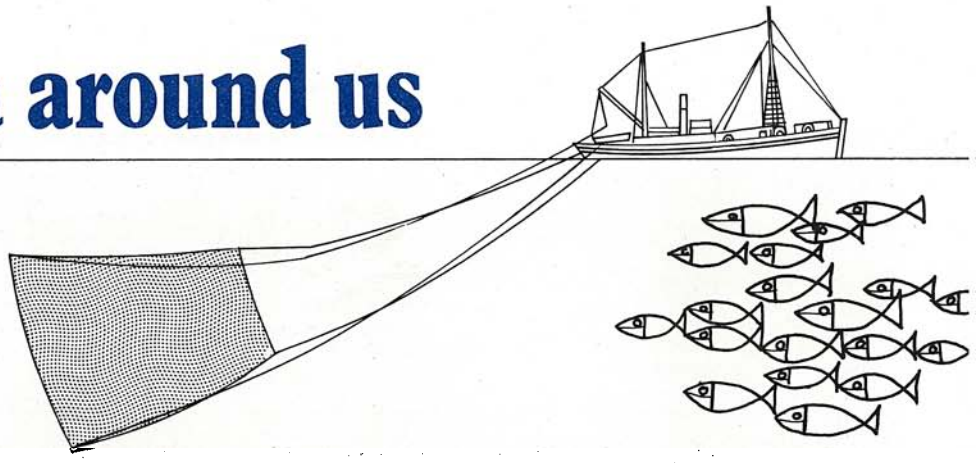
Using the sea around us



As this article goes to press, the fourth session of the United Nations Conference on the Law of the Sea is in progress in New York. Obviously we cannot see into the future, so we cannot know the outcome. Nevertheless, it seems likely that at this session or at later ones a convention will be drawn up that will give maritime nations jurisdiction over all the ocean within 200 nautical miles of their coastlines. As a result, 24% of the earth's surface that has traditionally been 'open sea' will come under national control.

Probably national influence over these waters will be of two types—the existing 3-mile zones of territorial waters will be expanded to 12 nautical miles from the coastline, and each maritime nation will also be able to claim a further 'exclusive economic zone' out to 200 nautical miles. Other nations will not be automatically excluded from the 200-mile zones, but the nearest country will have the right to have the first bite at the cherry of any resources within them.

The exclusive economic zones are about two things—minerals (especially oil), and fish. If the nation claiming the zone wants to keep others out, then it will probably have to be able to show that it is making full use of the resources within the zone.

Australia supports the concept of the 200-mile zones. Should they become reality we will have one of the largest. If we are to be able to support our claims to the resources of this huge segment of ocean we will have to know what's there. We have very little idea at present. This article concentrates on some of the little we do know about fish.

By world standards the Australian fishing fleet is small but efficient. By and large, the waters around our continent do not support the great concentrations of fish seen off the coast of Peru, or in the North Sea. Nevertheless Australian waters could more than supply our own needs. In this beef-eating country, a lack of markets is the main factor that has kept the fisheries to their present small size. Some, like the one in Western Australia for western rock lobster, which exports almost all of its catch to the United States, certainly are using their resource to its full potential. Many others do not.

Sea fisheries are of three types. They are based on:

- inshore fish, crustaceans, and shellfish along the coastline and in estuaries
- fish that live on the sea bottom on the continental slope
- pelagic fish that permanently swim in the waters between the surface and the bottom

At present most of our fisheries harvest either inshore fish or those on the continental slope. Best understood are the shallow-water fisheries for scallops, rock lobsters, prawns, oysters, and abalone.

Pelagic fish little known

Our commercially harvested pelagic fish include bluefin tuna, skipjack tuna, and jack mackerel off south-eastern Australia, and the Australian salmon, which is mainly caught off beaches around the continent's southern coastline. Of these only the bluefin tuna and Australian salmon are fairly well understood. The CSIRO Division of Fisheries and Oceanography has had major research programs on them for many years. The Japanese have also studied the bluefin tuna in detail.

It's not really surprising that we don't know much about the species away from the coast—fishing for them requires expensive boats and equipment, and the small local markets haven't made it worth anybody's while. Large steam trawlers based on Eden, N.S.W., were used in the past, but none remain.

Relatively little research has been carried out into pelagic fish resources here in Australia. Back in the years 1909–13, the Commonwealth government's research ship *Endeavour* located extensive trawl grounds in Bass Strait and off New South Wales. Just before and after World War II, the research vessel *Wareen*, belonging to the forerunner of the Division of Fisheries and Oceanography, explored the possibilities of fishing for tuna, jack mackerel, pilchards, snoek (barracouta), and Australian salmon. During the early 1950s the Division also carried out fisheries studies from the *Derwent Hunter*—a picturesque three-masted sailing schooner.

