

THE YUGOSLAV FISHERY IN THE ADRIATIC SEA

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Yugoslavia maintains a small commercial fishery of approximately 25,000-30,000 metric tons a year in the eastern Adriatic Sea (fig. 1). In 1966-1968, her marine fisheries become more important because of decreases in freshwater catch (see Table). However, their contribution to total catch is only slightly higher than in 1948 (64.6% in 1948; 66.6% in 1968). It is estimated that an additional 2,000-3,000 metric tons are taken by inhabitants of the coast for food and by sport fishermen.

This report examines the small but interesting fishery: the fishing methods and catch; utilization of catch and the social and economic factors that influence it; and the fishery's prospects. It is based on four articles (Basioli, 1968; Grubelić, 1963; Grubešić, 1968; Morović, 1968) and on information gathered firsthand in Yugoslavia from February to August 1969.

FISHING METHODS AND CATCH IN ADRIATIC

The Adriatic Sea is not a uniform fishing area in terms of the type of fishery conducted. Different types of gear are used in four areas--the area embracing the shoreline and offshore banks (various dragnets, set-nets, traps, etc.), the trawling area, the open-water

Fishery	YEAR						
	1968	1967	1966	1965	1960	1955	1948
	(In 1,000 Metric Tons)						
Marine	29.9	30.0	27.3	26.0	20.9	13.6	13.7
Freshwater	15.0	17.9	18.2	15.9	10.0	9.0	7.5
Total	44.9	47.9	45.5	41.9	30.9	22.6	21.2
Marine as % of Total	66.6	62.6	60.0	62.1	67.6	60.2	64.6

Source: FAO Yearbook of Fishery Statistics.

area (seines), and the deep-water area (long-lines). Each area is considered separately later.

In 1968, 8,246 people were engaged in the fishing industry: 2,412 full-time fishermen, 5,456 part time, and 378 shore workers. Fishermen shared 25 to 40 percent of the net income. The fishery involved 6,349 boats, including 4,265 with motor and 2,084 without. Of the motorized craft, only 193 exceeded 10 gross registered tons. The 43,290 nets used included 40,264 set nets, 1,507 drag seines, 460 trawls of various types, 426 purse seines, and 633 nets of other types. Also used were 16,083 basket-traps and over 1.3 million long-line hooks.

Fish make up about 96 percent of the catch; the rest are crustaceans (crabs and lobsters) and molluscs (oysters, mussels, octopus, and squid). The so-called blue or pelagic fish



Fig. 1 - Eastern shore of the Adriatic Sea showing locations important to this review. Inset shows the location of the Adriatic relative to the familiar land masses of Italy.

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(such as sardine, sprat, anchovy, and mackerel) compose about three-fourths the commercial catch. About 85 percent of these blue fish are canned; the rest are salted or consumed fresh.

Shoreline and Bank Area

This area includes the waters adjacent to the mainland of Yugoslavia, the islands, and the reefs. It makes up only one-thirtieth of the eastern half of the Adriatic (the other half is adjacent to Italy) but yields one-fifth the catch. It is by far the most varied region in number of species caught. The dominant fishes are: picarel (*Maena* spp.), grey mullet (*Mugil* spp.), dentex (*Dentex* spp.), bream (*Sparidae*), pandora (*Pagellus erythrinus*), salema (*Boops salpa*), bogue (*Boops boops*), greater amberjack (*Seriola dumerili*), leer fish (*Lichia amia*), wrasse (*Labridae*), bass (*Dicentrarchus labrax*), scorpionfish (*Scorpaena* spp.), corb (*Umbrina cirrosa*), brown meagre (*Corvina nigra*), red mullet (*Mullus barbatus*), striped mullet (*Mullus surmuletus*), forkbeard (*Phycis phycis*), comber (*Serranus* spp.), grouper (*Epinephelus guaza*), moray (*Muraena helena*), conger eel (*Conger conger*), gar-fish (*Belone belone*), blue damselfish (*Chromis chromis*), goby (*Gobius* spp.), and smelt (*Atherine* spp.). Also important are the following invertebrates: octopus (*Octopus vulgaris*), common squid (*Loligo vulgaris*), cuttlefish (*Sepia officinalis*), spiny lobster (*Palinurus vulgaris*), lobster (*Homarus vulgaris*), spider crab (*Maja squinado*), common prawn (*Palaemon serratus*), oyster (*Ostrea edulis*), mussel (*Mytilus galloprovincialis*), and date-shell (*Lithophaga lithophaga*)*

This area offers the most favorable conditions for effective year-round fishing: accessibility, shallow water, and high-quality fish. It is not surprising, therefore, that these grounds have been exploited for thousands of years.

