rangaunu Bay | 757 | 32–33 cm | 92 |

*Hefford's data *in* Paul (1976).
†Extrapolated from Paul (1976).
‡Data from Paul (1976).
§Data from present survey.

**TABLE 3: Areas (approximate*) and percentages of foul and trawlable sea floor, to the 100-m contour, from North Cape to area 005 out as far as Mokohinau Islands**

| Area | Foul bottom Area ($km^2$) | Foul bottom % | Trawlable Area ($km^2$) | Trawlable % |
|---|---|---|---|---|
| Northern zone | | | | |
| North Cape-Berghan Point | 210 | 25 | 620 | 75 |
| Middle zone | | | | |
| Berghan Point-Ocean Beach | 1200 | 75 | 400 | 25 |
| Southern zone | | | | |
| Ocean Beach-northern limit of zone 005 | 130 | 15 | 800 | 85 |
| Total | 1540 | 45.8 | 1820 | 54.2 |

*As determined by trawl skippers' fishing charts.

possible in the second schedule of Part III of the Fisheries Act 1908, with declaration of a moratorium and early introduction of a controlled fishery for snapper on the north-east coast.

**Quotas and fishing limits by method.** Catch quotas by zone could be introduced as soon as possible. Limits by method seem especially appropriate. It is possible that some slight expansion of the traditional fishing methods of trawling and especially long-lining could be sustained, but new methods such as trawling over the foul ground and low mid-water trawling should be disallowed, as these would represent a direct assault on the "stock capital" within the natural refuge areas.

**Marine reserves.** Appreciable control of the fishery could be effected by early and careful consideration of the extension of the marine reserve concept to include reserves of many different types (for example, scientific, scenic, wildlife, and recreational) and by the recognition of the importance of the principle of fisheries reserves for protection of areas of particular importance to fish stocks as nurseries, havens, and known feeding areas (for example, mangrove wetlands, harbours, and shallow bays).

Finally, it must be widely appreciated that this strategy has as its core protection of the industry, the marine environment, and the recreational resource through the holding of exploitation to its present acceptable levels. The biological health of the resource itself must be the first consideration to which all other factors are secondary.

## REFERENCES


ANDERSEN, R. 1978: The need for human sciences research in Atlantic coast fisheries. *Journal of the Fisheries Research Board of Canada 35*: 1031–49.

ANON. 1978: Bob fires last shot. *Catch '78 5 (6)*: 13.

CARLTON, F. E. 1976: Allocation of living marine resources—recreational fisheries perspectives. *In* Anderson, S. H. (Ed.), Recreation—Marine Promise: Proceedings, discussion, and overview of the National Conference on Marine Recreation held in Newport Beach, California, October 2–4, 1975, pp. 95–100. University of Southern California.

DICKIE, L. M. 1973: Management of fisheries; ecological subsystems. *Transactions of the American Fisheries Society 102*: 470–80.

GULLAND, J. A. 1978: Fishery management: new strategies for new conditions. *Transactions of the American Fisheries Society 107*: 1–11.

HARDY, A. 1959: "The Open Sea: its Natural History. Part II. Fish and Fisheries." Collins, London. 322 pp.

LOFTUS, K. H., JOHNSON, M. G., and REGIER, H. A. 1978: Federal-provincial strategic planning for Ontario fisheries: Management strategy for the 1980s. *Journal of the Fisheries Research Board of Canada 35*: 916–27.

PAUL, L. J. 1976: A study on age, growth, and population structure of the snapper, *Chrysophrys auratus* (Forster), in the Hauraki Gulf, New Zealand. *Fisheries Research Bulletin, N.Z. Ministry of Agriculture and Fisheries, No. 13.* 62 pp.

SINCLAIR, W. F. 1978: Management alternatives and strategic planning for Canada's fisheries. *Journal of the Fisheries Research Board of Canada 35*: 1017–30.

VOOREN, C. M. 1974: An analysis of the statistics on the fishery for tarakihi, *Cheilodactylus macropterus* (Bloch and Schneider), in New Zealand waters from 1936 to 1969, with notes on the trawl fishery in general. *Fisheries Research Bulletin, N.Z. Ministry of Agriculture and Fisheries, No. 7.* 44 pp.

WAUGH, G. D. 1977: Trevally resources and management problems: Bay of Plenty. *Catch '77 4 (11)*: 3–4.

YOUNG, D. 1978: Where do we draw the line? *N.Z. Listener 89 (2017)*: 26–8.

# A case for the small-scale operator

by J. Catton
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WHO is the small-scale operator? It is not clear any more. I thought 5 years ago that 45-ft (13.5-m) Danish-seine boats were large, but now they seem small. So it is a changing situation and we can talk only about relatively smaller and larger operators; there are no definite dividing lines.

For the purposes of this paper I will restrict my comments to the snapper fishery from Auckland north. For those not familiar with the situation, there are in this fishery several different methods competing for, substantially, the same fish:

- The long-line method, which is largely unmechanised, with vessels usually 20–35 ft (6–10.5 m).
- The gill-net method, with vessels similar in size to the long-liners. These are often fast boats.
- The power-net methods, which are
  - Danish seiners, about 35–50 ft (10–15 m) and generally owner operated;
  - single trawlers;
  - pair trawlers, of which the smaller pairs are owner operated and larger pairs are operated by the companies.

At present there is a lot of support for the view that bigger boats are more efficient than smaller ones. Obviously they do catch more fish, but efficiency cannot be measured simply by the amount of fish caught. Catches are higher, but so are expenses. To obtain definitive statistics would be a great undertaking, but until they are produced, I will not be convinced by this myth of greater efficiency.

## Factors

I do not think the following factors have been sufficiently considered.

**Owner operation.** The larger the vessel, the further it is from the grasp of an owner-operator. Owner operation is widely recognised as a most efficient method of organising industry.

**Capital.** The capital cost of many, if not most, older, smaller vessels has been repaid. New larger vessels built at today's high costs must start repaying their capital cost when they enter the fishery. Capital is one of New Zealand's limited resources. Use of this scarce resource is one of the factors that must go towards a consideration of efficiency from a national viewpoint, particularly when we start talking of one type of vessel displacing another from the fishery.

**Profit.** One company I approached considers that it makes virtually no profit on the fishing operations of its pair trawlers. The company's profit is made at the processing and marketing stage.