Fisheries research vessels past and present: *Derwent Hunter* and *Courageous*.

No further studies away from the coast could be made until the commissioning in 1970 of the 220-tonne research vessel *Kapala* by the New South Wales State Fisheries Department. Last year the Division of Fisheries and Oceanography chartered the 287-tonne vessel *Courageous* for 3 years to enable it to assess the open-sea fisheries resources around the Australian coastline. The Division's planned 1860-tonne research vessel will also be used for this purpose as well as for oceanographic work.

Kapala can make trial catches on the continental slope down to depths of about 700 metres. Her cruises have revealed fishable stocks off the New South Wales coast that include royal red prawns, jack mackerel, and possibly gemfish.

Courageous is being equipped with very sophisticated electronic equipment, including echo-sounders linked to an on-board computer. This will enable her to estimate the total size of fish stocks in the region she is covering. At present she is still working up her equipment and is concentrating on finding out how large the jack mackerel stocks off eastern Tasmania and in the Tasman Sea really are.

Jack mackerel studied

The jack mackerel is a true pelagic fish. It is completely unrelated to the mackerels of the Northern Hemisphere (unlike the Spanish mackerel, which is found around the Australian coast and is also fished in European waters). The species is mainly suitable for canning. A fishmeal plant that operated for several years at Triabunna, Tas., using jack mackerel has now closed.

These fish are often found by day in schools deep down in the Tasman Sea. Early results from *Courageous* indicate that they come to the surface at night, possibly in schools but the Division isn't yet quite sure. At present the maximum sustainable yield of jack mackerel is thought to be about 100 000 tonnes each year. The *Courageous* program should sort this question out.

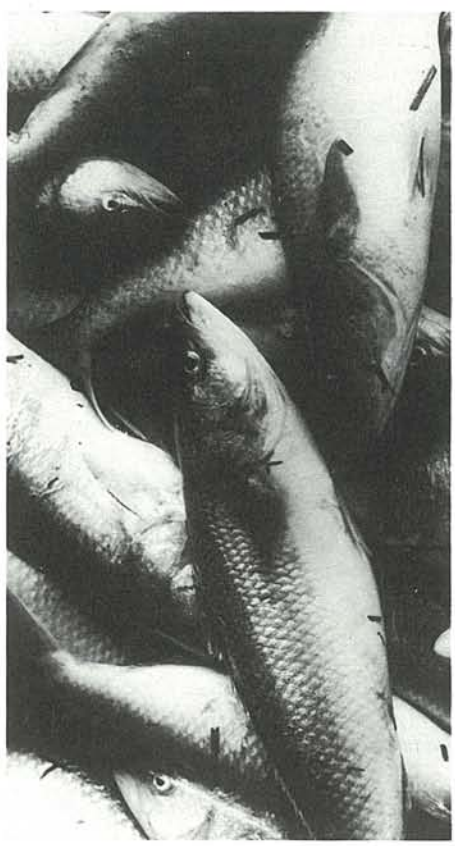
Two salmon stocks

Like the jack mackerel, the Australian salmon belies its name. It's not related to the Northern Hemisphere salmon at all. It has been caught for many years around the southern coasts of Australia, and the annual catch varies between 2500 and 6500 tonnes. The resource is thought to be fully exploited.

Dr W. B. Malcolm, then of the CSIRO Division of Fisheries and Oceanography, studied it during the 1950s. He showed that there are in fact two stocks of Australian salmon. The eastern subspecies inhabits the waters off the Tasmanian, Victorian, and New South Wales coasts. The western subspecies again inhabits the waters off the Tasmanian and Victorian coasts, but its range extends westwards along the South Australian coast into Western Australian waters to just north of Perth.

If we are to be able to support our claims to the resources of this huge segment of ocean we will have to know what's there.

Australian salmon—one of the riches of the sea.



The fishing fleet at anchor—Ulladulla, N.S.W.

Large school of salmon off a Western Australian beach. The black dots are dolphins herding the school.

Bringing in a beach seine net full of salmon.

For some unexplained reason Australian salmon form very dense schools just off the beaches of the southern Australian coast. Fishermen from the three southern mainland States use this behaviour to advantage by enclosing the schools in large 'seine' nets, which are then hauled onto the beaches.

Dr Malcolm deduced that the western subspecies spawns in the west—probably at sea, mainly off Busselton south of Perth. Eggs or young fish then move eastwards, presumably on the eastward-moving coastal current across the Great Australian Bight, to nursery areas off Tasmania, Victoria, and South Australia. Adult salmon then migrate westwards once more to spawn.

South Australian fishermen were thus having first go at the same stock as the Western Australians, and heavy fishing in South Australia may be reducing Western Australian yields.

