RECENT DEVELOPMENT IN FISHERIES FOR SKIPJACK TUNA, *KATSUWONUS PELAMIS*, IN THE CENTRAL AND WESTERN PACIFIC AND INDIAN OCEANS

By

Richard N. Uchida
Southwest Fisheries Center
National Marine Fisheries Service, NOAA
Honolulu, HI 96812

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CONTENTS

1. INTRODUCTION

At the world scientific meeting on the biology of tunas and related species held at La Jolla, California in July 1962, Chapman (1963) stated, "In the United States the market for canned tuna has a little more than doubled every ten years for the past fifty years and is still increasing at about the same rate." The world tuna production reached roughly 400,000 tons in 1950 and close to 800,000 tons by 1960. By 1970, Chapman estimated, the world tuna market would require about 1,500,000 tons of tuna. Chapman's estimate was remarkably close. In 1970, according to FAO statistics (FAO, 1972), the world's production of tuna and tunalike fishes reached 1,427,000 tons.

Roughly half of the 1970 production consisted of yellowfin tuna, Thunnus albacares, and skipjack tuna, Katsuwonus pelamis. But yellowfin tuna production appears to be stabilizing and a substantial increase in catches of this species seems unlikely. Intensive investigations by the Inter-American Tropical Tuna Commission (IATTC) have shown that the point of maximum sustainable production has been exceeded in the eastern Pacific fishery for yellowfin tuna. This led to regulation of the yellowfin tuna stocks in the eastern Pacific (Shimada and Schaefer, 1956). Kamimura (1966) has also shown that increases in effort for yellowfin tuna in the longline fishery beyond the 1962 level would not increase the catch.

Concerning skipjack tuna, the apparent abundance has not been affected despite the large catches (Broadhead and Barrett, 1964; Kawasaki, 1965; Rothschild and Uchida, 1968). In 1960-73, the eastern Pacific fishery produced catches that ranged between 31,933 and 122,381 metric tons (MT) and averaged 68,691 MT (Table 1). In the western Pacific, Japanese catches in the coastal and southern water fisheries have varied from 78,608 to 191,600 MT and averaged 140,810 MT. The frequently made observations that there are no observable effects of fishing on the established fisheries in Japan or the coasts of the Americas and that there is sizable potential skipjack tuna yield have induced the tuna-producing nations to turn to this species for increased production.

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Essentially, the major effort in the tremendous expansion of skipjack tuna fishing has come from Japan. Realizing that no large increase in yield can be expected from the large tunas, the Japanese Fisheries Agency announced a policy of skipjack tuna development on a large scale. In the opinion of some Japanese scientists, effort should not be expended to further develop the Japanese coastal skipjack tuna fishery or the present southern water fishery operating in the Bonin, Mariana, Caroline, and Marshall Islands (Kasahara, 1971; Kawasaki, 1972). The expansion, they feel, should concentrate on developing new fishing grounds in foreign waters. As early as 1967, the Japanese were actively pursuing the formation of cooperative surveys with foreign governments (Katsuo-Maguro/ Nenkan, 1973). For example, with the signing of the Japan-Australia Fishing Treaty in 1968, the Japanese began fishery surveys which eventually led to formation of joint ventures in Papua New Guinea.

This report reviews areas of the central and western Pacific and the Indian Ocean where fisheries for skipjack tuna have developed in recent years or where the potential for skipjack tuna fishery expansion or development lies. Geographically, the coverage is fairly extensive; the Japanese coastal and southern water fisheries and the eastern Pacific fishery within the scope of IATTC, both of which have been well documented in the literature, have been omitted. The major emphasis is on the Pacific Islands ranging across the tropical Pacific from Indonesia to the Marquesas Islands.

2. CENTRAL PACIFIC OCEAN

The present theory of stock separation and migration is that the skipjack tuna population in the Pacific is composed of a western Pacific stock that ranges from the Philippine Sea to Japan and from the Ryukyus south to New Guinea and into the Coral Sea, and a central Pacific stock that probably extends from the Carolines and the eastern portion of the Marianas to the Americas (Fujino, 1967, 1970, 1972).

For convenience, the Pacific Islands and nations dealt with in this review have been divided into two groups. Those lying between 130°W and 180° were classified under central Pacific; those from 180° west to the islands bordering the Indian Ocean were considered in the western Pacific. The groups in the central Pacific include the Hawaiian Islands, the island groups of French Polynesia, Samoa Islands, and Tonga Islands (Fig. 1).

Fig. 1

2.1 Hawaiian Islands

The fishery for skipjack tuna in the Hawaiian Islands has been adequately described in a number of publications (June, 1951; Yamashita, 1958; Uchida, 1966). Briefly, it is a pole-and-line fishery that began about 1900. The introduction of Japanese fishing sampans and gear brought about a rapid growth of the fishery, and by 1928 a little over 2,000 MT of skipjack tuna were being landed. Nowadays, the Hawaiian fleet, composed of 16 sampans of various sizes, lands about 5,000 MT of skipjack tuna annually (Table 1).

Of primary concern at the present time is the expansion and development of the fishery. Purse seining was tried in Hawaiian waters in the early 1950's (Murphy and Niska, 1953) and recently another attempt was made (Hawaii Fish and Game and Bumble Bee Seafoods, 1970), but these trials were only partially successful. Thus, pole-and-line fishing with live bait is still the preferred method in Hawaiian waters. At present the industry faces a twofold problem. First is the need to upgrade the entire fishing fleet; the second is the need to increase the supply of live bait.

The Hawaiian skipjack tuna fleet consisted of 28 full-time vessels during the 1950's. Between 1955 and 1971 the demand for tuna increased steadily, but even this failed to induce any investment in new fishing vessels and the fleet dwindled to 14 in 1971. The following year, however, reflecting changing economic conditions and favorable minimum prices, a 136-gross ton (GT) steel-hulled vessel with a cruising speed of 13.8 knots and a cruising range of 3,700 km joined the fleet (Uchida and Sumida, 1973).

A fluctuating supply of live bait continues to limit the expansion of the skipjack tuna fishery. In 1960-72, the fleet caught an average of 33,658 buckets of nehu, Stolephorus purpureus, a local anchovy that is the preferred bait of the Hawaiian fishermen (one bucket contains about 3.2 kg of nehu). Periodic shortages of bait reduce fishing time. Furthermore, an increase in demand for bait can be expected, because rising costs of new vessel construction and operations will undoubtedly force the owners to operate their vessels on a year-round basis.

In an attempt to alleviate the bait shortage, the Honolulu Laboratory of the National Marine Fisheries Service, Southwest Fisheries Center, has investigated a number of options. Among them have been the culture of baitfish and the transporting of live bait from areas of abundance to areas of scarcity. Experiments in transporting live anchovy, Engraulis mordax, from California to Hawaii are continuing at the present time.

2.2 French Polynesia

The island groups in French Polynesia include the Society, Tuamotu, Gambier, Rapa, Austral, and Marquesas Islands. Tahiti, in the Windward Islands of the Society group, is the only island in French Polynesia with a small commercial fishery for skipjack and yellowfin tunas. The fishery was described in detail by Van Campen (1953) and Van Pel and Devambez (1957).

Briefly, Tahitian fishermen use small, fast boats called "bonitier" (Brun and Klawe, 1968). These diesel-powered craft, measuring about 9 m in length, can accommodate three men. No refrigeration is used; therefore, each boat returns in the afternoon to unload its catch.

The fishermen locate schools of yellowfin and skipjack tunas by scouting for bird flocks. When a school is encountered, the boat is kept underway and moving with the school. The fishermen, using pole and line to which a pearl-shell lure is attached, slap and drag the lure on the surface of the water until the fish strikes. The hooked fish is flipped into the boat cockpit. In order to return the hook to the water as rapidly as possible, the fishermen shake the lure loose, disengaging the hooked fish while it is in the middle of its trajectory.

The growth of this fishery is reflected in the steady increase in the number of boats employed. Figure 2 shows that only 15 boats were fishing in 1954, but by 1967 there were 107 (Brun and Klawe, 1968). The fleet size has apparently stabilized; in 1972 there were 97 skipjack tuna fishing boats involved in pearl-shell lure fishing (Doumenge, 1973).

Doumenge (1973) reported that not all Tahitian "bonitier" go out to fish regularly. About half fish full time; others are idled periodically either for want of crew or for maintenance. Some boats operate only part time when the market is glutted and prices are low.

Figure 2 also shows that in 1954-67 the landings of tuna increased with the number of boats engaged in the fishery (Brun and Klawe, 1968). In this period, annual skipjack tuna landings fluctuated between 252 and 731 MT and averaged 379 MT. Annual landings of yellowfin tuna were smaller and varied from 41 to 126 MT, averaging 77 MT.

Tables 2, 3, 4

The skipjack and yellowfin tuna landings shown in Tables 2, 3, and 4 actually represent only about a third to a half of the true production of tuna from Tahiti. There are two important sources of error. First is that because the fish are gilled and gutted at sea, the landings at Papeete Municipal Market represent weights of eviscerated fish (Brun and Klawe, 1968). The other is that many fishermen dispose of their catches directly to local fish dealers or through roadside and door-to-door sales (Doumenge, 1973). The result is that only the surplus is sold through the Papeete Municipal Market. Thus the true production is considerably higher than the reported landings.

In 1972-73, to determine the feasibility of catching surface schools of skipjack and yellowfin tunas by pole and line and live bait in French Polynesian waters, the Fisheries Department of the Territory of French Polynesia arranged to have three bait boats carry out fishing trials (U.S. National Marine Fisheries Service [NMFS], 1972h; Doumenge, 1973). These trials, although involving mostly the Windward Islands, were also extended to the Leeward Islands and parts of the Tuamotu and Marquesas Islands.

bles 5, 6 The results of these trials are summarized in Tables 5 and 6. Initial catches of the fishing boat Moetu in the Windward Islands in February-June 1972 were not encouraging. Catch per trip averaged only 0.3 MT in 28 trips. In December 1972-February 1973, however, the Hawaiian pole-and-line boat, Anela, did very well. Despite difficulty in obtaining enough live bait to fish continuously (Captain George Higashide and crew, personal communication), Anela logged 19 trips and caught an average of 5.4 MT per trip. Redondo, the third boat engaged, fished on five trips in March-April 1973 and produced about 1 ton per trip.

In 20 trips to the Leeward Islands, Moetu caught an average of 0.6 MT per trip, which was considerably better than the catch rate in the Windward Islands during the same period (Doumenge, 1973). Anela, in six trips, confirmed the excellent prospects of the Leeward Islands fishing ground by producing an average of 3.0 MT per trip.

Fishing in the Tuamotu Islands proved disappointing (Table 5). Moetu produced less than 0.1 MT per trip, and Anela caught only 0.2 MT per trip. In the Marquesas Islands, however, six fishing trips by Anela yielded an excellent catch per trip of 4.7 MT.

These fishing trials gave ample indication of tuna, but not of a sustained abundance of baitfish. Anela found bait supplies limited and most of the bait used were juveniles of the scad mackerel, Trachurops sp. and jacks that were caught by night baiting. Many problems need to be solved before a commercial pole-and-line, live-bait fishery can be successfully established in French Polynesia.

2.3 Samoa Islands

Samoa Islands, divided into American Samoa, a U.S. territory administered by the U.S. Department of the Interior, and Western Samoa, an independent sovereign state, are situated between lat. 13° and 15°S and extend in an east-west direction from about long. 168° to 173°W (Tudor, 1968). American Samoa is comprised of all islands lying east of long. 171°W. Pago Pago on the island of Tutuila is the principal town. Western Samoa has two large main islands--Upolu and Savaii. The chief town and administrative center is Apia on Upolu. Pago Pago Harbor serves as a port of landing for foreign longline vessels, now mostly Chinese and Korean, which supply two American canneries with large, subsurface tunas (Van Campen, 1954; Otsu and Sumida, 1968; Uchida and Sumida, 1973).

In an effort to develop a viable pole-and-line skipjack tuna fishery in American Samoa, the Office of Marine Resources (OMR), Government of American Samoa, has launched an investigation to determine temporal and spatial distribution and abundance of skipjack tuna and baitfishes in Samoan waters (Swerdloff, 1974). In October 1971, OMR acquired a new 15.2-m live-bait vessel, the Alofaga. This survey vessel is equipped with four baitwells, fishing racks, ice holds, and has a range of 2,780 km at a cruising speed of 10 knots.

All bait surveys conducted in Samoan waters to date have revealed a scarcity of live bait (Hida, 1970; Uchida and Sumida, 1973; Swerdloff, 1974). According to Hida, baiting was best in Pago Pago Harbor. The results of day and night baiting in Pago Pago Harbor and in Apia Harbor, Western Samoa, are summarized in Table 7.

Table 7

To determine the seasonal fluctuations and relative abundance of baitfish in Samoan waters, OMR conducted not only visual surveys of all bays and estuaries but also sampled baitfish that collected around
ıble 8 a night light. The results are shown in Table 8. In all sampling conducted since August 1970, the annual catch per set has never exceeded 3.0 buckets. Whereas in August-December 1970 Stolephorus sp. predominated in the catch, there has been a steady deterioration of catches of this species in subsequent years.

The scarcity of bait severely handicapped the efforts of Anela to conduct pole-and-line fishing trials for skipjack tuna in Samoan waters in March-April 1972 (Uchida and Sumida, 1973). Anela was unable to locate, either day or night, any bait in sufficient amounts in all of the bays and harbors surveyed in both American and Western Samoa. Bait taken in Fiji by Anela was used to fish in Samoan waters.

The results obtained from the RV Charles H. Gilbert, Anela, and Alofaga survey cruises were ample evidence that skipjack tuna schools occur in Samoan waters in sufficient quantities to support a commercial fishery at least large enough to meet local demands. Waldron (1964) showed that sightings of bird flocks averaged 4.2 flocks per 10-hour period in December-February in 26 hours of scouting. Hida (1970) reported sighting 144 schools in 31 days of scouting and fishing or an
Table 9 average of 4.6 schools per day (Table 9). In March-April 1972, Anela sighted 25 schools in Samoan waters or an average of 6.2 schools per day (Uchida and Sumida, 1973). Sixteen were identified as skipjack tuna, 1 as kawakawa, Euthynnus affinis; the remainder was unidentified.

Concerning catches, Hida (1970) reported that Gilbert successfully fished 16 schools around American and Western Samoa and caught 1,075 skipjack tuna varying in size from 1.8 to 7.7 kg and 160 yellowfin tuna ranging between 1.1 and 27.2 kg. Twelve of the 144 schools sighted during the Gilbert cruise were estimated to be large, possibly over 45 MT (Table 10).

Table 10

In 4 days of scouting (3 days of actual fishing), Anela encountered 25 schools. Of these, 21 were pursued and chummed but only 8 were successfully fished. Total catch reached 2,407 skipjack tuna, weighing 12.1 MT, and 33 kawakawa. Catch per day averaged 4.0 MT. About half of the catch consisted of fish under 4.5 kg although the fish landed ranged from 2.3 to 11.6 kg. Hooking rate was calculated to be from 0.2 to 2.0 fish per hook-minute.

The results of the nearshore surveys conducted by OMR have shown that a skipjack tuna resource of considerable potential exists in Samoan waters (Swerdloff, 1974). School sightings compare favorably with those of the Hawaiian skipjack tuna fishery, and the fishing trials conducted by Anela showed that skipjack tuna are present in sufficient quantities to support a commercial fishery (Uchida and Sumida, 1973). Shoreside ship-servicing facilities already exist at Pago Pago Harbor. A vital prerequisite, however, is finding the best means of catching the tuna. Naturally occurring bait is scarce, but some baitfish such as the mollie, Poecilia maxicana, could probably be cultured in sufficiently large quantities to keep a small fleet of live-bait vessels operating full time (Rodman, 1974).

2.4 Tonga Islands

The Kingdom of Tonga, a constitutional monarchy, consists of three main groups of islands; in all, there are some 150 islands with a total land mass of 660 sq km (Wilkinson, 1973). The capital, Nukualofa, is on Tongatapu, which is the most densely populated id island. With the population growing at an annual rate of 4 percent, there is an urgent need in the kingdom to find sufficient animal protein food.