Yet, by contrast, I know of long-line fishermen who turn over four times their capital invested every year. Their expenses are low, and so they are in a healthy, profitable situation.

**Fuel.** Full figures comparing fuel consumptions for different fishing methods would make interesting reading, but the long-line vessel whose figures I looked at caught **on average** twice the weight of fish per litre of diesel compared with that obtained by west coast pair trawlers at their best catch rate, according to figures given in the September issue of *Catch '78*. The diesel burned by one high powered pair would be sufficient for ten Danish seiners or a score or more of long-liners.

Quite clearly it is the higher horsepower vessels that are going to be most detrimentally affected by the inevitable increases in diesel costs. The impact of this on the economics of such boats may be dramatic.

**The question of quality.** It would be fair to say that, generally speaking, the quality of the fish obtained in this fishery diminishes as the size of the boats catching it increases.

Long-line vessels obtain by far the best fish. Danish seiners obtain easily the highest quality power-net fish. The highest powered pair trawlers tend to obtain the lowest quality. They catch the biggest bags of fish, which then receive rougher treatment in the net and cannot be handled with the individual attention a long-line fisherman can accord to his catch. The fish tends to be stacked higher, and the time is longer between when the fish is boated and the last of the catch is iced.

My contention is that we should be aiming to obtain the **highest** quality fish from our limited prime species resources. This maximises the realisation to New Zealand from those resources and gives us a highly salable product in today's difficult marketing situation.

This sort of quality means the use of smaller boats and that in turn means more employment. From a fisheries management point of view we should not be blindly seeking the maximum sustainable yield from any fishery, but rather obtaining the maximum economic and social benefit for New Zealand from that fishery.

In other words, it makes much more sense in terms of use of resources to catch 1000 t of fish by methods which employ 100 fishermen and give a realisation of $1 million, than to catch the same amount by other so-called more efficient methods that employ 10 fishermen and provide a realisation of only, say, $600,000. And at the same time we spend fewer overseas funds on imported boats, machinery, and diesel.

## Lack of planning

These sorts of considerations seem to be apparent to many people within the Fisheries Divisions of the Ministry of Agriculture and Fisheries, yet they appear not to make their way up through the bureaucratic morass to the level at which the decisions are made. I do not know why that is, but it is most disturbing. There is deep dissatisfaction, too, among many of these people with the way the Ministry functions, but little rethinking is apparent. Sensible fisheries management must be planned for, but there is no overall planning in the New Zealand fishing industry. The Ministry appears to have neither a cohesive idea of its objectives nor the courage of conviction to make the firm management decisions that are desperately required now in some fisheries to prevent further debacles like those that occurred in the Chatham Island crayfish, Nelson scallop, and, just recently, Coromandel scallop fisheries.

## Snapper fishery management

As we have already heard, both the Auckland east and west coast snapper fisheries are considered by researchers to be fully exploited or overexploited. So, therefore, there is no room left for any extra fishing effort, yet we see increasing effort at all levels. We have newcomers to the fishing industry—the ex-car salesmen, taxi drivers, etc., who have read about the 200-mile zone and the tremendous opportunities that exist—who are buying long-line and gill-netting boats. We have established crayfish and groper fishermen converting their boats or building slightly larger boats for pair trawling (these are mostly 40–50 ft (12–15 m)) and we have companies acquiring more relatively large pair trawlers. Clearly some fisheries management regime restricting increased effort at **all these levels** is urgently required if damage to the resource is to be avoided.

The only room for any development in this situation is by the removal of some of the larger vessels into underexploited fisheries that the smaller ones are incapable of exploiting anyway. Of course this would have to be economical and we could all think carefully about R. T. MacKay's paper [page 66], in which he suggested that government subsidies of one kind or another should be considered to make some less preferred species profitable. If larger vessel effort were drawn off in this way, an increase in the number of smaller vessels with their various advantages could be allowed.

We do not need, in a fully exploited fishery such as this, a replacement of smaller vessels by larger ones, but quite the reverse. It is in that direction, I contend, that a fisheries manager should be looking. The reverse is occurring; the accent is on bigger being better, and the smaller-scale operator is being disadvantaged by this approach. The situation appears to be one where the large companies have the upper hand by being more readily able to take advantage of the various government incentive schemes.

## Competition

N. L. Mills, in his paper on open access [page 99], has called for fair competition. However, competition is not fair; it is distorted by things such as government incentive schemes that are available to only some of the competing interests. Such incentives are a tool of management. The duty-free importation scheme was introduced to encourage the exploitation of under-utilised species.

I read with dismay an article in the *Christchurch Star* on 3 October: "Sanfords is buying two new 29-m stern trawlers from Japan, and these will join the two similar vessels which entered service earlier this year." For those not familiar with the situation, I should explain that the two present vessels are the biggest in the fishery. They fish in the same places as the other trawlers. They have at times towed exactly the same shots as two 40-ft (12-m) vessels working out of my home port of Whangaroa. Therefore I was taken aback to hear Mr Mills talking about 30-m vessels to fish for deep-sea species. There is no **suggestion** that the present 30-m vessels are fishing for deep-sea species.

With relation to the new vessels, I tried to obtain information about the fishing plans subject to which these boats are being imported. However, I was told that the information is confidential. I find this distressing; surely the terms of the licence are a matter of serious public interest, particularly to the smaller-scale fishermen engaged in this fishery. Some of these people may be substantially disadvantaged by the arrival of these boats.

I was not able to get this information as an individual and so I put two questions to the conference:

1. Can anyone tell this conference what fishing restrictions these boats will be subject to?
2. Could the heads of the Fisheries Divisions indicate to the conference what restrictions their Divisions wanted to see imposed as a condition of the import of these boats?

I should explain that this is not a witch-hunt against big boats as such or Sanfords or the Ministry. This just happens to be the most graphic example of the incongruity of a situation where one branch of government says that a fishery is overfished while another appears to be providing duty concessions, and presumably loan monies, to enable an increase in the catching effort in that fishery.

If these vessels are being allowed into the fishery without heavy restrictions on their allowable snapper catch, as this is considered a fully exploited or overexploited species, the situation, in my view, is little short of scandalous.