Recently the Western Australian Department of Fisheries and Wildlife and the CSIRO Division of Fisheries and Oceanography have begun a new co-operative study to work this aspect out. Dr Clive Stanley from the Division is catching, marking with tags, and releasing salmon off the South Australian coast, with the assistance of the State Department of Agriculture and Fisheries, and off Esperance in Western Australia. Dr Mike Walker of the Western Australian Department is doing the same off Busselton.

If fish tagged by Dr Stanley in South Australia turn up in Western Australian nets, then the two fisheries must be using the same stock. However, it may well be that many of the young fish do not move as far east as South Australia. Tagging young specimens at Esperance should indicate whether this area too is a major source of recruitment for the Western Australian fishery.

Bluefin tuna

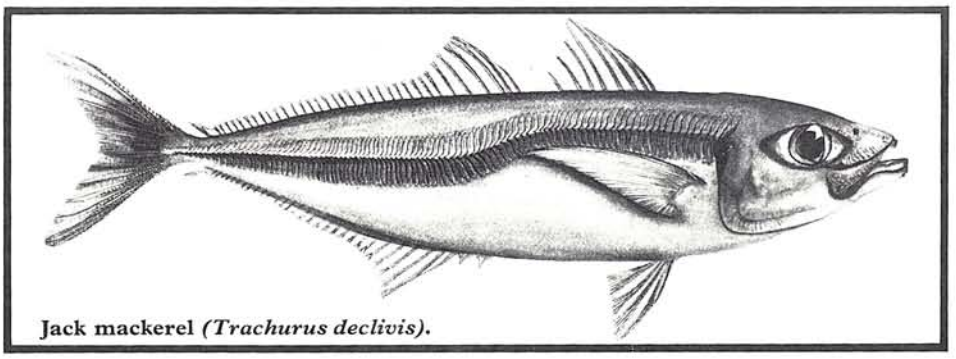
In some ways, on a rather larger scale, the world bluefin tuna fishery seems to have its similarities. The Australian tuna fishery catches about 10 000 tonnes each year, which just about keeps the Australian market supplied. Apparently there is only one stock of this species. It spawns south of Java. Tuna then migrate down the Western Australian coast, across to south-eastern Australia, and then out into the Southern Ocean. The Western Australians catch mainly small 2-year-old fish. Then off south-eastern Australia the fishermen catch 3-, 4-, and 5-year-olds. The Japanese catch the fish mostly at an age of 7 years or more out in the Southern Ocean. Bluefin tuna can probably live for more than 20 years.

Does each fishery reduce the yields of the one further down the line? Japanese and Australian scientists have been discussing this for some time. Dr Garth Murphy, who is in charge of the Division's pelagic fish research program, doubts that the Australian fisheries are in fact having much effect on the Japanese. Off both western and eastern Australia, the fishing industries are only taking those fish that are easily available in concentrations near the coast. These must represent only a fraction of the total population. In addition, young bluefin tuna of about 2–3 years of age also occur off the eastern coast of Africa, indicating that some migrate from Java to the Southern Ocean by this route.

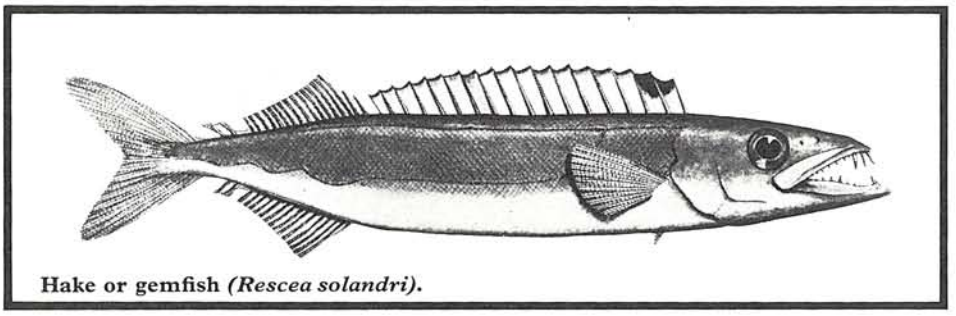
Bluefin tuna isn't the only one we could catch. The related skipjack tuna, which like the bluefin migrates over huge distances, also moves along the eastern and southern coasts of Australia in large numbers, and once canned it's indistinguishable from the bluefin variety. The skipjack tuna is probably at least as easy to catch as the bluefin, but is much smaller. This fact, which makes it less efficient to handle, probably explains its lack of popularity among fishermen. Australians do catch a small tonnage of this fish nowadays, but larger quantities would have to be exported in competition with other countries. In Papua–New Guinea, where a fishery has been operating for 5 years or so, 40 000 tonnes of this tuna are now landed. Little is known about skipjack tuna stocks around the Australian coastline.

