CIVIL AFFAIRS GUIDE The Fishing Industry of the Japanese Mandated Islands

OPNAV P22-20 (Formerly OPNAV 50E-20)



OFFICE OF THE CHIEF OF NAVAL OPERATIONS NAVY DEPARTMENT 15 AUGUST 1944

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Prepared By

SUPPLY AND RESOURCES SERVICE OFFICE OF ECONOMIC PROGRAMS FOREIGN ECONOMIC ADMINISTRATION

for

OCCUPIED AREAS SECTION CHIEF OF NAVAL OPERATIONS

OFFICE OF THE CHIEF OF NAVAL OPERATIONS NAVY DEPARTMENT 15 AUGUST 1944

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II

Letter of Promulgation

Office of Chief of Naval Operations, Navy Department, Washington 25, D. C., 15 August 1944.

CIVIL AFFAIRS GUIDE

THE FISHING INDUSTRY OF THE JAPANESE MANDATED ISLANDS

OPNAV P22-20

(Formerly OPNAV 50E-20)

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Vice Admiral, U.S. Navy, Vice Chief of Naval Operations.

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The fishing of the Japanese mandated islands is of two different kinds. One is the day-to-day fishing for food, engaged in throughout the islands by natives who operate as individuals or as small groups in the lagoons and close to shore. The other is the commercial fishing which is largely carried on in offshore waters by Japanese using modern equipment. In 1937 this commercial fishing industry landed about 77,775,000 pounds of fish, much of which was exported in the dried form. The commercial fishing is somewhat centralized with the production based chiefly upon the ports of Palau and Truk and, to a lesser degree, Ponape and Saipan.

Occupation of the islands is not likely to affect greatly the native fishing, which can be expected to continue much as before. The status of commercial fishing, on the other hand, will depend upon the condition of boats and gear and upon the disposal made of Japanese fishermen. Many boats and some men may have been removed from these ports; some bonito boats have undoubtedly been taken for military purposes. Boats and equipment may be destroyed or damaged in the occupation. If all Japanese colonists are interned there will be few commercial fishermen.

In the period of occupation, commercial fishing will be important in feeding members of our armed forces, the Japanese colonists of the islands and, to a much lesser extent the native peoples, particularly those of the larger settlements. The most important concern would seem to be the production of fish for use as food within the islands rather than the gathering of shell or the production of dried fish for export.

In order to achieve this end, attention might first be given to small-scale commercial operations in lagoons and coastal areas near the reefs. For this type of fishing, kits such as those devised by Foreign Economic Administration for use in the South Pacific should prove useful. (Appendix A describes these kits.) These operations can start immediately, whereas offshore fishing may be delayed. The knowledge of native fishermen will prove valuable in the locating of good grounds for this type of fishing. It is understood, of course, that resumption of commercial fishing is dependent primarily upon security matters. With a view to partial restoration of the offshore fishing, after a survey has been made of the existing boats and gear, consideration might be given to the possibility of using some Japanese fishermen, under proper surveillance, to help with the commercial operations. The offshore fishing should follow the methods used by the Japanese, i. e., long lining for bonito and line trawling for tuna, although purse seines might be used for several species, including herring, mackerel, bonito, and pompano. Coral reefs and rocky shoals preclude the use of trawl nets.

Much of the fish will be marketed fresh to the larger towns and villages; care should be taken to prevent spoilage. The possibility of including refrigerating units in the port areas is worth investigation. In preserving fish, drying is the method best known, although fish may also be preserved by smoking and salting.

Special attention should be given to the Marine Products Experiment Station at Koror (Palau) and to the records of the Marine Industry Section of the South Seas Government. It should prove invaluable to keep intact and save all records and informational material that might be useful to any future development. As soon as possible after the occupation of Palau the records of both the Experiment Station and the Marine Industry Section should be examined (with the aid of a competent translator). A survey of the commercial boats and gear should be made. Based upon this survey and a knowledge of the existing conditions, a small group of fishery experts, including men competent in tropical fishing, bonito and tuna operations, and the preservation of fish under tropical conditions, could then proceed with a definite program for placing operations on a systematic production basis.

At present, without a knowledge of the status of boats and gear, recommendations cannot be made as to the amount of equipment needed for offshore operations. However, it would be wise to provide now a minimum stockpile of gear including poles, long lines, bonito hooks and lures, trawl lines, and purse seines. Such a stockpile could provide a starting point for commercial fishing not only in the mandated islands but also in Taiwan (Formosa) and other areas to the north.

I. GENERAL SURVEY OF THE FISHING INDUSTRY

INTRODUCTION

The Japanese mandated islands of the Pacific consist of three groups, the Carolines, the Marianas, and the Marshalls, which in all comprise more than 1,400 islands, islets, and reefs scattered over an expanse of water extending about 1,200 miles from north to south and 2,500 miles from east to west. Within this vast water area (several thousand times the land area) are found many hundreds of species of fish of which a large number are edible.

The islands are inhabited by more than 121,000 people of whom 70,000 are Japanese using fish as their main animal protein food, and 51,000 natives most of whom eat fish daily. Supplying fish to the population of the mandated islands is, therefore, an important business. In addition to fish consumed within the region, marine products are exported.

SUBSISTENCE FISHING

Much of the fish consumed within the mandated area is secured by the natives and Japanese for their immediate wants—day-by-day subsistence fishing carried on by individuals or small groups. This subsistence fishing, although in small units scattered throughout all the islands, is large in the aggregate. Much of it is carried on by primitive methods including the use of native gear. The lagoons with the shelter of reefs fronting the coasts of the various islands are the chief field of activity although some subsistence fishing is carried on beyond the reefs.

COMMERCIAL FISHING

In the larger centers of population some of the fish consumed is obtained by commercial fishermen, i. e., men who are licensed to catch and sell fish as a means of livelihood. They operate both close to shore and at considerable distances offshore.

Commercial fishing for export, except for shells, trepang, and turtles, is largely carried on in the offshore waters. These fisheries center about bonito and tuna although mackerel, mullet, and other species are also taken. Shells constitute a major commercial product; in 1937 the value of these exceeded that of any other fishery product (tables 1 and 2). Trepang and turtles are also produced for the commercial market. The commercial fisheries are almost entirely operated by the Japanese. (Commercial fishing is the only type which enters into official statistics.)

IMPORTANCE OF THE FISHERIES

The fisheries of the mandated islands produce but a small part of the total fishery catch of the Japanese Empire; by value, the commercial products amounted to less than one percent of the total Empire production in many recent years and only slightly more than one percent in 1937 (table 3). The manufactured marine products likewise represent only about one percent of the total Empire production (table 4). Nevertheless, fishery products are of considerable commercial importance to the islands because they constitute the second most valuable export of the area, surpassed only by sugar (table 5). In recent years the marine products have made up about 10 to 15 percent of the value of all exports.

 TABLE 1.—Value of commercial fishery catch of Japanese mandated islands, 1932–38

[1.000¥]

Year	Bonito	Tuna	Mack- erels	Other fish	Shell- fish 1	Total
1932	944	51	51	136	65	1, 247
1933	1, 513	60	21	121	75	1,790
1934	2, 205	116	11	137	135	2,604
1935	1,318	106	15	111	80	1,630
1936	1,479	110	20	80	1,900	3, 589
1937	2,833	91	26	99	3,798	6, 847
1938	1, 357	43	28	80	2, 340	2 3, 848

¹ Taken primarily for shell.

 2 One source reports total value for 1938 as $\pm4,026,000.~$ The figure given in the table may be a preliminary figure.

TABLE 2.-Fish production (commercial fishing) of Japanese mandated islands, 1937

	<		c	aroline I	slands				Marian lands (distr	as Is- Saipan ict.	Marshall Islands Total		al	
Product	Palau	district	Yap o	listrict	Ponape	district	Truk o	listrict						
	Metric tons	¥	Metric tons	¥	Metric tons	¥	Metric tons	¥	tons	¥	tons	¥	tons	¥
Bonito. Tuna. Mackerels ¹ Gray mullet. Shark Other fish. Shellfish ^{2 3}	13, 774. 7 189. 8 7. 0 3. 5 5. 9 33. 9	1, 152, 125 26, 327 1, 527 1, 412 293 5, 707 3, 783, 012	1. 3	341 3, 222 14, 405	4, 064. 0 56. 4 24. 5 9. 1 24. 5	406, 396 11, 277 5, 451 2, 011 4, 508 257	12, 433. 6 342. 2 40. 5 9. 7 102. 7	870, 349 25, 274 15, 418 778 38, 647	3, 697. 3 88. 9 14. 5 0. 2 5. 8 156. 5	382, 210 27, 121 4, 071 60 704 37, 044	91. 3 4. 0	22, 825 1, 029 	34, 060. 9 681. 3 87. 8 12. 8 21. 4 344. 0 (²)	2, 833, 905 90, 828 26, 808 3, 483 1, 775 92, 624 3 , 797, 674
Trepang Turtles Misellaneous	6.4	257			8.9 (2) (2)	444 1, 116 250	22. 2 (²)	222 90	28.3 (¹)	869 180			65. 8 (2) (2)	1, 792 1, 386 250
Total	14, 021. 2	4, 970, 460	16.6	17, 968	4, 187. 4	431, 710	12, 950. 9	950, 778	3, 991. 5	452, 259	106.4	27, 350	4 35, 274. 0	4 6, 850, 5 25

¹ In official statistics most of the mackerel is listed as "horse mackerel." The species are not, however, the same as the American horse mackerel.
 ² Not reported by weight.
 ³ Taken primarily for shell.

TABLE 3.—Value of commercial fishery catch of Japanese mandated islands as compared with total catch of Japanese Empire

[1,000,000¥]

Year	Total Jap- anese Em- pire catch	Catch of mandated Islands	Percent of Empire catch
1933	338	1.8	0. 53
1934	361	2.6	. 72
1935	382	1.6	. 42
1936	549	3.6	. 66
1937	480	6.9	1.44

⁴ Total omitting shellfish, turtles, and miscellaneous, ⁵ This figure derived by adding data presented in this table is slightly higher than the official figure given in table 1.