According to Wilkinson (1973), there have been several attempts in the past to develop the fisheries of Tonga, all with varying degrees of success. At present, there is a government-owned longliner fishing for subsurface tunas in Tongan waters. The 27-m vessel of Japanese origin has a refrigerated capacity of 45 MT. The vessel is manned by a Tongan master and crew, Tongan trainee-fishermen, and a Japanese master fisherman.

Essentially, Tonga's fisheries are underdeveloped. With the exception of the longline and spiny lobster fisheries, there is no organized local fishery for any marine resource in Tonga. The subsistence fishery of the Tongan is carried on in outrigger canoes, sailing skiffs, and outboard-powered dinghies.

Trolling for pelagic species is carried out by sailing vessels and good catches of skipjack tuna and kawakawa are possible seasonally. Wilkinson (1973) lists the development of a skipjack tuna fishery as one of the priorities of the government. He states "...possible development exists in exploiting the shoals of skipjack and kawakawa, which occur in seasonal abundance in close proximity to the many Tongan islands."

According to Otsu (trip report: Trip to Japan February 3-26, 1974), the Japan Marine Fishery Resource Research Center conducted bait surveys in Tongan waters in 1972-73. The results of the Tongan survey indicated that among the 200-300 islets scattered throughout the archipelago, the waters around the northernmost island seemed most promising as a bait site. Using beach seines, the survey vessel caught 20-30 buckets of baitfish per set, but mortalities were heavy. The Center concluded that there is very little likelihood of developing a pole-and-line fishery in Tonga.

3. WESTERN PACIFIC OCEAN

It is in the western Pacific Ocean that the most rapid development of skipjack tuna fisheries has taken place in recent years. The thriving skipjack tuna pole-and-line fisheries of Papua New Guinea, Palau Islands, and the Solomon Islands are typical examples. Other countries are only now beginning to look seriously at their skipjack tuna and bait resources as bases for immediate or future economic development, and are seeking financial aid from countries that have established themselves as leading fishing nations in the Pacific basin. It is also in the western Pacific that Japan has been most active in establishing joint skipjack tuna fishing ventures with developing countries. Figure 3 shows some of the island groups and nations that are discussed in this section.

Fig. 3

3.1 Papua New Guinea

New Guinea, the world's largest defined island, consists of three territories--the Trust Territory of New Guinea, Territory of Papua, and Territory of West Guinea or West Irian (Tudor, 1968).

The Trust Territory of New Guinea, made up of the northeastern part of the New Guinea mainland together with six large islands and their numerous small neighbors, is administered by Australia under a Trusteeship Agreement with the United Nations issued in 1946. The Territory of Papua, which consists of the southeast section of the New Guinea mainland and adjacent islands came under Australian control in 1905. Under the provision of the Papua and New Guinea Act in 1949, however, the Territory of Papua was amalgamated with the Trust Territory of New Guinea and together they were called the Territory of Papua and New Guinea.

In 1972, Pownall wrote "Exploitation of skipjack and yellowfin tuna in the Bismarck and Solomon Seas promises to develop into the Territory's most profitable fishery." The development of the Papua New Guinea fishery for skipjack tuna and the associated bait fishery has been documented by Kearney (1973). Briefly, the commercial fishery for skipjack tuna in Papua New Guinea was started in March 1970 by a joint Japanese-Australian enterprise based in the northeastern Bismarck Sea ([U.S.] Bureau of Commercial Fisheries, 1970; Kearney, 1973). In the first year of operation, three 39-ton vessels working out of Kavieng, New Ireland averaged less than the break-even catch of 5 MT per vessel

per day. But fishing conditions appeared to be good and all indications were that the catch could be increased. By 1971, three Japanese firms were conducting exploratory skipjack tuna fishing in Papua New Guinea. Details of the joint-venture operations may be found in Katsuo-Maguro Nenkan (1973).

Catches fell below expectation in late 1971 and into 1972. Among the problems that plagued this newly established fishery were fluctuations in the availability of skipjack and of baitfish. Based on results of the first year of operation, several recommendations evolved. Among them were to continue development of skipjack tuna fishing and baiting grounds and to establish a skipjack tuna canning plant providing employment to local residents (U.S. NMFS, 1971h).

In spite of the results obtained at the Kavieng operation other joint ventures were established. A second joint venture, established initially in Manus, later shifted to Madang (Katsuo-Maguro Nenkan, 1973). Another started in Rabaul at about the same time that the Manus operation began. By 1972, three Japanese-Australian joint-venture corporations were activity engaged in skipjack tuna fishing. They joined an American canning firm and a Papua New Guinea investment corporation to establish the Papua New Guinea Canning Company (PNGCC). A summary of these joint-
Table 11 venture operations is given in Table 11.

Catcher boats fishing in Papua New Guinea are either Japanese or Okinawan in origin and crewed by Okinawan fishermen (Kearney, 1973). Each operation involves one or more mother ships to receive the catches. Catcher boats vary in size; most are about 39 GT, but some are as large as 192 tons ([U.S.] BCF, 1970; U.S. NMFS, 1972m; Table 11).

According to Kearney (1973), all fishing operations in 1970-71 were confined within or on the boundaries of the Bismarck Sea. The 1970 catch was restricted entirely to the northeastern sector, but the expansion of the fishery in 1971 broadened the area of operation to include the eastern and southwestern Bismarck Sea. Catches from these
Table 12 areas are shown in Table 12. Of the three areas, the eastern sector was most productive. And catches were highest from areas within 37 km of the large land masses.

In 1970, with only one joint-venture company in operation, the catches of skipjack and other tunas, including yellowfin tuna, kawakawa Euthynnus affinis, and frigate mackerel, Auxis thazard, reached 2,430 MT (Kearney, 1973). Monthly landings for March-August and November-
Table 13 December 1970 are given in Table 13. With three Japanese firms operating in 1971, the catch increased sevenfold to 17,002 MT (Table 13), but decreased to 13,124 MT in 1972 (Kearney, 1974). The annual landings for 1973 have been estimated at about 28,000 MT.

The seasonal nature of the fishery can be seen in the monthly landings in 1971, with peak catches occurring in June-August and low
Fig. 4 catches in November-December (Table 13 and Fig. 4). The average catch per vessel per day, plotted in Figure 4, varied from a high of 6.5 MT in June to 2.3 MT in December.

According to Table 12, skipjack tuna caught in the southwestern Bismarck Sea were usually largest, with monthly averages ranging from 3.6 to 5.1 kg. The northeastern Bismarck Sea usually had the smallest

according to Kearney (1974), the results of baitfish research have indicated that the bait resource present in Papua New Guinea waters appears adequate for considerable expansion of the fishery. Likewise, the tuna resource in waters adjacent to Papua New Guinea is large. In 491 hours of aerial surveys, an estimated 37,469 MT of pelagic fish, not including bait, were observed (Kearney, 1974). The aerial survey not only revealed possible new fishing areas, but also good concentrations of species other than skipjack tuna in some areas.

3.2 Solomon Islands

The Solomon Islands, a British Protectorate administered by the Commonwealth Office, London, through a High Commissioner, consist of 10 large islands or clusters of islands (Tudor, 1968). They lie in a double chain from northwest to southeast and extend over 1,700 km of ocean.

The Solomons are destined for independence in 1975; hence, fishery development is being advocated to strengthen the economic base (Katsuo-Maguro Nenkan, 1973). The local government negotiated with Japanese interests to begin a fishing survey in waters around the Solomons as a preliminary step to the establishment of a joint-venture fishing operation.

In 1971, three tuna mother ships were dispatched to fishing bases established in Shortland Island, Gizo, and Tulagi (Katsuo-Maguro Nenkan,

fish; they ranged from an average of 3.2 to 3.9 kg. Fishes caught in the eastern Bismarck Sea were usually intermediate in size compared to fishes from the northeastern and southwestern sectors.

Bait is available in sufficient quantities to maintain a sizable tuna industry in Papua New Guinea (Kearney, 1973). Of 300 or more different species collected from bait stations, about 10 are considered suitable as live bait for skipjack and other tunas (Kearney, 1974). Bait surveys by Japanese research vessels also indicated the presence of a number of species that possess the potential of a good baitfish; these species belonged to the families Engraulidae, Clupeidae, Dussumieridae, and Atherinidae (Kikawa, 1971).

From the inception of the fishery in March 1970 until May 1971, bait was caught during daylight by the drive-in net (oikomi ami) (Kearney, 1974). This bait was predominantly Gymnocaesio gymnopterus, but also caught was Pterocaesio pisang (Kearney, Lewis, and Smith, 1972). Both G. gymnopterus and P. pisang are relatively abundant and tolerate handling without high mortalities.

From May 1971, baiting operations were conducted exclusively at night with bright, submerged lights and stick-held lift nets (bo-uke ami) (Kearney, 1973). Stolephorus devisi was the dominant species taken by this method. This species, although excellent for skipjack tuna fishing, is very delicate and difficult to transport.

The potential for future expansion of the Papua New Guinea skipjack tuna fishery appears to be excellent. The importance of baitfish in this pole-and-line fishery cannot be overemphasized. And

1973). The mother ship purchased skipjack tuna caught by 39- and 47-ton Okinawan catcher boats. From five boats in the initial phase of fishing in the fall of 1971, the fleet grew rapidly to a maximum of 15 boats in the spring of 1972 (U.S. NMFS, 1972j).

The early period of the fishery was not without problems. The boats experienced good fishing the first 6 months of operation, averaging 5 MT per vessel per day, but catches declined thereafter and bait was in short supply (Katsuo-Maguro/Nenkan, 1973). By mid-1972, the Japanese firm engaged in exploratory fishing reported that catches of their vessels were below expectation (U.S. NMFS, 1972j). The majority were landing between 50 and 60 MT per month, with high performers catching 70-80 MT and low-performing vessels only 20-30 MT per month. Catches continued low until the spring of 1973, improving gradually thereafter. By August each vessel was averaging 4-5 MT per day (U.S. NMFS, 1973h). Also, larger skipjack tuna moved into the fishery. Whereas 70 percent of the fish caught in July averaged 3.2 kg, most of those taken in August averaged 3.5-4.0 kg.

Despite unstable conditions, the Japanese decided to enter into a joint venture with the local government (U.S. NMFS, 1973b). The joint-venture plans, which became effective in the spring of 1973, called for employing 12 pole-and-line vessels and 1 refrigerated carrier operating out of Tulagi and New Georgia Islands during the first year. By mid-1973, a tuna cannery with a daily production capacity of 1,300 cases was completed on Tulagi (U.S. NMFS, 1973c, 1973i). Plans also

call for an increase in output to 2,000 cases a day within the next 4 years and a fleet size of 23 vessels in 5 years. Additionally, a 600-ton capacity cold storage was built on Tulagi and 300-ton capacity storages were planned for other places. The joint venture was organized so that the local government invested 25 percent and retained the right to increase its share later. Also, over a period of 10 years, the fishing company and vessels, now in Japanese control, will revert to local control.

In 1973, the Solomon-based fleet landed about 6,500 MT of skipjack tuna (U.S. NMFS, 1973k, 1974). The cannery at Tulagi has been processing the fish, packing about 200 cases per day. The outlook is optimistic. The cannery, employing native workers, may begin full-scale operation earlier than the original schedule of 1977-78. The projected catch for 1974 is 8,000 MT based on the catches of about eight vessels.

3.3 Indonesia

The independent Republic of Indonesia, known as the Dutch East Indies until after World War II, consists of two chains of islands located in and surrounded by the Pacific and Indian Oceans. The southwest chain is made up of Sumatra, Java, Lesser Sunda Islands, and the western half of Timor (Tudor, 1968). The northeast chain consists of part of Borneo, Celebes Archipelago, Molucca Archipelago, and Tanimbar Archipelago. The Republic of Indonesia also administers the province of West Irian, formerly the Dutch Territory of West New Guinea.

Because of favorable environmental conditions, Indonesia has considerable fisheries resources (Zachman, 1973). Some parts of Indonesian waters are, at present, only minimally exploited. Substantial harvests can be anticipated from these areas, particularly those offshore, where there is a high pelagic resource potential. Skipjack tuna, mackerel-like fishes, clupeids, round scads, and squids constitute part of the main pelagic resources. Subsurface tunas also occur in Indonesian waters. Zachman (1973) reported that, according to the Master Plan of Fisheries Development, the skipjack tuna community in Indonesian waters is an estimated 150,000 MT.

The first fishery resource survey in Indonesian waters was carried out under the sponsorship of the United Nations Development Programme (UNDP) in November 1969 (U.S. NMFS, 1971c). Funds for the survey, made available to Indonesia by the Government of Netherlands through the United Nations, were intended for agricultural and fishery development (Katuso-Maguro Nenkan, 1973). A base was established in Sorong, West Irian and Japanese fishing firms were contacted to determine their interest in carrying out the survey.

Two Japanese firms, one with a background in fishing and the other in trading, joined forces and were selected by UNDP to begin exploratory fishing (U.S. NMFS, 1971a). Table 14 shows that the fleet consisted of five 110-GT pole-and-line vessels, four 10-ton bait catcher vessels, and a 700-ton freezer mother ship (Katsuo-Maguro Nenkan, 1973. The results of the 18-month survey, which began in November 1969 and ended in March 1971, were not encouraging (U.S. NMFS, 1971a, 1971c). As a

Table 14

result, the Japanese firms entered into a second agreement to conduct exploratory skipjack tuna fishing in the Molucca Sea from a base in Ternate, Halmahera Island from April to September 1971 (Table 14). Catches averaged 3.5 MT per vessel per day (Katsuo-Maguro Nenkan, 1973). At the end of the survey, which revealed that catches of more than 3 MT per vessel per day were possible, a joint venture was established with 80 percent capitalization by the Japanese. Included in the provisions of the joint-venture agreement was the construction of a 500-ton capacity cold storage equipped with a 5-ton ice-making plant.

Other Japanese firms also showed strong interest in the skipjack resource in Indonesian waters (Table 14). Plans were laid to establish fishing bases in Butung Island in the Banda Sea (U.S. NMFS, 1971f), at Pandiang on Sumatra Island with fishing operations concentrated in the Sunda Strait (U.S. NMFS, 1971g), and at Kendari on Celebes Island (U.S. NMFS, 1972c). Exploratory fishing was also conducted along the west coast of Sumatra Island bordering the Indian Ocean and in the Makassar Strait and the Flores Sea. The results of these latter two surveys, however, were disappointing (Katsuo-Maguro Nenkan, 1973).

Information on the operational aspects of the Indonesian skipjack tuna fishery is sparse. In the vicinity of Sorong, West Irian, the anchovy is caught by stick-held lift nets (bo-uke ami) and used in live-bait fishing (Katsuo-Maguro Nenkan, 1973). The vessels usually operate within a radius of about 460 km of their home base. Data on monthly trends in catches of skipjack tuna and bait are not available at the present time.

3.4 Fiji Islands

The Fiji group comprises 320 islands of various sizes between latitude 15° and 22°S and longitude 177°W and 175°E (Tudor, 1968). Two of the largest islands are Vanua Levu and Viti Levu, on which Suva, the present capital is located. The former capital, Levuka, on the island of Ovalau, serves as a port for foreign longline fishing vessels unloading frozen tuna for transshipment to canneries in the United States and Japan (Uchida and Sumida, 1973).

