AQUATIC RESOURCES OF THE RYUKYU AREA

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SUMMARY

1. The Ryukyu Islands are part of a larger island chain extending from the East Indies through the Philippine Islands into Japanese waters. Along this chain the warm Kuroshio brings many tropical species northward, and in the waters immediately surrounding the Ryukyu Islands is found a varied and diverse marine fauna, largely tropical in composition.

2. The Ryukyuans have devised and constructed ingenious gear for fishing the coastal coral and rocky areas, of which the drive-in-net is the most effective. Angling (surface and bottom), gill nets (floating and bottom), trolling jigs, stick-held dip nets, sledge nets, and long lines are among the many other kinds of gear used, but the inshore catch by these methods is minor compared with that of the drive-in-net. About 50 percent of the annual average coastal fish catch of approximately 3,000 metric tons landed in the southern Ryukyus (Ryukyu Retto) from 1926-40 was attributed to this gear. Tunas, mackerels, sharks, spearfishes, snappers, sea breams, horse mackerels, flying fishes, and a great variety of tropical reef fishes were among the most important of the numerous species taken by coastal operations. Spiny lobsters, shrimp, sea turtles, squid, cuttlefish, seaweed, and shellfish also contributed to the catch and amounted to about 5,300 metric tons annually during the same period.

3. The offshore fishing is done primarily in the deeper waters through which the major flow of the Kuroshio passes, or where offshoots of the current tend to swing against areas of lesser depth. Three major types of fishing operations have been practiced in the offshore waters: pole and line angling for skipjack; long line fishing for tunas, spearfishes, and sharks; and hook and line angling for bottom fish (chiefly snappers) in areas some distance from the main island groups but where submerged reefs are known to be present. During 1926-40 the offshore fisheries of the Ryukyu Retto produced an annual average catch of slightly more than 4,150 metric tons. The skipjack accounted for most of the catch, normally constituting about 80 percent of the total offshore landings. The greater part of this was processed into dried skipjack stick and exported to Japan.

4. Fishing operations in the northern Ryukyus (Satsunan Shoto) were similar to those in the islands to the south, but were on a smaller scale. All aquatic production totaled about 2,200 metric tons annually.

5. Major fishing operations in the Ryukyu area have been conducted by Japanese vessels of larger tonnage than those used by the Ryukyuans. Skipjack pole and line and tuna long line fishing by Kyushu-based vessels became increasingly important during the 1920's and early 1930's. In the later years of the decade, production exceeded 25,000 metric tons.

6. An estimate of the entire annual yield for the Ryukyu area, based on the native Ryukyu catch and that of the Japanese-based vessels, would be about 40,000 metric tons during peak years. Of this amount the Ryukyuans took about 14,650 metric tons (36.6 percent). The skipjack was by far the most important single species taken by both Ryukyu-

This report was prepared by Dr Sidney Shapiro, fisheries biologist, Fisheries Division. Masao Ishida and Haruyuki Koyama, technical consultants for Fisheries Division, aided in compiling the original data. All illustrations were prepared by Katsuyuki Kita and Saburo Satouchi, draftsman and artist respectively for Fisheries Division.

and Kyushu-based vessels. The combined tuna (excluding skipjack) and spearfish catch by long line vessels was next in importance and was virtually monopolized by the Japanese vessels operating from Kyushu.

7. Because of the isolated geographical position, the small populations, and the limited local and export markets of the Ryukyu Islands, most fishing operations by the natives have been on a small scale. Expanding these operations to the full extent of the resources of the entire Ryukyu area would necessitate developing large export outlets.

8. The hostilities of World War II reduced the Ryukyu fisheries to a deplorable state. Especially affected were those operating on the offshore grounds; as they were based on the larger islands where fighting was severe they were almost completely destroyed. The coastal fisheries showed little war damage but have been hampered by lack of materials for repairing and replacing fishing gear. Total production of the Ryukyu Islands is now estimated at about 50 percent of the catch of normal prewar years. The fisheries of Okinawa-jima, with the largest population, are in an especially critical state.

INTRODUCTION

1. Purpose, Sources, and Scope of Report

The purpose of this survey is to compile available data on the marine resources of the regions surrounding the Ryukyu Islands and to indicate resources accessible for future development. Because only a few studies dealing with the fisheries of the Ryukyu area have been completed by the Ryukyuans or the Japanese and no comprehensive survey of the resources of the area has been attempted previously, it has been difficult to obtain complete information. Moreover, the political subdivision of the islands by the Japanese has complicated the collection of reliable statistics, especially on the northern islands, the catch records of which are included in those of Kagoshima Prefecture and are difficult to break down. Statistics in this report should be considered only as approximations of true conditions.

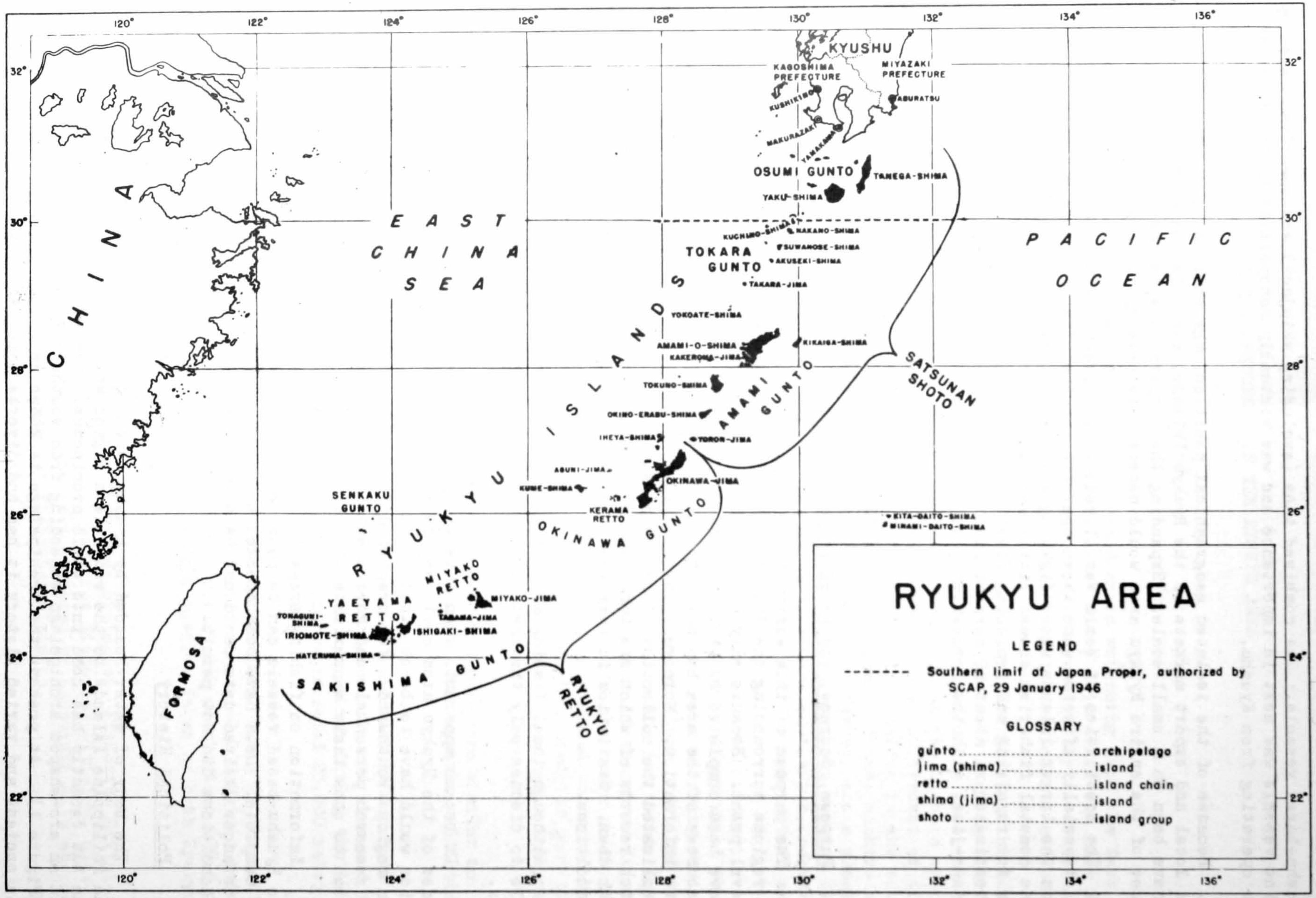
Although local fishing methods are many and varied, limitations of space make it possible to discuss only the most important of the fishing techniques practiced by the islanders.

It became apparent, when this study was planned, that a true evaluation of the resources of the Ryukyu area could not be made by surveying local fisheries alone. Information would have to be obtained on the scope of Japanese operations from Kyushu into the sea regions southward. Few precise data on these operations are available, but fishermen, research personnel, and government fishery officials have supplied sufficient information to show their approximate status.

Information on fishing areas for the major fisheries operated by the Ryukyuans and the Kyushu-based vessels can be considered reasonably accurate, although only partially complete. Data have been checked at many conferences with fishermen, but in several instances desired data could not be obtained without additional field investigations, which conditions did not permit.

2. Political History

The body of water bounded by Kyushu on the north, China on the west, and Formosa and the Philippine Islands to the south is a region which once was little known to western nations but recently has come into world prominence. The main geographical feature of the area is an arc-shaped archipelago extending from southern Kyushu southwesterly toward Formosa (Figure 1). At present the archipelago is known as the Ryukyu Islands, but throughout its ancient and varied history it has had diverse names and has undergone many political changes.



NATURAL RESOURCES SECTION GHQ SCAP

Figure 1

Before Japan controlled these islands, they were under Chinese jurisdiction and were known to Occidentals not only as the Ryukyu (also spelled Riu-kiu) Islands but also as the Luchu (also spelled Lew Choo, Loochoo, and Liu Chiu) Islands. Through a series of invasions and counter claims, sovereignty gradually was transferred to the Japanese, and in 1894 the islands became an acknowledged part of the Japanese Empire. The Japanese divided the islands into two political groups. Those north of Okinawa-jima were placed under the jurisdiction of Kagoshima Prefecture, and all remaining islands southward to Formosa were organized by the Japanese into Okinawa Prefecture. Japanese maps generally designate the northern island groups as the Satsunan Shoto, the southern as the Ryukyu Retto, and the entire archipelago as the Nansei Shoto. "Nansei" is a geographical term of recent date.

A directive by the Supreme Commander for the Allied Powers, Tokyo, Japan, dated 29 January 1946, removed from Japanese jurisdiction all islands south of Latitude 30°N, including Kuchino-shima, which lies across this latitude. The name "Ryukyu" is now applied to the islands south of the designated line.

3. Aquatic Resources

The waters surrounding the various islands of the Ryukyus contain valuable marine resources. Among the most important of these are the pelagic tunas and spearfishes 1/, which either remain in the area throughout the year or make seasonal migrations through the island chain, and the bottom fish in the shallow waters of the East China Sea. These resources, however, have been exploited but little by the Ryukyuans, who have fished close to their islands. Japanese vessels have all but monopolized offshore operations within the Ryukyu and adjacent areas.

The geographical isolation of the Ryukyu Islands, with their small populations and limited markets, accounts for the small scale of most of their fishing operations, for to expand the fisheries to take full advantage of the available resources of the entire Ryukyu area would require development of large export outlets. Even before World War II, export shipments were small compared with the amounts needed to support thriving large-scale fisheries. Moreover, large vessels fishing from Japan Proper and backed by sufficient capital could withstand Ryukyuan competition, which had to import gear, fuel, and boat materials from either Formosa or from Japan Proper.

Ryukyuan fisheries are of two main types, (a) small-scale, traditional operations in coastal waters by individual fishermen or small groups using skiffs, and (b) offshore operations by somewhat larger motor-driven vessels. As is usual with small-scale coastal operations in the orient, fishing methods are exceedingly primitive, but surprisingly effective. Much of the gear in use has been constructed by the fishermen themselves, with little outlay of capital. Such operations are of a local nature and have been governed by a strict code of local unwritten regulations. In many instances such details as those of deciding the time for fishing, dividing the shares of the fishermen, and disposing of the catch have been controlled by superstitious beliefs, varying with the members of different island groups.

Coastal fishermen took about 40 percent of the fish products landed at all Ryukyu ports. Numerous types of gear were employed, ranging from simple basket traps to the elaborate drive-in-nets. They have been devised ingeniously to overcome the difficulty of fishing in waters where the islands are almost completely surrounded by coral reefs and

1/ The terminology given here for the tunas and spearfishes follows that in the report on the Japanese tuna fisheries (Shapiro, 1948, pp 10 and 12). The name "tuna" is often used by the Japanese as an inclusive term for all species of tunas and the spearfishes; when a distinction is made, tuna includes black, big-eyed, and yellowfin tunas, skipjack, albacore, and other allied forms, whereas spearfishes include swordfish, sailfish, and marlins.

rocky bottom, and where the use of most standard fishing methods is impossible. The Ryukyu fishermen, especially those living at Okinawa-jima, are superlative swimmers, and many of their fishing techniques are based on their ability to swim down and chase fish from inaccessible places into nets. The Okinawan fishing methods are so effective that the techniques they originated have been introduced not only into all Ryukyu islands where they are practicable, but into some distant areas as well.

During the period when the Japanese controlled the Mandated Islands (1918-45) and attempted to develop the fisheries in that region, many Ryukyuans went to the southern seas to fish for Japanese companies. Other Ryukyuans, finding a small market and low prices for their catches at home, emigrated to the Dutch East Indies and Singapore where they practiced the drive-in-net fishery with much success. The number of Ryukyu drive-in-net fishermen in the southern regions eventually exceeded the number then fishing by that method in Ryukyu waters. This emigration strikingly illustrates why the Ryukyu catch of aquatic products never attained large proportions, despite the available resources. Although the Ryukyu fish fauna is not so abundant as that in northern waters, where sardines, herring, cod, salmon, and other species contribute to enormous catches, it is extremely varied in nature. Species are numerous, fishing techniques are many, and sizable catches are possible. However, as the island populations are small, limited operations could supply enough fish and other marine foods for the needs of the people and even provide a surplus for the small export trade.

The offshore fisheries took about 60 percent of the total fish catch landed in the islands, but, compared with the catch made by Kyushu-based Japanese vessels, these fisheries were relatively undeveloped. Most Ryukyu vessels were less than 20 gross tons and with few exceptions did not go more than 50 miles from their home port. Because offshore fishing requires large boats with relatively strong financial backing and a dependable market for the disposal of the catch, the Ryukyu offshore fisheries never attained their full possibilities. Skipjack pole and line and tuna long line vessels from Kyushu carried on the major portion of the offshore operations in the Ryukyu area.

As the Ryukyuans had no incentive to expand their fisheries beyond primitive coastal and single-day offshore operations, outside aid was necessary. During the 1930's the Japanese began to encourage the development of more modern enterprises, in keeping with their over-all program of expanding fishing activities. Little progress could be made, however, because the main fisheries in the area were dominated by the Kyushu fishermen. Experimental projects to aid in developing the resources of the area were undertaken locally by the Okinawa Fisheries Experimental Station. Chief among these projects were: (a) an investigation of skipjack fishing and the availability of live bait in the sea area extending from Kagoshima to Formosa; (b) an investigation of tuna long line fishing to determine the best fishing grounds and the best season of operation; (c) the location of coral grounds; (d) processing experiments for better utilization of the catch; (e) fish refrigeration and cold storage; (f) sponge, seaweed, and shellfish culture; and (g) freshwater fish culture. Lack of funds hampered many of the experiments. Some progress was made in the culture of sponges and seaweed, items in great demand in foreign markets.

World War II interrupted the development of indigenous resources of the Ryukyu area and reduced many of the fisheries to a deplorable state, especially those operating on the offshore grounds. The smaller coastal fisheries showed little war damage, but they have been hampered by lack of adequate materials for repairing and replacing nets and other gear which cannot be made locally. The offshore fisheries were affected most severely because they were based almost entirely in the larger islands, particularly Okinawa-jima. Virtually all vessels were lost, shipyards were destroyed, and the few prewar processing and refrigeration plants were damaged beyond repair. Present total production by the Ryukyuans is estimated at about 50 percent of the normal prewar catch, which was about 14,650 metric tons. Okinawa-jima, with the largest population, is in an especially critical state.

The marine resources of insular people, inhabiting small land areas, play a dominant role in their daily lives and contribute to their material wealth as well as their normal diet. Thus rehabilitation of the fisheries is an urgent problem for administrators now in charge of reconstruction. Rebuilding the offshore Ryukyu fisheries to their prewar level depends on heavy capital outlay. Materials such as netting, cordage, and petroleum are in critically short supply and must be imported. Development of processed fishery products, part of which might be exported to obtain needed supplies, requires technical and financial assistance. Rehabilitation is further complicated by the fact that economic ties, which were very strong with Japan Proper, are difficult to re-establish because the Ryukyuans have little to export at present.

The chief prewar export item was dried skipjack stick (katsuobushi), about 500 metric tons (dry weight) of which were sent to Japan Proper annually. Seaweed (Digenea simplex) for medicinal use in Japan also was in great demand, and in 1940, 125 metric tons (dry weight) were exported from Naha port. Small amounts of red coral were sent to Italy, dried shark fin and cuttlefish to China, and dried sardine to Japan. During years of peak production about 300 metric tons of shells were shipped to Japan to be manufactured into buttons. These export markets undoubtedly can be reclaimed and possibly expanded. Experiments with sponge, oyster, and seaweed culture have shown possibilities for producing such items on a commercial basis, and the products could be exported to Japan and other countries. High-vitamin content shark liver oil is in demand in the United States, so the availability of the species which can supply this demand should be investigated.

GEOGRAPHIC AND OCEANOGRAPHIC FEATURES OF THE RYUKYU AREA

1. General

Fishing techniques, their scope and practicability, are conditioned largely by the geographical and physical features of a region. Often the methods used are of local origin, designed to take advantage of topography and the individual behavior of a species. This is especially true in the Ryukyu area, where fishermen use many small-scale techniques unknown in other parts of the world. Much of the individuality of Ryukyu fishing methods also can be attributed to physical conditions which make the area a meeting place for fishes from the temperate and tropical zones.