# The legislative framework

by B. T. Cunningham

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*Ministry of Agriculture and Fisheries, Wellington*

THE 200-mile Exclusive Economic Zone came into effect on 1 April 1978, pursuant to the provisions within the Territorial Sea and Exclusive Economic Zone Act 1977. The economic zone is adjacent to the territorial sea and extends to the maximum distance of 200 nautical miles from the baseline from which the territorial sea is measured. That Act also established a territorial sea of 12 nautical miles in width around New Zealand, which includes the outlying islands and the islands within the Kermadec Group. In exercise of the sovereign rights of New Zealand the Act made provision for the exploration and exploitation of the resources of that zone and also for their management and conservation. The resources include those of the water column, the seabed, and its subsoil, whether living or non-living resources, but at this conference we have been concerned only with the demersal fisheries resources.

New Zealand fisheries waters, as defined within the Fisheries Act 1908, were extended by the Exclusive Economic Zone Act to cover the 200-mile economic zone. So the demersal resources include those of the territorial sea, those of the economic zone, and, while they are within the zone, those which migrate across the boundary. To harvest the demersal resources appropriate authorisation is required through the issue of either a method permit pursuant to the provisions of the Fisheries Act 1908 or a licence pursuant to the provisions of the Territorial Sea and Exclusive Economic Zone Act 1977.

**Method permits** are issued to New Zealand flag vessels. These include foreign flag vessels operated by New Zealand companies, where the Minister of Fisheries has authorised their temporary registration as New Zealand fishing vessels under the Fisheries Act 1908. The companies include authorised co-operative venture fishing companies with an equity contribution from the foreign partner or partners at, or less than, the approved maximum. Vessels imported under the present duty-free import scheme and those under temporary import approval as chartered vessels must be operated in accordance with the fishing plan approved by the Minister; otherwise the owner becomes liable for payment of the duty remitted under the Customs Act and for revocation of the import licence for the vessels.

**Licences** are issued to foreign flag vessels after a government to government agreement has been negotiated and the fishing plan submitted by the foreign country has been approved by the Minister of Fisheries. Separate and special authorisation is, of course, required to conduct research on demersal fish populations within the economic zone, and the research programme must be completed in accordance with the proposals which have been approved by the Minister of Fisheries.

The resources of the territorial sea can be harvested only by vessels issued with a permit under the Fisheries Act 1908. However, the Minister of Fisheries usually restricts the harvesting of demersal stocks by chartered foreign flag fishing vessels to the waters of the economic zone where licensed foreign flag craft can operate; that is, outside the territorial sea and outside any delineated areas where it has been assessed that the local New Zealand fleet can harvest the available resources.

The Minister must determine for every fishery the total allowable catch and also the portion of it that the New Zealand industry (including vessels chartered by New Zealand companies and authorised co-operative venture companies) has the capacity to harvest. The remainder shall constitute the allowable catch to be allocated to licensed foreign fishing craft. In apportioning that residue the Minister may take into account:

- Whether the vessels of countries with which New Zealand has a government to government agreement have habitually fished within the New Zealand zone.
- Whether the countries have co-operated with New Zealand in fisheries research, in the conservation of the living resources of the zone, and in the enforcement of New Zealand law relating to such resources.
- The terms of any appropriate international agreement.
- Any other matters that he, after consultation with the Minister of Foreign Affairs, determines to be relevant.

While in the New Zealand zone and authorised to harvest demersal fish, foreign fishing vessels must comply with:

- All conservation and management provisions within the Fisheries Act 1908 and the Territorial Sea and Exclusive Economic Zone Act 1977.
- The associated regulations or any conditions attached to the vessel's licence on the keeping and submission of catch-effort data.
- Any quota and area restrictions, including by-catch limits by species by area.
- Other management aspects, such as methods of position reporting, catch transfer, supervision, carriage of observers, etc.

Thus the activities of licensed foreign fishing craft are effectively controlled and monitored.

If it is necessary to manage the activities of the New Zealand fleet through restrictions additional to the usual controls of restricted areas, mesh sizes, and so on—such as imposition of catch quotas by areas—there are provisions within the Fisheries Act 1908 for this to be done. If it becomes necessary to restrict the number of vessels which can be operated in selected demersal fisheries, this can be done through the Controlled Entry provisions of that Act.

Thus, within the statute law there are provisions which enable the harvesting of the demersal resources of the territorial sea and exclusive economic zone to be managed for New Zealand's benefit. However, if it is shown that the current provisions are inadequate, enactment of further provisions to overcome such deficiencies can be expected.

## Discussion of preceding three papers

In answer to queries about policy decisions in fisheries, it was pointed out that the Research and Management Divisions were not the decision makers; they merely advised the Government, which seemed reluctant to make decisions. Government had often called for more research, which had sometimes caused unnecessary delays and even allowed development of situations to a point where it was too late to do anything.

One speaker reiterated that there would always be conflict between small and large vessels. He suggested that 75%–90% of the catch of large vessels was of non-preferred species and that large vessels used less fuel over all. He also said that when large vessels were used people were employed in processing factories.

A question was raised concerning a study by the Fishing Industry Board of the use of fuel. It was stated that the cost of fuel for obtaining deep-sea fish was greater than that for any other type of food, and the questioner wondered whether there were any contingency plans for the time when fossil fuel may be scarce or too costly.

Mr Jarman replied that the Fishing Industry Board could not look too far ahead, but that it was about to do research into methods of catching fish with less energy use. He suggested that boats might be designed differently to use alternative energy sources, such as sail power. He also suggested that acoustic herding of fish might be employed.

The restrictions placed on larger vessels—for example, Sanford's two new 29-m vessels—were questioned. It was explained that specific criteria could not be stated, as these were confidential. The suggestion was made that, though some matters were confidential, more information could be provided to allay the fears of fishermen. It was felt that the Government had missed out on a public relations exercise.

One speaker wondered whether there were any provisions for the removal of a large joint venture vessel if it was upsetting the operations of the New Zealand fishing fleet. Mr Cunningham replied that there were, and that the amount of control was even greater for chartered vessels.

It was suggested that some fisheries seemed to be expanding too rapidly and that it might be a good idea to slow the rate of development for, say, a year to take stock of the situation. However, there was the problem of who had the right or the ability to make the decision to do this. It was agreed that more dialogue was required between fishermen and scientists.

