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Editor's note

We include three articles in this edition. In the first, "Fishing for drummerfish (Kyphosidae) with termites and spider webs on the weather coast of Guadalcanal, Solomon Islands", William T. Atu describes a unique traditional fishing method known as *bulukochi*, which was used by his forefathers to catch drummerfish. This fishing method is on the verge of disappearing, and the only person who knows about it and the associated customs is Mr Atu's elderly uncle. So Mr Atu decided to preserve some of this information here, because, as he says "With the passing of my uncle the techniques and intricate customs associated with this method will be lost forever".

William T. Atu has set a wonderful example. We hope it will stimulate other people to set about documenting "endangered information" in their own communities. This Information Bulletin would be delighted to publish such material.

In "Indigenous ecological knowledge (IEK) on the aggregating and nocturnal spawning behaviour of the longfin emperor *Lethrinus erythropterus*", Richard J. Hamilton details indigenous ecological knowledge (IEK) regarding the aggregating and nocturnal spawning behaviour of the longfin emperor *Lethrinus erythropterus* (Valenciennes 1830) in Roviana Lagoon, Western Solomon Islands. He also reports on his observations over the last four years of *L. erythropterus* nocturnal aggregation sites in Roviana Lagoon. Although the genus *Lethrinus* is very abundant in coastal waters of the tropical and subtropical Indo-Pacific and is important in subsistence and artisanal coral reef fisheries, information on the reproductive biology of lethrinids is limited. Most documented accounts of reproductive behaviour in the family Lethrinidae are based on the IEK of fishers. The fishing communities of the New Georgia

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archipelago, where this study was conducted, are renowned for their comprehensive IEK bases, which have been shown to be highly accurate in many instances.

As is now well understood, a good ethnographic database is an essential prerequisite to fisheries surveys. However, before ethnographic data collection can begin and studies of local knowledge started, a practical knowledge of folk taxa is necessary. Identifying a folk taxa is also an excellent way of facilitating participatory monitoring of fisheries by resource users. In "Folk taxonomy of reef fish and the value of participatory monitoring in the Wakatobi National Park, southeast Sulawesi, Indonesia", Duncan May presents an etymological examination of folk taxa of nearshore fish caught around Kaledupa Island, in Wakatobi National Park (WNP). The suitability of folk taxa for monitoring and analysis, and the ability of participatory monitoring to stimulate appropriate fisheries management, are discussed in the context of Indonesia.

We would like to take this opportunity to congratulate Shankar Aswani, one of our frequent contributors. Anthropologist Shankar Aswani, of the University of California, Santa Barbara, was awarded a 2005 "Premier Ocean Award" from the Pew Foundation's Marine Conservation Program. He was one of five scholars this year to receive the world's most prestigious award in marine conservation. The Pew Fellowship in Marine Conservation includes USD 150,000 to support a three-year project. Aswani, the first anthropologist to be so honored, will use the fellowship to continue and expand his work with communities in the Solomon Islands. Through education and collaboration, he aims to establish and consolidate a network of marine protected areas designed to preserve vital resources and vulnerable species, such as coconut crabs, sea turtles and sea cows. Aswani's Pew Fellowship will complement other recent major grants supporting his work to establish marine protected areas in the Solomon Islands. The Pew Fellowship will also enable him to carry out a project to integrate marine and social science research in ways that will facilitate the future development of marine conservation projects in the Pacific Islands.

Kenneth Ruddle

Fishing for drummerfish (Kyphosidae) with termites and spider webs on the weather coast of Guadalcanal, Solomon Islands

William T. Atu[1]

Introduction

In the last century, many coastal communities in the South Pacific have discarded traditional fishing methods in favour of more efficient western technologies (Johannes 1981; Ruddle et al. 1992; Dalzell et al. 1996). Although western fishing technologies such as nylon gill nets and spear guns have allowed far greater fishing efficiency, they have come at an ecological, social and cultural price. A shift to western fishing technologies is frequently implicated in unsustainable subsistence fishing practices (e.g. Dalzell et al. 1996; Hamilton 2003), and when knowledge of traditional fishing methods are lost, so too is local knowledge, customs and social structures associated with these traditional techniques (Johannes 1981; Johannes et al. 1993; Hviding 1996). For instance, in traditional Pacific cultures, a person's ability to catch fish and feed the people in his community is highly esteemed. In many cases, the *mana* (blessing) and knowledge required to catch certain kinds of fish is sacred and is only passed on to a close and trusted relative. But when highly specialized traditional technologies are replaced with easily used and generalized methods such as gill nets, then the traditional recognition of special status and commemorations of fishing catches are often ignored.

Recognition of all of the above-mentioned factors has led many authors to call for the documentation of traditional fishing methods and associated local knowledge and customs before this information is lost from oral cultures (e.g. Johannes 1981; Ruddle et al. 1992; Lalonde and Akhtar 1994). In this paper I describe a unique traditional fishing method called *bulukochi* which was used by my forefathers to capture drummerfish (Kyphosidae) at Sukiki community on the weather coast of Guadalcanal, Solomon Islands. This traditional fishing method was used for many generations, but in recent decades has become less and less widely practiced. Today the only individual who knows of this method and the associated customs is my elderly uncle. With the passing of my uncle the techniques and intricate customs associated with this method will be lost forever. To preserve this knowledge and culture I decided to document aspects of this information[2] and present them in a written format.

Environmental and cultural setting

The Solomon Islands consists of two roughly parallel island chains, with six major island groups: Choiseul, Isabel and Malaita are found in the northern group while New Georgia, Guadalcanal and Makira are in the south. Rennell and Bellona, and the Temotu Province islands lie to the south and east respectively of these main island groups (Fig. 1). The largest of the main islands is Guadalcanal, which is 6475 km^2 in size. Guadalcanal is characterized by a rugged interior with high mountains and ridges. These high mountains intercept the prevailing southeast trade winds and create two distinctive climates. The southern part that bears the brunt of these trade winds is called the weather coast because it can be rough and treacherous. At times, huge waves tumble ashore, destroying entire villages. The people along the southern coast of Guadalcanal call this part of the island *tasimauri*, which literally means the sea that is alive. Conversely, the northern side of the island is known as *tasimate* which means the sea that is dead. On the weather coast the sea is a symbol of unity and cultural identity, and the communities on the coast share common myths and legends about the sea. The sea is so much an integral part of life that the status of a man in society is often determined by his ability to make seaworthy canoes and his fishing skills. Indeed, a man's ability to make a canoe and capture plenty of fish is often used as a mark to separate man-

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2. The traditional chants that are used when preparing this fishing method are very sacred so I have not included them in this paper.

hood from boyhood, and individuals who are highly skilled in either of these practices earn special status in their society.

Sukiki village is located on the southeast coast of Guadalcanal between Marau to the east and Avuavu to the west (Fig. 1). The village is remote and is accessible from Honiara only by boat. This Seventh-Day Adventist community is still largely subsistence based, with its population dependant on subsistence agriculture and the harvesting of marine resources. Although marine resources form the dominant source of protein (there is limited chicken husbandry), fish are the only resource exploited, as crustaceans, molluscs, eels, turtles, dugongs, stingrays and sharks are not eaten due to religious beliefs. Fish resources are relatively hard to obtain at Sukiki in comparison with many regions of the Solomon Islands. Pelagic fish such as tuna and rainbow runner can be captured in the open sea but rough weather frequently limits this type of fishing on this exposed coast. Moreover, the total amount of exploitable reef fish is low as there is only a limited amount of reef directly outside of the village. Indeed, much of the weather coast has no nearby reef at all.

The *lagui* (Kyphosids)

The kyphosids, drummers or sea chubs as they are commonly known, are an herbivorous family of fish, common in the tropical Indo-Pacific region (Randall et al. 1990). Known locally as *lagui* at Sukiki, different size classes are given individual names. The smallest sizes of drummers are called *verovero*, the next size class is called *ighahau*, and the largest size class is called *pasiae.* Fishers count their catches of drummers in multiples of ten known as *paga*. If 10 are caught then it is called *chika paga*. If, however, 20 are caught, then it is called *ruka paga*. At times, the catches of *lagui* may be as much as 100. If someone catches many *lagui* then he is expected to make a special customary pudding either from yam or taro depending on the season, which is called *lakengo*. In this instance, all the other fishers contribute their catch to the person who has caught the most *lagui*, and the whole community is fed. However, this is not expected every time one goes out fishing for drummers. In the past, people from other villages brought the bait for drummers (known as *kochi*) to my grandfather and asked him to fish for them. All the catches from the provided *kochi* were sent to the owner of the *kochi*,

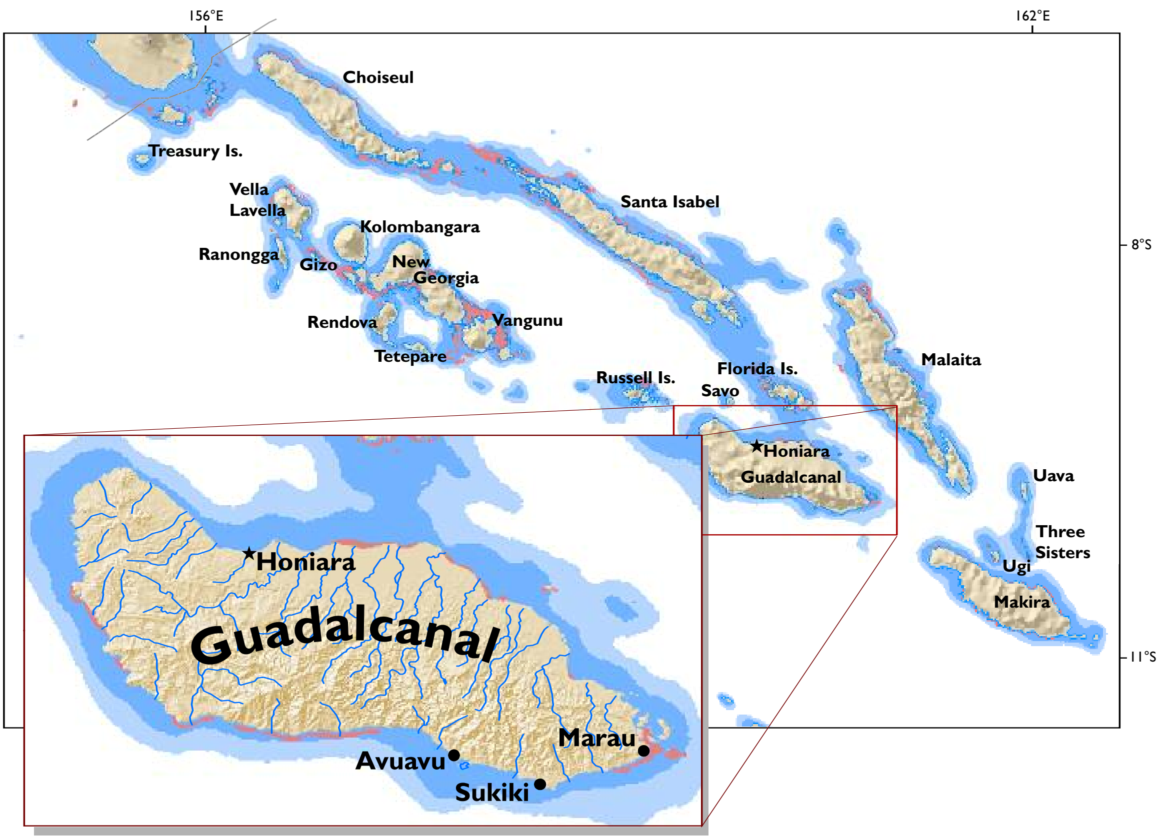

Figure 1. **Solomon Islands, with the enlarged portion showing the location of the Sukiki community on Guadalcanal.**

but no payments were required for the fishing effort. This was a very important aspect in the community because a person who could catch and distribute *lagui* had a high status and was widely respected. *Kochi* that was sent from orphans or widows was traditionally treated with priority, since these individuals do not have male family members to fish for them.

Indigenous ecological knowledge of the seasonality of drummers

On the weather coast the yearly season determines the kind of fish that can be caught and the fishing techniques and gears that are used. Year round, the seasons for fishing and planting are determined by the phases of the moon, the winds, the flowering, shedding and the re-growth of the leaves of certain plants. From January to April the westerly wind, which we called tavalosi, blows. These months correspond to the harvesting of certain root crops such as yams and *tavalosi* (sugarcane-like plant that grows in clusters). Then, from May to August, the easterly winds, which we called *ara,* blow. From September through December is the calmest time on the weather coast, and is called *odu*. The *odu* is characterised by fine weather when people can go out for long fishing trips in dugout canoes.

Drummers (*lagui*) can be caught year round on the weather coast which makes them an especially important source of protein. Drummerfish usually travel with floating debris (or what we call *chali*) that is brought by either the easterly or westerly winds from reefs far away. The drummerfish travel with the debris, feeding on the algae and plankton associated with the *chali*. When the *chali* is thrown ashore by the waves, the drummerfish often congregate near the shore so that they can continue to feed on the *chali*. At other times the drummers aggregate near river mouths, feeding from the *chali* (leaves and sediments) that is washed into the sea. At nightfall, the drummerfish move farther out toward the breakers where there are no currents, feeding on debris in the foam that is made by the waves. As dawn approaches the fish go to deeper depths and again look for feeding places near the seashore and river mouths. The drummerfish are usually caught in the morning and in the late afternoon. Fishing is best when the tides are high and the seas are neither too smooth nor too rough. The seas are often quite smooth during *odu*, and at this time the mouth of the river is the ideal place for *bulukochi* fishing.

The origins of the *bulukochi* fishing method

According to legend, there was once a man who went out fishing and on his arrival back at shore he began to gut the fish he caught. It happened that one of the fish was a drummer. He noticed that the stomach contents included termites and algae. The following day the fisherman went into the bush to find termites, to see if he could use them as bait to capture drummerfish. He collected some termites that are known as *ane*. The fisherman attached the termites to a traditional fishing hook called *alovinavinatu*, made out of a vine. The *alovinavinatu* was then attached to a traditional fishing line called *ghachigho*, made out of bush rope. One end of the *ghachigho* was then tied onto a bamboo pole. The fisherman tried this method and saw that the drummers were attracted to it but that the termites were quickly washed off the hook by the sea water, making it difficult for the drummerfish to be caught.

While he was fishing, he noticed that algae were in abundance near the seashore and that the drummerfish were feeding on them. It was *odu* season at this time and as he was looking at the algae it reminded him of a spider web (known as *laotaetaera*) that was greenish in colour. The next day he collected some *laotaetaera* and tied it on to the *alovinavinatu*, and he was then able to attach some termites to the sticky spider web. He tried this method, but to his disappointment the school of drummerfish quickly disappeared since the swallowed termites (*ane*) had bitten their stomachs.

These happenings made him increasingly curious about trying to find a solution to catch the drummerfish. He then noticed that the algae that were exposed to the sunlight during low tide were brownish-yellow in colour, which reminded him of another type of spider known as *laobulu* and another type of termite called *kochi*. The next day, when he tied the *laobulu* and the *kochi* onto the *alovinavinatu*, he found that the drummerfish were attracted to his bait and did not go away. He was able to catch some drummers that day and since then he earned himself the name *Kochi*.

Drummer fishing today at Sukiki

Since *Kochi* first discovered how to capture drummerfish, the *bulukochi* method has remained largely unchanged, although nylon fishing line and steel hooks replaced *ghachigho* and *alovinavinatu* in the 1900s. Below, is a detailed description of the *bulukochi* fishing method.

