

TRADITIONAL PALAUAN LUNAR CALENDAR AND THE FISHING-GLEANING ACTIVITIES ON REEF FLATS AND/OR IN LAGOONS IN THE WESTERN CAROLINE ISLANDS, MICRONESIA

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Introduction

Some fishing lores and methods will be of some assistance to the fishermen, so that they may be able to use them in recognizing the wind and the sea of the given time of the year, before they depart on their fishing expeditions. Many of the traditional lores are crucial for the revival and preservation of the methods and ideas that the Palauans have used in the past and recognized around 500 years ago in Palau, western Caroline Islands (Fig. 1). The traditional Palauan lunar calendar is a culturally-rooted treasure, rich in these traditional wisdoms, indicating the best times for resource exploitation. As described in JOHANESS (1981), KLEE (1972) and KRÄMER (1929), Palauans are excellent fishermen. While introducing this calendar that is still so closely connected with their selection of the optimum day, month and fishing grounds to use particular types of fishing devices and techniques, their fishing-gleaning activities are examined from the viewpoint of ecological anthropology.

Traditional Palauan Lunar Calendar

The early Palauans found out how the sun moved in the Palauan sky crossing over Babeldaob Island on its way from the eastern horizon to the western horizon ahead of the darkness. They tied knots on a cord to record daylights and darknesses, and found that after tying 30

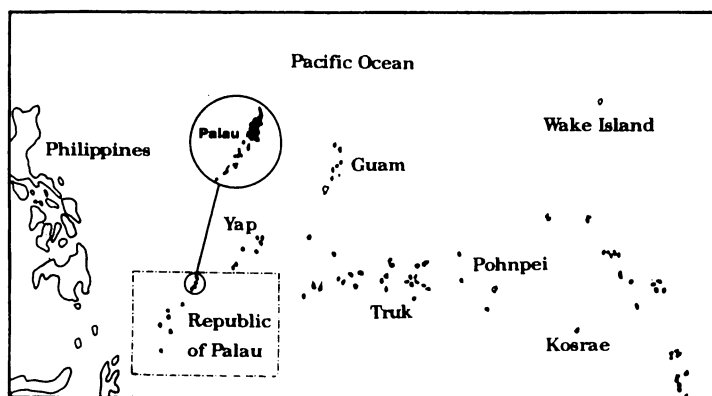


Fig. 1. The Republic of Palau is located in the western Caroline Islands.

Table 1. Weather and maritime information involved with fishing-gleaning activities in Palau *1

Palauan lunar month	Gregorian month	Temperature & Humidity	Rainfall and/or Wind	Tidal fluctuation	Sea condition	Underwater water visibility	Breakers' height on reef
1st month of the easterly wind (<i>Tmur er a ongos</i>)	November	Dry (Daytime) Warm/Humid (Nighttime)	Light rain *2 & frequent <i>Bedengel a kelat</i> *3 (8-9th darknesses) <i>Bedengel a kotiko</i> *4 (16th darkness)	Low tide maximum (Nighttime)			7-8 ft.
2nd month of the easterly wind (<i>Modelab er a ongos</i>)	December	Dry (Day.) Humid (Night.)	Light rain (at dawn) *5 <i>Bedengel a kelat</i> *3 (8-9th darknesses) <i>Bedengel a kotiko</i> *4 (16th darkness)	Low tide maximum (Nitht.)			5-6 ft.
3rd month of the easterly wind (<i>Taach er a ongos</i>)	January	Dry season Very hot/Dry (Day.) Humid (Night.)	The sky is clear & brilliant with sunshine <i>Tebedel a meas</i> *6 (5th darkness) <i>Tebedel a meas</i> *6 (6th darkness)		Calm	Maximum clear	3 ft.
4th month of the easterly wind (<i>Chelid er a ongos</i>)	February	Dry season V. hot/Dry (Day.) Humid (Night.)	<i>Tebedel a meas</i> *6 (6th darkness)		Very calm (West coast)		Not very violent
5th month of the easterly wind (<i>Orengodel er a ongos</i>)	March	Dry (Day.) Humid (Night.)	Slightly heavier & more frequent <i>Tebedel a meas</i> *6 (6th darkness)		Calm		Not violent
6th month of the easterly wind *7 (<i>Chiach er a ongos</i>)	April	Dry (Day.) Cold/Humid (Night.)	Heavy rain & frequent/ Wind direction changeable			Average ~ Minimum	5-6 ft. (Outside reef)
1st month of the westerly wind (<i>Tmur er a ngebard</i>)	May	Humid (Day.) Dry (Day.)	Rainy month/ Always windy	Little (Evening) L. t. max. (Daytime.)	Rough (West coast)	Average ~ Minimum	7-8 ft.