# Appendix
# Species composition of the demersal fish resource*

by L. J. Paul and D. A. Robertson
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THE total landings of demersal fish caught in New Zealand waters have increased dramatically in the last 10 years (Fig. 1). During this period the species composition of the catch has changed as new countries fished new grounds and as New Zealand effort shifted to deeper water. The six most important trawl-caught species by weight in 1968 (snapper, barracouta, tarakihi, jack mackerel, trevally, and gurnard) had almost all been replaced by 1977, when the six most important species were hoki, barracouta, ling, squid, southern blue whiting, and warehou (Table 1).

Much of this change has occurred during the last 4 years and we present here recent catches by country, by fishing method, and by species (Tables 2–8). There are several inadequacies in the data and these are noted for each table. The data are the best available to us, but must be regarded as unofficial.

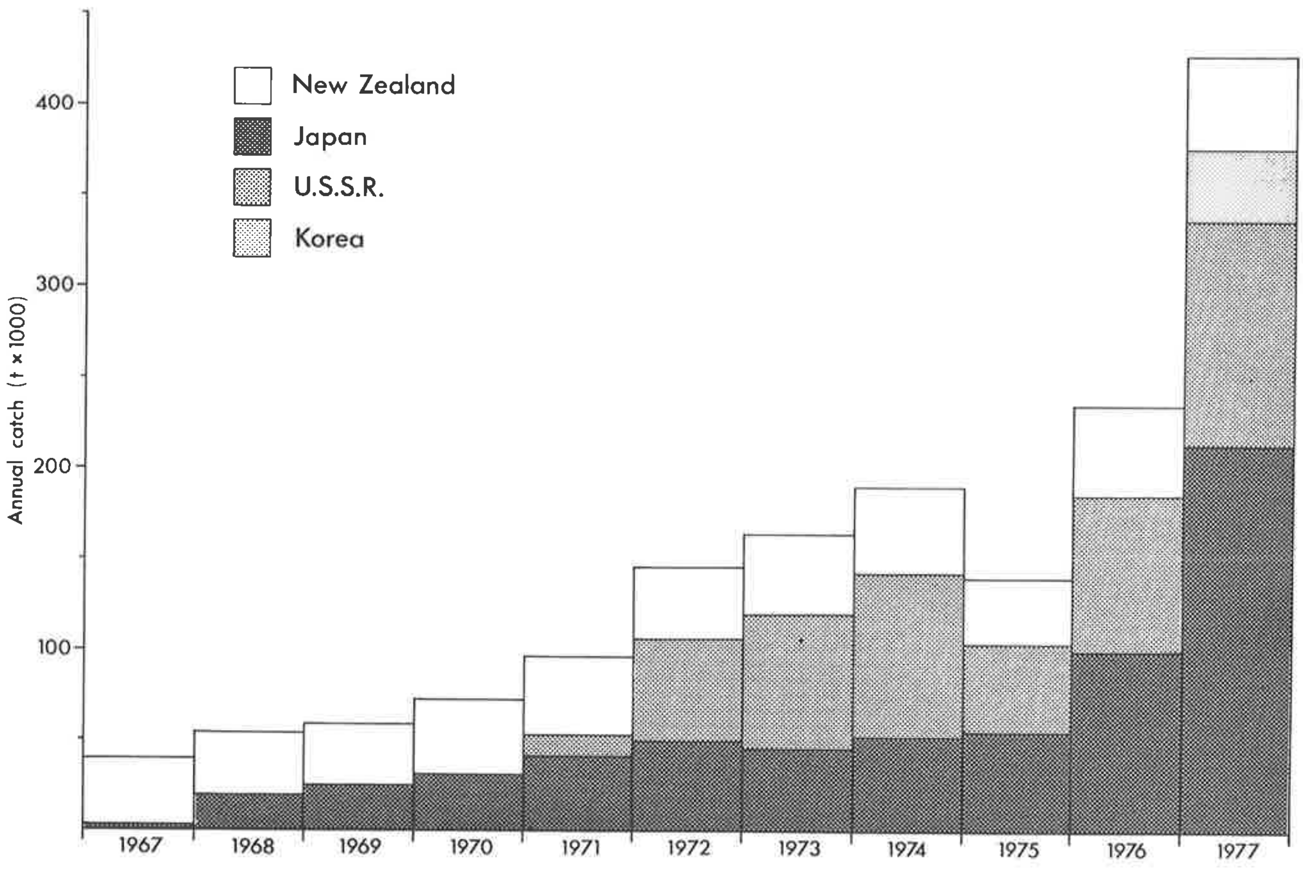


Fig. 1: Total demersal catch (including trawl-caught squid) for the New Zealand area, 1967–77.

*This paper was not read at the conference, but much of its content was incorporated into wall displays or referred to by speakers.

**TABLE 1: Fish species (including squid) contributing 5% or more to the total demersal catch in New Zealand waters for the years 1968, 1971, 1974, and 1977**

| 1968 | | 1971 | | 1974 | | 1977 | |
|---|---|---|---|---|---|---|---|
| Species | Percentage of total demersal catch | Species | Percentage of total demersal catch | Species | Percentage of total demersal catch | Species | Percentage of total demersal catch |
| Snapper | 21 | Barracouta | 16 | Southern blue whiting | 22 | Hoki | 23 |
| Barracouta | 20 | Snapper | 15 | Barracouta | 11 | Barracouta | 10 |
| Tarakihi | 11 | Jack mackerels | 15 | Jack mackerels | 10 | Ling | 7 |
| Jack mackerels | 10 | Southern blue whiting | 11 | Snapper | 8 | Squid | 7 |
| Trevally | 6 | Trevally | 6 | Hoki | 7 | Southern blue whiting | 6 |
| Gurnard | 5 | Tarakihi | 6 | Warehou | 6 | Warehou | 5 |
| | | | | Oreo dories | 5 | Hake | 5 |