2. Geography

The Ryukyu Archipelago (Figure 1) is composed of some 60 named islands, of which 25 have areas of four or more square miles. If named islets, rocks, and exposed reefs are included, the number is increased to more than 180. Lying as it does within the path of the Kuroshio 2/, the chain of islands is surrounded by seas warm enough to permit coral growth. As a consequence, practically all the islands except the northernmost have fairly extensive reefs, some of which are several miles wide. Okinawa-jima and Amami-o-shima are the largest islands in the archipelago, being 471 and 274 square miles respectively. A population census as of 1 October 1940 gave the number of inhabitants of the archipelago as 818,624, with 574,579 living in the Ryukyu Retto (Okinawa Prefecture) and 244,045 in the Satsunan Shoto (then a part of Kagoshima Prefecture). The largest concentration of people, 435,681, was on Okinawa-jima, followed by Amami-o-shima with 81,138 inhabitants.

The island chain consists of seven geographical sub-groups:

Osumi Gunto: The northeasternmost group of those forming the Ryukyu Archipelago consists of eight islands and a few rocks. The two largest islands, Tanega-shima and Yaku-shima, are directly below the southern tip of Kyushu and are within the 200-meter line of the Japanese continental shelf (Figure 2). These islands are separated from the other islands of the group by waters from 500 to 600 meters deep. Rocky areas and reefs are fre-

2/ Black, or Japan, Current.

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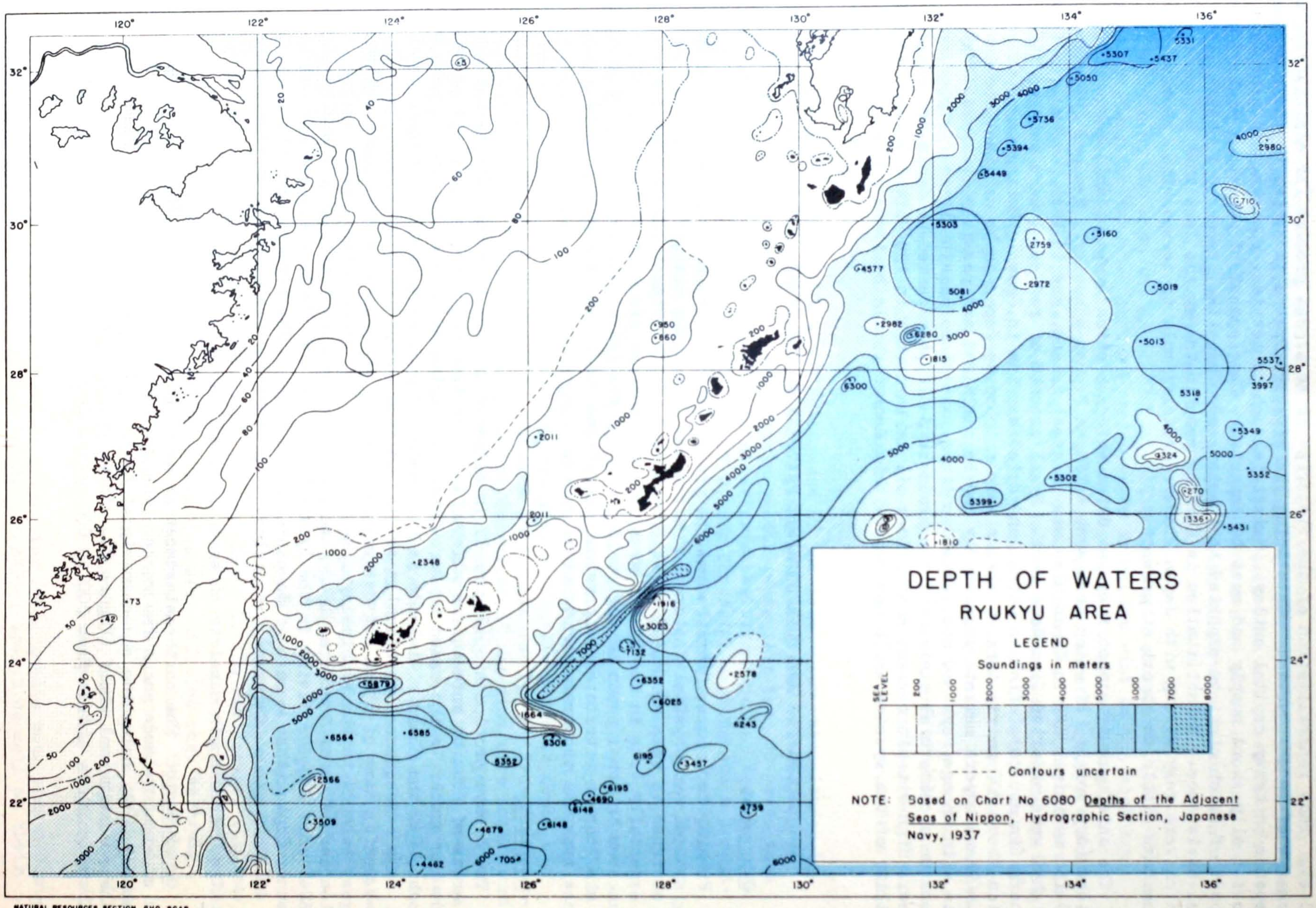

Figure 2

quent although not so extensive as in the islands to the south. The fauna of the islands differs little from that of southern Kyushu. The group is still under the jurisdiction of Kagoshima Prefecture.

Tokara Gunto: This group of small mountainous islands, islets, and rocks extends in an almost linear series from Kuchino-shima south to Yokoate-shima. Reefs occur along the coasts of the islands, and there are no sheltered anchorages. The waters east of the group and between Yaku-shima and Amami-o-shima are over a trench 1,000 to 2,000 meters deep (Figure 2). The sea bed west of the trench becomes shallower and is less than 1,000 meters deep in the general area of the islands. To the west, waters 1,000 meters or more in depth separate the islands from the broad shallow expanse of the East China Sea. The numerous shallow (less than 200 meters deep) isolated water areas surrounding the small islands make the region an excellent fishing ground, exploited especially by the skipjack vessels from Kyushu.

Amami Gunto: This group, the southernmost in the Satsunan Shoto, is composed of five principal islands and several smaller ones. Historically these islands always have had close ties with Japan Proper. The second largest island in the Ryukyu chain, Amami-o-shima, is within the group. Other islands are Kikaiga-shima, Kakeroma-jima, Tokuno-shima, Okino-erabu-shima, and Yoron-jima, the southernmost of the gunto. There are raised and fringing coral reefs along portions of the coasts of all the islands and wide reefs off the northeastern and northwestern coasts of Amami-o-shima.

Okinawa Gunto: This island group, the farthest north of those which constituted Okinawa Prefecture, was the most important under Japanese rule. Okinawa-jima, the largest island in the archipelago, was and still is the central seat of government. Most fishing operations, especially those in the offshore waters, were controlled from this island, and it was here that the Japanese placed the Okinawa Prefecture Fisheries Experimental Station. Other important islands included in Okinawa Gunto are Kume-shima, the Kerama Retto (a cluster of islands west of the southern tip of Okinawa-jima), Aguni-jima, and Iheya-shima. A large shallow-water area within the 200-meter line (Figure 2) surrounds all islands in the group with the exception of Iheya-shima and smaller associated islands, which are separated from the main islands of the gunto by waters 300 to 500 meters deep. All the islands are surrounded by coral reefs, with channels through the reefs only where fresh-water streams empty into the ocean. The abundance of coral bottom in these shallow waters accounts for the unique types of fisheries for which the Okinawans are famous.

Sakishima Gunto: Sakishima Gunto is composed of two clusters of islands, Miyako Retto and Yaeyama Retto. Coral reefs and rocks, both submerged and raised, are numerous, and shallow water areas are extensive. Many of the techniques developed by the Okinawans for fishing in areas where reefs and shoals abound have been successfully introduced into these waters.

(a) Miyako Retto: This cluster of islands is separated from Okinawa Gunto by a large ocean area which includes waters more than 1,000 meters deep and patches of shallow water (less than 200 meters deep) in which submerged coral reefs can be noted on hydrographic maps. The islands in this cluster admit of further subdivision into two groups, Miyako-jima being the largest island in one group and Tarama-jima in the other.

(b) Yaeyama Retto: The islands of this chain are separated from Miyako Retto by waters about 400 meters deep. Ishigaki-shima and Iriomote-shima, the two principal islands, and several smaller islands are separated from Yonaguni-shima by water 300 meters deep. The sea bed between Yonaguni-shima and Formosa is about 800 meters deep.

Senkaku Gunto: North of Sakishima Gunto and on the southern edge of the bank which extends outward from the China coast is a group of small islands, rocks, and exposed reefs. These islands have no permanent population, but valuable Ryukyu fisheries have been operated in the vicinity, and fishermen from Okinawa-jima, the Yaeyama Retto, Kyushu, and Formosa frequent them during the fishing season, from May to August.

Daito Shima: East of Okinawa Gunto and separated from it by the deepest trench in the Ryukyu area (more than 7,000 meters deep) are three small islands, Kita-daito-shima, Minami-daito-shima, and Okino-daito-shima 3/. Administratively the Japanese included them in Okinawa Prefecture, and they are still under the central government of the islands. A few fishing grounds in the general area of the two northern islands are sometimes visited by tuna long line vessels from Kyushu. Otherwise the islands have little importance as fishing bases. Local fishing operations by the inhabitants supply their requirements.

3. Oceanography

Japanese naval surveys have produced the only work of any consequence on ocean depths, water currents, and water temperatures in the Ryukyu area (Figures 2, 3, and 4). Such factors are unquestionably important in any survey of the aquatic resources of an area, but the Japanese have made few basic studies on the relation of physical factors to biological productivity. Despite the inadequacy of the biological work, note can be made of several important facts which largely account for the type of aquatic fauna that is known to exist in the Ryukyu area, and for the fishing methods practiced to exploit this fauna.

The major current flowing through the Ryukyu area is the Kuroshio. This warm oceanic current arises from the North Equatorial Current of the Pacific Ocean, pursues a northeasterly course to the east of the Philippine Islands, and then from Latitude 20°N trends north, passing along the eastern coast of Formosa. As the current approaches the broad, shallow Chinese continental shelf northeast of Formosa, it changes direction. A weak branch of the Kuroshio flows over the East China Sea and enters the Japan Sea through the narrow strait between Korea and Kyushu. The main body of the Kuroshio, flowing as fast as 3.0 knots per hour, passes northeasterly over sea bottom 1,000 to 2,000 meters deep. To the west is the great shallow mud and sand shelf of the East China Sea. To the east is the Ryukyu island chain with only a few deep-water passageways (more than 1,000 meters) interrupting its almost unbroken extent of shallow waters: a channel south of Okinawa-jima, two patches of deep water north of the island, and a trench north of Amami-o-shima (Figure 2). Weak branches of the Kuroshio sometimes break through the passages north and south of Okinawa-jima. However, the main body of the stream seeks its outlet north of Amami-o-shima and passes northeastward along the Pacific coast of Japan.

In summer the Kuroshio broadens out so that weak northeasterly currents sometimes are evident on the eastern side of the islands; at other seasons the current is found as a rule only to the west, the edge usually being at the 200-meter line. Tidal currents in the open ocean east of the Ryukyu chain are weak or absent.

The Kuroshio has a strong effect on the marine species. It divides the fauna of the Ryukyu Archipelago into temperate and tropical types. The islands south of the point at which the main current generally crosses the archipelago (north of Amami-o-shima) have extensive growths of coral, and some are surrounded almost completely by fringing reefs. The warmth that the Kuroshio brings northward is evident from the isotherms of surface water temperature which bend up sharply in the Ryukyu area (Figures 3 and 4). These factors account for a rich and varied fauna, predominantly tropical from Amami Gunto south. The fish fauna of Osumi Gunto and southern Kyushu is more typical of temperate waters and is comparable to that of the East China Sea.

East of the Ryukyu Islands the sea bottom drops off rapidly to depths of 4,000 meters or more, except for the waters immediately surrounding Daito Shima. The fauna of this region is little known except for the migratory tunas and spearfishes caught in small amounts by tuna long line vessels operating from Japan Proper.

3/ Okino-daito-shima is not shown on Figure 1. It is about 92 miles south of Minami-daito-shima.

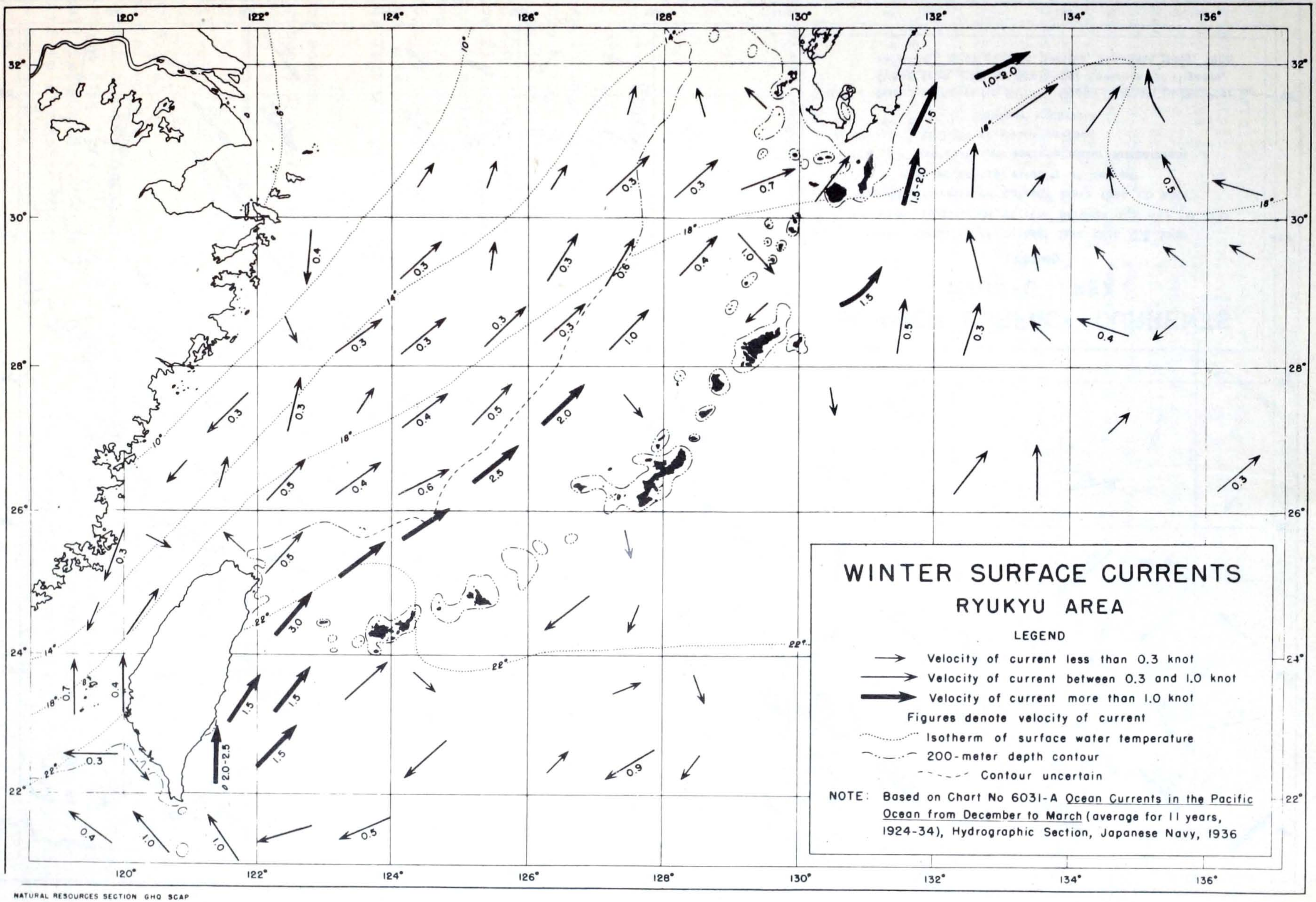
WINTER SURFACE CURRENTS
RYUKYU AREA
LEGEND
Velocity of current less than 0.3 knot
Velocity of current between 0.3 and 1.0 knot
Velocity of current more than 1.0 knot
Figures denote velocity of current
Isotherm of surface water temperature
200-meter depth contour
Contour uncertain
NOTE: Based on Chart No 6031-A Ocean Currents in the Pacific Ocean from December to March (average for 11 years, 1924-34), Hydrographic Section, Japanese Navy, 1936
NATURAL RESOURCES SECTION GHQ SCAP

