

Observations of Tuna Bait Species and Their Habitats in the Palau Islands

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ABSTRACT

The establishment of a live-bait skipjack tuna, *Katsuwonus pelamis*, fishery and several years of field observations have provided information on baitfishes and their habitats that were previously unavailable from the Palau Islands. The baitfish habitats in Palau include areas around limestone islands, mangrove shorelines, coral atolls, and barrier coral reefs. The principal fishes used as skipjack tuna bait in Palau are an engraulid, *Stolephorus heterolobus*; a dussumieriid, *Spratelloides delicatulus*; an atherinid, *Pranesus pinguis*; and a clupeid, *Herklotsichthys punctatus*. Species of lesser importance as bait include *Stolephorus buccaneeri*, *Dussumieria acuta*, and several unidentified apogonids.

INTRODUCTION

Prior to World War II the Japanese had developed a sizable skipjack tuna, *Katsuwonus pelamis*, fishery in the Trust Territory of the Pacific Islands with bases at Palau, Truk, Ponape, and Saipan. The fishery reached its peak in 1937 when 40 to 45 boats operating in Palau produced 13,600 t of skipjack tuna, and a similar number of boats in Truk produced a comparable amount of fish. Total landings in the Trust Territory during that year approximated 34,000 t. The fishery declined with the commencement of the Sino-Japanese War in 1938 (Smith 1947) and came to a halt during World War II.

After World War II a Fisheries Development Program was started in Palau in 1958. Its primary purpose initially was to develop the subsistence and inshore fisheries of the area, but the program later was expanded to include offshore and recreational resources as well.

Commercial fishing began in 1964 when the Van Camp Sea Food Company was established and fishing operations using Okinawan live-bait skipjack tuna boats with Okinawan and Micronesian crews were initiated. Within 5 yr the fishery, using eight or nine boats, reached a total annual production of over 5,500 t of skipjack tuna.

Because tropical bait species are often less hardy, smaller, and less abundant than those in more temperate waters, the fishery was forced to operate as a "day fishery," where vessels made trips lasting only 1 day. Fishing thus was limited to an area within a hundred miles of home port.

Not much is known of the live-bait resources of the Trust Territory, for the Japanese published little on the subject and even less has been written under United States auspices. The establishment of a live-bait skipjack tuna fishery in Palau, coupled with several years of field observations, has made it possible to gather infor-

mation on the various species of baitfish found in Palau. I have identified these fish and described where they can be found. I have also examined the nature of the biotope in which they live.

DESCRIPTION OF BAIT GROUNDS

The Palau Islands are comprised of numerous islands of which Babelthuap is the largest. The total land area of Palau is about 487 km², while the nearly enclosed lagoon, in which most of the islands are located, contains about 1,238 km². The main islands of Babelthuap, Koror, Malakal, Arakabesan, Urukthapel, Eil Malk, and Peleliu (Fig. 1) are all surrounded by a single coral reef about 113 km long. The reef fringes the eastern shores but on the western side it extends to almost 18 km from shore.

Palau's inshore area can be divided into the following baitfish habitats: 1) central limestone islands, 2) mangrove shoreline of Babelthuap, 3) coral atolls, and 4) barrier coral reef (Fig. 1).

Central Limestone Islands

The most important baiting area is found around the numerous limestone islands in the lagoon south of the west entrance to Malakal Harbor and west of Urukthapel. Some of the islands are less than one-half ha in size, but several are 800 ha or more and nearly all of them are more than 60 m high, affording considerable shelter from the prevailing winds. Most of the islands are bordered by deep water and seldom offer problems of navigation.

Foliage is heavy on all the limestone islands and varies from shrubbery and ferns to large trees (Fig. 2). Competition for sun and space sometimes causes trees to grow as much as 20 ft horizontally over the water.

There appears to be considerable runoff from the islands, carrying with it rotting vegetation, waste products from birds, and phosphate leached from the limestone.