2nd month of the westerly wind *8 (<i>Modelab er a ngebard</i>)	June	Dry (Day.) Humid (Night.)	Frequent rain Windy month	L. t. max. (Day.)	5-6 ft.
3rd month of the westerly wind (<i>Taach er a ngebard</i>)	July	Cool/Humid (Day.) Cool/Dry (Night.)	Wind direction changeable		3 ft.
4th month of the westerly wind (<i>Chelid er a ngebard</i>)	August	V. cold/Humid (Day.) V. cold/Dry (Night.)	Light rain & frequent Sky is often cloudy	Max. (Day.)	1 ft. (at max.)
5th month of the westerly wind (<i>Orengodel er a ngebard</i>)	September	Humid (Day.) Dry (Night.)			
6th month of the westerly wind *7 (<i>Chiach er a ngebard</i>)	October	Humid (Day.) Dry (Night.)	Wind direction changeable		3 big waves *9 (from the west; 15- 18 ft. for 10 days)

Source: 1995 *Kalender ra omenged e loltirabl ra buil ma dolech er Belau* (PALAU COMMUNITY ACTION AGENCY, 1995), HUIKATA (1942) and TAKEDA's field study carried out in Koror and Peleliu Islands, Palau in October and November, 1995 through interviews, direct observations and questionnaires.

*1 Data in Table 1 are based on the west side of Babeldaob. The annual mean temperature in Palau is 27.7°C. The annual mean rainfall is 3,700 mm. The climate of Palau is maritime and tropical. The climatological characteristics are roughly high temperature with little diurnal and annual variation, abundant rainfall with the peak in July, consistently high humidity, a surface with seasonal characteristics, and an occasional typhoon (KLEE, 1972).

*2 A little rain at dawn is called *olngebdel orrakl*.

*3 The rain called *bedengel a kelal*, [rain of the *kelat* fish] (fringelip mullet: *Crenimugil crenilabris* and bluespot mullet: *Vakamugil seheli*) comes on the 8th and 9th darknesses, and continues for two days. See also Tables 2 and 3.

*4 On the 16th darkness, the islands undergo a rain called *bedengel a kotiko* [rain of the *kotiko* fish] (moharra: *Gerres oblongus*), that continues from 24 to 36 hours. See also Tables 2 and 3.

*5 The rain shortly after dawn is called *tubkii er a ngeuoi*.

*6 The rain in 4th-5th darknesses continues from 24 to 36 hours.

*7 This month includes an intermediate or transitional period called *raud*.

*8 This season is called *sim* since fruits such as breadfruits are abundant. The first growing season begins during *modelab er a ongos* and continues through *chiach er a ongos*; this season called *remus*, produces the least fruits, so is called the time of little food (*kesai a kall*). *Sim* is the name of second growing season. This period of growth begins in *modelab er a ngebard* and continues through *chiach er a ngebard*, producing much plant food (*betok a kall*), with its peak in July (*taach er a ngebard*).

*9 Each swell lasts for about 10 days. At the end of these three giant swells, the new year begins. The first swell called *boid* or *labek*, is the strongest; the second one called *omeka dnger*, final swell called *mengelechel a uchoach*.