Proper fisheries management

It's one thing to find resources of fish, but the bitter experience over the centuries is that if the resource is to be used as a



Jack mackerel *(Trachurus declivis).*



Hake or gemfish *(Rescea solandri).*

long-term asset then the fishery has to be carefully managed. Even the ancient Egyptians and Romans had laws to regulate fishing. Too often, fisheries have collapsed after a few profitable years because too many boats have been catching too many fish, with the result that not enough fish become available later for the fleet to make a profitable living.

Some of the Tasmanian scallop-fishing enterprises would be among the most recent to become uneconomic because of overfishing. The collapse in 1974 of the world's largest fishery—the vast one for anchoveta off the Peruvian coast—was at least partly caused by over-fishing. For this reason the industry itself usually wants some kind of management imposed on it so that those people engaged within it can continue to make a living. Thus good fisheries management means good

Krill, whales, and the future

We hear quite a lot these days about krill—that shrimp-like marine animal that lives in the seas around Antarctica. Undoubtedly it could be a great source of human food. The general consensus among marine scientists is that it should be possible to harvest some 50–100 million tonnes each year—a quantity similar to the whole world fish catch. As it happens, the Antarctic waters to the south of our continent happen to be the ones containing the least krill.

Japan and Russia have been the main countries looking into catching and processing krill, but West Germany and Norway are now beginning to do so too. Australia probably won't.

Using krill has its problems. It doesn't keep well. It goes off within 3 hours, so it has to be processed on the catcher boats. The Japanese have marketed frozen blocks of boiled krill, and the Russians have been producing a protein paste made from it. Russian and Japanese housewives seem to be prepared to buy these offerings.

Krill harvesting may have another snag, especially if it becomes established in a big way. Krill happens to be the food of pelagic fish, penguins, crab-eater seals, and the much-sought-after baleen whales. Nations are making considerable, if belated, efforts through the International Whaling Commission to conserve what remains of the world's depleted whale stocks. Recovery of these stocks depends in no small way on there being an adequate supply of krill.

It's generally assumed that krill is more plentiful now than when it was grazed by large herds of whales. Nevertheless, scientists are still debating how much can be harvested while still leaving enough behind to feed a reasonable whale population.

Man has hunted whales for centuries—first as a source of oil and wax for lamps and candles, and more recently to obtain edible meat and oil for use in margarine and soap manufacture. The chemical and engineering industries also regard oil from sperm whales as crucial. Whale meat makes up about 10% of the Japanese protein intake.

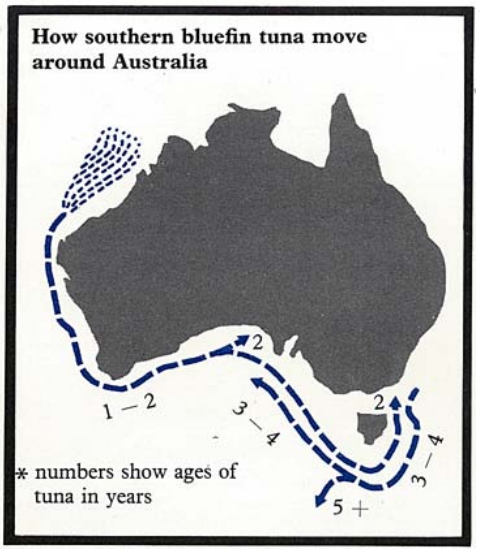
Whales in the Southern Hemisphere were already feeling the pressure by the first half of the 19th Century—exported oil and other products were worth more to Australia than wool until 1833. Antarctic whaling really built up after 1870 with the invention of the gun that fired a harpoon with an explosive head. As stocks of each large whale in turn became drastically reduced, whalers concentrated on progressively smaller species. Thus they first hunted blue whales, then fin whales, followed by seis, and most recently the still smaller minke whales. Now Antarctic whale populations yield only about 15% of what would have been possible had they been prudently managed from the beginning.