**TABLE 2: New Zealand marine fish landings (tonnes) by species, 1974–77. (1974 data from *Annual Report on Fisheries for 1974;* 1975 data from *Annual Report on Fisheries for 1975* (in press); 1976 and 1977 data from *Catch '78 5 (11)*, page 11)**

| | 1974 | 1975 | 1976 | 1977 |
|---|---|---|---|---|
| Snapper | 13 880 | 11 604 | 14 365 | 12 585 |
| Trevally | 5 106 | 3 478 | 5 680 | 6 482 |
| Skipjack | 659 | 1 159 | 4 527 | 5 402 |
| Barracouta | 3 375 | 2 503 | 3 673 | 4 697 |
| Shark[1] | 2 594 | 2 369 | 3 555 | 4 521 |
| Tarakihi | 3 801 | 3 403 | 3 509 | 4 185 |
| Gurnard[2] | 2 989 | 1 954 | 2 879 | 3 332 |
| Red cod | 1 852 | 692 | 944 | 2 395 |
| Kahawai | 812 | 345 | 729 | 1 461 |
| Flounder[3] | 917 | 948 | 1 212 | 1 394 |
| Mackerel[4] | 1 489 | 331 | 1 145 | 1 913 |
| Warehou[5] | 845 | 529 | 994 | 1 088 |
| Hapuku[6] | 1 252 | 1 106 | 1 066 | 1 025 |
| Sole[7] | 1 103 | 733 | 1 179 | 1 663 |
| Albacore | 890 | 646 | 9 | 938 |
| Elephant fish | 902 | 645 | 768 | 762 |
| Moki[8] | 730 | 598 | 589 | 685 |
| Ling | 435 | 486 | 447 | 549 |
| John Dory | 469 | 374 | 551 | 531 |
| Mullet[9] | 454 | 421 | 432 | 574 |
| Monkfish | 271 | 217 | 540 | 438 |
| Blue cod | 695 | 384 | 528 | 383 |
| Sthn. kingfish | 416 | 210 | 297 | 366 |
| Mixed flats[10] | 205 | 185 | 254 | 349 |
| Mixed rounds[10] | 741 | 907 | 480 | 280 |
| Hake, blue[11] | 127 | 62 | 142 | 217 |
| Creamfish[12] | 98 | 76 | 216 | 213 |
| Nthn. kingfish | 167 | 73 | 112 | 120 |
| Black bream[13] | 65 | 48 | 80 | 72 |
| Butterfish[14] | 58 | 47 | 80 | 71 |
| Brill | 34 | 15 | 37 | 62 |
| Skate | 23 | 30 | 28 | 27 |
| Pilchard | 19 | 2 | 6 | 20 |
| Maomao[15] | 20 | 5 | 8 | 15 |
| Conger eel | 7 | 6 | 4 | 12 |
| Rock cod[16] | 5 | 9 | 26 | 12 |
| Turbot | 3 | 3 | 7 | 7 |
| Sthn. bluefin | 4 | 0 | 0 | 5 |
| Garfish | 5 | 2 | 5 | 5 |
| Trumpeter | 5 | 3 | 3 | 3 |
| Frostfish | 0 | 0 | 0 | 0.8 |
| Yellowfin | 1 | 1 | 0 | 0.3 |
| Totals | 47 523 | 36 609 | 51 106 | 58 860.1 |

1. Includes school shark, *Galeorhinus australis*, and smooth-hound, pioke, or rig, *Mustelus antarcticus*; relative quantities unknown.
2. Red gurnard, *Chelidonichthys kumu.*
3. Sand flounder, *Rhombosolea plebeia*, and yellow-belly flounder, *R. leporina*; relative quantities unknown.
4. Jack mackerels, *Trachurus novaezelandiae* and *T. declivis*, and blue mackerel, *Scomber australasicus.*
5. Mainly common or blue warehou, *Seriolella brama.*
6. Also includes bass *Polyprion moeone* and bluenose, *Hyperoglyphe antarctica*; relative quantities unknown.
7. New Zealand sole, *Peltorhamphus novaezeelandiae*, and lemon sole, *Pelotretis flavilatus*; relative quantities unknown.
8. Mainly blue moki, *Latridopsis ciliaris.*
9. Grey mullet, *Mugil cephalus*, and yellow-eye mullet, *Aldrichetta forsteri.*
10. Identity unknown.
11. Hoki, *Macruronus novaezelandiae.*
12. Leather jacket *Navodon scaber.*
13. Parore, *Girella tricuspidata.*
14. Greenbone, *Odax pullus* (family Odaciidae), not the butterfish family Centrolophidae.
15. Mainly blue maomao, *Scorpis violaceus.*
16. Probably a variety of species, including the bastard red cod, *Physiculus breviusculus.*

**TABLE 3: New Zealand marine fish landings (tonnes) by method and species,* 1974–76. (1974 data from *Annual Report on Fisheries for 1974*; 1975 and 1976 data from *Annual Reports on Fisheries for 1975* and *1976* (in press))**

### 1974

**Trawl†**

| | |
|---|---|
| Albacore | 4 |
| Barracouta | 3 268 |
| Black bream | 4 |
| Blue cod | 39 |
| Brill | 33 |
| Conger eel | 4 |
| Creamfish | 97 |
| Elephant fish | 811 |
| Flounder | 408 |
| Gurnard | 2 764 |
| Hake, blue | 125 |
| Hapuku | 305 |
| John Dory | 392 |
| Kahawai | 272 |
| Nthn. kingfish | 87 |
| Sthn. kingfish | 336 |
| Ling | 240 |
| Mackerel | 247 |
| Maomao | 1 |
| Mixed flats | 174 |
| Mixed rounds | 597 |
| Moki | 552 |
| Monkfish | 271 |
| Pilchard | 1 |
| Red cod | 1 841 |
| Rock cod | 5 |
| Shark | 1 571 |
| Skate | 19 |
| Skipjack | 3 |
| Snapper | 9 255 |
| Sole | 1 098 |
| Tarakihi | 3 741 |
| Trevally | 4 086 |
| Trumpeter | 3 |
| Turbot | 3 |
| Warehou | 837 |
| Total | 33 494 |

**Line§**

| | |
|---|---|
| Albacore | 879 |
| Barracouta | 3 |
| Black bream | 4 |
| Blue cod | 491 |
| Brill | 1 |
| Conger eel | 3 |
| Elephant fish | 7 |
| Flounder | 1 |
| Gurnard | 77 |
| Hake, blue | 1 |
| Hapuku | 935 |
| John Dory | 1 |
| Kahawai | 82 |
| Nthn. kingfish | 11 |
| Sthn. kingfish | 15 |
| Ling | 323 |
| Mixed rounds | 9 |
| Moki | 4 |
| Mullet | 8 |
| Red cod | 10 |
| Shark | 266 |
| Skate | 2 |
| Skipjack | 199 |
| Snapper | 1 119 |
| Sole | 1 |
| Sthn. bluefin | 4 |
| Tarakihi | 17 |
| Trevally | 11 |
| Trumpeter | 2 |
| Yellowfin | 1 |
| Total | 4 487 |