TABLE 4	-Value of	f fishery	manufa	ctures	of Ja	panese	man-
dated is	lands as	compare	d with	total	catch (of Jap	anese
Empire							

[1,000,000¥]

Year	Total fishery manufac- tures of Japanese Empire	Fishery manufac- tures of mandated islands	Percent of Empire production
1933	249	1.7	0.68
1934	296	1.8	. 61
1935	319	2.2	. 69
1936	388	2.8	.72
1937	432	5.5	1. 27

TABLE 5.—Exports	of	marine	produ	cts f	rom	the	Japane.	se
mandated islands	as	compared	l with	suga	r exp	ports	and tot	al
exports, 1933-1938	31							

[1,000,000 ¥]

Year	Exports of sugar	Exports of marine products	Total exports
1933	12.9	1.7	18.2
1934	12.4	1.8	16. 5
1935	18.1	2.2	23.7
1936	13.0	2,8	25.0
1937	19.6	5.5	37.9
1938	25.3	2.6	45. 3

¹ Inclusive of exports to other parts of Japanese Empire.

II. FISH RESOURCES, FISHING GROUNDS, AND FISHING SEASONS

FISH RESOURCES

The waters of the Japanese mandated South Sea Islands are inhabited by approximately 1,500 to 2,000 kinds of fish, about one-tenth of the total known fish of the world. Both lagoon (inshore) and deepsea species are numerous. Many of the fish are sufficiently large and abundant enough to be of great commercial potentialities.

Although the resources are known to be large, detailed information concerning these resources is not available. Systematic investigations of the fishing resources of this area have been started by the Japanese. Fishery investigation boats are known to have surveyed the Palau region and the area between Palau and New Guinea. Undoubtedly the boats attached to the Marine Products Experimental Station at Palau have investigated the resources of other parts of the mandated area. Most of the Japanese investigations have been concerned with the distribution of bonito and, to a lesser degree, with that of tuna. In carrying out these surveys, however, information concerning other fish resources must have been obtained.

The following pages describe briefly some of the abundant fish by family groups and table 6 lists the important food fish.

TABLE 6.—Names of important food fish of the Japanese mandated islands

English name	Scientific name
albacore	Thunnidae: Germo alalunga (?)
barbel	Cyprinidae: Barbus sp.
barracuda	Sphyraenidae
bonito	Thunnidae:
	Katsuwonis pelamis
	Euthynnus yaito
butterfly fish	Chaetodontidae
cardinal fish	Apogonichthyidae
cavalla	Carangidae
chub mackerel	Scomber microlepidotus
damsel fish	Pomacentridae
eel, marine (moray)	Muraenidae
flounder	Pleuronectidae
flying fish	Exocoetidae
frigate mackerel	Auxis thazard
goatfish (surmullet)	Mullidae:
	Upeneoides sp.
	Mulloides sp.

TABLE 6.—Names of important food fish of the Japanese mandated islands.—Continued

English name goby ' grey mullet

grouper (sea bass) halfbeak herring Japan mackerel kingfish lancet fish leatherfish leatherfish leatherjacket mackerel

manahag moray

mullet pampano parrot fish

oceanic bonito porgy ray red mullet red snapper scarus (parrot fish) sea bass (grouper) shark skipjack

snapper Spanish mackerel

squirrel fish surmullet tuna Yaito tuna yellowfin tuna

Scientific name Gobiidae Mugilidae: Mugil scheli and other Mugil sp. Serranidae Hemiramphidae Clupeidae Scomber japonicus Scomberomorus sp. Acanthuridae Monacanthidae (?) Scomberoides sp. (?) Clupeidae: especially Rastrelliger sp. Acanthuridae (young) Muraenidae: Muraena polyuranodon M. thyrsoideus and other species Mugilidae Carangidae Scarichthvidae: Scarus sp. Callyodon sp. Katsuwonis pelamis Sparidae Batoidae (?) Mullidae Lutianus sp. Scarichthyidae: Scarus sp. Serranidae Galeidae Katsuwonis p elamis (sometimes applied to other species) Lutianidae Scomberomorus commersoni (Cybium commersoni) Holocentridae (?) Mullidae Thunnidae Euthynnus yaito Neothynnus macropterus

Table 6 is not complete as only those species specifically mentioned in the source material are included. A considerable number of other species which occur in the western Pacific can be expected in the waters of the mandated islands. The identification by species is not possible in some cases due to lack of correlation between common names and scientific names in this area. For many fish, therefore, family and/or genus names are listed rather than species. In many instances, also, the English name is applied not to a single species but to several species of a genus or a family. In addition to the fish listed here shellfish and other marine animals are found in considerable numbers and are used for food.

Thunnidae (tunas, bonitos, skipjacks, yellowfins, albacores).—These are strong fast-moving fish, usually pelagic, roving in the open sea and preying upon small fish like herrings and sardines.

Species of the Thunnidae occur over the western Pacific from the South China and Celebes Seas, and the waters north of New Guinea, northward to Japan proper, and eastward to the Hawaiian Islands. Some of the species occur in enormous schools containing vast numbers of individuals. The oceanic bonito or skipjack (Katsuwonis pelamis) is found in large schools in the mandated waters as well as in waters of the Philippines and Taiwan (Formosa) and Ogasawara Shoto (the Bonin Islands) to the east, northeast, and north. This species is the one usually referred to as "bonito." The Yaito tuna or bonito (Euthynnus yaito) and the yellowfin tuna (Neothynnus macropterus) are both widely distributed in the western Pacific including the Japanese mandated area. They also form schools and are caught commercially. The bluefin tuna (Thynnus thunnus) occurs generally throughout the western Pacific but is more important to the north in waters of Japan proper than in the South Seas.

Bonito and tuna occur throughout the year in the waters off the coast of the mandated islands. Extensive migrations are known to occur farther north of those species that form schools. Information concerning movements in the mandated waters is, however, not available. The eastern part of the mandated area appears to be less productive of tuna and bonito than the grounds of the Carolines and of the Marianas leading northward to the Bonins. The best season for "tuna" (species not indicated) in the southern Marianas is, according to one source, from August to December. At times bonito and tuna are caught by hundreds near the coast. Ordinarily, however, they do not approach the shore closely for they are fish of the open sea.

Scombridae (mackerels).—The mackerels are important food fish, among the best of this area. Those of the mandated waters are largely the *Rastrelliger* species which are moderate in size but occur in schools, and the Commerson's Spanish mackerel or kingfish (*Scomberomorus commersoni*) which is large in size and occurs in large schools. The Japan mackerel (*Scomber japonicus*) and the chub mackerel (*Scomber microlepidotus*) are migratory fish which occur in schools; these are less numerous in the waters off the mandated islands than the *Rastrelliger* species and the Spanish mackerel.

Clupeidae (herrings and sardines).—Members of this family are widely distributed in the western Pacific in quantities so large as to be of great economic importance. Several species of herrings and sardines are reported from the waters of the mandated area. They are all small, silvery fish, a few inches in length. They are pelagic, move in schools, and some species are migratory. In parts of the mandated waters they are reported as numerous during the months of April to August, but it is not known whether this is a major season.

Serranidae (sea bass or groupers).—These are sluggish fish and are usually encountered among coral reefs not far from shore. They can be found in almost any part of the mandated islands in fairly shallow waters where coral animals abound, as these animals constitute their major source of food.

Lutjanidae (*snappers*).—Most of the snappers are shallow-water reef dwellers although red snappers live, or at least feed, on submerged reefs and rocky bottoms often at depths of about thirty-five feet. Some snappers feed mostly on muldy bottoms where small fish and crustaceans are available as food. The snappers are widely distributed in the mandated area.

Mugilidae (*mullets*).—The mullets are rather thick-set, clumsy-looking fish, peculiarly broad across the snout, with large scales and a bluish silver color. Little is known about the habits of mullet in this area. Although caught for subsistence purposes in large numbers they are taken in only relatively small numbers commercially. They are excellent food fish although the keeping quality is poor.

Carangida (*pompanos or cavallas*).—These abound on coral reefs and a few kinds travel in schools, often at considerable distance from land. These are first-class fish for eating purposes.

Sphyraenidae (*barracudas*).—These are long, slender fish, capable of very swift motion. They are great travellers of the open seas, moving in schools following the movements of small fish. They are widely distributed in the waters of the mandated islands. On Guam they are reported to be taken almost the year round.

Hemiramphidae (*halfbeaks*).-These fish have slender, nearly cylindrical bodies and clear translucent flesh; many of them have a silver or black stripe along the middle. Some reach a length of more than two feet. They go in schools and at times large quantities may be taken in nets. They have a wellflavored flesh.

Exocetidae (*flying fish*).—Closely related to the halfbeaks are the flying fish. They do not really fly, but soar; they swim with great speed, give a mighty shove as they leave the water, spread their large fins, and soar away. Usually they make a series of flights, or soaring leaps, before dropping back into the water. Flying fish travel in schools, sometimes at great distances from the land. They are very abundant in the mandated waters. Yap Island in the Carolines is particularly famous for its flying-fish expeditions which occur in May and June. In the Marshalls they are reported to occur in largest numbers from December to May. They are specifically reported for Aur and Mille in the Marshalls.

Sparidae (*porgies*).—The porgies are reef dwellers found in shallow banks in many places within the mandated area.

Scarichthyidae (*parrot fish*).—These are coralreef dwellers, many of them large in size.

Gobiidae (gobies).—The gobies are mostly dullcolored, carnivorous bottom dwellers. They live chiefly in shallow bays and around reefs.

Muraenidae (morays).—These include many kinds of sea eels which abound in the coral reefs.

Other fish.—In addition to the above-named fish, the following are reported to be abundant in many parts of the mandated islands: barbels, butterfly fish, cardinal fish, damsel fish, rays and flounders, lancet fish, leatherfish, needlefish, sharks, and squirrel fish.

Shellfish.—Crustacea and molluses abound along the shores and reefs. Among those reported as numerous and important are clams, crabs, crawfish, lobsters, mussels, pearl oysters, and shrimps. Two kinds of turtle, *Dermochelys* sp. and the hawk's-bill (*Chelone imbricata*), frequent the northern atolls of the Marshalls and are also reported from the Carolines and the Marianas.