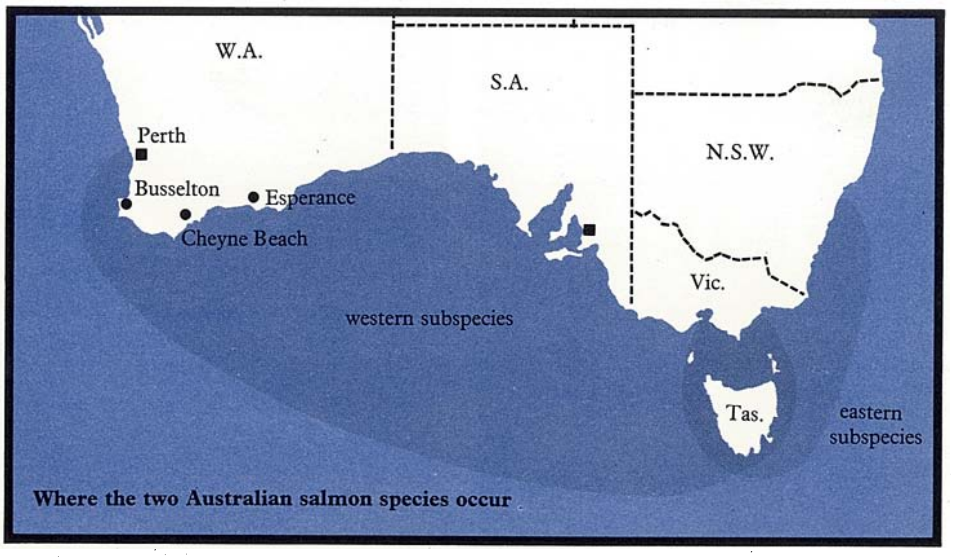
Thirty years after it was established, the International Whaling Commission has at last agreed on an enforceable set of rules that should promote the conservation of whale stocks. These rules are based on information compiled by the Commission's scientific committee. This committee is composed of scientists from several countries, and its current chairman is Dr Radway Allen, Chief of the CSIRO Division of Fisheries and Oceanography. Present chairman of the International Whaling Commission is Mr Arthur Bollen, First Assistant Secretary, Fisheries Division of the Australian Department of Primary Industry.

Whaling in Australia continues only at Cheyne Beach near Albany, W.A. It's a shore-based operation. The Cheyne Beach Whaling Company mainly catches sperm whales some 30 km offshore just off the continental shelf. Whale biologists estimate the Southern Hemisphere population of this squid-eating whale to be more than 350 000—that's about three-quarters of its original level. For 1975 the International Whaling Commission set a catching quota for sperm whales of 13 000, of which the Cheyne Beach Whaling Company was allotted 1395. During the last five seasons the company has averaged 930 whales per season—67% of its quota.

Developments in Antarctic krill research. *Australian Fisheries*, 1975, **34(8)**, 18–19.

Is the whale doomed ? *Australian Fisheries*, 1975, **34(6)**, 12–15.





conservation management. Good management of a fish resource ensures that its population remains at a considerable level, yet provides the optimum yield for Man's benefit.

Most fish species produce a huge number of small eggs and young. Consequently these compete for the available food, and many die. Removing the larger members of the population by fishing means that the remaining adults eat less of the available food. It may also mean that the adults eat less of their own young—a habit common to many fish species. Thus there is less pressure on the young for the food supply, and less predation, so a higher proportion of the young fish survive.

Because of this, it is possible to harvest a population so that a considerable tonnage is taken out, yet the population doesn't die out. Ideally, the fishing rate should balance the maximum rate at which the fish can compensate with lower mortality. Achieving this in practice is difficult and expensive, since the current level of the population must be continuously monitored.

In practice, fisheries management may be guided more by the economic optimum catch than the biological one—although the two often differ little.

When a new fishery is started, yields rise as more effort in the form of boats is put into the industry. However, as the effort increases, the yield, and hence the worth of the catch to each individual fisherman, begins to level off. If more and more boats continue to join the fishery, the yield actually begins to decline. The fisheries manager aims at having just that number of boats operating that gives the maximum long-term yield.

Probably no Australian pelagic fisheries are approaching this optimum, except perhaps the one for the Australian salmon. However, the non-pelagic fishery for the western rock lobster provides a good example of one that is probably being maintained fairly near the optimum.

Rock lobsters well managed

Adult rock lobsters are caught in pots on reefs at depths of between 30 and 90 metres. About 95% of all those caught off the Western Australian coast are sold on the American market.

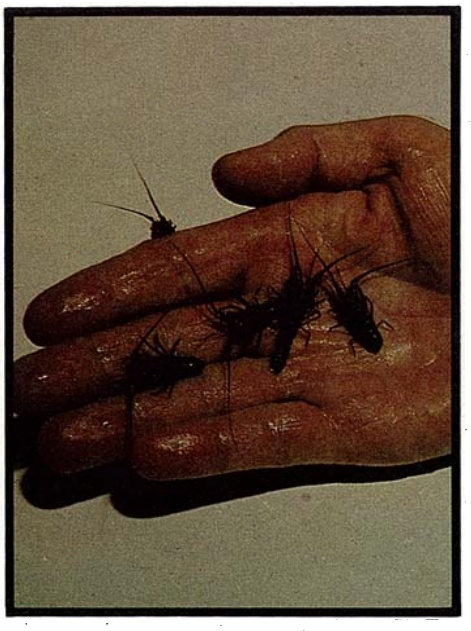
Good fisheries management means good conservation management.