In preparation for *bulukochi*, the termites and spider web are usually prepared a day or two ahead of the actual fishing day. Looking for *kochi* in the bush takes skill and practice, as termite nests are relatively rare and often obscured under a log or are located in trees. The *alana* (termite pathways) always lead to the termite nest. Once the *kochi* is located, the leaves of a customary plant are beaten against the *kochi*, and while doing this a special chant is muttered. This is done to ask an evil female spirit to leave the *kochi* so that it can be safely removed. The *kochi* is removed (Fig. 2) and then wrapped in leaves and taken home and dangled on a stand over water to prevent the termites from escaping from their nest. A *laobulu* spider web is then sought, and when it is found the web is removed with dry hands (Fig. 3). This is to prevent the web from sticking together. The spider web is kept in a leaf and is stored in a dry place in the house. You can be certain that you will always find a new spider web at the same site a week or so later.

The next stage is the preparation of the bamboo pole. When tying the fishing line to the top of the bamboo pole, a shoot of a special leaf is rubbed over the pole, starting from the top of the bamboo pole and working down to the bottom. Traditional chants are muttered during this process, and once this process is complete the leaf must be thrown away. Rubbing the leaf onto the bamboo is a means of casting off any omens that might be on the bamboo and thus alluring the drummers towards your fishing line. Once this is done the bamboo pole must then always be kept standing to prevent people stepping over it. The reason for this is that our feet carry us to many different places, not all of which are desirable locations. If people step over the pole the drummerfish may sense where the people have been, which will in turn make them refuse the bait. To this day the bamboo pole is a sanctified fishing gear and is always kept in a special place in an upright position. It is usually placed in front of the sleeping house after every fishing trip.

When all these things are ready then it is time to get the *kochi* out of their nests. The nest is cut into small pieces, and then a small piece is taken in one hand. The other hand is then used to constantly hit the wrist of the hand holding the termite nest, which causes the termites to fall on to a leaf (Fig. 4). While doing this, customary chants are also muttered, calling the drummers from both directions to come together at the location where one is about to fish.

All of the termites are then placed in a bag and mashed into a paste. The next step is to prepare the

Figure 2. **Penrick Selino holding up a *kochi* that was found under a rotting tree stump in the forest.**

Figure 3. **Joseph Mage removing a *laobaulu* spider web.**

Figure 4. **Joseph Mage knocking the termites out of their nest and onto a taro leaf.**

hook, which involves wrapping the *laobaulu* spider web around the hook until the entire hook is tightly enclosed in spider web (Fig. 5).

Once this is done the hook is attached to 4–5 metres of fishing line, which is attached to the bamboo fishing pole. One is now ready to go fishing. In accordance with local custom, a fisherman who wishes to go *bulukochi* fishing must abstain from eating bananas (*vuchi*) and cutnut (*vala*) during all stages of *bulukochi* preparation. It is believed that when you eat this food it adds more weight to the drummerfish, which in turn makes it difficult for them to swim elegantly in the waves, and they therefore will not be able to catch your lure.

Figure 5. **Wrapping the *laobaulu* around a fishing hook.**

Once a fisherman has arrived at his designated fishing spot, he begins by throwing handfuls of *kochi* into the sea to attract the drummers nearby (Fig. 6). Once a school of drummerfish is aggregated nearby, the fisher puts *kochi* all over the hook. The stickiness of the *laobaulu* spider web holds the *kochi* to the hook. He then casts his hook into the school of *lagui* (Fig. 7). As drummerfish have small mouths and will not swallow a baited hook, special skills are required to capture them. The fisherman keeps a careful eye on his baited hook, and when he sees a drummerfish just about to bite at the *kochi*, he flicks his bamboo pole upwards so that the hook becomes lodged in the drummerfish's mouth. Drummers that bite at the *kochi* also send slight distinctive vibrations up the bamboo pole. If the sea is very calm the vibrations can be felt, and inform the fisherman when to jerk his bamboo pole. During this entire time that he is fishing he must be careful not to allow his feet to enter the sea or this will cause the drummers to flee.

Discussion

The *bulukochi* fishing method described in this paper is a highly skilled and sacred fishing method that is an important component of Solomon Island cultural heritage. The chants, local knowledge and skill required to capture the highly esteemed drummers were held by a select few and these individuals gained special respect and recognition in their community. With this *mana* also came social responsibilities and obligations, with highly skilled *bulukochi* fishermen often being called on to capture drummerfish for individuals and families both within and outside of their communities.

Figure 6. **Throwing *kochi* into the sea to attract drummerfish.**

Figure 7. **A fisherman about to throw the baited hook and line into the sea.**

Over the last century, modern fishing techniques such as nylon nets and spear fishing have become increasingly popular in the Sukiki community and the wider Guadalcanal as a whole. These highly effective methods have enabled anyone who has access to these technologies to capture a wide variety and substantial amount of fish at any one time. Large quantities of drummerfish are also captured by nets or spear fishing and neither of these methods require particularly special skills. The ease with which drummerfish can now be captured by nets and spearguns has effectively destroyed both the *bulukochi* fishing method and the *mana* and special recognition that the *bulukochi* fishers traditionally received.

The demise of *bulukochi* fishing is resulting in a loss of culture heritage. Today, very few young people understand how *bulukochi* fishing was done, why it was important, the social status of *bulukochi* fishermen, or the customary chants and beliefs associated with this method. The last person in my village who knows the sacred chants associated with this fishing method is my uncle and he has passed this knowledge on to me. The sacredness of these chants prevents me from including them in this publication, but I have documented the general details of the *bulukochi* fishing method in this paper so that there is a written record for future generations. It is the author's opinion that the loss of traditional fishing techniques and customs described in this paper is typical of what is happening all over the entire Solomon Islands, where traditional fishing techniques and associated customs that have been acquired and maintained by our ancestors for centuries are being lost in one or two generations. Clearly there is an urgent need to document this cultural information quickly before more of it is lost from oral culture.

The final point I wish to make in this paper is that the abandonment of many traditional fishing technologies such as *bulukochi* have also had ecological consequences on the weather coast of Guadalcanal. Over the past decades around Sukiki there have been dramatic reductions in the catch rates of both reef and associated fishes, with spearfishing (particularly night spearfishing) and gill nets thought to be the main culprits. In widespread recognition of this, and in an attempt to rectify this situation, the Sukiki community banned gill nets and spearfishing over all of its nearshore reefs in 2002. Since 2002, only hook-and-line fishing has been allowed. This ban is strictly enforced and adhered to by customary measures and it already appears to be having a positive effect on fish abundances in this region. A full description of the locally managed marine protected areas around Sukiki and the process involved in developing them will be provided in a separate publication.

Acknowledgements

I sincerely acknowledge my uncle (*chagigu*) Joseph Mage for his trust and confidence in me as most probably his favourite nephew (I would like to think that way) and for entrusting to me the sacred chants of *bulukochi* fishing. I also thank Penrick Selino for his assistance at Sukiki. I thank Dr Richard Hamilton for encouraging me to "relive" and document the *bulukochi* traditional fishing method that was on the verge of disappearing, and for reading and commenting on an earlier edition of this manuscript. Finally, I thank Stu Sheppard from The Nature Conservancy Office in Brisbane for producing Figure 1.

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Indigenous ecological knowledge (IEK) of the aggregating and nocturnal spawning behaviour of the longfin emperor, *Lethrinus erythropterus*

Richard J. Hamilton[1]

Introduction

Many species of reef fish form spawning aggregations, in which large numbers (up to many thousands) of mature fish travel to a specific location at a specific time to reproduce (Domeier and Colin 1997; Colin et al. 2003). Some spawning sites are used by multiple species, either simultaneously or at different times of day, month or year, while other sites host only a single species (Colin et al. 2003). Although fishers have been aware of spawning aggregations for centuries (Johannes 1978; 1981), biologists' interest in them has been far more recent (Colin et al. 2003). In the last decade there has been mounting recognition among marine scientists and coastal managers of the need to understand the biological parameters of spawning aggregations and the effects of fishing them (Vincent and Sadovy 1998; Levin and Grimes 2002; Peterson and Warner 2002; Pauly et al. 2002). This recognition has stemmed from two realisations: first, that spawning aggregations of many commercially important species have often been rapidly overfished (Sala et al. 2001; Colin et al. 2003) and second, that spawning aggregations represent bottlenecks in the life histories of many reef fish species, and aggregation conservation and management is critical for the survival of the populations that form them (Sadovy and Vincent 2002). The logistical difficulties of locating spawning aggregations that form at localised areas for brief periods of time has meant that marine biologists wanting to research or protect spawning aggregations have often drawn on the local knowledge of fishers in the initial stages of their field work (e.g. Johannes 1981; Beets and Friedlander 1998; Johannes et al. 1999; Sala et al. 2001).

Detailed ethnographic studies that have focused purely on documenting the local knowledge of fishers have revealed that, as well as knowing about the locations of spawning sites, local fishers can also provide precise information on: the annual and lunar periodicity of spawning aggregations; migration pathways to and from aggregation sites; species composition at mixed species spawning sites; the spawning behaviour of aggregating fish; the response of aggregating fish to human disturbances; and changes in the status of aggregation populations over time (Johannes 1981, 1989; Hamilton 2003a; Hamilton et al. 2004).

In this paper I detail indigenous ecological knowledge (IEK) regarding the aggregating and nocturnal spawning behaviour of the longfin emperor *Lethrinus erythropterus* (Valenciennes 1830) in Roviana Lagoon, Western Solomon Islands. I also report on observations that I have made at several *L. erythropterus* nocturnal aggregation sites in Roviana Lagoon over the last four years. *Lethrinus erythropterus* is a medium sized species of the genus that is common in the tropical Indo-Pacific (Sato 1978). This species primarily inhabits coral reefs and adjacent sandy areas and is normally around 30 cm in length (Carpenter and Allen 1989). The lethrinids are bottom-feeding carnivores that primarily feed at night on invertebrates and fish (Carpenter and Allen 1989). They are very abundant in tropical and subtropical Indo-Pacific coastal waters (Sato 1978) and are of considerable importance in subsistence and artisanal coral reef fisheries, being captured predominantly using handlines (Wright and Richards 1985; Jennings and Polunin 1995). Despite their abundance on reef systems and their importance in coral reef fisheries, there is only limited information available on lethrinid reproductive biology.

Most documented accounts of reproductive behaviour in the family Lethrinidae are based on the IEK of fishers. Johannes (1981) provides a brief general description on lethrinid spawning behaviour, reporting that Palauan fishers were aware that some lethrinid species migrate in large

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numbers to spawning sites at the inner or outer edge of fringing reefs during new moon periods. Palauan fishers reported that spawning occurred at night (Johannes 1981). Titan fishers from Manus, Papua New Guinea, report that very large spawning aggregations of *L. erythropterus* form at fixed sites around the new moon in the months of March, April and May. These spawning aggregations are said to occur at large inner reef passage environments; the white-streaked grouper *Epinephelus ongus*, squaretail coralgrouper *Plectropomus areolatus*, brown-marbled grouper *Epinephelus fuscoguttatus* and the camouflage grouper *E. polyphekadion* also aggregate in overlapping territories at these times (Hamilton et al. 2004). In a study of the reproductive biology of the spangled emperor *Lethrinus nebulosus* around Okinawan waters, Ebisawa (1990) stated that spawning aggregations of this species were assumed to occur, given that large catches of *L. nebulosus* with fully mature gonads were made from limited areas during March to April. The limited available data on spawning behaviour in lethrinids resulted in Domeier and Colin (1997) listing Lethrinidae among a number of families of coral reef fishes that may aggregate to spawn, but for which spawning aggregations had not been confirmed.

Methods

The research reported in this study was conducted in Roviana Lagoon, Western Province, Solomon Islands. The Solomon Islands consist of a double-chained archipelago located east of Papua New Guinea, and extending over 1700 kilometres across the southwest Pacific (Fig. 1). The Western Province includes nine main islands, the largest of which is New Georgia (Fig. 1). Local fishing communities in the New Georgia archipelago are renowned for their comprehensive IEK bases

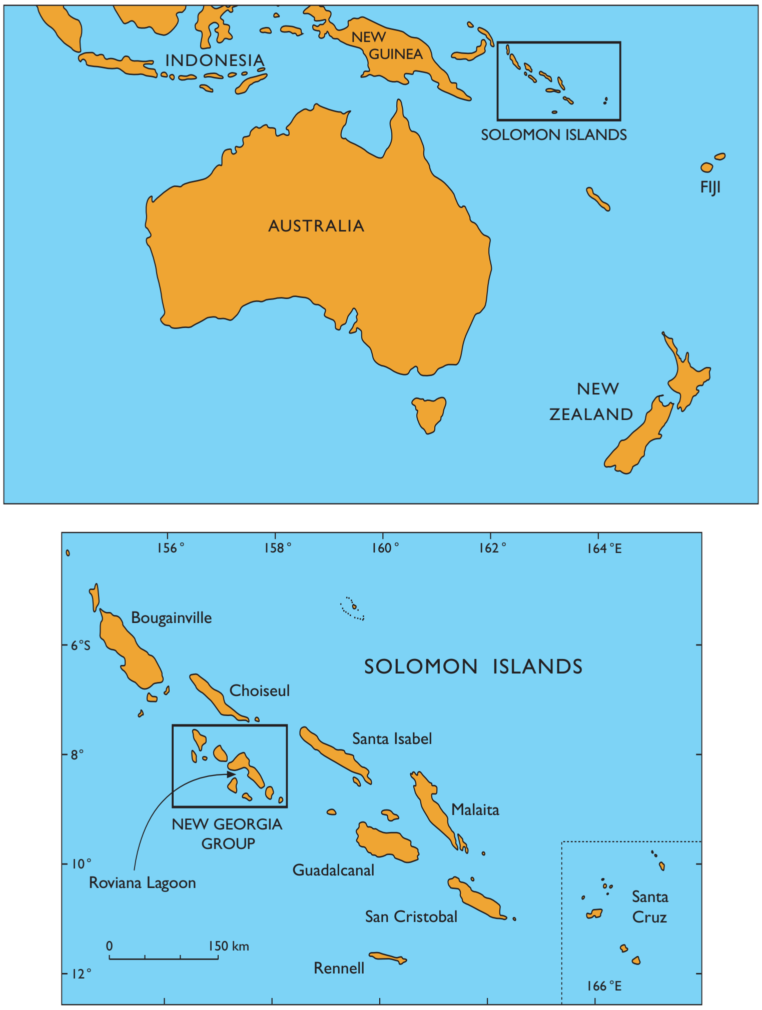

Figure 1. Solomon Islands and the New Georgia Group.

(Hviding 1996; Aswani 1997; Hamilton 1999; Johannes and Hviding 2001). This IEK has been shown to be highly accurate in many instances (Johannes 1989; Hamilton 1999; Hamilton and Walter 1999; Hamilton 2003b; 2004).

Lethrinus erythropterus make up an important component of subsistence catches in Roviana Lagoon, and are taken primarily by handlines. In Roviana folk taxonomy *L. erythropterus* is known as both *karapatu* and *osanga mila bongi*. The latter name is commonly used in the Munda region of Roviana Lagoon. Throughout the rest of this paper I use the Roviana name *osanga mila bongi* when referring to *L. erythropterus*. The nocturnal aggregating and spawning behaviour of *osanga mila bongi* was first brought to my attention in 1997, during a general discussion on reef fish aggregations with Michael Giningele, a renowned artisanal spear fisherman from Munda. Specific IEK on *osanga mila bongi* spawning behaviour at spawning aggregation Site A was obtained in 1999 when I conducted a detailed unstructured taped interview with Giningele in Solomon Pidjin. Observations that I made in 2000 on large aggregations of *osanga mila bongi* at aggregation Site B are also detailed in the results. Finally, I describe some[2] of the observations that I was able to make at Site A during an aggregating period in March 2004.