**Danish seine‡**

| | |
|---|---|
| Albacore | 2 |
| Barracouta | 18 |
| Flounder | 5 |
| Gurnard | 123 |
| Hapuku | 5 |
| John Dory | 73 |
| Kahawai | 11 |
| Nthn. kingfish | 4 |
| Sthn. kingfish | 2 |
| Mixed rounds | 1 |
| Shark | 34 |
| Snapper | 2 984 |
| Sole | 1 |
| Tarakihi | 20 |
| Trevally | 86 |
| Total | 3 369 |

**Purse seine**

| | |
|---|---|
| Albacore | 2 |
| Barracouta | 20 |
| Gurnard | 1 |
| John Dory | 1 |
| Kahawai | 247 |
| Mackerel | 867 |
| Mixed rounds | 129 |
| Shark | 2 |
| Skipjack | 430 |
| Snapper | 27 |
| Tarakihi | 5 |
| Trevally | 308 |
| Total | 2 039 |

**Net||**

| | |
|---|---|
| Albacore | 2 |
| Barracouta | 66 |
| Black bream | 57 |
| Blue cod | 152 |
| Butterfish | 88 |
| Elephant fish | 84 |
| Flounder | 502 |
| Garfish | 5 |
| Gurnard | 134 |
| Hake, blue | 1 |
| Hapuku | 7 |
| John Dory | 3 |
| Kahawai | 200 |
| Nthn. kingfish | 65 |
| Sthn. kingfish | 121 |
| Ling | 11 |
| Mackerel | 375 |
| Maomao | 19 |
| Mixed flats | 30 |
| Mixed rounds | 5 |
| Moki | 174 |
| Mullet | 446 |
| Pilchard | 18 |
| Red cod | 1 |
| Shark | 718 |
| Skate | 2 |
| Skipjack | 27 |
| Snapper | 495 |
| Sole | 3 |
| Tarakihi | 18 |
| Trevally | 615 |
| Warehou | 8 |
| Total | 4 422 |

### 1975

**Trawl**

| | |
|---|---|
| Albacore | 20 |
| Barracouta | 2 499 |
| Black bream | 4 |
| Blue cod | 51 |
| Brill | 15 |
| Conger eel | 1 |
| Creamfish | 76 |
| Elephant fish | 591 |
| Flounder | 460 |
| Gurnard | 1 856 |
| Hake, blue | 62 |
| Hapuku | 216 |
| John Dory | 328 |
| Kahawai | 132 |
| Nthn. kingfish | 53 |
| Sthn. kingfish | 189 |
| Ling | 205 |
| Mackerel | 223 |
| Maomao | 4 |
| Mixed flats | 162 |
| Mixed rounds | 490 |
| Moki | 414 |
| Monkfish | 216 |
| Red cod | 685 |
| Rock cod | 9 |
| Shark | 1 293 |
| Skate | 19 |
| Skipjack | 5 |
| Snapper | 8 024 |
| Sole | 731 |
| Tarakihi | 3 365 |
| Trevally | 2 879 |
| Trumpeter | 2 |
| Turbot | 3 |
| Warehou | 519 |
| Total | 25 801 |

**Line**

| | |
|---|---|
| Albacore | 616 |
| Blue cod | 233 |
| Butterfish | 1 |
| Conger eel | 5 |
| Elephant fish | 1 |
| Gurnard | 17 |
| Hapuku | 886 |
| Kahawai | 56 |
| Nthn. kingfish | 3 |
| Sthn. kingfish | 4 |
| Ling | 262 |
| Mixed rounds | 5 |
| Moki | 1 |
| Red cod | 4 |
| Shark | 261 |
| Skate | 1 |
| Skipjack | 146 |
| Snapper | 1 000 |
| Tarakihi | 9 |
| Trevally | 4 |
| Trumpeter | 1 |
| Warehou | 1 |
| Total | 3 517 |

**Danish seine**

| | |
|---|---|
| Barracouta | 4 |
| Gurnard | 67 |
| Hake, blue | 0 |
| Hapuku | 2 |
| John Dory | 46 |
| Kahawai | 3 |
| Nthn. kingfish | 1 |
| Sthn. kingfish | 1 |
| Mackerel | 1 |
| Mixed flats | 1 |
| Mixed rounds | 1 |
| Shark | 19 |
| Skate | 5 |
| Snapper | 2 101 |
| Tarakihi | 6 |
| Trevally | 50 |
| Total | 2 308 |

**Purse seine**

| | |
|---|---|
| Albacore | 9 |
| Kahawai | 15 |
| Nthn. kingfish | 1 |
| Sthn. kingfish | 1 |
| Mackerel | 11 |
| Mixed rounds | 403 |
| Skipjack | 1 000 |
| Trevally | 19 |
| Total | 1 459 |

**Net**

| | |
|---|---|
| Albacore | 132 |
| Black bream | 44 |
| Blue cod | 86 |
| Butterfish | 46 |
| Elephant fish | 53 |
| Flounder | 485 |
| Garfish | 2 |
| Gurnard | 14 |
| Hapuku | 2 |
| Kahawai | 139 |
| Nthn. kingfish | 15 |
| Sthn. kingfish | 15 |
| Ling | 13 |
| Mackerel | 96 |
| Maomao | 1 |
| Mixed flats | 22 |
| Mixed rounds | 8 |
| Moki | 183 |
| Monkfish | 1 |
| Mullet | 421 |
| Pilchard | 2 |
| Red cod | 3 |
| Shark | 795 |
| Skate | 5 |
| Skipjack | 8 |
| Snapper | 479 |
| Sole | 2 |
| Tarakihi | 23 |
| Trevally | 526 |
| Warehou | 9 |
| Yellowfin | 1 |
| Total | 3 631 |