Table 2. Lunar spawning rhythms and aggregations of fish in Palau

Palauan lunar month	Gregorian month	Lunar spawning rhythms & aggregations of major food fish *1
1st month of the easterly wind (<i>Tmur er a ongos</i>)	November	1st darkness: <i>Besechamel</i> fish (Bigeye emperor) 5th darkness: <i>Chudech</i> fish (Yellowstripe emperor) 6th darkness (outside reef): <i>Tehu</i> fish (Yellowfin tuna), <i>Ngelngal</i> fish (Narrow-barred king mackerel) & <i>Keskas</i> fish (Wahoo) 10th darkness: <i>Kelat</i> fish (Fringelip mullet & Bluespot mullet) 16th darkness: <i>Meat</i> fish (Pygmy barracuda), <i>Kelat</i> fish (Fringelip mullet & Bluespot mullet) & <i>Kotiko</i> fish (Moharra) 29th-30th darknesses (outside reef): <i>Terekrik</i> fish (Bigeye scad & Yellow band scad)
2nd month of the easterly wind (<i>Modelab er a ongos</i>)	December	10th darkness: <i>Meat</i> fish (Pygmy barracuda) & <i>Kelat</i> fish (Fringelip mullet & Bluespot mullet) 16th darkness: <i>Kotiko</i> fish (Moharra), <i>Besechamel</i> fish (Bigeye emperor) & <i>Chudech</i> fish (Yellowstripe emperor) Outside reef: <i>Tehu</i> fish (Yellowfin tuna), <i>Ngelngal</i> fish (Narrow-barred king mackerel), <i>Keskas</i> fish (Wahoo) & <i>Terekrik</i> fish (Bigeye scad & Yellow band scad)
3rd month of the easterly wind (<i>Taach er a ongos</i>)	January	5th darkness: <i>Meas</i> fish (Seagrass rabbitfish) *2
4th month of the easterly wind (<i>Chelid er a ongos</i>)	February	15th or 16th darkness: <i>Kemairs</i> fish (Dog-faced water snake)
5th month of the easterly wind (<i>Orengodel er a ongos</i>)	March	6th darkness: <i>Meas</i> fish (Seagrass rabbitfish) *2
6th month of the easterly wind (<i>Chiach er a ongos</i>) *3	April	4th-6th darknesses: <i>Meas</i> fish (Seagrass rabbitfish) *2
1st month of the westerly wind (<i>Tmur er a ngebard</i>)	May	6th darkness: <i>Meas</i> fish (Seagrass rabbitfish) <i>Debesochel el merangd</i> (<i>Meas</i> fish enter into lagoons, but easily scatter in lagoons) 1st darkness: <i>Beduut</i> fish (Forktail rabbitfish), <i>Bebael</i> fish (Peppered rabbitfish) & <i>Reked</i> fish (Pencil-streaked rabbitfish) 15th darkness: <i>Beduut</i> fish (Forktail rabbitfish), <i>Bebael</i> fish (Peppered rabbitfish) & <i>Reked</i> fish (Pencil-streaked rabbitfish) <i>Tiau</i> fish (Coral trout), <i>Mokas</i> fish (Red face grouper & Barred-cheek grouper), <i>Temekai</i> fish (Grouper) & <i>Bakungor</i> fish (Marbled grouper)
2nd month of the westerly wind (<i>Modelab er a ngebard</i>)	June	<i>Beduut</i> fish (Forktail rabbitfish), <i>Bebael</i> fish (Peppered rabbitfish), <i>Reked</i> fish (Pencil-streaked rabbitfish), <i>Tiau</i> fish (Coral trouts), <i>Mokas</i> fish (Red face grouper & Barred-cheek grouper), <i>Temekai</i> fish (Grouper) & <i>Bakungor</i> fish (Marbled grouper)
3rd month of the westerly wind (<i>Taach er a ngebard</i>)	July	? 29th, 30th darknesses: <i>Terekrik</i> fish (Bigeye scad & Yellow band scad) Few fish spawn except fish that spawn every month.
4th month of the westerly wind (<i>Chelid er a ngebard</i>)	August	The number of fish that spawn is very small.

5th month of the westerly wind
(*Orengodel er a ngebard*) September Big-sized *meas* fish are plentiful.

6th month of the westerly wind
(*Chiaich er a ngebard*) * 3 October

Source: 1995 *Kalender ra omenged e loltirakl ra buil ma dolech er Belau* (PALAU COMMUNITY ACTION AGENCY, 1995), HUIKATA (1942) and TAKEDA's field study carried out in Koror and Peleliu Islands, Palau in October and November, 1995 through interviews, direct observations and questionnaires.

* 1 See below for fish cited in Tables 1, 2 and 3.

Palauan name	Common name	Scientific name
<i>Babungor</i>	Marbled grouper	<i>Epinephelus microdon</i>
<i>Bebael</i>	Peppered rabbitfish	<i>Siganus punctatus</i>
<i>Beduul</i>	Forktail rabbitfish	<i>S. argenteus</i>
<i>Besechamel</i> * 7	Bigeye emperor or Porgy	<i>Monolaxis grandoculus</i>
<i>Chudech</i>	Yellowstripe emperor	<i>Lethrinus ramak</i>
<i>Cheluikl</i> * 7	Emperor	<i>L. sp.</i>
<i>Itotech</i> * 4	Thumb-print emperor	<i>L. harak</i>
<i>Kelat</i>	Bluespot mullet	<i>Valamugil seheli</i>
<i>Kelal</i>	Fringelip mullet	<i>Crenimugil crenilabris</i>
<i>Kemairs</i>	Dog-faced water snake	<i>Cerberus rhyncois</i>
<i>Keskas</i>	Wahoo	<i>Acanthocybium solandri</i>
<i>Kolitko</i>	Moharra or gerreid	<i>Gerres oblongus</i>
<i>Meai</i> * 4	Pygmy barracuda	<i>Sphyræna pinguis</i>
<i>Meas</i> * 4	Seagrass rabbitfish	<i>Siganus canaliculatus</i>
<i>Mechur</i>	Yellowlip emperor	<i>Lethrinus xanthurus</i>
<i>Melangmud</i>	Longnose emperor	<i>L. elongatus</i>
<i>Mesehuuk</i>	Ring-tailed surgeonfish	<i>Acanthurus xanthopterus</i>
<i>Mokas</i>	Barred-cheek grouper	<i>Plectropomus leopardus</i>
<i>Mokas</i>	Red face grouper	<i>P. maculatus</i>
<i>Ngetl'ngal</i>	Narrow-barred king mackerel	<i>Scomberomorus commerson</i>
<i>Reked</i>	Pencil-streaked rabbitfish	<i>Siganus doliaatus</i>
<i>Tehu</i>	Yellowfin tuna	<i>Thunnus albacares</i>
<i>Tenekai</i>	Groupers	<i>Epinephelus</i> spp.
<i>Terekrrik</i>	Bigeye scad	<i>Selar crumenophthalmus</i>
<i>Terekrrik</i>	Yellow band scad	<i>S. boops</i>
<i>Tiau</i>	Coral trout	<i>Plectropomus</i> sp.

