

The Fisheries of Chile

**UNITED STATES DEPARTMENT OF THE INTERIOR
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UNITED STATES DEPARTMENT OF THE INTERIOR

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By

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By

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ABSTRACT

Trends and developments in the Chilean fisheries are discussed, with special emphasis given to the expanding fish reduction industry. Within a few years Chile has become one of the world's largest producers and exporters of fish meal and oil. Information is also presented on other exportable products, mainly shrimp and plated lobster (langostino), and on segments of the industry that produce for domestic consumption.

INTRODUCTION

Attention is being focused on the Chilean fisheries because of the recent rapid increase in production of fish meal. In Latin America, the Chilean fisheries are second only to those of Peru, the world's leading fishing nation in quantity of catch. Although on a lesser scale, developments in Chile have been paralleling those in Peru, where the anchovy fish meal sector of the fishing industry is also paramount. Chilean fishery development is now concentrated on taking anchovies from its northern coastal waters, which are geographically the southern limit of abundance of the fish.

The Chilean shellfisheries have also shown indications of growth and are beginning to produce sizable quantities of shrimp and plated lobster, principally for export. Other sectors, especially those producing for domestic consumption, appear to be static. However, the Government, with the help of the Food and Agriculture Organization of the United Nations (FAO), has made intensive efforts to increase local fish consumption.

Chilean nutritionists claim that 26 kilograms (57 pounds) of fish, on a live-weight basis, are needed annually to maintain minimum dietary standards. Per capita consumption of fishery products has been about 13.5 kilograms (30 pounds). Chilean preferences for fishery products are highly selective, consumers preferring shellfish and more expensive fish, such as cusk eel, croaker, and silverside. Lower priced and more abundant species, such as hake, snake mackerel, and rock cod, do not appeal to the people. Moreover, as is

the case in many Latin American countries, fish supplies are irregular; marketing and distribution facilities are inadequate, especially in rural areas; and the low purchasing power of many people limits purchases. Consumption of fishery products is highest in the more densely populated central region. In rural inland areas, people rarely eat fish.

From a once insignificant amount, Chilean fishery exports increased to \$13.1 million in 1963, or to about 2 percent of the value of all Chilean exports. The fishing industry's contribution to the national income and to employment has been of this same magnitude.

Both local and foreign investors have participated in the development of the fish meal industry of northern Chile. As part of the Chilean Government's plan to utilize fishery resources more fully, its Production Development Corporation (CORFO) has invested more than \$30 million since 1950, mainly in northern Chile for fish reduction, canning, and freezing installations. Some of the plants are owned by CORFO; others have been established by private investors with liberal financial aid from CORFO. Joint ventures between Chilean and foreign companies have involved United States, Japanese, South African, Norwegian, and West German interests. The Government actively supports exports of fishery products. Since 1958 fish meal manufacturers in northern Chile have been eligible for a 20 to 30 percent bonus on the value of exports. Other laws permit free importation of fishing craft, fishing gear, and manufacturing equipment. Concessions on taxes have also been granted.

The Chilean fishing industry, especially the fish meal sector, is going through a period of uncertainty. In 1965 fish meal

Note:--Statistical data in this report are presented in metric units. A metric ton equals 2,204.6 pounds; a kilogram equals 2.2 pounds.

plants in northern Chile will have a reported annual capacity of between 2.3 and 2.5 million tons of raw materials and a potential annual output of 400,000 to 455,000 tons of fish meal and 50,000 to 60,000 tons of fish oil. Whether the anchovy resource is plentiful enough to support this capacity and output has not been demonstrated. The anchovy, caught close to shore, is highly susceptible to changes in water temperature and other oceanographic conditions; when temperatures become too high, the species moves out of range of present-type fishing craft. In early 1963 and 1964, and again in 1965, the fish did not appear in abundance in coastal waters, and fishing operations had to be curtailed. The lack of anchovies in the first half of 1965 has been especially severe, the catch being less than half of that recorded for the comparable period in 1964. About 50 percent of the 5,000 fishermen and plant workers in the northern fish meal industry are reportedly out of work.

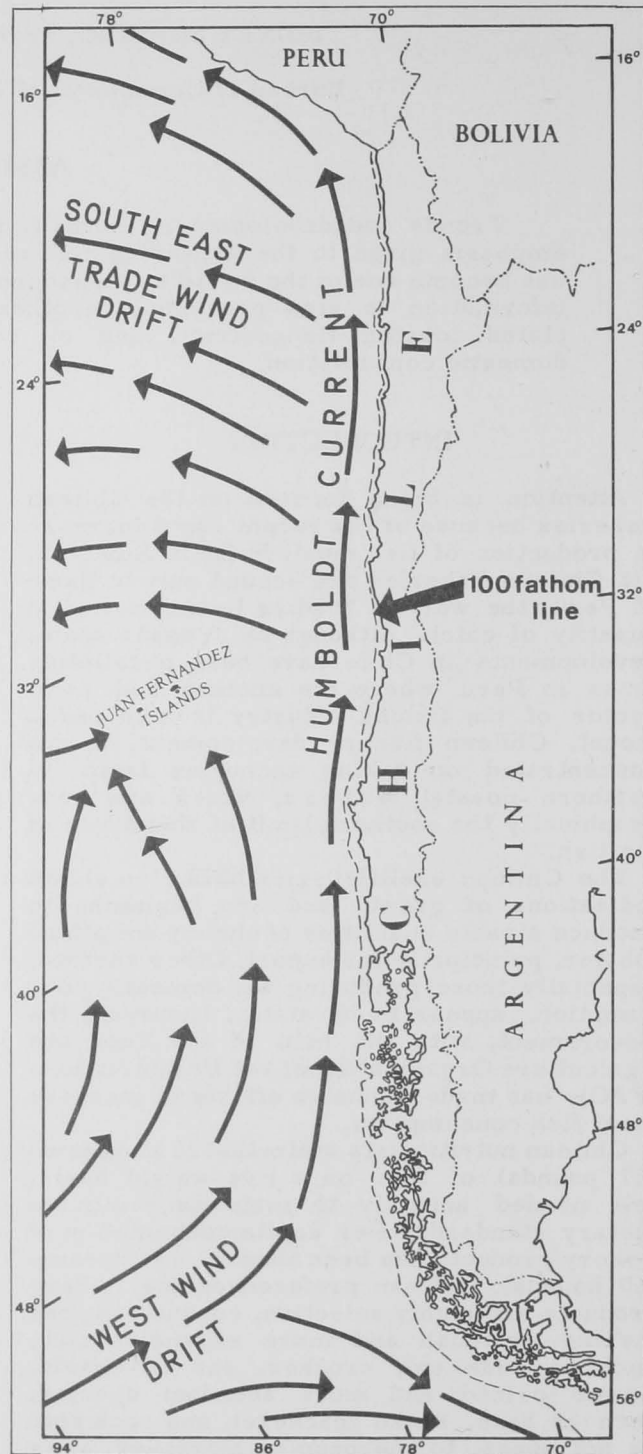
In a 1954 compact, Chile, Ecuador, and Peru claimed jurisdiction for conservation purposes over waters extending 200 miles from their coasts. This extensive territorial claim is in conflict with the 3- to 12-mile limits recognized by most coastal countries. Chile, in agreement with its partners, has adopted regulations that govern fishing and whaling in the 200-mile zone off its coast. Foreign fishing vessels planning to operate in these waters must apply to the Chilean Government for permits to fish and must pay duties on their catches. Special conferences sponsored by the United Nations have studied the problem of territorial waters and fishery zones, but international accord on their extent has not been reached.