In 1971, the Food and Agriculture Organization of the United Nations, in accordance with its program to determine the feasibility of fishery development among developing nations, scheduled a skipjack tuna resource survey in Fijian waters. This survey, known as the UNDP/FAO Local Tuna Project in Fiji, was conducted out of Suva, Viti Levu Island (U.S. NMFS, 1971b). A major Japanese fisheries firm was commissioned to undertake the survey and to provide technical training to the local fishermen. The project, originally scheduled to last 1 year, was extended and the tuna survey was not completed until July 1973 (U.S. NMFS, 1973ℓ),

In a paper submitted to the South Pacific Commission meeting on fisheries in Suva, Fiji in July 1973, it was reported that the vessel used by the project was of Japanese origin and typical of pole-and-line vessels operating in the western Pacific (Anonymous, 1973a). The 40-ton Shinpo Maru was powered by a 250-horsepower diesel engine and cruised at 8 knots. Its operating range was 3,200 km. Three baitwells

with natural circulation had a carrying capacity of about 85 buckets (bucket holds 1.82 kg of baitfish). Fishholds along both sides of the baitwells could hold 12 tons of iced fish. Crew consisted of four key personnel provided by the contractor--the vessel master, fishing master, chief engineer, and chummer--and 12 native Fijian trainees.

Bait and fishing operations have been described in detail by Anonymous (1973a) and Lee (1973). Briefly, three bait species were very abundant and constituted the major portion of the bait captured during the day with a beach seine. These were, in order of their predominance in the catch, sardine, Herklotsichthys punctatus, silverside, Pranesus pinguis, and anchovy, Thrissina baelama. Day bait was captured in shallow water along the beach with a Hawaiian-type beach seine measuring 73 m long and 4 m deep. The captured baitfish were then transferred to a bait receiver which was towed to the vessel for transfer to the baitwells. The sardine and silverside, making up 81 percent of the 1972 day bait catch, were hardy and withstood the transfer from seine to bait receiver to baitwell without significant mortalities. The anchovy was less vigorous; they scaled easily and mortalities were high. They constituted 19 percent of day bait catch.

At night, artificial light was used either above water or submerged to attract baitfish. When set above water a 1,000-watt lamp was used and usually a lift net was used to capture the bait congregated under the light. When a submerged light was used, lamp size was 500, 1,000, or 1,500 watts. For this method of night baiting, a stick-held blanket net was used exclusively.

Night bait captured in appreciable quantities included the small round herring, Spratelloides delicatulus; sardine, Sardinella sirm; silverside, Allanetta ovalaua; and small anchovy, Stolephorus buccaneeri. Other species were taken in smaller quantitites. Hardiest among the bait captured at night were sardine, silverside, mackerel, Rastrelliger kanagurta; bigeyed scad, Selar crumenophthalmus; leatherskin, Chorinemus tol; Caranx sp.; sardine, H. punctatus; and silverside, P. pinguis.

Baitfish catch amounted to 2,500 buckets in 1972. With better knowledge of the local baiting sites and increased efficiency in capturing bait, the crew of the Shinpo Maru caught 4,000 buckets of bait in January-June 1973. Four baiting sites produced the bulk of the bait catch in 1972--Momi Bay off Viti Levu, Kia Island, Savu Savu Bay off Vanua Levu, and Ono Island. In 1973, Soso Bay off Kandavu Island produced nearly half and Ovalau Island about one-fourth of the bait catch.

On the exploratory cruise of Anela, NMFS observers on board noted that bait was plentiful at Kia Island (Uchida and Sumida, 1973). In two baiting operations, the crew of Anela spent 1.7 hours baiting and in three sets caught 269 buckets (3.2 kg of baitfish per bucket) of bait, averaging 158.2 buckets per hour and 89.7 buckets per set. About 75 percent of the bait was sardine, H. punctatus, and the remainder was silverside, P. pinguis.

School sightings were numerous in Fijian waters. Lee (1973) reported that on 29 exploratory fishing cruises made in 1972, 103 days were devoted to scouting and fishing for tuna schools. There were 653 sightings of fish schools, 38 percent of which were identified as

ible 15. skipjack tuna (Table 15). The average sighting per day was 6.3 schools. Anela also found numerous bird flocks during its short trial fishing period in Fiji, sighting an average of 5.1 schools per day (Uchida and Sumida, 1973). The bird flocks associated with the fish schools were large: 56 percent were composed of 101-500 birds with noddy terns predominating.

In 1972, Shinpo Maru caught 44.7 MT of fish of which about 81 percent, by weight, was skipjack tuna (Lee, 1973). The catch was up considerably in 1973--in 6 months from January through June, 96.2 MT of fish were landed. The catch made by Anela was also very impressive. In 2 days of intensive fishing, Anela landed 19.1 MT of skipjack tuna or an average of 9.6 MT per day.

Lee (1973) reported that the size of skipjack tuna taken in Fijian waters ranged from 0.4 to 9.9 kg, a large percentage weighing less than 5 kg. Anela encountered many schools of small fish in Fijian waters. The skipjack tuna landed ranged from 1.2 to 4.5 kg and averaged 2.9 kg (Uchida and Sumida, 1973).

The results of the UNDP/FAO Local Tuna Project and of the brief survey of Anela strongly indicate that skipjack tuna schools occur in Fijian waters in sufficient numbers to support a small commercial fishery. And the Fiji Islands, as a future fishery base for a commercial skipjack tuna fishing operation, has attracted the attention of tuna fishing and packing firms of other countries (U.S. NMFS, 1973ℓ). A Canadian-British firm has sent a team to Fiji to promote fishery development plans which

Reports indicate that a South Korean firm and a United States firm formed a joint skipjack tuna fishing venture in January 1972 (U.S. NMFS, 1971i). Construction of eight pole-and-line vessels in South Korea was scheduled, and plans called for operations in the equatorial Pacific off the Philippine and Marshall Islands. Also included was construction of a tuna-packing plant in Masan. To support this plan, the South Korean Government requested that the Distant-Water Fisheries Training Centre, financed by UNDP, train pole-and-line fishermen (U.S. NMFS, 1972ℓ). Training in pole-and-line fishing was also scheduled aboard South Korean research vessels (U.S. NMFS, 1972b).

To conduct skipjack tuna fishing surveys, South Korea's Government took delivery of two skipjack tuna survey vessels built in Japan (U.S. NMFS, 1972ℓ). The 200-GT vessels have 1,000-horsepower main engines and an overall length of 35.6 m. Shipboard installations include a brine-freezing system and a seawater circulating live-bait well.

In January 1973, it was also reported that a fishermen's cooperative, the Central Federation of Fisheries Cooperatives (CFFC), planned to purchase eight 400-GT skipjack tuna vessels with a U.S. $13.2 million loan from the Asian Development Bank (Anonymous, 1973c).

These vessels will become part of a fleet of 20 skipjack tuna vessels that South Korea hopes to acquire by 1976.

include the establishment of a fishing base at Lautoka. Also included are the employment of South Korean vessels for fishing and the construction of a cannery and cold storage. Other firms, including two U.S. tuna packers and several Japanese and South Korean firms, have also submitted fishing development plans.

3.5 Republic of Korea

One of the countries on the periphery of the western Pacific, the Republic of Korea has a long tradition as a fishing nation. Until recently, however, South Korean fisheries were usually confined to inland and near-coastal waters (Anonymous, 1973b). In the late 1950's and early 1960's, the government intensified its effort to modernize the marine industry and the greatest expansion was concentrated in the offshore and deep-sea fisheries. An example of South Korea's bid to get a larger share of the offshore marine resources can be seen in the South Pacific albacore fishery operating out of a base in American Samoa. Here, the fishery was conducted exclusively by Japanese vessels in the early years, but from about 1958 more and more vessels from the Republic of Korea and Republic of China have been involved (Otsu and Sumida, 1968).

With no appreciable increase in catches of subsurface tuna possible, the South Koreans in recent years have turned to the development of a skipjack tuna fishery. Skipjack tuna fishing is new to the South Koreans (Anonymous, 1973b). Therefore, the government has sought assistance from the UNDP/FAO.

The training of deck and engine room officers has also received wide attention (Anonymous, 1973b). Under a UNDP-assisted program, the FAO-administered Coastal Fishing Training Centre at Pusan has expanded its training program to include engineers, officers, fishermen, and deckhands needed by the skipjack tuna fleet. The Coastal Fishing Training Centre and the Deep Sea Fishing Training Centre, both originally established in Pusan under two separate UNDP/FAO projects, have been combined to form the Korean Fishing Training Centre, one of the largest and best equipped institutions of its kind in the world.

At least one Korean exploratory skipjack tuna fishing cruise has been completed. Fishing off the Bonin Islands, the South Korean fishermen gained confidence in their ability to fish with pole-and-line and live bait (U.S. NMFS, 1973g). Forty-five metric tons of skipjack tuna and albacore were landed.

3.6 Republic of China

The Republic of China or Taiwan is situated off the east coast of the mainland of Communist China. Like South Korea, it has made remarkable progress in developing its tuna longline fishery. But like many countries presently exploiting the large, subsurface tunas, this island nation is faced with the problem that the tuna resources in all oceans are being exploited to the limit of their availability and that continued fleet expansion will not bring about a corresponding increase in the catch (U.S. NMFS, 1973g).

Plans have been laid to enter the skipjack tuna fishery. According to a report, Taiwan is planning to build 50-GT skipjack tuna fishing vessels (U.S. NMFS, 1973g).

3.7 U.S. Trust Territory of the Pacific Islands

The U.S. Trust Territory of the Pacific Islands, also referred to as The U.S. Trust Territory of Micronesia, is comprised of the Caroline, Marshall, and Mariana Islands. A vast area of about 10.3 million sq km dotted with 2,100 islands (Rothschild, 1966), has been under the trusteeship of the U.S. since July 1948.

The skipjack tuna resources of the Trust Territory region have a long history of exploitation. The pre-World War II fishery has been described in several publications (Smith, 1947; Shapiro, 1948; Wilson, 1965; Uchida, 1970). Briefly, the Japanese fishery for skipjack tuna in Trust Territory waters began in the early 1920's. By the mid-1920's, information gathered by Japanese research vessels indicated that important potential for skipjack tuna fishing existed in the Trust Territory. The result was a rapid expansion of the fishery in the 1930's. A peak in production, which occurred in 1937, was attributed to the operation of an unusually large number of fishing vessels (Table 16).

Table 16.

The outbreak of World War II halted commercial production of skipjack tuna from the Trust Territory region. Although longline fishing for subsurface tunas was resumed soon after the war, pole-and-line fishing for skipjack tuna was not revived until 1964 (Wilson, 1963; Uchida, 1970).

In that year, a United States firm established a 1,500-ton capacity freezer-storage plant at Malakal Harbor in Palau and operated a fleet of Japanese and Okinawan skipjack tuna vessels.

There is very little information on the current availability and abundance of baitfish in the Trust Territory region. Hida (1971) published the results of a research vessel survey of bait distribution and abundance in the Trust Territory. Sardines, Herklotsichthys sp. and possibly Sardinella sp., were found in large concentrations on Jaluit and Majuro atolls in the Marshalls. To the south and west of Truk, the islands surveyed showed no substantial amounts of bait except round herring, Spratelloides delicatulus. Hawaiian fishermen claim that round herring are weak bait and do not survive well in the baitwells. Other bait species found by Hida included goatfish, mostly Mulloidichthys samoensis, jack, Caranx spp.; cardinalfish, Apogonidae; bananafish, Caesionidae; silverside, Atherinidae; damselfish, Pomacentridae; and anchovy, Stolephorus indicus. Wilson (1971) surveyed Truk lagoon for bait and found that among those species that could be used for bait were snapper, Gymnocaesio argenteus; cardinalfish, Rhabdamia cypselurus; sardine, H. melaneura; round herring, S. delicatulus and S. gracilis, silversides, Allanetta ovalaua and Pranesus pinguis; and damselfish, Pomacentrus pavo. Also, in Majuro and Jaluit in the Marshalls, Anela found good concentrations of both silverside, P. pinguis and sardine, H. punctatus (Uchida and Sumida, 1973). At Majuro, Anela caught 205 buckets in five sets or 41 buckets per set. Baiting at Jaluit produced 189 buckets in two sets or 94.5 buckets per set.

Data supplied by the Office of the Legislative Counsel, Congress of Micronesia (1972), show that the annual catches from the Palau skipjack tuna fishery varied between 2,942 and 8,441 MT in 1966-70 (data for 1971 incomplete) and averaged 5,237 MT (Table 17). The average monthly catches in 1966-71, shown in Figure 5, ranged from 184 MT in March to 821 MT in July. In 1966-71, the number of vessels employed in the fishery never exceeded 12. Skipjack tuna sampled at Malakal Harbor by NMFS observers in 1965-67 ranged between 48 and 62 cm (Uchida, 1970). Usually, the average size tended to increase in October-January.

Fig. 5

Recent data on fishing in the Marshalls are sparse. In February and again in April-May 1972, Anela conducted fishing trials around Majuro, Arno, and Jaluit atolls (Uchida and Sumida, 1973). In February, there were several days of good fishing and Anela landed 20.0 MT of skipjack tuna and 1.2 MT of yellowfin tuna. Catch per day reached 3.5 MT of tuna. In April, however, Anela found that fishing conditions had deteriorated considerably. Bird flocks were usually smaller and only 3 of the 10 schools pursued and chummed were successfully fished. Anela caught 2.0 MT of skipjack tuna and 0.6 MT of yellowfin tuna. Catch per day, which reached 0.6 MT, was only one-sixth of the average catch per day in February.

In April 1969, a Micronesian Agreement was concluded between Japan and the United States (U.S. NMFS, 1971d, 1972k). The agreement provided for each of the two nations to extend U.S. $5 million to The U.S. Trust Territory of Micronesia over a 3-year period for promotion

of industrial development and improvement of facilities. Detailed arrangements for implementing the agreement were worked out between the Japanese Government and the U.S. High Commissioner of the Trust Territory.

Under the provisions of the agreement, Japanese fishing vessels were allowed to call at Truk and Ponape to purchase supplies and for rest and recreation (U.S. NMFS, 1972k). The Japanese fishing industry hoped to have its government's survey mission study port facilities as well as the feasibility of obtaining live bait for pole-and-line fishing in that region.

By 1971, Japanese firms were actively pursuing the establishment of joint skipjack tuna fishing ventures in Micronesia. Two Japanese firms, negotiating an agreement with a Trukese businessman, began fishing out of Truk Island with two pole-and-line vessels in the 20- to 25-GT class accompanied by one mother ship (U.S. NMFS, 1971e). Two other firms jointly negotiated an agreement with the local government in Ponape and began operations with one mother ship and three 30-ton skipjack tuna fishing vessels. Fishing reportedly began in late July 1971. Soon afterwards, a third Japanese firm, which was already operating eight vessels from a base in Rabaul, New Britain in New Guinea, proposed another joint venture in Ponape (U.S. NMFS, 1971f). In early 1972, the Ponape District Fishery Corporation agreed to form a partnership with still another Japanese firm. A five-man Japanese team, dispatched to survey Ponape's baitfish resources, found the

outlook for skipjack tuna fishery development very favorable (U.S. NMFS, 1972d). Under the joint-venture agreement, four 39-GT skipjack tuna vessels and one 1,000-ton refrigerated mother ship were to begin fishing operations in June 1972. The catch, according to the report, was to be shipped to Japan. Future plans include the construction of a cold storage and processing plant at Ponape.

By mid-1973, restrictions regarding the entry of foreign vessels into Micronesian ports were eased. The Congress of Micronesia passed legislation that opened seven Micronesian ports to foreign fishing vessels for the purpose of supplying fuel, water, and food as well as providing rest and recreation to crewmembers (U.S. NMFS, 1973f). The seven ports are Tanapag, Saipan; Tomil, Yap; Malakal, Palau; Moen, Truk; Ponape, Ponape; Jabor, Jaluit; and Darrit, Majuro.

Foreign vessels fishing in and around Micronesia include those from Japan, South Korea, and Taiwan. It is estimated that about 1,000 Japanese longline and pole-and-line vessels are likely to utilize Micronesian ports for their fishing operations.

3.8 Australia

Exploratory fishing trials for southern bluefin tuna, Thunnus maccoyii, and skipjack tuna with pole-and-line and live bait in Australian waters have been described in Blackburn and Rayner (1951). In 1940, pilchards, Sardinops neopilchardus, and anchovy, Engraulis australis, were carried in a bait tank and used successfully to catch bluefin and skipjack tunas. These early results carried no great significance at that time, because bait could not be obtained regularly in large enough quantities.