* 2 Before *meas* fish leave the mangrove swamps during the low tide to lay its eggs, rain continues from 24 to 36 hours in the 4th-5th darknesses, so this rain is called *lebedel a meas*.

* 3 This month includes an intermediate or transitional period called *raud*.

* 4 The *meas* rabbitfish and the *itotech* emperor are the day-feeder, and are caught mostly during the day. Night feeders on reef flats such as *cheluikl* emperor and porgy form the bulk of nighttime catches (JOHANESS, 1981).

Table 3. Traditional fishing methods in Palau

Palauan lunar month	Gregorian month	Major fishing methods, activities or remarks
1st month of the easterly wind (<i>Tmur er a ongos</i>)	November	<i>Oungeual</i> (Offshore shark fishing) * 1 Daytime underwater spearfishing or speargun for <i>melangmud</i> , <i>mechur</i> & <i>meseukuik</i> fish Nighttime fishing on 1st, 5th, 6th and 10th darkneses <i>Ng mo omub</i> (Periods for making fish traps)
2nd month of the easterly wind (<i>Modelab er a ongos</i>)	December	Nighttime fishing on 8th, 9th, 10th, 15th & 16th darkneses <i>Metilab</i> net for <i>kotiko</i> fish on 15th & 16th darkneses
3rd month of the easterly wind (<i>Taoch er a ongos</i>)	January	<i>Sab</i> net for <i>meas</i> fish at night on 5th, 15th & 16th darkneses <i>Taod</i> spearing (Three-pronged fish spear) in daytime <i>Kesokes</i> net (Long fishnet) at night <i>Bidekill</i> net (Cast net) in daytime Torch fishing at night
4th month of the easterly wind (<i>Chelid er a ongos</i>)	February	<i>Kesokes</i> net at night <i>Sab</i> net fishing for <i>meas</i> fish in daytime <i>Taod</i> spearing (Three-pronged fish spear) at night Torch fishing at night Preparation for <i>ruul</i> (Leaf sweep)
5th month of the easterly wind (<i>Orengodel er a ongos</i>)	March	<i>Sikes</i> (Spearhunting for green & hawkbill turtles) in daytime <i>Sab</i> net fishing for <i>meas</i> fish in daytime on 5th & 6th darkneses
6th month of the easterly wind (<i>Chiach er a ongos</i>) * 2	April	Not good catch of fish because of <i>debesockel el merangd</i> (<i>meas</i> fish enter into lagoons, but easily scatter in lagoons)
1st month of the westerly wind (<i>Tmur er a ngebard</i>)	May	<i>Kesokes</i> net fishing in daytime <i>Ruul</i> fishing (Leaf sweep) in daytime Preparation for angle & <i>ruul</i> fishing
2nd month of the westerly wind (<i>Modelab er a ngebard</i>)	June	Angle fishing <i>Metilab</i> net for <i>kotiko</i> & <i>kelat</i> fish on 15th & 16th darkneses ? <i>Ruul</i> fishing (Leaf sweep) in daytime

3rd month of the westerly wind (<i>Taoch er a ngebard</i>)	July	Angle fishing <i>Sab</i> net for meas fish <i>Bidekill</i> net (Cast net) for <i>lerekrik</i> fish on 29th & 30th darknnesses ? <i>Ruul</i> fishing (Leaf sweep) in daytime
4th month of the westerly wind (<i>Chelid er a ngebard</i>)	August	<i>Sab</i> net for <i>meas</i> fish
5th month of the westerly wind (<i>Orengodel er a ngebard</i>)	September	<i>Sab</i> net for big-sized and plentiful <i>meas</i> fish on 5th & 6th darknnesses No good catch of fish by angle fishing during 5th through 10th & 20th through 26th darkn- sses No good catch of turtles by <i>sikes</i> spearhunting in daytime
6th month of the westerly wind (<i>Chiach er a ngebard</i>) * 2	October	Not suitable for fishing because of 3 big waves with sudden and dangerous winds

Source: 1995 *Kalender ra omenged e lolitirakl ra buil ma dolech er Belau* (PALAU COMMUNITY ACTION AGENCY, 1995), HIJIKATA (1942) and TAKEDA's field study carried out in Koror and Peleliu Islands, Palau in October and November, 1995 through interviews, direct observations and questionnaires.