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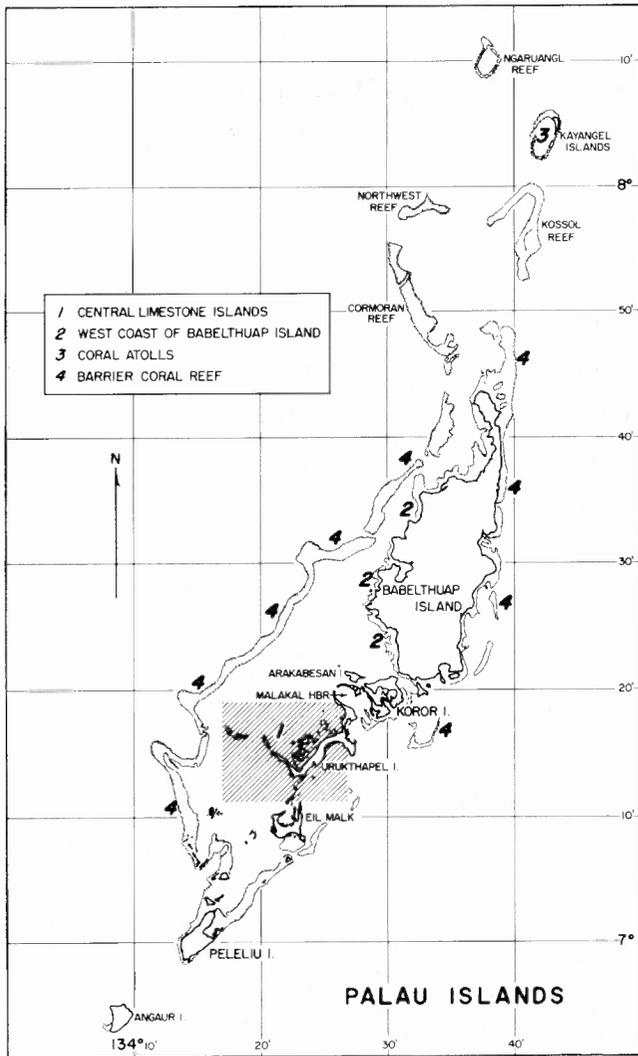


Figure 1.—Palau Islands (numerals indicate the various types of baiting grounds).



Figure 2.—Aerial view of the bait ground in Koror. The many limestone islands found in this area offer sheltered night baiting even in very poor weather.

The effect of the runoff is questionable, but in all probability it plays an important part in enriching the water in this area, enabling it to support a heavy population of plankton. This hypothesis was partially confirmed by a study carried out in Palau between 1935 and 1937 by Motoda (1969) in which he concluded that primary productivity of the phytoplankton population is higher in the lagoon than in the open sea.

The underwater profile of most of the limestone islands is similar, sloping abruptly into deep water. Sand and extensive coral growths form shallow areas between some of the more closely grouped islands.

Plankton hauls from various stations in this habitat all showed large populations of various kinds of zooplankters. No particular type predominated, and inshore and open ocean copepods occurred in equal abundance.

Mangrove Shoreline of Babelthuap

The west coast of Babelthuap is lined with heavy growths of mangrove. The shoreline adjacent to the mangroves has a mud bottom with some rocky areas. The

water is turbid and lateral underwater visibility is usually not more than 3 m. At high tide the water is approximately 2 m deep at the outer edge of the mangrove, and at low tide this area is either exposed or in very shallow water. There is little eel grass here, although it becomes more abundant in the deeper water about 90 m from the edge of the mangrove.

Plankton hauls from three stations adjacent to the mangroves produced exceptionally large amounts of *Acartia*, a calanoid copepod which serves as food for plankton feeders. A haul in a nearby area, however, consisted primarily of algal debris with practically no zooplankton. Another haul at yet a different location showed a heavy population of chaetognaths and a limited amount of crustaceans. With the presence of a large population of predacious zooplankton and the low pH characteristic of mangrove environments (Motoda 1940), it is possible that larval fish find it difficult to survive. This may account for the sparseness of fish in this environment.

Coral Atolls

The Kayangel Islands are the only atolls in the Palau group, and lie north of Kossol Reef. A reef surrounds the islands and the lagoon is quite shallow in most areas, varying in depth from 1.8 to 9.1 m. The water of the lagoon is usually clear and calm, and the bottom is characterized by large sandy areas with scattered coral heads and staghorn coral (*Acropora*).

Barrier Coral Reefs

The barrier reef on the western or outer rim of the lagoon is a typical fringing reef. The actual breaker area is relatively small, while the reef flat or shoal area inside the reef is quite large, occasionally extending inshore a kilometer or more.

