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*Japan's tuna fishery faces a major depression as catch rates decline, oil prices triple, and U.S. imports shrink.*

# Japan's Fisheries, 1975

TAMIO OTSU

## TUNA INDUSTRY DILEMMA

The Japanese tuna industry this year is facing a major depression, a situation which has developed following the "oil shock" of 2 years ago and the subsequent inflationary trend. The problems are compounded by generally declining tuna longline catch rates and depressed tuna prices. When compared with the "mercury shock" of about 4 years ago, or the "canned tuna decomposition" problem of 3 years ago, both of which caused heavy losses to the tuna industry in Japan, the present situation is considered far more serious. Some sources predict that perhaps as many as 20 percent to 30 percent of the tuna longline vessels will soon become inactive, with many going into bankruptcy. The problem and causes are complex, but some of the more obvious reasons for the present state are these:

1. Tripling of oil prices in the last year.
2. Increased cost of fishing gear (particularly those oil-related products) and provisions needed for extended fishing operations.
3. Generally declining catch rates throughout the areas of operation.
4. Depressed fish prices in Japan.
5. The virtual closing of the U.S. markets to Japanese exports of albacore and yellowfin and skipjack tunas.

These problems are not restricted to Japan alone; they affect Korea and Taiwan and other tuna fishing nations as well. Korea and Taiwan may be even more affected since their longline vessels fish strictly for the export market, whereas a segment of the Japanese longline fleet fishes primarily for the domestic "sashimi" market. This is not to say that vessels fishing for the domestic market are not also having their problems at this time.

The increased oil prices, having gone from $40-$50 per ton a year or so ago to the present $110-$130 per ton, have resulted in a daily fuel cost of more than $400 for vessels that burn about 3.5 tons of fuel per day (e.g., many of the Korean vessels in the 220-280 ton category). Added to this is the high cost of fishing gear and other provisions needed for extended fishing trips. Meanwhile, catch rates have been declining in all oceans where these longline vessels fish. Reports indicate that catches in some areas have now fallen to less than 1 ton per day of fishing. A recent report from American Samoa shows that albacore catches have fallen far below a ton a day. It is easy to see that ex-vessel revenues of $500-$550 per day will not pay for the present high cost of operations.

The longline vessels (Korean and Taiwanese) based in American Samoa have had to extend their fishing grounds farther and farther away from the base. Fishing trips have increased in length to about 6 months for the larger vessels of about 250 tons, while 140-ton vessels are out 3 to 4 months. And still many of the vessels are returning to port with less than a full load. A source believed that about 30 Korean vessels would soon leave American Samoa, probably to return to Korea.

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### Editor's Note

Early in 1975, Tamio Otsu attended the Japanese Tuna Research Conference, Shimizu City, Japan, as he has for the past 6 years. After the conference he spent two more weeks in Japan conferring with fishery biologists and members of the Japanese fishing industry with whom he maintains close ties. This article, written in late March 1975, summarizes his findings.

Probably most serious of all is the virtual closure of the American market to Japanese exports of albacore and yellowfin and skipjack tunas. Japanese sources reported that the U.S. canners have built up a large inventory of canned tuna as well as raw materials, and that they are no longer importing tunas from Japan (and presumably from other countries) or are offering prices for these fish that are agonizingly low. They attribute the large inventory to such causes as: 1) declining meat prices in the U.S.; and 2) bad publicity given "contaminated" canned tuna recently, both resulting in lower U.S. tuna consumption. Some expressed hope that U.S. consumption of fish would increase during the Lenten season and U.S. canners would then resume importing.

During my visit the newspapers and weekly magazines in Japan were giving considerable coverage to the financial problems of the Nichiro Gyogyo Kaisha. They reported that poor management had caused the company to overextend its operation to the point of near-bankruptcy. The company president and others in positions of leadership were removed and replaced by bank officials, and many of the executives were demoted in rank. The company reported that tuna and skipjack operations were to be terminated, and that 633 employees connected with this division would be released.

There are 13 Nichiro-owned skipjack tuna fishing vessels based in Tema, Ghana. The company decided to tie up all of the vessels, return the men to Japan, and terminate their employment. Subsequently, however, the powerful Seamen's Union in Japan has apparently forced Nichiro Kaisha to retract these plans (according to a news article dated 20 February). One company official told me that these 13 skipjack tuna vessels had been built especially for operation in the waters off West Africa and are not suitable for Japanese waters. They are built with very low freeboard, and fishermen fish off the sides and stern, but not at the bow as on traditional Japanese skipjack tuna vessels. The disposition of these vessels is a big problem, he said.

The reasons given for the problems encountered in the Ghana operation were: 1) low prices offered for skipjack and yellowfin tunas by the U.S. canner; 2) ICCAT (International Commission for the Conservation of Atlantic Tunas) regulations setting forth minimum sizes of yellowfin tuna to be taken off West Africa, which make operations difficult; and 3) increased cost of operations. Certainly this must be a simplified explanation of the problems faced by the Nichiro Kaisha, but it points to the generally depressed condition throughout the tuna industry.

During the "mercury shock" when the tuna fishery was faced with plummeting fish prices and decreased consumption, the Federation of Japan Tuna Fisheries Cooperative Associations (Nikkatsuren) did much to ease the problem. The Nikkatsuren carried out an intensive promotional campaign to assist in the recovery. They also purchased considerable amounts of fish, particularly albacore, and held them in freezers to stabilize prices. As a countermeasure to today's problem where Japan is unable to export its fish, Nikkatsuren apparently is planning construction of more freezers in order to purchase and store away the fish until the present situation eases.

Another serious problem faced by the tuna industry (particularly the producers) is that they have no direct control over prices. The depressed prices are attributable, in part, to the import of tunas into the Japanese markets directly by foreign fishing vessels. Vessels from Korea, Taiwan, and those flying the Panamanian flag (but manned mostly by Koreans) are delivering fish to Japanese ports. Such imports of fish amounted to 60,000 tons in 1974 and the amount has increased year after year. This situation is apparently unavoidable under present Japanese law. Because most of these imports are from Korea, negotiations were carried out recently to see if they would limit the amount of tuna delivered directly. The Koreans have apparently agreed to limit the number of vessels delivering directly to Japan to the present 160 vessels, or approximately a third of the Korean longline fleet. No agreement was reached on the amount to be delivered, however.

The foregoing account is based on scattered information provided by numerous sources and some of the statements are unverified. It is certain that the problems facing the Japanese tuna industry are given here in a most simplified form. Nevertheless, the important message is that the people in the industry consider the situation most serious, and that the Japanese word "fukyō" (depression) is most commonly used to describe the Japanese tuna fishery today.

## PURSE SEINING IN THE WESTERN PACIFIC

For several years now, the Japanese have been sending chartered seiners to the western equatorial Pacific to conduct exploratory purse seining for skipjack and yellowfin tunas. Initially, the Japan Fisheries Agency undertook this work, and it was later carried on by the Japan Marine Fisheries Resource Research Center (JAMARC). It has now come to the stage where the Japanese consider purse seining to be commercially feasible, and several commercial seiners are operating in the western Pacific and in the Coral Sea. Catches are averaging close to 10 tons per set; the vessels are achieving success in catching fish in 80 percent of the sets made. The average catches are lower than in the eastern tropical Pacific purse seine fishery, but these Japanese seiners are considerably smaller than the average U.S. seiners, most being from 250 to 500 gross tons in size.

The Japanese initially found it extremely difficult to successfully set around the schools as the fish tended to escape before the net could be pursed. They also found that certain types of schools were more difficult to capture than others, and that the time of day seemed to make a great difference. Today, the Japanese believe that they can achieve success under the following conditions:

1. Schools must be associated with drifting objects (driftwood, etc.).
2. Sets must be made either early in the morning or at dusk.
3. Nets must be larger than those used in the eastern Pacific.

Consequently, the fishing masters on the seiners constantly search for drifting objects and associated schools, and when such a school is found they often follow it until early morning (tracking it overnight by marking the drifting object with radiobuoy and lights) or dusk before making their set.

The purse seine nets used in the western equatorial Pacific (area north of Papua New Guinea) and in the Coral Sea are larger than those used in the eastern Pacific. The following examples of net sizes are provided:

| Vessel | Area used | Size of net |
|---|---|---|
| *Nippon Maru* | Eastern Pacific and West Africa (U.S.-type seiner) | 110 m deep × 1,025 m long or 118 m deep × 1,350 m long |
| *Hayabusa Maru* | North of Papua New Guinea | 220 m deep × 1,600 m long |
| *No. 58 Tokiwa Maru* | North of Papua New Guinea | 250 m deep × 1,960 m long |
| *No. 55 Hakuryu Maru* | Japan coastal waters for skipjack and yellowfin tunas | 150 m deep × 1,500 m long or 220 m deep × 1,500 m long |
| *Wakaba Maru* | do. | 220 m deep × 1,500 m long |
| *No. 23 Taikei Maru* | do. | 200 m deep × 1,500 m long |
| *No. 28 Kohoku Maru* | do. | 261 m deep × 2,025 m long |
| *No. 85 Seishin Maru* (two-boat seining) | do. | 350 m deep × 1,700 m long |
| *No. 7 Konpira Maru* (two-boat seining) | do. | 240 m deep × 2,400 m long |

The results of the most recent charter cruises were reported by JAMARC as follows:

Vessel: *Fukuichi Maru*, 500 tons
Survey area: Around the Caroline archipelago
Survey period: 18 June-30 November 1974

### First cruise

Departed Yaizu on 20 June 1974. Started survey southward beginning around the Bonin Islands, and worked as follows: 24-25 June, south of Hahajima; 1-8 July, west of the Carolines at lat. 6°-7°N, long. 141°-143°E; 9-15 July, east of Palau; 16 July-2 August, southeast of Palau at lat. 3°-4°N, long. 136°-138°E; 7-16 August, Western Carolines at lat. 4°-6°N, long. 142°-147°E.