Figure 3

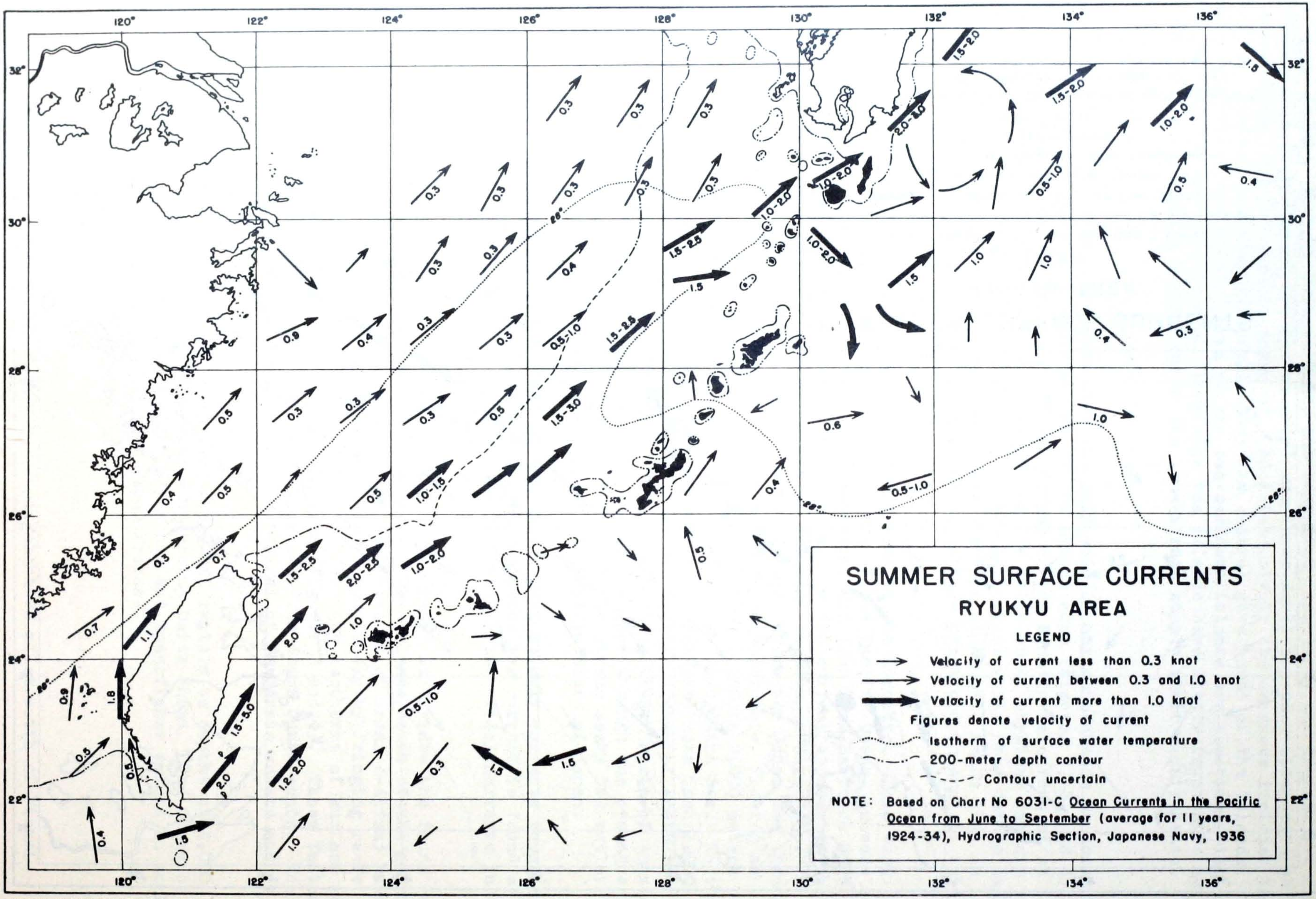

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Figure 4

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FISHES OF THE RYUKYU AREA

Detailed and comprehensive studies on the ichthyofauna of the Ryukyu region are numerous but inconclusive. The paper by Schmidt (1930) on the geographical distribution of the fishes of the Ryukyu Islands, although preliminary and probably based on less than one-half the rich ichthyofauna, shows the tropical nature of the majority of the fishes taken in the area. Only 7.8 percent (35 out of 447 species recorded for the Ryukyus by Schmidt) are common with Japan alone and have the Ryukyus as the southern limit of their distribution. These may be considered the temperate zone elements of the fauna. Another group, 23.0 percent (103 species), is common with Japan, the Philippines, Formosa, the East Indies, and the Indian Ocean. Most of these species are tropical and reach only the southernmost part of Japan (Kagoshima and Nagasaki prefectures) or occasionally the coasts of the more northerly Japanese islands. The remaining majority of the species have the Ryukyus as their northern boundary and for the most part are Indo-Pacific forms with a wide range of distribution, reaching the islands either by following the course of the Kuroshio (which sometimes carries a few species as far north as Tokyo) or by following the coast of Asia northward. In Schmidt's tabulation, 49 species are noted as being endemic to the islands. Because many of these are little-known species, future work may extend the distribution of a few to other parts of the Pacific.

A list of the economically important food fishes of the Ryukyu Islands is included in this report as an appendix. This list was prepared by Mr Tokiharu Abe of the Central Fisheries Station of Japan and the Zoological Institute, Faculty of Science, Tokyo University.

FISHERIES OF THE RYUKYU AREA

1. General

The Ryukyu Islands are part of a larger island chain extending from the East Indies through the Philippine Islands into Japanese waters. Along this chain the warm Kuroshio brings many tropical species northward, thus producing a varied and diverse marine fauna in the Ryukyu area. Numerous reef fishes abound in the waters immediately surrounding the islands, and many unusual and primitive types of gear are used locally by the native fishermen to exploit this fauna. In addition, pelagic species such as the skipjack, Spanish mackerel, and dolphin come near enough to the islands for the natives to catch them by small-scale coastal operations. Tunas, spearfishes, and sharks are as a rule found in the deeper waters farther from land, where some species are found all year and some seasonally, as they move through the island area on their annual migration northward into Japanese waters.

The tunas and the spearfishes are the most important of the species taken in numbers adequate to support large-scale commercial operations. These forms either follow the northward flow of the Kuroshio or remain in the Ryukyu area throughout the year. Although little is known about their migrations and habitat preferences, several facts reported by fishermen and fisheries investigators help explain the importance of the Ryukyu offshore and, to a lesser extent, coastal operations for these species. These reports indicate that high water temperature, the presence of the Kuroshio and other minor currents, and the contour of the ocean bed with its many shallow banks and deep runways are among the physical factors of the Ryukyu area which adapt it to the presence of the migratory fishes. Commercial operations for the tunas and the spearfishes are carried on most often where the current changes direction because it impinges on extensive shallow water areas, or where a sharp drop in water temperature occurs within a small area, or where reefs, rocks, and small islands are within the path of the current, as the migratory fishes are usually found in abundance under these conditions. Moreover, operations in the Ryukyu area are not hampered by rough and stormy weather for long periods, except during a few winter months.

In addition to local Ryukyu operations, skipjack pole and line and tuna long line vessels based at ports in southern Japan direct their operations into the area, especially during the seasons when the migratory tunas and spearfishes are not available in Japanese waters.

The main types of gear, places of operation, and main species taken in the Ryukyu area are shown in Table A on page 17.

2. Coastal Fisheries

The coral reefs and rocky bottom around and near many of the Ryukyu islands have been the main factor in determining the types of gear that the Ryukyuans have developed for their coastal fishing (Table A). Operations that contribute much to the Japanese coastal catch, such as beach seining, trawling, and dredging, are impossible in the Ryukyus 4/. To fish coral and rocky areas, the natives have devised and constructed ingenious gear, chief among which is the drive-in-net. Angling (surface and bottom), gill nets (floating and bottom), trolling jigs, stick-held dip nets, sledge nets, and long lines are among the many other gear used, but the inshore catch by each of these is minor compared with that obtained by the drive-in-net. Okinawan fishermen estimate that the drive-in-net takes more than 50 percent of the entire coastal catch.

Tunas, mackerels, horse mackerels, sharks, snappers, sea breams, billfishes, halfbeaks, flying fishes, sardines, and a great variety of tropical coral reef fishes (see Appendix) are among the more important species taken by coastal operations. Spiny lobster, shrimp, sea turtles, squid, cuttlefish, seaweed, and shellfish also contribute to the catch.

Drive-In-Net Fishery: This technique is believed to be entirely Ryukyuan in origin. Fishermen from the Itoman district of Okinawa-jima devised this method about 1860 for fishing in shallow waters (Figure 5) where long stretches of the coast are fringed with coral reef or where the ocean bottom is rocky. Because large hauls of fish, impossible by standard fishing techniques, can be caught with the drive-in-net and because almost all the islands south of Latitude 30°N are surrounded by extensive coral and rocky areas, this method of fishing has become the most effective of all those conducted in Ryukyuan coastal waters.

Snappers and allied forms, usually taken close to the surface, and butterfly fishes, caught at deeper levels, are the most important fish obtained with this gear. Many other types of tropical coral reef fishes, as well as sardines, horse mackerels, shrimp, and squid, also are taken.

Drive-in-net fishing for reef fishes is carried on all year, being suspended only because of rough weather or to repair and dye the netting. The net may be used in waters as deep as 45 meters. If the fishermen wish to operate near the surface or the water is too deep to set the net on the bottom, they reduce the size and number of the stone weights on the lead line and make adjustments between floats and weights to suspend the net at the desired level. If the fish are in reefs deeper than 45 meters, the fishermen drive them into shallower water (where the net has been set) by using scare ropes adjusted to the greater depth.

All drive-in-nets follow the general principle of driving fish out of reefs or rocky shallow areas and into the net. The construction of the drive-in-net varies with the preferences of local groups of fishermen and with the species desired. A description of one of the simpler types (Figure 6) now used widely throughout the islands to catch tropical reef fishes follows on page 20.

4/ Trawling is impractical outside the reefs and the rocky coastal area because the bottom drops away too rapidly. The nearest trawling grounds are in the East China Sea.

TABLE A. - FISHERIES OF THE RYUKYU AREA

Type of Gear	Place of Operation	Main Species Taken
Coastal a/		
Drive-in-net b/	Usually sandy bottom near coral reefs, in water 15-to 45 meters deep	Reef fishes (chiefly snappers and butterfly fishes), mackerel scad, horse mackerel, sardines, shrimp, squid
Angling		
Surface (pole and line)	From coast to about 20 miles offshore	Skipjack, small yellowfin tuna, needlefish
Below surface (hand line)	From coast to about 20 miles offshore	Tunas, sharks, mackerel scad, snappers
Trolling	Off small peninsula where current is strong	Skipjack, Spanish mackerel, dolphin, billfish
Gill net		
Drift or floating	From coast to eight miles offshore	Flying fish, mackerels, needlefish, halfbeak, sardines
Bottom	Coastal waters, 5 to 50 meters deep	Reef fishes, sharks, squid
Stick-held dip net	Coastal waters, 5 to 15 meters deep where current is strong, usually off small peninsula	Reef fishes, sardines
Sledge net	Coastal waters, less than one meter deep	Halfbeak, sardines, mullet, shrimp, silversides
Long line	From coast to about 20 miles offshore, on sandy bottom	Sharks
Miscellaneous (traps, spears, hooks)	Coastal waters, generally 10 to 15 meters deep	Squid, sea turtles, mackerel, reef fishes
Offshore a/		
Long line b/	In areas where migratory fish movements are hindered by reefs or shallow banks or where direction of current changes	Tunas (except skipjack), spearfishes, sharks
Angling		
Surface (pole and line) b/	Over shallow waters close to rocks, uninhabited islands, and reefs; open water over deep bottom	Skipjack, small yellowfin tuna
Below surface (hand line) b/	Submerged reefs and rocky bottom	Snappers

a/ No definite statement appears in the literature regarding the classification of coastal and offshore categories. In the Ryukyu area those types of gear operated within the 200-meter depth or within 20 miles of the coast may be designated coastal and operations outside these points termed offshore.

b/ Most important gear

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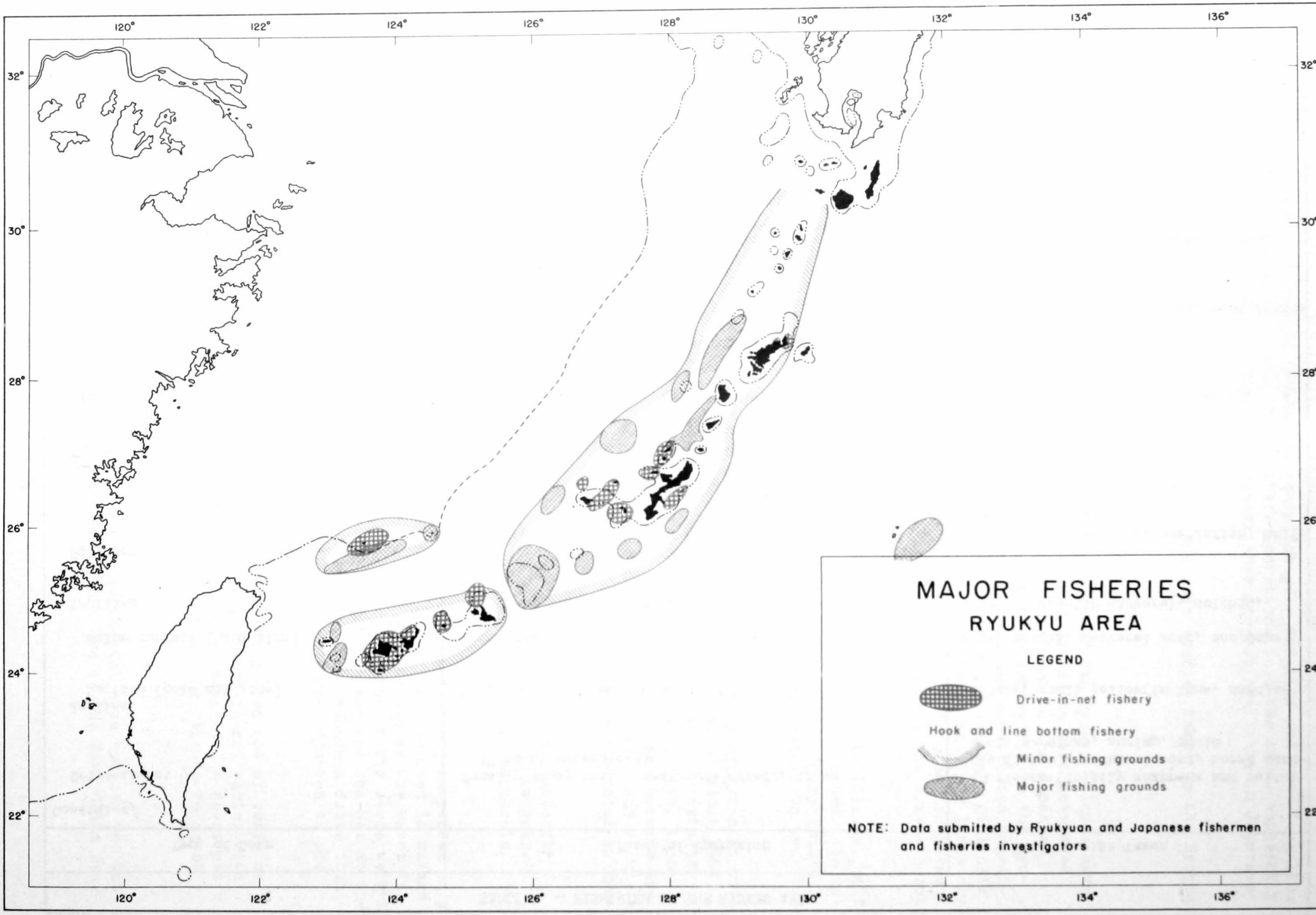

NATURAL RESOURCES SECTION GHQ SCAP

FIGURE 5

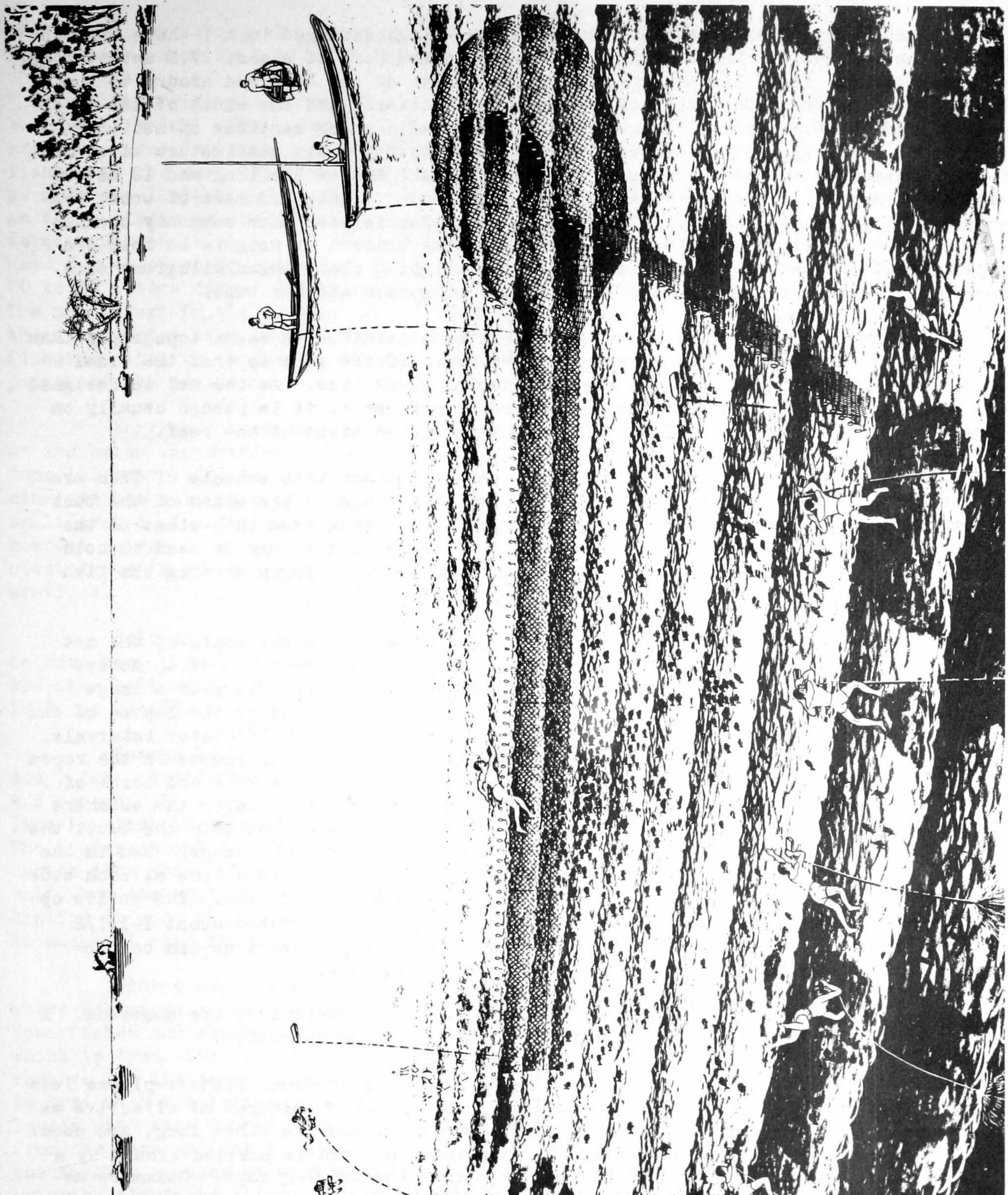

Figure 6. - Drive-In-Net for Reef Fishes

The net is in three sections, a bunt and two wings arranged in a V-shape with the bunt at the apex of the V. The bunt is constructed in the form of a sac, 27.3 meters long. The distance from the float line back to the farthest end of the bunt and around to the lead line is 48.5 meters. The depth of the bunt is 12 meters, and the width of its mouth at the lead line is 16.7 meters. The bunt is constructed of many sections of netting sewed together; the size of the mesh ranges from about three to six centimeters stretched, with the smallest mesh toward the rear. The wing nets are 182 meters long and 12 meters deep, with mesh generally about six centimeters stretched. Floats are made of wood; paulownia wood (Paulownia imperialis) is preferred, but cedar is used more commonly because it is cheaper and readily available. Lead or shells may be used as weights to hold the net in place, but the natives as a rule tie stones, weighing about seven kilograms each, at three-foot intervals along the lead lines of the wing nets and the bunt.