OCEANOGRAPHIC FEATURES

Chilean fishermen have ready access to a rich variety of marine resources. High productivity is accounted for mainly by the movements of oceanic water masses and by associated changes brought about by prevailing winds. In the southeastern Pacific, there is a net eastward movement of water, known as the West Wind Drift (fig. 1). This surface current, rich in plankton, approaches the Chilean coast at about lat. 50° S., where it divides. A southern branch flows southeastward around Cape Horn. The other branch, known as the Humboldt or Peruvian Coastal Current, flows northward along the Chilean and Peruvian coasts.

At various places along these coasts, southerly and southeasterly winds carry surface waters away from the coast and colder waters are drawn from moderate depths toward the surface, a process known as

upwelling. These colder waters, rich in nutrient salts, further enhance the growth of the plant plankton which is the basis for the variety and abundance of aquatic resources in Chilean waters, particularly off its northern and central coasts.



(Modified from Clarke, Fishing News International, October 1962).
Figure 1.--Schematic representation of surface currents off the Chilean coast.

The Continental Shelf (ocean bottom within the 100-fathom line) is narrow along Chile's coastline of 2,600 miles. At most places, especially off central Chile, the outer limit of the shelf is about 25 miles from shore; in other places, mainly off the northern coast, the distance often is less than 10 miles. The shelf broadens off southern Chile but is rarely as much as 50 miles wide.

RESOURCES AVAILABLE

The most abundant species of fish off northern Chile is the anchovy, which feeds on the enormous growths of plant plankton associated with the upwelled waters of the Humboldt Current. Other pelagic surface-swimming species, such as the bonito, sardine, and jack mackerel, are found in these waters. Tunas, especially yellowfin tuna, inhabit the warmer waters to the west of the colder Humboldt Current; these species generally stay offshore, except at certain times and in certain localities when the warmer waters extend inshore and cover the colder upwelled waters. Bottomfishes and shellfish are negligible resources off northern Chile because of the narrowness of the Continental Shelf.

A larger variety of fish and shellfish is taken off central Chile. The broader Continental Shelf has rich hake grounds, and other bottomfishes are also plentiful. Among the pelagic species, jack mackerel and sardine predominate. Moreover, the fishing grounds are closer to the densely populated consumer markets of central Chile, and a variety of food fishes such as snake mackerel, cusk eel, and croaker are also taken in this region. Shellfish appear in abundance in the central region. Shrimp, plated lobster, clams, and sea snails are among the many shellfish available.

The extent and productivity of the fishing grounds off southern Chile are comparatively unknown. Few fishery explorations have been made in this region. Inclement weather and distances remote from large consuming centers are mainly responsible for the small fishing industry, although sheltered passages between the numerous islands off the southern coast offer protection from westerly gales. So far, only the shellfish resources have been tapped, principally in the northern part of the region in the vicinity of Puerto Montt and Calbuco. Mussels, clams, sea snails, and sea urchins are among the more abundant shellfish. As for fish, hake, snake mackerel, and rock cod are now caught, but in small amounts. The rock cods--not true

cods but coastal fishes typical of antarctic and subantarctic waters and belonging to the superfamily Nototheniformes--are reported to be most abundant off the southern Chilean islands.

CATCH OF FISH AND SHELLFISH

After World War II, Chilean fishery landings rose steadily from 47,000 tons in 1945 to reach an average level of about 210,000 tons between 1955 and 1958 (fig. 2). Increased domestic consumption and the development of a hake reduction industry in central Chile were mainly responsible for the larger landings. Beginning in 1959 the fisheries entered a new phase of development. The center of activity shifted to northern Chile where a reduction industry, based on ever increasing landings of anchovy, has become the mainstay of the country's fisheries. Chilean fishermen landed a record catch of 762,800 tons in 1963 (table 1). Of this catch, about 70 percent was anchovy.

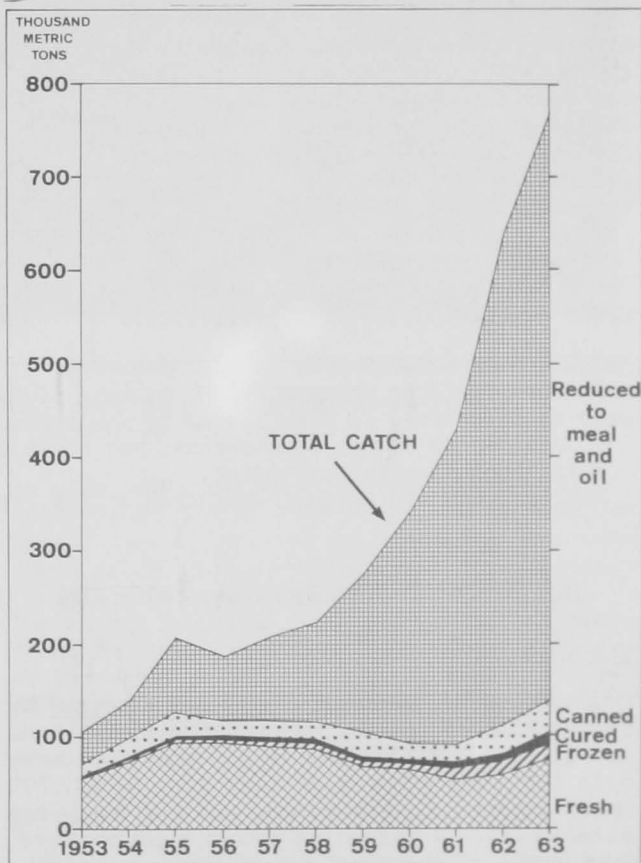


Figure 2.--Disposition of Chilean catch of fish and shellfish, 1953-63.