Made a total of 27 sets and caught 229 tons of skipjack tuna and 53 tons of yellowfin tuna for a total of 282 tons. The catch per set amounted to 10.4 tons; the maximum catch was 32 tons per set. A full load was obtained on 16 August so the survey was terminated and the vessel returned to Yaizu.

### Second cruise

*Fukuichi Maru* departed Yaizu on 2 September en route to fishing grounds. Started fishing in waters southeast of Palau. Fishing was not as good as on the earlier cruise. Worked in area lat. 0°-8°N, long. 135°-145°E, and on 7 October arrived in Guam, where they unloaded 22 short tons of skipjack tuna. Only 10 sets had been made for a catch of 22 tons of skipjack tuna and 33 tons of yellowfin tuna, a total of 55 tons.

### Third cruise

Fishing commenced on 12 October in the area lat. 4°-8°N, long. 145°-151°E (eastern Carolines). Three sets resulted in 18 tons of fish. In waters southeast of Palau at lat. 2°-5°N, long. 140°-145°E, 14 sets resulted in 127 tons of fish. Up to this point, fishing conditions were as poor as on second cruise. Only two sets had resulted in about 10 tons per set; others were on the order of 1-3 tons per set. However, toward the end of the survey period, on 6 November, a catch of 20 tons was made at lat. 2°N, long. 144°E. Since it looked as though fishing would improve after this, the cruise period was extended. The vessel fished until 18 November and returned to Yaizu on 26 November.

During the charter period, the *Fukuichi Maru* fished 53 schools associated with drifting objects, and caught 168 tons of yellowfin tuna, 320 tons of skipjack tuna, and 12 tons of miscellaneous species, for a total of 500 tons. The target catch of 468 tons was exceeded by 32 tons.

According to JAMARC, there are now five or six commercial seiners working in the Coral Sea (lat. 15°S, long. 147°E) for yellowfin tuna.

The average catches as well as the success rate of seining in the western equatorial Pacific must be considered in the light of fishing effort. If vessels avoid making sets during midday, this cuts down fishing effort considerably. The size of the seiners (small relative to U.S. seiners) may be the saving grace in this particular fishery.

Because Japanese seiners are so completely dependent upon drifting objects in order to make successful sets on skipjack and yellowfin tunas in the western equatorial Pacific, Japanese researchers would like to develop artificial drifting objects that will aggregate tunas for seining. Studies have already indicated that there is promise in this approach.

## JAPANESE SOUTHERN WATER SKIPJACK TUNA FISHERY, JULY 1974-JANUARY 1975[1]

### July-August 1974

Because fishing was poor in the Marianas area, many of the larger vessels (larger than 299 tons) went south and fished around lat. 3°-6°N, long. 143°-158°E, as well as around lat. 1°N, long. 168°-173°E (Figs. 1 and 2). Initially, the catches ranged from 3 to 20 tons per day, averaging between 5 and 7 tons, with considerable variation from vessel to vessel. The first part of August the fishing grounds east of long. 160°E became very unproductive. Vessels shifted westward to lat. 2°-6°N, long. 145°-155°E, where fishing was somewhat better; there some vessels took more than 30 tons per day. However, results were mixed, and the fishing condition was generally unstable. Of the skipjack tuna taken, 70 percent-75 percent were 3-4 kg fish.

At the end of the albacore season, there were vessels which ventured eastward from the Emperor Seamount towards the Hawaiian Islands. These vessels reported maximum catches of 20-25 tons per day, but average catches were between 7 and 8 tons (including small yellowfin tuna). In this area (northwest Hawaiian Islands) large skipjack tuna of 9-15 kg are usually quite abundant, but this year such large fish were few and about 70 percent of the catch consisted of 1.5-4.0 kg fish.

In August, there were 50-60 vessels fishing in southern waters and about 20 vessels operating near the northwest Hawaiian Islands. The landings of southern water fish at Yaizu during July-August were as follows:

#### July

Twelve vessels unloaded 751.4 tons; the average landings per vessel amounted to 62.6 tons (including 17.9 tons of small yellowfin tuna). From the waters around the northwest Hawaiian Islands, four vessels unloaded 721.8 tons, averaging 180.4 tons per vessel (including 101.1 tons of small yellowfin tuna).

[1]From a preliminary report prepared by Tamotsu Tanaka, Yaizu Branch, Tohoku Regional Fisheries Research Laboratory.

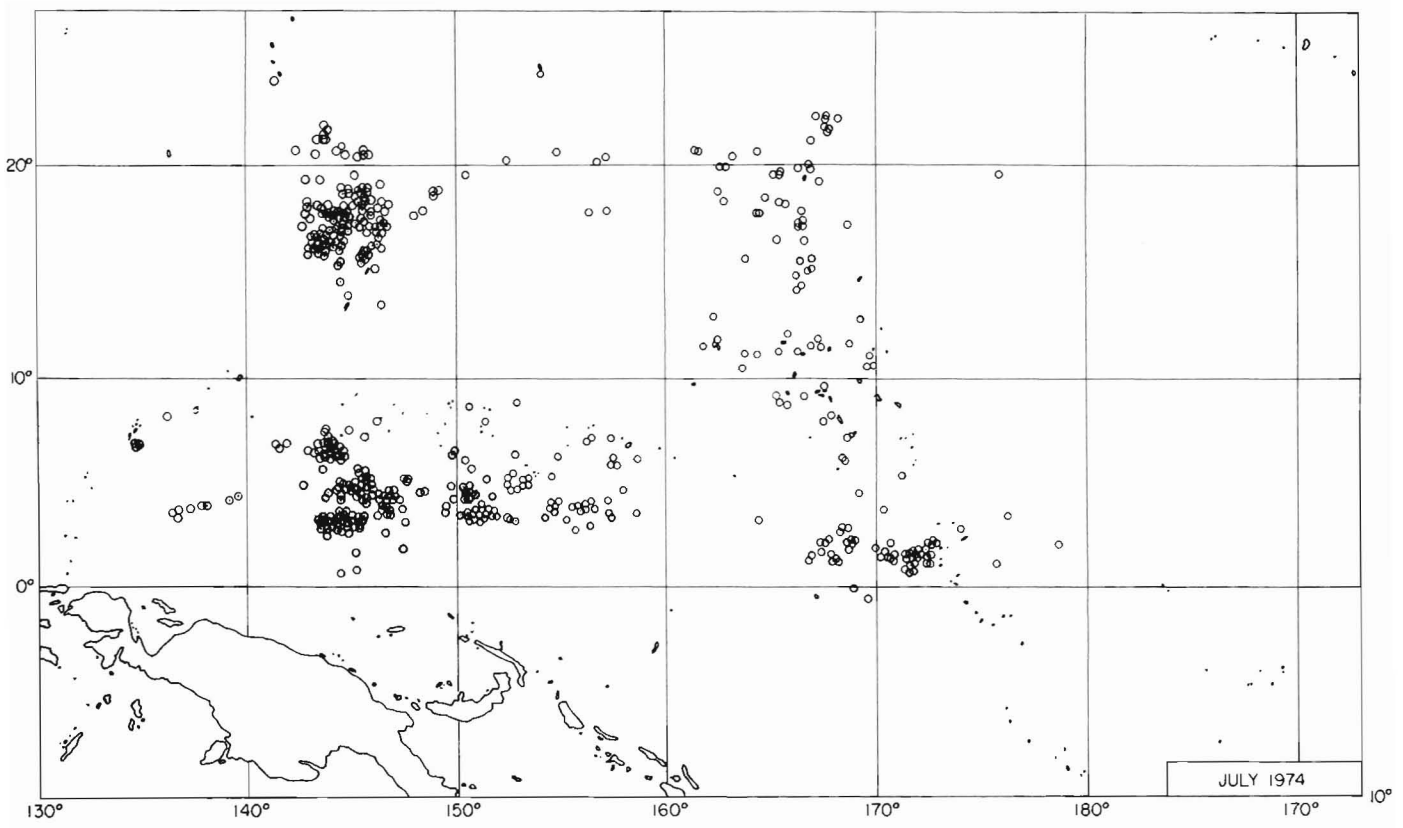


Figure 1.—Location of skipjack tuna catches, July 1974.