In setting the net the fishermen give more consideration to ocean topography than to water current, although they usually spread the mouth of the bunt so that the tidal flow will not collapse it. Operations are best during slack tide. As the net is designed to catch species that are in among inaccessible rocks and reefs, it is placed usually on sandy bottom near the outer side of a reef or in interrupted areas of the reef.

When the leader of a group of fishermen has determined that schools of fish are present, the drive-in-net operation is begun by tying the wings to the sides of the bunt with Pandanus rope. The net is set with the wing nets extending from both sides of the bunt. If tidal currents are strong, additional large stone anchors may be used to hold the bunt and wing nets in place. The fishermen are now ready to begin driving the fish into the net.

The swimmers are taken to a point about 2,000 meters from the mouth of the net and are deployed in an arc facing it. Each swimmer uses a scare rope, about 45 meters long, with a wooden float fastened at the surface end and three iron rings or a large stone at the bottom end. Three or four bunches of white cloth strips or the leaves of the Pandanus plant are tied near the bottom of the scare rope at 1- or 1 1/2-meter intervals. As the swimmers advance they drive the fish before them. The cloth or leaves on the ropes prevent the fish from turning back, and the iron rings beating on the rock and coral of the sea bed chase the fish out of crevices into the open water. The nearer the swimmers approach the net, the narrower becomes the arc. As the fish are driven into the bunt, the leader and several assistants swim down and unfasten the bunt from the wings. Men in the boats pull the bunt up with hauling ropes which are attached to the lead line at each side of the bunt. The wing nets remain in place for use in the next operation. The entire operation, from setting the net to bailing the fish out of the bunt, takes about 1-1 1/2 hours. With favorable weather and tide conditions, five or six operations can be completed in a day. An average haul is about 1,500-1,750 kilograms.

All drive-in-nets operate on the same principle, but variations are numerous. A few will be cited to illustrate the versatility of this fishing operation.

One type of drive-in-net, also constructed primarily for reef fishes, places less reliance on swimmers. It has been used extensively but is not considered as effective as the newer type just described. Two driving ropes, one short and the other long, are used. One end of each rope is attached to a wing net, and the other end is carried around by a small boat. Scare ropes are suspended at intervals from the driving rope. Swimmers assist by preventing the ropes and nets from tangling and tearing on the coral bottom. As the longer of the two driving ropes is brought around and the fish enter the space between the wing nets, the wings are brought together, forcing the fish into the bunt. The bunt is then raised in the manner indicated above.

Horse mackerels, scads, jacks, and similar species are taken by the drive-in-nets when found in large schools during the summer in the southern Ryukyu Islands. The operation requires much skill. The net is similar in construction but is larger than the one designed for reef fishes. It is operated in the same manner except that the wing nets are hauled slowly into the boats. At this time swimmers hinder the fish from escaping over the margins or through the opening between the front edges of the wing nets and drive the fish slowly into the bunt. The net usually is placed at a depth of about 25 meters.

The drive-in-net also is utilized to obtain small fish for use as live bait in skipjack fishing. The chief species taken for this purpose are members of the Apogonidae and Caesonidae families. This operation is very profitable, as the skipjack live bait fishery is the most important one in the islands and bait is in great demand. The fishing grounds are limited to those places where the desired small fish are known to be present. As these places are too few for the number of fishermen, lots are drawn each year to determine who shall fish the few good localities. In general only the bunt of the net is used for the fishing operation (Figure 7). The net is placed on a submerged reef in water 20 to 35 meters deep. Unlike most other drive-in-nets it never is placed on sandy bottom. The net is set in the evening and allowed to remain overnight. Before the sun comes up the fish emerge from the reefs to seek food and enter the net through the large mesh. The fishermen then raise the net slowly. Swimmers assist in driving the fish into the deep pocket of the bunt.

<u>Angling</u>: Hook and line angling in coastal waters is operated to obtain fish both on and below the surface. Pole and line surface angling for skipjack and small yellowfin tuna and hand line, bottom fishing for snappers (lutianids) and other rock-inhabiting species are the main hook and line fisheries. Usually such fishing is done by individuals or small groups of fishermen using hand-powered craft or small powered boats. Angling in coastal waters is an operation of minor importance in the Ryukyu fisheries, as the efficient drive-in-net has supplemented angling and many other old-type individual fishing operations.

Pole and line angling for skipjack in coastal waters generally is done from April to November. The boats average only six or seven gross tons. The methods used in the Ryukyu live bait skipjack fishery are similar to those used by the Japanese (see Shapiro, 1948, pp 44-45).

Summer bottom fishing with hook and line usually is done in water 9 to 10 meters deep, just outside the reef, although it may be done where the ocean bed is as shallow as 4.5 meters. Snappers predominate among the many species in the catch. The cotton hand line is about 15 meters long, with 7.5 meters kept in reserve for fishing in a fast tide. The leader, about 45 centimeters long, is made of hemp. Lead sinkers are fastened to the cotton line about five meters above the hemp leader. Sliced skipjack roe is preferred as bait, but the meat of horse mackerel, common mackerel, or barracuda may be used effectively. Angling is done throughout the night, except on moonlit nights when the fishermen engage in mackerel scad fishing.

Winter angling for bottom fish is carried on in waters 90 to 300 meters deep, where submerged reefs are known to be present. The catch is composed mainly of snappers. Spearfishes and sharks occasionally are caught by the anglers. The cotton hand line, which is dyed with swine's blood, is about 75 meters long, with some 225 meters held in reserve for the deeper fishing. The leader is made of hemp, six to seven meters long, and is dyed with a solution made from hen's egg. The galvanized iron hook is tied to the hemp leader with fine double-strand wire 15 centimeters long. The meat of a sardine, separated from the bone and cut into two to four pieces, is used as bait. Fishermen generally reach the fishing grounds at daybreak and prepare to locate the proper fishing area. A stone weighing about one kilogram is fastened loosely to the cotton line just above the leader. When the fisherman feels that the stone has reached the ocean bed, a jerk on the hand line releases the stone weight, and fishing begins.

Mackerel scad angling is practiced during summer months in water 20 to 60 meters deep. The sea bottom is located by using a small stone (about 300 grams in weight) as described. Shrimps are used as bait.

Another specialized type of angling is for needlefish and billfish, with live shrimp as bait. A bamboo rod is used to hold the line, whereas in other bottom fishing the line is held by hand. The fishing season is from March to May.

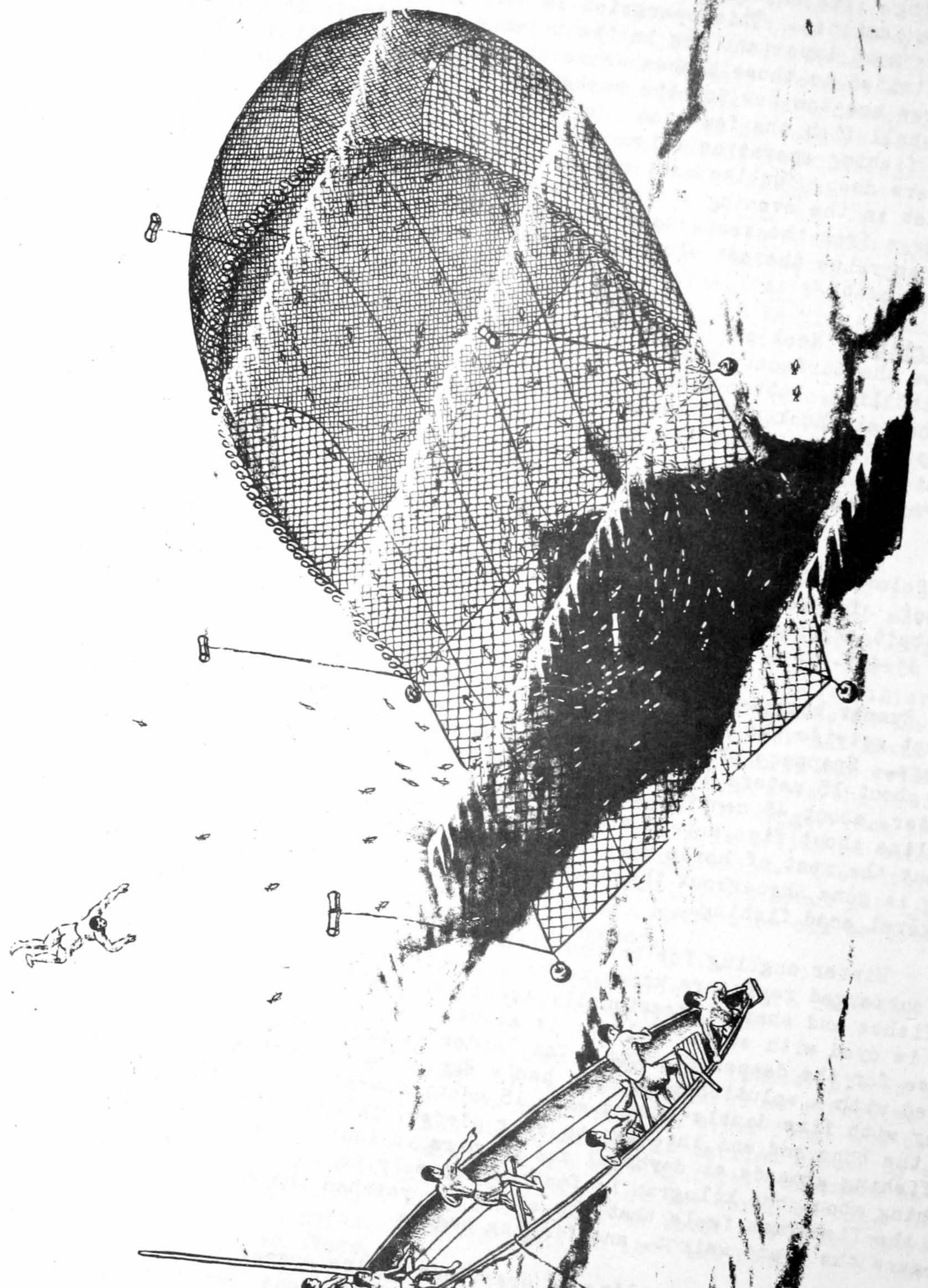

Figure 7. - Drive-In-Net for Live Bait

An interesting but now almost obsolete type of angling has been used to catch cuttlefish and squid in the waters around reefs. Two rods are handled alternately from a skiff by two fishermen. One rod has a lure line 10 meters long with a small hook on which a live shrimp is baited. The other rod has a jig line 2.2 meters long to which is fastened a jig made of a small piece of bamboo weighted with lead. At the end of the piece of bamboo eight small hooks are arranged in a circular fashion, with the barbs facing outward. A live shrimp is baited to the jig line just above the bamboo jig. During fishing, one fisherman handles the lure line and brings it slowly to the surface. If a squid is holding onto the bait it releases its hold upon coming near the surface. Meanwhile the other fisherman has cast the jig line into the water. The squid invariably reaches for the baited jig and is caught by the hooks. This rather primitive method requires a great deal of skill and is used to lure squid out of crevices in the reefs.

Trolling: In recent years trolling in coastal waters has been practiced on a small scale for skipjack, Spanish mackerel, and dolphin, the skipjack being the most important of the species taken. Trolling vessels are either small sailing skiffs operating one or two lines (Figure 8) or powered vessels of about seven or eight gross tons with outriggers holding five or six lines. The natives use the horn of sheep exclusively for jigs. Trolling is carried on throughout the year, whereas live bait fishing for skipjack is practiced chiefly from April through November. The area selected for trolling is usually off a cape where the currents are strong. The natives occasionally troll for billfishes, using a prawn or shrimp for bait instead of a jig.

Gill Nets: Several varieties of gill nets are used by the Ryukyuans, but the gear does not contribute a large catch. These nets are operated only at definite times of the year to obtain certain species. The flying fishes, taken some distance from shore, are the most important species caught by the floating type of gill net. Other floating gill nets are used quite close to shore, often just outside coral reefs, to obtain mackerels, sardines, needlefishes, and halfbeaks. Gill nets placed on the ocean bottom catch sharks, reef fishes, cuttlefish, and squid.

Devices such as scare ropes or sound tubs may be used to chase the fish toward the gill net. The scare rope (see page 20) is handled by swimmers. The sound tub is a wooden barrel with a wooden handle fastened across the open top. Weights are hung from the handle. When the waves move the floating tub, the weights hit the sides of the barrel and make considerable noise. Sound tubs are effective in driving fish out of their hiding places into the net.

A floating gill net for catching needlefishes consists of a bunt, about 20 meters long and 13.5 meters deep, and two wings, each 12 meters long and 7.5 meters deep. The mesh is about two centimeters stretched. Floats are made of cedar wood. The natives use shells as sinkers on the lead line of the wings. A stone weighing about two kilograms is fastened at each corner of the bunt. Two methods of setting the net are used; in one the net is permitted to float freely and in the other the net is held close to a reef by the fishermen (Figure 9). When near a reef the best time to begin the operation is during a rising tide. As the fish swim offshore with the ebbing tide they become entangled in the net. Spring and fall are the usual fishing seasons for this operation in the southern Ryukyu Islands.

Stick-Held Dip Net: This net is used to obtain sardines and silver-sides for use as live bait in skipjack fishing. The gear consists of a net 10 meters square supported by bamboo rods suspended from a wooden stick (Figure 10). The skiff is moored in place by stone anchors during fishing. Sometimes the net is used without any special device for attracting fish, but more often the fishermen spit chewed fish over the surface of the water to bring the fish to the side of the skiff. Torches sometimes are used at night to attract the fish. The Ryukyuan stick-held dip net is rapidly becoming obsolete because most boats now are powered, so the use of larger-type dip nets similar to those operated by the Japanese is possible.