Table 1.--Chilean catch of fish and shellfish, 1955, 1960, and 1963

Species	Quantity			Value 1963 ¹
	1955	1960	1963	
	<u>Thousand metric tons</u>	<u>Thousand metric tons</u>	<u>Thousand metric tons</u>	<u>Thousand U.S. dollars</u>
FISH				
Anchovy (anchoa).....	7.5	169.0	539.4	3,165
Hake (pescada).....	81.4	79.0	102.0	1,650
Sardine (sardina).....	22.2	23.6	27.9	200
Snake mackerel (sierra).....	17.3	6.1	9.6	934
Jack mackerel (jurel).....	1.2	6.2	8.7	547
Cusk eel (congrío).....	6.6	5.9	4.4	1,580
Croaker (corvina).....	1.8	1.9	3.0	808
Bonito (bonito).....	8.0	2.3	2.5	113
Other.....	23.7	10.6	8.8	1,396
Total fish.....	169.7	304.6	706.3	10 393
SHELLFISH ²				
Mussels (choro, chorito, and cholga)..	23.6	10.1	21.1	728
Clams (almeja and macha).....	5.0	3.1	5.3	361
Sea snail or limpet (loco).....	3.0	2.5	4.5	906
Plated lobster (langostino).....	2.0	8.1	9.0	419
Shrimp (camarones).....	(³)	2.6	4.0	205
Sea urchin (erizo).....	3.7	2.1	2.8	486
Other.....	7.3	6.5	9.8	880
Total shellfish.....	44.6	35.0	56.5	3,985
Grand total.....	214.3	339.6	762.8	14,378

¹ Converted from Chilean values at rate of U.S. dollar equals 0.52 escudos. Values are prices paid at first sale of fish landed by fishermen.

² Includes mollusks, crustaceans, and other invertebrates, such as sea urchins and sea squirts.

³ Included in other shellfish.

Source: Food and Agriculture Organization, Yearbook of Fishery Statistics.

IMPORTANT COMMERCIAL SPECIES

Anchovy

Landings of anchovy (*Engraulis ringens*) by Chilean fishermen increased from 39,500 tons in 1958 to 539,400 tons in 1963. Preliminary data for 1964 show a further rise to 909,700 tons. Anchovies are caught mainly by purse seiners (fig. 3) operating within sight of shore. The anchovy taken by Chilean fishermen is the same species that is taken by Peruvian fishermen. Off Chile the anchovy is most abundant in northern waters (fig. 4), but is found as far south as Talcahuano and San Vicente. Most Chilean anchovy landings are made at Iquique and Arica. Although the fish can be taken the year round, peak landings occur usually during

the warmer months, November to April. Landings are used almost entirely for reduction to meal and oil; a small amount enters the fresh-fish trade.

Anchovy fishing has at times been uncertain. Sporadic absences of the fish from shallow coastal waters occurred in both early 1963 and 1964. These absences were in part attributed to the unseasonably high water temperatures that pushed the anchovy out to sea beyond the operating range of the fleet. Vessels must deliver their catches to the reduction plants the same day or carry ice, and the latter has not been possible. So far in 1965, anchovy landings have been much below the norm of recent years, and a crisis has developed in the meal and oil reduction industry. Too little is yet known about the life history of



(Photograph courtesy of Richard Saunders, Scope Associates).

Figure 3.--View from airplane near Iquique, Chile. Vessel and skiff in center are setting the purse seine used to catch anchovy for reduction to meal and oil.

the anchovy to state fully the reasons for its present disappearance from coastal waters. Among the possibilities advanced, in addition to shifting temperatures, are overfishing as shown by a recent reduction in catch per unit of effort and an increase in the proportion of small fish with high water and low oil contents. Some researchers claim that the anchovy is a species that has cyclic highs and lows in abundance, with the low prevailing now.

Hake

Before the anchovy took over as the leading species, hake predominated in the Chilean fisheries. Several species of hake are found in coastal waters, but almost all landings consist of one species (Merluccius gayi). This codlike fish is taken mainly with trawls on the Continental Shelf off central Chile (fig. 4) in waters 20 to 50 feet deep. Other gear used are line trawls, hooks, and gill nets. Most of the hake

is processed. About 60 percent of the 102,000 tons landed in 1963 was sent to meal reduction plants and 25 percent to fresh-fish markets; about 10 percent was dried, and the remainder frozen. The main fishing season for hake is November to April, the peak months usually being February and March; landings in excess of the amount that can be sold fresh or cured are sent to the reduction plants. When landings are lowest (May to July), the fish are sent exclusively to fresh-fish markets.

Sardine

Third in importance is the sardine (Sardinops sagax), which is taken along the northern and central Chilean coasts (fig. 4). It is reported that the sardine occurs in large schools at the surface in many places, but utilization is at a low level. At present, most catches are made in the Talcahuano area, principally between October and April. Lesser amounts are landed