Other marine animals.—Of the sea mammals, porpoises are numerous in the Carolines and the Marshalls. Whales occur in the waters of all three major island groups. In the Carolines they were formerly more common than now; in the Marianas sperm whales appear seasonally between January and March. Dugong (sea cows) were formerly very numerous in Palau and constituted an important source of food and item of commerce; now they are relatively scarce. Cuttlefish and octopuses which live in holes in the reefs are caught for food throughout the area. Holothurians, especially sea-cucumbers, are common in most of the islands and provide dried trepang, one of the export products.

Fresh-water fish.—Most of the islands of the mandated area are small and have few or no fresh-water streams or lakes. In the streams of the larger islands of the Marianas Islands (Saipan, Tinian, and Rota) edible perch and eels are reported.

FISHING REGIONS

Fishing for subsistence purposes is carried on throughout the mandated islands. From place to place local abundance varies, but in general all lagoon and coastal waters are fishing grounds. The leading commercial fishing grounds are the waters off Palau, Truk, and Ponape in the Carolines and Saipan in the Marianas. These waters account for most of the bonito and tuna catch, the major fish product (table 2). (Since bonito and tuna are open-sea fish the boats fish at considerable distances from the shore, but part of the catch is from the waters adjacent to these islands.) Palau is also the center of the shellfishing industries. At Koror (Palau) are the only fishing settlements reported for the mandated islands-on the shore of Arakabesan Island (facing Koror) and on Malakal Island.

FISHING SEASONS

The fishing seasons for particular fish, insofar as available, are given in the section on resources, page 3 ff. The season during which large numbers of fish come in close to the shores of the islands where they are caught by the natives lasts from April until about October (variously reported as September, October, and November). During these months fishing in lagoons and on reefs is at its best. During the months from October through March, the time of steady northeast trade winds, reef fishing is less successful. This part of the year, however, is most suitable for deep-sea fishing as carried on in small boats, for navigation conditions then are better than during the calms, variable winds and storms of the wet season (April to October). (This is a somewhat generalized statement, for within the belt of the mandated islands (more than 15° of latitude) the climatic conditions vary considerably.) Additional information concerning the seasonal abundance of fish is desirable; this may exist in records of the Marine Industry Section of the South Seas Government at Koror (Palau).

III. FISHING METHODS AND GEAR

COMMERCIAL METHODS AND GEAR

The commercial fishery products consist primarily of bonito, tuna, mackerel, shells, and trepang. The latter two products are considered elsewhere. Some of the bonito, tuna, and mackerel which enter into commercial trade are taken by natives and Japanese who fish close to shore and use primitive techniques; such production representing surpluses above subsistence needs is, however, small. Most of the commercial catch is based upon offshore operations of Japanese fishermen with modern gear and modern power craft.

Bonito fishing .- Bonito boats scour the ocean waters covering a wide belt in searching out fish. Schools of bonito may be detected by the fish breaking water or, at greater distances, by flocks of sea birds which follow the schools and hover overhead. (The presence of schools can also be disclosed by airplanes; this method has been employed by the Japanese in the Pacific.) When a school is found small fish are thrown into the water to stop the advance of the bonito and the fishing begins. Bonito is fished by several methods: angling, trolling, and seining. The most common Japanese method in the mandated waters, as well as elsewhere, is bamboostick angling (ippon-zuri). The bamboo pole measures about 20 feet in length and about 1 inch in diameter. From it is dropped a 25-foot strong line with a fishhook attached to its end. On the hook is placed a live fish (herring or sardine) as bait. As the bonitos bite, live bait is gradually replaced with lures.

Tuna fishing.—Tuna are caught by the Japanese in several ways, but the largest quantities are secured by long lines (trawl lines) and by hook and line angling. (Nets are used by Japanese fishermen for tuna, but less commonly.) The latter method, less common than the former, is similar to angling as described for bonito. In long-line fishing (magurohaenawa) the line used is a hemp rope with a diameter of about one-third inch. The trunk line, also hemp, is about 900 feet long, to which are attached, at intervals of 120 feet, six branch lines. Of these six lines, two are about 240 to 300 feet and the others but 60 feet. At the end of each branch line is attached a fishhook. Trunk lines are suspended into the water from float lines with glass buoys which float on the water. At about 120 feet below the surface the trunk lines lie horizontally, and from these the branch lines are suspended. Thus the hooks are between 180 and 420 feet below the surface of the water. All these lines, buoys and hooks make up a *hachi*. A vessel of 50 to 60 tons has about 50 *hachis*. The lines, lowered at dawn or in the evening, are allowed to remain under water for about 12 hours.

This method, although the most important Japanese method of catching tuna (for the Japanese Empire as a whole about 80 percent of the tuna are taken by this method), may not be used as much in the mandated South Seas as farther north. In general the long line is especially preferred in winter when the fish do not swim as near the surface as in the warmer season. In the warmer South Seas the angling method may, therefore, be somewhat more important than in the more northerly waters of Japan proper.

All the crew members, except the helmsman and engineers, participate in the fishing. They line one side of the boat, standing a few inches above the water, on a narrow rack or sponson. If biting is good several thousand fish are caught in the few minutes that the fish swarm by the side of the boat.

Mackerel fishing.—Japanese fishermen take mackerel by long lines, hand lines, circle nets (purse seines), and drift nets. No specific mention was found of the methods employed by the commercial fisheries of the mandated islands.

NATIVE METHODS AND GEAR

Fish are caught in numerous ways by the natives: with hook and line; in nets, baskets, traps, and weirs; with unbaited hooks dragged in the wake of a sailing canoe; with spears and clubs; and with poisons.

Hook-and-line fishing, used for many species, is common throughout the islands. It ranges from fishing with a slender line and bone hook up to deep-sea equipment consisting of 600 feet of line, sinkers, and large hooks. Formerly, native-made equipment prevailed : hooks of tortoise-shell, mother-of-pearl, coconut shell, bone and wood; lines of twisted coconut fiber, hisbiscus bast or pipturus bast; sinkers of stone; and rods fashioned from the wood of native shrubs. Today, however, the natives on most of the islands rely largely on traders for metal fishhooks, cotton line, and lead sinkers. On all of the islands native gear is still used and on a few its use still predominates.

On the atolls of Nukuoro and Kapingamarangi of the East Carolines where angling is particularly well developed, mother-of-pearl hooks are variously shaped for numerous species of fish and each fisherman has a basket in which he keeps an assortment of hooks and lines. Hooks are baited with small fish, crawfish, and crabs; in the Marshall Islands worms are reported to be used for trolling.

Several types of nets-dip nets, hand-cast nets, and drag nets-are employed in native fishing, and some native groups are primarily net fishermen. Many natives of the Caroline Islands belong to this group. It may be that the Caroline Islanders, as a whole, are somewhat more net fishermen than the natives of the Marianas and the Marshalls. The natives of all island groups, however, use nets. Simple dip nets are made with a forked branch as a handle. Hand-cast nets made of pineapple fiber are skilfully used by the Chamorros of the Marianas Islands. The net, round and about 12 feet in diameter, is carried over the right arm of the fisherman until he sees a school of fish close to the shore. He then casts the net out swiftly and accurately. Weights around the periphery sink the net to the bottom, after which it is slowly brought ashore, and the catch is placed in a basket. In the Marshalls nets 16 to 25 feet long are used to encircle fish on the outer reefs; the fish are frightened into them by the throwing of stones. In recent years drag nets have been used on the open sea. Special nets, used for flying fish, are made of hibiscus bast and coconut fiber knotted into a mesh and fastened to an ovel frame of wood. Large nets are used in community fish drives. The native materials employed in making nets are coconut fiber, hibiscus bast, pineapple fiber, creepers, vines, and certain types of seaweed. The large nets are not as commonly made of native materials but of cotton or hemp. Smaller nets, however, are still being produced of native materials.

Weirs and dams are used to capture fish on many of the islands. Herring are caught in dams built of coral stones on the reef platform. Swimming at high tide, they are cut off from deep water at low tide and are taken by baskets. Often the fish are directed shoreward by a rope dragged along the surface of the water between two canoes.

Basket traps, made of split aerial roots of the pandanus and of small sticks, are set in the passages between the lagoons and the outer sea to catch small fish which do not take the hook.

Spears are widely used. They are employed by day on the outer reef and by night in the shallow lagoons and for torchlight fishing. On many of the islands spears with wooden shafts and metal points have replaced the earlier native fish spears.

The narcotizing of fish is commonly practiced. Barringtonia nuts and derris root are pounded and placed in the water, favorite places being the deep gaps in the reef. The fish become stupefied and float to the surface of the water where they are easily captured with a net or a two-pronged spear. The drug does not render the flesh inedible.

The use of dynamite in fishing is forbidden and is not reported to occur.

The information available concerning methods of catching various species of fish and marine animals is summarized below. This discussion is probably incomplete, and in some instances the information is based only upon descriptions of the practice in a few places. In general, however, the basic methods are similar throughout the mandated islands.

Albacore are caught with a hook to which wings of fresh pandanus leaves are fastened. When attached to a line, trolled behind a moving boat, and jiggled, the winged hook is mistaken for a flying fish. Albacore are also caught from the edge of the reef by rod and line, the hook being jerked up and down to entice the fish.

Barbel are driven into fish baskets by women and children at ebb tide by striking the water with their hands.

Bonito.—The aboriginal method of securing bonito is to surround them on the high sea in canoes and drive them into the lagoon, where they are trapped in palm-leaf weirs and speared. Today bonito are mainly caught from power boats with rod and line. Metal fishhooks have largely supplanted the older barbless hooks of mother-of-pearl or wood. Herring are used as bait, or feathers as lures, but the fish appear to be primarily attracted by the sound of the motorboat.

Cuttlefish.—Natives prod with sticks in small holes in the reef and drag out cuttlefish.

Eels.—Eels are caught by diving into holes in the reef. In places they are caught by hook and line or by baited trap. Eels are not eaten by some native groups (Marshall Islands), but are relished by the Japanese and also by other native groups.