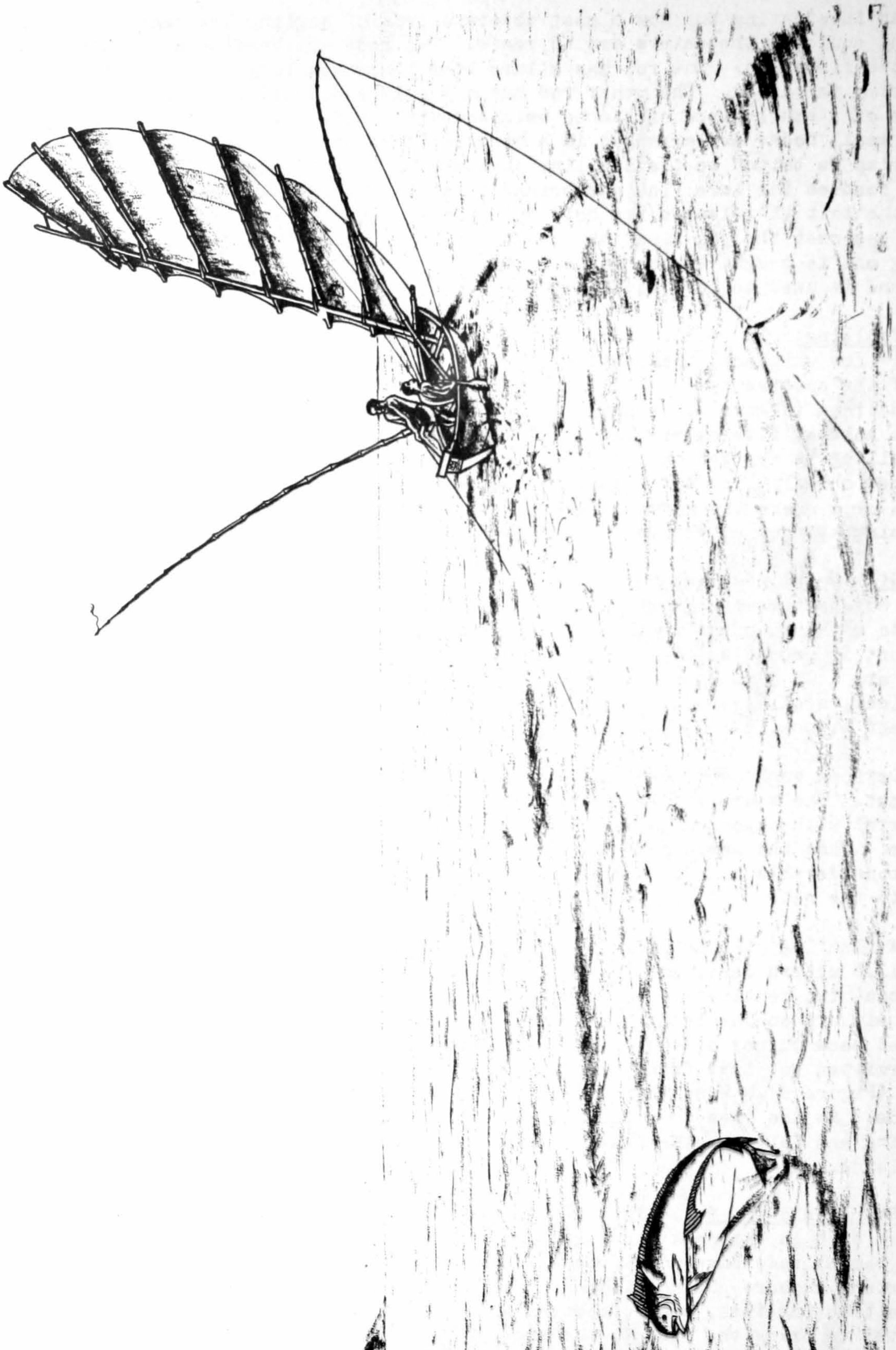

Figure 8. - Trolling for Skipjack, Spanish Mackerel, and Dolphin

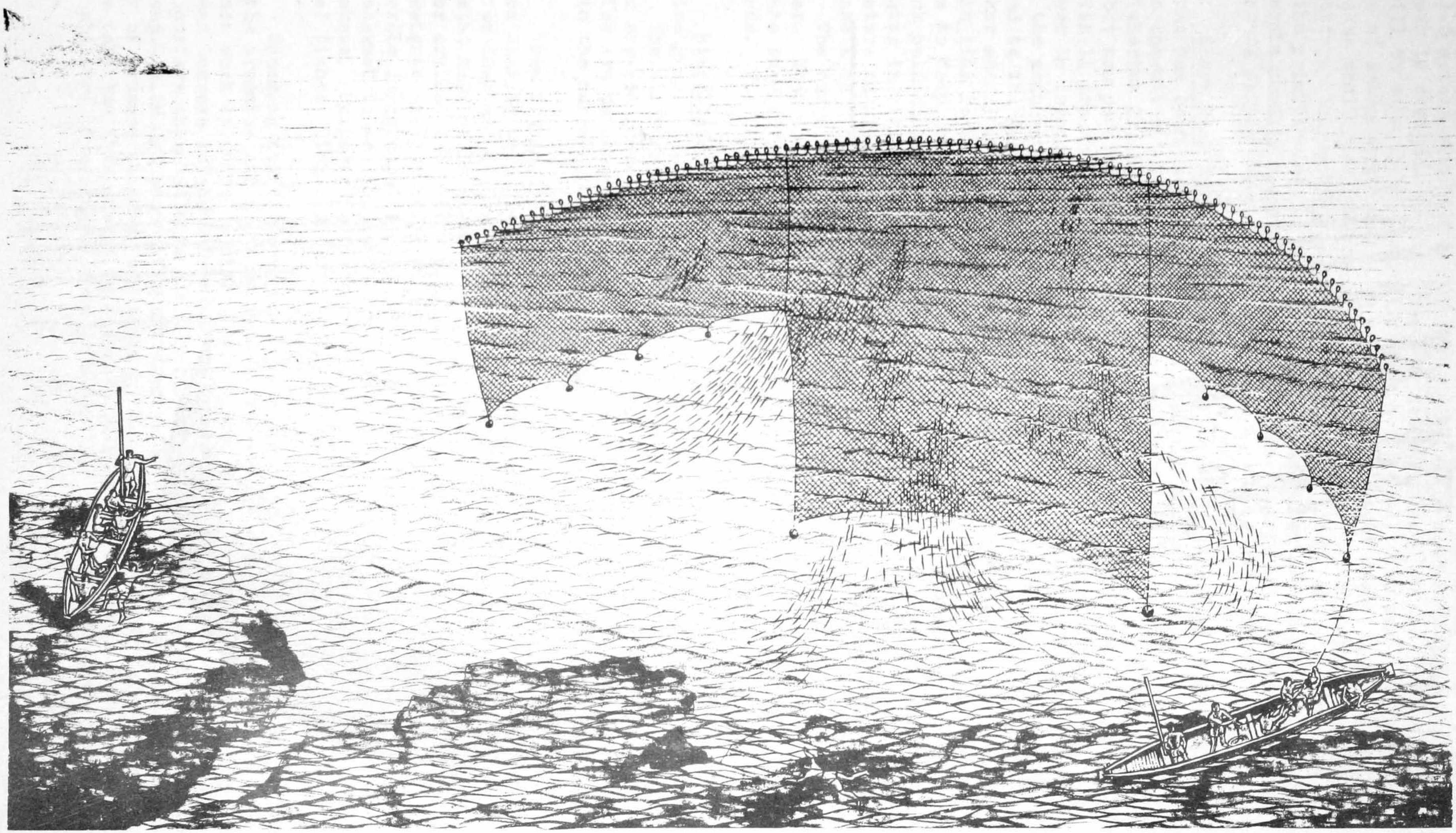

Figure 9. - Gill Net for Halfbeaks

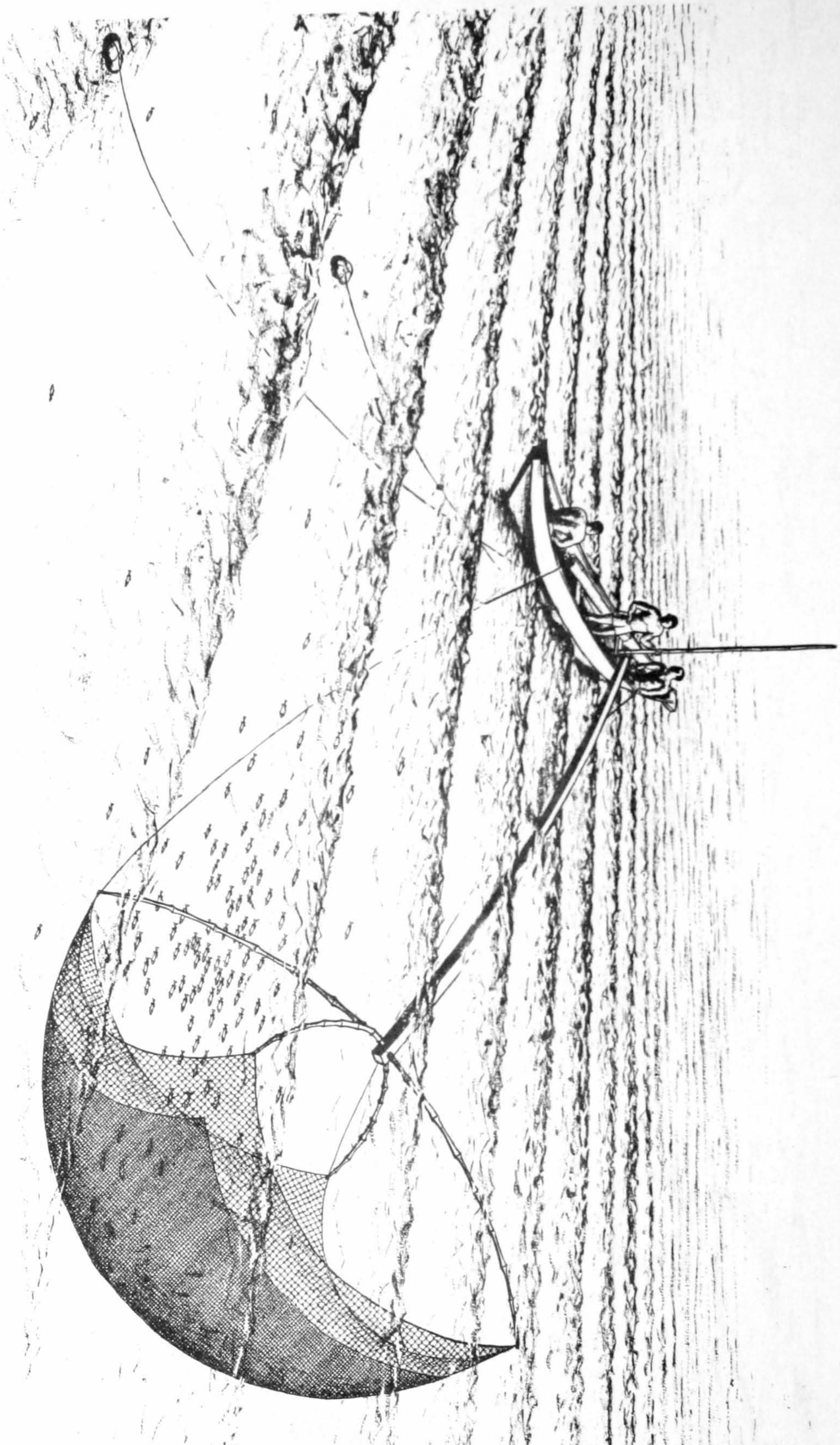

Figure 10. - Stick-Held Dip Net for Live Bait

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Sledge Net: A sledge net consists of a rectangular frame of bamboo and wood about 10 by 1.5 meters with a piece of netting of small mesh stretched over it (Figure 11). The framework is designed so that when the gear is placed on the surface of the water the netting will be at a slight angle from the horizontal. Two small skiffs pull the net on the surface of water which should be less than one meter deep. The disturbance caused by the gear makes small fish jump from the water, and as the net passes under them they drop onto the netting. Silversides, mullets, halfbeaks, shrimp, and other species are caught. Despite the primitiveness of the method, catches often exceed 200 kilograms per night. Elderly people usually operate the gear, because it does not require exhausting effort and because young people frown upon it as being an ancient technique.

Shark Long Line: A variation of the long line gear used in the offshore waters for tunas has been designed for shark fishing in coastal waters. Although this gear has been in operation for more than 40 years, it did not come into wide usage until the Okinawa Fisheries Experimental Station perfected it in 1930. At first, small skiffs were used, but now powered vessels operate the gear. The gear (Figure 12) is about 450 meters long with 11 branch lines strung at intervals from the main line. The line is set from shallower to deeper water and is held in place by large perforated stone anchors at each end of the main rope. The anchor at the shallower end weighs about 40 kilograms and is attached to the main line by old line 27 meters long. Because of the greater water depth the other anchor is heavier, about 50 kilograms, and the anchor rope is 30 meters long. The main line is held off the ocean bottom by four buoy ropes spaced at intervals from shallow to deep water, 22, 27, 30, and 38 meters long respectively. The main line is made of black palm hemp, one centimeter in diameter, and the buoy ropes are cotton, also one centimeter in diameter. The branch lines are constructed as follows: cotton line, six millimeters in diameter and six meters long; a swivel; a leader of wire chain 3.3 meters long; and a hook of forged steel, 36.5 centimeters full length and 12 millimeters in diameter. The buoys are bamboo (Phyllostachys mitis), 1.8 meters long and 30 centimeters in diameter. When a shark takes the hook, which is baited with two to three kilograms of pork, the buoy not only acts as a brake but also signals the fisherman that a strike has been made. The fishing season is from October to May.

Miscellaneous Fishing Operations: The Ryukyuans use many other types of quite primitive gear. Some depend on considerable skill and diving ability to make a worthwhile catch. The daily catch varies considerably but rarely exceeds 50 kilograms. These types of gear are too numerous and restricted in their uses to warrant detailed descriptions, but a few are mentioned to indicate the variety of techniques developed by individual fishermen in the narrow coastal reef zone immediately surrounding the inhabited islands.

Trap fishing: Woven bamboo baskets or a bamboo framework sheathed by cotton netting are used to trap fish, often in water as deep as 15 to 18 meters. The traps are about 0.5 meter deep and two meters wide, with a narrow opening at the top. One fisherman may operate as many as 10 baskets. Bait of boiled sweet potato, sea lettuce, the head of skipjack, or crushed sea urchin is placed around the mouth of the trap and in the interior. Stone weights are put into the baskets to keep them on the sea bottom. The fishermen set the baskets using bamboo poles with wooden hooks at the end. A glass-bottom box permits the fishermen to see the ocean bottom and thus locate the most suitable places for setting the baskets. Periodic visits are made to collect the trapped fish. The main species taken are reef fishes. This type of fishing takes place throughout the year.

Spearing reef fishes: As a rule spearing is done in water 12 to 15 meters deep among the trenches and crevices in the reefs. A spear with a detachable head is used. Fishermen work in pairs, a diver and a man in the skiff. When the diver stabs a fish, the spearhead becomes detached from the bamboo handle, which floats to the surface. The man at the surface then hauls in the fish by the line which is attached from the handle to the spearhead. Although many different species of reef fishes are taken, the catch is composed largely of wrasses weighing one to five kilograms. The catch may be as much as 50 kilograms a day, but this amount is attained only if the fishermen have considerable skill and diving ability. Spearing is done from May to September, with best results during July and August.

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APPENDIX

LIST OF THE ECONOMICALLY IMPORTANT FOOD FISHES OF THE RYUKYU ISLANDS 1/

Although many papers have been written about the fishes of the Ryukyu Islands, knowledge of the economically important species is still fragmentary. Since the author's first visit to Okinawa-jima (Dec 37–Jan 38), he has been studying the Ryukyu fauna, with special attention to the chief marketable forms. Material for this study was obtained from Yaku-shima, Tanega-shima, Amami-o-shima, and many islands of Sakishima Gunto by Dr S. Tanaka, Mr S. Inuo, and the writer. The number of specimens has been so large, and the comparison of the fishes with those of adjoining waters and the tropical Indo-Pacific region has taken so many years to make, that short reports are being published ahead of completion of the study.

In this list are: (1) the scientific names of the economically important Ryukyu fishes, arranged in the sequences adopted by Jordan, Tanaka, and their followers; (2) the Ryukyuan vernacular names gathered by the author during his first and second (Dec 39–Jan 40) visits to Okinawa-jima, followed by common English names; (3) the known geographic distribution of each form in the western Pacific and Indian oceans; and (4) general notes on some of the species. Detailed studies are reserved for future work.

Except for five freshwater species (Cyprinus carpio, Carassius auratus, Misgurnus anguillicaudatus, and two species of Anguilla) all the forms listed are marine. The majority of the fishes are distributed throughout the tropical and subtropical parts of the Indian Ocean and the western and middle Pacific regions. The resemblance of the most important food fishes of the Ryukyu area to those of the Hawaiian Islands is striking.

Family SPHYRNIDAE

Sphyrna zygaena (Linneaus)

Ihei-saba : Hammerhead shark

Widely distributed in warm seas. The economic importance of other species of sharks caught in commercial numbers is difficult to determine because fishermen dispose of their catch without separation of forms.

Family DOROSOMIDAE

Clupanodon nasus (Bloch)

Ashichin : Thread herring

Distributed from India to southern Japan. Especially valued as food by Okinawans. Abundant during March. Enters estuaries.

Family STOLEPHORIDAE

Stolephorus delicatulus (Bennett)

Sururu, Sururu-gawa : Ally of sardine

Distributed in tropical Indian and Pacific oceans, from East Africa to Australia, Ryukyus, Fiji, and Melanesia. Often salted and eaten with rice.

1/ This list was prepared by Tokiharu Abe, Central Fisheries Station of Japan and the Zoological Institute, Faculty of Science, Tokyo University.

Family CLUPEIDAE

Harengula ovalis (Bennett)

Mizun : Sardine

Distributed in tropical Indian and Pacific oceans, from Red Sea and East Africa to the Ryukyus and Polynesia. Clupea mizun Kishinouye is regarded as a synonym. Used as bait for Pristipomoides sieboldii.

Sardinella clupeoides (Bleeker)

Yamato-mizun : Sardine

Distributed from Red Sea to East Indies, the Philippine Islands, Ryukyu Islands, and Kagoshima Prefecture, Southern Kyushu. Clupea okinawensis Kishinouye is regarded as a synonym.

Family CYPRINIDAE

Cyprinus carpio Linnaeus

Kuu-yu : Carp

Endemic in Europe and Asia but has been introduced into many countries. The Okinawans keep the carp in freshwater ponds and value it as food, especially from February to April. Because of lack of freezing and cold storage plants and inadequate transportation, Okinawans living some distance from the coast cannot utilize marine fishes during warm seasons. For these reasons the carp and the following four species of freshwater fishes are important as food in the interior of Okinawa-jima.

Carassius auratus (Linnaeus)

Taa-yu : Goldfish

Endemic in Europe and Asia but has been introduced into many countries. Freshwater. Especially valued as food by the Okinawans from February to April.

Family COBITIDAE

Misgurnus anguillicaudatus (Cantor)

Dojo : Loach

Distributed in Japan, Korea, and Ryukyu Islands (Tanega-shima, Yaku-shima, Amami-o-shima, Okinawa Gunto, and Yaeyama Retto). Freshwater. Expecially prized as food by the Okinawans from May to August.

Family ANGUILLIDAE

Anguilla japonica Temminck and Schlegel

Unagi, Micha-unagi : Common eel

Distributed in Japan, Ryukyu Islands, Korea, China, and Formosa. Taken in rivers. Valued as food in summer.

Anguilla mauritiana (Bennett)

Kawa-unagi, Kaan-no-ji : Giant eel

Distributed from tropical and subtropical parts of the Indo-Pacific region northward to Wakayama Prefecture, Japan. Taken in rivers but considered inferior in taste to the common eel.

Family BELONIDAE

Athlennes hians (Cuvier and Valenciennes)

Shiji : Needlefish

Distributed from tropical and subtropical Indo-Pacific regions northward to southern Japan. Not uncommon in the Hawaiian Islands.

Tylosurus melanotus (Bleeker)

Ke-shijaa : Billfish

Distributed from East Indies to central Japan.

Family HEMIRHAMPHIDAE

Hai-yu : Halfbeaks

Hemirhamphus far (Forskal)

Distributed from East Africa through the Indo-Pacific region eastward to Polynesia and northward to the Ryukyu Islands.

Family EXOCOETIDAE

Tubuu : Flying fishes

Cyselurus rondeletii (Cuvier and Valenciennes)

Probably circumtropical in distribution. It is an important food fish in the Ryukyu Islands and is said to appear in abundance near Okinawa-jima in March. It is much valued for its flavor by the Okinawans when taken in January and February.

Family SPHYRAENIDAE

Kamasaa, Kamashii : Barracudas

Sphyraena obtusata Cuvier and Valenciennes

Distributed from East Africa through the Indo-Pacific region eastward to Polynesia and northward to the Ryukyu Islands. The barracuda is valued as food by the Okinawans, especially during September and October.

Family FISTULARIIDAE

Fistularia petimba (Lacepede)

Hifuchaa : Cornet fish

Distributed from the Indian Ocean to central Japan.

Family MUGILIDAE

Chikura, Bura : Mullets

Mugil cephalus Linnaeus

Distributed in circumtropical warm seas. Other species of mullets are also taken in small amounts by a kind of barrier net (chikura ami).

Family ATHERINIDAE

Hadara : Silversides

Atherina woodwardi Jordan and Evermann

Known from the Ryukyu Islands and Kochi Prefecture, Japan.

Family SCOMBRIDAE

Scomber scombrus tapeinocephalus (Bleeker)

Saba : Spotted mackerel

Distributed from Fukushima Prefecture, Japan, to Formosa and probably to the Philippines; also taken along the eastern coast of Korea and in the Korean Strait. Said to be prized as food on Okinawa-jima in February and March. The writer obtained no specimens of this and the next species, but both species are reported to be important food items.