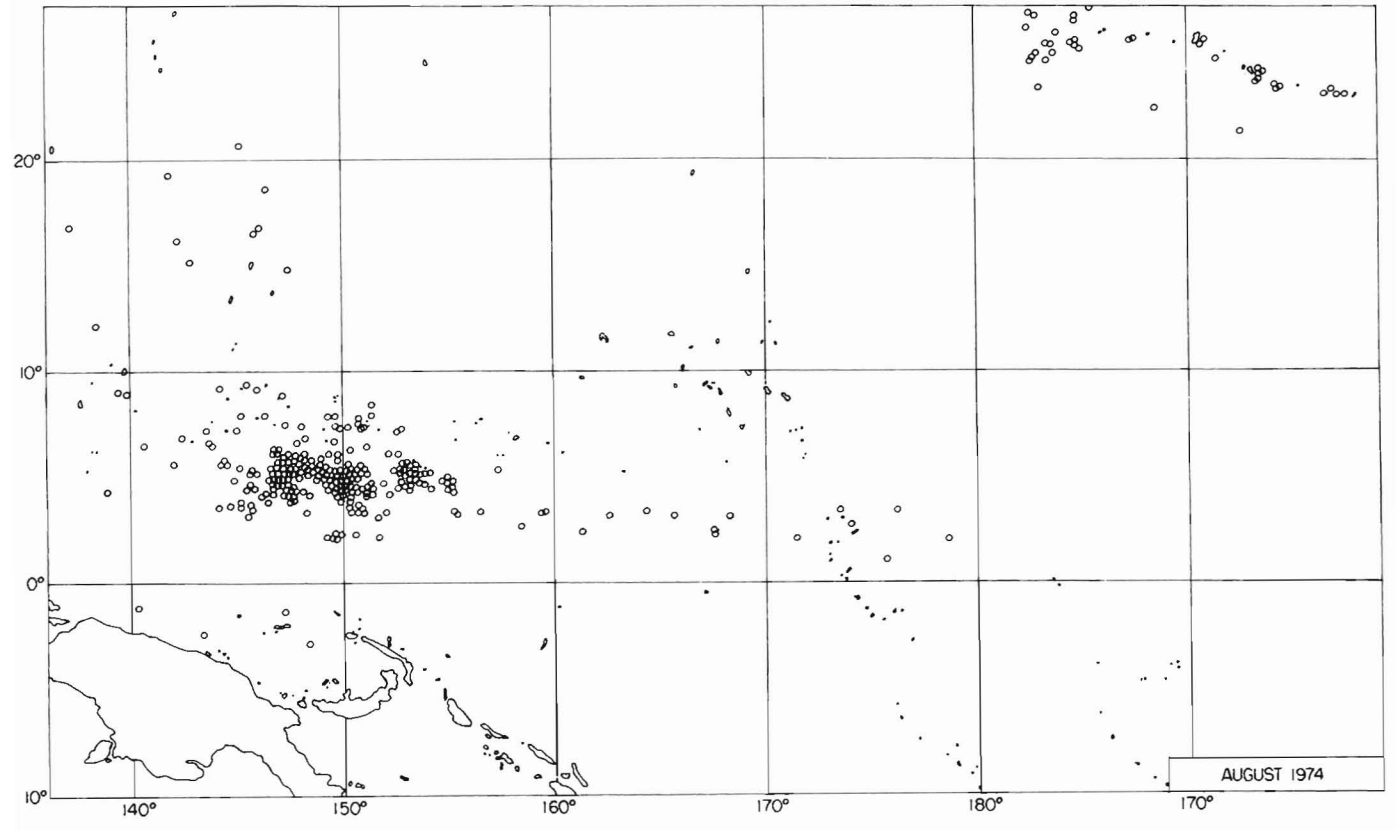


Figure 2.—Location of skipjack tuna catches, August 1974.

### August

Sixty-one vessels unloaded 5,675.5 tons (including 99.9 tons of small yellowfin tuna), averaging 93.0 tons per vessel. One purse seine vessel unloaded 192.2 tons of skipjack tuna and 83.5 tons of small yellowfin tuna. From the waters near the northwest Hawaiian Islands, six vessels delivered 655.0 tons (including 55.9 tons of small yellowfin tuna); the average landing per vessel amounted to 109.1 tons.

## September 1974

In September (Fig. 3), most of the vessels over 299 tons shifted to the southern water skipjack tuna fishery and the fishing grounds expanded widely in an east-west direction. There were 130-140 vessels in the fishery. Fishing continued to be poor, with daily catches of 2-15 tons, averaging around 4 tons per day. The waters south of the equator were scouted but no good fishing grounds were located. Although fishing conditions had been poor since July, considerable numbers of fish schools (with bird flocks) were reportedly being seen in waters west of long. 145°E to the vicinity of Palau. However, the fish were poor-biting, and the maximum catches were 7 or 8 tons per day. The average catches amounted to around 3 or 4 tons per day. As in July-August, the fish sizes were 3 or 4 kg for the most part. In the vicinity of the equator as well as in waters west of long. 145°E, fish of 1.5-2.0 kg generally make up 10 percent to 20 percent of the catch. This year, however, such small fish were reported to be very scarce.

The water temperatures in the fishing grounds west of long. 150°E were 29.5°-30.7°C, higher than usual by 0.5°-1.0°C. In these higher temperatures, the baitfish suffered considerable mortality. In most years, the vessels report some baitfish mortality around lat. 20°N when encountering high water temperatures. However, the survival is usually good thereafter, and the remaining baitfish can be used on the fishing grounds. This year, however, the high temperatures on the fishing grounds appeared to have caused additional mortality. Many vessels reported mortalities greater than 60 percent. As a result, the tuna catches were also poor, and many vessels returned to port with less than 50 tons of fish. Even those vessels that managed to maintain their baitfish supply encountered such poor fishing that they had to spend 26-30 days on the fishing grounds, thus extending the trip to 35-45 days.

In September, 50 vessels unloaded 4,310.6 tons of fish at Yaizu for an average delivery per vessel of 86.2 tons (including 111.5 tons of small yellowfin tuna). One vessel returning from east of the international dateline delivered 106.5 tons (including 14.5 tons of small yellowfin tuna).

## October 1974

The fishing grounds in October (Fig. 4) extended broadly from the Caroline Islands to the northern part of the Solomon Islands. In all areas, vessels reported seeing considerable numbers of fish schools. However, the fish were not responding well to chumming and catches were poor. Throughout the Caroline Archipelago, the water temperatures were higher than usual by 1.0°-1.5°C, being reported at 29.5°-31.0°C. There were many reports of

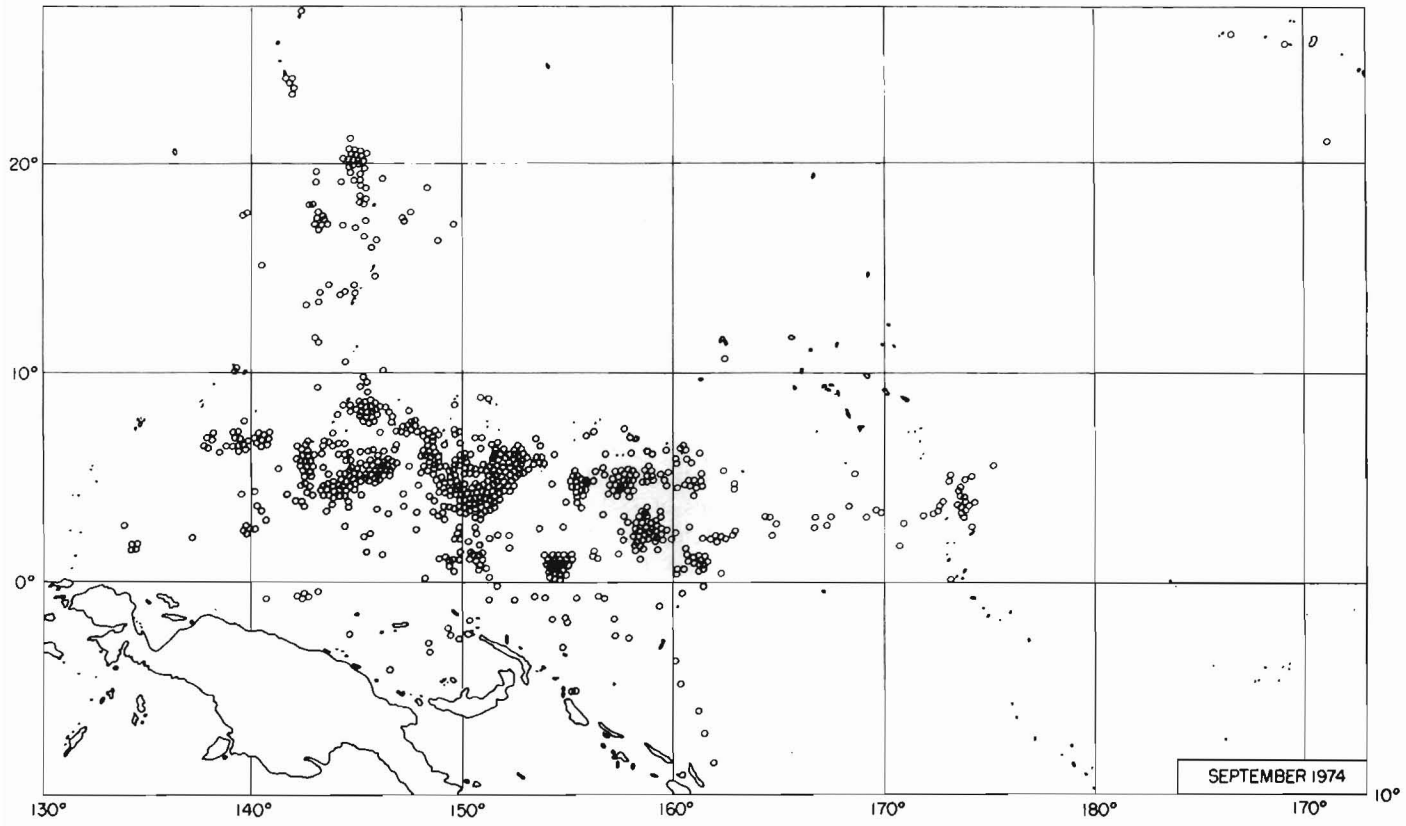


Figure 3.—Location of skipjack tuna catches, September 1974.