Flying fish appear in schools and during the season are caught in large numbers (a hundred is considered a good night's catch). Yap (Carolines) has long been famous for the expeditions for flying fish which occur during May and June. Specially trained crews in large outrigger canoes paddle along shore in the open sea to attract the fish with torches of coconut fronds, netting them as they leap out of the water.

They are also caught during the daytime with an unbaited gorge of coconut shell about 1½ inches long which is fastened to a cord and made to dance on the surface of the water. When a fish snaps at the gorge it becomes fixed in its mouth.

Groupers are caught from boats by day with hooks. Crawfish tails are a common bait.

Herrings.—Various species of herring are captured in nets or fish dams when they flee inshore in great schools to escape the voracious fish which pursue them. In some places they are driven into baskets.

Leatherfish.—One type of leatherfish is caught in the Marshalls in basket traps set in a lagoon near a reef passage.

Lobsters are dragged out from under coral blocks on moonlit nights.

Mackerels are caught by several methods—some by trolling hooks behind small boats and others by angling. On the island of Rota in the Marianas an unusual method requiring great patience is practiced. A coconut shell filled with shredded coconut and glued to a flat stone with breadfruit sap is lowered on a line to the bottom of the lagoon. The shredded coconut slowly escapes through a hole in the shell and attracts a school of mackerel. Each day shredded coconut is placed in the shell, and the line is shortened. At the end of a month or two, the school of fish is so close to the surface that large numbers can be netted.

Mullets are caught in palm-leaf weirs and then gathered up with the hands when the ebb tide uncovers the reef. Large nets operated by groups are also used. Natives paddle out in a fleet of cances and make a fence of vertical nets, hung rectangular affairs about 20 feet long and 8 feet high. They are placed in a great circle sometimes 500 feet across. Their lower edges touch the seabottom, but most of the fence is above the surface, projecting high into the air. Those who hold the nets begin to walk in, making the circle smaller and smaller. The caged fish swim madly about, seeking a way of escape, and finally take to leaping in an effort to jump over the fence. Some succeed; others fall short and are caught in mid-air by the meshes of the net. Instantly there is someone at hand with a club to kill the fish with a blow on the head, and to toss it into a nearby canoe. Mullets are also taken with baited hooks.

Octopuses live in holes in the coral rocks and are gathered by divers who thrust a stick into the midst of the animal's tentacles and draw it out when it clings to the stick.

Parrot fish.—Species of parrot fish are caught by several methods. In the Marshalls some are caught in basket traps in the lagoons. The traps are set out at ebb tide near a passage in the reef in water 30 to 50 feet deep. They are covered with stones and leaves with a few stones laid in palisade fashion on either side of the opening. After a day or two have passed, the trap is opened by a diver who removes the catch through a side door.

Scarus, a greenish-blue parrot fish, is speared by Marshall Islanders at night by torchlight and another species is caught by daylight with a palmleaf weir and a net on the table reef between the surf and the outer shore. When a school of fish gets through the surf on to the table reef, they are driven into the weir by the throwing of stones. They are also caught on the outer reef on short lines. On the island of Rota (Marianas) an unusual technique is practiced in catching parrot fish. A piece of line is fastened to the lower jaw bone of a living parrot fish which is then released in water about 35 feet deep. The wounded fish is attacked by one of its kind. The line is shortened until the fighting is just below the surface and the attacker can be netted.

Porpoises are driven ashore by dragging a coconut fiber rope along the surface of the water between two boats. They will not swim under the line and only occasionally jump over it so that nearly an entire school can be secured at one time. They are also driven into palm-leaf weirs on the reef where they are kept until ebb tide and then speared.

Sharks hover in great numbers about the passages through the reef, preying on incoming and outgoing schools of fish. They are caught from the land with a hook. Sometimes natives fish for sharks in sailing canoes. They rattle empty coconut shells strung on a stick in the water. The sound brings the shark up from the bottom, and it is speared. A coconut rope of about 500 feet is fastened to the haft of the spear, and gradually the natives draw it in on the line.

Snappers are taken by hook and line and by basket traps.

Tuna.—Tuna are driven toward shore with a rope stretched between two canoes and by beating the surface of the water. As the tide ebbs and the reef emerges, the fish are caught with baskets, spears, and the bare hands. Such opportunities to secure large numbers of tuna are rare, however, and these fish are more commonly secured by hook and line. Strips of fresh pandanus are tied to the hook to make wing-like projections about 6 inches long to simulate the flying fishes, a favorite food of the tuna.

Turtle.—The methods of hunting turtle vary. In Palau (Caroline Islands) strong nets of coconut fiber 30 to 40 meters in length are used. On Pul the natives put out beyond the reef in canoes during the turtle-mating season and slip snares over the forefeet of pairs. Turtles are also speared from canoes.

Whales.—Small whales occasionally stray in numbers into the lagoons. The natives surround the herd in their canoes and, by knocking stones together under the water, drive the animals on to the dry reef.

NATIVE SUPERSTITIONS CONCERNED WITH FISHING

Formerly native fishing was surrounded by many beliefs and taboos. Most of them are not observed today, and fishing is more of a practical activity nearly divested of superstitions. The range of these superstitions, some of which may still prevail on some islands, is indicated by the following samples:

No cooked food may be taken on a fishing trip except when catching flying fish.

Wives may not look on when the men are fishing for bonito.

One may not eat two kinds of fish or both meat and fish at the same meal.

Fishermen must abstain from sexual intercourse prior to setting out on extensive fishing expeditions.

Fish caught by net or weir on the outer shore may not be transported but must be prepared and eaten on the spot, with no women present.

A more important complex of beliefs and taboos is that concerned with allegedly poisonous fish. Authorities agree that some sea foods are actually poisonous, at least at certain times or places, and that severe illnesses and deaths do occasionally occur in consequence of eating them. The number of species which the natives consider poisonous is large, but there is little agreement in the beliefs prevalent on different islands. It is probable that the complex of beliefs about poisonous fish had some basis in objective fact but is heavily encrusted with superstition.

There is no rule of thumb for distinguishing a poisonous fish, for a species which is harmless at some times and places is dangerous at others. A large proportion of the fish regarded as poisonous in the Marshall Islands belongs to the class of the *Acanthopteri*, possessing spiny fins. One source reports that the flesh of certain butterfly fish, eels, mackerel, and sharks is occasionally harmful. Another reports that a certain black moray is considered poisonous; other marine fauna reported to be dangerous include edible mussels and crabs.

A wide variety of reasons have been offered to explain why certain fish are poisonous or are believed to be. One theory attributes fish poisoning to the products of decomposition, which takes place rapidly in the tropical climate. Since the natives eat the liver and kidneys of fish as well as the flesh, one authority thinks that the poison may be generated in these or other internal organs. This is consistent with the reported fact that of two persons eating different parts of the same fish, one may become ill though the other is unaffected. Stagnant sea water has been suggested as a cause and religious beliefs have also been advanced as an explanation. According to another theory, the source is ascribed to the marine flora upon which the fish feed in particular lagoons at definite seasons; this would explain why certain species considered edible on one atoll are avoided on another and why certain species are said to be poisonous only at particular seasons. Post hoc ergo propter hoc reasoning is doubtless a factor in some cases. Thus illness due to infection of wounds from spiny fins received from allegedly poisonous fish might be attributed to eating their flesh. Moreover, the natives of some islands attribute to the eating of poisonous fish any complaint ranging from a toothache to syphilis. Since fish form part of the daily diet, fish eaten 2 or 3 days before may be held responsible for any illness.

No scientific study of the causes has been made to sift out the rational beliefs from the irrational in this region. However, a practical guide to the poisonous and harmful fish likely to be encountered in the Southwest Pacific was prepared recently in Australia (Appendix B). In general, it is wise to follow local customs regarding poisonous or allegedly poisonous fish.

IV. FISHING BOATS AND FISHERMEN

Fishing boats of the Japanese mandated islands vary from modern power boats to small native canoes. There are, however, because of the relatively small development of large-scale fishing, only a few large power boats. Most of the small native canoes, used only for subsistence fishing, are not recorded in statistics.

COMMERCIAL FISHING BOATS

Data available for 1937 indicate that 644 craft were engaged in commercial fishing, more than half of which were boats of less than five tons without motive power (table 7). The number of fishing craft operating in the commercial fisheries each year from 1932 to 1938 is given in table 8.

TABLE	7.—Japanese	mandated	islands:	Number	of	boats
	engaged	in commerc	ial fishing	7, 1937		

	Power	boats	Non-	(1)-1-1
	Less than 20 tons	More than 20 tons	re 20 s	number of boats
West Carolines:				
Palau district	58	146	80	284
Yap district			7	7
East Carolines:				
Ponape district	14	1	51	66
Truk district	52	4	100	156
Marianas	36	4	89	129
Marshalls			2	2
Total	160	155	329	644

TABLE 8.—Japanese mandated islands: Number of fishing craft, 1932–38

	With engine	Without Engine		With engine	Without engine
1932	63	1, 053	1936	216	237
1933	62	314	1937	315	329
1934	93	316	1938	391	468
1935	108	265			

The boats used for the bonito fisheries numbered 145 in 1939 distributed as follows: Palau 45, Yap 2, Ponape 17, Truk 47, and Saipan 34. These are motor vessels from about 15 to 60 tons; most of them are small types under 25 tons. (The bonito boats of the Japanese Empire as a whole averaged about 40 tons in 1937.) A number of larger vessels in the class from 60 to 100 tons, fishing primarily for tuna, also operate in mandated waters. These latter boats, equipped with large refrigeration facilities and based upon ports in southern Japan or Taiwan, fish in waters bordering the islands without landing the catch within the mandated territory. If the catch of these boats were added to the landing of the mandated islands, the tuna catch would nearly equal that of bonito.

The angling racks on most bonito boats extend around the entire outside of the bulwark, but in most cases they are detachable. Livebait tanks are placed fore in some boats, aft in others.

A feature of many Japanese bonito boats is the provision for a number of sprays on the leeward side. The spray, supplied with sea water by the same pump which serves the livebait tanks, produces a disturbance on the water surface which, to the fish, almost exactly duplicates the behavior of a large school of sardines.