The coastal fishery is a mosaic of different types of gear. Most numerous are nylon gillnets, various drag-nets (set from small boats, then retrieved by hand from the beach), and small beam trawls. In recent years, the use of drag-nets has been greatly curtailed because of the conviction that this gear takes too many immature fish. As drag-nets are phased out, gillnets tend to replace them.

*All scientific and most common names are from Bini (1965). Where common names familiar to U.S. and Canadian readers were needed, the names recommended by the American Fisheries Society (1960) were used.



Fig. 2 - Dalmatian fisherman preparing basket-traps. These traps are widely used in Yugoslavia for taking fish and shellfish.

Fishing with basket-traps (fig. 2) is done mostly by islanders, who also use hooks, spears, gillnets, drag-nets, and beam trawls in their subsistence fishery.

The subsistence fishery is the biggest single element of the coastal fishery today. It involves thousands of fishermen--at least a few from every community. Nearly every household has a few fish dinners weekly. Iz Veli, a typical island community, is shown in figure 3.

Sport Fishing

Sport fishing is increasing. In 1962, over 5,000 members were registered in 52 clubs. The number of unregistered sport fishermen was estimated to be twice that large. These fishermen used about 6,000 skiffs, 1,500 underwater spear-guns, 2,500 gillnets, and 300,000 longline hooks. One concerned scientist calculated, on the basis of 1962 statistics



Fig. 3 - The village of Iz Veli on the island of the same name--a typical island fishing village of Yugoslavia.

data, that each square kilometer in the coastal area had 11 fishermen (professional, subsistence, and sport), 4.6 boats, 12.7 nets, 5 basket-traps, and 1.5 longlines. These figures did not include large numbers of unregistered small nets--especially gillnets. The intensity of sport fishing has probably increased several fold since these calculations were made. Dynamite is now widely (but illegally) used to kill fish.

These data attest the heavy exploitation in the coastal zone. Catch statistics show, furthermore, that some of the most valuable species, red mullet, striped mullet, dentex, bass, bream, scorpionfish, and octopus, are far less abundant today than 100 or even 50 years ago. Less desirable species, such as dogfish and other small fishes, make up an increasing percentage of the catch. The young of most important species have legal protection--a minimum body length regulation. The regulation is difficult to enforce, however, and seems largely ineffective.

Trawling Area

This area extending out to depths of 300 meters (the limit for standard Adriatic trawlers) ranks second in size and in the number of species taken. Important are hake (Mer-

luccius merluccius), skate (Raja spp.), sole (Solea spp.), anglerfish (Lophius spp.), gurnard (Trigla spp.), whiting and poor cod (Gadus spp.), John Dory (Zeus faber), dogfish (Squalus spp., Scyliorhinus spp.), smoothhound (Mustelus spp.), angel shark (Squatina spp.), stingray (Dasyatis spp.), picarel, pandora, bream, weever (Trachinus spp.), argentine (Argentina sphyarena), squid, cuttlefish, Norway lobster (Nephrops norvegicus), and spider crab. There are large but as yet unmarketable populations of fan mussel (Pinna nobilis), sea urchin (Echinus spp.), starfish (Antedon mediterranea), and sponge (Geodia spp., Mycale spp.).

The history of exploitation in the trawling area dates to the third and fourth century B.C., when the Greeks had colonies on the present-day Yugoslav coast. Ancient Greek documents show that longlines were used to take fish (chiefly hake, dogfish, and skate) in water down to 100 meters. Trawling with two-boat combinations (pair trawling) in depths to 80 meters began about 200 years ago. Motorized vessels were first used in these pair trawling operations in 1908; modern trawling (with doors) began just after World War I. The number of boats in the trawl fishery has fallen in recent years (from 154 in 1961 to 117 in 1965).