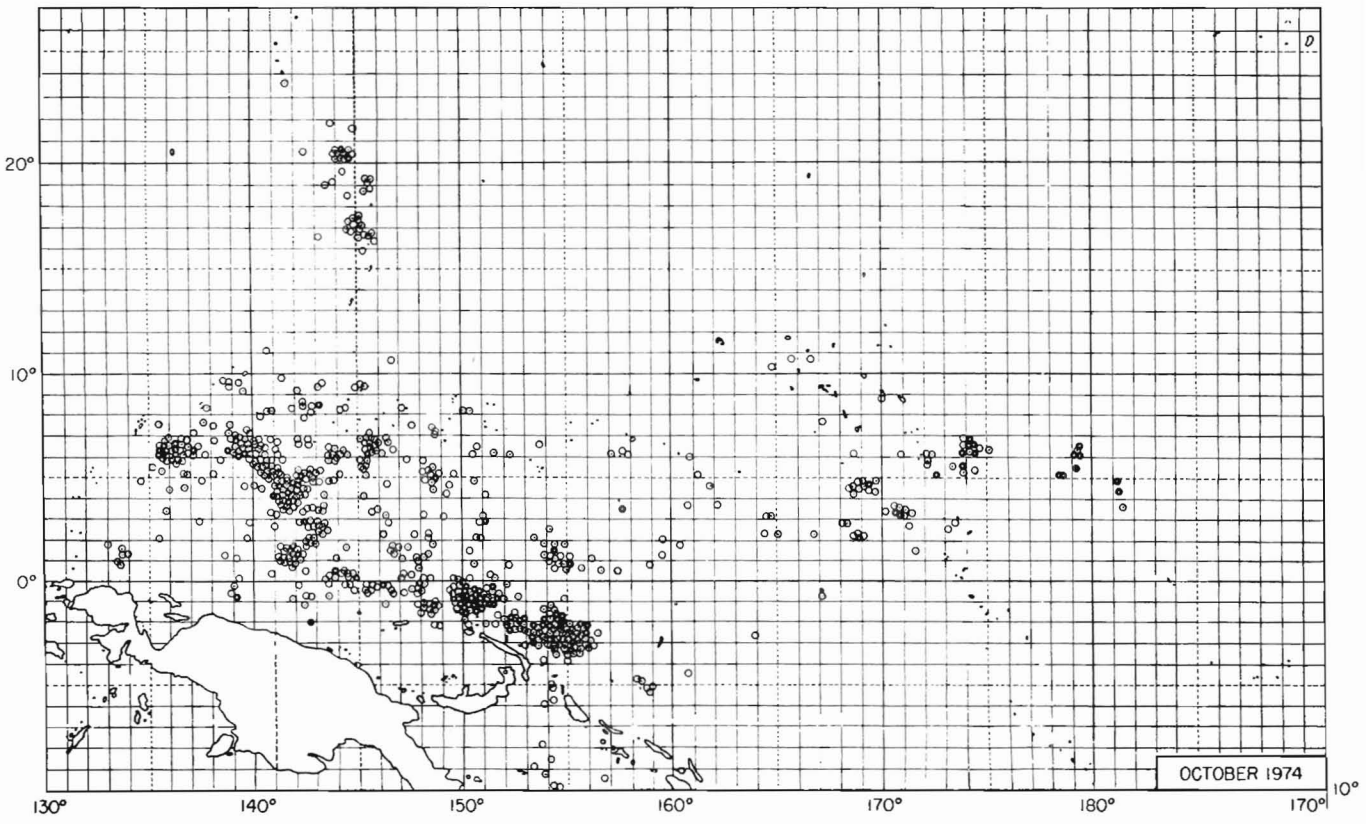


Figure 4.—Location of skipjack tuna catches, October 1974.

heavy baitfish (anchovies from Japan) mortality, a condition that first started in September. The effect of temperature on baitfish was being felt by all vessels that had gone to southern waters at the end of the albacore season in Japanese coastal waters.

Many vessels fished in the area bounded by lat. 3°-6°N, long. 136°-145°E in early and mid-October. Towards the end of the month the effort shifted to the waters north of the Solomon Islands (lat. 0°-3°S, long. 150°-156°E). The catches improved some, but there was still considerable variation among vessels, and fishing conditions continued unstable. Only a few vessels returned to port with catches exceeding 100 tons. In early- and mid-October, the maximum catches were reported to be 10-15 tons per day, averaging 3-4 tons per day; towards late October, the maximum catch was 32 tons, averaging 5-6 tons per day. The skipjack tuna ranged in weight from 1.8 to 3.5 kg, and averaged 2.5 kg. There were about 120 vessels fishing in southern waters during the month.

The fishing grounds in the waters extending from the Gilbert Islands to the Marshall Islands, usually good at this time of the year, turned out to be very poor this year. Fishing was particularly poor in the Marshalls north of lat. 8°N, where schools were reportedly very scarce. In waters south of lat. 7°N, schools were also scarce but were better biting and catches of 7-10 tons per day were reported. There were 10-15 vessels in the Gilberts-Marshalls area.

On the other hand, vessels fishing east of the international dateline reported good catches of 18-32 tons per day. The water temperatures in the area ranged from 28.5° to 29.2°C. The fish sizes ranged from 3 to 7 kg.

In late October, two skipjack tuna vessels went to the Coral Sea to handline for tunas. These vessels caught 60 tons and 18 tons, respectively, of bigeye and yellowfin tunas. Two purse seiners in the Coral Sea reported taking a total of 200-250 tons of tunas.

In October, 96 vessels delivered a total of 7,913.3 tons of fish, averaging 82.4 tons per vessel. At the same time last year, 83 vessels landed 10,874.8 tons, averaging 131.0 tons per vessel.

## November 1974

Within the area bounded by lat. 2°S-5°N, long. 141°-146°E, the northern and southern boundaries provided good fishing and many of the vessels began shifting their efforts accordingly (Fig. 5). The maximum day's catch was reported at 30 tons; the average catch was around 4-5 tons per day in both areas. The skipjack tuna were 2-6 kg in size. Most of the 35-40 vessels fishing there were large.

In the vicinity of the Gilberts at lat. 1°-2°S, long. 172°-174°E, good fishing occurred for a very short time. Soon thereafter, good fishing was reported at lat. 4°N, long. 168°-169°E, where toward late November catches of 30 tons were reported. There were 50-60 vessels in the vicinity.

Some vessels worked farther to the east of the international dateline than they had in October, and reached the vicinity of lat. 5°-6°N, long. 163°W. But