NATIVE CRAFT

The natives of the Japanese mandated islands, competent navigators and fishermen for a long period, are builders of several types of craft. In former times when inter-island travel and even travel to distant islands was common, large sailing canoes were constructed, but today on most of the islands native craft are confined to small boats. In general there are two types of modern native craft which are used for fishing purposes: the small paddling canoe and the somewhat larger sailing canoe.

Craft of the Caroline Islands.—In the Carolines almost every family has a small canoe for use in lagoons and coastal waters. The larger sailing canoes for deep-sea fishing are also common. Most of the canoes of both types are made of wood and lashed together with sennit. Except for bamboo rafts, found in a few islands, all craft are equipped with outriggers. Although the native boats exhibit a basic similarity throughout the Carolines, there are distinctive features characterizing the craft of local areas as well as different types designed for particular uses.



1. Waterfront at Garapan, Saipan, showing native canoe (c. 1930).



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2. Interior of a canoe house, with canoe and fishing gear, Satawal (1909).

In the Palau district each canoe, however elaborate, is hollowed from a single log. The boat used in this district for offshore fishing has a narrow hull with the lee side bulging more than the weather side. Some of these are equipped with covers so that they can be closed to protect them against the surf and waves. The paddle used by the Palau natives is about four and a half feet long, has a cylindrical loom, and is without a handle grip.

The dugout canoes of Merir, Pul, Sonsorol, and Tobi Islands are long, narrow, and sharp-keeled. The outrigger float is short and sharply pointed at the ends. The paddles of Sonsorol are comparatively long and have a peculiarly wide, diamond-shaped blade. The paddles of Tobi have a short, round shaft and an extremely long blade which is concave on one side, convex on the other.

The most characteristic canoe of the Yap district is the *popo*, a deep-sea sailing canoe which averages about 30 feet in length and 4 feet in width. The keel is slightly curved along the bottom. Identical fore and aft pieces are joined to the keel at a marked angle and curve slightly upward toward the bow and stern, where they terminate in characteristic forked figureheads. The side plank on the outrigger side is higher than the opposite plank and bulges outward more noticeably, making the canoe markedly asymmetrical in transverse cross-section. On the lee side, opposite the outrigger, a raised platform extends beyond the gunwale over the water. In some canoes this platform supports a small hut to protect the occupants from the sun and rain. The *popo* carries a mast and sail. With relatively slight local variations this type of canoe is found from Satawal in the east to Ngulu in the west.

Most of the islands in the Yap district have small sailing canoes and paddling canoes of several types, some of them of dugout construction. Characteristic of Yap proper is a large sailing canoe called *tsukupin* which is esteemed by the islanders as a sacred craft. It is said to be used only during the season for flying fish, and is stored in a special boathouse during the remainder of the year. The keel is boldly curved in crescentic form, and the hull is symmetrical in transverse section. The bow and stern rise to a considerable height, forming a swanneck, and turn downward at the ends to represent a frigate bird's beak.

The characteristics of the canoes of the different islands of the East Carolines are listed below. Here as in the West Carolines, the two major types are present: the paddling canoe and the small sailing canoe.

TABLE 9.— Characteristics of native canoes in the East Caroline islands

	Canoe	Paddle	Hull	Decoration	Float
Kusaie	Paddling only	Long shaft, pointed blade, painted red.	Slender, no keel, round bot- tom.	Painted red and white.	Almost as long as the
Pingelap	do	Red shaft, pointed blade, painted black and white.	Broad	None	Medium length.
Mokil	Paddling and sailing,	Long blade with cornered edges.	Slender, sides symmetrical	do	Long, curving upward at both ends.
Ponape	do	Long shaft, oval blade, painted red.	Slender, no keel, round bot- tom.	Painted red	Almost as long as the canoe.
Nukuoro	do	Long shaft, lanceolate blade.	Broad	None	
Kapingamarangi	do	Plain shaft, flat oval blade unpainted.		Painted white	Long, pointed at both ends.
Nomoi, Truk, Hall, Pulap, Namonuito and Puluwat.	do	Slender shaft, lanceolate blade.	Forked-tail figureheads at bow and stern.	Painted red and black, or black.	Canoe-shaped.

Craft of the Marianas Islands.—The fishing expeditions of the natives of the Marianas are confined almost exclusively within the reef barriers of the islands. The native craft, therefore, are small. The canoes have bow and stern of the same shape, and the outrigger is attached to a long transverse pole. Most of the canoes of the Chamorros are of the dugout type while those of the Carolinians are made of planks.

Craft of the Marshall Islands.—The natives of the Marshall Islands have long been known as competent navigators and boat builders. Today they build two types of boats which are employed in fishing operations: A small dugout canoe used only in the lagoons and an outrigger sailing canoe about 20 feet in length.

The outrigger canoe is constructed entirely of wood, lashed together with sennit. A dugout breadfruit log forms the keel and bottom portion of the hull. On this the sides are raised by the addition of irregular strakes running parallel with the keel and fitting at each end into a solid-block prow and stern piece. No ribs or frames are employed; two platforms, and in some cases inserted thwarts, stiffen the hull adequately. The sides are asymmetrical, the one on the side of the outrigger being rounded and bulging, the other perpendicular. The sail is of matting (pandanus leaves) and is triangular in form.

FISHERMEN

Almost all natives of the mandated islands are fishermen in that they catch fish for subsistence purposes; fish forms an important item of their daily diet. Commercial fishermen, however, are relatively small in number. Table 10 presents the number of fishing households and persons engaged in fishing for the period 1933–38.

 TABLE 10.—Fishing households and fishermen of the Japanese mandated islands, 1933–38

	Number of fishing house- holds	Number of fishing popula- tion		Number of fishing house- holds	Number of fishing popula- tion
1933	803	1, 539	1936	1, 480	3, 100
1934	1,178	2, 236	1937	1,837	4, 755
1935	1,093	2,356	1938	n. a.	7, 616

n. a. Not available.

In contrast to the subsistence fishing, commercial fishing is carried on almost exclusively by the Japanese. Table 11 shows that in 1937 of the 4,755 fishermen licensed, 4,680 were Japanese and only 75 were natives. The greatest concentration, as would be expected from the data concerning production and boats, is in the Carolines with Palau and Truk the chief centers. In the Marianas only Saipan had commercial fishermen in 1937.

TABLE 11.—Commercial	fishermen	of the	Japanese	mandated
	islands, 19	37		

District		Japanese		N	Total		
District	Male	Female	Total	Male	Female	Total	men
Caroline Islands:							
Palau	1,400	572	1,972	71		71	2,043
Yap Truk	3 1,390	120	3 1, 510	4			3 1, 514
Ponape Kusaie	336	70	406				406
Total Caroline Islands							3, 966
Marianas Islands: Saipan Tinian Rota	656	129	785				785
Total Marianas Islands							785
Marshall Islands	4		4				4
Total Marshall Islands							4
Total	3, 789	891	4, 680	. 75		75	4, 755

SHELL INDUSTRIES

The collection of commercially valuable shells is, next to bonito and tuna fishing, the most important fishing industry of the mandated islands, at least in point of value of exports. Commercially shell is produced primarily in the Palau district of the West Carolines, where in 1937 it was the leading fishery export by value.

The collection of *takase* (nilotic-top shell), *hakucho* (white oyster shell), and *kokucho* (black oyster shell) is an industry which requires licensing. In 1937 the number of such licenses totaled 2,046, of which 1,972 were issued to Japanese in the Palau district, 3 to Japanese in the Yap district, and 71 to natives in the Palau district. Among those holding licenses in Palau were 572 women. The number engaged in the actual collecting of shells in 1937 is not known, but in 1932 official reports listed 22 Japanese and 244 natives as specifically engaged in shell collecting. The recent trend toward Japanese control, evidenced by the licensing in 1937, is noteworthy.

Takase (nilotic-top shell), in great demand for the manufacture of cheap pearl buttons, is collected in May and June chiefly in the Palau Islands. Of the production of this type of shell in the mandated islands, the Palau district (West Carolines) accounts for almost 75 percent and the Yap district (West Carolines) for the rest. According to one report, due to the efforts of the Marine Products Experiment Station, nilotic-top shells were transplanted to Truk about 1939. A new fishing ground for these shells may now exist on Truk. The quantity (in kilograms) and value of the production of the West Carolines is shown in table 12.

Although the production of *hakucho* (white oyster shell) greatly exceeds that of *takase* or any other shell, specific information is lacking prior to 1937. In this year 4,265,594 kilograms of *hakucho* valued at $\frac{1}{3}$,704,595 were produced in the Palau district. It is fished by Japanese divers. The diver boats, which may number 150 to 170 at a time, make Palau their base. *Kokucho* (black oyster shell), like *hakucho*, is apparently produced only in the Palau district, where the 1937 production totaled 9,479 kilograms, valued at ¥352. In the same year miscellaneous shells totaling 4,163 kilograms and worth ¥3,349 were produced in the Palau district.

TABLE	12.—Production	of	Takase	(Nilotic-top)	shell	in	the
		Wes	st Carol	ines			

Year	Quantity (kilo- grams)	Value ·(¥)	Year	Quantity (kilo grams)	Value (挙)
1927	106, 387	44, 280	1933	136, 785	73,090
1928	143, 429	59, 180	1934	144,866	134, 386
1929	n. a.	n. a.	1935	87,099	80, 379
1930	n.a.	n. a.	1936	58, 282	57, 734
1931	155,065	48,609	1937	87, 255	89, 321
1932	186, 375	62, 349	and the		

n. a. Not available.

PEARL INDUSTRY

The culture of pearls according to the Mikimoto system is another industry of the Palau district. Records indicate that Palau is the only producing area in the mandated islands and that the industry, an expansion from Japan proper, is exclusively in the hands of Japanese. One company, operating in Koror, is believed to have a monopoly. Reports indicate an attempt to introduce pearl culture on Ponape and another somewhere in the Marshalls. The former is known to have failed and the latter may still exist.

The cultured pearl is produced by inserting a foreign substance into a pearl oyster. This forms a nucleus which is covered with the many layers of nacre necessary to produce a perfectly spherical pearl. The gem is completed in 3 or 4 years, less than the time required in Japanese pearl farms where the water is colder. During these years the oysters are kept in wire cages suspended in the lagoon. The Palau pearls are reported to be of unusual size, many of them from one-fourth to one-half inch in diameter. Most are white, but some are black and a few mauve.

