Hunting method and the ecological knowledge of dolphins among the Fanalei villagers of Malaita, Solomon Islands

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Introduction

In the Solomon Islands, men of particular villages hunt dolphins to obtain the teeth, which are then used as the traditional currency, for bride price and for personal adornment. Young girls are decked out with beautiful shell beads and dolphin teeth, and young boys and their parents collect many teeth to take these girls for wives. Dolphin teeth are one of the items used to form a network among the people of the area. There is an exquisite sense for the shape of dolphin teeth.

There are five specialised dolphin-hunting villages on Malaita Island, all occupied by Lau-speakers (Figure 1). The Lau are renowned fishers. Fanalei is one of these villages. The Fanalei villagers are "saltwater people" (*wane i asi*). To hunt dolphins, groups of men go by dugout canoe to the open sea early in the morning, and drive individual schools of dolphins to the beach by hitting two stones together below the surface of the water. They usually live by the beach and possess a profound knowledge about the sea. Such knowledge, specifically concerning dolphin hunting and the dolphin itself, demonstrates how the Fanalei villagers perceive their biological and physical environment, and especially the dolphin.

Dolphins are called *kirio* in the Lau language and fish are called *ia*. The terms *ia* or *ika* are widely used in Malay-Austronesian languages. People in Malaita categorise dolphins as a kind of fish, and the word *ia* sometimes denotes only the dolphin. (For example *nifo ia* is literally "the teeth of fish" but to Lau people it means "dolphin teeth".) Thus, the dolphin is thought to be "the fish of fishes" by Malaita people.

I observed 38 different fishing methods at Fanalei. As always, a particular fishing method is selected according to time, place and target species (Takekawa 1992). Dolphin hunting is but one of these methods, although it requires more skilled team work and heavy labour than other kinds of fishing. If a Fanalei villager goes fishing instead of dolphin hunting, he can easily get enough fish for his family. On the other hand, the probability of success in dolphin hunting is low, and is risky for those who subsist mostly on local foods. Although about 100 dolphins can be taken at one time, frequent failure results in a total absence of meat.

Nevertheless, Fanalei villagers still go hunting when the season begins. Prior to the introduction of Christianity, only Fanalei and Bita'ama were the places for dolphin hunting on Malaita. Even today Fanalei is the only village that constantly catches dolphins. The villagers are proud of their tradi-

Figure 1. Location of study area.

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tional status and their annual collection of some 100,000 dolphin teeth, almost all of which are sent to other parts of Malaita and neighbouring islands. So Fanalei is a special village intimately concerned with the circulation of dolphin teeth, and equivalent to a few Langalanga villages for red shell money (Cooper 1971).

Others have written on dolphin hunting in the Solomon Islands. Ivens (1930) described it and Dawbin (1966) reported on hunting at Bita'ama village in north Malaita. Both of them mainly examined the courtesy of dolphin hunting.

In the former studies the term "porpoise hunting" was used. But it is more appropriate to use "dolphin hunting", because in the Solomon Islands only ocean dolphins are hunted. It therefore becomes important to distinguish between porpoises (Family Phocoenidae) and ocean dolphins (Family Delphinidae).

Data for this study were collected during a total of nine months stay in Fanalei village, from July to October 1990, from December 1992 to March 1993 and from January 1994 to April 1994. I went dolphin hunting with Fanalei fishers several times during my research, and this article is based on information obtained during those periods.

Dolphin hunting

Brief history of dolphin hunting in Fanalei village

According to village oral history, a Polynesian woman named Barafaifu introduced dolphin hunting to Malaita from Ontong Java Atoll, which lies 500 km to the north. She traveled around Malaita to find the best place for hunting, and finally settled in Fanalei. She gave the Malokwalo clan, already settled there, the magic stone (*taraa*) capable of gathering dolphins with the spell of the sea spirit. They started hunting from that time, although then dolphins were not hunted every year, unlike now.