Results

Indigenous ecological knowledge of osanga mila *bongi spawning aggregations*

Some translated transcripts from the interview conducted with Giningele in 1999 are presented below. These transcripts demonstrate the extensive body of observations that Giningele has been able to make at this spawning site over more than a decade. Prior to 1995 only Giningele and one of his fishing partners knew of and exploited this aggregation, and it has only been in the last five or so years, through word of mouth, that the location and lunar periodicity with which aggregations of *osanga mila bongi* form at Site A have become more widely known in the Munda fishing community. It appears that the vast majority of fishers in Roviana Lagoon are unaware of other aggregation sites (including Site B) for this species in the lagoon. Between 1999 and 2004, I interviewed over 30 Roviana fishing experts about *osanga mila bongi*, but no IEK on this species' aggregating behaviour or aggregation sites (other than Site A) was uncovered.

Spawning aggregation history

> *I first came across this nocturnal aggregation by chance about ten years ago while spearfishing at night, and although it interested me, back then I never bothered to spear* osanga mila bongi*, as I didn't know that the fisheries centre would purchase this fish. About six years ago the fisheries centre at Munda told me they would purchase* osanga mila bongi*, so I asked them how many kilos they wanted. They told me they would buy whatever I caught, and were astounded when one night several weeks latter I turned up with over 400 kg of* osanga mila bongi [representing approximately 2000 fish]. *After that, they told me they only wanted to purchase small amounts of this fish, so normally I do not bother to target this aggregation unless someone specifically requests it.*

Other species that aggregate at this site during this period

> Pazara kalula (E. ongus) *also aggregate at this site during the same lunar and seasonal periods as* osanga mila bongi. *Although the* pazaa kalula *are not as numerous as the* osanga mila bongi*, there are still many hundreds of* E. ongus *here at this time.*

Aggregation site

> *Large numbers of ripe* osanga mila bongi *aggregate at Site A*[3] *on the inner edge of a large outer barrier reef around the new moon. Aggregations form over shallow reef areas that are adjacent to a small passage. Several days prior to spawning, aggregations of* osanga mila bongi *form at Site A between depths of 1 and 6 metres over a reef area of approximately 5000–10,000 m*^{2}*. The reef in this area consists of live corals* [predominantly stag horn coral (Acropora sp.] *sand and coral rubble. Aggregating fish reside in among staghorn corals and out in the open on the sand. On the night that spawning takes place fish aggregate into a small core area of the aggregation site (<1000 m*^{2}*) that is no more 3 m deep.*

Spawning behaviour

> *If you arrive at the* osanga mila bongi *site during a big nocturnal spawning event, you will see thousand and thousands of* osanga mila bongi *aggregated in several metres of water on one*

2. Some of the biological information that was documented in March 2004 (i.e. the length-sex ratios of *osanga mila bongi*) is not reported here. This data can be found in Hamilton and Kama (2004).
3. In an effort to protect sites from heavier exploitation, the precise location of aggregation sites is not given here.

> *small area of the reef. Spawning occurs around midnight. Spawning fish lie horizontally on the substrate, quivering in a trance like state. There are so many* osanga mila bongi *in one small area that the fish actually stack up horizontally on top of each other. I have seen spawning in* osanga mila bongi *many times, where small groups of approximately 5–10 individuals dart up from the aggregation to the surface and simultaneously release clouds of gametes. After this the fish dart down and rejoin the aggregation. At this time it is like swimming through a pool of milk. Often many separate spawning events occur above the aggregation site at the same time. If the light of a flashlight is shone directly on the aggregations, spawning groups abort their spawning ascents and quickly return to the bottom where they return to a trance like state. Once the light is directed away from the aggregations spawning recommences almost immediately.*

Lunar and annual periodicity of aggregation formations

> *The* osanga mila bongi *aggregations only ever form around the new moon period, but the specific days on which nocturnal spawning aggregations form are quite variable, and I have sighted spawning aggregations both before and after the new moon. I have noticed that* osanga mila bongi *aggregations always occur in the same months that spawning aggregations of* pazara haquma (P. areolatus) *form in this region* [See Hamilton and Kama 2004]. *In some months* pazara haquma *aggregations occur after* osanga *aggregations, and in other months the reverse pattern is true.*

Harvesting strategy

Giningele's harvesting strategy provides insights into his acute observational powers and his detailed understanding of this fish's behaviour at spawning aggregations. He had this to say regarding how he identified the ideal night to target spawning aggregations of *osanga mila bongi:*

> *If I want to harvest* osanga mila bongi *I will travel to the aggregation site several days before the new moon in the months when I suspect aggregations are likely to form. I go in the afternoon, and as soon as I am in the water it is easy to tell if an aggregation is going to form, as large numbers of* osanga mila bongi *begin to aggregate around the wider area of the specific aggregation site several days prior to spawning. If I see* osanga mila bongi *aggregating, I will spear four or five of them and press their bellies to see if any eggs or milt come out. If I press their bellies but nothing comes out, then I know the nocturnal spawning aggregation is a day or two away. I will return the next day and repeat this process. When speared fish produce milt and eggs as soon as their bellies are pressed, then I know a nocturnal spawning aggregation will occur that night. If I come back that night the fish are so aggregated and so docile that you can spear three or four fish with a hand spear in a single thrust — there is no need to use the rubber to power the spear, as the* osanga mila bongi *simply lie down on top of each other.*

Observations on nocturnal aggregations of osanga mila bongi *that were made at Site B*

An extremely large nocturnal aggregation of *osanga mila bongi* was encountered at Site B by Giningele and the author on 26 October 2000 between 21:00 and 24:00 hours, two days before the new moon. Site B is one of five deep water passages in Roviana Lagoon that link the inner lagoon to the open sea. The aggregation of *osanga mila bongi* that was sighted on 26 October 2000 had formed on the western seaward portion of the passage. We discovered this nocturnal aggregation completely by chance while spearfishing. The passage wall where this aggregation was sighted descends initially at approximately 90 degrees, sloping into the sandy bottom of the passages at around 40–60 m. The passage slopes support relatively little living coral. A survey of the aggregation site revealed that *osanga mila bongi* were aggregated over an estimated 1 km linear stretch of the passage slope.

Fish were aggregated in cracks and crevices in the coral wall and from a depth of one metre to at least 20 m (this being our maximum free diving range), giving a very conservative aggregation area of >20,000 m^2. In many instances over 20 *osanga mila bongi* could be seen crammed into small holes in the reef wall. Some fish were completely exposed, while others had found some shelter in the reef structure and only parts of their bodies could be seen. *Osanga mila bongi* appeared to have aggregated in every suitable piece of cover that the passage wall had to offer. Because of variable passage wall topography, fish were clumped in their distribution, but maximum densities (number of fish per square metre) were estimated to be in excess of 30 fish m^{-2} in areas that provided suitable shelter. The authors estimated that the total number of *osanga mila bongi* in the aggregation exceeded 10,000 individuals.

Although easily approached, the aggregated fish were not asleep or in a trance like state, and spawning behaviour was not observed. *Osanga mila bongi* moved around within their limited shelters when flashlights were directed at them, and very exposed fish would occasionally move away from the disturbances that the free divers created and attempt to locate more suitable shelter. We speared 43 *osanga mila bongi* from this aggregation. All individuals had well developed (ripe) male and female gonads; however none of the individuals collected were running ripe.

Two nights later on 28 October 2000 (new moon) I returned to this passage to check on the status of this aggregation. Despite an extensive survey of the western side of the passage, no *osanga mila bongi* were sighted, but interestingly, a smaller aggregation of *osanga mila bongi* was sighted on the eastern side of the passage, slightly further down the passage than the aggregation that was sighted on the western side two nights previously. I had dived on the eastern side of this passage two nights previously, but had not seen any aggregating *osanga mila bongi* at that time. Fish had again aggregated over the passage wall between at least 1–20 m, with the aggregation area estimated to be approximately 10,000 m^2, with maximum densities of >10 fish m^{-2}. I speared eight individuals from this aggregation, and all had ripe well developed gonads but none were running ripe. Although I dived extensively at night in this passage environment over an uninterrupted 12-month period between August 2000 and July 2001, this was the only occasion that I sighted aggregations of *osanga mila bongi* here.

Field observations made at aggregation Site A in March 2004

On 21 March 2004 (new moon) I accompanied Giningele and several other local spear fishers to Site A, hoping to observe the spawning aggregations and spawning behaviour of *osanga mila bongi*. I entered the water at 23:00 hours and immediately located approximately 300–500 *osanga mila bongi* in a small area, residing among shallow corals in water depths of one to five metres. I investigated the core area where *osanga mila bongi* are known to spawn, but fish were not aggregated there in densities any higher than in surrounding areas and no spawning behaviour was observed. Giningele and other local fishers who exploit this site stated that this was a very small aggregation. *E. ongus* were also aggregated in among the same corals as *osanga mila bongi*, but in lower numbers. Approximately 50–80 *E. ongus* were sighted at this site. A sample of aggregating fish was randomly speared by fishers over a 20-minute period so that the gonads and reproductive state of these fish could be investigated. In total, 26 *osanga* mila bongi and 8 *E. ongus* were speared (Fig. 2).

All *osanga mila bongi* speared were sexed macroscopically. All females sampled had visibly swollen bellies, and a mass of watery clear hydrated oocytes could be expelled by simply applying light pressure to the abdomen of female fish (Fig. 3). Males were also running ripe, with some males expelling milt as soon as they were placed into the boat.

Figure 2. ***Osanga mila bongi* and *E. ongus* that were speared at Site A on the new moon in March 2004. Several *E. ongus* can be seen in the bottom right-hand corner of the picture.**

Figure 3. **Two gravid female *osanga mila bongi* that were speared at 23:00 hours at Site A on 21 March 2004. The eggs of the female on the right were cut from the gut cavity immediately before taking this photo, and it can be seen how the watery hydrated oocytes of this female have spilled over the piece of timber that these fish were photographed on.**

Discussion

Published accounts detailing coral reef fish spawning aggregations and spawning behaviour have been based predominantly on the observations of marine biologists, almost all of which have made underwater observations exclusively during daylight hours (e.g. Samoilys 1997; Rhodes and Sadovy 2002). The fact that very few marine biologists studying spawning aggregations have conducted underwater field observations at night (see Johannes (1989) as an exception) is likely to explain why there are so few accounts of nocturnal spawning behaviour in coral reef fish. In this paper I have drawn on the observations that Giningele has made while night diving at Site A over more than a decade to provide one of the first detailed written accounts of spawning behaviour in the family Lethrinidae. Specifically:

1. *Osanga mila bongi* aggregate in very large numbers at fixed spawning sites around the new moon, with spawning in this species occurring at night. The hydrated females that were captured from this aggregation site on 21 March 2004 provide independent confirmation that this species spawns at this site. [Undisputed spawning observations and females with hydrated eggs are two direct signs that are used to verify that a group of fish is spawning (Colin et al. 2003)].

2. All females that were captured around 23:00 hours on 21 March readily exuded hydrated eggs, providing some independent support for Giningele's observations that this species spawns around midnight, as females typically only exude hydrated eggs an hour or two before spawning (Colin et al. 2003). Note, however, that Giningele reports that eggs (presumably hydrated) can be exuded from female *osanga mila bongi* in the afternoon prior to a nocturnal spawning event.

3. Spawning fish form into a very tight cluster over a relatively small area in very shallow water, often being so densely aggregated that fish lie horizontally on top of each other. Fish in these aggregations are very easy to approach and appear to be in a trance like state, where they are not easily disturbed. Such behaviour has been noted in other species that form spawning aggregations, and is referred to as "spawning stupor" by Johannes (1978).

4. This species shows set lunar periodicity in its reproductive behaviour, with spawning aggregations occurring only around the new moon in Roviana Lagoon. This fish also appears to have an annual spawning season, although existing local knowledge of this season is not detailed. These factors indicate that although this species only reaches a moderate size, it is likely to be a transient spawner as opposed to a resident[4] spawner (Domeier and Colin 1997).

5. Group spawning occurs in this species, where small groups of 5–10 individuals break from the aggregation and make rapid ascents towards the surface (spawning rush), releasing gametes at the peak of their ascent. The direct light of underwater flashlights temporarily disturbs a spawning rush. The fact that the light of a flashlight easily disturbs spawning rushes in *osanga mila bongi* may relate to a defence mechanism in this species, since the most vulnerable moment in a spawning sequence is during the spawning rush (Sancho et al. 2000). Indeed, the use of external video lights is known to disturb spawning behaviour in some species of serranids and for this reason is not recommended when filming aggregations (Colin et al. 2003).

6. The large nocturnal aggregations of *osanga mila bongi* observed at Site B differed from the aggregations at Site A in that the fish were aggregated on a coral passage wall in both deep and shallow water, and aggregating fish covered a much larger area. Furthermore, no spawning behaviour was observed at Site B and the gonads of female fish sampled from this aggregation were not hydrated. I conclude that the aggregations observed at Site B represented aggregations of *osanga mila bongi* that would spawn in a day or so. I could not determine where in the passage actual spawning takes place, but based on Giningele's observations at Site A, it seems likely that the aggregating fish at Site B would have congregated into a small core area within the observed aggregation area for the purpose of spawning.

7. Many reef fish species aggregate at the same location as *osanga mila bongi* during similar lunar and seasonal periods, presumably to spawn. *E. ongus* is known to aggregate in overlapping territories with *osanga mila bongi* at Site A, and *Plectropomus areolatus*, *Epinephelus fuscoguttatus* and *E. polyphekadion* also aggre-

4. Resident spawner aggregations draw individuals from a relatively small and localised area and may form very frequently throughout the year. Aggregations are often small and typically only persist for a short time (several hours to a day). The spawning sites can usually be reached through a migration of a few hours or less and are often located within the home range of the participating individuals (Domeier and Colin 1997).

gated in very close proximity to Site A up until the early 1990s, when these aggregations were fished out by night divers (Hamilton and Kama 2004).

8. Giningele's observations on the aggregating behaviour of *osanga mila bongi* agree closely with observations made by Manus fishers, who report that this species aggregates to spawn at multi species aggregation sites around the new moon in the months of March, April and May (Hamilton et al. 2004). Giningele's observations also agree with those made by Palauan fishers, who state that lethrinids form large spawning aggregations during new moon periods on the inner and outer edges of barrier reefs barrier reefs, with spawning occurring at night (Johannes 1981).

As well as being of biological interest, this study also demonstrates how expert fishers often know a great deal about fish behaviour, a point that has been made many times in the past (e.g. Nordhoff 1930; Johannes 1981; Johannes et al. 2000). Numerous researchers have also highlighted the fact that IEK is often stratified by gender, age, geographical location and clan structure, with specific knowledge pertaining to specific families of fish often restricted to fishers who specialise in targeting those species (Hviding 1996; Johannes et al. 2000; Hamilton 2003a). This study has shown that highly detailed and precise IEK on fish behaviour may be restricted to single individuals who are expert fishers and outstanding natural historians.