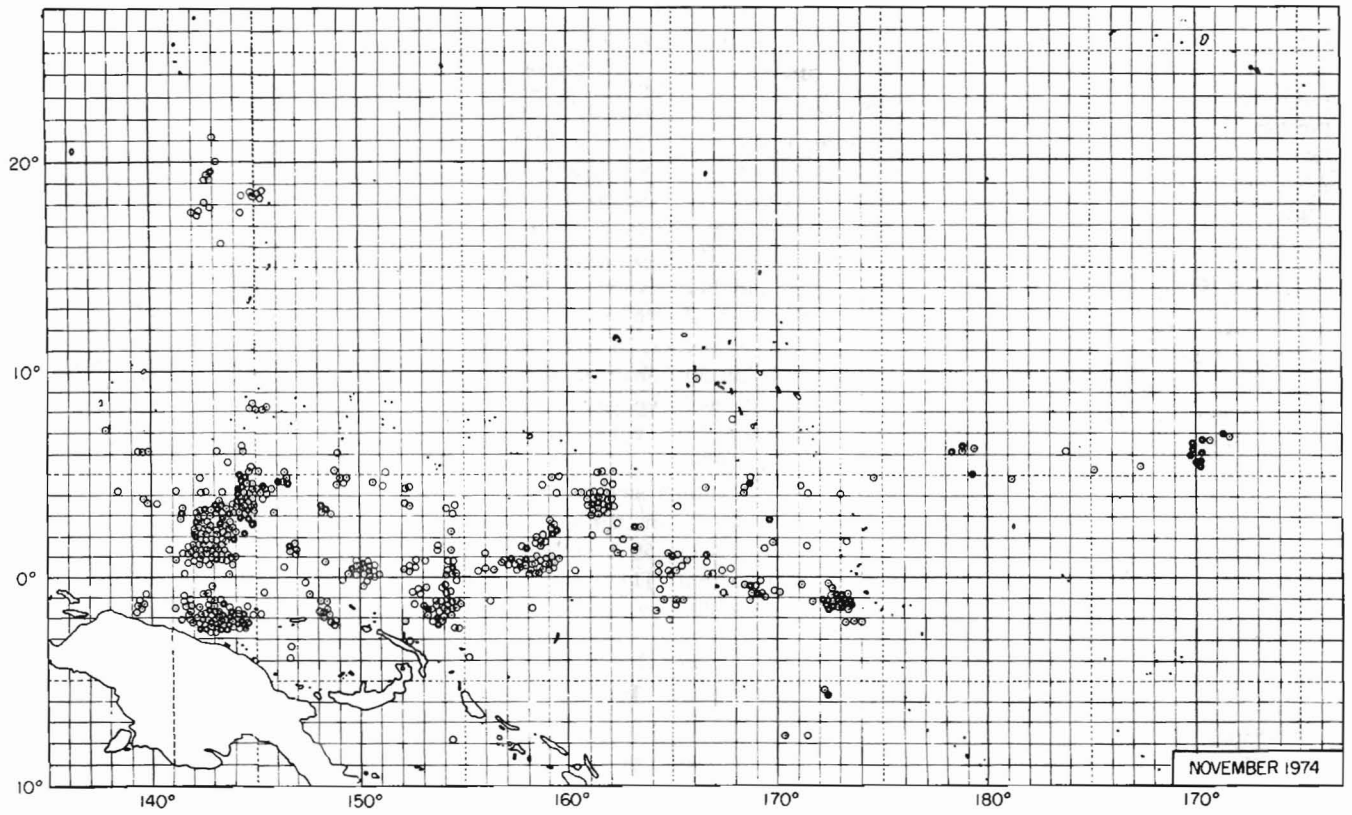


Figure 5.—Location of skipjack tuna catches, November 1974.

they fished mainly around lat. 5°-7°N, long. 168°-171°W where the water temperatures were 28.2°-28.3°C. Maximum catches were around 50 tons per day. The size composition of the skipjack tuna was as follows: larger than 6 kg, 24 percent; 4.5-5.9 kg, 72 percent; 2.5-4.4 kg, 4 percent. Thus, virtually all of the fish were large, weighing more than 4.5 kg.

A vessel entering the port of Makurazaki reported sighting numerous large schools of very small skipjack tuna (around 10 cm long).

In late November, the *No. 3 Inasa Maru* from Tago in Shizuoka Prefecture and three other vessels caught considerable amounts of "doku-uroko ibodai" (*Tetragonurus atlanticus*) around a night light at lat. 3°N, long. 161°E, where the water temperature ranged from 29.0° to 29.4°C. Using this "high seas" baitfish, the vessels experienced good results in skipjack tuna fishing. This is probably the first time that baitfish has been taken in quantity on the high seas in southern waters. It is desirable to conduct detailed studies on this potential baitfish resource in the future.

## December 1974

Five separate fishing grounds developed during the month (Fig. 6) as follows:

### 1. Lat. 9°-17°N, long. 130°-135°E

Most of the vessels fishing in this area were from Kagoshima Prefecture, but a few were from Mie Prefecture. In early December, the main ground formed at lat. 17°N, long. 133°-134°E. The ground gradually shifted southward. Later in the month it was at lat. 9°-10°N, long. 131°-133°E. The maximum catch amounted to 20-25 tons and the average was around 7 or 8 tons per day. Fishing conditions were stable; the skipjack tuna weighed 5-6 kg. There were about 30 vessels in the area.

### 2. Lat. 2°S-5°N, long. 139°-145°E

In this area, the fishing grounds formed along the northern and southern borders similar to the previous month. Fishing was rather poor with a maximum catch of 25-30 tons per day and an average catch of 4 or 5 tons per day. Fish schools were reportedly numerous, however. As for fish sizes, the skipjack tuna taken along the southern border weighed 3-5 kg; those along the northern border were 3-6 kg. The fish along the southern border were somewhat larger than in other years.

### 3. Lat. 3°-6°N, long. 164°-170°E

There were 30-40 vessels fishing this area; the average catch amounted to 4-5 tons per day. Maximum catches were around 18-20 tons per day and the skipjack tuna weighed 3-6 kg.

### 4. Lat. 5°-8°N, long. 172°-176°W

The water temperature in the area was 28.0°-28.3°C. Fishing continued to be poor through mid-December. There were 15-20 vessels venturing eastward to this area. Towards late December, the catches reached about 20 tons per day. The vessels reported

winds of force 3 or 4 in the area. Some experienced rather good fishing and five or six vessels returned to port with full loads. The skipjack tuna size composition was as follows: larger than 6 kg, 2 percent; 4.5-5.9 kg, 51 percent; 2.5-4.4 kg, 43 percent; 1.5-2.4 kg, 1 percent.

### 5. Lat. 7°-9°S, long. 150°-155°E

The water temperature in this area (Solomon Sea) was 29.1°-30.0°C. Fishing grounds developed about 2 months earlier than in previous years but catches were poor, with a maximum of 20 tons per day and an average catch of 4 or 5 tons per day. The skipjack tuna weighed 1.5-3.5 kg; there were five or six vessels fishing this area.

## January 1975

Fishing grounds developed in four locations (Fig. 7): 1) lat. 7°-9°S, long. 150°-155°E; 2) lat. 2°S, long. 152°-160°E; 3) lat. 8°S, long. 161°-163°E; 4) lat. 6°N, long. 175°-177°W.

### 1. Lat. 7°-9°S, long. 150°-155°E

The water temperature in this area (Solomon Sea) was 29.2°-30.0°C. Through mid-January, the catches were exceedingly poor, with vessels reporting catches of 3-5 tons per day. In late January, the fishing improved and catches of 10-20 tons per day were seen here and there. Numerous reports were received of schools associated with whale sharks. Fishing such schools, the proportion of small yellowfin tuna and small bigeye tuna of 3-7 kg increased to 5 percent to 10 percent of the total catches.

The skipjack tuna size composition was as follows: larger than 4.5 kg, 5.5 percent; 2.5-4.4 kg, 55.5 percent; 1.5-2.4 kg, 39 percent. There were 30-40 vessels fishing the area.

### 2. Lat. 2°S, long. 152°-160°E

Water temperature in the area was 29.2°-29.5°C. Most of the schools were associated with bird flocks. Catches averaged around 5 or 6 tons per day, with a reported maximum catch of 25 tons. In late January, catches improved to around 8-13 tons per day and fishing conditions continued to be rather stable. The skipjack tuna were mostly (80 percent to 90 percent) between 3.0 and 3.5 kg. There were 30-40 vessels in the area.

### 3. Lat. 8°S, long. 161°-163°E

The water temperature was reported to be between 29.0° and 29.5°C. in this area located north of Guadalcanal. In late January, the catches averaged 7-8 tons, and the maximum reported was 20 tons per day. Some vessels moved to this area from farther west, until there were 10-15 vessels fishing here. The skipjack tuna taken were 3.0-3.5 kg in size.

### 4. Lat. 6°N, long. 175°-177°W

The water temperature was 27.0°C. Weather conditions were unfavorable with winds of force 3-4 prevailing. In