*1 Only after the occurrence of a little rain at dawn (*olngebdel orrakl*), men went outside the reef for shark fishing.

*2 This month includes an intermediate or transitional period called *raud*.

knots on the cord, the lunar cycle repeats itself. They also found out that the lunar cycle repeats itself six times, when the wind is blowing from the east constantly. The lunar cycle also repeats itself six times when the wind is blowing from the west. If the moon's path across the sky is leaning northward, it is the year that the wind blows from the east. In the middle of the 1st month of the east wind, *tmur er a ongos*, its path across the sky will be over the most northern latitude that the moon could travel directly over. When the moon passes directly overhead, it is the middle of the *chelid er a ongos*, the 4th month of the east wind, or the *chelid er a ngebard*, the 4th month of the west wind. When its path across the sky is over the most southern latitude that it could travel over, it is the middle *tmur er a ngebard*, the 1st month of the west wind.

It should be obvious that, the situations they observed in the past pertaining to the year in Palau had six months in it. The first month in each year always begins with the appearance of the new moon at the horizon and continues for 30 days. In comparing the traditional Palauan lunar calendar with the Gregorian calendar, the season when easterly wind begins toward the end of October, sometimes, it is the beginning of November, is *tmur er a ongos*, 1st month of the Palauan. When the wind changes its direction into westerly at the beginning of May, it is *tmur er a ngebard* (Table 1 with information on climate and so on).

During the months of the easterly wind, the tips of the moon's crescent are pointing up and toward the north. When it is *chelid*, the 4th month of easterly and westerly winds, the tips of the crescent are pointing up to the heavens. During the months of the westerly wind, the tips of the crescent are pointing up and toward the south.

Some of the signs regarding the time change of time of fish spawning during the year are the low and high tides and the heights of the breakers on the reef, and the position of the Pleiades, *mesikt*, along with the moon and the current in the sea. These are more signs that have regular occurrences every year (Table 2). Optimum fishing methods and grounds are still adopted, varying according to the traditional Palauan culture (Table 3).

Traditional Fishing Activities on Reef Flats and/or in Lagoons

1. Shark fishing

Traditionally fishermen seldom ventured much beyond the outer reef slope, but offshore fishing (*oungueuol*) was done by a few prestigious specialists. These men fished the open ocean for several species of sharks, only after the occurrence of a little rain at dawn (*olngebdel orrakl*). Prevailing winds and currents bring significantly more drifting logs past Palau during the *ngebard* season of easterly winds. Sharks tend to congregate around these logs. During the season of the northeast trades, fishermen sailed up to ten miles off the east coast of Babeldaob looking for floating driftwoods.

Whereas sharks used to be esteemed as food by Palauans they are not popular today. This fishing died out around the turn of the century.

2. Throwing spears

Small mullets are commonly speared by collective labor in six to eight inches of water on reef flats with multiple-pronged *laod* spear. A single-pronged *klebiskang* spear was preferred for rabbitfish.

2-1. Underwater spearfishing

Diving goggles were imported by German traders to facilitate diving for pearl shell at the turn of the century. In the late 1940s underwater spearguns were also introduced. A few years later underwater flashlights became available, facilitating nighttime underwater spearfishing. After the introduction of diving goggles underwater spearfishing became popular. An underwater speargun with a detachable shaft propelled by rubber was reportedly first introduced to Palau in the late 1940s by an Indonesian fisherman. Today most village men have at least one fishing gun. A few Palauan fishermen have had the opportunity to use SCUBA (OHYAMA et al., 1980) while spearfishing, enabling them to go deeper after fish than has been customary.

In reef and lagoon waters the clearest conditions usually occur during the first two or three hours of the incoming tide. Neap tide also offer good for spearfishing. As a consequence of reduced tidal currents, visibility is usually fairly good. Less effort is needed to fight the currents.

2-2. Spearfishing at night

Many fish that are active during the day are inactive at night, so spearfishing is much more productive at night. Before the advent of lamps, palm leaf torches were used. Night spearguns are usually made of dense wood, such as beefwood or ironwood called *ngas* (*Casuarina litorea*), so that are negatively buoyant.

2-3. Hand spears

The introduction of outboard motors has created new employments for the hand spear. With the introduction of spearguns and high-powered underwater flashlights are favorably targetted bumphead parrotfish.