It is noteworthy that the information presented here on *osanga mila bongi* spawning aggregations is but one component of Giningele's indigenous ecological knowledge. The remarkable knowledge that Giningele possesses on coral reef fish behaviour and ecology relates in part to his chosen fishing strategy and the overwhelming amount of time that he spends in the water. It is estimated that Giningele has spent over 10,000 hours spearfishing at night on the reefs in Roviana Lagoon over the past 20 years, and an equivalent amount of time spear fishing on these reefs during the day; the night dive time alone is more than most marine biologists acquire in their entire lives. Moreover, the fact that Giningele has focused the majority of his fishing efforts in a small region adds a spatial-temporal element to his observations that transcends that of most biological studies.

The points raised here point to an important methodological issue: how IEK researchers can assess the accuracy of local knowledge. An increasing number of social and natural scientists who are interested in incorporating IEK into resource management or environmental assessment programs have stated that the highest reliability should be assigned to IEK that has been verified by several local experts (Neis et al. 1999; Usher 2000; Davis and Wagner 2003; Mallory et al. 2003). While I agree that aspects of IEK that are consistent and frequently raised by numerous local knowledge experts should be assigned a high degree of credence, I disagree with the assertions that un-corroborated IEK should be discounted or left out of summary reports (Davis and Wagner 2003). While clearly there is a danger in over generalizing from limited information or untested assumptions (Wenzel 1999), it is equally true that not all "experts" are created equal; some fishers are simply superb natural historians, whose knowledge surpasses that of everyone else in the region. Furthermore, most fishing communities know who these people are, and treat their information accordingly. Because these individuals will often know far more than anyone else about local ecologies, much of their local knowledge cannot be corroborated by interviewing other fishers in the region. In cases where a single individual's local knowledge could potentially be very relevant for research or management, efforts should be made to validate this local knowledge using alternative means. It is vital that credible ethnographic research methods are used. This includes taking care to understand the roles, status, expertise and relationships of the persons one is interviewing, rather than assuming that all indigenous people have access to the same body of ideas and knowledge.

A note on the current status of *osanga mila bongi* aggregations at Site A

Recent interviews have revealed that the spawning aggregations of *L. erythropterus* at Site A have been heavily overfished by night spear fishers in the past five years (Hamilton and Kama 2004). Since the late 1990s the location and lunar periodicity of this aggregation forms has become increasingly widely known, and artisanal night spear fishing pressure at this site has intensified. By 2003 both the total number of *osanga mila bongi* aggregating at Site A and the maximum catches of this species had declined by at least one order of magnitude (Michael Giningele, pers. comm. 2004). Numbers of the less abundant and less sought after *E. ongus* are also reported to have declined steadily.

The shallow staghorn corals (*Acropora* sp.) at this site have also been extensively damaged by night time spear fishers, who will break the coral branches surrounding a speared fish in order to remove it from the coral. It seems very likely that this aggregation is under threat of being fished to the point of extinction in the near future if current levels of night time spear fishing pressure are sustained. Indeed, night spear fishers appear to have fished out spawning aggregations of *P. areolatus*, *E. fuscoguttatus* and *E. polyphekadion*, which once formed in this area, by the early 1990s (Hamilton and Kama 2004). The council of chiefs that claim ownership over Site A are currently in the process of instituting a community based marine protected area at this site. Aswani and Hamilton (2004) provide a description of recent community based management efforts in Roviana Lagoon.

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Folk taxonomy of reef fish and the value of participatory monitoring in Wakatobi National Park, southeast Sulawesi, Indonesia

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Introduction

This study presents an etymological examination of folk taxa of nearshore fish caught around Kaledupa Island, in Wakatobi National Park (WNP), Indonesia. Translations of Bajo and Palo fish taxa presented here provide a basis for fisheries studies in WNP, and have already assisted participatory monitoring (PM) by trained fishers. The suitability of folk taxa for monitoring and analysis, and the ability of PM to stimulate appropriate fisheries management are discussed in the context of Indonesia.

The value of folk taxa knowledge and participatory monitoring

As a prerequisite to fisheries surveys, ethnographic data need to be collected — a process that can unearth a wealth of local knowledge on the biology and ecology of species, and technical fishing details (Johannes 1978, 1981; Ruddle 1994; McClanahan et al. 1997; Poizat and Baran 1997; Foale 1998; Neis et al. 1999; Johannes et al. 2000; Obura 2001; Sabetian 2002). Before studies of local knowledge can proceed, a working knowledge of folk taxa must be obtained (Foale 1998). This is particularly challenging in Indonesia where there are an estimated 583 languages spoken, often with highly divergent dialects. Though Bahasa Indonesian is the national language, in most rural locations a local language is used in everyday life and specifically to discuss fishing practices or fish taxa.

As well as aiding in the collection of local knowledge, identification of folk taxa can facilitate PM of fisheries by resource users. The primary benefit of PM is its ability to address complexity vs cost issues inherent to most fisheries surveys (Wilson et al. 1994) and specifically tropical nearshore fisheries (Poizat and Baran 1997; Johannes 1998). Participatory monitoring can take the form of log books or creel surveys, which offer a low cost alternative to fisheries-independent methods such as underwater visual censes. Log books require a high level of literacy, which is not present among Indonesian artisanal fishers. However, creel surveys utilising key members of the community who can interact with all fishers, can generate data on effort, technique, total catch and length frequency of folk taxa.

Participatory monitoring, in association with other management actions, can engender a strong commitment to conservation and co-management. It also places coral reef management within the cultural framework of fisher communities, addressing community requirements by creating a demand for resource use education, local investment and community-level decision making. Furthermore, PM can generate awareness and encourage independent proactive evaluation of trends by user groups (Davos 1998; Obura 2001).

Wakatobi National Park

The Wakatobi National Park (WNP) marine protected area (13,900 km^2) was formed in 1996, and includes the atolls and islands of the Tukang Besi Archipelago (Fig. 1). The support for the formation of WNP was based on the park's position in the centre of the Wallacea Region — a biodiversity "hot spot"[2,3,4], and the relatively low level of subsistence and commercial fishing on the 50,000 ha

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2. http://www.gefweb.org/COUNCIL/council9/workprog/indonesi.pdf (Indonesia: Coral Reef Rehabilitation and Management Project – COREMAP)
3. http://international.nos.noaa.gov/heritage/pdfs/seasia.pdf (Chou L.M. World heritage biodiversity: Filling critical gaps and promoting multi-site approaches to new nominations of tropical coastal, marine and small island ecosystems. Potential tropical coastal, marine and small island world heritage sites in Southeast Asia)
4. http://www.biodiversityhotspots.org/xp/Hotspots/wallacea/?showpage=Biodiversity

of coral reef within the park. Since its well-intended start, WNP languished as a paper park, suffering from a lack of funding, continued destructive fishing practices, and complacent park rangers and management (Elliott et al. 2001; Clifton 2003). Furthermore, there has been limited success in addressing the dipolar needs of expanding local resource use and centralised WNP management objectives. In 2003 a new Head of WNP was appointed and WNP was selected for the Indonesian government's Coral Reef Rehabilitation and Management Program (COREMAP), which aims to develop co-management of reef fisheries in Indonesia. Since 2001, Operation Wallacea has examined various aspects of fisheries around Kaledupa, as part of volunteer programmes, and as ongoing monitoring studies. This work is being put forward as part of a fisheries co-management programme evolving from the WNP, COREMAP and TNC/WWF.

Figure 1. **Wakatobi National Park, Tukang Besi archipelago, southeast Sulawesi, Indonesia.**

Social background

Within WNP there are two socially-segregated ethnic groups: the Orang Bajo (Bajo People), who speak Bahasa Sama, and the Orang Palo (Island People), who speak Bahasa Pulo. Originally, the Bajo were sea nomads living on boats throughout the Malay Archipelago, whose livelihoods and culture were based on subsistence fishing (Djohani 1996; Sather 1997). The Palo are decedents of nearby ethnic Butonese and were predominantly land dwellers, practicing both fishing and farming. In addition the Palo have a strong maritime history as sea traders and pirates, possessing many large wooden sail boats called sopes (Schoorl 1986), which traditionally formed the bulk of the Sultan of Buton's fleet. However, these seemingly unassociated ethnic groups appear to have cohabited the area, as flood stories in both folk histories tell of a split in one people, the Bajo travelling far out to the sea and the Palo climbing the highest peaks.

Increasing enforcement of national borders from the early 1900s and strong political pressure during the 1950s forced nearby Bajo to settle in permanent communities on coral platforms on the reef flats, and the Palo to sell most of their boats and adopt a new centralised government. These changes have caused the loss of important Bajo and Palo maritime history, which had been a way of life for centuries. Now the Bajo are embracing commercialisation and material aspirations, which has caused a shift from subsistence to small-scale commercial fishing and has led to many men seeking work outside fisheries, particularly in Malaysia. The Palo continue to farm as they always have but have now become less active fishers, dominating the developing infrastructure and government.

Of the 87,953 inhabitants of WNP in 2000, 6.1% were ethnic Bajo and 93.9% were ethnic Palo (BPS Statistics of Kec. Wangi-Wangi, Kaledupa, Tomia and Binongko 2000). However, the equal importance of both Palo and Sama languages for fisheries monitoring is indicated by comparable numbers of Bajo (58.6%) and Palo (41.4%) nearshore fishers around Kaledupa in 2003 (May, in prep.). This skewed demography is due to the total reliance of the Wakatobi Bajo on marine resources for subsistence and commerce, and the dominance of farming and administration by the Palo.

Methods

Bajo and Palo fish folk taxa were collected during creel and onboard surveys of all fishing techniques used on the reef flat, crest and wall in the waters around Kaledupa Island between 2001 and 2004. Fish names were re-corrected for misidentification and pronunciation initially, and where confusion arose, fishers were interviewed for clarification. All interviews were conducted in fishers' respective languages with experienced interpreters. During all interviews, folk taxa were checked using the illustrations in Allen (2000) and Lieske and Myers (1996), and photographs in Allen et al. (2003). If there was no general consensus for a species-specific folk taxon, only well known folk taxa for the generic groups were recorded. Most common English names were taken from Allen (2000), as it was found to be very comprehensive for WNP, good for identification of most species, and easy to use for referencing. Etymological translations were obtained from local Bajo and Palo translators who worked closely on fisheries surveys between 2001 and 2004.

Results

During creel and onboard surveys, 313 species of bony fish (*dayah*$_b$: *kenta*$_p$)[5] were recorded, for which 229 individual Bajo and 199 individual Palo folk taxa were identified (Appendix I). There were around 40 commonly caught species that most fishers could readily identify, beyond which identification became ambiguous. Consequently, the folk taxa displayed in Appendix I represent the collective knowledge of fishers, not the general ability of fishers to identify folk taxa, which improved with age and fishing experience. It was also evident that few Bajo and Palo fishers knew folk names in the other's respective language, which is reflected in the lack of similarity between folk taxa. Similar names only extend to: *pogo*$_{bp}$, the generic name for triggerfish; *ruma-ruma*$_{bp}$, the generic name for scad; and *bebete*$_b$/*bete-bete*$_p$, *Leiognathus smithursti*. Within folk taxa there are no variations in names assigned to fish around Kaledupa, with the exception of *Cheilenus chlorurus* in Palo, which is *tai pere*$_p$ on the east coast and *tai repe*$_p$ on the west coast.

Both Bajo and Palo folk taxa use either a species-identifying primary lexeme, which may have a secondary lexeme of descriptive qualifiers, or a primary lexeme relating to a generic group. A generic group lexeme is often followed by secondary lexemes of descriptive qualifiers, which may make the whole folk taxon species-specific. Generic group lexemes were defined as those identified by fishers to have an appreciated generic value, though not necessarily with a known translation. There are 53 and 54 generic group lexemes that represent 43%

5. Words with the subscript $_b$ and $_p$ indicate Bajo and Palo languages, respectively.

and 40% of the caught species in Bajo and Palo, respectively. A further 8% and 3%, respectively, of caught species appeared to have generic values that were not identified by fishers. The use of species-identifying primary lexemes generally corresponds to species with clearly identifying features and does not appear to be related to locally desirable species. However, identification of infrequently caught non-target species (i.e. damsel fish), was not possible below generic groups, mostly because fishers' appeared to have little interest in such species.

Even with a substantial number of species-identifying primary lexemes (41% of Bajo and 47% of Palo taxa) and many generic groups with species-indicating secondary lexemes, both Bajo and Palo taxa fail to distinguish 48% and 55% respectively, of caught species to a species level. Though this percentage seems high, the generic groupings found normally correspond to family, sub-family and genus, sometimes with descriptive qualifiers which identify species to sub-genus generic groups.

The similarity between Linnean and folk taxonomic systems can be seen by the synchrony of generic groupings within Linnean family and genus groupings, with the exception of only 2 Palo and 1 Bajo groupings: jarah gigi$_b$ and bicara$_p$ (*Synodus variegatus* and *Saurida gracilis*); and randa moruta$_p$ (*Gnathodentex aurolineatus* and *Scolopsis auratus*). However, a Linnean system does not apply to Scaridae, where both Bajo and Palo identify Scaridae into colour types, apparently unaware of sexual dimorphism. Interviews revealed that these groupings, as well as other folk taxa which fail to identify species to a species level, are at the level to which identification was important for both Bajo and Palo fishers, and are viewed by fishers as essentially "folk species". These folk species can consist of a generic group lexeme, with or without a descriptive qualifier. For example: snappers with similar appearance, *Lutjanus quinquelineatus, L. kasmira, L. lutjanus* and *L. rufolineatus*, are sasageh$_b$ "folk species" to Bajo fishers; or black parrotfish, *Scarus niger, S. viridifucatus,* and *Chlorurus bleekeri* are *lehe biru$_p$* "folk species" to Palo fishers. The only exception of identifications below species level are due to colour morphs of *Plectropomus laevis* and a Palo name for small grouper (*tulareke$_p$*).

Table 1 presents etymologies of Bajo and Palo taxa together with etymologies of West Nggela (Solomon Islands) folk taxa, as the percentage of species described by that category. Over half the species caught have untranslatable primary lexemes in Bajo and Palo, with many primary lexemes for generic groups having lost their meaning to almost all fishers. For example, the meanings of *pogo$_{bp}$* (triggerfish) and *mogoh$_b$* (parrotfish) are hardly known, and the associated story indicating the meaning of *mbula$_p$* (soliderfish) is no longer fully understood. A few generic groups have retained their meanings, probably because of their direct association to the fish group. For example *kuu$_p$*, which translates as "smelly" and *sala$_p$*, which translates as "don't accidentally eat". Generally, the loss of the meaning of primary lexemes does not appear to be related to the importance of species to fishers. For example, Bajo and Palo folk taxa with untranslatable primary lexemes can be both important commercial or food species (*Herklotsich quadrimaculatus*, *Gerres oyena* and *Lethrinus olivaceus*) and species with little commercial or food value (*Ostracion cubicus* and *Scolopsis monogramma*).