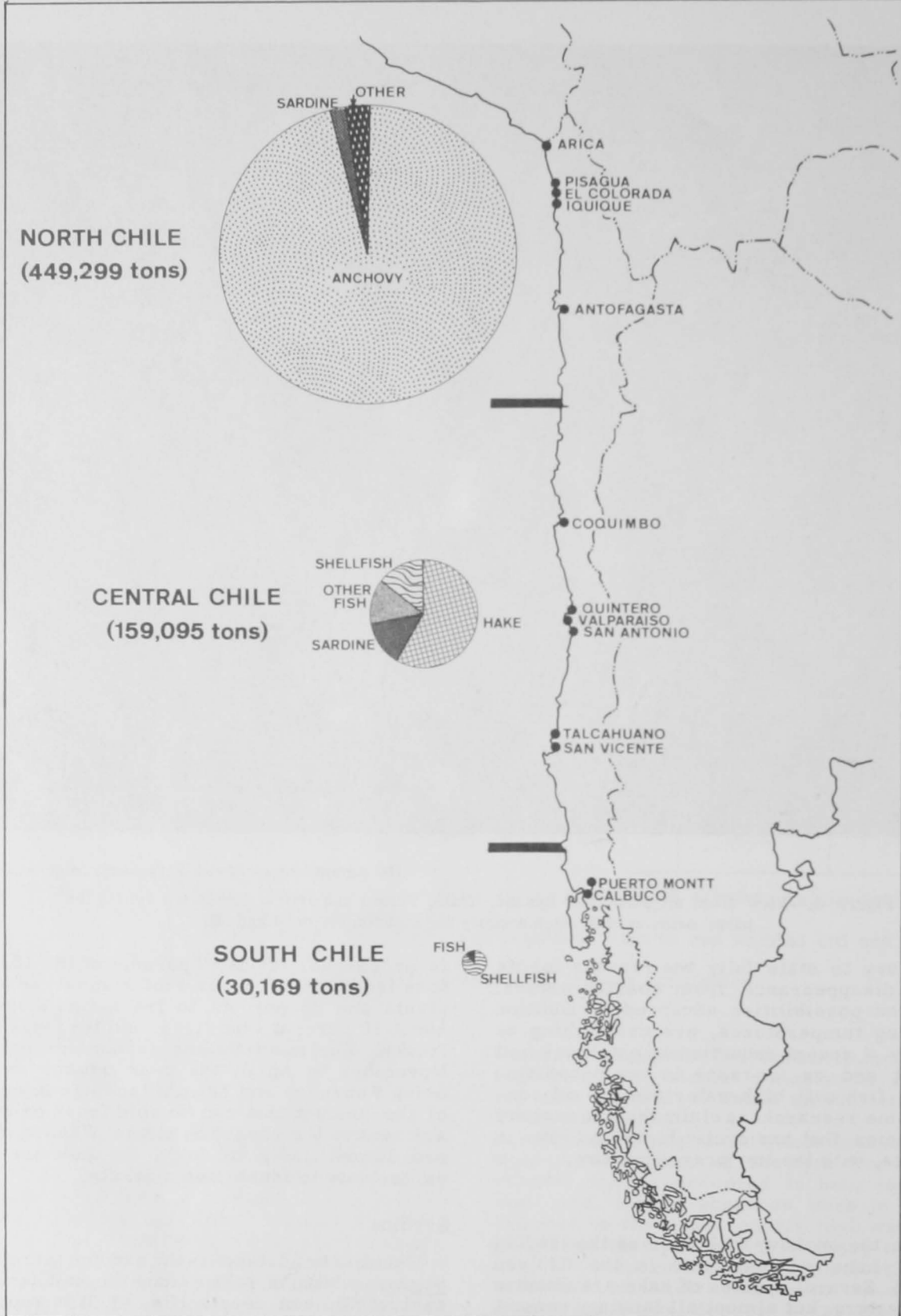


Figure 4.--Regional catch of fish and shellfish and principal fishing ports, 1962.

at Antofagasta. Purse seines or ring nets operated from small craft are the only gear used. In 1963 over half the sardine catch--16,100 tons out of a total of 27,900 tons--was reduced to meal and oil. The remainder was mostly canned.

Snake Mackerel

In 1963 about 9,600 tons of snake mackerel were taken. Most of these landings (8,100 tons) went to fresh-fish markets; about 1,400 tons went to canneries; and the remainder was reduced to meal. The snake mackerel (Thyrstites atun) is a pelagic migratory form, found mainly in cold upwellings of the Humboldt Current from Coquimbo southward to the Strait of Magellan. Little information is available on its abundance off southern Chile but it is believed to be present in large quantities. Most of the catch is now taken between April and June off Talcahuano by trolling with lures. In more southern waters, landings are heaviest between December and April.

Jack Mackerel

Inhabitants mainly of temperate waters, the jack mackerels are found from Arica to Talcahuano. A number of species (Trachurus trachurus, T. picturatus, and Caranx chilensis) are included in this group of coastal migratory species. In 1963 about 8,700 tons were caught. About half the catch was marketed fresh, 3,600 tons were sent to the canneries, and 890 tons to reduction plants. Trolling with artificial lures is the principal fishing method; heaviest landings are between December and April.

Cusk Eel

The most sought after table fish in Chile is the cusk eel. Genypterus chilensis is the most valuable of the three species landed. The cusk eels are cold-water forms living along the entire Chilean coast in waters about 120 fathoms deep; the principal fishing grounds extend from Coquimbo to San Antonio, where demand is greatest. In this fishery, craft of all types (motorized and nonmotorized) set out longlines to which several thousand baited hooks are attached.

Tuna and Bonito

Although the potential exists for increased catches, tuna and bonito have not been taken in large amounts by Chilean fishermen. These species are abundant off northern Chile, but few population centers of large size exist locally, and therefore, nearby domestic markets for fresh fish are limited. Future increases in landings would undoubtedly have to go mainly into export markets. In 1963 only 2,500 tons of bonito and 70 tons of tuna were caught.

Small amounts were consumed locally as fresh fish; the remainder was canned or frozen.

Shellfish

The most significant trend in the catch of shellfish is the increased production of plated lobster and shrimp, both of which are mainly frozen for export. The plated lobster, also known in the export trade by its local name, langostino, is a member of a group (family Galatheididae) intermediate between shrimp and spiny lobsters. In 1963 the catch of plated lobster was about 9,000 tons and that of shrimp 4,000 tons. Ten years previously the catch of these crustaceans had been negligible. Present trawling grounds for shrimp and plated lobster are off central Chile, principally in shallow waters near Valparaiso and as far north as Coquimbo. Deepwater grounds have not been explored.

About 100 tons of spiny lobster (langosta) are taken annually from the warmer waters surrounding the Juan Fernandez Islands, 350 to 430 miles west of Valparaiso. These lobsters are transported live by small boats to mainland urban areas where they are in great demand. Off southern Chile some effort has gone into utilizing the king or spiny crab (Lithodes antarcticus), a smaller species than the closely related highly valuable king crab of the North Pacific. The Chilean king crab (known locally as centolla) is taken mainly in the Strait of Magellan area, although it is found as far north as Puerto Montt. This fishery has yet to be developed; catches were 260 tons in 1962 and 158 tons in 1963. Most of the catch is frozen or canned.