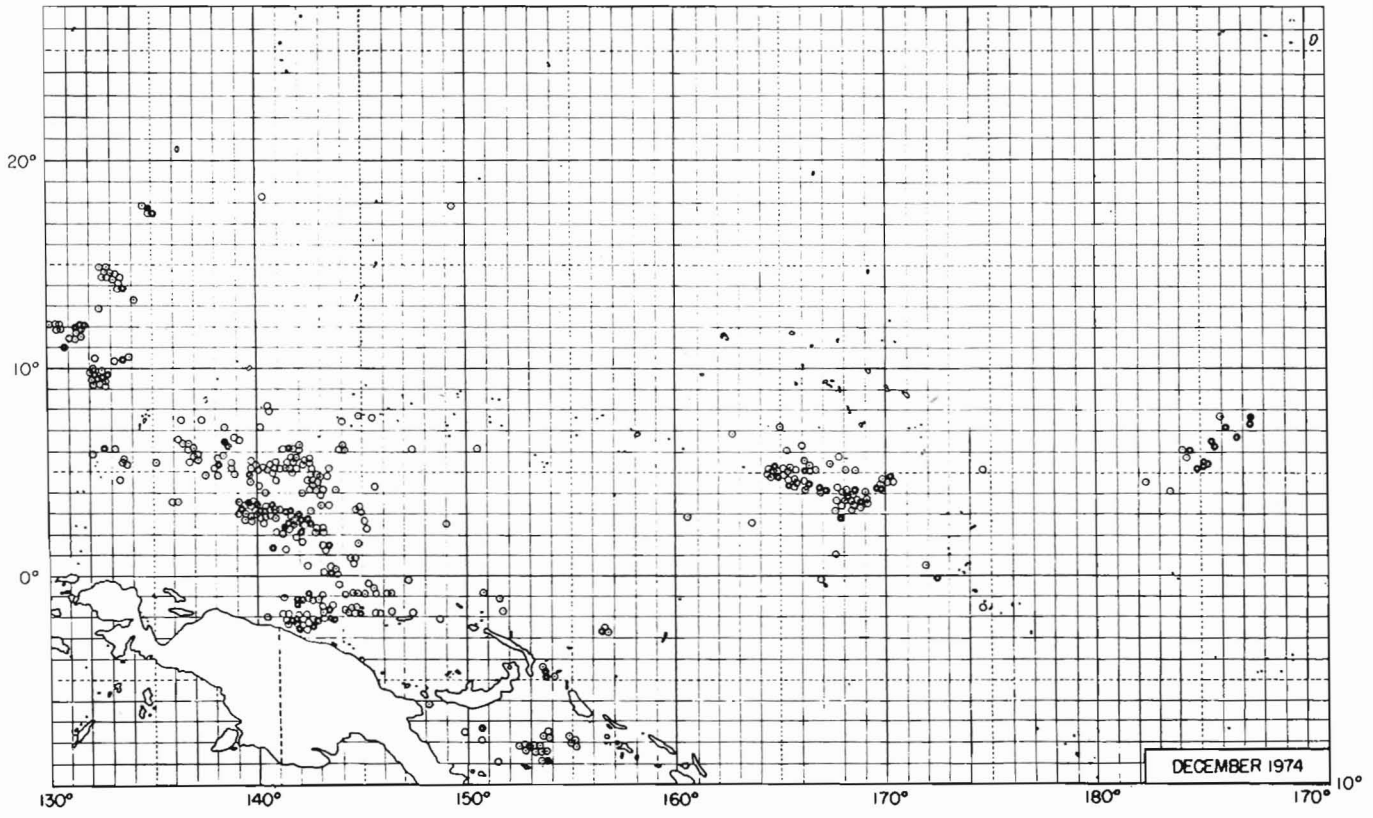


Figure 6.—Location of skipjack tuna catches, December 1974.

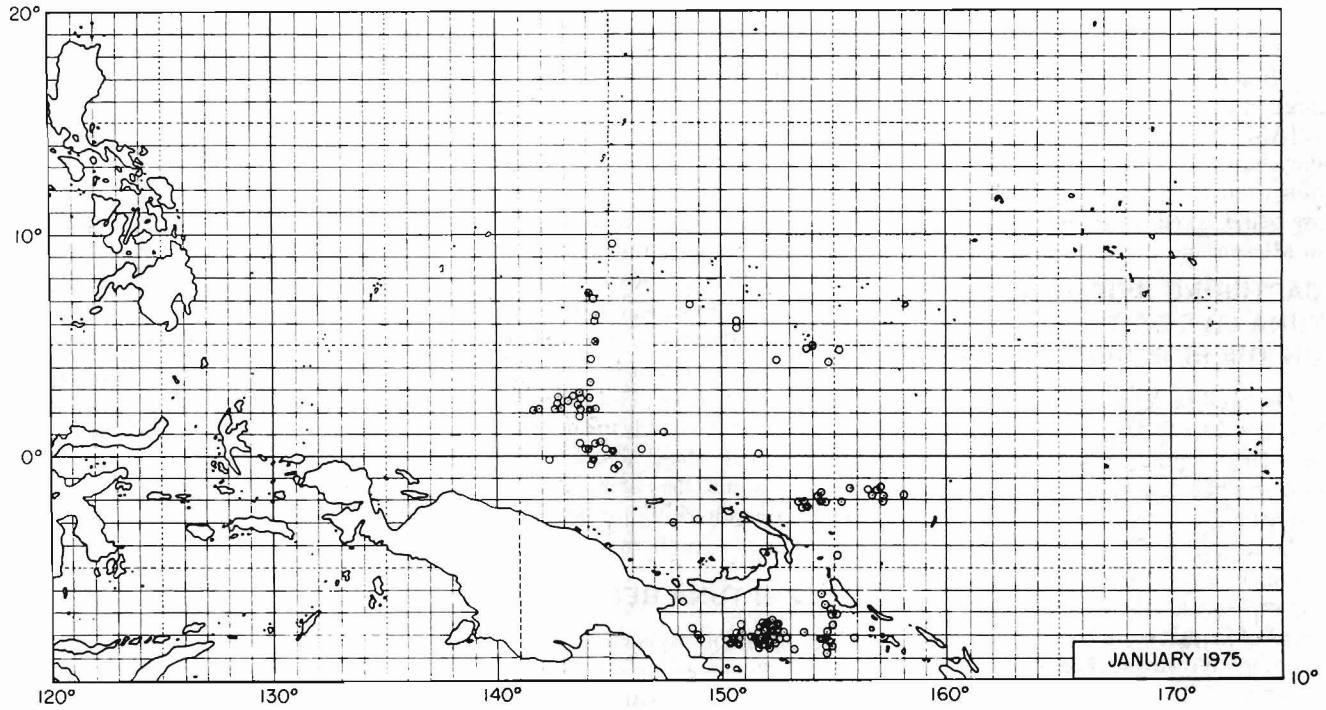


Figure 7.—Location of skipjack tuna catches, January 1975.

late January, catches were up to 30-49 tons in some cases and three vessels returned home with total catches of 190-220 tons. The skipjack tuna size composition was: larger than 6 kg, 17 percent; 4.5-5.9 kg, 62 percent; 2.5-4.4 kg, 20 percent; and 1.5-2.4 kg, 2 percent. There were around 20 vessels fishing this area.

In general, fishing conditions during the July 1974-January 1975 period were quite poor throughout southern waters as compared with the previous year. The reasons can be partially attributed to heavy bait mortalities, at least during September and October 1974. Furthermore, though vessels reported sighting numerous schools, they found the schools generally "poor-biting."

## SKIPJACK TUNA FISHERY SURVEY IN MICRONESIA

For the last several years the Japan Marine Fisheries Resource Research Center (JAMARC) has been conducting skipjack tuna fishery surveys in various places in the Pacific. In 1972 and 1973, JAMARC sent a chartered skipjack tuna fishing vessel to survey the waters of New Hebrides, New Caledonia, Nauru, Tonga, and Wallis Islands. The results were generally poor, as I reported in last year's trip report. JAMARC concluded that of the various islands surveyed for live bait and for skipjack tuna fishing, New Caledonia held the greatest potential. The insufficiency of baitfish was generally the principal problem. Even in New Caledonia, JAMARC researchers found baitfish to be rather scarce.

In 1974 JAMARC chartered the *No. 20 Akitsu Maru*, a 190-ton skipjack tuna vessel, to survey Micronesian waters. The survey period extended from 1 July through 15 October 1974. The following is the report on the charter cruise.

The vessel departed Kurihama on 4 July and fished for 6 days in waters between the Bonin Islands and Saipan. Fishing was poor and the catch totaled only 8 tons. The vessel entered the ports of Saipan (15-19 July) and Truk (22-24 July) and discussions were held with local authorities regarding the fishery survey of the Truk area. However, no definite agreement could be reached so the survey of Truk was temporarily suspended.

On 26 July, the vessel entered Ponape, and again the officers met with local authorities. Here, the local authorities were quick to agree on the survey plan. The survey of Ponape was conducted between 5 August and 5 October following the successful negotiation.

A bait survey was conducted by sampling with a stick-held dip net, "bouke ami", 79 times, beach seine 10 times, and drive-in net, "oikomi-ami", 8 times. The most successful method was the use of the stick-held dip net at night on baitfish attracted to a night light. A total of 1,056 buckets of baitfish such as engraulids, clupeids, and atherinids (3 kg per bucket) was taken. The beach seine during the day caught 13 buckets, mainly of carangids and engraulids. The drive-in net, which is considered a difficult bait-catching method, resulted in only one bucket of baitfish. The latter method is used to catch reeffish such as apogonids.

Skipjack tuna fishing was conducted over 34 days during which 116 schools were fished for a total catch of 34 tons of skipjack tuna, and 0.2 ton of yellowfin tuna. The results were disappointing since the cruise target had been set at 105 tons. Observers cited the following reasons for the poor showing. Bait was scarce and sufficient quantities could not be taken; this often precluded the vessel from fishing during the best hours of early morning and late afternoon. Furthermore, some of the baitfish (anchovies in particular) were very

weak, some were stronger but too scarce (clupeids), and some, although rather plentiful and strong, were too large in size (carangids).

JAMARC officials reported that they have received excellent cooperation from local officials and that they are being asked to continue the survey in Micronesia.