Very heavy spears were once used from canoes to spear dugong and turtles. Dugong abounded in Palau and were a staple food sixty years ago (KRÄMER, 1929), but now are an endangered species. Hawksbill and green turtles are still common in Palau, even though they have been heavily fished in daytime. Fishermen harvested hawksbill turtle eggs for food and the adults for their shells, which were traditionally made into women's money and jewelry. Sea turtles are usually speared in a front flipper underwater. However, in *orengodel* of the east wind (March) turtle spearfishing (*sikes*) is done by a fisherman who stands on the canoe bow and poises to spear turtles that surface to sea. In recent years Palauans learned that strong-smelling meat of the hawksbill becomes palatable when it is boiled several times, changing the water each time. The flesh is not wasted as it once was. See TAKEDA (1994c) for further fishing methods and food habit of sea turtles among the Okinawan people.

3. The leaf sweep (*ruul*)

The leaf sweep was done in a group by using a rope festooned with coconut palm fronds to herd and capture fish. Although fish can easily swim through or under a leaf sweep, it forms an effective psychological barrier for most species except rabbitfish.

The traditional movable *ruul* has given way almost completely within the past few years to an imported stationary barrier net (*kesokes*). A variation on this strategy is to interpose a special wooden fish trap (*semael*) or a net (*osel*) between the two sections of the *ruul* and herd the fish into it.

4. Fish weirs

Stone or wooden fish weirs were built on the reef flats to trap fish on receding tides. They were replaced in function by the less labor-intensive *kesokes* net. See TAKEDA (1994a; 1994b) for detailed information on stone tidal weirs in Japan.

5. Stationary barrier nets

It can be employed by a single individual on reef flats, whereas the *ruul* net requires many people to operate. It is usually several hundreds yards long, from two to five feet deep and has a stretched mesh of from one to two and one-half inches. The segments are tied together and the net is set in a V shape on a falling spring tide. As many as three sets per trip may be made during the ebb of an extreme spring tide. *Kesokes* nets are set at night as well as during the day. Catches made with *kesokes* nets are generally greater at night and are composed largely of different species than those caught during the day. The *kesokes* net is best used during the last two or three hours of a falling spring tides. The net can only be used during the lower of the two low spring tides. *Kesokes* fishing is carried out mainly at night for six months of the *ongos* season, for other *ngebard* six months mainly during the day.

Stationary barrier nets, together with underwater fishing guns, are now the most productive and extensively used fishing devices whereas others account for most of the rest of the catch.

6. Cast netting

The cast net, or *bidekill*, was introduced into Micronesia by Spaniards in the 19th century. A fisherman stalks school of fish by crouching low while pointing his feet and lifting them straight out of the water as he walks so as to minimize the noise he makes. Because the net is quite heavy when wet, this is particularly physically demanding technique and is best done by well-muscled younger fishermen (JOHANESS, 1981).

Some species are best caught with a throw net at low tide on the fringing reef flat. Others may be caught in deeper water and on any tide by casting from the reef edge, a cliff, or a dock.

An overcast sky and light rain are the preferred daytime conditions for cast netting. The lack of shadows and the slightly disturbed surface of the water help conceal fisherman and net. Experienced cast net fishermen also fish at night, even in the absence of a moon.

7. Portable fish trap

Although Palauans once used at least 13 different kinds of wooden fish traps (KRÄMER, 1929), only one basic type is used with much frequency today. It is usually 3 to 4 feet high and 6 to 7 feet long.

The trap is usually placed in shallow areas through which fish are known to migrate diurnally or with the tides. Traditional Palauan traps were not baited.

8. Fishing with dynamite

A fish bomb is made by packing a beer can about two-thirds full with powder. Such a dynamite-fishing was also done shortly after WWII among the coast-dwellers in Okinawa (TAKEDA, unpublished). The fuse is made from match head shavings that are tamped down firmly into a thin bamboo rod using a thin stick. The fuse is stuck into the powder and the can is then sealed with a layer of mangrove mud.

Its use was made illegal after the war. But abandoned ammunition caches and unexploded

bombs provided dynamite for some less principled fishermen for many years.

9. Line fishing

On rising tides reef fish are often seeking food and thus less likely to seek shelter and enter traps than they are on falling tides. Some species congregate around the outer entrances of channels through the reefs to feed on what the outgoing currents bring. Line fishermen therefore work these areas mainly on falling tide.

9-1. Trolling

Barracuda trolling is done at night. Trolling outside the reef is better on a rising tide. It requires a piece of fish works much better as a nighttime trolling lure for barracuda than conventional feather lure.

9-2. Dropline fishing

Dropline fishing is conveniently done in several days bracketing each of the second and fourth quarters during the period of neap tides. Smallest tidal fluctuations bring out weakest tidal currents. The daily period is for an hour or so during slack tide when tidal currents are at their weakest are preferred. The fishermen therefore maximum control over his line. Less weight is required on the line to get the bait down, and it is easier to place the bait in a desired spot. Fish tend to bite better in an incoming tide; and early in the morning and again in the evening.