Table 1. **Percentage of 313 bony fish species caught around Kaledupa described by Bajo and Palo taxa categories, compared with West Nggela, Solomon Islands folk taxa for 350 cartilaginous and bony fish (Foale 1998). Percentages do not total to 100% as some categories overlap.**

	Bajo	Palo	West Nggela
Untranslatable 1° lexeme	63%	56%	31%
Appearance only	33%	36%	39%
Habitat only	17%	8%	9%
Behaviour only	6%	6%	3%
Appearance & other	5%	1%	4%
Habitat & other	4%	1%	4%
Behaviour & other	3%	1%	4%
Taste or smell	3%	2%	1%
Fishing	1%	2%	5%
Other	1%	6%	4%
Untranslatable 2° lexeme	3%	2%	n/a
No name	1%	4%	n/a

Descriptive qualifiers, for both species identifying primary lexemes and secondary lexemes of generic groups, can be categorised into "appearance", "habitat", "behaviour", "taste and smell", "fishing", "other", and combinations thereof (Table 1). The category "other" tends to contain complicated explanations that identify the fish, but are not related to direct observations, for example: *mbula$_p$* (first), *tumolla$_p$* (bang), *meah$_b$* (pay) and *ruma-ruma$_p$* (small house). The use of "appearance" dominates descriptive qualifiers in both Bajo and Palo taxa to a similar degree as in West Nggela folk taxa.

Variations in the use of the remaining translatable etymological categories between Bajo and Palo taxa appear small, though when compared to those for West Nggela folk taxa, the relative importance of descriptive qualifiers can be gauged. Etymology of Bajo taxa are very strongly influenced by "habitat", strongly by "behaviour" and weakly by "fishing" and "other". Palo taxa are strongly influenced by "behaviour" and "other", and weakly by combined categories. While West Nggela taxa are strongly influenced by "other", "fishing" and combined categories.

Discussion

Linguistics

As well as aiding fisheries surveys within WNP, Bajo translations may be useful to fisheries scientists and anthropologists across Indonesia, as the Bahasa Sama spoken in WNP is spoken across most of Indonesia (Noorduyn 1991). The wider value of Wakatobi Bajo translations is supported by a strong similarity in Wakatobi Bajo fish names to a small list of Bajo fish translations from Indonesian Lesser Sunda Islands, at least 300 km to the south (Fig. 1a) (Verheijen 1986). Conversely, Palo translations are likely to have a limited value outside the national park, as Bahasa Pulo is a strongly divergent dialect of Bahasa Cia-Cia, one of five core languages on Buton Island. Furthermore, Palo fishers believed there are small island-specific differences in the pronunciation and names of some fish relating to island-specific dialects within the Wakatobi. Considerable differences between geographically close islands are not unusual, as Jennings and Polunin (1995) found between the Fiji islands. However, the differences within the Wakatobi are not thought to be extreme.

Etymological examination of Bajo and Palo folk taxa revealed a lack of meaning of the majority of words, with around twice the number of untranslatable primary lexemes in Bajo and Palo compared with that of West Nggela, Solomon Islands (Foale, 1998). Such a difference in the number of untranslatable primary lexemes suggests a loss of traditional understanding in Bajo and Palo, which may have arisen from cultural erosion due to recent shifts in both the Bajo and Palo lifestyles discussed previously. These changes in socioeconomic factors appear to confirm the feared loss of fishers' knowledge identified by Sabetian (2002), as there has undoubtedly been a loss of marine tradition over the last two generations.

Translatable lexemes show a dominant use of "appearance" as a descriptive qualifier in Bajo and Palo folk taxa, which together with size, habitat and spawning times used to discriminate folk species, tends to identify similar Linnean species. This is not unusual with folk taxa round the world (Poizat and Baran 1997; Foale 1998; Obura 2001), as both Linnean and folk taxa are primarily based on appearance. Of the remaining descriptive qualifiers, Bajo taxa uses "fishing" and "other" — which is usually related to folk law, with a surprisingly low frequency for a culture that depends on fishing. Conversely, Palo fishers tend to use less obvious visual identifiers, such as "behaviour" and "other", as well as less combined categories and more species-specific primary lexemes. The more frequent use of "habitat" by Bajo could indicate the Bajo's closer relationship to marine environment, though as recent folk history describes the Palo as highly skilled fishers. However, the Palo's more frequent use of "other" and more species-specific primary lexemes could be accounted for by a build up of folk laws among a non-transient island dwelling people, and the Bajo frequent use of "habitat" could reflect the practicality of "habitat" to converse within a previously transient and dispersed people.

Folk taxa and analytical resolution

One concern about using folk taxa for monitoring is the potential loss of analytical resolution caused by grouping species with a similar physical attributes within one folk taxon. However, Bajo and Palo folk taxa identify approximately half of the species individually, the remainder of which are identified at least to family level, and most to genus or sub-genus levels. These "folk species" normally consist of 2–10 species of similar body shapes, growth rates and feeding guilds/trophic levels, and are congruent with the Linnean system. Due to this, folk taxa are highly suited to complex fisheries analyses using multi-species and ecosystem models based on feeding guilds or trophic levels. Though Bajo or Palo folk taxonomy per se is unlikely to cause the loss of statistical resolution to fisheries analysis, the degree of rigor in community data collection and misidentification can reduce its value. However, trials of PM around Kaledupa suggest that rigorous data collection can easily be achieved using either Bajo or Palo folk taxa by effective training.

Importance of participatory monitoring in Indonesia and experience in WNP

Indonesia has one of the longest coastlines in the world, with over 17,000 islands and 51,020 km^2 of coral reef (17% of the world's total) (Spalding et al. 2001). This vast area is coming under increasing threat from the expanding (1.49% year^{-1})

Indonesian population of over quarter of a billion in 2004[6], who derive 60% of their protein from fisheries, 90% of which are artisanal (Spalding et al. 2001). The massive funding required for the development of sustainable reef fisheries in Indonesia, via expert based surveys and analysis, is an unrealistic prospect. The economic reality dictates low-cost, community-run fisheries monitoring, assessment and management.

The cost-effectiveness of PM using folk taxa has already been demonstrated in Kenya (Oburu, 2001) and the Takabonerate National Park, South Sulawesi (Malik and Kusen, 1997), where large areas were surveyed with minimal investment. Around Kaledupa the cost PM survey was substantially smaller than for underwater visual censuses (UVCs), with a substantial portion of PM cost being taken up by payments required to sample Bajo fishers who at present do not see aiding monitoring as a civic duty.

Within Indonesia, PM using folk taxa was found to permit meaningful community involvement in Takabonerate National Park (Malik and Kusen 1997) and it was felt that PM would have aided more effective management in three co-managed marine management programs in Maluku, North Sulawesi and South Sulawesi (Malik and Kusen, 1997). PM around Kaledupa proved to be socially rewarding in many subtle ways, and stimulated the assimilation of further fishers' knowledge. As expected, PM generated more questions from fishers than could be explained briefly during creel or on-water surveys, and forced an expanded explanation to an increasingly curious fishing community. The surveys around Kaledupa caused a degree of self analysis by some fishers on the existence of over fishing and its causes, culminating in quantitative interview surveys of anecdotal evidence. Awareness and self-evaluation of trends can incite a gradual step away from expert-based, paternalistic co-management and "rational analyses", as advocated persuasively by Davos (1998). Self supported community management, however "underdeveloped", should be the goal of sustainable development in Indonesia, as realistic long-term monitoring and management must be independent of external aid — which can breed corruption and community fragmentation. With analysis geared towards locally appropriate management issues and developing in complexity over time, such adaptive ad hoc management is perhaps more appropriate to near shore tropical fisheries and reflects the essence of reduced data management suggested by Johannes (1998). Moreover, under recently formed political and legal framework in the wake of Indonesian government decentralisation (Crawford et al. 1998; Patlis et al. 2001), grass roots self-management is a real possibility.

Economics, achievable and locally appropriate analysis, and practical application of data, determines what type and how much data is required for individual situations. In the context of WNP, and perhaps Indonesia, PM using folk taxa is appropriate to the goals of nearshore fisheries monitoring and should aid skills transfer from scientists to the communities living in WNP, Indonesia's second largest marine national park.

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Appendix I

Bajo and Palo fish taxonomy

Dayah$_b$ and Kenta$_p$:

Notes on pronunciation: Both Bajo and Palo are non-written languages and are recorded phonetically. In Palo a repeated word implies small size.

Species index format:

Species (English name: phase of maturity or colour morph): Bajo name [primary lexeme translation/secondary lexeme translation/etc.] (notes on etymology); Palo name [primary lexeme translation/secondary lexeme translation/etc.] (notes on etymology). Local knowledge.
Note: TP = Terminal Phase; IP = Initial Phase; - = etymology locally unknown.

Acanthuridae – Surgeonfish

Family or genus groupings/primary lexemes:

Small surgeonfish species: dodoh$_b$ [-]. Large surgeonfish species: malelah$_b$ [-]. Generic surgeonfish: kuu$_p$ [smelly] (refers to the strong smell of fish on hands and mouth when eaten). *Naso* genus: kumai$_b$ [-] and tui-tui$_p$ [-].

Acanthurus leucocheilus (pale-lipped surgeonfish): malelah$_b$ [-/-]; kuu$_p$ [smelly].
A. lineatus (blue-lined surgeonfish): dodoh igah$_b$ [-/side]; kuu ragi-ragi$_p$ [smelly/-].
A. mata (yellowmask surgeonfish): malelah silah$_b$ [-/deep-open sea]; lutu-lutu$_b$ [-/-].
A. nigricans (white-cheeked surgeonfish): dodoh tambako$_b$ [-/tobacco] (tastes faintly like tobacco); kuu wuta$_p$ [smelly/ground].
A. nigricauda (blackstreak surgeonfish): dodoh$_b$ [-]; kuu wadu$_p$ [smelly/bajo] (palo people believe this fish is highly favoured by the bajo to eat).
A. olivaceous (orange-spot surgeonfish): dodoh$_b$ [-]; kuu tanda meha$_p$ [smelly/marking/red].
A. triostegus (convict surgeonfish): kikida$_b$ [-]; not known in Palo.
A. xanthopterus (yellowfin surgeonfish): malelah$_b$ [-]; kuu wadu$_p$ [smelly/Bajo].
Ctenochaetus binotatus (twospot bristletooth): dodoh$_b$ [-]; kuu$_p$ [smelly].
C. striatus (lined bristletooth): dodoh loong$_b$ [-/black]; not known in Palo.
Naso brachycentron (humpback unicornfish): kumai bukku$_b$ [-/hunched]; tui-tui bungku$_p$. [-/flick or poke].
N. brevirostris (longnosed unicornfish): kumai$_b$ [-]; tui-tui mohute$_p$ [flick or poke/white].
N. lituratus (stripe-face unicornfish): kutiteh$_b$ [-]; tui-tui kangka$_p$ [flick or poke/-].
N. hexacantus (sleek unicornfish), *N. lopezi* (elongate unicornfish) & *N. thynnoides* (single-spined unicornfish): kumai belowis$_b$ [-/generic rabbitfish]; tui-tui iba$_p$ [flick or poke/-].
N. tuberosus (humphead unicornfish) & *N. vlamingii* (Vlaming's unicornfish): kumai$_b$ [-]; dakke$_p$ [-].
N. unicornus (brown unicornfish): kumai tumbo$_b$ [-/collide or poke]; tui-tui sahi$_p$ [flick or poke/bent].
Zebrasoma scopes (blue-lined tang): dodoh$_b$ [-]; kuu mohato$_p$ [smelly/itchy].

Apogonidae – Cardinalfish

Family or genus groupings/primary lexemes:

Generic Cardinalfish: Gogombel$_b$ [-] and Karangka$_p$ [-].

Apogon trimaculatus (threespot cardinalfish): gogombel$_b$ [ugly]; karangka aka$_p$ [-/mangrove].
Cheilodipterus macrodon (eight-lined cardinalfish) gogombel$_b$ [ugly]; karangka watu$_p$ [-/coral].

Atherinidae – Hardyhead

Family or genus groupings/primary lexemes:

Generic hardyhead: babalombah$_b$ [-] and opuru$_p$ [-]. Palo believe they spawn in the seagrass around October.

Atherinomorus endrachtensis (endracht hardyhead): babalombah silah$_b$ [-/deep-open sea]; opuru$_p$ [-].
Hypoatherina temminckii (Samoan hardyhead): babalombah$_b$ [-]; opuru ole$_p$ [-/*Spratelloides robustus*].

Balistidae – Triggerfish

Family or genus groupings/primary lexemes:

Generic triggerfish: Pogo$_{bp}$ [small mouth] (caused by disease in humans). Large triggerfish species: ampala$_b$ [-] and komparu$_p$ [-].

Balistapus undulatus (red-lined triggerfish): pogo loong$_b$ [small mouth/black]; pogo meha$_p$ [small mouth/red].
Balistoides conspicillum (clown triggerfish): pogo panau$_b$ [small mouth/white blotches] (white blotches are caused by a disease locally called panau): pogo buri$_p$ [small mouth/write].
B. viridescens (blue-finned triggerfish): ampala biasa$_b$ [-/normal] or ampala batu$_b$ [-/coral]; komparu watu$_p$ [-/coral].
Melichthys niger (ebony triggerfish): pogo rambai$_b$ [small mouth/thread-like filament]; pogo olo biru$_p$ [small mouth/deep sea/black].
M. vidua (pinktail triggerfish): pogo kambose$_b$ [small mouth/corn] (shape like corn cob); pogo biru$_p$ [small mouth/black].
Odonus niger (red toothed triggerfish): pogo nyuloh$_b$ [small mouth/green]; pogo olo ijo$_p$ [small mouth/deep sea/green].
Pseudobalistes flavimarginatus (yellowmargin triggerfish): ampala mira$_b$ [-/red], ampala silah$_b$ [-/deep sea] or ampala kuba$_b$ [-/cave]; komparu$_p$ [-].
P. fuscus (yellow-spotted triggerfish): pogo$_b$ [small mouth]; komparu ndokke$_p$ [-/monkey].
Rhinecanthus aculeatus (white-barred triggerfish): pogo pote$_b$ [small mouth/white]; pogo mohute mata kinda$_p$ [small mouth/white/bright eyes].
R. rectangulus (wedge-tailed triggerfish): pogo mankuri$_b$ [small mouth/yellow]; pogo$_p$ [small mouth].
R. verrucosus (blackpatch triggerfish): pogo$_b$ [small mouth]; pogo tanda biru$_p$ [small mouth/marking/black].
Sufflamen chrysopterus (black triggerfish): pogo$_b$ [small mouth]; pogo biru$_p$ [small mouth/black].
S. fraenatus (brown triggerfish) pogo kombose$_{bp}$ [small mouth/corn] (shape like corn cob).

Belonidae – Longtom

Family or genus groupings/primary lexemes:

Generic longtom: timbaloah$_b$ [–] and sori$_p$ [spy].

Platybelone platyura (flat-tailed longtom): timbaloah silah$_b$ [-/deep-open sea]; sori urapi$_p$ [spy/hyporhamphus quoyi].
Strongylura leiura (slender longtom): timbaloah tampae$_b$ [-/tempae] (same colour as tempae); sori gonggo$_p$ [spy/bark] (make noise like a dogs bark when taken out of water).
Tylosurus crocodilius (Crocodilian longtom): timbaloah$_b$ [-]; sori gonggo$_p$ [spy/bark] (makes noise like a dog when taken out of water).
T. gavialoides (stout longtom): timbaloah silah$_b$ [-/deep-open sea]; sori olo$_p$ [spy /deep sea].

Bothidae – Flounder

Bothus pantherinus (panther flounder): kalempede$_b$ [thin]; kalepa$_p$ [vagina].
Pseudorhombus jenynsii (small-toothed flounder): kalempede$_b$ [thin]; kalepa$_p$ [vagina].