Mollusks are a favorite with Chileans. At least three species of mussels (Mytilus spp.) are taken in quantities sufficient to make Chile one of the leading mussel-producing nations in the world. In 1963 Chileans harvested 21,100 tons of mussels; about one-quarter of this was consumed fresh, the remainder canned. The centers of abundance are the shallow indented shorelines of the many islands off southern Chile's mainland. Some of the more northern mussel beds have been depleted, and the Government has closed some areas at certain seasons of the year. Clams and sea snails are next in quantity taken--5,300 tons of clams and 4,500 tons of snails in 1963. Many species of marketable clams exist off southern Chile, including a species similar to the commercially important razor clam of the U.S. Pacific Northwest. Utilization of these resources, however, is barely underway. Oysters are in great demand, but less than 50 tons a year are harvested. Scallop beds in shallow waters are depleted as soon as they are located; nothing is known about this resource in deeper waters.

Other invertebrates, such as tunicates and sea urchins, are included by the Chileans in

the category of shellfish. These species are eaten mainly raw. The sea urchin--2,800 tons taken in 1963--is esteemed for its roe.

FISHING CRAFT

The latest data available on the size of the Chilean fishing fleet are for 1962, when 5,819 fishing craft of all types were officially listed. Most of these craft (4,240) were small row and sail boats used for other purposes besides fishing. The remaining craft (1,579) were motorized and consisted mainly of small motorboats. Only 261 motorized craft were over 5 gross tons in size; purse seiners accounted for 128 of these craft, trawlers for 46, and fish carriers for 87. Progress in modernizing the Chilean fishing fleet has been made only in the trawl fisheries of the central region and in the purse seine fisheries of northern waters.

Trawlers

The first step in modernization of the fishing fleet took place when the hake fishery was developed in the early 1950's. Most trawlers are of European manufacture and usually range in size from 40 to 80 gross tons; a few are over 100 gross tons. The vessels use otter trawls having an average length of about 120 feet and an opening of about 65 feet. Besides taking hake, the trawlers are used for shrimp and plated lobster fishing. Home ports for the trawlers are in the central region between Coquimbo and Talcahuano. In recent years the trawler fleet has had more withdrawals than additions.

Purse Seiners

The new purse seine fleet based in northern Chile has been built specifically for anchovy fishing. In mid-1964 this fleet consisted of 205 vessels; nearly 100 of these vessels had been built during the previous 12 months. Because of the construction of new reduction plants, about 250 modern purse seiners--with a capacity of 42,000 to 50,000 tons of fish per day--will be required by 1965. CORFO has extended liberal credit to boatbuilders and purchasers in order that the vessels be constructed as soon as possible. Once the construction goal is reached, boatyard capacity will undoubtedly be in excess of replacement requirements.

With few exceptions, the new purse seiners are equipped with an echo sounder, radio telephone, power block, anchor winch, and a diesel-powered skiff. Many of the larger craft have fish pumps for emptying the nets. The fleet is supported by spotter planes that effectively cover the 200 miles of coastline extending from Arica to the south of Iquique. Some planes are used to direct the setting and hauling of the nets.

During the late 1950's purse seiners were constructed in foreign shipyards and were mostly of 30- to 50-ton capacity. Construction of modern seiners in Chile began in 1960. The first such vessel, a wooden 63-footer equipped with a 250-hp. diesel engine, was built by the State Industrial College of Valdivia and was sold for \$65,000.

In late 1960, a Chilean affiliate of a U.S. marine construction company began building steel vessels at Iquique. Its first vessel was a 66-footer of 100-ton capacity, equipped with a 250-hp. diesel engine. In 1962 the shipyard began construction of 73-footers with a 140-ton capacity and a 330-hp. diesel engine. By 1964 about 60 of these vessels had been built.

Two other shipyards--one in Valdivia and the other in Santiago--have been building 74-footers of 130-ton capacity since 1962. About 70 such vessels have been scheduled for completion. A third shipyard, opened at Antofagasta in 1963, has been constructing 77-foot seiners with a 160-ton capacity, costing \$120,000 fully equipped. A fourth shipyard, constructed at Valdivia in 1963, has been building seiners 73 feet in length and with a 140-ton capacity. A Government-owned naval shipyard at Talcahuano has programmed construction of 6 seiners, each with a capacity of 165 tons. Smaller shipyards continue to build wooden seiners of 60- to 115-ton capacity. Several reduction companies have bought steel seiners from Peruvian shipyards. Other recent additions have been built in Norway and in the United Kingdom.

Tuna Vessels

At the end of 1964, only three vessels in the fishing fleet of northern Chile were capable of fishing for tuna, and none had been used for this purpose during the past 5 years. Plans are underway, however, to institute sizable tuna fishing operations. A Government-owned canning and freezing plant, scheduled to go into operation in 1965 at Iquique, will have a tuna fleet of 8 vessels with a combined hold capacity of 1,240 tons of fish per trip. One vessel is a 170-ton purse seiner of U.S. construction. Two British-built vessels were scheduled to start fishing in late 1964. Five vessels, being built in West Germany, are to be delivered in 1965.

Other Fishing Craft

The majority of Chilean fishing craft, because of their small size, use simple gear such as beach seines, line trawls, gill nets, handlines, trolling lines, trammel nets, traps, dredges, and harpoons. Most of their catches are destined for the fresh-fish markets. Diving for mulluscan shellfish is also conducted from small boats; the divers use suits and helmets. On some of the boats, classified as nonpowered,

outboard motors have been installed, but high fuel and maintenance costs in Chile have limited their widespread use.

WHALING

Whales, especially sperm whales, are abundant off Chile in waters up to 200 miles from the coast. These whales inhabit the rich feeding grounds of the Humboldt Current, migrating north from the Antarctic during the Southern Hemisphere's fall and winter; in spring and early summer the whales migrate southward from the Tropics. Sperm whales yield a waxy oil for industrial use. Five species of baleen whales are also taken, the principal species being the fin and blue whales. Baleen oil is the well-known whale oil of international trade and is used mainly in the manufacture of margarine.

Chilean coastal whaling is conducted from three land stations. One company, with bases at Iquique and at Quintay (south of Valparaiso), operates seven catcher boats; the other company with a base at Bahía San Vicente, near Talcahuano, operates three catcher boats. The number of whales taken has been declining since the peak year of 1958 when 6,400 tons of sperm oil, 1,800 tons of whale (baleen) oil, and 2,100 tons of whale meal were produced. In 1963 output was 4,700 tons of sperm oil, 400 tons of whale oil, 800 tons of whale meal, and 1,900 tons of whale solubles.