In 1950-51, a 19-m American-Fijian tuna clipper, Senibua, fished experimentally for 4 months in southern New South Wales waters to assess the value of pole-and-line fishing (Anonymous, 1965). Results were encouraging and the fishing industry took immediate steps to establish a pole-and-line fishery in Australia.

But the mainstay of the Australian pole-and-line fishery that developed was the southern bluefin. In March 1963, to exploit the skipjack tuna that appeared on a definite seasonal pattern between Coff's Harbour (N.S.W.), and St. Helen's (Tas.), experiments with monofilament gill nets were begun, and the results indicated that skipjack tuna could be taken in sufficient quantities with this gear (Temple, 1963; Anonymous, 1965). The early gill net fishery for skipjack tuna was started off Lakes Entrance, Victoria and the vessels operated off the eastern coastal waters of this state. Skipjack tuna in this area were found closely associated with a warm current near the coast. The average weight taken was about 3.2 kg.

The skipjack tuna gill net vessels varied in size from 9 to 18 m. Although a Puretic power block was used in the early stages of the fishery, the fishermen later favored the powered hauling drum and sheaves. The monofilament gill net originally measured 604 m long and 20 m or 200 meshes deep. Mesh size was 14 cm. Later trials indicated that a net depth of 150 meshes was satisfactory for taking skipjack tuna. Usually, the crew consisted of up to three fishermen.

Heaviest catches of skipjack tuna occurred off Victoria in January and February. Interest in this fishery declined in 1964 when the monofilament gill nets, modified to fish on the bottom, were found to be effective in taking edible sharks, which were much higher priced than skipjack tuna.

Thus, marketing difficulties inhibited the further development of the monofilament gill net skipjack tuna fishery (Anonymous, 1965). In 1966, a 450-ton former U.S. purse seiner, Espíritu Santo, was purchased by a South Australian firm. A U.S. crew spent a short time instructing Australian fishermen on purse seining techniques (Anonymous, 1966). Fishing off Eden in mid-December 1966, Espíritu Santo shot the net twice and netted 29 MT of bluefin tuna and a little over 7 MT of skipjack tuna. At the 1967 Fisheries Development Conference in Canberra, it was decided that special attention should be focused immediately on the use of purse seines for capturing skipjack tuna (Anonymous, 1967). The CSIRO Division of Fisheries and Oceanography estimated that prospective catches of skipjack tuna by purse seining could reach 36,300 MT (Lorimer, 1970).

Catches of skipjack tuna and other tunas recorded for Australian
able 18 waters for 1960-61 to 1971-72 are given in Table 18.

3.9 New Zealand

Of the nine species of tuna and tunalike fishes found in New Zealand waters, four are readily available to the local vessels (Roberts, Baker, and Slack, 1972). Only two species--albacore and skipjack tuna--

however, constitute the bulk of the catch. The other two--southern bluefin tuna and yellowfin tuna--appear occasionally in large numbers, but make up only a small percentage of the annual landings.

Off New Zealand's coast, skipjack tuna usually appear in summer and autumn. They are usually caught by gill netting, trolling, and pole-and-line fishing. The average size varies from 3.6 to 4.5 kg although pole-and-line fishing has produced fish that weighed from 6.3 to 8.2 kg.

Roberts et al. (1972) reported that experienced fishermen from both Japan and the United States, working in New Zealand, have demonstrated that pole-and-line fishing is at least partially successful for taking several species of tuna. In the Bay of Plenty, small vessels have successfully fished with pole and line and live bait, which was carried to sea in modified 166-liter drums.

In February-March 1972, a pole-and-line tuna fishing survey was conducted in New Zealand waters (Webb, 1972a). Among the goals of the survey were assessment of the potential of Tasman Bay pilchards and anchovies as baitfish and investigation of tuna potential offshore using longline, pole and line, and troll gear.

The results of the survey suggested that pole-and-line fishing would be more practical in warmer waters to the north of the Bay of Plenty rather than in the cooler southern waters (Webb, 1973). Fish in southern New Zealand waters were more agile and less inclined to school. Furthermore, weather conditions were unstable and unpredictable, thereby interfering with pole-and-line fishing operations.

The survey also revealed that baitfish were found in sufficient quantities for a limited, but profitable, bait venture (Webb, 1972b). They were distributed throughout Marlborough Sounds (down to the lower reaches) and Tasman Bay. It was estimated that the potential catch could reach 1,000 MT. Baiting was possible in all untouched areas. With five baiting methods available--purse seine, lampara, bo-uke net, beach seine, and trap nets--weather was not a serious limiting factor in Marlborough Sounds, but it hindered baiting activity in Tasman Bay.

The New Zealand Marine Department has continued to research new techniques for catching tuna in order to promote a tuna export trade. Avery (1970a, 1970b) described an unusual series of experiments where monofilament gill nets were used in conjunction with sonic and other lures to capture skipjack tuna. Briefly, signals associated with the presence of tuna, such as the transmission of various dolphin signals and thrashing and fear noises of baitfish under attack were recorded. A broad sea front of about 37 km was covered with sono buoys to detect the presence of schooling tuna. The recordings of the signals were then transmitted in areas where tuna were scattered in order to attract them to the point of signal, which in fishing strategy would be to the nets or longlines.

In December 1969-May 1970, the New Zealand Marine Department supplied the Whakatana commercial fishing fleet with gill nets and other equipment. Fishing with gill nets and sonic lures produced a catch of 64 MT. The efforts of this fleet established the prospect of future gill netting for skipjack tuna, possibly in other areas. The 1970-71 program of the Marine Department emphasized further experiments in tracking and attracting tuna with sonar equipment.

3.10 Philippine Islands

The Republic of the Philippines, comprising a vast cluster of more than 7,000 islands, extends from north to south about 1,600 km. and from east to west about 1,000 km (Tudor, 1968).

The early history of the pole-and-line fishery established for skipjack and yellowfin tunas in the Philippines has been adequately described by Domantay (1940a, 1940b). Briefly, four vessels ranging from 24 to 40 GT were employed to fish primarily for skipjack tuna, most abundant of the tunas found in southern Mindanao, and yellowfin tuna. The area of operation included the Sulu Sea, Celebes Sea, and off Zamboanga.

Several species of Sardinella found along Zamboanga and Davao provinces were used as live bait. S. leiogaster and Scutengraulis mystax were usually preferred over other species because of their hardiness. Bait was caught in a net, locally called "sangab," which is set against the current. Several dugouts with lights attracted the bait.

Fishing at sea was the same as in many other places with sea birds guiding the fishermen to surface tuna schools. Actual fishing time on one school usually lasted 10 minutes, although it varied widely. Ice was used to preserve the catch. The skipjack tuna caught in Philippine waters never exceeded 5 kg; those caught between October and April were usually larger, weighing not less than 3 kg. Yellowfin tuna, on the other hand, were as large as 30 kg.

It does not appear that the pole-and-line fishery as described by Domantay (1940a, 1940b) has changed significantly over the years. There has been, however, a recent resurgence of interest in expanding the pole-and-line fishery by securing venture capital from foreign sources. A fishery firm at Jolo, Sulu Island reportedly was seeking Japanese firms for a joint skipjack tuna fishing venture (U.S. NMFS, 1972i). Upon approval by the Japanese Government for a Japanese company to participate in this venture, it was expected that four 10- to 15-ton purse seiners would start skipjack tuna baitfish surveys in the Sulu Sea. If the baitfish resource proved adequate, pole-and-line vessels were to be chartered from Japan.

In 1973, two more Japanese firms and a Philippine corporation agreed to form a joint fishing venture based at Zamboanga, Mindanao Island (U.S. NMFS, 1973j). According to the agreement, the Japanese will provide two 39-ton catchers and a 200- to 300-ton carrier. Fishing will be concentrated in the Sulu Sea, with a first-year goal of 1,800 to 2,300 MT of skipjack tuna. The catch will be processed locally and exported to Japan.

Under a UNDP-SF Deepsea Fishing Development Project, a live bait master fisherman from France was appointed to train Filipino fishermen in pole-and-line fishing (Reyes, 1972). The project vessel, MV Hasa-Hasa, was to be used to train the crew in catching and keeping bait and in chumming and working skipjack and yellowfin tuna schools. The project was expected to demonstrate to the Philippine fishing industry that pole-and-line fishing could be refined and further developed into an efficient means of taking skipjack and other tunas.

Table 1 shows the catches of skipjack tuna from Philippine waters in 1967-72. They varied widely from 200 MT in 1970 to 21,300 MT in 1972. Not all the skipjack tuna were taken by pole and line. In 1970, for example, the Philippine Fisheries Commission (1970) included in their statistics catches of skipjack tuna as follows: bag net - 79,440 kg, hook and line - 4,000 kg, purse seine - 18,000 kg, otter trawl - 13, 720 kg, and round haul seine - 7,200 kg.

3.11 New Hebrides and New Caledonia

New Hebrides, a condominium administered jointly by Great Britain and France, consists of an incomplete double chain of roughly 80 islands extending from northwest to southeast for 834 km (Tudor, 1968). The administrative center is at Vila on the island of Efate. New Caledonia, a territory of the French Republic, lies south of New Hebrides and about 1,300 km east of the Queensland coast of Australia.

A tuna fishing industry based at Palekula, which is southeast of Espíritu Santo, was established in 1957 (Tudor, 1968). The operating company, which has American, British, French, and Japanese capital, obtains tuna from the Japanese longline vessels based at Palekula. Here facilities also exist for slipping and repairing fishing vessels.

Water surrounding the New Hebrides and New Caledonia has been surveyed by Orsom III (Angot, 1959). The results indicated that trolling gear was the most suitable for taking skipjack and yellowfin tunas. Yellowfin tuna were usually taken just outside the reef, and skipjack tuna catches farther offshore. Angot stated that trolling catches of

the Orsom III were quite satisfactory. A commercial trolling fishery has been established in New Caledonia and the catch is sufficient to supply the demands of the Noumea market.

Angot (1959) concluded from the survey that waters surrounding New Caledonia were sufficiently productive to support a small-scale troll fishery, but not a pole-and-line fishery. Very few surface tuna schools were sighted during the survey period. Furthermore, small fish that could be used as live bait were not found in sufficient quantities to permit extensive pole-and-line fishing.

In 1973, it was reported that the 190-ton Japanese pole-and-line vessel, Akitsu Maru No. 20, was chartered by the semi-government Marine Fishery Resource Research Center of Japan to conduct surveys of baiting grounds in the South Pacific (U.S. NMFS, 1973m). In late November, Akitsu Maru caught 35 buckets of sardines and 0.9 MT of skipjack tuna east of New Caledonia. Thirty-six buckets of sardines were also taken in December near lat. 20°-22°S and long. 165°-167°E. Otsu (trip report: Trip to Japan, February 3-26, 1974) reported that lift nets used by the survey vessel produced catches of 50-100 buckets of bait per night. The baiting grounds were usually from 1 to 3 km offshore. Exploratory fishing resulted in poor catches, unlike catches reported from the previous year. The Center concluded that New Caledonia has definite possibilities for the development of a pole-and-line skipjack tuna fishery.

3.12 Ryukyu Islands

The historical development of the pole-and-line skipjack tuna fishery in the Ryukyu Islands has been discussed by Shapiro (1949) and Isa (1972).

Skipjack tuna is one of the most important species taken in the Ryukyu Islands. Isa (1972) estimated that annually, catches of skipjack tuna accounted for as little as 14 percent and as much as 69 percent of the total fish landings in the Ryukyu Islands.

Briefly, the Ryukyuan skipjack tuna fishery employs small vessels of wooden construction that vary from 10 to 53 GT (Isa, 1972). The vessels either buy live bait from independent bait fishermen or spend a day at the baiting grounds catching enough bait for a day's fishing. The common bait species used throughout the Ryukyu Islands
Table 19 are given in Table 19. The amount of bait used for 1966-67 is shown
Table 20 in Table 20. Ryukyuan fishermen generally use the "drive-in" method to catch bait, but night lighting for bait is also employed to some extent.

Skipjack tuna fishing is highly seasonal. Usually the largest
Table 21 catches occur in July (Table 21) and the smallest catches in March (Isa, 1972).

The Ryukyuan fishery for skipjack tuna has been beset with problems of declining effort and wide fluctuations in catches. The vessels have experienced difficulty in obtaining sufficient quantities of bait and in keeping bait alive for extended periods. Furthermore, the small Ryukyuan vessels are incapable of fishing along the Ryukyu

Islands chain as the Japanese vessels do. The result is that Ryukyuan vessels are unable to shift their operations with the movement of the fish on the fishing grounds. These are some of the reasons that there has been no significant growth of this fishery.

Isa (1972) pointed out that the Ryukyu's skipjack tuna fishery will not develop or expand under the present system of operation and management. There are, however, plans to obtain vessels in the 200-ton class and to operate them throughout the year in the northwestern Pacific. Bait could be obtained locally and from other sources. There are also plans to develop multi-purpose vessels capable of operating not only in the skipjack tuna pole-and-line fishery in the summer, but also in the tuna longline fishery in the winter.

Skipjack tuna landings in the Ryukyu Islands in 1921-70 are given in Table 1.

4. INDIAN OCEAN

Accurate data on the production of skipjack tuna from the Indian Ocean are lacking. According to Shomura et al. (1967), there is every indication that the skipjack tuna resource is underutilized. Sivasubramaniam (1972) estimated that 41,000 to 45,000 MT of skipjack tuna are taken anually from the Indian Ocean, but Kikawa et al. (1969) estimated that this ocean may be capable of yielding about 360,000 MT of skipjack tuna per annum. Thus, it is highly conceivable that there is a large resource of skipjack tuna still to be harvested in the Indian Ocean.

According to Jones and Silas (1963), pole-and-line fishing is the most effective method for catching skipjack tuna in the Indian Ocean and is practiced around Minicoy Island in the Laccadive Islands, around several islands in the Maldives, and in Ceylon (Sri Lanka). Because of similarities in the method of fishing for skipjack tuna among the fishermen in the Laccadives, Maldives, and Ceylon (Sri Lanka), the fisheries in these areas will be discussed together (Fig. 6).

Fig. 6

4.1 Laccadive and Maldive Islands and Ceylon (Sri Lanka)

Minicoy Island in the Indian Ocean, which lies between the Laccadive and Maldive Islands, is the most important skipjack tuna fishing center in the Indian Ocean (Jones and Kumaran, 1959). A review of the fishery is from Jones and Kumaran (1959). There is scarcely any difference between the Minicoy fishery and that operating in the Maldives (Jonklaas, 1967), and therefore, the following description applies to the fisheries operating in both areas.

The skipjack tuna pole-and-line fishery of Minicoy, on which the economy of the island depends, is seasonal and extends from September to April with the bulk of the catch occurring in December-March. At the start of the skipjack tuna fishing season, the large fishing boats, which are kept covered onshore in the off-season, are launched. Constructed usually of coconut planks fastened by copper nails, they are about 12.5 m long and 3 m wide. There are 3-4 baitwells with 2-3 holes on the bottom of each to permit a free flow of water from below. Usually, sails and oars are used to propel the craft.

The baitfishes used in fishing consist of a variety of small fishes found in the lagoon (Jones, 1958). The most common ones are pomacentrids, Daya jerdoni, Chromis caeruleus, and Pomacentrus spp. Other important baitfishes are the caesiodids, labrids, atherinids, and apogonids.

They are caught with a lift net. To attract them over the submerged net, crushed crabs and tuna entrails and flesh are scattered in the water. Attracted by the presence of food, the baitfishes gather and feed over the net, which is then quickly raised.

Usually 20-30 people constitute the crew. Fishing grounds are seldom more than 16 km from the island. The captain is the bait chummer. During fishing, four-five fishermen line up on each side of the vessel and flip the skipjack tuna on board. Fishing usually lasts 10-30 minutes and a fishing trip only 1 day. After the day's catch is unloaded, the skipjack tuna is processed by the womenfolk into smoked and cured fish sticks, locally called mas min, and exported.