Caesionidae – Fusilier

Caesio caerulaurea (blue and gold fusilier): kakambule$_b$ [-]; andou$_p$ [-].
C. cuning (red-bellied fusilier): kakambule ecor cunning$_b$ [-/tail/yellow]; Iku makuri$_p$ [tail/yellow].
C. lunaris (lunar fusilier) & *Caesio terus* (yellow and blueback fusilier): kambule lempes$_b$ [-/thin]; opa$_p$ [ubi] (has shape like ubi vegetable).
Pterocaesio tile (dark-banded fusilier): kambule$_b$ [-]; andou meha$_p$ [-/red].

Carangidae – Trevally

Family or genus groupings/primary lexemes:

Generic trevally: nyubba$_b$ [swoop to attack] and simba$_p$ [-]. small trevally: simba-simba [-]. Though simba is the primary lexeme for most trevallies in Palo Bubara$_p$ [-] is used to describe trevallies in general. scad species: ruma-ruma$_p$ [small house] (during Islamic baptism parties on Kaledupa, a small house is filled with food, particularly ruma-ruma$_p$ species). The Palo believe ruma-ruma$_p$ come to the Wakatobi during the easterly wind season.

Alectis ciliaris (pennant fish): nyubba$_b$ [swoop to attack]; simba lili bonua$_p$ [-/visit/continent].
Atule mute (yellowtail scad): nyubba bubuloh$_b$ [swoop to attack/jellyfish]; simba-simba bungku$_p$ [-/bent]. The Bajo believe that the yellowtail scad follow jellyfish swarms, hiding among then to swoop out to catch pray.
Carangoides caeruleopinnatus (onion trevally): tuduh tobah$_b$ [top/water container]; simba-simba lili bonua$_p$ [-/visit/continent].
C. ferdau (blue trevally): nyubba biasa$_b$ [swoop to attack/normal]; simba one nduru$_p$ [-/sand/noisy sound]. The Palo believe the blue trevally digs holes in the sand.
C. othogrammus (yellow-spotted trevally): pipilli$_b$ [-]; simba bnngha$_p$ [-/-].
Caranx ignoblis (giant trevally): meah pote$_b$ [pay/white]; simba moo$_p$ [-/very big].
C. lugubris (black trevally): meah mondo$_b$ [pay/monkey] (black head of monkey); simba biru$_b$ [-/black].
C. melampygus (bluefin trevally): langoang$_b$ [blue bottle flies-many] (blue spots look like it is covered in blue bottle flies); simba$_p$ [-].
C. papuensis (brassy trevally): nyubba langko kape$_b$ [swoop to attack/long/armpit]; simba$_p$ [-].
C. sexfasciatus (bigeye trevally): anggatang$_b$ [apprehensive] (eats bait and slow to move); simba$_p$ [-].
Decapterus macrosoma (long-bodied scad): gagadeh$_b$ [-]; ruma-ruma$_p$ [small house].
D. russelli (Russell's mackerel scad): ruma-ruma$_b$ or roo-ruma$_b$ [small house]; ruma-ruma$_p$ [small house].
Elegatis bipunnulata (rainbow runner): ururoh$_b$ [-]; uru-uru$_p$ [to let out] (fishing line).
Pseudocaranx dentex (silver trevally): kalumbe$_b$ [name of tree]; simba mohute$_p$ [-/white].
Scomberoides iysan (double-spotted queenfish): manua$_b$ [chicken] (jumps out of the water like a fighting chicken); tangiri$_p$ [-].
Selar boops (oxeye scad): tandu tulai$_b$ [horn/-]; anggora$_p$ [-].
S. crumenthalmops (purse-eyed scad) & *S. leptolepis* (small-tailed trevally): layah$_b$ [-]; ruma-ruma$_p$ [small house].

Centropomidae – Bass

Psammoperca waigiensis (sand bass): talunsoh$_b$ [-]; kaka$_p$ [older brother].

Chaetodontidae – Butterflyfish

Family or genus groupings/primary lexemes:

Generic butterflyfish, including bannerfish: tatape$_b$ [rice shaker] (looks round, like basket rice shakers). generic butterflyfish: kali bomba$_p$ [crow bar/wave] and generic bannerfish kali bomba buku wemba$_p$ [crow bar/wave/bamboo/bone].

Clupeidea – Herring and relatives

Amblygaster sirm (northern pilchard): tembah mancoh$_b$ [*herklotsich quadrimaculatus*/bait or lure] (used as bait for tuna); betelalaki olo$_p$ [-/deep sea].
Anodontostoma chacunda (gizzard shad): kuasi$_b$ [-]; kowasi$_p$ [-].
Herklotsich quadrimaculatus (bluestripe herring): tembah$_b$ [-]; bisuko$_p$ [-]. The Palo believe they spawn in the seagrass and coral around June, August and October on lunar days 15 and 16.
Spratelloides robustus (blue sprat): tatambang$_b$ [-]; ole$_p$ [-]. Palo believe they spawn in the seagrass around October.

Diodontidae – Porcupinefish

Family or genus groupings/primary lexemes:

Generic porcupinefish: konkeh$_b$ [-].

Chilomycterus reticulatus (spotfin porcupinefish): konkeh silah$_b$ [-/deep-open sea]; nona'a$_p$ [-].
C. spilostylus (spotbase porcupinefish): konkeh$_b$ [-]; lombe$_p$ [-].
Diodon liturosus (blotched porcupinefish): konkeh batu$_b$ [-/coral]; borutu$_p$ [pricklie].

Ephippidae – Batfish

Platax teira (teira batfish): buna biasa$_b$ [-/normal]; vuna$_p$ [-].

Exocoetidae – Flyingfish

Cypselurus spilopterus (flyingfish): tutue$_b$ [-]; kambala$_p$ [-].

Fistulariidae – Flutemouth

Fistularia commersonii (smooth flutemouth): tarigongoh igabuku$_b$ [-/reef wall]; hoppa$_p$ [ridge of coconut frond]. Palo believe the smooth flutemouth can be found in sandy habitats.
F. petimba (rough flutemouth): tarigongoh terusang$_b$ [-/deep off shore]; hoppa$_p$ [ridge of coconut frond]. Palo believe the rough flutemouth can be found in mangroves.

Gerreidae – Biddy

Gerres acinaces (longtail silver biddy): lamudo$_b$ [-]: kenta pute$_p$ [fish/white].
G. filamentosus (whipfin silver biddy): taboh$_b$ [-]; ulu watu$_p$ [-/coral].
G. oyena (common silver biddy): bansa$_b$ [-]; kenta ommuu$_p$ [-]. When small, the Palo call the common silver biddy kenta pute$_p$ [fish/white]. The Palo believe they spawn in the seagrass and coral around September to November during the full moon.

Haemulidae – Sweetlips

Plectorhinchus lessoni (striped sweetlips) & *Plectorhinchus oreintalis* (oriental sweetlips): luppe$_b$ [-]; kabulu$_b$ [strong expression of frustration] (possibly related to the ease with which the fish can slip off the hook).

Harpodontidae – Lizardfish

Saurida gracilis (slender grinner): jarah gigi$_b$ [spaced out/teeth]; bisara$_p$ [speak] (because it makes a noise when taken out of water).

Hemiramphidae – Halfbeak

Family or genus groupings/primary lexemes:

Generic halfbeak: oras$_b$ [-] and taruda$_p$ [-].

Hemiramphus far (barred garfish): pilangan$_b$ [-]; taruda nguhu$_p$ [-/charcoal] (colour). The Bajo say that the barred garfish shoal on the reef flats to breed during the easterly winds and is mainly found in lagoons.
H. robustus (robust garfish): oras$_b$ [-]; taruda mohute$_p$ [-/white].
H. affinis (tropical garfish): tampae$_b$ [-]; taruda mohute$_p$ [-/white]. the bajo believe the tropical garfish has a bitter taste.
H. quoyi (Quoy's Garfish): oras silah$_b$ [-/deep-open sea]; urapi$_p$ [-]. The Palo believe they shoal along the coasts during September and October.

Holocentridae – Soldierfish & Squirrelfish

Family or genus groupings/primary lexemes

Generic soldierfish: babakal$_b$ [-] and mbula$_p$ [first] (this fish was the first fish to come to when all fish were invited to a dance by the king of the sea).

Myripristis adusta (blackfin soldierfish): babakal silah$_b$ [-/deep-open sea]; mbula butukeo$_p$ [first/call].
M. murdjan (crimson soldierfish): babakal batu$_b$ [-/coral]; mbula$_p$ [first].
M. pralinia (scarlet soldierfish) & *M. vittata* (whitetip soldierfish): babakal mira$_b$ [-/red]; mbula$_p$ [first].
M. violacea (lattice soldierfish): babakal$_b$ [-]; mbula$_p$ [first].
Neoniphon argenteus (smooth squirrelfish), *N. openrcularis* (black-finned squirrelfish), *N. sammara* (spotfin squirrelfish) & *Sargocentron diadema* (crowned squirrelfish): kakaroe$_b$ [name of thin bird]; kanari$_p$ [name of plant] (leaf shaped like the fish).
Sargocentron caudimaculatum (tailspot squirrelfish): lambe batu$_b$ [wave (hand)/coral]; not known in Palo.
S. cornutum (threespot squirrelfish): kakaroe garas$_b$ [name of thin bird/small branching coral]; kanari$_p$ [name of plant] (leaf shaped like the fish).
Sargocentron spiniferum (spiny squirrelfish): lambe$_b$ [wave (hand)]; wesui$_p$ [thin].

Istiophoridae – Marlin & Sailfish

Family or genus groupings/primary lexemes

All marlin: tumbo$_b$ [sword] and melayare$_p$ [to sail].
Istiophorus platypterus (Indo-Pacific sailfish): layarang$_b$ [sail]; melayare$_p$ [to sail].

Kyphosidae – Drummer

Family or genus groupings/primary lexemes

Generic drummer: ila_b [-] and ilo_p [-].

Kyphosus bigibbus (southern drummer): ila $silah_b$ [-/deep-open sea]; ilo $mohute_p$ [-/white].
K. cornelii (western drummer) & *K. vaigiensis* (low-finned drummer): ila $batu_b$ [-/coral]; ilo $mohute_p$ [-/white].

Labridae – Wrasse

Family or genus groupings/primary lexemes

Generic wrasse: $lampa_b$ [mouth]. most small thin wrasse species: $pello_b$ [weak]. Small wrasse that the palo say never grow to a large size: $tanggili_p$ [-]. Choerodon genus: lamu-$lamu_p$ [-].

Anampses geographicus (scribbled chisel-toothed wrasse): $pello_b$ [weak]; tanggili olo_p [-/deep sea].
A. lennaroi (blue & yellow wrasse) & *A. meleagrides* (yellowtail wrasse): $pello_b$ [weak]; $timu_p$ [east] (caught in the easterly winds).
Bodianus mesothorax (spiltlevel pigfish): $lampa_b$ [mouth]; $longe_p$ [branching coral].
Cheilenus undulatus (Napoleon or double-headed Maori wrasse): $langkoe_b$ [early to catch]; $menami_p$ [always taste] (because cooks always taste it).
C. chlorurus (yellow-dotted Maori wrasse) & *C. trilobatus* (tripletail Maori wrasse): lampa $biasa_b$ [mouth/normal] or lampa iga-buku $tubba_b$ [mouth/reef wall/reef]; tai $pere_p$ or tai $repe_p$ [faeces/gone off] (does not taste very good and smells slightly like faeces). In Palo it is pronounced tai pere on east coast and tai repe on west coast of Kaledupa. Bajo believed *C. chlorurus* is caught mostly on reef wall. Palo believe they spawn in the seagrass and coral around June.
C. fasciatus (scarlet-breasted Maori wrasse): lampa $terusang_b$ [mouth/deep off shore]; $wakkoru_p$ [-].
C. unifasciatus (whiteband Maori wrasse): lampa $terusang_b$ [mouth/deep off shore]; moturu $oloo_p$ [sleep/sun].
Cheilio inermis (sharp-nosed wrasse): $palugandah_b$ [drum stick]; wee-wee_p [stye] (it is believed that if you eat the sharp-nosed wrasse the consumer will develop a stye).
Choerodon anchorago (anchor tuskfish): $bukalang_b$ [-]; $torokai_p$ [trapped].
C. cyanodus (blue tuskfish): $lalamong_b$ [-]; lamu-$lamu_p$ [-].
C. jordani (Jordan's wrasse): not known; lamu-lamu $kakanda_p$ [-/beautiful].
C. rubescens (Baldchin groper): $lalamong_b$ [-]; lamu-lamu $wungo_p$ [-/violet].
Coris gaimardi (red-finned rainbowfish) & *Pseudodax moluccanus* (chiseltooth wrasse): pello $mira_b$ [weak/red]; tanggili olo_p [-/deep sea].
Epibulus insidiator (slingjaw wrasse): lampa $dosa_b$ [mouth/owe]; $medosa_p$ [debtor]. Both the Bajo and Palo tell the story of the borrower/debtor fish, which talks other fish to lend it money which it never pays back.
Halichoeres hortulanus (fourspot wrasse: ip): pello $batu_b$ [weak/coral]; tanggili olo_p [-/deep sea].
H. hortulanus (fourspot wrasse: tp): pello $igabuku_b$ [weak/reef wall]; $tanggili_p$ [-].
H. scapularis (zigzag wrasse): pello alo_b [weak/lagoon]; $tanggili_p$ [-].
Hemigymnus melapterus (thick-lipped wrasse): $baseparai_b$ [-]; $melamu_p$ [-] or hone-$honeke_p$ [digger].
Oxycheilinus diagrammus (violet-lined Maori wrasse): lampa $igabuku_b$ [mouth/reef wall]; ka $karenga_p$ [name of green and black parrot].
Stethojulis strigiventer (silver-streaked wrasse): $pello_b$ [weak]; pulen $pule_p$ [-]. The Palo believe that the flesh and bones of the silver-streaked wrasse are weak.
S. trilineata (three-lined wrasse): pello $samo_b$ [weak/seagrass]; tanggili olo_p [-/deep sea].
Suezichthy soelae (soelae wrasse): $pello_b$ [weak]; punto-$punto_p$ [slippery]. palo believe they spawn in the seagrass and coral around June.
Xyrichtys pavo (pavo rasorfish): pello $mongoli_b$ [weak/-]; hone-$honeke_p$ [digger].

Leiognathidae – Ponyfish

Gazza minuta (toothpony): $bebete_b$ [-]; loba-$loba_p$ [type of vegetable] (looks like shape).
Leiognathus equulus (common ponyfish) & *Leiognathus smithursti* (Smithurst's ponyfish): $bebete_b$ [-]; bete-$bete_p$ [break] (looks like broken nose).

Lethrinidae – Emperor

Family or genus groupings/primary lexemes:

Generic emperor: $kadafo_p$ [-]. Specific emperors are eaten on skewers during usu-usu, a 7-month pregnancy celebration and these fish are often called usu-usu as well as species-specific names.