## 1976

**Trawl**

| | |
|---|---|
| Barracouta | 3 664 |
| Black bream | 13 |
| Blue cod | 39 |
| Brill | 37 |
| Conger eel | 1 |
| Creamfish | 215 |
| Elephant fish | 689 |
| Flounder | 553 |
| Gurnard | 2 748 |
| Hake, blue | 142 |
| Hapuku | 250 |
| John Dory | 502 |
| Kahawai | 301 |
| Nthn. kingfish | 88 |
| Sthn. kingfish | 275 |
| Ling | 171 |
| Mackerel | 371 |
| Maomao | 4 |
| Mixed flats | 229 |
| Mixed rounds | 315 |
| Moki | 414 |
| Monkfish | 537 |
| Red cod | 937 |
| Rock cod | 24 |
| Shark | 1 772 |
| Skate | 14 |
| Skipjack | 1 |
| Snapper | 10 283 |
| Sole | 1 169 |
| Tarakihi | 3 440 |
| Trevally | 3 885 |
| Trumpeter | 2 |
| Turbot | 7 |
| Warehou | 921 |
| Total | 34 013 |

**Line**

| | |
|---|---|
| Albacore | 9 |
| Blue cod | 285 |
| Butterfish | 3 |
| Conger eel | 2 |
| Elephant fish | 12 |
| Flounder | 1 |
| Gurnard | 28 |
| Hapuku | 805 |
| Kahawai | 12 |
| Nthn. kingfish | 4 |
| Sthn. kingfish | 5 |
| Ling | 260 |
| Mixed rounds | 5 |
| Moki | 3 |
| Mullet | 1 |
| Red cod | 3 |
| Shark | 462 |
| Skate | 3 |
| Skipjack | 4 |
| Snapper | 1 196 |
| Tarakihi | 12 |
| Trevally | 8 |
| Trumpeter | 1 |
| Warehou | 2 |
| Total | 3 126 |

**Danish seine**

| | |
|---|---|
| Barracouta | 7 |
| Flounder | 12 |
| Gurnard | 67 |
| John Dory | 47 |
| Maomao | 1 |
| Shark | 9 |
| Snapper | 2 304 |
| Tarakihi | 10 |
| Trevally | 44 |
| Total | 2 501 |

**Purse seine**

| | |
|---|---|
| Kahawai | 209 |
| Nthn. kingfish | 1 |
| Sthn. kingfish | 1 |
| Mackerel | 472 |
| Mixed rounds | 151 |
| Skipjack | 4 519 |
| Trevally | 1 140 |
| Total | 6 493 |

**Net**

| | |
|---|---|
| Barracouta | 2 |
| Black bream | 67 |
| Blue cod | 181 |
| Butterfish | 77 |
| Creamfish | 1 |
| Elephant fish | 67 |
| Flounder | 644 |
| Garfish | 5 |
| Gurnard | 36 |
| Hapuku | 7 |
| John Dory | 2 |
| Kahawai | 207 |
| Nthn. kingfish | 18 |
| Sthn. kingfish | 16 |
| Ling | 16 |
| Mackerel | 302 |
| Maomao | 3 |
| Mixed flats | 25 |
| Mixed rounds | 9 |
| Moki | 172 |
| Monkfish | 3 |
| Mullet | 431 |
| Pilchard | 6 |
| Red cod | 4 |
| Rock cod | 2 |
| Shark | 1 311 |
| Skate | 11 |
| Skipjack | 3 |
| Snapper | 582 |
| Sole | 10 |
| Tarakihi | 47 |
| Trevally | 603 |
| Warehou | 71 |
| Total | 4 941 |

* For identity of species and species groupings see notes to Table 2.
† Includes bottom trawl, pair trawl, beam trawl, and mid-water trawl.
‡ Includes single and pair seines.
§ Includes long-lines, hand-lines, trolling, and poling.
‖ Includes set nets, teichi (box) nets, beach seines, drag nets, and cod pots (in which most blue cod are taken).

**TABLE 4: Japanese trawl catch (tonnes) by species, 1974–77. (1974 data from Japan Fishery Agency; 1975–77 data from Japanese statistical data held at Fisheries Research Division)**

| | 1974 | 1975 | 1976 | 1977 |
|---|---|---|---|---|
| Silverside | | 34 | 78 | 88 |
| Flounders[1] | | 9 | 3 | 24 |
| Hake | | 155 | 5 058 | 12 062 |
| Red cod | 2 950 | 2 131 | 4 001 | 8 001 |
| Southern blue whiting | | 278 | 1 189 | 435 |
| Hoki | | | 8 152 | 34 436 |
| Other Gadiformes[2] | 2 069 | 4 748 | 16 684 | 19 732 |
| Croakers[3] | | | 1 | 3 |
| Grunts[3] | | 2 | 2 | 2 |
| Gurnards[4] | | 146 | 147 | 268 |
| Sea perches[5] | | 152 | 228 | 391 |
| Dories[6] | | 88 | 252 | 290 |
| Gropers[7] | 141 | 149 | 110 | 275 |
| Snapper | 472 | 922 | 970 | 864 |
| Other Spariformes[8] | | 161 | 88 | 1 |
| Tarakihi | 1 480 | 1 500 | 1 180 | 2 260 |
| Lizardfishes[3] | | 2 | 3 | 6 |
| Ling | 568 | 2 180 | 5 108 | 5 014 |
| Other demersal fishes[9] | | 125 | 251 | 3 536 |
| Butterfishes[10] | 2 343 | 9 085 | 15 580 | 11 135 |
| Pikes[3] | 1 321 | | | |
| Horse mackerels[11] | 17 738 | 13 486 | 15 145 | 14 539 |
| Barracouta | 18 219 | 10 560 | 10 151 | 34 357 |
| Mackerel[12] | | 3 | 79 | 74 |
| Other pelagic fishes[9] | | 2 593 | 5 838 | 3 193 |
| Sharks and rays[13] | 414 | 879 | 916 | 1 628 |
| Other finfishes[9] | | 1 112 | 4 978 | 4 201 |
| Fishes total | 47 715 | 51 820 | 96 189 | 156 814 |
| Squid[14] | 3 045 | 3 469 | 4 256 | 21 782 |