The clan ceased hunting in the mid-19th century, when Maesiora and his son Baena of the Malokwalo clan were the only transmitters of the spell. One day they were killed by a devil and the spell of hunting was nearly lost. Fortunately Oikada, a young man who belonged to Fanalei's chief clan, Ngora, had overheard Maesiora and Baena talking about dolphin hunting. Oikada held a dolphin hunt only once, when the Suraina clan demanded 10,000 teeth in compensation for a Suraina man's death. After that the people of Fanalei stopped dolphin hunting for about 50 years.

The oral history does not tell exactly why hunting stopped. But Christianity had been introduced during this period, and as a consequence many traditional customs were prohibited. It is possible that dolphin hunting was also prohibited at the same time. In addition, however, the most valuable dolphin, locally known as *robo au*, the melon-headed whale (*Peponocephala electra*), was becoming very rare. In 1948, during the Masina Rule Movement, William Masura, the vicar of Fanalei together with other chiefs revived dolphin hunting under Christianity. In 1958 Father Martin Fia introduced dolphin hunting to Walande, the sister village of Fanalei located 10 km to the north. He also initiated other Lau villages in North Malaita, including Ata'a, Felasubua, Sulufou, Mbita'ama, where dolphin hunting also started. However, Fanalei was and remains the preeminent dolphin hunting village.

Hunting tools

Malaitans use only simple tools made of local materials to hunt dolphins. Single canoes, without an outrigger, are used. Large canoes, such as *saralaku*, *beroko* or *olaisula* were used in former times, but today small canoes (*aigalua*) are the most common. To drive dolphins, hunters hit two 15-cm diameter stones (*nagi*) together beneath the sea surface. The very hard, unsplit flint from which they are made is obtained from Rauafu Island, about 50 km north off Fanalei. Signal flags (*boko*) are used to communicate among canoes dispersed more than 2 km apart. These are a strikingly coloured piece of cloth of about 80 cm^2 attached to a 4-m length of bamboo. Nets are sometimes used to catch dolphins in mangroves.

Searching for dolphins

Dolphin hunting is called *oto asi kirio* (lit."to go out into the open sea") or *ala ni kirio* "(lit. to surround something"). The canoe formation when driving dolphins is called *ala* and the usual group of 20–30 dolphin hunters is also called *ala*. The 52 households in Fanalei are organised into one *ala*.

Most adult male villagers hunt every day during the season when the trade winds do not blow (*ara*). Figure 2 shows events for the entire 1994 hunting season of 99 days. Bad weather and two tropical cyclones affected hunting, but fishers hunted for a total of 56 days. They found dolphins on 24 of those 56 days, and half the time they succeeded in catching them. During 12 days of hunting 865 dolphins were caught. These annual numbers fluctuate little. Average monthly harvest rates and frequency of hunting over a 7-year period are shown in Figure 3.