Only about one of every six boats is a full-time trawler. The others divide their fishing time between trawling and other types of fishing--chiefly seining for pelagic fish. The full-time trawlers are smaller vessels (under 100 hp.) built between the two world wars. They operate in the canals between the larger islands but, even there, they are often blown into port by adverse winds and so average only about 150 fishing days per year. Of the larger boats (over 100 hp.) that divide their fishing time between trawling and other types of fishing, only every tenth boat fishes intensively in the open sea areas. The others fish either inside or outside, but not extensively. Crews range from seven to eight men for the larger vessels, upward from 25 m., but are five or less for the smaller boats working in the canals.

Trawlers now take 1,000-1,600 metric tons annually. The main trawling area is the Blitvenica grounds (fig. 1). By agreement, part of this area is allocated to Italian fishermen. The Yugoslavs are reexamining this agreement, however, in light of their own declining catches. (For details, see CFR, July 1969, page 47.)

Open-Water Area

Although this area is by far the largest in terms of sea surface, scarcely one-half of it contains significant fish populations. Furthermore, fish in that one-half are not uniformly distributed; they are fairly abundant on some grounds but scarce in others.

Of the about 200 commercially important species in the Adriatic, only about 14 are found in the open-water area. Yet this small number makes up three-quarters of the commercial catch. Important species are: sardine (*Sardina pilchardus*), sprat (*Clupea sprattus*), anchovy (*Engraulis encrasicolus*), Atlantic mackerel (*Scomber scombrus*), chub mackerel (*Scomber japonicus colias*), Atlantic saury (*Scomberesox saurus*), gar-fish, horse mackerel (*Trachurus* spp.), bluefin tuna (*Thunnus thynnus*), Atlantic bonito (*Sarda sarda*), frigate mackerel (*Auxis bisus*), little tuna (*Euthynnus alletteratus*), swordfish (*Ziphius gladius*), and bogue. These are all schooling fish--some dwell close and others far from shore. A catch of Atlantic mackerel, a popular fish cooked on a grill, is shown in figure 4.

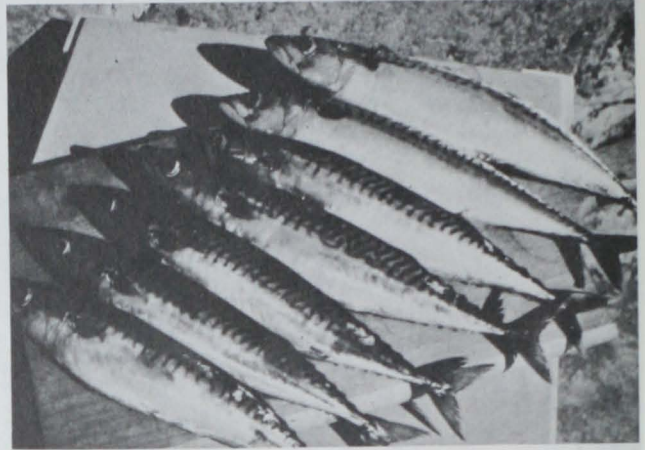


Fig. 4 - Atlantic mackerel, a popular fish, especially when cooked on a grill.

The exploitation of pelagic fish in the Adriatic Sea is centuries old and spans three distinct periods. During the first, before 1929, the fishery was limited to a narrow band near the shore and involved only drag-nets and set-nets. In 1929, the advent of purse seines enabled the fishermen to move farther offshore. The first use of modern fish-detection equipment and radio-telephones in 1953 marked a beginning of the third period--expansion into previously unexploited areas.

In 1968, 416 boats were engaged in seining. These were two basic types. The first, about 170 boats, operated by true professional fishermen, is typically 16-19 (occasionally 20-25) meters long with 80-150 (occasionally 150-240) hp. (fig. 5). Nylon nets used are on the average 350 m. long, 80 m. deep, and are lifted with a winch. The average crew is about nine; the average yearly catch 90-100 metric tons.