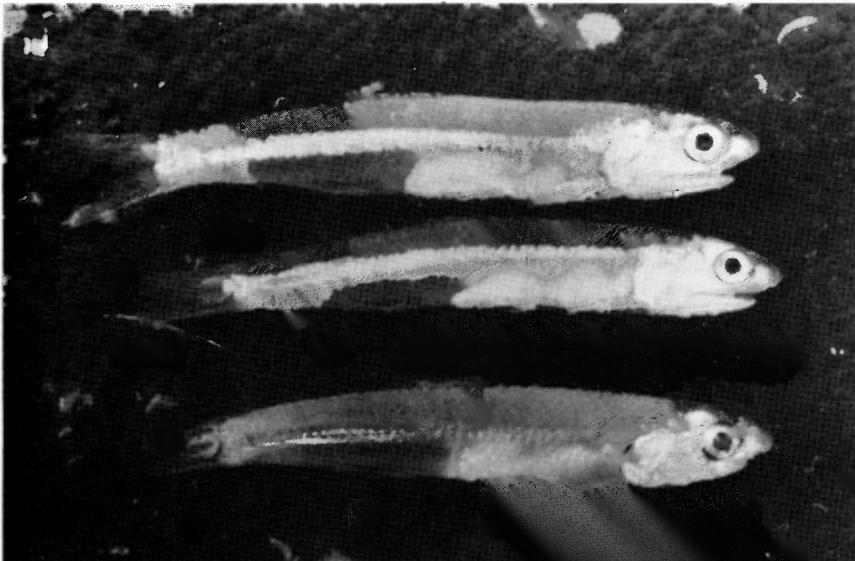


Figure 3.—The anchovy, *Stolephorus heterolobus*. This is the most commonly used bait species in Palau.

Plankton samples collected from just inside the breaker zone were practically devoid of zooplankton while algal debris was common. Since wave action makes this zone turbulent, such results are not unexpected.

DESCRIPTION, DISTRIBUTION, AND ABUNDANCE OF BAITFISH

There are four principal species of fish found in Palau that are recognized as good live bait for fishing skipjack tuna in tropical waters. The most commonly used and most desirable is an anchovy, *Stolephorus heterolobus*. Others include a round herring, *Spratelloides delicatulus*; a silverside, *Pranesus pinguis*; and a sardine, *Herklotsichthys punctatus*. These and several less important species found in Palau are discussed here.

Engraulidae

Scientific name:	<i>Stolephorus heterolobus</i> (Rüppell)
Palauan name:	Tilai
Japanese-Okinawan name:	Nanyo katakuchi iwashi or tarekuchi iwashi
English name:	Anchovy

This nearly transparent anchovy is the best and most commonly used bait species in Palau (Fig. 3). It is quite closely related to the Hawaiian nehu, *S. purpureus*, which is the best and most abundant bait species in Hawaii. In Palau there is no record of *S. heterolobus* being taken while day baiting. It is readily attracted to a light and is taken at night in this manner. It is reportedly abundant in water 30 to 40 m deep (Marukawa 1939), but I have never seen it during daylight. In Hawaii, *S. purpureus* is often seen in bays but frequent observations of similar areas in Palau have failed to disclose the presence of *S. heterolobus*.

It must be handled very carefully during night baiting operations, but stays alive reasonably well after capture. The live-bait method of skipjack tuna fishing requires the bait to live at least 1 day aboard the fishing vessel. This is normally accomplished with no problem and on occasion it has lived 3 days in baitwells with overflow pump systems.

Scientific name:	<i>Stolephorus buccaneeri</i> (Strasburg)
Palauan name:	none
Hawaiian name:	Nehu
Japanese name:	unknown
English name:	Anchovy

This species is mentioned here not for its importance as a baitfish, but for its scientific interest. The Palauans have no name for it and it was never recorded as being present or used for bait during the Japanese period. Until recently this species was known only from Hawaii, but more recent collections have also shown it to be present in the Red Sea.

The manner in which this fish was collected is unique. Two Palauans working in the Marine Resources Development Program were trolling between Angaur and Peleliu when they noticed a tight ball of baitlike fish being fed upon by a school of *Euthynnus affinis*. They approached this dense ball in their outboard skiff and, while alongside, simply reached down with a hat and scooped up a sample. It has not been observed since.