Hiebert and Alverson (1971) recognized several factors that limit extensive development of the Maldivian fisheries. Of primary importance is the availability of live bait (on some islands where it is unobtainable, pole and line are used with a plant lure). Also, because of difficulty in navigating from very deep to shallow water, the fishing vessels have only limited access to distant-water fishing grounds.

A small amount of skipjack tuna are also taken by trolling in the Indian Ocean. According to Jonklaas (1967), some skipjack tuna are taken by trolling gear in the Maldives. Sivasubramaniam (1965) reported that in Ceylon (Sri Lanka), in addition to pole and line, skipjack tuna are caught by troll gear and gill net (Fig. 7). A troll fishery for tuna also exists off the Tinnevelly coast in the Gulf of Mannar (Silas, 1967). However, in this troll fishery, the bulk of the catch consists of kawakawa; northern bluefin, Thunnus tonggol; yellowfin tuna; sailfish, Istiophorus gladius; and seerfish, Scomberomorus commersoni. Skipjack tuna appeared only rarely in the catch.

Fig. 7

In Ceylon (Sri Lanka), pole-and-line fishing has been practiced since 1919 (Sivasubramaniam, 1965). Equipment and methods of operation are similar to those of fishermen in Minicoy and the Maldives, where this method has been in operation since 1909.

The live bait used in Ceylon (Sri Lanka) is "red bait," Dipterygonotus leucogrammicus, which congregates over large rocks at depths of 9-18 m. A special dip net is used to catch the bait. An average day's catch of skipjack tuna and other tunas by a mechanized pole-and-line boat is usually about 0.2 MT. Fishing is best off the southwest coast of Ceylon (Sri Lanka) in November-March and off the east coast in July-September. Sivasubramaniam (1965) attributed large variations in annual landings of skipjack tuna in Ceylon (Sri Lanka) to the annual variation in the spawning stock and availability of live bait.

Table 22 gives the production of skipjack tuna from the Indian Ocean for 1965-72 (FAO, 1973). It is obvious that skipjack tuna from the Maldive Islands predominated, but it should be pointed out that production figures from the Maldives were estimated. Jonklaas (1967) stated that it was impossible to obtain any statistical data in such a vast and relatively undeveloped archipelago. Not even reasonably accurate statistics of annual catches could be obtained, primarily because of the lack of communication and systematic recording of catch data by trained observers. But as a rule, Jonklaas estimated, scombroid fishes, primarily skipjack tuna constituted 90 percent of the fishes caught in the Maldives. Sivasubramaniam (1972) estimated that the Maldivian skipjack tuna fishery produced the largest percentage of the catch followed by the fishery based in Ceylon (Sri Lanka). The Minicoy fishery probably contributed about 1,000 MT. Monthly data on fishing effort (days fished) and catches of skipjack tuna, yellowfin tuna,

able 23 kawakawa, and frigate mackerel are given in Table 23 for 1965 for the fishery operating in the Maldive Islands.

Concerning fishery development in the Indian Ocean, the Japanese, as they have done in the southwestern Pacific, have taken the initiative in attempting to establish fishing bases. Cooperating with the Ceylonese Government program to develop its fisheries, a Japanese firm sent two 250-GT pole-and-line fishing vessels to conduct exploratory skipjack tuna fishing (U.S. NMFS, 1973a). The Japanese vessels started fishing in March 1973 in the Indian Ocean from a base at Galle in southwestern Ceylon (Sri Lanka) (U.S. NMFS, 1973d).

Exploratory fishing will be carried on for 1-1/2 years under a permit granted by the Ceylonese Government. Also, under the agreement, five or six Ceylonese natives and government officials are scheduled to board each of the two Japanese vessels for training. If fishing, baitfish purchases, and labor costs are favorable, the Japanese firm hopes to organize a joint skipjack tuna fishing venture with Ceylonese interests.

In the Maldives, two Japanese firms have begun purchasing skipjack tuna (U.S. NMFS, 1972n). It was originally intended that purchases would be about 635 MT per month, but poor catches have reduced purchases to about 90 MT per month. The Japanese firms negotiated a contract with the Maldivian Government to purchase skipjack tuna over the next 6 years.

4.2 Madagascar

Gross (1967) stated that schools of skipjack and yellowfin tunas were frequently reported off the west and northwest coasts of Madagascar, particularly in April-June These schools were reportedly very large even at other times of the year. The Organization de Recherche Scientifique d'Outre Mer (ORSTOM), which maintains a marine laboratory at Nosy Bé, planned to try purse seining these tuna schools provided funds were available.

The Japanese started experimental skipjack tuna fishing off Madagascar in February 1972. A Japanese firm, after conducting a feasibility study at Seychelles Island, has three 190-ton vessels

working that area (U.S. NMFS, 1972a, 1972f). Live bait for the operation was caught within the 22-km territorial sea limit of Madagascar and according to the report, this availability of bait has attracted the attention of other Japanese fishing firms seeking joint ventures. Two were scheduled to form a joint skipjack tuna fishing venture with local interests in November 1974 (U.S. NMFS, 1973e). Three pole-and-line fishing vessels are scheduled to fish off Madagascar and the anticipated catch has been set at about 9,000 MT of skipjack tuna in the first year.

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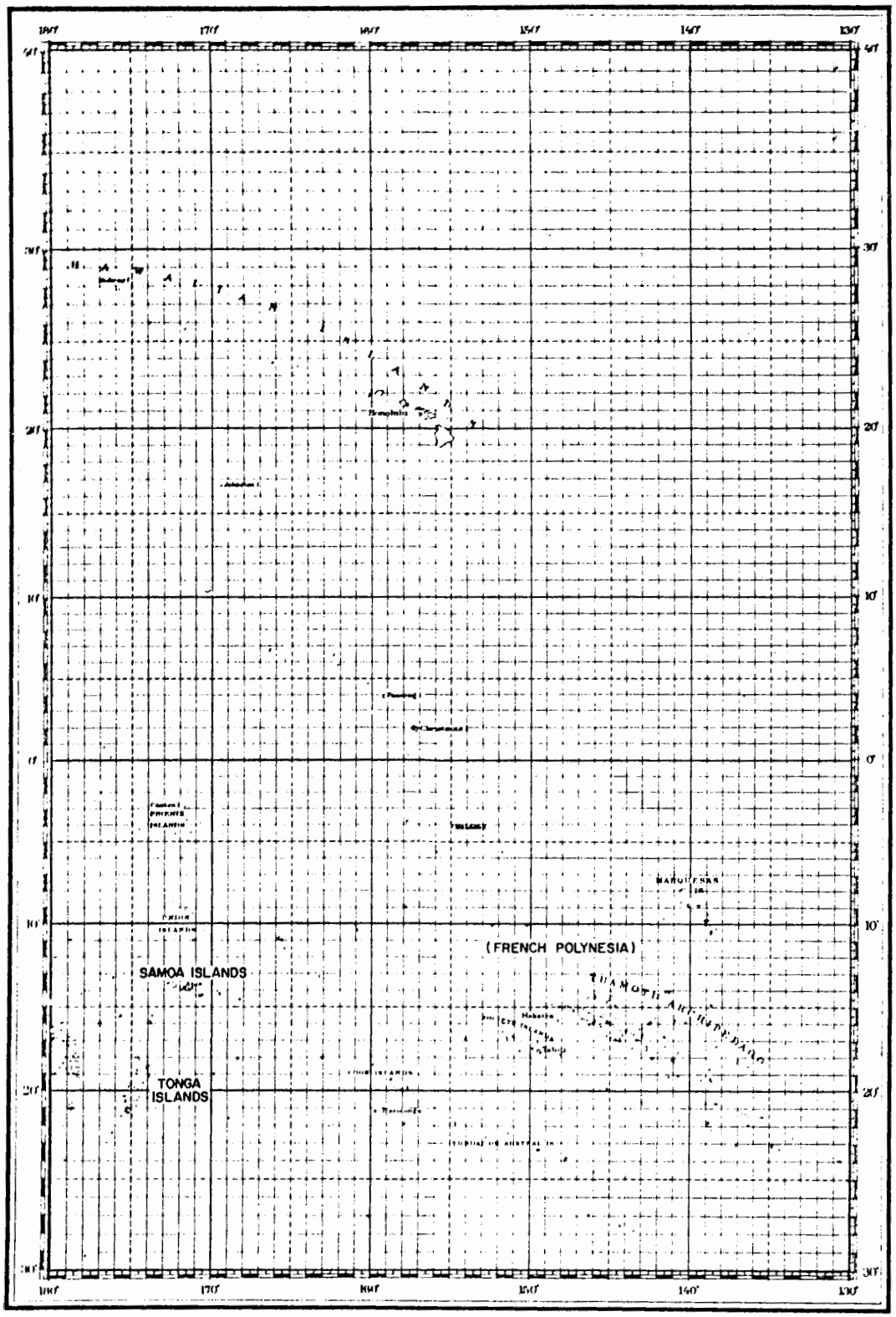


Figure 1. Island groups in the central Pacific Ocean.

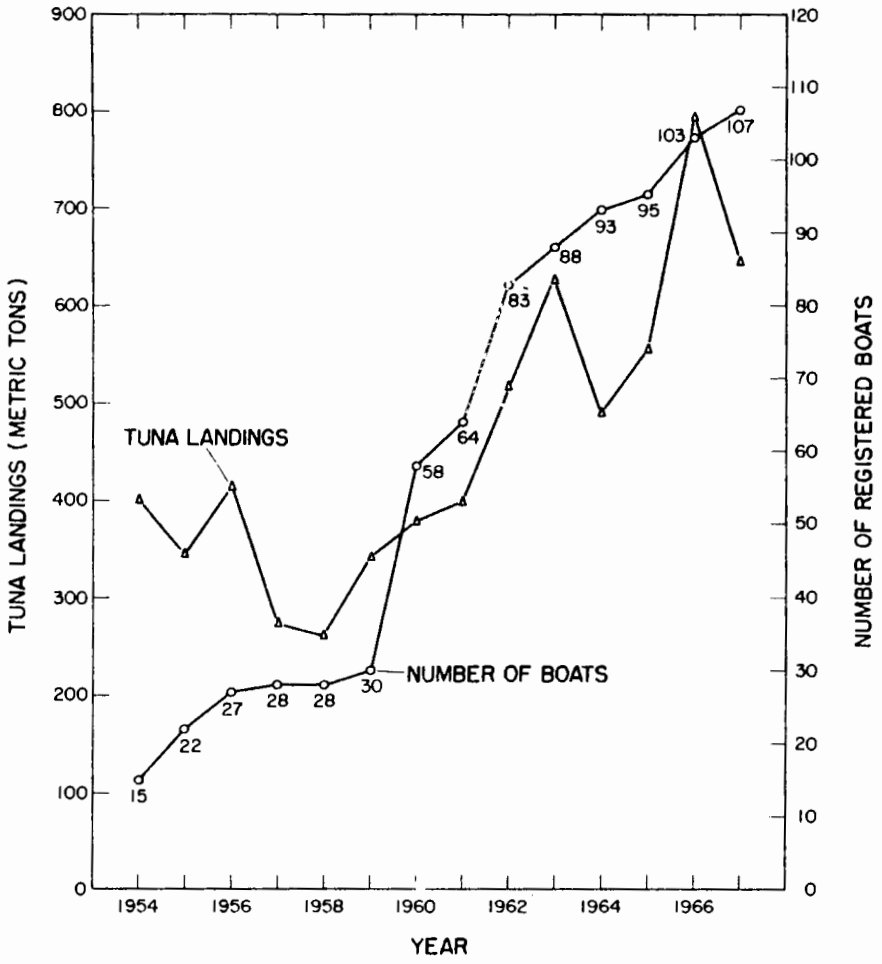


Figure 2. Combined landings of skipjack and yellowfin tunas, and numbers of boats engaged in the tuna fishery (from Brun and Klawe, 1968).

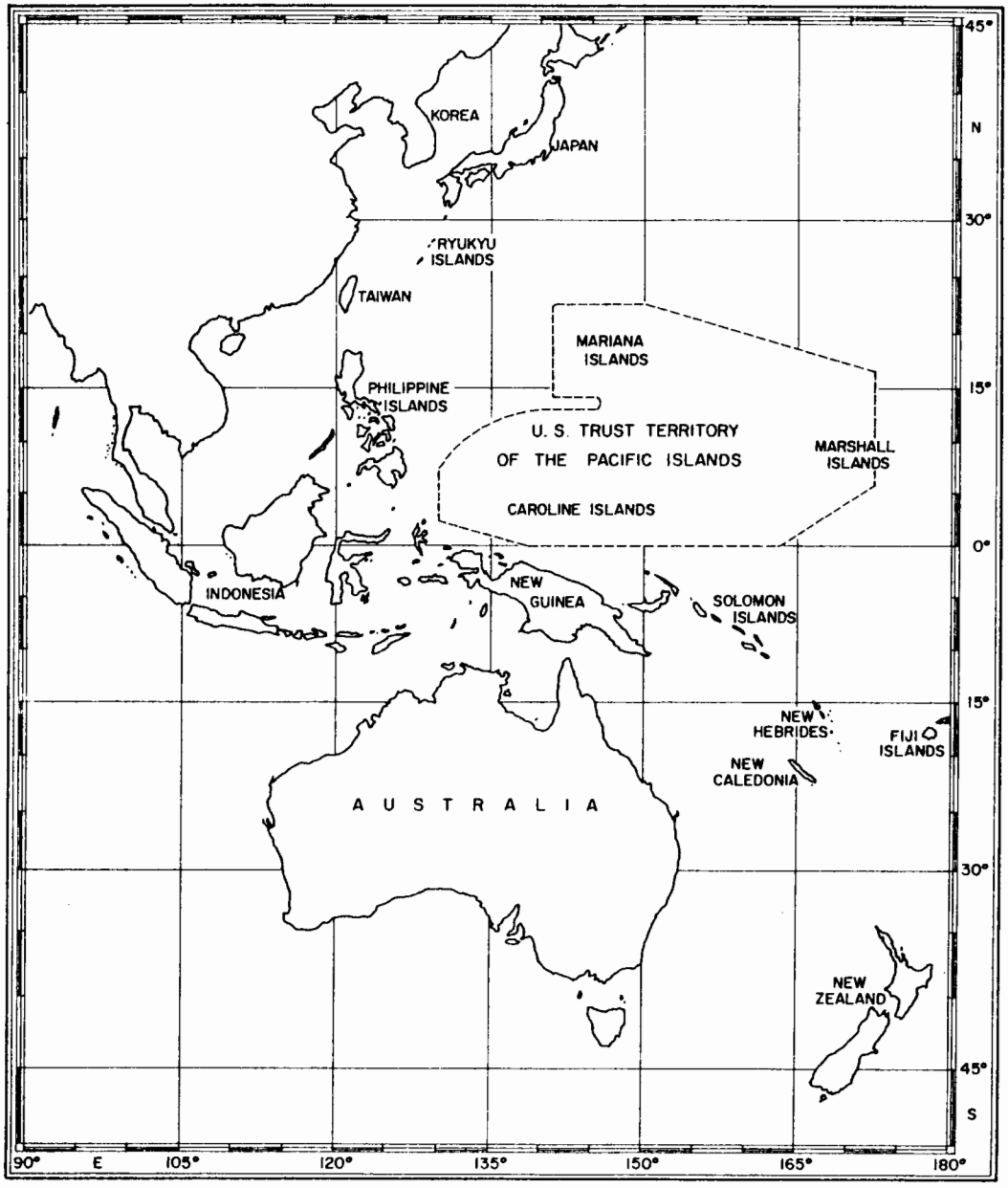


Figure 3. Island groups and countries in the western Pacific Ocean.