Another type of seiner (246 boats) fishes closer to shore, with cotton netting that requires much more maintenance than nylon nets. These boats often fish on stations in narrow local areas where fish are known to occur. Crews are made up of seasonal workers who otherwise work at agricultural jobs; the crews are often twice as large as those of true professional seiners. The average catch is 25-30 metric tons a year. Some beach seines are still used for catching pelagic fish but in decreasing numbers. Special skiffs, outfitted with lights to attract fish schools, are an important part of the pelagic fishing (fig. 6).

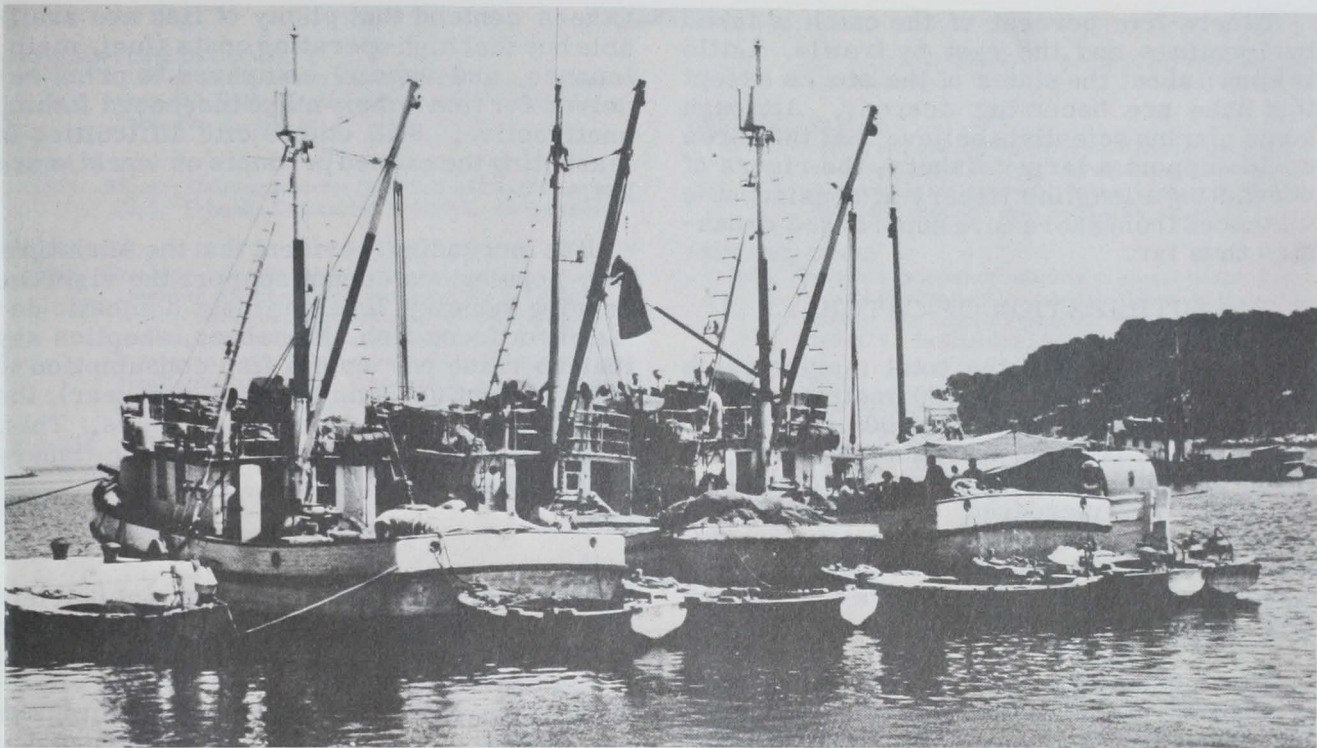


Fig. 5 - Three large purse seiners lying in port. The vessels are the backbone of the Yugoslav fishery for pelagic species.



Fig. 6 - A skiff outfitted with lights for attracting pelagic fishes. In 1968 about 4,000 of these units engaged in the Yugoslavia fishery for sardines, sprat, and anchovies, and the other open-water species.