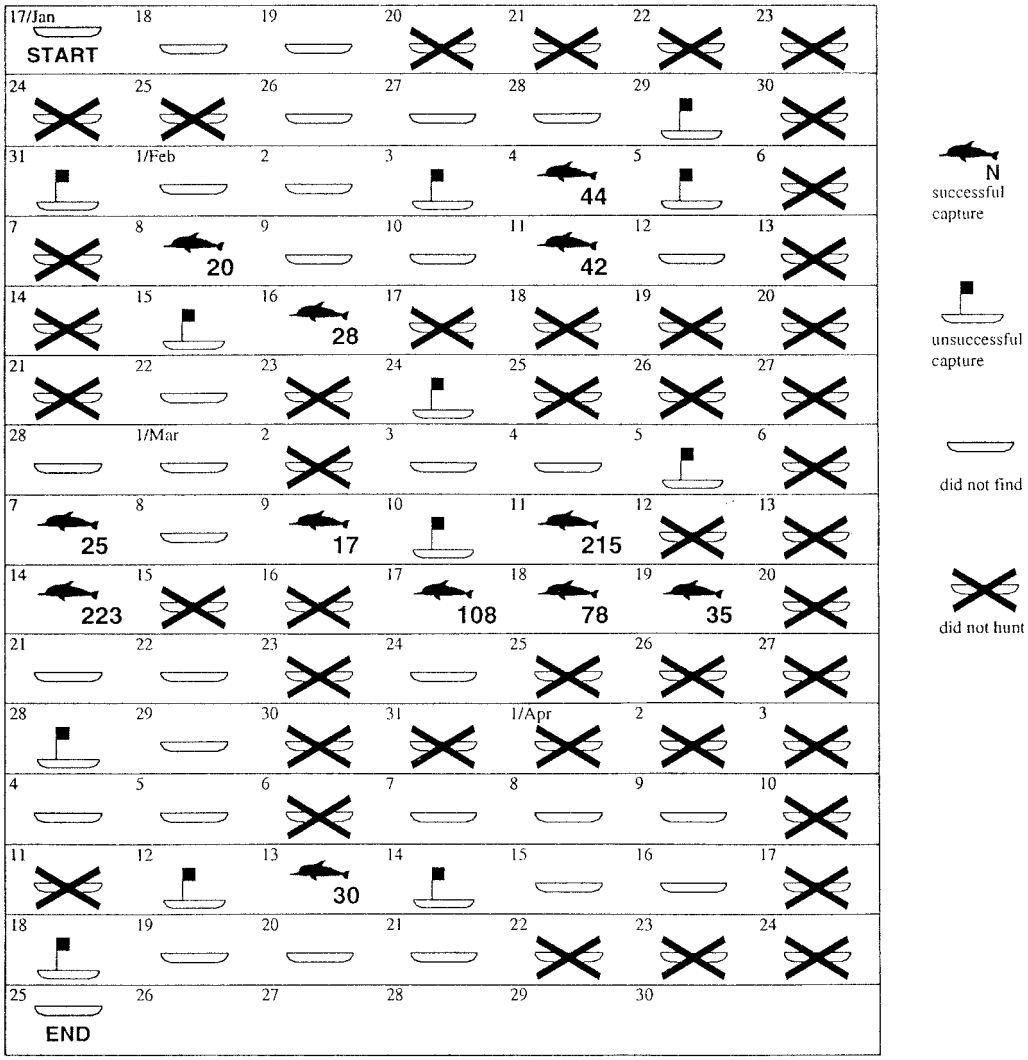

Figure 2. **Record of the 1994 dolphin hunting activity.**

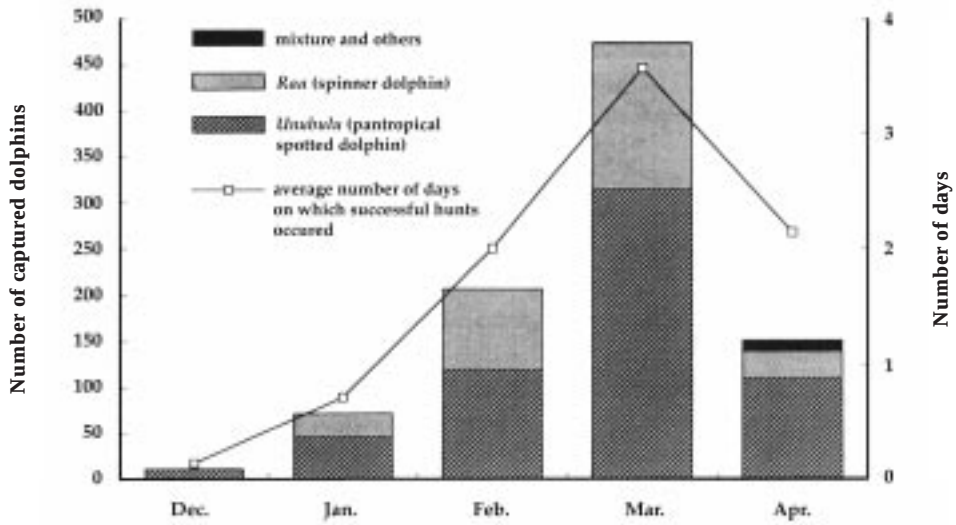

Figure 3. **Monthly dolphin hunting records.**

Hunting starts at about 04:00 hours. A large trumpet shell is blown in the village to summon all hunters to the meeting house (*tofi*), where they pray for success. Then they paddle as far out as possible in the calm sea of the pre-dawn darkness.