The practice of the pearl company is to harvest and store its pearls each year, until enough have been accumulated for export. During the 6-year period 1931 to 1936, exports of pearls are recorded only for 1932 when 7,055 pearls valued at ¥35,745, were exported. The recorded production during these years was as follows:

TABLE 13.—Production of pearls in the Japanese mandated islands, 1931–35

Year	Number of pearls	Value ¥	Year	Number of pearls	Value ¥
1931	4, 106	21,000	1934	10, 776	32, 32
1932	2, 949	15, 745	1935	1,000	3, 000

Koror is the base for the pearl-fishing fleet which consists of about 150 boats equipped with Diesel engines and radios.

TORTOISE-SHELL INDUSTRY

Since early times the natives of the mandated islands, particularly those of the Carolines, have used tortoise shell in many ways-for fishhooks, special blades, and receptacles. As trade developed with Europeans, tortoise shell became an item of barter for cloth, tobacco; and other articles. It is still used by the natives for various manufactures and for barter. It is difficult to estimate the total production of tortoise shell since native production is not necessarily recorded with the commercial production of the islands. Even commercial production is, however, sufficiently large to be listed as one of the industries of the Carolines. In 1937 the Palau district produced 36 kilograms valued at ¥324, and articles manufactured from tortoise shell aggregated 1,238 pieces valued at ¥1,770. Production is small in the Yap district and none was reported in 1937. Both the Truk and Ponape districts have produced

some tortoise shell in past years. The major portion of the shell is from the hawk's-bill turtle (*Chelone imbricata*).

TREPANG INDUSTRY

Trepang (sea cucumbers) are found on reefs throughout the islands. They are obtained mostly by wading along the reefs and shore line at low tide, but the animals from which the better grades of dried trepang are made live in waters 9 to 25 feet deep. The preparation of dried trepang is discussed elsewhere (p. 17).

THE SHARK-FISHING INDUSTRY

This is not a large industry but some sharks are taken by the natives and a small commercial fishery is reported to exist in the West Carolines. Commercial sharking is done by schooners. Six lines about 30 feet long ending in a length of wire cable and a big hook a foot long are used on each side of the boat. After the shark is drawn up to the block above the deck it is speared. The best time for sharking is reported to be at night from 1900 to 2100.

The fins are cut off, cured, and shipped to China (in normal times) as table delicacies or for use in making gelatin. Some of the liver oil may also be exported.

SPONGE FISHING

Sponges are found in depressed areas of the reef platform and in the lagoons. In the past a small number of sponges, reported to be of good quality, were exported. In 1932 the exports were 36 kilograms valued at ¥32. Sponges are reported to be cultivated at Palau.

VI. PROCESSING AND MARKETING OF MARINE PRODUCTS

PROCESSING

Most of the products of commercial fishing are exported in the processed form. The usual process is drying, the important finished products being dried bonito, dried tuna, and dried trepang. In 1937, the year when production was largest, the dried marine products amounted to more than 6,200 metric tons and were valued at \$5,485 (table 14).

TABLE 14.—Production of processed marine products of the Japanese mandated islands, 1933–38

	Dried	bonito	Dried	tuna	Dried t	(T-1-11	
	Metric tons	1,000 ¥	Metric tons	1,000 ¥	Metric tons	1,000 ¥	1,000 ¥
1933	1, 305	1,662	69	76	5	3	1, 748
1934	1, 594	1,715	93	85	24	8	1, 811
1935	2,097	2, 127	102	99	27	9	2, 239
1936		2,671		75			2,760
1937	5, 813	5,082	384	381	17	4	5, 485
1938	n. a.	2, 430	n. a.	42	n. a.	n. a.	2, 596

¹ The total, given only as a value figure, includes small amounts of other manufactured marine products.

n. a. Not available.

Dried bonito.—The manufacture of dried bonito on a commercial scale is carried on in several places in the Carolines—on Palau, Truk, and Ponape—and on Saipan in the Marianas (table 15). Much of the drying is done in factories, many of them operated by the Nanyo Kohatsu Kaisha. In 1933 there were reported to be a total of 23 factories in the mandated islands: 7 in Palau, 8 in Truk, 4 in Ponape, and 4 in Saipan. One of the large bonito drying plants equipped with all accessories is at Koror, on Malakal Island.

The bonito is processed into *katsubushi*, which is greatly prized in Japan as an ingredient of soups. Thin shavings of it are scraped into the daily soup. The fish is cleaned, boiled, boned, dr ed over a fire for a few days, smoked, and then placed in damp sheds to mildew. The mildew is wiped off, and the fish placed in the sun. Again the fish is allowed to mildew, and the procedure is repeated until mildew ceases to form, when the product, a hard, dark red substance, is packed for shipment.

Dried tuna.—Dried tuna is manufactured in much smaller quantities; the production in 1937 amounted to 384 tons. Most of this was manufactured at Palau (table 15).

Dried trepang.—Dried trepang, which is in much demand by the Chinese for use in gelatinous soups, has been produced in the islands in moderate amounts ever since the Spanish period. The amount has varied considerably from time to time. In recent years the annual production has been 17 to 27 metric tons. The preparation of trepang in 1937 was largest in the Marianas (Saipan) and in the West Carolines (Palau). Lesser amounts were prepared commercially at Truk and Ponape in the East Carolines.

	Dried bonito		Dried tuna		Dried trepang		Canned fish		Other products		Total	
	Metric tons	¥	Metric tons	¥	Metric tons	¥	Metric tons	¥	Metric tons	¥	Metric tons	¥
Caroline Islands: Palau district. Yap district	2, 358. 4	2, 410, 684	318. 5	327, 925	5.1	1, 470	50. 2	9, 679	(1)	47:	2, 732. 2	2, 750, 230
Ponape district Truk district Marianas Islands Marshall Islands	660, 6 2, 148, 6 626, 2 19, 0	540, 927 1, 506, 218 601, 738 22, 207	7.4 57.3 .8	6, 361 46, 610 481	1.4 .6 9.9	897 594 1, 511			41. 7 (1)	4, 766 1, 557	711. 1 2, 206. 5 636. 1 19. 8	552, 951 1, 554, 979 603, 249 22, 688
Total	5, 812. 8	5, 081, 774	384.0	381, 377	17.0	4, 472	50. 2	9, 679	41.7	6, 795	2 6, 305, 7	3 5, 484, 097

TABLE 15.—Production of processed marine products of the Japanese mandated islands, 1937

1 Not reported by weight.

² This total does not include "other products" for Palau and Truk district (about 18 tons).

³ Total of figures given here. This is slightly lower than the official total.



3. Bonito drying by the South Seas Development Co., Ponape (prior to 1936)



4. Cleaning bonito in the South Seas Development Co. plant, Ponape (prior to 1936).

In making the best grade trepang the sea cucumbers are boiled in water 15 or 20 minutes, then slit open, gutted, and placed in the sun until nearly dry, after which they are placed under a shed and smoked for about 24 hours. After smoking they are sun dried until entirely hard and free from moisture. Some of the trepang of the mandated islands, however, is not gutted and is imperfectly dried.

Fish canning.—The canning of fish in the mandated islands is negligible—about 50 tons in 1937. Two canneries have been reported: one at Nanko on the southwestern side of Dublon Island in Truk (East Carolines) and one at Jaluit (Marshall Islands). The fish canned is probably bonito and tuna.

In 1930 a fisheries manufacturing plant was established at Koror in Palau to study the manufacture of such products as canned tortoise, boiled tuna, and canned fish boiled in oil in addition to the regular dried products.

Native preparation.—Most of the fish used by the natives is fresh, but some is prepared for use at a later time. Small fish are stored in brine; large fish are split, gutted, rubbed with a layer of salt and dried in the sun. The natives of Palau have developed a method of preserving fish by smoking.

Supplies for processing.—Most of the processing is that of drying which does not require much in the way of supplies. Salt is little used in the commercial processing. Salt is manufactured on a small scale in Rota (southern Marianas) and other islands by drawing sea water out of depressed areas on reef platforms and boiling it in kettles. Several hundred thousand pounds of salt, however, are imported into the mandated islands annually (482,000 pounds in 1935).

MARKETING

Exports.—Almost all the commercial catch is exported—dried bonito, dried tuna, dried trepang, shell, tortoise shell, and pearls. Most of these products are exported to Japan through the ports of Palau, Truk, Ponape, Saipan, Tinian, and Jaluit. Table 16 summarizes the incomplete data available concerning exports of marine products during the period 1933 to 1938, and Table 17 gives the value of exports of dried bonito, the chief marine food product, by districts in 1937.

Domestic marketing.—Most of the fish caught by natives and even much of that caught by the Japanese does not enter into trade channels as it is consumed directly by the fishermen and their families. (The daily diet of the natives consists of starchy foods supplemented by fish of all kinds, shellfish and meat. Fish is eaten both cooked and raw. The Japanese depend upon fish as a staple food.) In a few centers where several hundred or even a few thousand people are concentrated, especially where Japanese predominate as in towns like Koror (Palau) and those on Ponape, Saipan, and Tinian, local fish markets may exist; however, only one specific mention was found of such a market—at Colony on Ponape.

Domestic commerce, including that which involves marine products, is carried on largely through trading stations operated by private entrepreneurs or by large companies. The natives buy food and cheap manufactures from Japan in exchange for the production of their own industries including *takase* and other shell, tortoise shell and dried ish. One of the items which is said to be particularly in demand by the natives of the Marshalls and the Marianas is canned salmon. Total imports of canned fish are

Product	Quantity							Value (thousand ¥)					
	1933	1934	1935	1936	1937	1938	1933	1934	1935	1933	1937	1938	
Dried bonito, tons	1, 218	1, 296	1, 861	n. a.	n. a.	n. a.	1, 512	1, 812	2, 216	2, 725	² 5, 771	3, 598	
Dried trepang, liters	7, 380	47, 258	17, 187	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	³ 2	n. a.	
Nilotic-top shell, tons	56	684	25	n. a.	n. a.	n. a.	(4)	(⁴)	(4)	⁽⁴⁾	(4)	n. a.	
	149	94	96	n. a.	n. a.	n. a.	89	107	87	66	849	118	

TABLE 16.-Exports of marine products of the Japanese mandated islands, 1933-38

n. a. Not available.