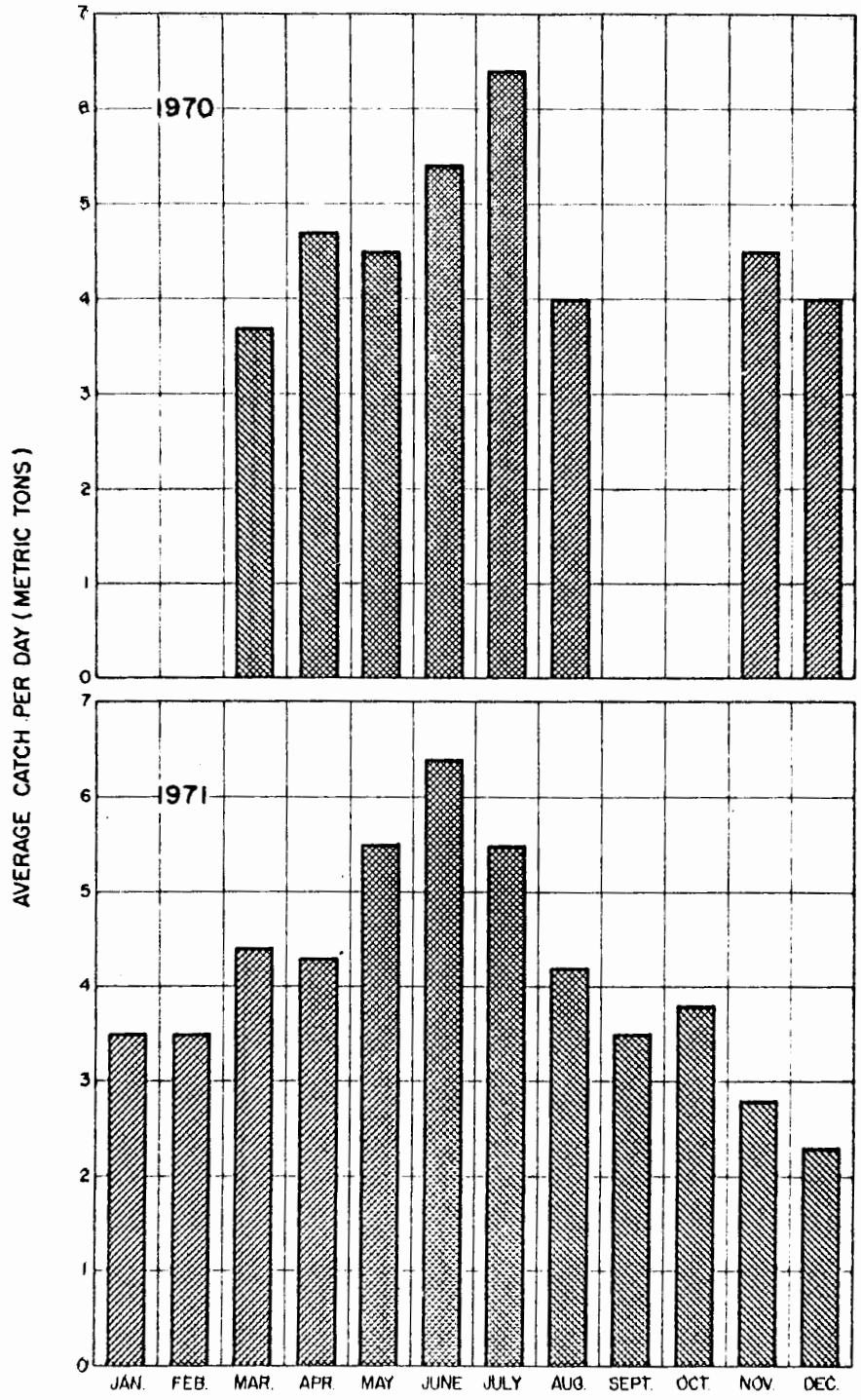
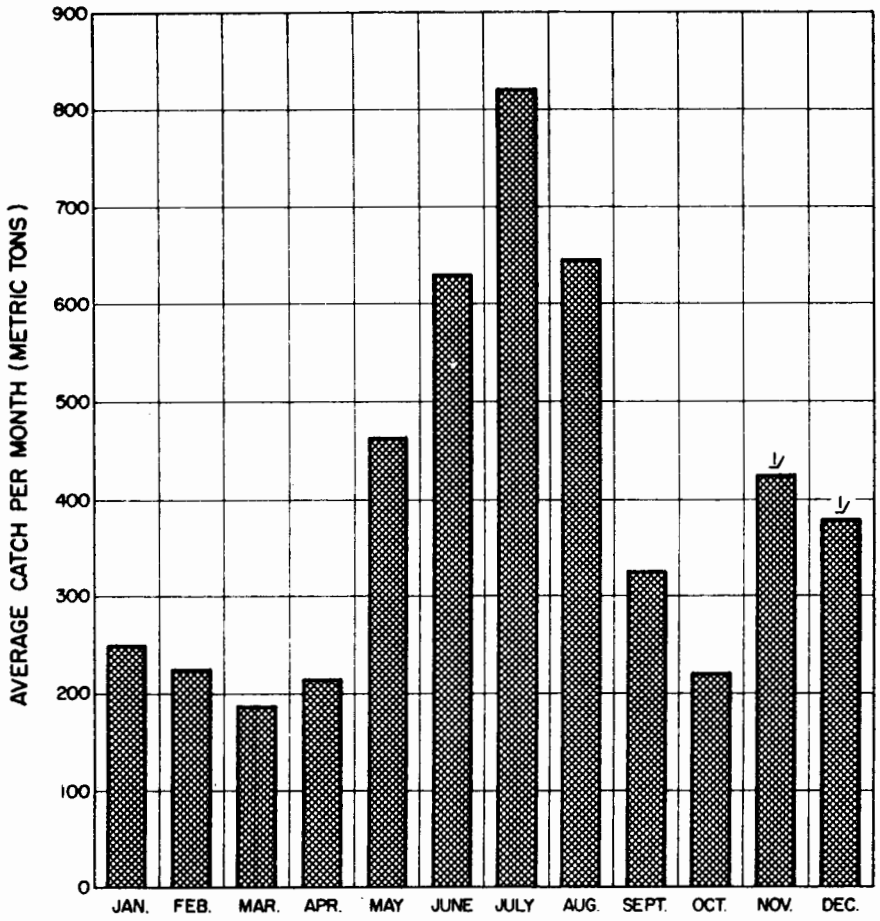


Figure 4. The average catch per day, by month, in the Papua New Guinea fishery, 1970-71.



[1]Based on data for 1966-70.

Figure 5. Average monthly catch of skipjack tuna in the Palau fishery, 1966-71.

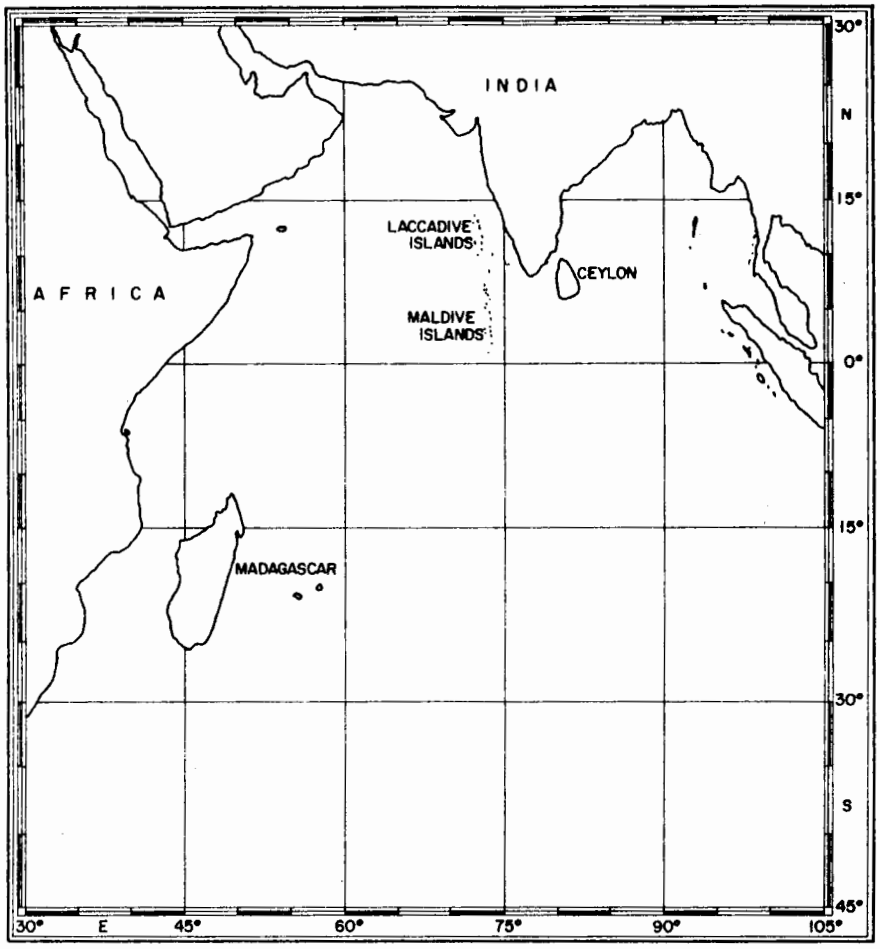


Figure 6. Island groups within and bordering the Indian Ocean.

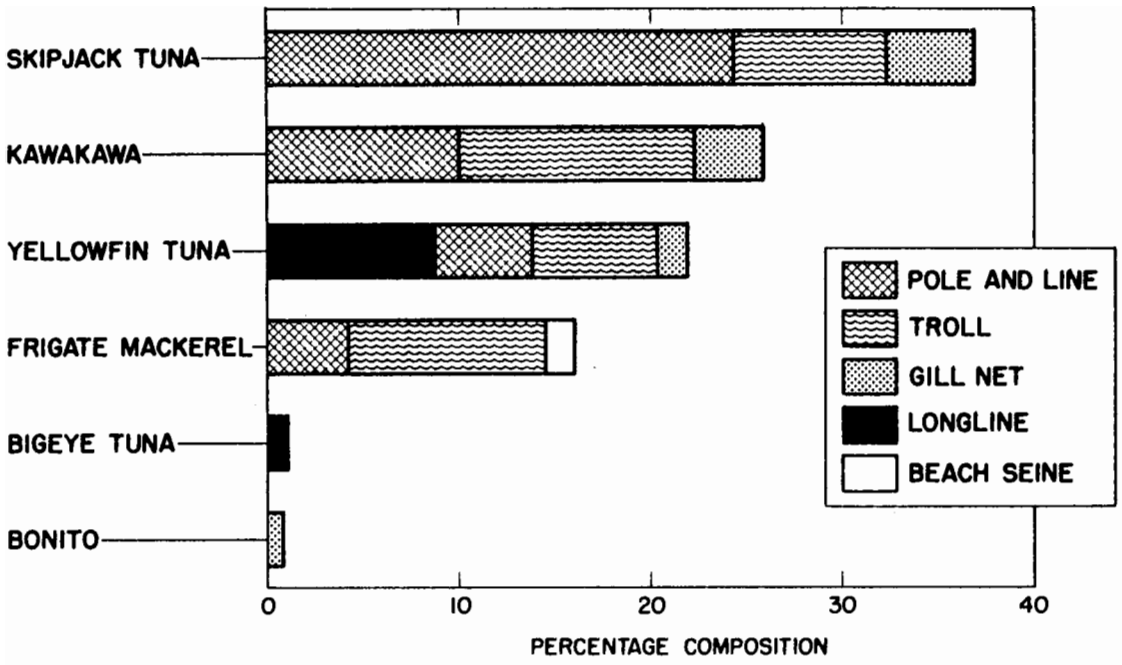


Figure 7. Percentage composition of tuna species caught from the coastal waters (from Sivasubramaniam, 1965).

TABLE 1. Annual catches in metric tons for various established fisheries for skipjack tuna in the Pacific Ocean

Year	Eastern Pacific[1]	Japan[2]	Hawaiian Islands[3]	Ryukyu Islands[4]	Philippine Island[5]
1900	-	-	191	-	-
1903	-	-	345	-	-
1917	190	82,795	-	-	-
1918	1,372	70,091	-	-	-
1919	3,128	64,395	-	-	-
1920	3,609	88,195	-	-	-
1921	517	81,592	-	6,702	-
1922	5,381	65,280	-	6,621	-
1923	5,200	67,784	-	6,423	-
1924	1,715	68,275	-	5,533	-
1925	6,457	69,536	-	4,854	-
1926	9,523	68,767	-	5,034	-
1927	15,335	85,701	-	3,890	-
1928	7,174	76,987	2,007	4,652	-
1929	12,246	72,135	1,514	3,288	-
1930	9,292	68,789	2,829	3,735	-
1931	7,488	80,343	2,777	2,594	-
1932	9,814	67,143	1,434	3,201	-
1933	7,569	77,305	2,522	3,110	-
1934	6,727	84,915	3,594	3,939	-
1935	7,801	72,881	2,210	3,288	-
1936	12,250	101,032	2,523	3,906	-
1937	21,366	105,907	5,800	3,194	-
1938	10,276	120,813	4,410	3,234	-
1939	13,663	100,518	3,903	3,304	-
1940	26,118	116,349	6,087	4,246	-
1941	11,692	91,629	1,656	4,194	-
1942	17,685	79,715	4	3,294	-
1943	13,349	51,691	-	2,318	-
1944	14,127	39,642	-	-	-
1945	15,438	19,653	1,772	-	-
1946	19,256	41,447	2,554	1,302	-
1947	24,259	48,732	2,536	2,945	-
1948	27,885	40,716	3,803	2,846	-
1949	36,749	46,471	4,488	3,419	-
1950	58,634	84,626	4,314	3,493	-
1951	54,948	104,309	5,863	2,606	-
1952	41,179	85,924	3,308	3,714	-
1953	60,626	72,690	5,470	2,620	-
1954	78,805	99,191	6,360	5,143	-
1955	58,061	99,626	4,397	3,235	-
1956	68,176	97,988	5,050	4,111	-
1957	58,197	97,418	2,781	4,056	-
1958	74,799	147,433	3,100	7,064	-
1959	80,559	166,707	5,631	10,957	-
1960	50,123	78,608	3,338	4,406	-
1961	64,910	144,327	4,942	5,922	-
1962	73,211	170,284	4,271	7,284	-
1963	93,033	112,887	3,674	5,514	-
1964	56,791	166,763	4,093	5,043	-
1965	84,324	136,067	7,329	3,800	-
1966	60,057	191,600	4,257	3,521	-
1967	122,381	154,200	3,647	5,136	500
1968	70,444	125,900	4,227	6,000	2,400
1969	58,605	138,800	2,705	3,400	600
1970	50,077	151,300	3,334	9,700	200
1971	103,330	99,100	6,051	21,700	700
1972	31,933	160,700	4,952	-	21,300
1973	42,457	-	4,875	-	-

[1]Data for 1917-66 are from Rothschild and Uchida (1968); data for 1967-73 are from Inter-American Tropical Tuna Commission (1974).

[2]Data for 1917-65 are from Rothschild and Uchida (1968); data for 1966-72 are from FAO (1973).

[3]Data for 1900-66 are from Rothschild and Uchida (1968); data for 1967-73 are from catch records of the Hawaii Division of Fish and Game.

[4]Data for 1921-67 are from Isa (1972); data for 1968-71 are from FAO (1972).

[5]Data for 1967-72 are from FAO (1973).

TABLE 2. Annual catches in metric tons in newly developed or developing fisheries for skipjack tuna in the Pacific Ocean

Year	French Polynesia[1]	Palau[2]	Papua New Guinea[4]	Solomon Islands[6]
1953	261	--	--	--
1954	324	--	--	--
1955	279	--	--	--
1956	371	--	--	--
1957	252	--	--	--
1958	181	--	--	--
1959	268	--	--	--
1960	320	--	--	--
1961	286	--	--	--
1962	385	--	--	--
1963	519	--	--	--
1964	401	--	--	--
1965	515	--	--	--
1966	731	2,942	--	--
1967	519	3,404	--	--
1968	--	5,212	--	--
1969	--	6,186	--	--
1970	--	8,441	2,430	--
1971	--	1,717[3]	17,002	4,707
1972	--	--	13,124	7,643
1973	--	--	28,000[5]	6,500

[1]Data for 1953-55 are from Van Pel and Devambez (1957); data for 1956-67 are from Brun and Klawe (1968). Landings are for eviscerated fish. FAO (1972) estimates landings to be about 1,500 MT per year in 1965-71.