Dolphins are sometimes found near the shore. These schools are called *Raa fafonafo*. But in many cases dolphins are located more than 10 km offshore. After moving out to the open sea, canoes are deployed to wait for the dolphins. The distance between canoes is more than 1 km (Figure 4), and visibility among them depends on the weather or waves. At most it is 2 km. No one knows when and where the dolphins will come. The solitary hunters float on the sea until midday waiting for them.

If a hunter finds a school of dolphins, he quickly follows it and moves his canoe outside of them. Then he raises a flag to signal the others. The next hunter to see the flag then raises his, and so information is transmitted among all canoes. (The flags can be seen for about 5 km.) By using the flag, hunters can recognise the most distant canoes. Each man must then decide his proper direction of movement by his relative position and by the location of other flags. Great skill is required to properly organise a "U" shaped formation in which each canoe will maintain an approximately 1-km spacing.

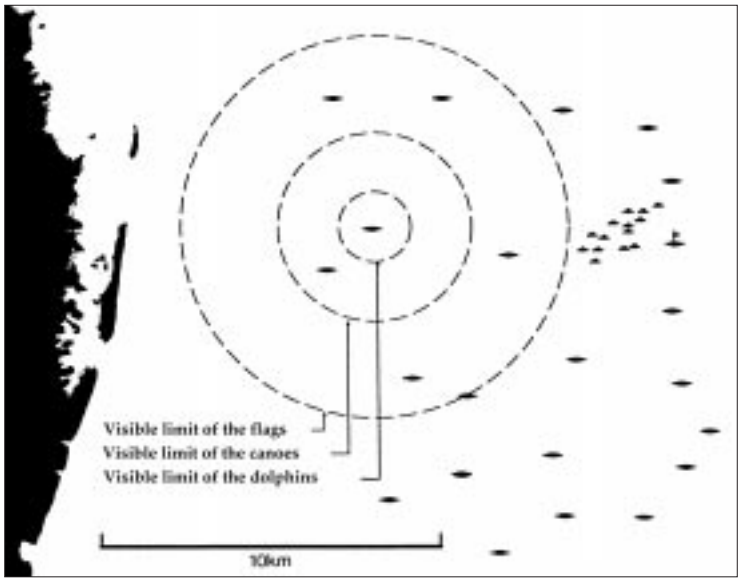

Figure 4. Visible range of a dolphin hunter from his canoe and other canoe positions when searching for prey.

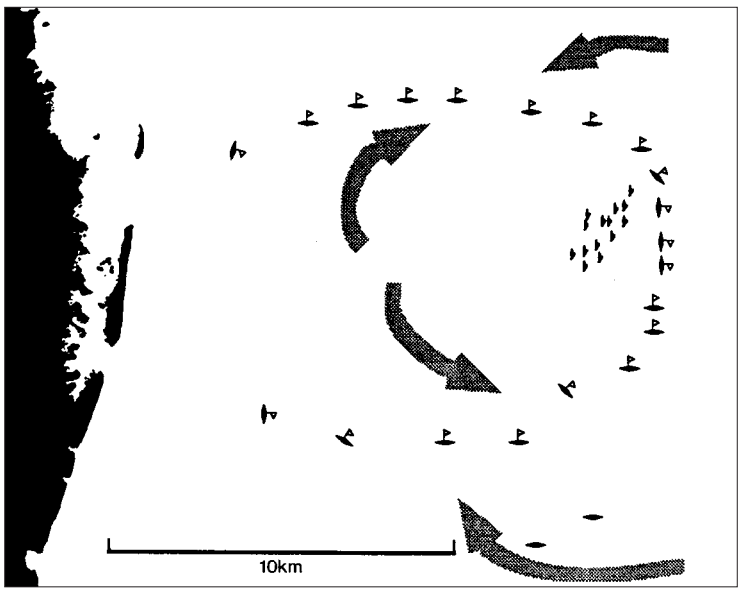

Figure 5. Canoes following dolphins and making the *ala* formation.