Dussumeriidae

Scientific name:	<i>Spratelloides delicatulus</i> (Bennett)
Palauan name:	Kuaol
Hawaiian name:	Piha
Japanese-Okinawan name:	Aoesa, shira, minami- kibinago
English name:	Round herring

Kuaol is one of the most abundant bait species found in Palau waters. Scattered schools are regularly seen all through the inner reef area, but seldom are these schools very large. Kuaol can easily be found during the day in such areas as Malakal Harbor, on the shoal sand and coral flats near bodies of moving water, and in the shallow water inside fringing reefs. It can be taken with a day net,

but is seldom caught in commercial quantities at night.

Reports from Palauan fishermen indicate that kuaol is occasionally encountered some distance from the islands. Fishermen catching skipjack tuna 11 km off Kayangel reported that although they had been using mekebud, *H. Punctatus*, for bait, hooked tuna regurgitated large amounts of kuaol. Conversely, observations made in the mangrove area, in muddy bays, on banks, and in rivers have failed to show any evidence of kuaol, and it appears that this species prefers clear water of the type found around the limestone islands and fringing reefs.

Scientific name:	<i>Dussumieria acuta</i> (Valenciennes)
Palauan name:	Adins
Hawaiian name:	none
Japanese-Okinawan name:	Urume iwashi
English name:	Round herring

This species is closely related to the Clupeidae and is distinguishable by its lack of abdominal scutes.

I suspect that there are considerable numbers of this species present in the mangrove area around the island of Babelthuap as it is easily recognized by island fishermen; however, only one specimen has been collected in Palau to date by the Marine Resources Division. Additional specimens have been sought unsuccessfully. Local fishermen were able to agree on a name, which indicates that it, or a related species, probably is common in Palau.

Atherinidae

Scientific name:	<i>Pranesus pinguis</i> (Lacépède)
Palauan name:	Teber
Hawaiian name:	Iao
Japanese name:	Togoro-iwashi
English name:	Silverside

Of the major bait species in Palau, this is probably the most hardy (Fig. 4). Observations have revealed no favored habitat for this species, and it appears to have the widest range of occurrence of all the baitfish in Palau. It is found in either brackish water or seawater and, unlike mekebud or kuaol, frequents the mangrove area, the fringing reef, and the limestone island habitats.

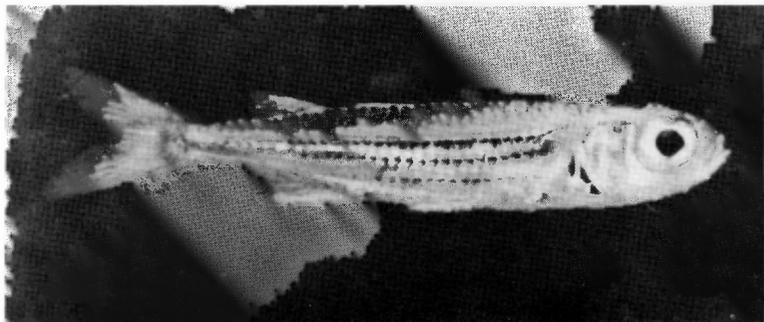


Figure 4.—The atherinid, *Pranesus pinguis*. This is probably the strongest of the major bait species in Palau.

Reports differ as to the extent this species was used as bait prior to the war. Local fishermen familiar with the Okinawan fishing methods recall that it was a relatively common bait species, but Marukawa (1939) says it was almost never used for bait because skipjack tuna do not take it readily. The Fisheries Research Station's progress report states "togoro-iwashi are taken well by the fish and are very suitable for use as bait" (Shimada and Van Campen 1951).

Palauan fishermen feel that the behavior of this atherinid does not make it suitable as chum for skipjack tuna fishing. In limited trials in Palau, hooks baited with the mangrove sardine or mekebud produced more skipjack tuna than did those baited with teber.

Catching teber in commercial quantities at night has proved difficult, as this species is not attracted to light in adequate numbers. Seining with a Hawaiian day net in sandy coves and along the beaches, however, is an efficient method of catching teber in suitable quantities. Care must be taken to shut off all avenues of escape, as this species will readily swim under, over, or through any opening in the net.

Clupeidae

Scientific name:	<i>Herklotsichthys punctatus</i> (Rüppell)
Palauan name:	Mekebud
Hawaiian name:	none
Japanese-Okinawan name:	Mangurobu iwashi
English name:	Mangrove sardine

This sardine is common in Palau and can be found along the mangrove coastline of Babelthuap. It lies quietly in dense schools along sandy beaches in the limestone island area. It has never been reported around waves or currents of any strength.