The fishing season lasts 9 months and is confined to areas less than 120 meters deep. Beyond that depth only a rare school of Atlantic saury or tuna are found--never sardines. The catch of pelagic fish has increased steadily from about 9 thousand metric tons in 1955 to 23 thousand tons in 1968; sardines make up 54 percent, mackerel 13.5 percent, sprat 13 percent, anchovies 8 percent, and the others 11.5 percent.

Deep-Water Area

This area in the southern Adriatic is given a special classification because it is farther from shore and deeper than the open-water area. Depths range from 300 to 1,000 meters.

Of the 31 species of fish and shellfish in the deep water area, the most important are hake, stone bass (*Polyprion cernium*), roughshark (*Centrophorus granulosus*), sixgill shark (*Hexanchus grisseus*), blue shark (*Carcharias glaucus*), rockfish (*Sebastes dactyloptera*), congor eel, greater forkbeard (*Phycis blenniodes*), Norway lobster, and shrimp (*Aristeomorpha foliacea*).

Ninety-five percent of the catch is taken by longlines and the rest by trawls. Little is known about the status of the stocks except that hake are becoming scarcer. Although some marine scientists believe that this area could support a larger fishery, the rigors of conducting a longline fishery at considerable distances from shore have suppressed expansion thus far.

UTILIZATION OF CATCH

In round figures, the total marine catch has increased from 26,000 metric tons in 1965 to 27,000 in 1966 and 30,000 in 1967 and 1968. Most of this increase, however, is from the catch of pelagic fish. The catch of shellfish has increased only slightly, and that of the highly sought demersal or "white" fish (groundfish) has decreased. For the Yugoslav housewife who prefers the "white" fish, the situation is bleak.

First, even within the decreasing catch of groundfish, fewer prime species and more less-desirable species are being caught. Second, to meet skyrocketing demands of expanding Yugoslav tourist industry, hotels and restaurants are buying more and more available prime fish, even before they reach the dock. The result: fewer high-quality fish appear on the public market and these are expensive. Since 1963, in fact, frozen Japanese fish have been imported to meet the demand--a bitter situation, indeed, for coastal people with a great tradition of eating fresh groundfish.

The fish-canning industry has a long history. Even before World War II, Yugoslav sardines in oil and fillets of anchovies were well received on the world market. Immediately after 1945, the canning industry expanded its capacity to 30,000 metric tons annually. This proved to be overexpansion because catches of pelagic fish did not increase accordingly. Despite recent catch increases, from 18,000 metric tons in 1965 to 23,000 in 1968, and the purchase and canning of frozen tuna from Japan's Atlantic Ocean fleet, the industry continues to operate below capacity.

In giving reasons for this less-than-optimum operation, some experts contend that the stocks of pelagic fish already are fished to capacity and no significant reserves exist. Only anchovies, sprat, and saury, they maintain, can support increased fishing effort.

Others contend that plenty of fish are available but that high operating costs (fuel, maintenance, and repair) compared to price received for fish simply make increased fishing unattractive. Still others cite difficulties in marketing the canned products on world market.

It is increasingly evident that the Adriatic's fish populations cannot support the vigorous canning industry, let alone meet domestic demand for fresh fish. Moreover, skeptics say that to raise per-capita fish consumption to the average European's (15 kg. per year), the catch would have to increase 10 times. This, they feel, cannot be done because the fishery reserves are too limited.

THE FUTURE

The Adriatic Sea, deficient in nutrient salts, is not a productive body. Therefore it is difficult to envision significant expansion of the conventional fisheries. Yet the possibility of increasing production by farming the sea appears tremendous. The Yugoslav coastline is surprisingly extensive. The direct distance from the border with Italy southward to the border with Albania is only 628 km., but the total length of the shoreline of the mainland and islands is 6,106 km. Yugoslavia has one of the most richly indented coasts in Europe.

The possibilities for fish farming and shellfish culture are almost unlimited under such circumstances. Fish production could be increased by rearing high-quality fish (chiefly mullet) in enclosed or semi-enclosed bays, artificially fertilized. Initial studies by Yugoslav marine scientists have proved that such rearing can be successful. The main species of shellfish in the Mediterranean and Adriatic Seas are the mussel and the oyster; the mussel is much easier to rear. Fan mussels, which can be farmed on the sea floor, offer another possibility. From each hectare of suitable ocean floor, it is possible to harvest 50,000 fan mussels annually with more than 8,420 kg. of pure flesh. This yield is better than the amount of meat produced per hectare on much of Yugoslavia's grazing lands.