Chile conducts its whaling operations under the 1954 agreement with Ecuador and Peru. Instead of complying with the regulations of the International Whaling Commission, Chile abides by the regulations established by the Permanent Commission of the three South American countries. Chile can catch sperm whales the year round, whereas the International Commission has an 8-month season. Other differences are that (1) Chile has more land stations than permitted by the International Commission, which requires 1,000 miles between stations, and (2) Chile can catch smaller sperm whales than the International Commission permits. Efforts to settle these differences have failed. Chile, Ecuador, and Peru are asking for recognition of their sovereignty over a 200-mile maritime zone as part of any agreement on conservation of fish, whales, and other aquatic resources.

In an attempt to increase the catch of whales, Chile is permitting a Japanese whaling company to operate off its coast and land the whales at shore stations. The Japanese company began operating whale catcher boats off the Chilean coast in 1964 under contract with one of the local Chilean companies. By the end of the year, five Japanese catcher boats were operating.

PRESERVATION AND PROCESSING

Freezing

Chilean output of frozen fishery products, especially shellfish, has been rising. In 1963 about 12,300 tons of fish and shellfish were utilized by being frozen, compared with 100 tons 10 years earlier. Domestic consumption of frozen fishery products is still small, and most of the output is destined for foreign markets. A large amount of waste is obtained in preparing shellfish for freezing. From the raw materials sent to freezing plants in 1963, about 1,200 tons of frozen shrimp and plated lobster and 400 tons of frozen fish (mostly hake) were produced (table 2).

Larger production of Chilean frozen fishery products can be expected. Investments in new freezing plants have been made recently in northern Chile, expressly for the purpose of freezing tuna and bonito for export. The new facilities are being built as adjuncts to private and Government-owned fish reduction plants so as to take advantage of the slack season for anchovy fishing. In central Chile, where increased exports of frozen shrimp and plated lobster are contemplated, existing plants have acquired new equipment. Two new freezing plants under construction at San Antonio are expected to go into operation in 1965. In the southern region, freezing is almost nonexistent. Only small amounts of king crab are frozen.

Canning

Among edible processed products, the output of canned fish and shellfish ranks first in the Chilean fishing industry. In 1963, from the 33,100 tons of raw materials sent to the canneries, about 10,100 tons (net product weight) of fish and shellfish were obtained (table 2). Sardines, jack mackerels, bonito, and mussels were the principal species packed. Lesser amounts of other species, such as anchovy, tuna, herring, snake mackerel, shrimp, king crab, clams, and plated lobster, were also packed.

Chile has had a fish canning industry for many years, but production has been increasing slowly. Canneries are of small size, automatic equipment is at a minimum, and the products are unable to compete in world markets on a quality and cost basis. Despite their high prices, canned fishery products find ready acceptance in domestic markets, where they are protected from imported products by a system of import duties, surcharges, and prior deposit requirements.

The northern fishing zones, centered at Iquique and Antofagasta, are considered to have the greatest potential for the development of a modern canning industry. Production of

Table 2.--Chilean output of preserved and processed fishery products, 1958 and 1960-63

Product	1958	1960	1961	1962	1963
FISH	<u>Thousand metric tons</u>	<u>Thousand metric tons</u>	<u>Thousand metric tons</u>	<u>Thousand metric tons</u>	<u>Thousand metric tons</u>
Frozen.....	0.4	0.1	(¹)	0.4	0.4
Dried, salted, or smoked...	.2	.3	0.3	1.3	5.7
Canned.....	3.0	4.2	6.5	6.0	8.1
SHELLFISH					
Frozen.....	.4	.9	.9	1.2	1.2
Canned.....	1.8	.7	1.3	1.8	2.0
OILS AND FATS					
Whale (baleen) oil.....	1.8	1.4	1.5	.3	.4
Sperm oil.....	6.4	5.6	6.4	6.4	4.7
Fish body oil.....	.7	2.5	3.9	12.1	12.5
MEAL AND SOLUBLES					
Whale meal.....	2.1	1.1	1.6	.8	.8
Whale solubles.....	--	--	.7	1.5	1.9
Fish meal.....	18.3	42.3	58.0	91.6	107.4
Total.....	35.1	59.1	81.1	123.4	145.1

¹ Insignificant.

Source: Food and Agriculture Organization, Yearbook of Fishery Statistics.

two canneries in operation at Antofagasta in 1964 was only 70,000 cases (48 cans to the case). The first fully automatic fish cannery, however, is being built as part of a fully integrated Government-owned fish meal and freezing establishment at Iquique. Other reduction plants in the area are also considering branching out into canning operations.

With few exceptions, the canneries of central Chile appear to be operating at a status-quo level. The annual canning capacity of the largest plants is about 40,000 cases. Some of the plants handle only 1,000 to 2,000 cases per year.

In southern Chile, the center of the canning industry is Calbuco, with six plants. Other plants are located nearby at Puerto Aguirre and Quellon. Shellfish are handled mainly in these plants; some fish is canned during the closed season for mussels (December to February). About 35,000 cases are produced annually in the largest plants and 5,000 to 10,000 cases in the smaller plants.

Curing

The salting and drying of fish has been practiced along the Chilean coast for many hundreds of years. Production, however, was small until 1963, when about 5,700 tons of salt-dried fish were produced, almost entirely from hake. Most of the curing establishments are located in the Talcahuano-San Vicente area.

Fish Reduction

The Chilean fish reduction industry utilizes a large number of species, but anchovy and hake are the mainstays (table 3). In central Chile, hake reduction plants were built during the early 1950's. Producers of hake meal have been unable to compete in world markets because of the relatively high price paid for the raw material and because of the low oil content of hake. The limited domestic market for fish meal is reserved for hake meal, which costs considerably more to produce than anchovy meal. Since 1959 northern Chile, with the rich

Table 3.--Chilean output of fish meal, 1953-64

Year	Anchovy meal	Hake meal	Sardine meal	Other meal	Total
	<u>Thousand metric tons</u>	<u>Thousand metric tons</u>	<u>Thousand metric tons</u>	<u>Thousand metric tons</u>	<u>Thousand metric tons</u>
1953.....	(¹)	6.5	0.5	0.5	7.5
1954.....	(¹)	5.0	2.0	.4	7.4
1955.....	(¹)	10.6	3.4	1.6	15.6
1956.....	(¹)	9.3	1.3	2.4	13.0
1957.....	(¹)	10.3	2.3	4.0	16.6
1958.....	(¹)	9.0	2.1	7.2	18.3
1959.....	13.6	10.1	5.2	1.1	30.0
1960.....	29.0	10.0	3.0	.3	42.3
1961.....	45.3	8.9	3.8	(²)	58.0
1962.....	75.8	12.2	3.3	.3	91.6
1963.....	92.6	11.0	3.5	.3	107.4
1964 ³	156.6	--	--	--	175.4

¹Small amounts produced; included in other meal.