I have not observed these fish in deep water during the day, but they may move there at night to feed since the schools of mekebud disappear from their daytime habitat in the evening. In addition, stomach samples taken during the day were always empty, indicating night feeding habits. Palauan fishermen have reported that this species is found only as far north as northern Babelthuap, and that the maximum size increases from south to north.

During the prewar skipjack tuna fishery, fishermen did not utilize mekebud for bait as it is weak and does not live long when confined (Marukawa 1939). Marukawa stated that this fish is attracted to night-light and is taken with lift nets; however, night baiting operations since the war have not attracted large concentrations of this species and it is doubtful that it can be taken by this method in commercial quantities.

Mekebud was used as live bait by a group of Palauan fishermen shortly after the war. They caught mekebud with a day net and fished off a former Okinawan skipjack tuna boat. The fishermen who were engaged in the actual fishing operations stated that the skipjack tuna

took this fish readily and that they felt it was an adequate baitfish.

This species is a popular food fish of the Palauans. It is commonly taken with throw nets and illegally with explosives. It is also an important forage fish and schools of carangids and small tuna may be seen feeding on it. Schools of mekebud are often mixed with teber.

Apogonidae

Scientific name:	(Palauan species not identified; a Truk species is <i>Rhabdamia cypselurus</i>)
Palauan name:	Sebus
Hawaiian name:	unknown
Japanese-Okinawan name:	Akadoro or akaesa
English name:	Cardinalfish

There are about 15 members of this family presently in the Palau Islands. Some of the species have been used for bait in the past by Okinawan skipjack tuna fishermen. They are a hardy fish but difficult to catch and are not as abundant as other baitfish. They do not travel in large schools and are not found free-swimming in the lagoon or in other areas. Instead, the species used for bait live around coral heads, forming a dense layer a few inches away from the coral. They remain almost motionless and, when alarmed, seek shelter among its branches.

The best grounds for these fish are on the inside of the outer fringing reefs, where the coral heads are usually found on flat sandy stretches. According to local fishermen, an average coral head yields four or five 15-liter buckets of bait. When the Okinawan fishermen wanted to catch this type of bait, they went to the outer reef in the early morning, since sebus is not attracted to a light and cannot be caught at night. There was usually a sufficient amount of this bait available, as sebus was seldom fished except when the moon was full and it was difficult to night bait for the local species of anchovy.

Fishermen who formerly worked in the Okinawan skipjack tuna fishery indicate that the skipjack tuna took sebus as readily as tilai. Some of them say it was actually a better bait as it came to the boat faster and remained there longer. An advantage of sebus over kuaol was that it lived longer in the baitwells of the fishing boats.

Of all the bait species found in these waters, however, sebus appears to be the most difficult to catch. For this reason, it is seldom used in today's Palau skipjack tuna fishery.

OTHER BAITFISH OF MINOR IMPORTANCE

Marukawa (1939) reported that *Caesio chrysozoma*, a lutjanid, was used for bait by prewar Okinawan fishermen. They called it "akamuro" or "umeiro," and "saneera" or "gurukon." Adults of this species are too large for bait; only juveniles measuring 7 to 10 cm are used. Schools have been observed in the general reef area in concentrations that appeared large enough to be used

for bait. Marukawa stated that this species was usually caught during the day in shallow water with drive-in nets. He also stated, "they are strong when confined and make excellent bait for skipjack. This species is extremely important as baitfish at Saipan and in other localities where the South Sea anchovy is not available in quantity."

Local fishermen have also reported several other small fish used for bait when they were available and when the usual bait was difficult to catch. Marukawa identified at least some of these as *Selar crumenophthalmus* called "me-aji," and several other carangids of the genus *Caranx*, called "gatsun" by the Okinawans, and stated that they were attracted to night-light and taken while night baiting. They were reportedly of more importance in areas such as Saipan, where bait stocks were poor, than in Palau and Truk where bait was more abundant.

Goatfishes (Mullidae) have also been reported as bait, but were used only when the preferred bait species were not available.

CONCLUSION

With commercial skipjack tuna fishing operations now

underway again in the Trust Territory, we can look forward to learning more about the bait and tuna resources of the area. As knowledge of these stocks accumulates, more effective development and management programs should be initiated to take maximum advantage of skipjack tuna, Micronesia's greatest known marine resource.

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