Through fish farming, the Yugoslavs would like to raise the consumption of fresh seafood from one-half kg. per year--among the lowest in Europe--to 4 kg. per person per year.

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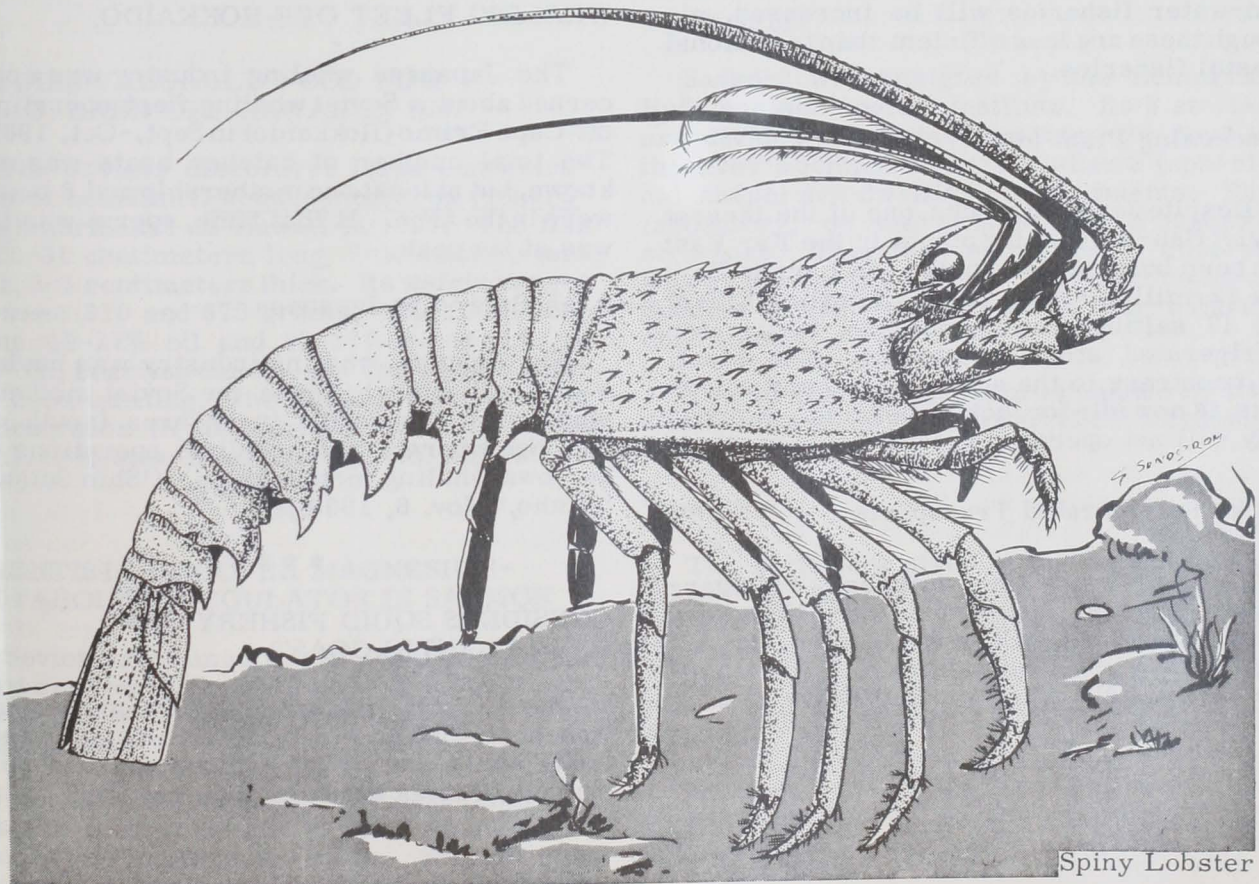
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Spiny Lobster