Scomber scomber japonicus Houttuyn

Saba : Common mackerel

Distributed from Sakhalin to the Philippines. Said to be highly prized as food on Okinawa-jima during February and March.

Rastrelliger chrysozonus (Ruppell)

Gurukumaa, Mureji : Ally of mackerel

Distributed from the Indian Ocean to southern Japan.

Family KATSUWONIDAE

Katsuwonus pelamis (Linnaeus)

Katsuo : Skipjack

Ranges through tropical and temperate seas. Said to be especially abundant near Okinawa-jima in May and June, sometimes entering the Unten Wan (the bay north of Naha). The Okinawans value it especially for its taste during March and April.

Family KATSUWONIDAE (Cont'd)

Euthynnus yaito Kishinouye

Kuchino-yu : Mackerel tuna

Ranges from the Philippines to the Japan Sea and to Chiba Prefecture, Japan.

Auxis hira Kishinouye

Shibuta : Frigate mackerel

Ranges from Formosa to Hokkaido. Appears in the Ryukyus in abundance during July.

Auxis tapeinosoma (Bleeker)

Shibuta : Frigate mackerel

Ranges from Formosa to Hokkaido and probably is taken in the Philippines.

Family THUNNIDAE

Thunnus orientalis Temminck and Schlegel

Ushi-shibi, Kuro-shibi : Black tuna

Known distribution is from the Philippines to the Kuril Islands and Sakhalin. Taken by long line in the Ryukyu area. Valued for its fine taste by the Okinawans during May, but is said to appear most abundantly off Okinawa-jima in June.

Thunnus germo (Lacepede)

Bin-naga-tombo : Albacore

Ranges throughout warm and temperate seas. Taken by long line in the Ryukyu area. Valued as food by the Okinawans during January.

Parathunnus sibi (Temminck and Schlegel)

Mebachi-mishibi : Big-eyed tuna

Known distribution range is from the Philippines to southern Japan. Also reported from Hawaii. Taken by long line in the Ryukyu area. Okinawans value the species for its fine flavor when it is obtained during the winter. Said to appear in abundance off Okinawa-jima during November and December.

Neothunnus macropterus (Temminck and Schlegel)

Aka-shibi : Yellowfin tuna

Known from the Indo-Pacific region to Hokkaido and from Hawaii. Taken by long line.

Family CYBIIDAE

Saara : Seer-fishes

Several species of this family are valued as food by the Okinawans, especially when taken during January and February.

Family TRICHIURIDAE

Trichiurus haumela (Forskal)

Bashikaiyu : Hairtail

Distributed in warm seas of western Pacific.

Family ISTIOPHORIDAE

Istiophorus orientalis (Temminck and Schlegel)

Kanga : Sailfish

Distributed from Formosa to northern Japan.

Makaira mazara (Jordan and Snyder)

Achinui-yu, Kuro-achi : Black marlin

Known from the Philippines to central Japan and from Hawaii. Okinawans value it as food during the winter.

Makaira mitsukurii (Jordan and Snyder)

Achinui-yu : Striped marlin

Known from Formosa to Hokkaido and from Hawaii.

Family CORYPHAENIDAE

Coryphaena hippurus Linnaeus

Manbiki, Fuu, Hyu-nui-yu : Dolphin, Dorado

Known from the East Indies to central Japan and from Hawaii. Taken by lampara net (maki ami) and by long line. One of the most important Okinawan food fishes, being valued for its taste especially during September and October.

Family CARANGIDAE

Trachurus argenteus Wakiya

Gatsun : Horse mackerel

Distributed from Formosa to central Japan.

Decapterus russelli (Ruppell)

Naga-yu : Mackerel scad

Distributed from the Ryukyus to central Japan.

Caranx species

Soji : Jacks

Several species of this genus are valued as food.

Family MULLIDAE

Kataka-shi : Goatfishes

Several species appear in abundance off Okinawa-jima in July and August.

Family APOGONIDAE

Ufumi : Cardinal fishes

Used as bait for the skipjack.

Family SERRANIDAE

Miibae : Sea basses

More than 10 members of this family, belonging to the genera Epinephelus, Variola, and Cephalopholis, are prized highly as food by the Ryukyuans.

Family SPARIDAE

Taius tumifrons (Temminck and Schlegel)

Yunabaru-majiku : Sea bream, Porgy

Distributed from Formosa to central Japan.

Sparus latus Houttuyn

Chin : Sea bream, Porgy

Distributed from Formosa to central Japan. Valued as food in winter.

Sparus aries (Temminck and Schlegel)

Shiru-majiku : Sea bream, Porgy

Distributed from Formosa to central Japan.

Family LETHRINIDAE

Taman, Kuchinaji, Kuchinagi, Kuchinagi-daman,

Yaki-daman, Shitaa-yu : Allies of snappers

Several species of this family are valued as food.

Family LUTJANIDAE (LUTIANIDAE)

Lutjanus (Lutianus) species

Mimichaa, Inakuu, Kasbii, Chinbana : Snappers

About 15 species of the genus are used as food. Some species are said to be poisonous, as at Saipan and some other mid-Pacific Islands.

Family LUTJANIDAE (LUTIANIDAE) (Cont'd)

Pristipomoides sieboldii (Bleeker)

Ma-machi, Machi : Snapper

Known from southern Japan, Hachijo Island (Izu Islands), Ryukyu Islands, and Hawaiian Islands. One of the most highly prized of the Ryukyu food fishes.

Pristipomoides amoenus (Snyder)

Bitaron : Snapper

Known from Ryukyu Islands, Hachijo Island (Izu Islands), and Kochi Prefecture, Japan.

Aprion virescens Cuvier and Valenciennes

Gin-mutsu, Maru-dai : Snapper

Distributed from the Indo-Pacific islands to the Ryukyus, Hawaii, Queensland, and Tasmania.

Etelis carbunculus Cuvier and Valenciennes

Aka-machi : Snapper

Ranges through the tropical and subtropical Indo-Pacific northward to southern Japan. This fish is one of the most highly prized in the Ryukyus and at Kagoshima Prefecture, Japan.

Aphareus rutilans Cuvier and Valenciennes

Torekuchi, Taikochaa : Snapper

Distributed from the Red Sea through the tropical Indo-Pacific to Okinawa-jima and the Hawaiian Islands. Highly prized as food.

Family CAESIONIDAE

Gurukun, Ukuu, Aka-urume (at Amami-o-shima), Aka-jumaa,

Jumaa-gurukun : Red scads

The members of this family are valued by the Okinawans as food in February and March and are most abundant in the latter month. They are used also as bait for skipjack fishing but are not as valuable for this purpose as sardines.

Caesio tile Cuvier and Valenciennes

Known from the Bonin Islands, Kagoshima, Ryukyu Islands (from Amami-o-shima to the Yaeyama Retto), Formosa, Philippine Islands, Amboina, Banda, Gilbert Islands, Caroline Islands, Tonga Islands, and the Society Islands.

Caesio xanthonotus Bleeker

Known from Hachijo Island, Bonin Islands, Japan (Nagasaki and Kagoshima prefectures), Ryukyu Islands (Amami-o-shima to the Yaeyama Retto), Philippine Islands, East Indies, and the Solomon Islands.

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APPENDIX

LIST OF THE ECONOMICALLY IMPORTANT FOOD FISHES OF THE RYUKYU ISLANDS 1/

Although many papers have been written about the fishes of the Ryukyu Islands, knowledge of the economically important species is still fragmentary. Since the author's first visit to Okinawa-jima (Dec 37–Jan 38), he has been studying the Ryukyu fauna, with special attention to the chief marketable forms. Material for this study was obtained from Yaku-shima, Tanega-shima, Amami-o-shima, and many islands of Sakishima Gunto by Dr S. Tanaka, Mr S. Inuo, and the writer. The number of specimens has been so large, and the comparison of the fishes with those of adjoining waters and the tropical Indo-Pacific region has taken so many years to make, that short reports are being published ahead of completion of the study.

In this list are: (1) the scientific names of the economically important Ryukyu fishes, arranged in the sequences adopted by Jordan, Tanaka, and their followers; (2) the Ryukyuan vernacular names gathered by the author during his first and second (Dec 39–Jan 40) visits to Okinawa-jima, followed by common English names; (3) the known geographic distribution of each form in the western Pacific and Indian oceans; and (4) general notes on some of the species. Detailed studies are reserved for future work.

Except for five freshwater species (Cyprinus carpio, Carassius auratus, Misgurnus anguillicaudatus, and two species of Anguilla) all the forms listed are marine. The majority of the fishes are distributed throughout the tropical and subtropical parts of the Indian Ocean and the western and middle Pacific regions. The resemblance of the most important food fishes of the Ryukyu area to those of the Hawaiian Islands is striking.

Family SPHYRNIDAE

Sphyrna zygaena (Linneaus)

Ihei-saba : Hammerhead shark

Widely distributed in warm seas. The economic importance of other species of sharks caught in commercial numbers is difficult to determine because fishermen dispose of their catch without separation of forms.

Family DOROSOMIDAE

Clupanodon nasus (Bloch)

Ashichin : Thread herring

Distributed from India to southern Japan. Especially valued as food by Okinawans. Abundant during March. Enters estuaries.

Family STOLEPHORIDAE

Stolephorus delicatulus (Bennett)

Sururu, Sururu-gawa : Ally of sardine

Distributed in tropical Indian and Pacific oceans, from East Africa to Australia, Ryukyus, Fiji, and Melanesia. Often salted and eaten with rice.

1/ This list was prepared by Tokiharu Abe, Central Fisheries Station of Japan and the Zoological Institute, Faculty of Science, Tokyo University.

Family CLUPEIDAE

Harengula ovalis (Bennett)

Mizun : Sardine

Distributed in tropical Indian and Pacific oceans, from Red Sea and East Africa to the Ryukyus and Polynesia. Clupea mizun Kishinouye is regarded as a synonym. Used as bait for Pristipomoides sieboldii.

Sardinella clupeoides (Bleeker)

Yamato-mizun : Sardine

Distributed from Red Sea to East Indies, the Philippine Islands, Ryukyu Islands, and Kagoshima Prefecture, Southern Kyushu. Clupea okinawensis Kishinouye is regarded as a synonym.

Family CYPRINIDAE

Cyprinus carpio Linnaeus

Kuu-yu : Carp

Endemic in Europe and Asia but has been introduced into many countries. The Okinawans keep the carp in freshwater ponds and value it as food, especially from February to April. Because of lack of freezing and cold storage plants and inadequate transportation, Okinawans living some distance from the coast cannot utilize marine fishes during warm seasons. For these reasons the carp and the following four species of freshwater fishes are important as food in the interior of Okinawa-jima.

Carassius auratus (Linnaeus)

Taa-yu : Goldfish

Endemic in Europe and Asia but has been introduced into many countries. Freshwater. Especially valued as food by the Okinawans from February to April.

Family COBITIDAE

Misgurnus anguillicaudatus (Cantor)

Dojo : Loach

Distributed in Japan, Korea, and Ryukyu Islands (Tanega-shima, Yaku-shima, Amami-o-shima, Okinawa Gunto, and Yaeyama Retto). Freshwater. Expecially prized as food by the Okinawans from May to August.

Family ANGUILLIDAE

Anguilla japonica Temminck and Schlegel

Unagi, Micha-unagi : Common eel

Distributed in Japan, Ryukyu Islands, Korea, China, and Formosa. Taken in rivers. Valued as food in summer.

Anguilla mauritiana (Bennett)

Kawa-unagi, Kaan-no-ji : Giant eel

Distributed from tropical and subtropical parts of the Indo-Pacific region northward to Wakayama Prefecture, Japan. Taken in rivers but considered inferior in taste to the common eel.

Family BELONIDAE

Athlennes hians (Cuvier and Valenciennes)

Shiji : Needlefish

Distributed from tropical and subtropical Indo-Pacific regions northward to southern Japan. Not uncommon in the Hawaiian Islands.

Tylosurus melanotus (Bleeker)

Ke-shijaa : Billfish

Distributed from East Indies to central Japan.

Family HEMIRHAMPHIDAE

Hai-yu : Halfbeaks

Hemirhamphus far (Forskal)

Distributed from East Africa through the Indo-Pacific region eastward to Polynesia and northward to the Ryukyu Islands.

Family EXOCOETIDAE

Tubuu : Flying fishes

Cyselurus rondeletii (Cuvier and Valenciennes)

Probably circumtropical in distribution. It is an important food fish in the Ryukyu Islands and is said to appear in abundance near Okinawa-jima in March. It is much valued for its flavor by the Okinawans when taken in January and February.

Family SPHYRAENIDAE

Kamasaa, Kamashii : Barracudas

Sphyraena obtusata Cuvier and Valenciennes

Distributed from East Africa through the Indo-Pacific region eastward to Polynesia and northward to the Ryukyu Islands. The barracuda is valued as food by the Okinawans, especially during September and October.

Family FISTULARIIDAE

Fistularia petimba (Lacepede)

Hifuchaa : Cornet fish

Distributed from the Indian Ocean to central Japan.

Family MUGILIDAE

Chikura, Bura : Mullets

Mugil cephalus Linnaeus

Distributed in circumtropical warm seas. Other species of mullets are also taken in small amounts by a kind of barrier net (chikura ami).

Family ATHERINIDAE

Hadara : Silversides

Atherina woodwardi Jordan and Evermann

Known from the Ryukyu Islands and Kochi Prefecture, Japan.

Family SCOMBRIDAE

Scomber scombrus tapeinocephalus (Bleeker)

Saba : Spotted mackerel

Distributed from Fukushima Prefecture, Japan, to Formosa and probably to the Philippines; also taken along the eastern coast of Korea and in the Korean Strait. Said to be prized as food on Okinawa-jima in February and March. The writer obtained no specimens of this and the next species, but both species are reported to be important food items.

Scomber scomber japonicus Houttuyn

Saba : Common mackerel

Distributed from Sakhalin to the Philippines. Said to be highly prized as food on Okinawa-jima during February and March.

Rastrelliger chrysozonus (Ruppell)

Gurukumaa, Mureji : Ally of mackerel

Distributed from the Indian Ocean to southern Japan.

Family KATSUWONIDAE

Katsuwonus pelamis (Linnaeus)

Katsuo : Skipjack

Ranges through tropical and temperate seas. Said to be especially abundant near Okinawa-jima in May and June, sometimes entering the Unten Wan (the bay north of Naha). The Okinawans value it especially for its taste during March and April.

Family KATSUWONIDAE (Cont'd)

Euthynnus yaito Kishinouye

Kuchino-yu : Mackerel tuna

Ranges from the Philippines to the Japan Sea and to Chiba Prefecture, Japan.

Auxis hira Kishinouye

Shibuta : Frigate mackerel

Ranges from Formosa to Hokkaido. Appears in the Ryukyus in abundance during July.

Auxis tapeinosoma (Bleeker)

Shibuta : Frigate mackerel

Ranges from Formosa to Hokkaido and probably is taken in the Philippines.

Family THUNNIDAE

Thunnus orientalis Temminck and Schlegel

Ushi-shibi, Kuro-shibi : Black tuna

Known distribution is from the Philippines to the Kuril Islands and Sakhalin. Taken by long line in the Ryukyu area. Valued for its fine taste by the Okinawans during May, but is said to appear most abundantly off Okinawa-jima in June.

Thunnus germo (Lacepede)

Bin-naga-tombo : Albacore

Ranges throughout warm and temperate seas. Taken by long line in the Ryukyu area. Valued as food by the Okinawans during January.

Parathunnus sibi (Temminck and Schlegel)

Mebachi-mishibi : Big-eyed tuna

Known distribution range is from the Philippines to southern Japan. Also reported from Hawaii. Taken by long line in the Ryukyu area. Okinawans value the species for its fine flavor when it is obtained during the winter. Said to appear in abundance off Okinawa-jima during November and December.

Neothunnus macropterus (Temminck and Schlegel)

Aka-shibi : Yellowfin tuna

Known from the Indo-Pacific region to Hokkaido and from Hawaii. Taken by long line.

Family CYBIIDAE

Saara : Seer-fishes

Several species of this family are valued as food by the Okinawans, especially when taken during January and February.

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Family TRICHIURIDAE

Trichiurus haumela (Forskal)

Bashikaiyu : Hairtail

Distributed in warm seas of western Pacific.

Family ISTIOPHORIDAE

Istiophorus orientalis (Temminck and Schlegel)

Kanga : Sailfish

Distributed from Formosa to northern Japan.

Makaira mazara (Jordan and Snyder)

Achinui-yu, Kuro-achi : Black marlin

Known from the Philippines to central Japan and from Hawaii. Okinawans value it as food during the winter.

Makaira mitsukurii (Jordan and Snyder)

Achinui-yu : Striped marlin

Known from Formosa to Hokkaido and from Hawaii.

Family CORYPHAENIDAE

Coryphaena hippurus Linnaeus

Manbiki, Fuu, Hyu-nui-yu : Dolphin, Dorado

Known from the East Indies to central Japan and from Hawaii. Taken by lampara net (maki ami) and by long line. One of the most important Okinawan food fishes, being valued for its taste especially during September and October.

Family CARANGIDAE

Trachurus argenteus Wakiya

Gatsun : Horse mackerel

Distributed from Formosa to central Japan.

Decapterus russelli (Ruppell)

Naga-yu : Mackerel scad

Distributed from the Ryukyus to central Japan.

Caranx species

Soji : Jacks

Several species of this genus are valued as food.

Family MULLIDAE

Kataka-shi : Goatfishes

Several species appear in abundance off Okinawa-jima in July and August.

Family APOGONIDAE

Ufumi : Cardinal fishes

Used as bait for the skipjack.

Family SERRANIDAE

Miibae : Sea basses

More than 10 members of this family, belonging to the genera Epinephelus, Variola, and Cephalopholis, are prized highly as food by the Ryukyuans.

Family SPARIDAE

Taius tumifrons (Temminck and Schlegel)

Yunabaru-majiku : Sea bream, Porgy

Distributed from Formosa to central Japan.

Sparus latus Houttuyn

Chin : Sea bream, Porgy

Distributed from Formosa to central Japan. Valued as food in winter.