## CAPTURING SKIPJACK TUNA LIVE BAIT ON THE HIGH SEAS

The well-being of the skipjack tuna pole-and-line fishery is dependent to a very large degree on how well and how long live bait can be maintained aboard the fishing vessels. For example, from 1973 to early 1974, the long-ranging skipjack tuna vessels were returning to Japan from southern waters with full loads of skipjack tuna, one vessel after another. However, beginning in the summer of 1974, perhaps due to unusually high water temperatures, the vessels began to experience heavy bait mortalities. Vessels began to report bait mortalities of 30 percent to 70 percent, and many vessels returned to port with very small catches.

Because live bait is so vitally important, the Mie and Shizuoka Prefectural Fisheries Experimental Stations have been devoting considerable effort toward the problem of maintaining baitfish on skipjack tuna vessels. They have worked on various approaches (as I have reported in previous trip reports) but the problems are far from solved at this time.

Because of the importance of live bait, however acquired, in skipjack tuna fishing, a recent occurrence created considerable stir among the industry people. As mentioned earlier, a skipjack tuna vessel from Shizuoka Prefecture reported catching baitfish on the high seas. The *No. 3 Inari Maru* (299 tons), at lat. 3°51'N, long. 161°15'E, managed to capture 50-60 buckets (3 kg per bucket) of a fish the Japanese call "dokuuroko ibodai," (*Tetragonurus atlanticus*) that had gathered around the light of a 500-watt lamp. The location was the eastern Carolines, about 180 miles south of Ponape. Using this baitfish, the vessel managed to capture 10 tons of skipjack tuna.

When informed of this, two other vessels from Shizuoka Prefecture, the *Tagoshima Maru* (299 tons) and the *Yasufuku Maru* (299 tons), also managed to catch this baitfish in the same general location.

Researchers believe that these fish, coal black in color, probably inhabit deep water. They were 4-7 cm in length and appeared to be a very satisfactory live bait for skipjack tuna fishing. They swam slowly at the surface when chummed and were readily fed upon by the tuna. Furthermore, it was possible to maintain these fish in bait-wells at least up to 16 days. The Japanese reported the need to study the distribution of these fish, their seasonality, and whether or not they can be taken in reliable quantities to further skipjack tuna fishing in southern waters.

## BLUEFIN TUNA REARING

A program of "tuna culture and rearing" was financed by the Japan Fisheries Agency in 1970 with national, prefectural, and university laboratories involved in a cooperative effort. The lead agency was the Far Seas Fisheries Research Laboratory in Shimizu. This was a 3-year program which ended in 1973. However, before its termination, considerable progress had been made. Many tuna species were successfully fertilized artificially, eggs hatched, and the larvae reared to a certain size. Tunas were also reared from young taken in the wild. This was the case with the bluefin tuna: young fish taken in traps or by surface trolling in coastal waters were held in net enclosures, fed, and reared as long as possible. Originally, the difficult problem was to get the captive fish to feed during the cold winter months. Thus, the first hurdle was to "over-winter" the fish while maintaining some growth. The heavy mortality with the onset of low temperatures remained a major problem. Nevertheless, several of the research facilities reported various degrees of success in this effort.

Although the Kochi Prefectural Fisheries Experimental Station in Kochi, Shikoku Island, was not part of the original program, researchers there are also conducting rearing experiments. Kochi is ideally located for this project since winter temperatures do not fall below 15°C. (Bluefin tuna generally cease feeding when temperatures go below 15°C.) The rearing facility is located in Komame, Kochi Prefecture, near the southwestern tip of Shikoku Island. Komame is bathed by the warm waters of the Kuroshio, and the bay is blessed with an excellent circulation of clean oceanic water.

Young fish are captured by surface trolling or in traps generally during the latter half of the year. Fish smaller than 0.3 kg are found to be the hardiest for rearing purposes. The young fish are placed in the "kowari" (net enclosures) set up in the bay at Komame. They begin to feed in 3-7 days. The "kowari" is octagonal in design, 4.2 m to a side, 6 m deep. In general, growth of bluefin tuna is found to be very rapid. The fish grow from 0.1-0.2 kg to 2.5-3.0 kg in 6 months and to 10 kg by the end of the second year. The growth after the second year is estimated at 25-30 kg by the end of the third year, and 40 kg by the end of the fourth year.

The researchers reported that bluefin tuna rearing has a big advantage over yellowtail rearing (the latter is carried out commercially on a rather large scale in Japan). For example, they noted that bluefin tuna growth rate is much faster than yellowtail growth. Also, conversion of food to body weight is better in the case of the bluefin tuna (it was reported that 6 kg of food adds 1 kg of body weight in bluefin tuna whereas it requires 8 kg of the same food to add 1 kg of body weight in yellowtail). Both fish are fed mackerel, sardines, and the like.

Organoleptic taste tests have shown that bluefin tuna reared for 2 years were very similar in flavor and overall quality to fish taken in the wild, although fish reared only for 1 year were found wanting in flavor. The biggest advantage to bluefin tuna rearing is that they can be marketed at about 4 times the market price for yellowtail. Test marketing has shown that there is ready acceptability of fish reared for more than 2 years.

Although many fishermen who are now rearing yellowtail are beginning to show considerable interest in bluefin tuna rearing, many problems remain before the latter can be made commercially feasible. Unlike yellowtail, no large quantities of young bluefin tuna can now be taken to start a commercial rearing operation. Another problem is that bluefin tuna require much better

quality oceanic water than do yellowtail. They are more readily susceptible to mortality from heavy runoffs or deteriorating water quality in the rearing area. In spite of these problems, the Japanese are optimistically looking to the day when commercial rearing of bluefin tuna, and perhaps other high-quality tuna species, becomes a reality.

## USE OF LIVE BIGEYE SCAD AS LONGLINE BAIT

Last year I reported on the use of live bigeye scad, *Trachurus japonicus*, as longline bait in Oita Prefecture. In discussing this matter with researchers of the Nansei Regional Fisheries Research Laboratory, I learned that longline vessels of Kagoshima, Miyazaki, and Kochi Prefectures also use live bigeye scad as bait. These are the smaller coastal longline vessels, mostly under 20 tons.

Apparently, the fishermen of Miyazaki Prefecture were the first to use live bigeye scad in longlining. They began experimenting with this live fish as longline bait in experimental fishing for the dolphin, *Coryphaena hippurus*. Because it also did so well on tunas, this use has become quite widespread. Today, fishermen claim that live bigeye scad results in better than twice the catch rate obtainable with frozen bait.

Recently, however, bigeye scad has become a very expensive market fish. In Oita Prefecture, for example, where they have been rearing this fish for use as longline bait, the trend has been towards marketing it as food fish rather than as longline bait. If the price for this fish stays up, it will undoubtedly be used less as longline bait in the future. Coastal longline fishermen may experiment with other species.

## ANTARCTIC KRILL

According to the Japan Marine Fisheries Resource Research Center (JAMARC), many nations indicated interest in the Antarctic krill resource during the October 1974 FAO meeting in Rome. As a result, FAO will begin to include krill harvest in its annual world fishery statistics, and information on the krill resources, survey results, etc. will be disseminated through FAO. The krill is an important unutilized resource that has the potential of solving some of the world's food problems.

According to JAMARC, there are about 80 species included among the "krill," 30 of which are euphausiids. A good example is *Euphausia superba*. This species grows about 3 cm per year and reaches a size of 5-6 cm in 2 years. It spawns from November through March, with each female spawning from 2,000 to 30,000 eggs depending upon its size. Life span is believed to be about 2 years.

Krill is the principal food of the baleen whales in the Antarctic. The resource has been variously estimated at from 100 million to 600 million tons; some estimates have been much larger. The maximum sustainable yield has been estimated at 50 million to 100 million tons. No matter, it is true that the krill resource is very large.

These tiny animals occur in swarms or patches which have been estimated to range from a few meters to as much as 10 km across. The swarms apparently appear at the surface during the day and sink at night. They are abundantly distributed between lat. 60° and 75°S, particularly in such locations as the Weddell Sea and the Scotia Sea, in waters with temperature ranging between 0.3° and 2.0°C.

The Japanese and the Russians are probably equally advanced in krill harvesting techniques today. Both report catching 1 or 2 tons per trawl tow, and catching as much as 10 tons per tow in exceptional cases. Both are using the midwater trawl, making tows between the surface and about 70 m in depth. The Russians are scouting for krill patches visually, while the Japanese report scouting visually as well as with fish finders. The Soviets are said to have about three stern trawlers of the 3,500-ton class harvesting krill.

JAMARC has for the last 3 or 4 years sent a chartered stern trawler to the Antarctic. The report on the present charter cruise is as follows:

| | |
|---|---|
| Vessel: | *No. 11 Taishin Maru*, 1,500-ton stern trawler |
| Survey area: | Antarctic Ocean (Weddell Sea) |
| Survey period: | October 30, 1974-March 31, 1975 |

On 1 November, 1974 the vessel departed Cadiz, Spain and entered Cape Town on 26 November to make final preparations. It departed Cape Town on 29 November and arrived on the fishing grounds on 4 December and began searching for krill patches with a fish finder. Fishing began on 6 December at lat. 63°-65°S, long. 55°-66°E (northeast of Cape Ann, Enderby Land). By the end of December, it had trawled 166 times in 22 days catching 262 tons of krill. The largest catch per day during the period amounted to 25.7 tons; the best catch in a single tow was 7.1 tons.