10. Fish poison

ABE (1938) lists four plants as fish poisons: *Derris elliptica*, *Callicarpa cana*, *Pangium edule* and *Barringtonia asiatica*. Derris root (*Derris elliptica*) called *dub* or *deris* is still used occasionally for reef fish today. The Japanese imported this species, a more potent variety than the indigenous *Derris trifoliata* (JOHANESS, 1981). During the *ngebard* season fish poisons were traditionally used. They were seldom used during *ongos* months because the daytime low tides were not very low; the water on reef flats tended to be so deep, even at low tide, that poison was diluted rapidly and its effectiveness reduced. Sometimes, when a very large quantity of fish was needed, poisoning was done by the village. Hundreds of baskets of poison were used (PALAU COMMUNITY ACTION AGENCY, 1976). See also TAKEDA (1994a) for further information on fish poisons in Japan.

Gleaning Activities on Reef Flats and/or in Lagoons

The gathering by hand of small fish and invertebrates is done mostly during the day. It is restricted largely to the season of very low daytime spring tides when most of the reef flat is uncovered. Such tides occur during the *ngebard* season when offshore fishing is poor along the western coast of Babeldaob. The harvest from reef gleaning by women and young boys provides a valuable supplement when the men make poor catches. But even today sea cucumbers and giant clams are seldom eaten during the good weather months of *ongos* easterly winds in a conscious effort to conserve their populations for use during the rough *ngebard* westerly wind months when fishing is poor. Quantitative data were not available in Palau at all this time, but the detailed field study based on long-term direct observations will be necessary to elucidate the survival strategy of the islanders since reef-gleaning activities are closely related to their

Table 4. Sea cucumbers in Palau

Palauan name	Common name	Scientific name	Japanese name	Remarks
<i>Agas</i>	Sea cucumber (White fish, White sand fish)	<i>Halodeima edulis</i>	<i>Akamishikiri</i>	Blackish purple-colored
<i>Bakelungal</i>	Sea cucumber	<i>Microthelae nobilis</i>	<i>Ishinamako</i>	Black colored & round shaped; soften by cooking with coconut milk a long time; this species which was valued highest in 1880s as Chinese food
<i>Biback madal</i>	Sea cucumber (Tiger fish)	<i>Bohadschia argus</i>	<i>Janonenamako</i>	Eaten raw
<i>Cheremrum</i> *	Sea cucumber	<i>Actinopyga</i> sp. ?		Black or chocolate-colored; eaten raw: slenger shaped with smooth skin; used as fertilizer for coconut trees; eaten raw in Ponape Is.
<i>Chesabel</i>	Sea cucumber	<i>Bohadschia bivittata</i>	<i>Futasujinamako</i>	
<i>Choas</i> *	Sea cucumber	<i>Holothuria atra</i> (= <i>Halodeima atra</i>)	<i>Kuronamako</i>	Red liquid containing a nerve toxin was used to stun in Japan (TAKEDA, 1994a) & large edible sea-anemones; used as food in Palau and to drive octopus out of the lair (JOHANESS, 1981).
<i>Iirind</i> *	Sea cucumber	?		Corrugated skin; innards are eaten at breakfast time
<i>Meremarech</i>	Sea cucumber	<i>Bohadschia vitiensis</i>	<i>Chizunamako</i>	Eaten raw or cooked after peeling skin; lemon or soy sauce added when eaten raw
<i>Molech</i> *	Sea cucumber	<i>Holothuria impatiens</i>	<i>Zounamako</i>	Eaten raw or cooked after peeling skin; innards are also eaten since they do not feed on sands, particularly when gathered early in the morning or before dawn
<i>Ngimes</i>	Sea cucumber (Pricky fish)	<i>Stichopus variegatus</i>	<i>Tananamako</i> (= <i>Agemushi</i>)	Sometimes eaten, particularly when gathered early in the morning or before dawn; innards with sands are used as fish baits
<i>Temelamel</i>	Sea cucumber	<i>Thelenota ananas</i>	<i>Baikanamako</i>	Most commonly gathered; dried ones are also valued; usually 40 cm in length, but sometimes 80 to 100 cm at most

Data based on TSURUMI (1990) and TAKEDA's field study carried out in Koror and Peleliu Islands, Palau in October and November, 1995 through interviews, direct observations and questionnaires.