Sparus aries (Temminck and Schlegel)

Shiru-majiku : Sea bream, Porgy

Distributed from Formosa to central Japan.

Family LETHRINIDAE

Taman, Kuchinaji, Kuchinagi, Kuchinagi-daman, Yaki-daman, Shitaa-yu : Allies of snappers

Several species of this family are valued as food.

Family LUTJANIDAE (LUTIANIDAE)

Lutjanus (Lutianus) species

Mimichaa, Inakuu, Kasbii, Chinbana : Snappers

About 15 species of the genus are used as food. Some species are said to be poisonous, as at Saipan and some other mid-Pacific Islands.

Pristipomoides sieboldii (Bleeker)

Ma-machi, Machi : Snapper

Known from southern Japan, Hachijo Island (Izu Islands), Ryukyu Islands, and Hawaiian Islands. One of the most highly prized of the Ryukyu food fishes.

Pristipomoides amoenus (Snyder)

Bitaron : Snapper

Known from Ryukyu Islands, Hachijo Island (Izu Islands), and Kochi Prefecture, Japan.

Aprion virescens Cuvier and Valenciennes

Gin-mutsu, Maru-dai : Snapper

Distributed from the Indo-Pacific islands to the Ryukyus, Hawaii, Queensland, and Tasmania.

Etelis carbunculus Cuvier and Valenciennes

Aka-machi : Snapper

Ranges through the tropical and subtropical Indo-Pacific northward to southern Japan. This fish is one of the most highly prized in the Ryukyus and at Kagoshima Prefecture, Japan.

Aphareus rutilans Cuvier and Valenciennes

Torekuchi, Taikochaa : Snapper

Distributed from the Red Sea through the tropical Indo-Pacific to Okinawa-jima and the Hawaiian Islands. Highly prized as food.

Family CAESIONIDAE

Gurukun, Ukuu, Aka-urume (at Amami-o-shima), Aka-jumaa,

Jumaa-gurukun : Red scads

The members of this family are valued by the Okinawans as food in February and March and are most abundant in the latter month. They are used also as bait for skipjack fishing but are not as valuable for this purpose as sardines.

Caesio tile Cuvier and Valenciennes

Known from the Bonin Islands, Kagoshima, Ryukyu Islands (from Amami-o-shima to the Yaeyama Retto), Formosa, Philippine Islands, Amboina, Banda, Gilbert Islands, Caroline Islands, Tonga Islands, and the Society Islands.

Caesio xanthonotus Bleeker

Known from Hachijo Island, Bonin Islands, Japan (Nagasaki and Kagoshima prefectures), Ryukyu Islands (Amami-o-shima to the Yaeyama Retto), Philippine Islands, East Indies, and the Solomon Islands.

Family CAESIONIDAE (Cont'd)

Caesio diagramma Bleeker

Distributed from the East Indies through the Philippine Islands to southern Japan.

Caesio chrysozonus (Kuhl and Van Hasselt)

Tropical and subtropical in distribution, from the Red Sea and East Africa through the Indo-Pacific region north to Kagoshima, Japan, south to Queensland, and east to the Solomon Islands.

Caesio caerulaureus Lacepede

Tropical and subtropical in distribution, from the Red Sea and East Africa through the Indo-Pacific region and north to Kagoshima, Japan, south to Queensland, and east to Polynesia.

Family POMACENTRIDAE

Shichugaa, Shikwagwaa, Kurubikwaa : Damsel fishes

About 50 species of this family are used as food by the Ryukyuans. They are distributed mostly throughout the tropical Indo-Pacific region.

Family LABRIDAE

Irabuchaa, Irabuchi, Kasabu : Wrasses

About 100 species of this family are valued as food by the Ryukyuans. They are distributed mostly throughout the tropical Indo-Pacific region.

Family CALLYODONTIDAE

Obachaa : Parrot fishes

About 10 species of this family are used as food by the Ryukyuans. They are distributed mostly throughout the tropical Indo-Pacific region.

Family CHAETODONTIDAE

Kaa-e, Kaa-saa : Butterfly fishes

About 50 species of this family are used as food by the Ryukyuans. The majority of these species are distributed throughout the tropical Indo-Pacific region.

Family HEPATIDAE

Tukazaa, Tukajaa : Surgeon fishes

Some 30 species of this family are used as food by the Ryukyuans. They are distributed mostly throughout the tropical Indo-Pacific region.

Family SIGANIDAE

Suku, Eno-yu : Scraper

About 20 species of this family are used as food by the Ryukyuans. The majority of these fish are distributed throughout the tropical Indo-Pacific region. The young of some species are considered a delicacy when salted and are known as "suku-garasu".

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TABLE 1.-NUMBER OF FISHING VESSELS, RYUKYU RETTO 1921-40 a/

Year	Vessels Without Power				Vessels With Power						Grand Total
	Less Than 5 Tons	5-10 Tons	10-20 Tons	Total	Less Than 5 Tons	5-10 Tons	10-20 Tons	20-50 Tons	More Than 50 Tons	Total	
1921	1,958	ND	10	1,968	ND	ND	91	ND	ND	91	2,059
1922	1,962	ND	ND	1,962	15	ND	102	ND	ND	117	2,079
1923	2,092	5	7	2,104	18	ND	135	1	ND	154	2,258
1924	1,968	1	ND	1,969	32	ND	148	ND	ND	180	2,149
1925	1,896	ND	ND	1,896	51	ND	155	ND	ND	206	2,102
1926	1,722	ND	ND	1,722	24	27	128	2	N	181	1,903
1927	1,971	1	ND	1,972	19	32	112	1	ND	164	2,136
1928	2,134	1	ND	2,135	20	43	111	2	2	178	2,313
1929	2,120	1	ND	2,121	22	51	97	3	4	177	2,298
1930	2,163	1	ND	2,164	26	51	80	4	4	165	2,329
1931	2,207	1	ND	2,208	24	50	77	3	2	156	2,364
1932	2,084	1	ND	2,085	25	45	69	8	2	149	2,234
1933	1,997	1	ND	1,998	34	40	65	3	2	144	2,142
1934	2,139	1	ND	2,140	38	46	59	2	1	146	2,286
1935	2,060	1	ND	2,061	17	60	91	1	ND	169	2,230
1936	2,072	ND	ND	2,072	18	59	97	1	ND	175	2,247
1937	2,066	ND	ND	2,066	20	57	90	ND	ND	167	2,233
1938	2,009	ND	ND	2,009	20	52	81	1	ND	154	2,163
1939	1,936	ND	ND	1,936	13	61	80	ND	ND	154	2,090
1940	1,945	ND	ND	1,945	12	61	91	ND	ND	164	2,109

a/ Comparable statistics are not available for the years before 1921, when the self-governing Okinawa Prefecture was established.
ND: No data available
SOURCE: Statistical Yearbook of Agriculture and Forestry, published by Ministry of Agriculture and Forestry

TABLE 2.-OFFSHORE FISHING VESSELS, BY TYPES OF FISHERIES, RYUKYU RETTO 1921-40 a/

Year	Skipjack Fishery with Power			Long Line Fishery						Hook and Line Fishery with Power			Other Types of Fisheries with Power			Total					
				Without Power			With Power									Without Power			With Power		
	No of Vessels	Total Tonnage	Average Tonnage	No of Vessels	Total Tonnage	Average Tonnage	No of Vessels	Total Tonnage	Average Tonnage	No of Vessels	Total Tonnage	Average Tonnage	No of Vessels	Total Tonnage	Average Tonnage	No of Vessels	Total Tonnage	Average Tonnage	No of Vessels	Total Tonnage	Average Tonnage
1921	5	57	11	5	37	7	51	610	12	ND	ND	ND	ND	ND	ND	5	37	7	56	667	12
1922	89	1,184	13	ND	ND	ND	3	29	9	ND	ND	ND	ND	ND	ND	ND	ND	ND	92	1,213	13
1923	149	2,227	15	ND	ND	ND	9	77	8	ND	ND	ND	ND	ND	ND	ND	ND	ND	158	2,304	14
1924	175	2,534	14	ND	ND	ND	5	50	10	1	7	7	5	25	5	ND	ND	ND	186	2,616	14
1925	149	2,245	15	ND	ND	ND	3	24	8	1	7	7	ND	ND	ND	ND	ND	ND	153	2,276	15
1926	134	2,199	16	ND	ND	ND	5	26	5	2	34	17	ND	ND	ND	ND	ND	ND	141	2,259	16
1927	118	1,884	16	1	5	5	13	86	6	ND	ND	ND	ND	ND	ND	1	5	5	131	1,970	15
1928	106	1,600	15	1	5	5	33	235	7	ND	ND	ND	ND	ND	ND	1	5	5	139	1,835	13
1929	103	1,680	16	1	5	5	37	278	7	ND	ND	ND	ND	ND	ND	1	5	5	140	1,958	14
1930	90	1,533	17	1	5	5	34	279	8	ND	ND	ND	ND	ND	ND	1	5	5	124	1,812	14
1931	86	1,339	15	1	5	5	10	87	8	19	168	9	ND	1	ND	1	5	5	115	1,594	14
1932	95	1,265	13	1	5	5	33	310	9	ND	ND	ND	ND	ND	ND	1	5	5	128	1,575	12
1933	72	938	13	1	5	5	34	347	10	ND	ND	ND	ND	ND	ND	1	5	5	106	1,285	12
1934	55	784	14	1	5	5	41	523	13	ND	ND	ND	ND	ND	ND	1	5	5	96	1,307	13
1935	89	1,117	12	ND	ND	ND	57	554	10	ND	ND	ND	12	240	20	ND	ND	ND	158	1,911	12
1936	83	1,073	13	ND	ND	ND	45	475	10	ND	ND	ND	11	63	6	ND	ND	ND	139	1,611	11
1937	83	936	11	ND	ND	ND	40	428	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	123	1,364	11
1938	78	877	11	ND	ND	ND	51	538	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	129	1,415	11
1939	57	693	12	ND	ND	ND	41	434	10	ND	ND	ND	27	138	5	ND	ND	ND	125	1,265	10
1940	89	901	10	ND	ND	ND	41	434	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	130	1,335	10

a/ Comparable statistics are not available for the years before 1921, when the self-governing Okinawa Prefecture was established.
ND: No data available
SOURCE: Statistical Yearbook of Agriculture and Forestry, published by Ministry of Agriculture and Forestry

TABLE 3.-NUMBER OF FISHING VESSELS, SATSUNAN SHOTO (SOUTH OF LATITUDE 30°N) 1938-39

Year	No of Vessels without Power	No Vessels with Power				Total
		Less than 5 Ton Gross	5-10 Tons	10-20 Tons	Total	
1938	1,645	5	1	21	27	1,672
1939	1,626	7	9	13	29	1,655

SOURCE: Fisheries Section, Kagoshima Prefectural Government

TABLE 4.-OFFSHORE FISHING VESSELS, BY TYPES OF FISHERIES, KAGOSHIMA PREFECTURE 1921-40

Year	Skipjack Fishery			Long Line Fishery			Total		
	No of Vessels	Total Tonnage	Average Tonnage	No of Vessels	Total Tonnage	Average Tonnage	No of Vessels	Total Tonnage	Average Tonnage
1921	72	1,400	19	8	94	12	80	1,494	18
1922	171	3,552	21	7	84	12	178	3,636	20
1923	168	3,599	21	30	355	12	198	3,954	20
1924	163	4,237	26	33	351	10	196	4,588	23
1925	152	4,177	27	140	1,990	14	292	6,167	21
1926	95	3,312	35	187	2,623	14	282	5,935	21
1927	87	3,381	39	175	2,562	14	262	5,943	22
1928	89	4,519	51	185	2,877	15	274	7,396	27
1929	95	3,994	42	171	1,543	9	266	5,537	21
1930	93	4,197	45	170	2,764	16	263	6,961	26
1931	81	4,123	51	146	2,459	17	227	6,582	29
1932	71	3,460	49	138	2,405	17	209	5,865	28
1933	61	3,047	50	138	2,446	18	199	5,493	27
1934	59	3,084	52	111	2,356	21	170	5,440	32
1935	78	3,269	42	126	3,252	26	204	6,521	32
1936	72	3,328	46	141	2,686	19	213	6,014	28
1937	63	3,011	47	164	4,454	27	227	7,465	33
1938	60	3,355	56	167	4,975	30	227	8,330	36
1939	57	3,038	53	168	4,962	29	225	8,000	35
1940	53	3,017	57	164	5,280	32	217	8,297	38

SOURCE: Statistical Yearbook of Agriculture and Forestry, published by Ministry of Agriculture and Forestry

TABLE 5.-OFFSHORE FISHING VESSELS, BY TYPES OF FISHERIES, MIYAZAKI PREFECTURE 1921-40

Year	Skipjack Fishery			Long Line Fishery			Total		
	No of Vessels	Total Tonnage	Average Tonnage	No of Vessels	Total Tonnage	Average Tonnage	No of Vessels	Total Tonnage	Average Tonnage
1921	46	729	16	14	126	9	60	855	14
1922	46	706	15	32	466	14	78	1,172	15
1923	39	638	16	34	503	15	73	1,141	15
1924	ND	ND	ND	ND	ND	ND	ND	ND	ND
1925	66	907	13	30	370	12	96	1,277	13
1926	64	836	13	60	782	13	124	1,618	13
1927	29	548	19	14	126	9	43	674	15
1928	29	517	18	17	164	9	46	681	15
1929	35	707	20	38	644	17	73	1,351	18
1930	46	990	21	489 a/	10,837	22	535 a/	11,827	22
1931	47	1,120	24	625 a/	11,607	18	672 a/	12,727	19
1932	46	988	21	604 a/	11,215	18	650 a/	12,203	19
1933	42	823	19	b/	b/	b/	b/	b/	b/
1934	43	932	21	b/	b/	b/	b/	b/	b/
1935	44	954	21	81	2,269	28	125	3,223	26
1936	45	1,017	22	271 a/	8,956	33	316 a/	9,973	32
1937	47	1,047	22	416 a/	12,507	30	463 a/	13,554	29
1938	35	710	20	415 a/	12,352	30	450 a/	13,062	29
1939	56	1,306	23	226	5,941	26	282	7,247	26
1940	53	1,654	31	228	5,948	26	281	7,602	27

a/ Visiting vessels from other prefectures evidently were included in this tabulation.
b/ Data discarded. Recorded figures are in error.
ND: No data available
SOURCE: Statistical Yearbook of Agriculture and Forestry, published by Ministry of Agriculture and Forestry

TABLE 6.-TOTAL PRODUCTION OF AQUATIC RESOURCES, RYUKYU RETTO 1926-43 a/ (metric tons) b/

Year	Fish	Shellfish	Other Aquatic Animals	Seaweeds	Total c/
1926	7,206.2	623.0	410.3	4,619.6	12,859.1
1927	7,087.1	689.4	615.6	3,069.6	11,461.7
1928	8,227.1	606.7	784.9	4,768.5	14,387.2
1929	6,791.1	702.0	743.8	6,028.9	14,265.8
1930	7,082.7	576.0	723.6	5,903.2	14,285.5
1931	6,041.3	423.0	704.2	4,364.7	11,543.2
1932	6,840.3	433.4	518.5	3,319.6	11,111.8
1933	6,910.2	479.2	532.4	3,479.9	11,401.7
1934	7,608.8	463.7	583.1	3,699.6	12,354.7
1935	6,925.6	430.7	543.1	2,855.8	10,755.2
1936	8,593.6	429.1	435.1	3,239.9	12,697.7
1937	7,248.2	377.4	490.6	3,831.8	11,948.0
1938	7,054.1	359.1	451.8	4,267.1	12,132.1
1939	6,364.3	318.2	440.3	4,784.7	11,907.5
1940	7,067.1	367.9	539.8	5,594.7	13,569.5
1941	8,406.2	216.2	390.5	1,716.8	10,729.7
1942	7,382.7	215.0	384.7	1,508.7	9,491.1
1943	4,686.8	261.6	354.2	441.4	5,744.0

a/ Comparable production figures are not available for years before 1926.
b/ Original data in kan (one kan equals 3.75 kilograms).
c/ Average annual total production for 1926-40 was 12,445.4 metric tons.
SOURCE: Statistical Yearbook of Agriculture and Forestry, published by Ministry of Agriculture and Forestry

TABLE 7.-COASTAL FISH PRODUCTION, BY SPECIES, RYUKYU RETTO 1921-43 a/ (metric tons) b/