[2]Data are from Congress of Micronesia (1972).

[3]Catches for November-December 1971 not available at time of publication.

[4]Data for 1970-71 are from Kearney (1973); data for 1973 are from Kearney (1974); catches include small amounts of other tunas.

[5]Estimated.

[6]Data for 1971-72 are from Kearney (personal communication); data for 1973 are from U.S. NMFS (1974).

TABLE 3. Monthly landings of skipjack tuna, Katsuwonus pelamis, at the Papeete Market (in kg) (from Brun and Klawe, 1968)

Year	Month												Total
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
1954		41,807	23,952	6,903	31,031	31,445	15,547	8,746	18,940	35,098	39,696	29,791	282,956
1955	34,000	37,567	34.835	32,449	51,564	19,538	11,311	3,467	6,294	5,286	9,059	33,492	278,862
1956	47,412	44,326	46,527	40,417	36,504	14,262	14,660	8,632	8,589	3,640	36,245	69,473	370,687
1957	50,408	35,684	32,357	22,495	29,149	21,120	7,788	5,185	4,364	13,689	12,901	17,228	252,368
1958	14,897	19,392	14,567	13,946	32,857	16,474	10,395	7,340	12,347	11,611	13,466	13,557	180,849
1959	14,050	14,020	9,889	16,956	36,729	36,274	19,737	13,339	8,512	22,973	22,953	52,093	267,525
1960	39,881	41,873	36,131	41,114	33,486	29,659	15,512	5,407	3,494	9,775	23,149	40,385	319,866
1961	41,419	35,034	32,480	29,370	33,145	22,161	10,579	9,228	8,423	16,290	18,822	29,064	286,015
1962	30,344	30,056	39,451	41,870	34,589	25,236	16,290	7,767	24,069	44,290	38,678	52,512	385,152
1963	78,223	41,742	40,993	45,540	61,327	40,677	26,361	21,789	23,711	27,747	48,314	62,917	519,341
1964	41,989	40,933	43,508	31,374	41,409	24,840	12,588	15,109	21,122	33,555	46,456	47,864	400,747
1965	38,183	34,535	32,410	41,479	62,915	57,759	26,103	28,443	23,831	42,572	49,126	77,892	515,248
1966	70,289	48,881	41,198	53,849	63,616	78,799	51,443	48,984	75,488	75,792	63,792	58,759	730,860
1967	51,926	79,328	56,603	44,950	62,654	35,198	13,903	6,030	12,091	41,105	46,033	69,172	518,993
1968	58,291												

TABLE 4. Monthly landings of yellowfin tuna, Thunnus albacares, at the Papeete Market (in kg) (from Brun and Klawe, 1968)

Year	Month												Total
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
1954		11,468	7,206	8,474	10,398	9,514	3,465	1,913	2,631	3,846	9,913	6,491	75,319
1955	7,063	14,775	4,394	7,777	7,974	4,223	3,137	2,410	2,160	2,440	1,132	4,073	61,558
1956	12,303	7,269	8,907	2,425	2,368	1,754	1,285	867	112	654	1,170	1,454	40,568
1957	3,296	5,777	5,690	7,162	6,496	2,110	1,756	447	342	2,539	4,273	3,954	43,842
1958	8,959	23,987	13,392	4,409	7,706	5,273	2,389	1,877	1,172	1,009	2,588	5,724	78,485
1959	12,805	5,557	8,340	6,016	8,524	3,090	1,986	2,689	1,073	5,389	9,232	10,686	75,387
1960	2,886	1,371	12,395	6,208	7,352	7,820	4,382	3,545	1,063	1,055	1,780	9,948	59,805
1961	19,570	15,422	13,504	18,409	10,258	4,628	3,737	712	1,148	1,737	5,038	14,672	108,835
1962	16,756	20,010	12,132	10,090	13,525	8,051	5,243	2,792	664	1,840	8,788	26,273	126,164
1963	17,170	15,431	18,017	6,080	9,256	5,559	3,795	2,001	2,108	4,655	9,172	13,823	107,067
1964	10,551	8,232	11,389	11,830	11,590	7,040	4,751	3,695	2,017	1,504	5,073	9,906	87,578
1965	5,021	5,475	4,673	2,622	3,967	3,340	3,416	567	743	1,073	3,437	6,758	41,092
1966	7,987	7,933	3,841	2,873	8,478	4,551	2,950	1,828	1,961	2,689	5,820	7,366	58,277
1967	21,270	28,982	26,421	9,364	9,498	8,232	1,567	509	185	2,844	2,204	9,798	120,872
1968	13,180												

TABLE 5. Live-bait skipjack tuna fishery experiments in various French Polynesian Island groups (from Doumenge, 1973)

Boat	Period	Trips	Fish caught								Total		Yield/trip	
			Skipjack						Yellowfin tuna					
			2 - 3 kg		3 - 8 kg		8 - 20kg							
			No.	kg	No.	kg	No.	kg	No.	kg	No.	kg	No.	kg
Leeward Islands														
Moetu	20 - 25 Feb. 72	2	27	54							27	54	13.5	27
	19 - 30 March 72	5	970	2910					62	2440	1032	5350	206.4	1078
	1 - 7 July 72	7	181	543					173	990	354	1533	50.5	219
	21 - 24 August 72	2			270	4050					270	4050	135	2025
	28 August - 8 Sept. 72	4	162	426					3	90	165	516	41	129
Anela	14 - 20 Dec. 72	4	635	3810	396	3168	37	555	46	257	1114	7790	2785	1947.5
	14 - 18 January 72	2	80	160			731	10103	6	80	817	10343	408.5	5171.5
Tuamotu														
Moetu	24 July - 3 August 72	4	79	237	2	16					81	253	20	55.5
Anela	3 - 7 December 72	3	246	663							246	663	82	221
Marquesas														
Anela	19 February - 25 March 73	5			1735	10410					1735	10410	347	2082
	27 May - 7 April 73	1	391	1173	2110	16880					2501	18053	2501	18053

TABLE 6. Results of experimental live-bait fishery in the Windward Islands (from Doumenge, 1973)

Boat	Period	Trips	Fish caught								Total		Yield/trip	
			Skipjack						Yellowfin tuna					
			2 - 3 kg		3 - 8 kg		8 - 20 kg							
			No.	kg	No.	kg	No.	kg	No.	kg	No.	kg	No.	kg
Moetu	15 - 18 Feb. 72	1	32	64					24	48	56	112	56	112
	6 - 11 March 72	2	34	68			46	690	10	100	90	868	45	434
	13 - 18 March 72	1			1	8	127	1918			128	1926	128	1926
	30 March-2 April 72	1					80	1200			80	1200	80	1200
	4 - 8 April 72	2	50	150					36	360	86	510	43	255
	10 - 13 April 72	3	108	216			2	30	100	1200	210	1446	70	482
	17 - 22 April 72	3	98	196	2	16			17	85	117	297	39	99
	25 - 29 April 72	2					15	180			15	180	7.5	90
	9 - 19 May 72	5	229	458			87	870	70	420	386	1748	77.2	349.6
	23 - 28 May 72	4			13	91	42	425	2	82	57	598	20.5	149.5
	29 May - 2 June 72	2	22	44					19	95	41	139	20.5	69.5
	5 - 10 June 72	2			87	435					87	435	43.5	217.5
Moetu	Total	28	573	1196	103	550	399	5313	278	2390	1353	9449	48.5	337.5
Anela	10 - 13 Dec. 72	3	907	2721	204	1020	121	1573	79	237	1311	5551	437	1850
	7 - 11 Jan. 73	3	72	37			853	11089			925	11126	308.3	3708.6
	12 Jan. 73	1			253	3102					253	3102	253	3102
	25 - 26 Jan. 73	2					500	8068			500	8068	250	4034
	28 - 30 Jan. 73	2					1606	21722			1606	21722	803	10861
	31 Jan. - 2 Feb. 73	2	20	40			982	12766	2	4	1004	12810	502	6405
	4 - 7 Feb. 73	3					1300	16900			1300	16900	433.3	5633.3
	8 - 9 Feb. 73	1					311	4043			311	4043	311	4043
	10 - 15 Feb. 73	2					1418	18434			1418	18434	709	9217
Anela	Total	19	999	2798	457	4122	7091	94595	81	241	8628	101756	449	5355.5
Redondo	27 March - 7 Apr.73	5	161	644			50	750	1200	3600	1411	4994	282.2	998.8
Grand total		52	1733	6638	560	4672	7540	100658	1559	6231	13392	116199		

TABLE 7. The species and amount of baitfish caught day and night baiting in Pago Pago Harbor and Apia Harbor by the RV Charles H. Gilbert (from Hida, 1970)

Baiting locality	Time of day	Sets	Amount of bait caught	Species
		Number	Buckets	
Pago Pago Harbor	Night	8	54	Mackerel, Rastrelliger kanagurta
			22	Sardines, Sardinella melaneura and Herklotsichthys punctatus
			4	Bigeye scad, Trachurops crumenophthalmus
	Day	31	88	Sardines, S. melaneura and H. punctatus
Apia Harbor	Day	5	13	Silverside, Pranesus pinguis

TABLE 8. Baiting effort (sets), total catch by species and all species combined, and catch per set at night baiting stations at American Samoa, August 1970-June 1973

Month-year	No. of sets	Total catch	Catch per set	*Stolephorus* sp.		*Sardinella* spp.		*Herklotsichthys punctatus*		Others	
				Amount caught		Amount caught		Amount caught		Amount caught	
	No.	Bkt.	Bkt.	Bkt.	Percent	Bkt.	Percent	Bkt.	Percent	Bkt.	Percent
Aug.-Dec. 1970	67	202	3.0	90	44.6	32	15.8	64	31.7	16	7.9
Jan.-Dec. 1971	133	337	2.5	72	21.4	43	12.8	68	20.2	154	45.7
Jan.-Dec. 1972	49	149	3.0	23	15.4	3	2.0	31	20.8	92	61.7
Jan.-Jun. 1973	58	119	2.0	7	5.9	76	63.9	23	19.3	13	10.9

Data for August 1970-June 1972 are from Swerdloff (1974); data for July 1972-June 1973 are from Sesepasara (1973).

TABLE 9. Noon positions, dates and number and kinds of schools sighted around the Samoa Islands during cruise 117 of the RV Charles H. Gilbert (from Hida, 1970)

Noon Position		Date	Number of Schools Sighted[1/]						
Lat. (S.)	Long. (W.)	1970	SJ	YF	KK	Mixed YF, SJ	UN	Mixed KK, DO, SK	Total
12°00'	169°15'	2/8	-	-	-	-	4	-	4
South of	Pago Pago	2/11	-	-	-	-	5	-	5
16°55'	170°45'	2/12	2	1	-	-	4	-	7
16°03'	170°13'	2/13	4	-	-	-	2	-	6
14°33'	170°23'	2/15	2	-	-	-	2	-	4
14°30'	169°22'	2/16	-	1	-	1	3	-	5
13°37'	169°24'	2/17	-	-	-	-	1	-	1
14°09'	171°00'	2/23	-	-	1	-	2	-	3
14°27'	171°45'	2/25	1	-	-	-	-	-	1
13°49'	173°15'	2/26	-	3	-	2	4	-	9
13°50'	172°08'	2/27	-	-	2	-	3	-	5
14°12'	172°12'	3/1	1	1	1	1	1	-	5
14°45'	171°02'	3/2	1	-	-	-	5	-	6
14°19'	170°36'	3/5	-	-	-	-	3	-	3
14°18'	170°35'	3/6	-	-	-	-	4	-	4
14°19'	170°39'	3/10	-	-	1	-	1	-	2
14°17'	170°53'	3/11	-	-	1	-	-	1	2
14°51'	170°30'	3/14	2	-	-	-	1	-	3
14°11'	170°14'	3/18	-	2	-	-	4	-	6
14°02'	169°22'	3/19	-	-	-	2	4	-	6
14°39'	168°36'	3/20	4	-	-	1	2	-	7
14°38'	170°14'	3/21	3	-	-	-	5	-	8
14°25'	170°47'	3/23	3	-	-	-	4	-	7
15°42'	170°45'	3/24	-	-	-	-	2	-	2
14°23'	170°35'	3/25	-	-	-	-	1	-	1
14°15'	170°56'	3/26	2	1	1	1	4	-	9
13°46'	171°45'	3/27	-	-	-	-	2	-	2
13°42'	173°08'	3/28	1	1	-	-	3	-	5
14°15'	172°29'	3/29	-	-	1	-	5	-	6
13°44'	171°50'	3/31	-	-	2	2	1	-	5
15°03'	171°16'	4/1	2	1	-	-	2	-	5
Total			28	11	10	10	84	1	144

[1/] SJ = skipjack; YF = yellowfin; KK = kawakawa; UN = unidentified; DO = dolphin; SK = shark.

TABLE 10. Information on large tuna schools seen in the vicinity of the Samoa Islands during cruise 117 of the RV Charles H. Gilbert (from Hida, 1970)

Position		Date	Species	Fish Size	Type of
Lat. (S)	Long. (W)	1970	Common names of tuna	pounds	School[1/]
14°30'	169°21'	2/16	Yellowfin	20-50	Boiler
13°25'	172°45'	2/26	Yellowfin	30-40	Boiler
14°09'	172°11'	3/1	Yellowfin-Skipjack	7-16	Boiler
14°12'	169°35'	3/19	Yellowfin-Skipjack	5	Breezer
13°30'	168°41'	3/19	Skipjack Yellowfin	11 60	Breezer
14°39'	168°25'	3/20	Skipjack	10	Boiler
14°37'	168°25'	3/20	Skipjack	10	Boiler
14°45'	168°51'	3/20	Skipjack	6	Boiler
14°26'	170°42'	3/23	Skipjack	8	Breezer
14°27'	170°46'	3/23	Skipjack	7-8	Breezer
13°54'	171°21'	3/26	Skipjack	5	Breezer
14°12'	172°04'	3/31	Skipjack Yellowfin	6 9	Jumper

[1/] See Scott (1969) for school terminology.