* : Sea cucumbers living on shallow reef flats

Table 5. Edible marine benthic flora, but not eaten by Palauan islanders

Taxa	Scientific name	Countries used as food	Japanese name
Chlorophyta (Green algae)	<i>Enteromorpha</i> sp.	Japan	
	<i>Caulerpa racemosa</i>	Ryukyu Archipelago (TAKEDA, 1994a), Philippines & Southeast Asia	
	<i>C. lentillifera</i>	"	<i>Umibudou / Kubirezula</i>
	<i>Codium</i> spp.	Japan, Korea, Hawaii, and other countries	
	<i>Sargassum</i> spp.	"	
Phaeophyta (Brown algae)	<i>Halymenia</i> spp.	Ryukyu Archipelago, Hawaii, and other countries	
Rhodophyta (Red algae)	<i>Hypnea charoides</i>	Japan and other countries	<i>Mooi</i>
	<i>Gracilaria</i> spp.	Japan, Korea, Hawaii, and other countries	
	<i>Laurencia</i> spp.	Hawaii and other countries	

Data based on OHBA (1996; personal communication) and TAKEDA's field study carried out in Koror and Peleliu Islands, Palau in October and November, 1995 through interviews, direct observations and questionnaires. See also TAKEDA (1994a) for further information on seaweeds used by the Okinawan islanders.

daily intake of proteins (*odoim*).

Sea urchins (KLEE, 1972), sea cucumbers (Table 4), sea anemones (*Stoichactis kenti*), peanut worms (sipunculid worms: *Sipunculus* spp.) (ARAMATA, 1994; MORI, 1977; NISHIMURA, 1992) and starfish (JOHANESS, 1981: species unspecialized) are also easily harvested reef invertebrates as food. In Peleliu sea anemones are harvested by fastening the outer fringes with a coconut midrib string while taking care to refrain from the stings, but he failed several times because it retracted into its hole. Neurotoxic secretion of a sea cucumber was not used to paralyze large edible sea anemones used as food (JOHANESS, 1981). At low tides of spring tides sipunculids are harvested with a stick pushed into the hole on reef sands.

Palauan sea cucumber utilization is characteristic of cooking method after peeling off the outer skin, some sea cucumber used as fertilizer in the coconut fields and used as baits for fishing; the innards which contain sands are wound around fish-hooks as baits. Some are preferred to harvest in the morning, since the innards do not contain sands on which sea cucumbers feed.

The people in Fiji-Samoa-Tonga region gather the *palolo* or *balolo* annelid worm (*Palolo siciliensis*: UTINOMI, 1990) when it rises annually in late October and early November with another rising time in two consecutive last quarters of the moon (WATLLING, 1986). These worms are gathered and favored as a coral reef delicacy called also the South Seas Caviar (WATLLING, 1986), but Palauans do not know them and so do not have the food habit at all.

In addition, there are various kinds of edible seashells including giant clams and so on, which will be reported elsewhere. It is very curious for Palauans not to have had a food habit of seaweeds such as *Caulerpa* spp. (OHBA, 1996) which are abundant in Palau (Table 5). As stated in TAKAYAMA (1993), Palauans do not eat seaweeds at all. Although some kinds of seaweeds were used as fertilizer in the Ryukyu Archipelago, it has not been used as fertilizer in Palau. Land crabs, coconut crabs and mangrove crabs are very important food source in Palau, but the gathering or gleaning of these crabs will be reported and discussed elsewhere together with hunting activities in Palau.

Conclusion

The coral ecosystem ensures the food sufficiency and food-availability of marine resources throughout the year (TAKEDA, 1994c). Food-gleaning or gathering has been carried out on a daily basis by women, children and even the aged using non-specialized techniques in the Ryukyu Archipelago. Fishing remains the primary subsistence in Palau and men carry out the fishing. Palauan women and young boys are also engaged in gleaning marine edible fauna and flora although traditional women's subsistence is taro and/or cassava cultivation. Although fishing is mainly done by men for the primary purpose of providing the protein, fishing for commercial needs is on the increase. Various kinds of fishing-gleaning are adopted, varying according to the position of the sun, the rising and setting of the stars, the waxing and waning of the moon, the ebb and flow of the tide, the changing wind direction, the height of the breakers on the reef, and the life cycles within lagoons and reef flats. Rapid westernization has, however, occurred throughout Palau. Palauan fishermen are also confronting with the introduction of new fishing methods or fishing devices. It is evident that these technological factors will make them estrange from the past culture and lore deeply based on the traditional Palauan lunar calendar. Therefore, their conventional monthly fishing patterns, and their traditional skill and knowledge necessary for fishing at sea will be altered rapidly or degree by degree in near future, too. The

accumulation of such a culturally-established tradition of fishing-gleaning or gathering activities through intensive field works in various countries will give us an ecological-anthropological clue to reconstruct the human evolution in the stage from hunting-gathering to agriculture, although it needs an urgent and intensive field work based on long-term direct observations.

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