For example, if dolphins are found by an offshore canoe as in Figure 5, the other hunters must not move straight to the flag. The canoes to his landward side should move parallel to the shore and those seaward of him should move in the direction of the village. This manoeuvre could be easily understood were a bird's eye view possible. But the hunters cannot see the complete shape of the required formation, and only a few canoes are barely visible. Hunters must therefore envisage the actual situation based on very limited information.

Canoe formation for hunting

The "U" formation of canoes is called *ala* (Figure 6). *Oga na ala* is the main position to hit stones for driving the dolphins. During the hunt the dolphins usually swim near the *oga na ala*. *Ana ala wane baita* (lit. "the big man of the hunt"), commands all the canoes in the middle of *oga na ala*. Fanalei hunters do not have a particular leader, but a very experienced hunter occupies this position.

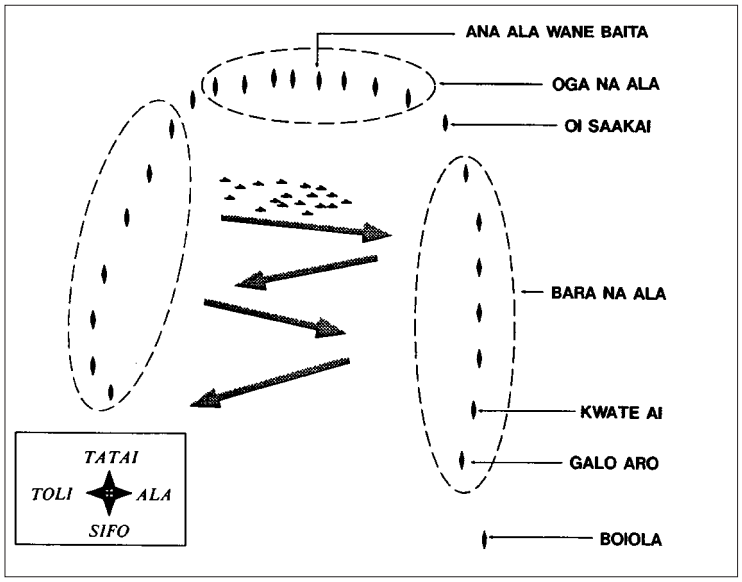

Figure 6. The canoe formation of *ala* during dolphin hunting.

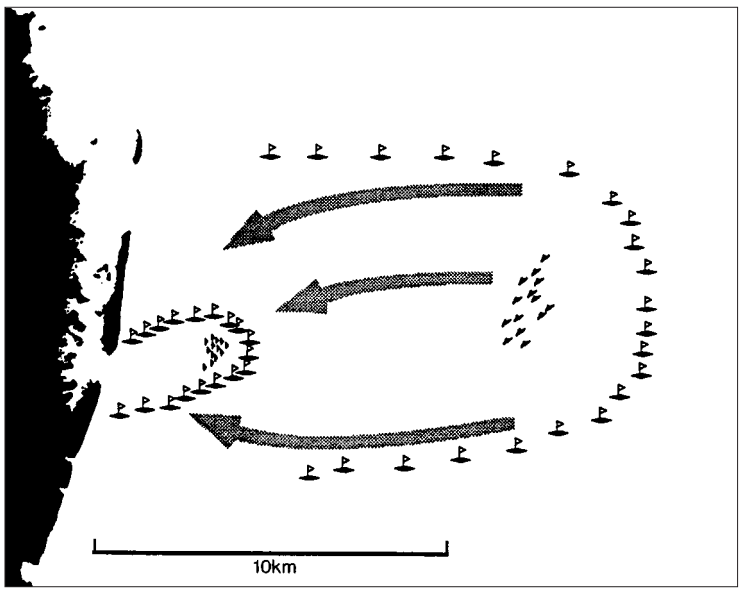

Figure 7. Driving dolphins to the Fanalei passage.

The next canoe at both ends of the *oga na ala* are *oi saakai*. These two canoes work as a joint of *oga na ala* and *bara na ala*. *Oi saakai* indicate the lining up direction to *bara na ala*.