Year	Sardine	Skipjack	Mackerel	Tuna (excluding skipjack)	Spearfish	Shark	Sea Bream	Porgy	Spanish Mackerel	Horse Mackerel	Flying Fish	Mullet	Thread Herring	Ayu	Carp	Eel	Others	Total c/
1921	ND	4,207.1	55.6	264.4	ND	177.7	78.0	17.3	22.8	1,219.9	108.4	25.0	ND	ND	1.1	8.4	ND	ND
1922	ND	1,314.0	54.1	307.1	30.7	173.9	66.9	15.9	25.9	832.3	35.9	21.0	6.7	0.0	0.7	7.9	ND	ND
1923	ND	628.0	56.1	140.3	42.0	214.8	85.9	23.8	12.3	98.8	168.0	26.2	6.7	0.1	0.5	8.4	ND	ND
1924	ND	124.9	43.2	160.7	35.6	211.9	62.6	13.3	9.8	460.4	130.4	18.0	6.6	0.0	0.5	8.2	ND	ND
1925	ND	429.7	34.3	220.6	29.4	214.1	55.3	9.1	12.8	73.7	125.3	16.8	8.0	0.0	0.4	6.5	ND	ND
1926	ND	361.4	32.9	302.2	33.1	230.1	44.1	27.3	16.9	115.2	135.5	17.1	6.6	0.2	0.1	6.9	985.7	2,315.3
1927	ND	510.1	24.5	354.3	44.7	449.9	52.1	35.6	36.0	75.5	176.6	20.9	3.1	0.1	ND	6.5	1,291.4	3,081.3
1928	68.9	559.2	31.3	360.1	45.4	695.7	54.2	35.4	41.3	87.4	239.3	24.0	9.6	0.3	0.1	6.8	1,138.6	3,397.6
1929	79.1	300.2	43.6	264.7	42.1	493.6	53.4	32.3	43.3	119.0	185.0	26.1	13.6	0.1	0.2	7.4	1,403.7	3,107.4
1930	90.7	478.8	27.0	312.5	50.3	344.2	57.6	30.8	40.0	127.6	157.7	25.3	13.1	0.1	0.0	7.8	1,391.1	3,154.6
1931	88.2	472.7	24.6	307.9	47.0	283.6	77.1	26.3	38.6	171.9	177.9	25.7	11.8	0.1	ND	8.0	1,539.0	3,300.4
1932	69.7	515.1	20.7	412.0	38.8	243.0	52.4	22.8	29.3	128.7	101.9	24.8	9.7	0.0	0.0	8.3	1,706.2	3,383.4
1933	71.7	517.1	11.3	431.9	36.9	263.2	55.7	25.4	29.7	183.0	111.1	37.1	13.4	0.1	0.2	9.1	1,707.4	3,504.3
1934	ND	502.7	50.4	409.0	37.3	230.4	49.2	28.4	25.3	145.2	110.6	32.1	15.2	2.0	0.3	8.3	1,750.5	3,396.9
1935	ND	41.5	58.1	89.8	205.8	393.8	55.8	27.3	31.2	131.4	93.9	30.2	12.3	3.2	1.2	13.5	1,818.9	3,007.9
1936	ND	51.9	312.4	135.0	180.1	361.6	43.0	26.2	38.0	144.9	85.5	31.4	12.2	3.3	0.3	10.8	1,794.1	3,230.7
1937	ND	61.5	28.2	78.2	33.5	297.3	28.2	29.7	32.8	161.0	92.7	29.5	13.2	2.8	0.8	11.0	2,019.8	2,920.2
1938	ND	61.7	23.7	57.4	28.5	210.8	51.7	27.2	34.0	171.6	117.8	30.1	15.6	2.1	0.9	9.5	1,902.4	2,745.0
1939	ND	58.4	19.0	63.0	33.4	106.6	29.8	26.0	24.1	152.1	84.1	30.3	14.2	1.5	0.9	9.8	1,381.5	2,034.7
1940	ND	284.7	22.9	76.8	36.2	89.3	25.3	23.7	16.7	120.0	107.6	28.3	11.8	1.5	1.0	10.2	1.264.5	2,084.5
1941 d/	245.9	4,194.3	19.4	454.1	139.8	201.8	116.1	30.4	31.7	339.0	92.1	41.4	30.9	0.6	1.3	9.1	2,446.5	8,394.4
1942 d/	193.5	3,293.6	11.3	255.0	271.9	210.7	155.0	26.5	33.0	295.0	138.4	30.9	26.9	0.0	0.8	6.2	2,426.5	7,375.2
1943 d/	91.9	2,318.1	8.6	165.6	191.4	149.0	70.8	52.3	ND	63.2	86.2	18.1	7.3	ND	ND	5.8	1,458.5	4,686.7

a/ Comparable production figures are not available for years before 1921, when the self-governing Okinawa Prefecture was established.
b/ Original data in kan (one kan equals 3.75 kilograms)
c/ Average annual total coastal fish production for 1926-40 was 3,017.6 metric tons.
d/ Includes both coastal and offshore production
ND: No data available
SOURCE: Statistical Yearbook of Agriculture and Forestry, published by Ministry of Agriculture and Forestry

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TABLE 8.-OFFSHORE FISH PRODUCTION, BY SPECIES, RYUKYU RETTO 1921-40 a/ (metric tons) b/

Year	Skipjack	Tuna (excluding skipjack)	Shark	Spanish Mackerel	Sea Bream	Others	Total c/
1921	2,495.3	2.8	1.3	ND	ND	ND	ND
1922	5,306.6	73.5	2.1	ND	ND	5.1	5,387.3
1923	5,795.1	197.2	19.0	1.6	0.0	21.3	6,034.2
1924	5,408.2	192.3	6.3	0.1	16.0	23.7	5,646.5
1925	4,424.2	159.5	7.2	0.1	10.5	16.7	4,618.2
1926	4,672.6	170.2	10.3	ND	0.5	37.4	4,891.0
1927	3,379.5	346.2	48.3	0.2	ND	231.6	4,005.8
1928	4,092.6	387.5	75.1	3.0	ND	271.3	4,829.5
1929	2,988.4	283.2	78.7	3.0	ND	330.6	3,683.9
1930	3,256.5	277.1	70.1	10.0	ND	314.6	3,928.3
1931	2,121.3	142.8	35.7	6.7	ND	434.7	2,741.2
1932	2,685.7	320.4	30.2	9.3	ND	411.2	3,456.8
1933	2,592.6	469.2	52.9	6.5	0.3	284.4	3,405.9
1934	3,436.1	198.5	14.2	12.4	1.8	549.3	4,212.3
1935	3,246.4	299.5	36.4	8.4	25.9	301.1	3,917.7
1936	3,854.0	625.1	212.2	16.7	1.0	653.6	5,362.6
1937	3,132.1	298.7	58.0	3.0	0.9	835.4	4,328.1
1938	3,171.8	224.0	92.7	9.6	5.1	806.0	4,309.2
1939	3,245.7	181.8	265.7	16.1	7.1	613.5	4,329.9
1940	3,960.5	162.5	319.0	16.9	4.0	517.7	4,980.6

a/ Comparable production figures are not available for years before 1921, when the self-governing Okinawa Prefecture was established.
b/ Original data in kan (one kan equals 3.75 kilograms).
c/ Average annual total offshore fish production from 1926-40 was 4,198.7 metric tons.
ND: No data available
SOURCE: Statistical Yearbook of Agriculture and Forestry, published by Ministry of Agriculture and Forestry

TABLE 9.-AQUATIC ANIMAL PRODUCTION (EXCLUDING FISH AND SHELLFISH), RYUKYU RETTO 1921-43 a/ (metric tons) b/

Year	Cuttlefish & Squid	Octopus	Shrimp	Spiny Lobster	Sea Cucumber	Others	Total c/
1921	650.5	62.6	3.1	1.6	7.6	ND	ND
1922	649.4	66.2	3.4	2.2	3.1	ND	ND
1923	742.4	64.6	5.1	2.0	9.0	ND	ND
1924	568.2	51.5	2.3	4.3	7.3	ND	ND
1925	616.2	59.4	2.2	5.5	5.8	ND	ND
1926	311.3	66.0	5.2	4.3	3.8	19.7	410.3
1927	493.5	59.3	2.9	5.6	4.0	50.3	615.6
1928	575.0	70.1	3.9	6.0	108.5	21.5	785.0
1929	513.2	72.9	5.6	7.6	92.0	52.4	743.7
1930	469.9	76.0	5.2	8.0	106.6	58.1	723.8
1931	450.7	78.0	5.9	7.3	100.9	61.6	704.4
1932	289.5	86.9	5.6	8.3	102.5	25.8	518.6
1933	294.0	93.9	10.0	7.6	96.0	31.0	532.5
1934	365.3	88.8	9.1	12.3	82.9	24.7	583.1
1935	318.6	97.3	9.6	12.6	78.5	26.5	543.1
1936	256.6	98.7	9.0	12.9	18.5	39.4	435.1
1937	324.7	93.8	14.1	13.0	17.7	27.1	490.4
1938	294.1	96.9	11.3	10.2	16.5	22.8	451.8
1939	287.7	85.7	10.0	8.6	17.7	30.5	440.2
1940	377.4	88.3	10.1	7.7	32.6	23.6	539.7
1941	202.5	73.4	11.0	2.5	29.4	72.8	391.6
1942	208.3	75.7	16.2	5.8	28.2	50.4	384.6
1943	110.9	66.6	3.4	11.5	14.7	147.1	354.2

a/ Comparable production figures are not available for years before 1921, when the self-governing Okinawa Prefecture was established.
b/ Original data in kan (one kan equals 3.75 kilograms).
c/ Average annual total aquatic animal (excluding fish and shellfish) production from 1926-40 was 568.0 metric tons.
ND: No data available
SOURCE: Statistical Yearbook of Agriculture and Forestry, published by Ministry of Agriculture and Forestry

TABLE 10.-SHELLFISH PRODUCTION, RYUKYU RETTO 1921-43 a/ (metric tons) b/

Year	Abalone	Hard Clam	Spiny Whelk	Little Clam	Others	Total c/
1921	ND	0.8	487.7	0.1	ND	ND
1922	0.0	0.5	293.8	0.2	ND	ND
1923	0.1	0.4	221.4	0.5	ND	ND
1924	ND	0.6	372.0	0.4	ND	ND
1925	0.2	0.2	410.0	0.3	ND	ND
1926	0.2	0.7	454.5	5.7	161.8	622.9
1927	0.3	0.7	514.7	0.1	173.6	689.4
1928	0.2	1.0	434.9	0.2	170.4	606.7
1929	0.2	1.2	581.0	0.2	119.3	701.9
1930	0.1	0.6	489.1	0.2	85.8	575.8
1931	0.2	0.6	364.5	0.2	85.5	433.0
1932	0.1	0.3	366.4	0.1	66.5	433.4
1933	0.2	0.4	408.8	2.0	67.9	479.3
1934	0.3	6.0	384.9	2.0	70.2	463.4
1935	0.3	10.2	345.6	2.0	72.5	430.6
1936	0.1	5.8	349.7	2.0	72.0	429.6
1937	ND	3.5	309.2	1.8	62.8	377.3
1938	0.0	3.4	293.2	1.8	61.4	359.8
1939	0.0	3.6	250.8	1.6	62.2	318.2
1940	7.4	3.2	218.5	0.4	138.3	367.8
1941	2.8	1.0	166.5	ND	46.0	216.3
1942	0.7	4.2	177.6	ND	32.5	215.0
1943	0.1	0.8	199.2	0.6	60.9	261.6

a/ Comparable production figures are not available for years before 1921, when the self-governing Okinawa Prefecture was established.
b/ Original data in kan (one kan equals 3.75 kilograms).
c/ Average annual total shellfish production from 1926-40 was 486.0 metric tons.

ND: No data available
SOURCE: Statistical Yearbook of Agriculture and Forestry, published by Ministry of Agriculture and Forestry

TABLE 11.-SEAWEED PRODUCTION, RYUKYU RETTO 1921-43 a/ (metric tons) b/

Year	Laver	Funori	Others c/	Total d/
1921	3.5	0.6	ND	ND
1922	1.5	ND	ND	ND
1923	0.3	ND	ND	ND
1924	0.3	ND	ND	ND
1925	0.2	ND	ND	ND
1926	ND	0.4	4,619.2	4,619.6
1927	ND	0.3	3,069.3	3,069.6
1928	ND	0.1	4,768.4	4,768.5
1929	0.0	0.1	6,028.8	6,028.9
1930	0.1	0.0	5,903.1	5,903.1
1931	0.1	0.1	4,364.6	4,364.8
1932	0.1	0.1	3,207.0	3,207.2
1933	0.2	0.4	3,479.3	3,479.9
1934	ND	0.5	3,699.0	3,699.5
1935	ND	1.3	2,854.5	2,855.8
1936	ND	1.4	3,238.5	3,239.9
1937	ND	1.2	3,830.5	3,831.7
1938	0.2	1.0	4,265.8	4,267.0
1939	0.2	1.0	4,783.5	4,784.7
1940	0.9	1.0	5,592.9	5,594.8
1941	ND	ND	1,716.8	1,716.8
1942	ND	ND	1,508.7	1,508.7
1943	ND	2.0	441.2	441.4

a/ Comparable production figures are not available prior to 1921, when the self-governing Okinawa Prefecture was established.
b/ Original data in kan (one kan equals 3.75 kilograms).
c/ Chiefly "Kaijinso" (Digenea simplex)
d/ Average annual total seaweed production from 1926-40 was 4,287.6 metric tons.
ND: No data available
SOURCE: Statistical Yearbook of Agriculture and Forestry, published by Ministry of Agriculture and Forestry

TABLE 12.-PRODUCTION OF AQUATIC RESOURCES, SATSUNAN SHOTO a/ 1938-39 (metric tons) b/

Species	1938	1939
Coastal fish		
Skipjack	114.5	105.1
Mackerel	8.3	2.8
Tuna	35.2	30.0
Spearfish	9.8	8.6
Yellowtail	8.2	7.3
Shark	33.2	34.3
Sea bream	11.0	11.8
Black porgy	14.6	10.7
Spanish mackerel	59.4	59.5
Horse mackerel	71.3	55.5
Flying fish	107.4	108.3
Mullet	7.3	6.3
Ayu	0.5	1.0
Carp	0.0	0.0
Eel	6.0	4.4
Other fish	763.0	577.3
Total	1,249.7	1,022.9
Offshore fish		
Skipjack	1,203.4	365.4
Tuna	60.2	24.9
Spanish mackerel	9.3	7.3
Other fish	36.2	26.3
Total	1,309.1	423.9
Shellfish		
Abalone	0.9	0.9
Spiny whelk	7.3	4.6
Little clam	1.5	1.5
Others	57.6	56.0
Total	67.3	63.0
Aquatic animal (excluding fish and shellfish)		
Cuttlefish and squid	100.3	69.9
Octopus	22.0	20.0
Spiny lobster	20.1	18.6
Sea cucumber	0.3	0.3
Others	39.0	23.5
Total	181.7	132.3
Seaweed		
Laver (amanori)	4.4	2.7
Tengusa	8.6	8.8
Funori	12.2	10.4
Others	28.2	20.2
Total	53.4	42.1
TOTAL c/	2,861.2	1,684.2

a/ South of Latitude 30°N
b/ Original data in kan (one kan equals 3.75 kilograms).
c/ Average annual total aquatic resources production for 1938-39 was 2,272.7 metric tons.
SOURCE: Fisheries Section, Kagoshima Prefectural Government

TABLE 13.-OFFSHORE FISH PRODUCTION, KAGOSHIMA AND MIYAZAKI PREFECTURES 1921-40 (metric tons) a/

Year	Skipjack		Tunas (excluding skipjack) b/		Sharks		Total		Total
	Kagoshima	Miyazaki	Kagoshima	Miyazaki	Kagoshima	Miyazaki	Kagoshima	Miyazaki	
1921	7,743.6	913.7	121.7	31.1	ND	4.1	7,865.3	948.9	8,814.2
1922	9,378.7	1,530.7	168.4	126.9	28.1	27.0	9,575.2	1,684.6	11,259.8
1923	9,824.5	721.0	457.9	121.6	11.6	ND	10,294.0	842.6	11,136.6
1924	7,919.1	924.6	1,011.4	213.6	21.8	18.8	8,952.3	1,157.0	10,109.3
1925	8,044.9	1,262.9	508.0	197.2	405.1	18.8	8,958.0	1,478.9	10,436.7
1926	10,065.8	782.7	1,447.1	682.2	641.1	37.5	12,154.0	1,502.4	13,656.4
1927	8,166.4	779.1	907.0	150.2	878.6	10.5	9,952.0	939.8	10,891.8
1928	10,835.6	826.0	466.2	514.6	338.4	14.8	11,640.2	1,355.4	12,995.6
1929	9,128.8	578.3	881.5	3,391.3	825.5	19.0	10,835.8	3,988.6	14,824.4
1930	6,325.3	1,415.4	1,362.2	3,321.3	933.5	100.2	8,621.0	4,836.9	13,457.9
1931	6,346.5	1,681.1	1,656.6	3,644.0	206.6	132.7	8,209.7	5,457.8	13,667.5
1932	7,480.6	1,169.0	2,453.0	3,590.8	322.4	133.2	10,256.0	4,893.0	15,149.0
1933	8,445.2	1,845.5	2,597.4	3,535.7	337.1	120.0	11,379.7	5,501.2	16,880.9
1934	11,874.6	1,084.9	3,712.3	3,753.8	329.7	121.9	15,916.6	4,960.6	20,877.2
1935	8,904.0	1,361.3	4,354.4	3,611.3	225.4	399.0	13,483.8	5,371.6	18,855.4
1936	9,199.3	1,807.9	4,072.0	4,221.4	1,062.0	573.4	14,333.3	6,602.7	20,936.0
1937	10,878.9	1,433.6	5,339.2	8,926.6	1,164.9	579.8	17,383.0	10,940.0	28,323.0
1938	11,742.7	504.8	5,486.3	8,466.6	1,409.3	242.8	18,638.8	9,214.2	27,853.0
1939	8,827.6	724.2	7,811.0	7,733.4	1,531.5	250.8	18,170.1	8,708.4	26,878.5
1940	12,073.3	1,106.6	7,432.4	9,439.9	1,466.8	254.6	20,972.5	10,801.1	31,773.6

a/ Original data in kan (one kan equals 3.75 kilograms).
b/ Includes both tunas (chiefly black, big-eyed, and yellowfin tunas, and albacore) and spearfishes (chiefly striped and black marlins and swordfish).
ND: No data available
SOURCE: Statistical Yearbook of Agriculture and Forestry, published by Ministry of Agriculture and Forestry

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United States Department of the Interior, J.A. Krug, Secretary
Fish and Wildlife Service, Albert M. Day, Director

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THE EFFECT OF A SEAFOOD DIET ON THE RED CELL COUNT, HEMOGLOBIN VALUE, AND HEMATOCRIT OF HUMAN BLOOD[1/]

By Shirley J. Wilson*

Contents

Abstract: The effect of a seafood diet upon certain blood values was studied with six college women ranging in age from 19 to 24 years. Two of the subjects served as controls and consumed free-choice diets; four received the seafood diet. The experimental period was composed of a three-week preliminary period of a free-choice diet, a seven-week period of the seafood diet, and a final one-week period similar to the preliminary period. The first and third periods were used to obtain a comparison of the free-choice diet and the seafood diet for each of the four subjects. During the seven-week test period, seafoods furnished the protein of a daily main meal which was prepared and served during the noon lunch hour.

Each subject recorded the total daily food intake for the entire experimental period. From the dietary records, the consumption of protein, calcium, iron, vitamin A, thiamine, riboflavin, niacin, ascorbic acid, and the number of calories were calculated; those of the seafoods were reported separately.

A blood sample was taken by venipuncture once every week from each subject. The volume of packed cells (hematocrit reading), red blood cell count, and hemoglobin content were determined for these samples. The color, saturation, and volume indices were calculated, but these did not show significant results.

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