The Division of Fisheries and Oceanography and the Western Australian Department of Fisheries and Wildlife have been studying the biology of the western rock lobster for about 10 years. Most intriguing and not yet fully understood is the movement of the lobster larvae. Surface wind drifts and currents carry the newly hatched larvae up to 1000 km out into the Indian Ocean. Somehow they get back again to the coast and settle down on the shallow inshore reefs, where they remain for 4–6 years before migrating into deeper water. Biologists from the Division have been trying to discover how the larvae return to the shore. Free-drifting buoys that can be tracked by satellite have already been released and may give the answer.

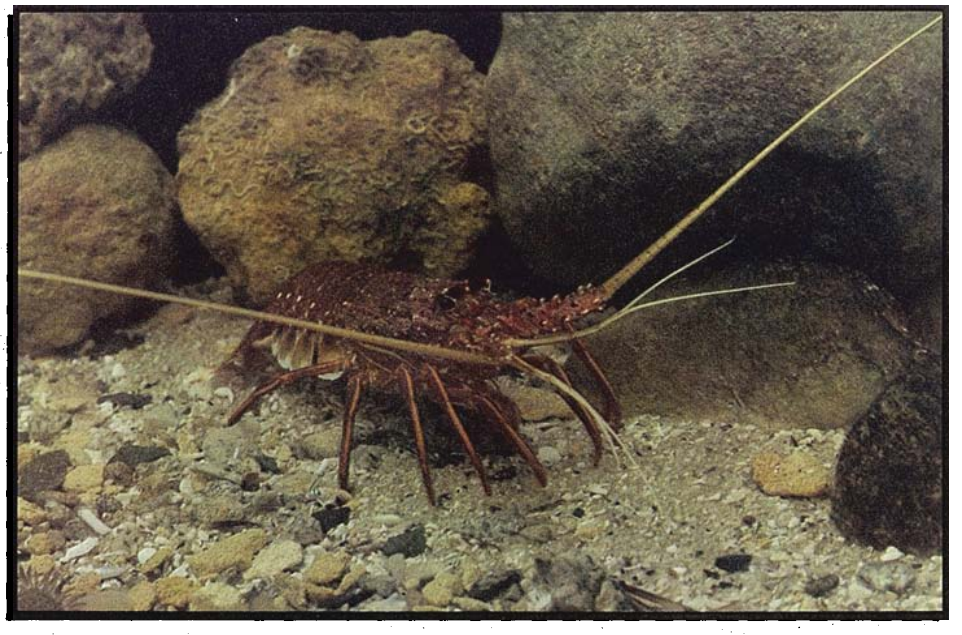
Catching western rock lobsters in a big way began during the late 1940s. By 1963 the price had risen five-fold, and rock lobster fishing was a very attractive financial proposition. The number of boats had risen to 800, and State government and industry alike viewed the situation with concern. The rock lobster population seemed to be getting smaller. At the same time the industry's technology was improving and so each boat was catching more rock lobsters. Studies carried out by Dr Graham Chittleborough of the Division and Mr B. K. Bowen, Director of the Western Australian Department of Fisheries and Wildlife, revealed that during the mid '60s between 60% and 70% of the population was being caught each season.

State government legislation aimed at maintaining the industry at a viable level has included declaring a minimum length below which the rock lobsters may not be caught, decreeing that all lobster pots must have escape hatches so that small ones can escape, and limiting the total fishing effort. Early in 1963 the number of boats in the industry was fixed, and no further licences have been issued since. In addition, the number of pots per boat was limited to three per foot of boat length. The number of pots in the water consequently was reduced from 97 000 during the 1962–63 season to about 76 000 in the 1963–64 one.

The first reaction of individuals within the industry to these new regulations was the usual human one—fishermen began replacing their boats with bigger ones, thus adding to their entitlement of pots. So in 1965 the State government laid down that lobster fishermen could replace their boats, but they would not be allowed to increase their pot numbers no matter what the size of the replacement boat. Nevertheless, the effective fishing effort is still slowly increasing as a result of more-efficient fishing and operating even in poor weather.



Young western rock lobsters at the Western Australian Marine Research Laboratories.



Adult western rock lobster—eagerly sought prize that supports a $20 million industry.

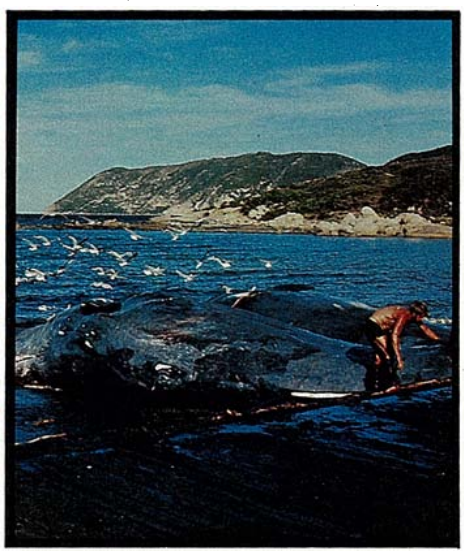
On the whole the policy of limiting the lobster-fishing effort has proved very successful. Annual production has stabilized at about 7 million kg, and the monetary return for each boat has resulted in a high standard of living for those in the industry. In addition, being keen to ensure the long-term health of the industry, most lobster fishermen have adopted a very responsible attitude towards the management regulations.