²Insignificant.

³Preliminary estimates; breakdown for meals other than anchovy not available.

Source: Food and Agriculture Organization, Yearbook of Fishery Statistics, and U.S. Foreign Service despatches.

anchovy resource close to shore, has become one of the major fish meal and oil producing and exporting areas in the world.

Chilean fish meal production increased from about 7,500 tons in 1953 to 18,300 tons in 1958. From then on output rose more rapidly to 107,400 tons in 1963. Preliminary information on fish meal production in 1964 shows a further rise to 175,400 tons. Although this is an impressive increase, production was still far short of plant and vessel capacity. As reported in October 1964, production costs were between \$80 and \$90 per ton of fish meal.

The Chilean output of fish oil is almost entirely from anchovy. In 1958 only 700 tons were obtained, compared with 12,500 tons in 1963 and an estimated 16,200 tons in 1964.

At the end of 1964, Government and private capital investment in plants and purse seiners directly involved in the northern fish meal industry was estimated to be the equivalent of about \$75 million. The Government is holding expansion in this area to an authorized level of 41 plants. As of July 1964, Tarapacá Province, in which Iquique and Arica are located, had 24 reduction plants with a combined capacity of about 680 tons of raw materials per hour. In addition, 12 new plants were being built and 7 new lines were being installed in existing plants. In 1965 the industry should have

a total installed capacity of 1,200 tons per hour. This capacity could handle between 2.3 and 2.5 million tons of fish per year. For 1964 the yield from the anchovy is calculated at 18 percent meal and 2½ percent oil, and for 1965 about 19 percent meal and 2½ percent oil. Because of unforeseen seasonal disappearances of the anchovy from Chilean coastal waters (referred to above, under Important Commercial Species), plant expansion is now proceeding more slowly.

Iquique is the major fish meal producing port, with over half the raw material capacity reported for northern Chile. Arica is next in importance. Between these two ports is Pisagua, where two plants built jointly by Chileans and Norwegians began operations in 1962. The Norwegians are no longer active in these plants. About 37 miles south of Iquique, several plants were reported under construction at Caleta Patillos. In 1964 Antofagasta had two small reduction plants, but four new companies, with foreign capital participating, have been authorized to establish plants.

Equipment in new Chilean reduction plants is of the most advanced type (figs. 5 and 6). Since it rarely rains in the northern area, reduction plants have little or no cover (fig. 7). The more recently constructed plants have equipment for pumping fish directly from vessel to plant.



(Photograph courtesy of Richard Saunders, Scope Associates).

Figure 5.--The automated fish reduction process begins here. Workers are shoveling anchovies into a screw-type conveyor on the wharf, Iquique, Chile.



(Photograph courtesy of Richard Saunders, Scope Associates).

Figure 6.--New Chilean fish reduction plants have modern equipment. This centrifuge separates fish oil from water and impurities, Iquique, Chile.



(Photograph courtesy of Richard Saunders, Scope Associates).

Figure 7.--Bags of anchovy meal stored outdoors awaiting shipment overseas. Iquique, Chile.

INTERNATIONAL TRADE

The trend in Chilean exports of fishery products has closely followed developments in the producing segments of the industry. A substantial trade in exports of fish meal and oil (table 4) has been fostered with Government support. Exports of fish meal, which were about 5,000 tons in 1950, rose to 24,300 tons in 1960 and 88,500 tons in 1963. Preliminary data for 1964 indicate a further increase to 146,450 tons. Exports of fish oil have followed a similar pattern, rising from 600 tons in 1957 to 11,800 tons in 1963 and an estimated 12,570 tons in 1964.

The principal markets for Chilean fish meal in 1963 were the United States (19,800 tons), Belgium (11,400 tons), Venezuela (10,400 tons), West Germany (10,000 tons), The Netherlands (8,700 tons), and Spain (8,600 tons). Most of the fish oil was sent to The Netherlands (9,900 tons), with smaller amounts to West Germany (1,800 tons).

A recent estimate on export possibilities for 1965 indicates that the northern fish reduction plants have a capacity to support an annual export trade of over 400,000 tons of fish meal and 50,000 tons of fish oil. At present prices

this would yield an exchange earning of over \$55 million. Much, however, depends on the availability of the anchovy resource.

Exports of fish meal and fish oil have been given special treatment by the Chilean Government. Between 1958 and October 1962 an export bonus was paid to producers of meal and oil in Tarapaca Province. Exporters are still eligible for this bonus but, because of a strong international market for these commodities, it is doubtful that payments will be resumed. Plants located in the Arica and Iquique fishing zones are not permitted to sell in domestic markets. Owing to a shortage of fish oil in central Chile, however, permission was granted for some of the northern oil production to be sold to domestic oil facilities in 1964.

In 1963 Chile joined the Fishmeal Exporters Organization (FEO), which has regulated international shipments by setting export quotas for each member country. Peru, Iceland, South Africa, Norway, and Angola are also members of FEO. The purpose of the organization is to prevent falling prices and disruption of markets resulting from sharp increases in exports. Chile's fish meal industry would be especially vulnerable to a drop

Table 4.--Chilean exports of fishery products, 1957, 1960, and 1963

Product	1957		1960		1963	
	Quantity	Value	Quantity	Value	Quantity	Value
	<u>Thousand metric tons</u>	<u>Thousand U.S. dollars</u>	<u>Thousand metric tons</u>	<u>Thousand U.S. dollars</u>	<u>Thousand metric tons</u>	<u>Thousand U.S. dollars</u>
FISH						
Fresh, chilled, or frozen.....	0.6	106	(¹)	23	(¹)	22
Dried, salted, or smoked.....	--	--	--	--	(¹)	(¹)
Canned.....	.3	164	0.1	30	0.1	16
SHELLFISH						
Fresh, frozen, dried, salted, etc.....	² .4	690	² .7	677	(¹)	4
Canned.....	.1	217	.4	469	² 1.4	1,973
OTHER PRODUCTS						
Oils and fats, crude or refined:						
Fish body oil.....	.6	128	3.1	345	11.8	1,293
Sperm oil ³3	44	1.5	255	1.5	310
Meals, solubles, and similar products, of aquatic animal origin.....	5.0	592	24.3	1,723	88.5	9,440
Total.....	7.3	1,941	30.1	3,522	103.3	13,058

¹Insignificant.