JAMARC reported that as of 15 February, 1975 the vessel had taken 961 tons of krill. As far as catching technique is concerned, JAMARC officials are quite satisfied with progress made over the last 3 years of exploratory work. Although several types of nets had been prepared, only the midwater trawl seemed to work efficiently. It also had the advantage of being able to fish in winds of up to force 6 or 7. The midwater trawl had a mouth opening of 10 × 10 m, total length of 48.7 m. Trawling was done using special otter boards made of aluminum alloy of neutral buoyancy, 3.6 × 2.5 m in size. The method of towing was the same as in regular trawling but the towing depth was adjusted by changing warp length or ship speed. The average towing time was about 45 minutes at a ship speed of 1.7 knots. The catch per tow averaged around 1 ton. Both the Russians and the Japanese have found the best fishing in January.

The Nippon Suisan Company, a large Japanese fishing firm, recently sent its 3,600-ton stern trawler, *Aso Maru*, to the Antarctic Ocean to fish commercially. The reported catch was 1,600 tons of krill. The company is now working on product development.

Product processing and utilization problems remain. It has already been learned that krill frozen immediately after capture tends to lose much of its nutritive body fluids when thawed. A better method is to boil the krill before freezing. As for utilization, the Russians have developed a product called "krill paste" which is being marketed in frozen blocks. This paste reportedly has a very fine flavor and the odor of shrimp, and is a product very well accepted by consumers for flavoring salads or mixing with butter or cheese. The Russians are also using the krill to make meal as well as a product called "pressed cake."

The Japanese have sent samples of krill to various laboratories to work on product development. As of now, some use has been made of krill as soup stock, or as "tsukudani," where krill is cooked in soy sauce. Work is proceeding on using krill to manufacture "FPC," or protein concentrates. JAMARC is interested in developing products that would have universal appeal rather than something that would be suitable to the Japanese palate alone.

Undoubtedly, krill will figure more importantly in the future as the problem of feeding the growing world population becomes more critical. Several other nations have indicated interest in the krill. West Germany and Norway are reported planning to dispatch survey ships to the Antarctic for the coming krill season.

## UNUSUAL ABUNDANCE OF EEL ("UNAGI") ELVERS

Although the most recent statistics are unavailable, I have heard that in 1970, the annual consumption of "unagi" in Japan amounted to around 30,000 tons. Of this amount, Japan was able to produce 20,000 tons, and the remainder had to be imported. Furthermore, it was reported that of the 20,000 tons produced domestically, 17,000 tons comprised "cultured" eels, and 3,000 tons were fish taken in the wild. The remainder came from Korea and Taiwan. Eels are one of the favorite food fishes in Japan, and are served at specialty restaurants. Today, the Japanese are often heard to say that "unagi" dishes are now so expensive that they can rarely afford to enjoy them. The reasons for the high prices are the scarcity of "wild" eels, the high cost of "culturing" (in effect, it is "rearing" rather than "culturing"), and the need to import elvers for rearing.

In recent years Japan has been depending more and more on the so-called cultured eels where elvers are reared to marketable size. Because of the shortage of elvers in Japan, they had to be imported from such countries as France, Spain, South Korea, and Indonesia at very high prices. During my visit to an "eel culturing cooperative" in Hamamatsu, Shizuoka Prefecture, I was told that prices of elvers reached a record high of 400,000-500,000 yen/kg (US$627-784/lb) a few years ago because of general scarcity. In February 1975, during my visit, prices had fallen to 15,000 yen/kg (US$24/lb) and even lower in some places. The reason for this great decrease in elver prices was the unusually high abundance of elvers in Japanese coastal waters this year.

For the first time in 10 years, elvers appeared in great quantities off the Pacific coast extending from around Shikoku Island to the vicinity of Shizuoka in Honshu. In Shizuoka, the elvers first made their appearance around December 1974, about a month ahead of the usual elver season, which extends into March. At Lake Hamano, about 50 km west of Shizuoka City, fishermen were busily harvesting elvers with set nets ("teichaku ami") placed just inside of the lake entrance. According to the officials of the cooperative, fishing is done at night, as the incoming currents sweep the elvers into the large net. The cod end is lifted to remove elvers at hourly intervals. No lights are used.

After some initial mortality the elvers apparently do quite well, with about an 80 percent survival. They are taken to the rearing areas where they are held in cages, 2 kg of elvers to a cage, suspended in freshwater. These transparent elvers, 5-7 cm in length, are said to be about a year old when captured. They change color in a few weeks, becoming quite dark and nearly doubling in size. As the elvers grow they are transferred to larger rearing ponds and fed regularly on specially prepared powdered food. Adults are fed mackerel and other fish.

During winter, the rearing ponds are heated to about 25°C to induce feeding and rapid growth. The water is aerated by stirring with a paddle-wheel contraption. The elvers increase in length to 20-30 cm in 2 years. (According to one official, this amount of growth requires 10 years in nature.) The eels are marketed soon thereafter. When asked about spawning grounds, the official replied that these eels are believed to be spawning in the vicinity of Taiwan, but that there may be some spawning also off southern Japan, with elvers being swept north along the Kuroshio. The low prices for elvers may not affect the retail prices of eels too greatly since rearing costs continue to be very high, particularly the cost of fuel oil necessary to heat the water in the rearing ponds during winter. (Author's note—Many of the details given in this section were recorded during my interview with the cooperative official, but they are unverified and may contain errors in detail.)

## PROBLEMS WITH SOVIET FISHERMEN

On 17 February I saw a television newscast showing Japanese coastal fishermen demonstrating in large numbers, asking the Government to intervene in their behalf in regard to their problems with Soviet fishermen. The news report indicated that Soviet trawlers off Kinkazan (northeastern Japan) were damaging nets used by Japanese coastal fishermen, thereby causing painful financial losses. Later, I learned that 30-40 Soviet trawlers were fishing around huge motherships of 20,000-30,000 tons just over 3 miles from the Japanese coast. By mid-February, the fleet had moved southward to off Choshi (approximately the latitude of Tokyo), where they were harvesting mackerel by stern trawling. Japanese Coast Guard helicopter crews reported sighting several fleets of trawlers just outside of the 3-mile zone. They reported that mackerel fishing was being done by stern trawling, and that the catches were being processed on board the motherships (canning factories). Heads, tails, and entrails of mackerel were being tossed overboard.

The Japanese fishermen reported that their small vessels (30 tons in size) are absolutely no match for the Soviet trawlers, which are about 400 tons in size. They have already sustained heavy damages to fishing gear. In December, Japanese fishermen reported suffering $121,000 in damages to nets off Iwate Prefecture. This year, they reported damages totaling $241,000 in 12 separate incidents. Off Choshi, the damages in two reported incidents totaled $55,000. There were other reported incidents, bringing total losses to many thousands of dollars.

An even worse fear loomed. Mackerel spawning off Shizuoka was coming up soon and the Japanese felt certain that the Soviet fleet would move southwest to harvest the spawning fish. If they did, the coastal fishermen were afraid that the mackerel resource would be decimated. They were appealing to the Government to come to their

assistance, and if possible, declare a 12-mile fishery zone in Japan.

Japanese fishermen had complained to the Soviet Embassy in Tokyo with no results. But news reports indicated that the Japanese Foreign Ministry was to meet with the Russians to work out an amicable solution.

## MISCELLANEOUS

### Sardines

Sardine catches began to increase in the spring of 1973, and the year's catch amounted to 200,000 metric tons. The catch was reported to be even better in 1974, when an estimated 500,000 metric tons were anticipated. In February 1975, sardines were reportedly being taken in such large quantities that they were being given away at some of the northern ports.

### Building Boom Continues for Large Skipjack Tuna Vessels

In February, more than 10 large (499-ton) skipjack tuna fishing vessels were being constructed, mostly under order from Mie Prefecture. This trend toward larger vessels is due to the greater distance to fishing grounds and the need for vessels of larger carrying capacity. A 434-ton vessel reportedly can carry about 300 tons of fish; a 499-ton vessel should be able to carry 400 tons. Such large vessels started fishing around September 1974, but their efficiency is not yet clearly determined. The opinion being expressed now is that such large vessels will do very well during good seasons such as 1973 but poorly during such years as 1974, when fishing was relatively poor and bait mortality high.

### Roback[2] Automatic Fishing Machines

According to officials of Iwatani & Co., sales agent for the Roback automatic fishing machines, there are now 25 Roback fishing machines installed on Australian vessels, 4 in Hawaii, 15 on the west coast, and about 600 machines on Japanese vessels. The company has received inquiries from Spain and France. An order for machines has come from Canada. An albacore vessel being built in Seattle apparently will install 10 machines and thus greatly automate its fishing capabilities.

[2]Reference to commercial products does not imply endorsement by the National Marine Fisheries Service, NOAA.

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