Without the United States market, the western rock lobster fishery would not have been able to expand to its present size. Indeed it would never have started at all. Other Australian fisheries are being kept small by lack of local or export markets. Yet the oceans are often pointed to as an untapped source of food to feed the world's hungry. What contribution can Australian waters make?

Feeding the hungry?

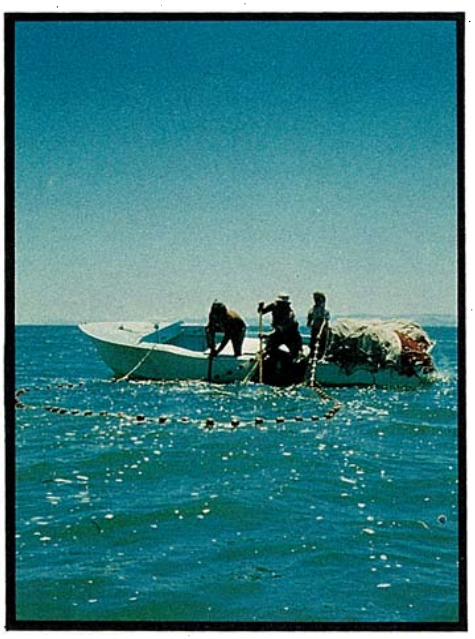
In fact, the oceans are not the biblical widow's cruse that will provide food for the hungry. Probably no fisheries scientists now think this possible. The current total world catch is about 65 million tonnes per year. In a report to the Committee on Resources and Man of the U.S. National Academy of Science, W. E. Ricker calculated that this catch contains enough energy to support only about 75 million people. (The world population passed 4000 million this year.)

More fish can be caught; some stocks—mainly in the Southern Hemisphere on the continental shelf of Antarctica—have yet to be touched. Also, the world's fishing industry has been becoming steadily better at catching fish, particularly since the last war. So today we see Russian, Japanese, and European factory ships and their attendant catching vessels roaming all over the world. Even so—as Dr Radway Allen, Chief of the Division of Fisheries and Oceanography, has pointed out—for all his sophistication Man is only slightly more effective when hunting the oceans for fish than primitive Man was when hunting on land.



Dead sperm whales at the Cheyne Beach Whaling Company's station near Albany, W.A.

Placing a ring net around a salmon school in Spencer Gulf, S.A.



Using a systems approach, the Food and Agriculture Organization of the United Nations has come up with a figure of 150–200 million tonnes per year as the ultimate limit to the harvest from the sea. That's only somewhere between two and three times the present level. So all the world's fisheries can probably support not more than about 225 million people.

And the potential of fisheries in Australian waters? Probably by world standards it's not very big—not more, the Division of Fisheries and Oceanography has estimated, than a few million tonnes each year. Fisheries research vessels like *Kapala* and *Courageous* will probably continue to locate new stocks big enough to support new fisheries, but such fisheries are unlikely to be large. Anyway, for many of the fish species that can be caught, no way is yet known of rendering them acceptable for human consumption.

There are anchovy and 'pilchard' schools off the eastern coast. There could also be a trawling industry in the Great

Australian Bight. The Russians and Japanese have investigated it—the fish are outside the 3-mile limit. Again it would be small by world standards, and would probably be best worked for a few months and then allowed to recover. The continental shelf is only a few kilometres wide there and, like most of the waters around the continent's coastline, the sea is low in nutrients.

The north-west-shelf area off Western Australia probably has the greatest potential. A weak upwelling of waters from deeper down occurs here. The rising water brings up nutrients with it, enabling marine life to thrive. From its studies, the Western Australian Department of Fisheries and Wildlife has a reasonable idea of what surface-living fish inhabit this area of upwelling, and regards it as being able to become quite an active fishery. Japanese and Taiwanese trawlers have already been fishing the area for about 5 years. At present it is outside the 3-mile territorial limit (and the proposed 12-mile one). So the area is in international waters. If the 200-mile exclusive economic zones become included in the law of the sea then this fishery could, no doubt, be claimed by Australia.

All the world's fisheries can probably support not more than about 225 million people.

The United Nations Development Program is considering sponsoring, within the next year or so, a survey of the resources of the eastern Indian Ocean between the latitudes of Indonesia and Perth. The survey would include the north-west-shelf upwelling. Using money provided by the UNDP, FAO may charter a large oceanographic ship. Possibly the Division of Fisheries and Oceanography will be sending *Courageous* to the north-west-shelf area to assist.