¹ Not listed here, as quantitative figures are not available, are dried tuna, other shells, pearls and sponges.

² The statistics by district (table 17) total slightly higher than this official export figure,

³ Exports to Japan only from the Marianas. Total exports were probably more than double this figure.

4 Less than ¥500.

probably small; no statistics are available on this import.

Some trade in marine products is carried on between islands of the mandated area. Such trade in mother-of-pearl, shell, tortoise shell and preserved fish, although still sizable, is not as large as formerly when inter-island voyages were more common than they are at present. Local barter in foodstuffs continues among some native groups. Where this occurs fish is among the important items of trade.

TABLE 17Value	of	exports	of	dried	bonito	by	districts,	1937
		(in	¥)				

Caroline Islands:	
Palau	
Truk	2, 194, 994
Yap	
Ponape	520, 726
Kusaie	
Marianas Islands:	
Saipan	1, 000, 323
Tinian	
Rota	
Marshall Islands	

5, 838, 569

BUSINESS ORGANIZATIONS CONCERNED WITH FISHERIES

Three Japanese business firms are known to have interests in the fisheries of the mandated islands: Nanyo Kohatsu Kaisha (South Seas Development Co.).—The principal enterprise of this firm is sugar and its byproducts. However, the firm has some interest in fishing as well as in phosphates, shipbuilding, agriculture and ice manufacturing. In the East Carolines it operates fish-processing factories in Truk and Ponape. The head office of the company is in Saipan and its branch office in Tokyo.

Nanyo Boeki Kaisha (South Seas Trading Co.).— This is one of the dominant business organizations of the Carolines. Its principal activities are shipping, copra production, and fishing. Its fisheries are reported to be rather limited but the firm has interests in both bonito fishing and the preparation of dried bonito in Ponape.

Nanyo Takushoku (South Seas Exploitation Co.).—This company, founded in 1936, has its head office at Koror (Palau) and a branch office in Tokyo. Although primarily interested in mining phosphates it also has interests in fishing activities. Its affiliated companies include Pacific Pearl Co., Japan Pearl Co., and Nanko Marine Products Co.

In addition to these three companies and their affiliates, there are probably a number of smaller organizations interested in the fisheries of the mandated islands. Some of- them are independent; others act as middlemen between native fishermen and the large companies.

VII. GOVERNMENT ADMINISTRATION, CONTROL, AND AID

ADMINISTRATION

The commercial fishing industry is administered by the Department of Economic Development of the South Seas Government. One of five sections of this department is the Marine Industry Section, headed in 1941 by Haruhiko Tsuneyoshi (*Sonin*). This section has cognizance of the following:

Marine industry.

Manufacture and disposal of marine products.

Propagation and protection of marine animals and plants.

Administration of fishing bases.

Fishing vessels.

Inspection of marine products.

Marine industry cooperative guilds and other organizations.

Investigations concerning marine industry.

One of the institutions of the South Seas Government is the Marine Products Experiment Station at Koror (Palau), established in 1931, which conducts research on fishing, the artificial hatching of fish, the manufacture of marine products, and oceanographic problems. In 1941 the head of the station, responsible directly to the Governor, was Kiyoshi Okajima. He was assisted by Yoshioro Tomo. These two officials were of *Sonin* rank. In 1939 in addition there were 6 officials of *Hannin* rank and 13 other lower officials, making a total personnel of 21.

In 1933 the Marine Products Experiment Station operated two experimental ships, the *Suiho Maru* (180 tons) and the *Haku Maru* (10 tons).

[Sonin and Hannin (referred to above) are two of the ranks of the Japanese Civil Service System. Members of Sonin rank are appointed by the cabinet from among graduates of the imperial universities who possess the Ph. D. degree. Officials of Hannin rank are appointed by the ministry under which they serve. In the South Seas the appointive power is in many instances delegated to the Governor or other high ranking officials. Sonin and Hannin officials are Japanese; ranks below Hannin include both Japanese and natives.]

REGULATION

Commercial fishing has been regulated by the South Sea Government since 1916 by a series of ordinances last amended in 1936. All fishermen must secure licenses from the Governor. For natives using their traditional fishing techniques the procedure is simplified. A special procedure is prescribed for all others and particularly for the following categories of fishing activities: The breeding and culture of fish and shellfish, fishing with stationary appliances, fishing for pearl oysters and nilotic-top and Hirose shellfish, the catching of hawk's-bill turtles, sponge fishing, coral fishing, whaling, pelagic fishing from a base in the mandated islands, fishing with poles or ropes, using a screw-driven power boat of more than 5 tons. and the transportation or disposal of marine products caught.

An application for a license must be made in writing to the Governor, and must be accompanied by a plan of enterprise with duplicate copies of maps showing the location and area of the fishing grounds. The application must contain the following information: the full name, date of birth, adress, and domicile of the applicant (and in the case of a juridical person or guild also a copy of the articles of incorporation or bylaws and a certified copy of the registration), the type of fishing to be undertaken, a description and enumeration of the appliances to be used, the location and area of the fishing grounds, the kinds of marine animals to be caught or bred, the size, type, number, and crew of the fishing vessels to be used, the fishing season, and the base of operations.

Fishing permits must be carried on the person when fishing, may not be bought, sold, transferred, or loaned, and must be returned immediately when invalidated or when fishing has been abandoned. When a permit is lost or damaged, or when any entry requires change, application must be made immediately for reissue, with a specification of the circumstances in writing. In case of death, a license may be transferred to the heir of the deceased if the latter's permit is returned within 6 months accompanied by written proof that the new applicant is the heir. The following schedule of fees is prescribed: Application for a permit under the special categories of fishing activities enumerated above, \$10; application for renewal of such a permit, \$5; application for a permit for other kinds of commercial fishing, \$2; application for a change of entry, \$1; reissue or revision of a permit, \$1; permission to peruse the fishing register, 10 sen; application for a transcript from the fishing register, \$2; application for a copy of maps of fishing grounds, \$1; application for an extract from the fishing register without maps, \$1; application for an extract from the fishing register without maps, \$1; application for an extract from the fishing register without maps, \$1; application for a set an extract from the fishing register without maps, \$1; application for a set an extract from the fishing register without maps, \$1; application for a set an extract from the fishing register without maps, \$1; application for a set an extract from the fishing register without maps, \$1; application for a set an extract from the fishing register without maps, \$1; application for a set an extract from the fishing register without maps, \$1; application for a set an extract from the fishing register without maps, \$1, application for a set an extract from the fishing register without maps, \$1, application for a set an extract from the fishing register without maps, \$1, application for a set an extract from the fishing register without maps, \$1, application for a set an extract from the fishing register without maps, \$1, application for a set an extract from the fishing register without maps, \$1, application for a set an extract from the fishing register without maps, \$1, application for a set an extract from the fishing register without maps, \$1, application for a set an extract from the fishing register without maps, \$1, application for a set an extra the fishing register without maps, \$1, applicating the set an extra the set an extrement for

The ordinance of 1936 also expressly forbids the use of poison, explosives, or electricity in the catching or collecting of marine animals and plants unless special permission is secured from the Governor at Koror. Closed seasons were declared for specified marine animals as follows: Nilotic-top and Hirose shellfish, from July 1 to April 30; pearl oysters, from August 1 to December 31; hawk's-bill turtles, from June 1 to August 31 and from December 1 to January 31. The taking of the following marine animals was forbidden at all seasons of the year : Nilotic-top shellfish of less than 8 centimeters in diameter at the base; Hirose shellfish of less than 5 centimeters in diameter at the base; hawk's-bill turtles and sea turtles of less than 60 centimeters in length and their eggs, as well as any such turtles found on shore.

The following penalties are prescribed for violations of the fishing regulations described above:

1. Penal labor for not more than 6 months, or a fine of not more than ¥200, for using poison, explosives, or electricity in fishing, or for violating the provisions respecting the specifically enumerated categories of commercial fishing activities.

2. A fine of not more than ¥100, or a minor fine, for violating the provisions respecting other than the specifically enumerated categories of fishing activities, for failure to carry one's permit when fishing, for buying, selling, transferring, or lending a permit, for failure to respect closed seasons, for taking forbidden marine animals, for taking turtles or nilotictop or Hirose shellfish when not engaged in fishing, for making false statements, and for evading, obstructing, or refusing to answer Government inspectors. In all such cases, the catch and fishing appliances of the offender are confiscated, or a sum equal to their value is collected.

3. Minor fines for other violations.

SUBSIDIES

The South Seas Government has encouraged the development of commercial fishing through the granting of subsidies. An ordinance issued in 1935 authorized the Governor to grant subsidies to individuals, guilds, or corporations to defray the cost, in whole or in part, of the following:

- Construction or improvement of fishing vessels Manufacture or purchase of new and improved fishing implements
- Institution of improved methods of fishing and of disposing of the catch
- Construction or equipment of hatcheries
- Purchase or collection of desirable fish eggs or aquatic seedlings and propagation of young fish or marine plants
- Construction or equipment for processing plants
- Research or experimentation on the manufacture, marketing, or sale of marine products
- Construction or equipment of ice-manufacturing plants, refrigerator ships, or cold storage facilities
- Divers services performed by marine products guilds in connection with research, conservation, relief, marketing, and the provision of public facilities
- Other activities recognized as deserving assistance

Applications for subsidies must be accompanied by written statements outlining the enterprise, furnishing plans and specifications, detailing the costs, estimating probable income and expenditures, and giving other pertinent information. Provision is made for the control and supervision of recipients and for the making of regular reports.

Subsidies granted to the fishing industry of the Carolines and Marianas Islands amounted to ¥99,265 in 1937, distributed as shown in table 18.