TABLE 11. Summary of joint-venture operations in Papua New Guinea (from Pownall, 1972)

Joint venture base location	Fleet	Area of operation	Future plans
Kavieng on northern tip of New Ireland; also a tuna smoke-drying plant on Nago Island	Operates two mother ships (1,000 and 500 GT), a 150-ton Japanese steel catcher boat with automatic fishing poles, and nine chartered Okinawan 39-ton, wood, pole-and-line fishing boats.	Bismarck Sea	[No information]
Rabaul in New Britain	Operates two mother ships and nine chartered Okinawan catcher boats.	Bismarck Sea	Hopes to increase fleet to 3 mother ships and 15 catcher boats; expects to catch 15,000 tons of skipjack tuna per year; plans to build a cold storage and a smoking plant. Within 5 years, they expect to be operating five boats under Papua New Guinea flag. Fishery training expected for 500 Papua New Guinean fishermen.
Madang	Operates two mother ships (1,000 tons), eight chartered Okinawan, and one 192-ton Japanese catcher boats.	[No information]	Catches were disappointing; all vessels in fleet except one large Japanese catcher boat returned to Japan.
Still on survey	Operates one mother ship; three chartered Okinawan catcher boats, and the 400-ton pole-and-line vessel, Redondo.	Bismarck Sea	[No information]

TABLE 12. Distribution by area of the total catch and average weight of skipjack tuna in 1971 (from Kearney, 1973)

1971	Northeastern Bismarck Sea		Eastern Bismarck Sea		Southwestern Bismarck Sea	
	Total catch	Average weight of skipjack tuna	Total catch	Average weight of skipjack tuna	Total catch	Average weight of skipjack tuna
	Tons	Kg	Tons	Kg	Tons	Kg
January	447.6	3.9	470.1	-	0	-
February	625.3	3.8	366.6	-	0	-
March	477.3	3.9	569.4	-	414.9	5.0
April	367.8	3.8	645.8	-	498.1	4.8
May	649.4	3.7	788.4	4.0	446.7	4.7
June	224.3	3.3	1078.9	-	736.3	5.1
July	87.7	3.5	1348.3	4.2	516.5	4.9
August	353.3	3.3	1257.0	3.9	416.5	4.9
September	534.9	3.4	818.9	3.8	135.8	4.7
October	538.1	3.8	520.2	4.6	16.3	5.0
November	412.8	3.40	462.7	4.2	86.9	3.6
December	129.5	3.2	381.6	4.0	188.5	4.5
Total	4837.1		8707.9		3456.5	
Grand total					17,002.5	

TABLE 13. Monthly catches of skipjack, yellowfin, and other tunas in the Papua New Guinea skipjack tuna fishery, 1970-71 (from Kearney, 1973)

Year	Month	Catch (metric ton)				Average catch/day
		Skipjack	Yellowfin	Others	Total	
1970	Jan.	-	-	-	-	-
	Feb.	-	-	-	-	-
	Mar.	279.2	27.8	0.0	307.0	3.743
	Apr.	336.6	11.3	0.1	348.0	4.704
	May	361.8	8.2	0.1	370.1	4.512
	June	438.5	2.5	0.0	441.0	5.444
	July	472.8	7.5	0.0	480.3	6.403
	Aug.	101.4	11.3	0.0	112.7	4.026
	Sept.	-	-	-	-	-
	Oct.	-	-	-	-	-
	Nov.	143.9	0.3	1.0	145.2	4.539
	Dec.	220.3	5.4	0.5	226.2	3.968
Totals:		2,354.5	74.3	1.7	2,430.5	
1971	Jan.	899.7	16.7	1.3	917.7	3.543
	Feb.	969.8	21.3	0.8	991.9	3.493
	Mar.	1,445.0	13.8	0.8	1,461.6	4.402
	Apr.	1,499.1	6.4	6.1	1,511.6	4.270
	May	1,862.2	15.1	7.1	1,884.4	5.510
	June	2,037.9	1.3	0.4	2,039.6	6.433
	July	1,950.6	0.8	1.1	1,952.5	5.515
	Aug.	2,021.9	3.0	1.9	2,026.8	4.231
	Sept.	1,486.0	3.0	0.6	1,489.6	3.547
	Oct.	1,058.3	2.7	2.6	1,064.6	3.775
	Nov.	945.6	15.6	1.3	962.5	2.856
	Dec.	687.6	8.3	3.7	699.6	2.332
Totals:		16,863.7	108.0	27.7	17,002.4	

TABLE 14. Summary of joint-venture operations in Indonesia

Month and year	Area of operation	Size of fleet	Remarks
Nov. 1969 to Mar. 1971[1]	Sorong, West Irian.	Five 110-ton catcher vessels, four 10-ton bait catchers, and one 700-ton freezer mother ship.	Results of fishing not satisfactory.
Apr.-Sept. 1971[2]	In Molucca Sea off Halmahera Island; vessels based in Ternate.	Five 110-ton catcher vessels two 400-ton carriers.	Joint venture, called East Indonesian Fisheries Company formed. Plans call for fleet of 10 vessels. Catch target for first year is 4,000 MT. Vessel crew half Japanese and half Indonesian at present; to be all Indonesian in future.
Aug. 1971[3]	Butung Island in Banda Sea.	Three catcher vessels and one mother ship.	No information on results of survey.
Sept. 1971[4]	Pandiang, Sumatra Island with fishing in Sunda Strait.	Three or four catcher vessels.	Operations terminated in March 1972; probably because of poor fishing.
Sept. 1971[5]	Kendari, Celebes Island.	Five 39-ton catcher vessels and one 1,000-ton mother ship.	Joint venture formed. Landings reached 600 tons. Catch was 2-3 tons per vessel per day. Bait available in sufficient amounts.
Dec. 1971 to July 1972[1]	West coast of Sumatra Island in the Indian Ocean.	One 190-ton catcher vessel.	Survey terminated after a few months because of difficulty in obtaining sufficient quantities of live bait and because of poor weather conditions.
May 1972 to Dec. 1972[1]	Kotobaru on Laut Island; test fishing in Makassar Strait and in Flores Sea.	One 190-ton catcher vessel.	Results were disappointing, but conclusion was that a brief test fishing by a single vessel was inadequate.

Source of information:

[1]Katsuo-Maguro Nenkan, 1973
[2]U.S. NMFS, 1971a, 1971c, 1971j, 1972g
[3]U.S. NMFS, 1971f
[4]U.S. NMFS, 1971g, 1972c
[5]U.S. NMFS, 1972c, 1972e

TABLE 15. Number and percentages of schools, by species, sighted in Fijian waters in 1972

Species	Schools sighted	
	Number	Percent
Skipjack tuna	247	37.8
Yellowfin tuna	53	8.1
Skipjack-yellowfin mixed	44	6.7
Kawakawa	40	6.1
Skipjack-kawakawa mixed	8	1.2
Tuna-pelagic species mixed	28	4.3
Mahimahi (*Coryphaena hippurus*)	18	2.8
Miscellaneous species	18	2.8
Unidentified	197	30.2
Total sightings	653	

TABLE 16. Skipjack tuna catch in metric tons landed in the former Japanese mandated islands, 1922-41 (from Smith, 1947; Shapiro, 1948)

	Saipan	Yap	Palau	Truk	Ponape	Jaluit
1922	2	-	-	4	4	-
1923	3	1	-	3	-	-
1924	9	2	2	5	<1	-
1925	15	2	9	6	5	-
1926	45	2	42	3	<1	-
1927	28	<1	15	8	2	<1
1928	26	1	131	5	<1	-
1929	25	<1	229	215	<1	-
1930	258	<1	157	913	6	-
1931	564	<1	548	1,097	525	81
1932	1,310	-	1,592	810	534	615
1933	1,762	-	2,144	1,883	927	172
1934	2,516	4	3,779	1,200	1,202	255
1935	1,786	-	5,391	3,002	1,313	230
1936	1,696	-	3,836	5,870	2,696	168
1937	2,697	-	13,775	12,434	4,064	91
1938	2,392	149	3,420	5,295	1,496	7
1939	2,087	36	3,549	7,640	3,708	-
1940	3,379	4	6,047	7,217	1,586	<1
1941	1,295	5	3,301	4,337	2,419	169

TABLE 17. Number of boats fishing, catches of skipjack tuna, and catch per boat, by month, in the Palau skipjack tuna fishery, 1966-71 (from Congress of Micronesia, 1972)

Month	1966			1967			1968		
	Boats	Catch	Catch per boat	Boats	Catch	Catch per boat	Boats	Catch	Catch per boat
	No.	MT	MT	No.	MT	MT	No.	MT	MT
January	—	101.414	—	5	361.103	72.2	10	341.896	34.2
February	—	220.402	—	4	107.918	26.9	9	477.397	53.0
March	—	133.402	--	4	101.678	25.4	8	443.479	55.4
April	--	108.210	—	4	120.516	30.1	6	375.414	62.5
May	--	161.820	--	4	130.399	32.6	6	733.787	122.3
June	--	185.283	--	10	258.949	25.9	11	771.853	70.1
July	—	524.830	—	10	384.659	38.4	11	996.055	90.5
August	--	326.672	—	9	430.843	47.9	9	769.427	85.4
September	—	477.440	--	10	210.327	21.0	9	177.879	19.7
October	8	320.839	40.1	10	205.587	20.6	5	37.497	7.5
November	8	250.227	31.2	10	580.735	58.1	6	84.864	14.1
December	8	130.871	16.3	9	510.787	56.7	4	2.868	0.7
Total	--	2,941.600	--	—	3,403.501	—	—	5,212.416	--
Average	—	245.134	--	7.4	283.625	38.2	7.8	434.368	55.5
		1969			1970			1971	
January	8	72.107	9.0	7	389.421	55.7	6	242.875	40.4
February	9	141.385	15.8	7	274.983	39.2	6	102.734	17.1
March	8	35.330	4.4	6	192.730	32.1	8	199.799	24.9
April	5	58.195	11.6	7	422.949	60.4	7	190.919	27.2
May	5	259.846	51.9	9	1,021.297	113.5	8	466.544	58.3
June	4	623.630	155.9	9	1,642.223	182.4	8	282.685	35.3
July	8	678.585	84.8	9	2,343.803	260.4	12	72.200	6.0
August	9	1,282.252	142.4	9	1,055.522	117.3	12	78.200	6.6
September	9	809.540	89.9	2	95.873	47.9	12	197.877	16.5
October	9	593.678	65.9	5	149.753	29.5	6	31.895	5.3
November	7	702.714	100.4	5	512.560	102.5	—[1]	—	--
December	7	929.011	132.7	6	340.172	56.7	—[1]	—	—
Total	—	6,186.183	--	--	8,441.286	--	--	1,716.832	—
Average	7.3	515.515	70.3	6.75	703.441	104.2	8.5	171.683	20.2

[1]Data unavailable at time of publication.

TABLE 18. Catches of skipjack tuna and other tunas caught in Australian waters, 1960-61 to 1971-72

Fiscal year	Catch (MT)	
	Tuna[1]	Skipjack tuna
1960-61	4,429	--
1961-62	4,814	--
1962-63	4,989	48
1963-64	8,134	34
1964-65	7,184	2
1965-66	8,054	1
1966-67	5,649	2
1967-68	6,792	4
1968-69	8,916	35
1969-70	8,450	1
1970-71	6,802	42[2]
1971-72	10,125	105[2]

[1]Catches from 1960-61 to 1969-70 include catches of skipjack tuna not reported separately by several states.

[2]Catches of skipjack tuna in 1970-71 and 1971-72 are reported separately from other tunas.

TABLE 19. Skipjack tuna baitfish used in the Ryukyu Islands (asterisks denote important species)[1] (from Isa, 1972)

Family	Species	Japanese name	Local name
Clupeidae	Sardinella clupeoides	Yamato-mizun	Yamato-mizun
	Sardinella sindensis	Miyako-iwashi	Mizun
	Harengula ovalis	Mizun	Mizun or ashichin
Dorosomatidae	Konosirus punctatus	Konoshiro	Ashichin
Dussumieridae	*Spratelloides japonicus	Kibinago	Sururu
	*Spratelloides delicatulus	Minami-kibinago	Shiiraa
	*Spratelloides atrofasciatus	Bakajako	Bakajako
Engraulidae	Stolephorus indicus	Indo-ainoko	Mizusururu
	Stolephorus zollingeri	Taiwan-ainoko	Mizusururu
	*Stolephorus pseudoheterolobus	Mizusururu	Mizusururu
Atherinidae	Allanetta woodwardi	Okinawa-toogoroo	Hadaraa
Carangidae	Decapterus macrosoma	Kusayamoro	Nagaiyuu
	*Trachurops crumenophthalmus	Meaji	Gatsun
Apogonidae	*Archamia fucata	?	Ufumii
	Apogon notatus	Kurohoshi-ishimochi	Ufumii
Pempheridae	*Parapriacanthus beryciformis	Kinmemodoki	Gasagasaa
Caesionidae	*Caesio tile	Kumasasa-hanamuro	Ukuu
	*Caesio chrysozonus	Takasago	Saneeraa
Pomacentridae	*Chromis ternatensis	Kaburaya-suzumedai	Hikaagwaa
	Chromis caeruleus	Debasuzumedai	Hikaagwaa
	Abudefduf dickii	Ishigaki-suzumedai	Hikaagwaa

[1]Source: Mr. Nishijima, University of Ryukyu Islands, personal communication.

TABLE 20. Baitfish used, in metric tons, in the three major localities in the Ryukyu Islands skipjack tuna fishery, 1966 and 1967 (from Isa, 1972)

Baitfish family	Yaeyama		Miyako		Okinawa		Total	
	1966	1967	1966	1967	1966	1967	1966	1967
Apogonidae	34.9	77.5	7.7	10.5	29.5	23.1	71.7	111.1
Caesionidae	16.7	35.4	20.5	1.2	29.9	15.7	67.1	52.3
Dussumieridae	3.3	3.2	6.0	22.7	45.4	19.1	54.7	45.0
Engraulidae	1.5	-	2.1	17.2	15.3	8.2	18.9	25.4
Carangidae	0.4	-	0.9	-	40.1	17.7	41.4	17.7
Clupeidae	0.5	-	-	-	7.3	5.0	7.8	4.8
Pomacentridae	4.0	5.6	0.1	-	-	0.5	4.1	6.1
Dorosomatidae	-	-	-	-	1.0	6.8	1.0	6.8
Others	7.5	-	-	-	-	-	7.5	-
Total	68.8	121.7	37.3	51.6	168.1	96.1	274.2	269.4

TABLE 21. Monthly landings (in metric tons) of skipjack tuna in the Ryukyu Islands, 1959, 1962-63, and 1965-67 (from Isa, 1972)

Month	1959	1962	1963	1965	1966	1967	Monthly average	Percent
January	20.4	6.2	5.5	15.5	23.5	72.1	23.9	0.4
February	21.0	7.1	2.3	15.1	30.1	86.3	26.9	0.4
March	14.5	11.8	3.2	11.8	28.8	23.3	15.6	0.2
April	99.0	89.6	118.0	62.1	128.7	33.6	88.5	1.4
May	643.3	602.0	581.3	469.8	283.1	241.0	470.1	7.6
June	1,766.8	1,518.7	843.9	420.9	466.7	788.6	967.6	15.6
July	3,594.4	2,127.8	1,584.4	1,164.7	1,145.4	1,342.9	1,826.6	29.5
August	2,742.9	1,671.9	1,424.2	933.6	1,011.1	1,397.5	1,530.2	24.7
September	1,650.8	1,017.6	678.9	419.2	200.8	967.6	822.5	13.3
October	1,223.8	139.9	175.0	135.4	179.1	152.8	334.3	5.4
November	69.3	26.2	53.0	68.7	16.7	14.2	41.4	0.7
December	111.5	1.4	43.5	62.4	7.4	15.6	40.3	0.6
Total	11,957.7	7,220.2	5,513.2	3,779.2	3,521.4	5,135.5	6,187.9	100.0

Source: GRI Annual Fisheries Reports for 1959, 1962-63 and 1965-67.

TABLE 22. Catches of skipjack tuna in the Indian Ocean, 1965-72

Year	Maldive Islands (1,000 MT)	Japan (1,000 MT)	Australia (1,000 MT)
1965	13.1[1]	0.1	--
1966	15.9[1]	0.1	--
1967	17.9[1]	0.2	--
1968	16.3[1]	0.3	--
1969	18.4	0.3	--
1970	20.0[1]	0.1	--
1971	28.9	0.1	0.0
1972	15.0[1]	0.1	0.1

[1]Data estimated or calculated by FAO.

TABLE 23. Catch of tuna (in thousands of fish) and fishing days by month and type of boat in the Maldive Islands, 1965. (a) Skipjack and yellowfin tunas; (b) Large skipjack tuna; (c) Kawakawa and frigate mackerel (from Hiebert and Alverson, 1971)

	Large boat (live-bait fishing)				Small boat (mailing trolling)			
	Days** fishing	(a)	(b)	(c)	Days** fishing	(a)	(b)	(c)
January	18,908	1,156	66	1,083	11,915	49	3	72
February	16,949	933	21	492	12,232	28	1	91
March	15,341	715	3	291	9,262	20	1	32
April	13,322	464	6	166	10,062	14	*	29
May	11,301	553	10	92	11,585	32	1	32
June	14,145	616	4	126	11,994	58	1	51
July	15,067	460	13	74	11,870	22	2	29
August	13,184	452	21	114	10,408	53	2	32
September	11,664	274	40	84	10,190	15	*	25
October	14,444	364	62	294	10,568	22	5	42
November	15,730	333	47	347	10,412	36	1	32
December	17,295	597	76	125	13,667	69	4	50
Total	177,350	6,917	369	3,288	134,165	418	21	517

* less than 500.

** minor discrepancies are due to rounding.