More about the topic

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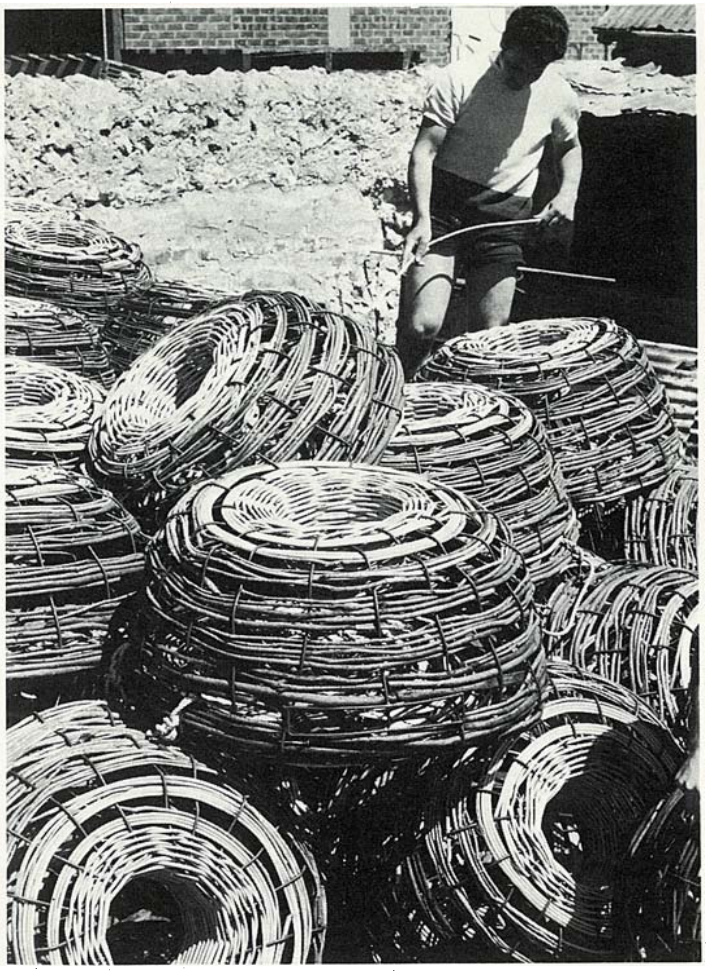
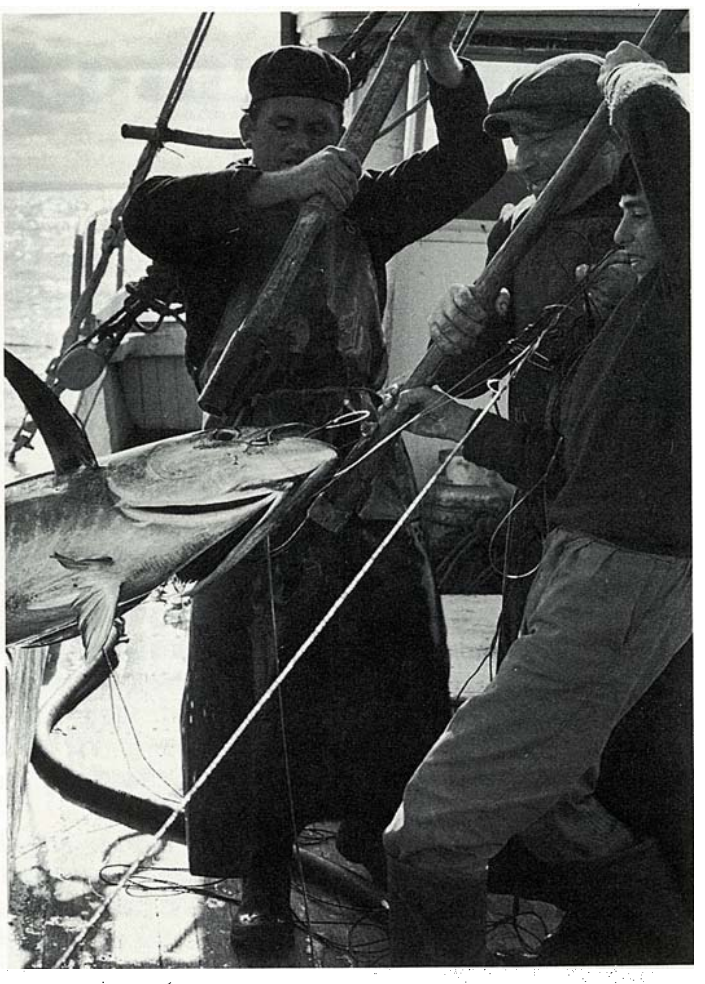


Lobster pots at Fremantle. Undersize lobsters can escape.



Pulling a tuna aboard.