Bonito fishing was especially encouraged in recent years; it is reported that the Japanese Government provided power boats to any group of 30 or 40 men who undertook to fish for bonito.

the Japanese manualea islands, 1957 (\pm)	
Caroline Islands:	
Palau district:	
Fishing equipment	20, 517
Construction of a ship for marine research	30, 000
Purchase of land for erection of lodgings	9,000
Establishment of a cannery	5, 680
Unloading equipment	4,000
Office expenses	3,000
	72, 197
Yap district	
Truk district:	
Fishing equipment	2,100
Construction of fishing boats	4,000
Building of landing platforms	3, 928
Construction of ice-making plant	1, 760
	11, 788
Ponape district: Fishing equipment	3,600
Marianas Islands:	
Saipan district:	
Construction of fishing boats	2,940
Unloading equipment	4,675
Fishing equipment	3, 865
	11, 480
Marshall Islands	-
Total, mandated islands	¥99, 265

TABLE 18.—Government subsidies to the fishing industry of the Japanese mandated islands 1937 (¥)

APPENDIX A—FOREIGN ECONOMIC ADMINISTRATION FISHING KITS FOR SMALL-SCALE COMMERCIAL OPERATIONS IN THE SOUTH PACIFIC

In 1942 the Foreign Economic Administration (then the Board of Economic Warfare) devised a fishing kit for small-scale fishing operations in the South Pacific. It is composed of an assortment of apparatus which can be used under various fishing conditions and circumstances and can be easily transported. One or more of these kits, assigned to military bases or to local settlements, can provide the means for catching a considerable amount of fresh fish for immediate consumption. These kits, which have now been used in the Solomons, Fijis, New Hebrides, and other parts of the South Pacific, have proved excellent producers, although as a result of use in these areas, several changes have been suggested.

The kits are made up of simple types of standard fishing gear which can be fished in the coastal areas and around the reefs from small motor or row boats and canoes. It is estimated the gear in each kit will catch around 2,000 to 6,000 pounds of fish per week, depending upon the amount of the different types of gear used at one time and, of course, on the presence and kinds of fish in the area.

In detail each kit contains the following:

Nets:

One complete haul seine. One complete gill net. One complete trammel net.

Lines:

Three complete sets of trawl lines. Twelve complete hand lines.

Traps:

One fish trap (collapsed). One cravfish trap (collapsed).

One craynsh trap (con

Accessories:

An assortment of hooks, lines, lures, lead-

ers, swivels, sinkers, snaps, rings, etc., for the construction of trolling gear and shark set lines. Six fish knives. Two gaff hooks. One dip net. Mending apparatus.

All of this equipment is packed compactly in plainly marked packages which, if necessary, can be shipped by airplane. The material in each kit as packed will weigh about 1,100 pounds, and will occupy about 100 cubic feet of space.

The most useful gear of the fishing kits as reported from operations in New Caledonia is that which is used for line fishing. The hard lines (trolling lines) have proved excellent. The beach seines have been little used as such in New Caledonia because of the omnipresent coral. These nets, however, were cut to half their depth and the halves fastened together to make nets twice the original length. These improvised nets, fitted with cork and lead lines, are used as blocking nets in which a section of coastal water is cut off and fish are trapped as the tide recedes. A blocking or barrage net might be added to the kit or replace the beach seine for use in areas where coral bottom prevails. The gill nets used in New Caledonia were destroyed by sharks and the trammel nets and traps were used only to a very limited extent.

On the basis of the above experience the proportion of hand lines to other types of gear should probably be increased. It is thought, however, that other types of gear, although little used in New Caledonia, should not be entirely eliminated. In the Japanese mandated islands nets and traps are in common use among the natives and there appears to be no reason why they cannot be used by occupation forces.

APPENDIX B-POISONOUS AND HARMFUL FISH OF THE SOUTHWEST PACIFIC

[This appendix is based upon Whitley, G. P., *Poisonous and Harmful Fishes*, Bulletin No. 159, Council for Scientific and Industrial Research, Commonwealth of Australia (Division of Fisheries Report No. 10), Melbourne, 1943.]

Although the information given in this appendix is based upon study of fish in Australia, New Guinea, and islands of the southwest Pacific, much of it is thought to be applicable to the Japanese mandated islands.

Most fish can be eaten without fear of ill effects, but there are a few poisonous kinds. Furthermore, some fish can inflict serious injury by means of stinging spines. Fish harmful (and sometimes fatal) to man fall into three main groups: (1) poisonous fish those poisonous as food; (2) venomous fish—those capable of stinging; and (3) aggressive predaceous fish—those which attack man. Each of these groups will be dealt with in turn.

POISONOUS FISH

There are two main causes of fish poisoning: Bacterial poisoning and toxic poisoning. The first, caused by germs in the fish (not necessarily, but in many cases, due to putrefaction) may occur after eating any kind of fish. This type of poisoning depends upon whether one is unlucky enough to be stricken by the germs.

Toxic poisoning is easier to avoid as it is known that certain kinds of fish have caused, on numerous occasions, illness or death, and by abstaining from these fish, danger from toxic poisoning is reduced to a minimum. Toxic fish belong to the following groups:

- 1. Toadfish and their near relatives the porcupine fish, box fish and trigger fish.
- 2. The red bass group (snappers).
- 3. Sweetlips.
- 4. Hinds.
- 5. Goatfish.
- 6. Adult barracuda.

Toadfish and relatives.—The toadfish or toado is also known as the globefish, swellfish, and pufferfish because of its habit of self-inflation. It belongs to the family Tetraodontidae having many different species. Some species have prickly or spiny bodies; others have smooth skin. The colors are diverse, according to the species; toadfish may be almost any color, plain, spotted, striped, banded, or marbled. There have been many cases of poisoning through eating toadfish.

Porcupine fish (family Diodontidae) are very similar to toadfish, but have bodies beset with long spines. They are very poisonous as food. There are several different genera and species.

Several species of boxfish (family Ostraciontidae) have been listed as poisonous though it is difficult to imagine people eating them since both the head and body are encased in a bony "box" making whatever flesh there is inside hardly worth extraction.

Trigger fish or filefish (family Balistidae) are covered with rough scales, like the surface of a file. They are said to be poisonous as food and should be avoided.

Red bass group (snappers).—Several species of the genus Lutianus are suspected of being poisonous, although generally they are esteemed as food. In the case of poisoning reported, no specimens appear to have been obtained for study so that their precise identification has not yet been settled.

Sweetlips.—These fish (Lethrinum and Lethrinella) are ordinarily good to eat, but a few cases of poisoning have been reported. These may have resulted from bacterial infection, independent of the kind of fish.

Hinds (*Epinephelus* sp.).—These fish have been regarded by some authors as poisonous at times.

Goatfish (red mullet or surmullet).—Goatfish (family Mullidae) are edible, indeed delicious, but it has been found in some areas that eating the head is followed by delirium and mental paralysis. The head should not be eaten.

Barracuda.—Barracuda (Sphyraena sp.) of large size have a bad reputation in the West Indies as being poisonous, but no cases are reported from the Pacific.

VENOMOUS FISH

The main kinds of stinging fish likely to be encountered in the tropical Pacific are: Stingrays.

Catfish.

Stonefish (family Synancejidae).

- Waspfish, rock cod, butterfly cod (family Scorpaenidae).
- Miscellaneous—tangs or surgeon fish (*Teuthis* sp.), unicorn fish (*Naso* sp.), spinefeet (*Amphacanthus* sp.), frogfish or bastard stonefish (*Halophryne and Pseudobatrachus*).

all of these venomous fish are only dangerous because of their spines; they are all good to eat.

PREDACEOUS FISH

Of the fish or fish-like animals which attack man, sharks are the most dangerous. However, barracuda, reef eels, and gropers have been reported to be vicious in tropical waters.

TREATMENT OF POISONING AND WOUNDS

Treatment for bacterial poisoning.—"In the prevention of bacterial fish poisoning the greatest care must be taken in the avoidance of contamination of food, its storage, efficient cooking, and the avoidance of contact with flies, rats, mice, etc.

"The patient should be put to bed and given a liquid diet and brandy—two hourly. Milk is probably best avoided. Hot applications should be made to the abdomen—and morphia may be indicated. In early cases emetics or gastric lavage may be of value. The bowel should be washed out if there is much diarrhoea. If the loss of fluid by vomiting or diarrhoea is great, saline should be given intravenously. Bacteriological investigation of the stools should be carried out whenever possible."— (Dr. V. M. Coppleson.)

Treatment of wounds caused by venomous fishes.— "Immediately after wounding, the area should be covered with a clean handkerchief or dressing, and as soon as possible (if not large) it should be scrubbed thoroughly with soap and water, using a soft nailbrush. Scrubbing must be gentle and must not injure the tissues. Larger wounds (which are not common) should be gently washed in soap and water. Sulphanilamide powder, if available, should be put into the wound, which must be left open. If a barb or foreign body is left in the wound, gentle attempts should be made to remove it. If not, cleansing should be done all round the barb, and the patient brought to a medical officer as soon as possible. Treatment for shock should be carried out, the patient kept warm and given warm drinks. Where there is severe local pain in these injuries, local anaesthetic should be injected round the site."—(Dr. V. M. Coppleson.)

Treatment of wounds caused by predaceous fish.— "First, stop the bleeding, with towels or tourniquets (if a tourniquet is applied, it should be *immediately above the wound*); there is not a second to lose as haemorrhage is the chief cause of death. This should even be done during rescue, and there is an instance in which a man's life was undoubtedly saved by the presence of mind of his rescuer, who tied the surf line around the affected limb whilst being hauled ashore.

"A doctor should be summoned and a hospital advised so that a blood transfusion may be given. Treat the patient for shock, cut off costume and dry the patient's skin a small portion at a time. Wrap him in warm, dry blankets and apply hot-water bottles, carefully wrapped in a towel. When bleeding has been controlled, hot milk or coffee may be given.

"On arrival at hospital, morphia should be given and immediate treatment for shock instituted. All bleeding points should be tied off in the wound and the tourniquet released if possible. The wound should be filled with sulphanilamide powder and firmly bandaged, and splinted if necessary. Operation should be undertaken when shock permits, and the wound should be dealt with on the same principles as those of large war wounds."—(Dr. V. M. Coppleson.)

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