The wings of the *ala* formation are *bara na ala*. *Bara na ala* controls the shape of formation to keep the dolphins inside *ala*. It is claimed that "If any canoe of *bara na ala* lies in a zigzag position the dolphins can escape from that place." *Bara na ala* must line up straight. When only a few canoes stand by and they are still far from the shore, *bara na ala* close both ends and make an "O" formation (*lo gosi ala*). If the range of vision is limited because of fog or waves both *bara na ala* keep a short distance and make a "V" formation (*koko fono*)

The landward canoes of *bara na ala* are called *kwate ai* and *galo aro*. Both *kwate ai* men of each wing lead *ala* in the correct direction, and the other canoes follow *kwate ai*. *Kwate ai* is also an important position next to *ana ala wane baita* ("big man of the hunt"). *Galo aro* assist *kwate ai*. When a school of dolphins swims very fast and nearly goes out of *ala*, *galo aro* move in front of the school and force them to turn back.

Boiola are canoes that come from the village after hunting has started to help in driving the dolphins. They usually weave into *bara na ala*.

Driving the dolphins

After the formation is set, the hunters start driving the school of dolphins. A hunter located by the side of the school hits two stones together under the sea (*alu fou*), thereby producing a sound that confuses the dolphins' echolocation system. The dolphins rush directly away from it. When the school approaches another canoe, the hunter in it starts to hit his stones. He must make a sound by the side of the school so as not to split it into groups. Thus, as in a football game where the ball is passed and directed toward a goal, hunters drive a school of dolphins toward the Port Adam passage in front of Fanalei village. It usually takes one to four hours to accomplish this (Figure 7).

The passage entrance is one of the critical points in the hunt, because dolphins often hesitate to go inside. Once inside the passage many other villagers, including woman and children, join to help the hunters and they finally succeed in getting the dolphins to swim into a mangrove bay located in

the passage. Then everyone jumps into the sea to catch them. They hold a dolphin gently by its mouth and swim with it toward a canoe, in which they are transported back to the village.

Traditional knowledge

Knowledge of seasons and winds

Dolphins are hunted only during the period January through April. For the rest of the year villagers usually fish in the shallow waters inside the coral reef. For the eight months from May through December, the trade winds (*ara*) blows constantly from the Southeast, generating rough seas that prevent small canoes to go to the open sea. The only exception is the turtle-hunting season, mostly in July, when the strong trade wind known locally as the *malafalisi* blows. Sea conditions are generally bad in this season, except when the weak easterly winds (*nonofolo*) blows.

During the dolphin-hunting season the northwest wind (*koburu*) usually blows in the afternoon. But in the early morning it stops and the sea becomes quite calm. Villagers regard this season, especially during the periods of week-long westerly winds (*balaitolo*) interspersed with calm, as the best time for dolphin hunting.

Knowledge of the lunar calendar and tides

Tidal movement is an important consideration in fishing, and dolphin hunting is no exception. Villagers recognise the lunar phase by the shape and location of the moon, and know that the 5th to the 9th (*singali bala*) and the 20th to the 24th day of the lunar calendar (*fulu fane*) are good lunar phases for hunting. During these periods low tide ends in early morning and high tide occurs around midday.

Dolphins are said to approach the land early in the morning to feed. For this reason, the dolphin hunters set out before sunrise, and return after midday. When the tide ebbs during the night, flotsam and seaweed are carried offshore (*rama*) and dolphins congregate. Moreover, if the tide is rising during the hunt, the canoes will be assisted by the current, which makes it easier to drive the dolphins. When the waning moon (*fulu fane*) remains in the sky until morning, dolphins often feed on the sea surface under the moonlight. Overall, this is the best time for hunting.

Current (*afe*) must also be considered. School of dolphins are known locally to move along the current. Off the coast of Fanalei, the currents flow south to north when the tide rises, and in the opposite direction when it ebbs. While hunting, every hunter keeps in mind the direction of the current and the time it will change. For example, even if dolphins run to the south, hunters should not persist in following them, because they will sometimes return after the current direction changes.