Gnathodentex aurolineatus (striped large-eye bream): totokke tuba$_b$ [head down /reef] (swims with head down); randa moruta$_p$ [chest/thin] (lack of food).
Gymnocranius frenatus (yellowsnout large-eye bream): tatabe$_b$ [-]; not known by Palo.
Lethrinus atkinson (yellow-tailed emperor): sumpa pote$_b$ [difficult/white]; kadafo pudu$_p$ [-/short]. The Palo believe they spawn in the seagrass and coral around October and November on lunar days 27 and 28.
L. erythropterus (longfin emperor): kutamba bannah$_b$ [-/gaff hook]; kadafo onuhi$_p$ [-/allergic red spot] (on skin). The Palo believe they spawn in the seagrass and coral around October and November of lunar days 27 and 28.
L. genivittatus (threadfin emperor): tatam biro [-/-]; kadafo rondo$_p$ [-/seagrass] or usu-usu$_p$ [name for 7-month pregnancy celebration]. Palo believe they spawn in the seagrass and coral around August.
L. harak (thumbprint emperor): kutamba$_b$ [-]; kadafo tanda$_p$ or kadafo salafau$_p$ [-/spot] (both tanda and salafau mean spot). The Palo believe they spawn in the seagrass and coral around October and November of lunar days 27 and 28.
L. lentjan (purple-headed emperor): dara papa alo$_b$ [land/cheeks/lagoon]; kadafo betomba$_p$ [-/-]. The Palo believe they spawn in the seagrass and coral around October and November of lunar days 27 and 28.
L. miniatus (sweetlip emperor): popontu lausu$_b$ [-]; onuhi$_p$ [-].
L. nebulosus (Spangled emperor): andupen$_b$ [-]; kikiaa$_p$ [-]. The Bajo say that the spangled emperor aggregates to spawn in July (yam season) to August (finishes before Boe Pote, a period of "white water").
L. obsoletus (orange-striped emperor): mantirus$_b$ [-]; kadafo$_p$ [-]. The Palo believe they spawn in the seagrass and coral around October and November of lunar days 27 and 28 .
L. olivaceus (long-nosed emperor): lausu$_b$ [-]; saso$_p$ [-]. The Bajo say that the Long-nosed Emperor aggregates to spawn in July (yam time) to August (finishes before Boe Pote, a period of "white water").
L. ornatus (ornate emperor): sumpa mira$_b$ [difficult/red]; kadafo pudu$_p$ [-/short]. The Palo believe they spawn in the seagrass and coral around October and November of lunar days 27 and 28.
L. rubrioperculatus (spotcheek emperor): tatam biro$_b$ [-/-]; tari wande$_p$ [dance/wind] or usu-usu$_p$ [name for 7-month pregnancy celebration]. Palo believe they spawn in the seagrass and coral around August.
L. semicinctus (black-blotch emperor): popontu lausu$_b$ [*l. variegates/l. olivaceus*]; kadafo rondo$_p$ [-/seagrass]. The Palo believe they spawn in the seagrass and coral around October and November of lunar days 27 and 28.
L. variegatus (variegated emperor): popontu$_b$ [-]; usu-usu kandole$_p$ [name for 7-month pregnancy celebration/-]. Palo believe they spawn in the seagrass and coral around August.
L. xanthocheilus (yellowlip emperor): kutu$_b$ [-]; ru'u$_p$ [-].
Monotaxis grandoculis (humpnose bigeye bream): bagangan$_b$ [teeth/molars]; tua butu$_p$ [old/open eyes].

Lutjanidae – Snapper

Family or genus groupings/primary lexemes

Most long snappers with jobfish body form: bero$_b$ [-] and lompa-lompa$_p$ [-]. Grouping of small, similar coloured and shaped snappers: sala$_p$ [don't accidentally eat] (causes an allergic reaction in some people, and irritated itching of scabs that form).

Aphareus furca (small-toothed jobfish): kurus bali$_b$ [-/-]; lompa-lompa$_p$ [jump around].
A. rutilans (rusty jobfish): bero babi igabuku$_b$ [-/reef wall]; not known by Palo.
Aprion virescens (green jobfish): guntor$_b$ [thunder] (the fish makes an audible noise in the sea); lompa-lompa$_p$ [jump around].
Etelis carbonculus (ruby snapper): langkuabo mira$_b$ [-/red]; lompa-lompa$_p$ [jump around].
E. radiosus (pale snapper): langkuabo$_b$ [-]; lompa-lompa$_p$ [jump around].
Lutjanus biguttatus (two-spot banded seaperch): bitte jateh$_b$ [pattern/increment markings on weighing scales]; not known by Palo.
L. bohar (red bass): ahaang$_b$ [-]; kotoha$_p$ [-].
L. carponotatus (stripey seaperch): langsuroh alo$_b$ [-/lagoon]; sala$_p$ [don't accidentally eat/coral].
L. decussatus (checkered seaperch): bangaro$_b$ [-]; sala$_p$ [don't accidentally eat /coral].
L. ehrenbergi (Ehrenberg's seaperch): baba banku$_b$ [arab/mangrove]; tumolla$_p$ [bang!] (because the meat bursts noisily when cooked).
L. fulviflamma (black-spot seaperch): baba igabuku$_b$ [arab/reef wall]; sala$_p$ [don't accidentally eat/coral].
L. fulvus (yellow-margined seaperch): sumpehlea$_b$ [weaving] (pattern on the fish looks like weaving); sala wau$_p$ [don't accidentally eat/coral].
L. gibbus (paddletail): daapa$_b$ [-]; dayah meha$_p$ [fish/red].
L. johnii (fingermark seaperch): kumbah buha$_b$ [finning] (movement through water); baga$_p$ [cheek].

L. kasmira (blue-striped seaperch), *L. lutjanus* (bigeye seaperch), *L. quinquelineatus* (five-lined seaperch) & *L. rufolineatus* (yellow-lined seaperch): sasageh$_b$ [-]; sala$_p$ [don't accidentally eat].
L. lemniscatus (dark-tailed seaperch): ine$_b$ [-]; kotoha$_p$ [-].
L. malabaricus (saddle-tailed seaperch): ine$_b$ [-]; koni meinte$_p$ [teeth/spread over] (irregular teeth).
L. monostigma (onespot seaperch): baba$_b$ [arab]; roraga$_p$ [-] or kotoha$_p$ [-].
L. rivulatus (Maori seaperch): sangai$_b$ [fish/wind]; baga$_p$ [cheek].
L. russelli (Moses perch): kumbah buha$_b$ [finning] (movement through water); tumolla$_p$ [bang!] (because the meat bursts noisily when cooked).
L. vitta (stripped seaperch): langsuroh terusang$_b$ [-/deep off shore]; sala$_p$ [don't accidentally eat].
Macolor macularis (midnight snapper): sulai asau$_b$ [reverse/gills]; tonalu$_p$ [-].
Pristipomoides filamentosus (rosy snapper): bero babi$_b$ [-]; lompa-lompa$_p$ [jump around].
P. auricilla (goldflag jobfish): bero babi igabuku$_b$ [-/reef wall]; not known by Palo.
P. flavipinnis (goldeneye jobfish): bero babi alo$_b$ [-/lagoon]; not known by Palo.
P. zonatus (oblique-banded snapper): bero babi terusang$_b$ [-/deep off shore]; not known by Palo.
Symphorus nematophorus (Chinaman fish): mora pisa$_b$ [-/banana]; baga$_p$ [cheek].

Malacanthidae – Tilefish

Malacanthus brevirostris (blanquillo): babala$_b$ [tree species] (has the same colour and pattern as local tree); not known by Palo.

Monacanthidae – Leatherjacket

Family or genus groupings/primary lexemes:

Generic leatherjacket: epe$_b$ [-] and sogoh$_p$ [-].

Acreichthy tomento (bristle-tailed leatherjacket): epe samo$_b$ [-/seagrass]; sogoh pei$_p$ [-/-].
Amanses scopas (brush-sided leatherjacket): epe loong$_b$ [-/black]; sogoh$_p$ [-].
Cantherhines parkalis (honeycomb leatherjacket): epe$_b$ [-]; sogoh olo$_p$ [-/deep sea].
Monacanthus chinensis (fan-bellied leatherjacket): epe samo$_b$ [/seagrass]; sogoh rondo$_p$ [-/seagrass].

Mugilidae – Mullet

Liza vaigiensis (diamond-scale mullet): bonte$_b$ [-] or duppua$_b$ [-]; fonti tambora$_p$ [deflect/-].
Valamugil buchanani (blue-tailed mullet): bonte silah [-/deep-open sea]; fonti$_p$ [deflect].

Mullidae – Goatfish

Family or genus groupings/primary lexemes:

Mulloidichthys genus: banguntu$_b$ [-]. *parupeneus* genus: timbungan$_b$ [-]. *upeneus* genus: balubba$_b$ [-]. Generic goatfish: tio$_p$ [-]. Palo believe all goatfish spawn during the full moon in the seagrass and coral around October.

Mulloidichthys flavolineatus (yellowstripe goatfish): banguntu janggutan tuba$_b$ [goat beard/reef]; tio lumalo$_p$ [-/pass by].
M. vanicolensis (yellowfin goatfish): banguntu janggutan igabuku$_b$ [goat beard/reef wall]; tio lumalo$_p$ [-/pass by].
Parupeneus barberinoides (swarthy-headed goatfish): timbungan igabuku$_b$ [-/reef wall]; tio tandai$_p$ [-/to give a sign].
P. barberinus (dash-dot goatfish): timbungan tubba$_b$ [-/reef]; tio bata$_p$ [-/sunken wood, big or tree trunk] (called tio bata$_p$ because it is the only goat fish that grow to a large size).
P. bifasciatus (doublebar goatfish): timbungan samo$_b$ [-/seagrass]; tio$_p$ [-].
P. cyclostomus gold-saddled goatfish timbungan igabuku [-/reef wall]; tio makuri [-/yellow].
P. heptacanthus (spotted golden goatfish): timbungan igabuku$_b$ [-/reef wall]; tio meha$_p$ [-/red].
P. indicus (Indian goatfish): timbungan tubba$_b$ [-/reef]; tio$_p$ [-].
P. macronema (stripe-spot goatfish): timbungan igabuku$_b$ [-/reef wall]; tio$_p$ [-].
P. multifasciatus (banded goatfish): timbungan tubba$_p$ [-/reef]; tio liku$_p$ [-/out side] (moves from one area to another never staying in one place or has a home).
P. pleurostigma (sidespot goatfish): timbungan$_b$ [-]; tio$_p$ [-].
Upeneus asymmetricus (asymmetrical goatfish): balubba$_b$ [-]; tio tingkuca$_p$ [-/-].
U. tragula (bar-tailed goatfish): balubba samo$_b$ [-/seagrass]; tio tingkuca$_p$ [-/-]
U. vittatus (striped goatfish): balubba alo$_b$ [-/lagoon]; tio tingkuca$_p$ [-/-].
U. moluccensis (goldband goatfish): balubba$_b$ [-]; tio lumalo$_p$ [-/pass by].

Muraenidae – Moray Eel

Gymnothorax fimbriatus (fimbriated moray eel): undoh silah$_b$ [snake/deep-open sea]; kompa bunga moliri$_p$ [local flower] (looks like).

Nemipteridae – Monocle Bream

Family or genus groupings/primary lexemes

Threadfin Bream: lankiaba$_b$ [-]. Monocle breams: tintah$_b$ [-] and tonto$_p$ [see].

Nemipterus celebicus (five-lined threadfin-bream): lankiaba$_b$; not known in Palo.
N. baliensis (Bali threadfin-bream): lankiaba$_b$; not known in Palo.
Pentapodus caninus (smooth-toothed whiptail): tintah$_b$; tonto mohute see/white.
P. trivittatus (three-striped whiptail) & *Scolopsis ciliatus* (whitestreak monocle bream): tintah bonda$_b$ [-/species of short seagrass]; tonto$_p$ [see].
Scolopsis auratus (yellowstripe monocle bream): not known in Bajo; randa moruta$_p$ [chest/thin] (from lack of food).
S. lineatus (lined monocle bream): tintah tuba$_b$ [-/reef]; tonto$_p$ [see].
S. margaritifer (pearly monocle bream): tintah iga buku$_b$ [-/reef wall]; wai-wai$_p$ [-].
S. monogramma (monocle bream): sualala$_b$ [-]; wai-wai$_p$ [-].
S. trilineatus (three-lined monocle bream): tintah$_b$ [-]; tonto buri$_p$ [see/write] ("write" refers to the lines on the fish).

Ostracidae – Boxfish

Ostracion cubicus (yellow boxfish): taburroh$_b$ [-]; falampopa$_p$ [-].

Pempheridae – Bullseye

Pemphperis oualensis (Qualan bullseye): beseh boe$_b$ [generic bigeye/boe pote$_b$] (white water – two week period of large waves when winds change from easterly to northerlies); not known in Palo.

Platycephalidae – Flathead

Cymbacephalus beauforti (giant flathead): kumba buaya$_b$ [internal organs/crocodile]; not known in Palo.
Papilloculiceps nematophthalmus (fringe-eyed flathead) & *Rogadius asper* (olive-tailed flathead): kumba buaya$_b$ [internal organs/crocodile]; kumbou$_p$ [lizard].

Plotosidae – Catfish

Plutosus canius (catfish): not known in Bajo; oitu$_p$ [-]. Palo believe they spawn in the seagrass around September and November.

Pomacentridae – Damselfish

Family or genus groupings/primary lexemes:

Generic damselfish: tibo$_b$ [-] and boku-boku$_p$ [-].

Dischistodus perspicillatus (white damsel): tibo pote$_b$ [-/white]; boku-boku$_p$ [timid].
Hemiglyphidodon plagiometopon (lagoon damselfish): tibo$_b$ [-]; boku-boku$_p$ [timid].

Priacanthidae – Bigeye

Family or genus groupings/primary lexemes:

Generic bigeye: beseh$_b$ [showoff] and bula-bulawa$_p$ [very gold].

Heteropriacanthus cruentatus (duskyfin bigeye): beseh loong$_b$ [show off/black]; bula-bulawa [very gold].
Priacanthus hamrur (lunar-tailed bigeye), *Priacanthus macracanthus* (red bigeye) & *Priacanthus sagittarius* (robust bigeye): beseh$_b$ [show off]; bula-bulawa$_p$ [very gold].

Scaridae – Parrotfish

Family or genus groupings/primary lexemes:

Generic small parrotfish: mogoh$_b$ [close bad mouth] (said to someone who is verbally insulting you). In Bajo parrotfish without mogoh as a primary lexeme (amammar$_b$ taste better to most parrotfish. Generic parrotfish: lehe$_p$ [-]. The Palo believe parrotfish spawn around September.