²Until 1963, frozen shrimp and plated lobster (langostino) were recorded in customs returns as semiprocessed exports under "fresh and frozen." In 1963 these products were shifted to the industrialized sector and were included with canned products; no breakdown is available.

³May include whale oil.

Source: Food and Agriculture Organization, Yearbook of Fishery Statistics.

in world prices because its labor and fuel costs are higher than those in Peru.

Chile's only other fishery exports of significance are frozen shrimp and plated lobster. In 1963 about 1,050 tons of these commodities were exported, mainly to the United States and the United Kingdom. Frozen tuna is exported in small amounts to Puerto Rican canneries. With expansion of the tuna fleet and completion of modern freezing facilities in northern Chile, exports of tuna undoubtedly will increase. Some canned shrimp, plated lobster, and king crab are exported, but in small amounts; most of the production is consumed domestically.

Chilean imports of fishery products are negligible, averaging less than 200 tons annually. Trade controls and the growth of the domestic fisheries during the early 1950's are responsible.

DEVELOPMENT PROGRAMS

The Chilean Government has a triple-pronged program to develop the fisheries of the country. One phase of development has been concerned with expanding exports of fishery products.

The Government's Production Development Corporation (Corporacion de Fomento de la Produccion), known widely as CORFO, has largely guided this effort. A second phase of development has been to assist in improving the diet of lower income groups through increased fish consumption. The third phase is concerned with biological and technological research to determine the extent and abundance of available aquatic resources and to devise methods of utilizing them.

CORFO serves as a planning agency for the Chilean Government and also makes investments in public and private sectors of the economy. Its income is derived from (1) funds transferred to it by the Government, (2) domestic and foreign borrowing, (3) amortization on loans to private sectors, and (4) income from the sale of assets. In 1964 its investment in the fishing industry, mainly of northern Chile, was estimated at the equivalent of \$30 million. Also, fishermen have received liberal loans for purchasing or modernizing fishing craft and gear. Domestic shipyards have been able to obtain credit up to 35 percent of the value of a fishing boat.

In northern Chile, the Government has attempted to replace the once flourishing but now obsolete nitrate trade with the export trade in fishery products. Besides expanding facilities for anchovy fishing and meal reduction, CORFO has endeavored to diversify the fisheries by emphasizing investment in canneries and freezers.

CORFO has also built and is operating its own fishery facilities. At Iquique, it has an \$8 million investment in a state-owned corporation, Empresa Pesquera de Tarapacá, which is expected to be fully operational in 1965 as an integrated enterprise with fish reduction, canning, freezing, and cold-storage facilities. The supporting fleet will consist of 10 purse seiners and 8 tuna boats. Part of the investment forming the corporation was a \$5 million loan from the Inter-American Development Bank.

CORFO was instrumental in developing the hake reduction industry in central Chile during the early 1950's. It pioneered in trawling for hake and also constructed and operated a modern meal reduction plant at San Vicente. Cold-storage plants and other fishery installations have been built and operated in central Chile. In southern Chile, under the national Ten-Year Plan (1961-70), CORFO expects to invest in programs to revitalize the fishing industry and raise the income level of the fishermen.

Two semiofficial organizations guide relations between the Government and the fishing industry. The National Fisheries Society (Sociedad Nacional de Pesca), a cooperative organization of processors, represents industry in dealings with Government and international bodies, such as FAO. In an effort to stimulate domestic fish consumption, the second organization--National Committee to Develop Consumption of Fishery Products (Comision Nacional de Fomento al Consumo de Productos Pesqueros)--has studied problems relating to production costs, refrigeration facilities, and consumption habits. The National Committee, composed of Government and industry officials, is promoting ways of increasing the domestic market for fishery products by building, or stimulating the building of, more efficient landing, storage, and distribution facilities. One of its major efforts is the planning and joint Government-industry construction of a new fish wholesale market in Santiago. Other markets are to be established in other population centers.

Since 1958, U.S. aid programs have included technical services to the Chilean Government and to private individuals interested in installing new fishery facilities or improving processing and marketing in established plants. At first, the fish meal sector was given particular attention. More recently, efforts have been made to introduce modern and effective gear for taking fish and

shellfish for domestic use, as well as for export. Technicians have been trained in canning, freezing, and curing methods. Exporters of shellfish especially have been given details on modern processing techniques, and their employees have been trained in production methods. Studies made on the Chilean king crab by a U.S. technician have demonstrated that this resource can be utilized more fully.

As a member of FAO, Chile has obtained the services of foreign fishery experts to advise on biological, technological, and marketing problems confronting the fishing industry. FAO has provided boat, processing, and marketing experts to help improve conditions in the fisheries that supply domestic markets. With FAO aid, the Chilean Government has conducted promotion and education campaigns on the nutritive value of fishery products. These campaigns have stressed the use of abundant low-priced fish, such as hake, snake mackerel, and rock cod.

In 1964 the Fisheries Development Institute was established at Santiago as a 5-year project of the United Nations Special Fund. The cost of operating the Institute is being borne by the Government of Chile, which is contributing the equivalent of \$3.6 million, and the Special Fund, which is contributing \$1.3 million. FAO has been appointed executing agency for the project and has provided the project manager as well as technical staff. This Special Fund project is intended to conduct surveys and research likely to lead to the economic development of Chile's fisheries, especially by increasing the opportunity for capital investment. As expected, work on the anchovy resource has high priority.

Fishery research is sponsored by the Chilean Government through its Department of Fish and Game (Departamento de Pesca y Caza). The Department has a fishery laboratory at Valparaiso, established with the technical assistance of West Germany. Research is being conducted on hake and anchovy in relation to the oceanographic environment. As a major project, the Government's San Antonio Fishery Biology Station has been studying the hake resource. The Department of Fish and Game also operates three fish hatcheries, and has an experimental oyster farm at Quelalhue and mussel-culture stations on the islands of Chiloé and Talcan.

Some research is also performed at universities. Catholic University of Valparaiso has a School of Fisheries. The University of Chile has biological laboratories at Viña del Mar (near Valparaiso), Antofagasta, and Santiago. Marine and fresh-water fishery research are also conducted at the University of Concepción and the Southern University of Chile.