1. Presumably several flounder and sole species, with the lemon sole, *Pelotretis flavilatus,* undoubtedly a major component.
2. Other Gadiformes are predominantly hoki, which were not recorded separately before 1976. The only other common gadiform fish is ribaldo or deep-sea cod, which is probably also included here.
3. Identity unknown, as these fish groups are not recorded from New Zealand.
4. Predominantly the red gurnard, *Chelidonichthys kumu.*
5. Predominantly the sea perch, *Helicolenus papillosus.*
6. Includes the John Dory *Zeus japonicus,* lookdown dory, *Cyttus traversi,* silver dory, *Cyttus novaezeelandiae,* and oreo dories *Neocyttus* sp. and *Pseudocyttus maculatus.*
7. Groper undoubtedly includes both the hapuku, *Polyprion oxygeneios,* and the bass *P. moeone.*
8. Identity unknown; snapper is the only spariform fish in New Zealand.
9. Identity unknown. Probably includes assorted by-catch species, plus some vessel catches which are not reported by species.
10. Butterfish is a recognised international name for warehou. This listing must include New Zealand's three species.
11. The two jack mackerels, *Trachurus declivis* and *T. novaezelandiae.*
12. Presumably the blue mackerel, *Scomber australasicus,* but might include jack mackerels not listed as such.
13. Includes a number of species, important ones undoubtedly being spiny dogfish *Squalus acanthias,* ghost sharks, *Hydrolagus* spp., and school shark, *Galeorhinus australis.*
14. Predominantly arrow or short-fin squid *Nototodarus sloanii.*

**TABLE 5: Japanese bottom long-line catch (tonnes) by species, 1975–77**

| | 1975 | 1976 | 1977 |
|---|---|---|---|
| Ling | 9 269 | 19 381 | 24 631 |
| Deep-sea cod[1] | 2 417 | 4 920 | 4 283 |
| Sea perch | 606 | 1 727 | 1 820 |
| Blue warehou[2] | 111 | 618 | 821 |
| Groper[3] | 167 | 336 | 642 |
| Snapper | 1 510 | 2 057 | 2 208 |
| Hoki | 82 | 80 | 110 |
| Hake | 227 | 416 | 420 |
| Tarakihi | 50 | 253 | 283 |
| Squid | 93 | 85 | 102 |
| Other finfish | 755 | 533 | 390 |
| Totals | 15 287 | 30 406 | 35 710 |

1. Ribaldo, *Mora pacifica.*
2. Blue warehou normally refers to the common warehou, *Seriolella brama*, but the listing here is more likely to be of bluenose, *Hyperoglyphe antarctica.*
3. Groper undoubtedly includes both the hapuku, *Polyprion oxygeneios* and the bass *P. moeone.*

**TABLE 6: Korean trawl catch (tonnes) by species, April[1]–December 1977**

| | |
|---|---|
| Hoki | 9 865 |
| Barracouta | 8 109 |
| Hake | 5 784 |
| Snapper | 2 840 |
| Ling | 200 |
| Jack mackerels | 1 534 |
| Cods[2] | 1 358 |
| Other species[3] | 9 692 |
| Squids | 1 473 |
| Total | 40 855 |

1. The Korean fleet began fishing in April.
2. Principally red cod and ribaldo, though other species may have been included in this category.
3. This probably included small quantities of such species as warehou, silver kingfish or gemfish, frostfish, and tarakihi as well as reported catches which were not properly itemised by species.

**TABLE 7: Korean bottom long-line catch (tonnes) by species, April[1]–December 1977**

| | |
|---|---|
| Ling | 4 002 |
| Cods[2] | 286 |
| Eels[3] | 248 |
| Other species[4] | 655 |
| Total | 5 191 |

1. The Korean fleet began fishing in April.
2. Principally ribaldo, *Mora pacifica.*
3. Principally swollen-headed congers, *Bassanago bulbiceps* and *B. hirsutus.*
4. Includes sea perch, ghost shark, smooth-hound (probably both *Mustelus antarcticus* and *Squalus acanthias*), and perhaps gropers.

**TABLE 8: Russian trawl catch (tonnes) by species, 1971–77. Mid-water trawl data are included; that is, pelagic as well as demersal species are represented**

| | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 |
|---|---|---|---|---|---|---|---|
| Southern blue whiting | 10 400 | 25 800 | 48 500 | 42 200 | 2 100 | 15 900 | 26 000 |
| Grenadiers[1] | –[2] | 7 300 | 3 900 | 13 700 | 36 300 | 41 800 | 33 500 |
| Dories[3] | – | 7 000 | 7 600 | 10 200 | 2 600 | 8 000 | 11 500 |
| Warehou[4] | – | 6 500 | 6 000 | 7 400 | 200 | 2 200 | 6 300 |
| Argentines[5] | – | – | – | 1 500 | – | 500 | 3 800 |
| Berycids[6] | – | 1 000 | 1 200 | 1 400 | 800 | 2 300 | 3 500 |
| Red cod | – | +[7] | + | + | + | 600 | 2 200 |
| Ling | – | 400 | 500 | 800 | + | 1 300 | 700 |
| Hake[8] | – | – | – | – | – | 300 | 1 200 |
| Jack mackerels[9] | – | 600 | 200 | 100 | – | 400 | 700 |
| Sea breams[10] | – | 200 | + | + | + | 100 | 300 |
| Squid[11] | – | + | + | 1 800 | 4 400 | 7 800 | 26 800 |
| Others | + | 8 100 | 6 400 | 11 500 | 2 800 | 4 800 | 6 500 |
| Totals | 10 400 | 56 900 | 74 300 | 90 600 | 49 200 | 86 000 | 123 000 |

1. Includes hoki, *Macruronus novaezelandiae*, as well as assorted rattails.
2. Catch not recorded.
3. Includes oreo dories, *Allocyttus* spp., and lookdown dory, *Cyttus traversi.*
4. Includes common warehou, *Seriolella brama*, silver warehou, *S. punctata*, and white warehou, *S. caerulea.*
5. Silverside *Argentina elongata.*
6. Includes alfonsino, *Beryx splendens*, and orange roughy, *Hoplostethus atlanticus.*
7. Less than 100 t.
8. *Merluccius australis.*
9. *Trachurus declivis* and *T. novaezelandiae.*
10. Includes tarakihi, *Cheilodactylus macropterus*, snapper, *Chrysophrys auratus*, and probably an assortment of similar percid fishes.
11. Predominantly arrow squid *Nototodarus sloanii.*

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