Bolbometopon muricatum (double-headed parrotfish): angke$_b$ [-]; tofoula$_p$ [-].
Calotomus spindens (spinytooth parrotfish): amammar$_b$ [-]; puto punto$_p$ [-].
Cetoscarus bicolor (red-speckled parrotfish: tp): mogoh borra$_b$ [close bad mouth/angel like spirit and chariot used by Mohamed to visit Allah] (beautiful)]; wangu kakanda$_p$ [violet/beautiful].
Chlorurus bleekeri (Bleeker's parrotfish: ip): mogoh loonge$_b$ [close bad mouth/black]; lehe biru$_p$ [-/black].
Chlorurus bleekeri (Bleeker's parrotfish: tp): mogoh nyuloh$_b$ [close bad mouth/green]; lehe biru$_p$ [-/black].
Chlorurus sordidus (green-finned parrotfish: it): mogoh loonge$_b$ [close bad mouth/black]; fangu ijo$_p$ [-/green].
Chlorurus sordidus (green-finned parrotfish: tp): mogoh nyuloh$_b$ [close bad mouth/green]; lehe watu$_p$ [-/massive coral].
Hipposcarus longiceps (long-nosed parrotfish): ulapai$_b$ [-]; wangu$_p$ [violet].
Leptoscarus vaigiensis (blue-spotted parrotfish): mogoh nyuloh$_b$ [close bad mouth/green]; lehe$_p$ [-].
S. chameleon (chameleon parrotfish): mogoh nyuloh$_b$ [close bad mouth/green]; lehe$_p$ [-].
S. dimidiatus (saddled parrotfish): mogoh$_b$ [close bad mouth]; lehe ijo$_p$ [-/green].
S. flavipectoralis (yellowfin parrotfish): mogoh nyuloh$_b$ [close bad mouth/green]; lehe kakanda$_p$ [-/beautiful].
S. frenatus (six-banded parrotfish: ip): mogoh mira$_b$ [close bad mouth/red]: lehe kakanda karenga$_p$ [-/beautiful/-].
S. frenatus (six-banded parrotfish: tp): mogoh nyuloh$_b$ [close bad mouth/green]; lehe watu$_p$ [-/massive coral].
S. ghobban (blue-barred parrotfish: ip): bataan$_b$ [-]; lehe wangu$_p$ [-/violet].
S. ghobban (blue-barred parrotfish: tp): pandanan$_b$ [palm species]; wangu tambaga$_p$ [violet/copper].
S. globiceps (violet-lined parrotfish: ip): mogoh pote$_b$ [close bad mouth/white]; nama-nama [-]. *S. globiceps* (violet-lined parrotfish: tp): mogoh nyuloh$_b$ [close bad mouth/green]; lehe$_p$ [-].
S. niger (swarthy parrotfish): mogoh loonge$_b$ [close bad mouth/black]; lehe biru$_p$ [-/black].
S. oviceps (blue parrotfish: ip): mogoh$_b$ [close bad mouth]; lehe$_p$ [-].
S. oviceps (blue parrotfish: tp): mogoh nyuloh$_b$ [close bad mouth/green]; lehe watu$_p$ [-/massive coral].
S. prasiognathus (dusky parrotfish): mogoh sasah$_b$ [close bad mouth/white breakers] (Bajo believe the dusky parrotfish comes to seagrass when are white breakers); lehe$_p$ [-].
S. psittacus (palenose parrotfish: ip): mogoh loonge$_b$ [close bad mouth/black]; lehe kofungo$_p$ [-/-] or lehe firiso$_p$ [-/-].
S. psittacus (palenose parrotfish: tp) & *Scarus schlegeli* (Schlegels parrotfish): mogoh nyuloh$_b$ [close bad mouth/green]; lehe ijo$_p$ [-/green].
S. quoyi (Quoy's parrotfish): mogoh nyuloh$_b$ [close bad mouth/green]; lehe kakanda$_p$ [-/beautiful].
S. rivulatus (surf parrotfish: ip): mogoh pote$_b$ [close bad mouth/white]; lehe mohute$_p$ [-/white].
S. rivulatus (surf parrotfish: tp): mogoh nyuloh$_b$ [close bad mouth/green]; lehe$_p$ [-].
S. rubroviolaceus (ember parrotfish: ip): borra$_b$ [angel-like spirit and chariot used by Mohamed to visit Allah] (beautiful); lehe$_p$ [-].
S. rubroviolaceus (ember parrotfish: tp): angke$_b$ [-]; lehe ijo$_p$ [-/green].
S. viridifucatus (greenlip parrotfish): mogoh loonge$_b$ [close bad mouth/black]; lehe biru$_p$ [-/black].

Scombridae – Mackerel & Tuna

The Bajo say tuna species come close to the shore during the northerlies and westerlies and generally tuna come closer to the surface and are easier to catch when it is windy.

Auxis rochei (corseletted friget mackerel): turingah boyo$_b$ [-/cucumber] or babalaki$_b$ [-]; balaki$_p$ [-]. The Bajo believe they shoal round Kaledupa between December and February.
Euthynnus affinis (mackeral tuna): turingah$_b$ [-]; cakala biru$_p$ [-/black].
Grammatorcynus bicarinatus (shark mackerel): ande ande$_b$ [-/-]; talan-tala$_p$ [tray].
G. bilineatus (double-lined mackerel ande ande$_b$ [-/-]; talan-tala$_p$ [tray].
Gymnosarda unicolor (dogtooth tuna): bambulo$_b$ [-]; mambulo$_p$ [bad taste] (like goat).
Katsuwonis pelamis (skipjack tuna): turingah$_b$ [-]; balang$_p$ [-].
Megalaspis cordyla (finny scad): kulli$_b$ [-]; mambulo$_p$ [bad taste] (like goat).
Thunnus albacares (yellowfin tuna): rambayan$_b$ [fillement] (to have); balang kuni$_p$ [-/yellow].
T. obesus (bigeye tuna): bangkunis$_b$ [-]; balang kuni$_p$ [-/yellow].

Scorpaenidae – Scorpionfish

Generic stonefish: kenta watu$_p$ [fish/stone].

Serranidae – Grouper

Family or genus groupings/primary lexemes:

Generic grouper (excluding coral trout): $kiapu_b$ [-] and $okke_p$ [-]. Small groupers: $tulareke_p$ [-]. Coral trout type $sunu_{bp}$ [-]. The Palo say that sunu meat is soft and tastes different to groupers. Commercial grouper fishing only occurs between November and May when most grouper aggregate.

Aethaloperca rogaa (red-flushed rockcod): kiapu $popokah_b$ [-/ghost] (looks like the flying head ghost that comes to kill babies); okke $koka_p$ [-/like black bird]. The Palo believe the red flushed rock cod lives in mangroves.
Anyperodon leucogrammicus (white-lined rockcod): kiapu $tallah_b$ [-/type of thick bamboo]; okke $mohute_p$ [-/white].
Cephalopholis argus (peacock rockcod): kiapu $loong_b$ [-/black]; okke $dalika_p$ [-/three stones used to keep pots on fire] (colour of fish like the stones) or Kenta $China_p$ [fish/Chinese] (the Palo say that this fish is not normally liked in the Wakatobi but fish traders from Sumatra asked the Palo to catch them to sell on to the Chinese).
C. aurantia (golden hind) & *C. sexmaculata* (six-blotch rockcod): kiapu $mira_b$ [-/red]; $okke_p$ [-].
C. cyanostigma (blue-spotted rockcod) & *c. miniata* (coral cod): kiapu mira $binti_b$ [-/red/spot]; $okke_p$ [-].
C. polleni (harlequin hind): $kiapu_b$ [-]; $mangkarnia_p$ [-].
C. sonnerati (tomato rockcod): kiapu mira $lempes_b$ [-/ red/thin]; $okke_p$ [-].
C. spiloparaea (strawberry rockcod): kiapu mira $polos_b$ [-/red/pure]; $okke_p$ [-].
C. urodeta (flag-tailed rockcod): kiapu $panenele_b$ [-/shy]; okke olo_p [-/deep-open sea].
Cromileptes altivelis (Barramundi cod): kiapu $kamudi_b$ [-/rudder] or kiapu $tikus_b$ [-/rat]; okke $beka_p$ [-/cat].
Epinephelus areolatus (yellow-spotted rockcod): kiapu $kubah_b$ [-/small hole]; $okke_p$ [-].
E. caeruleeopunctatus (oscillated cod): kiapu buntar $tikolo_b$ [-/round/head]; okke $tulareke_p$ [-/all warts].
E. cyanopodus (blue Maori cod): lumu $tarusang_b$ [weak/deep off shore] (the fish looks weak but is very strong); $okke_p$ [-].
E. fasciatus (black-tipped cod): kiapu $matekuli_b$ [-/dead skin]; $okke_p$ [-].
E. fuscoguttatus (flowery cod): kiapu tongal [-/-] or kiapu tiger [-/tiger]; $okke_p$ [-]. The Bajo say the flowery cod is mostly found on fringing reefs and very few around atolls. The Bajo say this fish aggregate from November to May, on lunar days 15–20.
E. lanceolatus (Queensland grouper): kiapu $mansarunae_b$ [-/-]; $okke_p$ [-].
E. maculatus (trout cod) & *Epinephelus miliaris* (netfin grouper) kiapu $nyarengkeh_b$ [-/brave] (cocky); $okke_p$ [-].
E. magniscuttis (speckled grouper): kiapu $kokoro_b$ [-/-]; $lanti_p$ [-].
E. malabaricus (Malabar grouper): $kiapu_b$ [-]; $okke_p$ [-].
E. merra (honeycomb cod): kiapu $sibbo_b$ [-/large branching coral]; okke $tulareke_p$ [-/all warts].
E. morrhua (comet grouper): kiapu $kokoro_b$ [-/-]; kurapu $meha_p$ [-/red].
E. polyphekadion (small-toothed cod): kiapu $ngaluhu_b$ or kiapu $tiger_b$ [-/slippery]; $okke_p$ [-]. The Bajo say that the small-toothed cod is found mostly around atolls and very few on fringing reefs and that it aggregates from November to May, on lunar days 15–20. The Palo say the small-toothed cod is very aggressive.
E. tukula (potato cod): kiapu buntar $tikolo_b$ [-/round/head]; $okke_p$ [-] & kenta $China_p$ [fish/Chinese] (the Palo say that this fish is not normaly liked in the Wakatobi but fish traders from Sumatra asked the Palo to catch them to sell on to the Chinese).
Gracila albomarginata (thinspine rockcod): kiapu $bandoka_b$ [-/place name on Wangi-Wangi Island]; $okke_p$ [-].
Plectranthias japonicus (Japanese perchlet): kiapu $mira_b$ [-/red]; okke olo_p [-/deep-open sea].
Plectropomus laevis grey colour morph (Chinese footballer): sunu $bantoel_b$ [-/-]; $okke_p$ [-].
P. laevis yellow colour morph (Chinese footballer): sunu $sunurang_b$ [-/-]; okke $makuri_p$ [-/yellow].
P. leopardus (coral trout) & *Plectropomus oligocanthus* (vermicular cod): sunu $mira_b$ [-/red] or sunu alo_b [-/lagoon]; $sunu_p$ [-]. The Bajo say the coral trout and vermicular cod aggregate from November to May, on lunar days 20–25.
P.maculatus (bar-cheeked coral trout): sunu $camba_b$ [-/sour]; $sunu_p$ [-].
Variola albimarginata (white-edged lyretail): $taringang_b$ [tusk]; okke $meha_p$ [-/red].
V. louti (yellow-edged lyretail): $taringang_b$ [tusk]; $sunu_p$ [-].

Siganidae – Rabbitfish

Family or genus groupings/primary lexemes:

Generic rabbitfish: $belowis_b$ [-]. rabbitfish type: $kola_p$ [-] and $borona_p$ [-]. The Palo believe all kola spawn in the seagrass and coral around August and November during the full moon and all borona spawn in the seagrass and coral around October and November between lunar days 9 and 15.

Siganus argenteus (silver spinefoot): belowis silah$_b$ [-/deep off shore]; monoi$_p$ [-]. The Palo believe they spawn in the seagrass and coral around August and November.
S. canaliculatus (smudgespot spinefoot): belowis samo$_b$ [-/seagrass]; kola biru$_p$ [-/black]. The Bajo say the smudgespot spinefoot aggregate to spawn just before boe pote$_b$.
S. doliatus (doublebar spinefoot): kekea$_b$ [-]; borona$_p$ [-].
s. fuscescens (black spinefoot): Belowis samo$_b$ [-/seagrass]; Kola mohute$_p$ [-/white]. The Palo say the black spinefoot spawn from September to Jannuary.
S. guttatus (golden spinefoot): birra$_b$ [-]; borona$_p$ [-].
S. lineatus (golden-lined spinefoot): birra$_b$ [-]; borona buri$_p$ [-/write] ('write' refers to the lines on the fish).
S. puellus (blue-lined spinefoot): kekea$_b$ [-]; borona makuri$_p$ [-/yellow].
S. punctatus (spotted spinefoot): mangilala$_b$ [-]; borona watu$_p$ [-/coral].
S. spinus (spiny spinefoot): belowis kangkang$_b$ [-/long type of seagrass]; kola bungi$_p$ [-/spring tide] (appears during spring tides).
S. trispilos (threespot spinefoot): kekea$_b$ [-]; borona tanda biru$_p$ [-/marking/black].

Sphyraenidae – Barracuda

Sphyraena barracuda (barracuda): pangaluang$_b$ [-]; alu$_p$ [eight].
S. jello (giant seapike): papalo silah$_b$ [call a lot/deep-open sea]; ndoma$_p$ [-].
S. obtusata (stripped seapike): papalo samo$_b$ [call a lot/seagrass]; falo-falo$_p$ [-].
S. qenie (military seapike): lenko$_b$ [name for natural fibre rope]; sombu woku$_p$ [make hole/-].

Synodontidae – Lizardfish

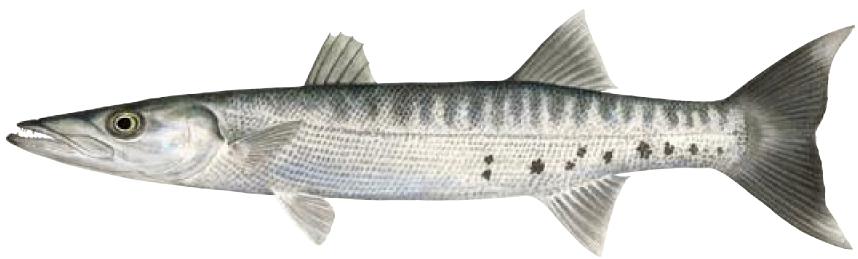
Synodus variegatus (variegated lizardfish): jarah gigi$_b$ [spaced out/teeth]; bicara$_p$ [speak] (makes a talking noise when it is taken out of water).

Terapontidae – Grunter

Terapon jarbua (crescent perch): kokoreh$_b$ [-]; kalaero$_p$ [-].

Zanclidae – Moorish Idol

Zanclus cornatus (moorish idol): tatape rambai$_b$ [rice shaker (looks like)/thread-like filament]; buku nuo'o$_p$ [bone/-].



Sphyraena barracuda
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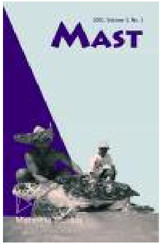
Traditional Marine Resource Management and Knowledge



Maritime Studies (MAST) Special Issue*: Marine turtles as flagships

Guest Editor: Jack Frazier (Smithsonian Institution)

Human societies have used marine turtles as symbols for millennia. Today these reptiles are employed as flagship species for diverse conservation and community development projects around the world. Yet, there has been little academic scrutiny of how marine turtles are employed as flagships or of their effectiveness in that role. This Special Issue brings together twelve papers from different sites in the Atlantic, Pacific, and Indian Oceans, as well as from the Caribbean Sea, that examine how marine turtles have been used as flagship species and how this bears on the relationship between people and the sea. The Special Issue demonstrates that conservation of marine turtles, and of the ecosystems of which they are conspicuous symbols, requires collaboration among diverse stakeholders and interdisciplinary scientific investigation of these interactions. While the natural sciences provide the biological context and indicators, social sciences offer the fundamental role of deciphering social issues over a broad range, from citizen empowerment and participation in resource management, to international law and the trade-environment confrontation. The flagship concept provides a singular tool for mobilising and coordinating conservation, while furnishing a point of connection and common interest between natural and social scientists.

"This issue of MAST documents the importance of sea turtles, but with an interesting twist. The contributors present the case that sea turtles can serve as symbols around which social behaviour can be organized. Conservation of sea turtles is important biologically and ecologically, but their value to human communities has fundamental social importance, as these innovative contributions make clear. They show that conservation is a social activity."
Professor Ben Blount, Department of Anthropology, University of Texas at San Antonio

Contents:

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