Knowledge concerning the sea

Shallow sea and open sea

The sea surrounding the village is classified into the shallow sea *(asi hara)* and the open sea *(asi matakwa)*. The former is highly varied in topographical and other features, for example, in the shape of the reef, the types of bottom deposits, depth, current and wave condition. Each feature and condition has various local names (Akimichi 1978).

The open sea and area of the dolphin hunting

The open sea is classified by distance from the land. *Fafo nafo*, literally "on the wave", is the area where the bottom of the sea is visible from the canoe. Depth in this area is at most 20 m. It is called *asi ni aole* (lit. "the sea of flying fish"), and is about 20 minutes from the land by canoe. The area where white waves breaking can be seen from the canoe is called *nafo sina*, and that where only the white sand beach is visible is *onetarau*. The area from where the tops of coconuts trees are seen to be the same height is called *niu gere*, and that where the high hills are seen on the horizon is called *tolo dama*. In *lua folosia* only the tops of high mountains can be seen, and in the area of *tolo saufini* the land is no longer visible. *Asi dadala*, which means "the very middle of the open sea", is still further out. Hunters search for the schools of dolphin from the area of *nafo sina* to *niu gere*, i.e. about 5–20 km from land.

Terms for relative direction are also used during the hunt: *sifo* is the landward side of the sea from one's canoe, and *tatae* is the opposite side. *Toli* is the right side of the sea when a hunter faces the land, and *ala* is the left side. These terms are often used when the dolphins are driven. When paddling in the open sea a dolphin hunter sometimes becomes lost, but can locate himself by triangulation.

Knowledge concerning dolphins schools

Composition

Dolphins usually move in groups, and every hunter must recognise the individual schools, because the driving method is different for different species. I will describe this using the example of their main targets, the Spinner dolphin (*Stenella*

longirostris) and the pantropical spotted dolphin (*Stenella attennuata*).

Naonao ia means "the first dolphin of the school" or "the individual leading the school". The last is called *bulibuli ia.* When the school is driven by the sound of hitting stones, hunters pay close attention to these first and last individuals. If they can successfully control the *naonao ia* and *bulibuli ia*, they can easily control the others.

One school can range from 30 to 600 dolphins. The average capture is about 80. A large school is called *ia ofu*, and when the view of swimming dolphins extends as far as the eye can see, this even larger school is called *sina afu*. A villager often uses the word "*sina afu*" when relating old stories or dreams. Schools the size of *ia ofu* and *sina afu* are difficult to drive, so the hunters use their canoes to force the school to divide, a technique called *oba.*

A school composed of only mature individuals is called *susu bora*. *Susu bora* is considered good because it is easily driven and includes many large individuals. A school that includes immature dolphins is called *le fai gale. Ia dolola* is a school composed of two or more species. The false killer whale (*Pseudorca crassidens*) will sometimes swim with the pantropical spotted dolphin. The last two types of school, *le fai gale* and *ia dolola*, frequently split into small groups while being driven toward the land. These split groups are termed *unu*. Sometimes *unu* will rejoin the main group, but in many cases the hunt is not completed once a school has divided. So hunters are very cautious when driving such schools.

Behavioural states of dolphins

Skilled hunters are also very conscious of the dolphin's behavioural state. When dolphins play by spinning or jumping in one spot, it is called *asi kale*. Hunters say that when dolphins are doing this the density of the school is high and there must be many dolphins.

Dolphins unaware of the presence of a canoe and swimming slowly before the start of the drive are said to be in the state of *oirau*. If a hunter finds *oirau* dolphins, he raises a signal flag and follows them until the hunting formation has been arranged.

When hunters who are following dolphins think that every canoe is ready, they simultaneously start to hit two stones under the water. The dolphins are surprised at the sound of the stones and their echo location system becomes confused. They will rush directly away from the noise in a state called *tolo.* When they tire, the dolphins float and swim around on the surface of the sea. This state is called *fa ngata.* When dolphins are *fa ngata*, hunters can easily recognise the location of the school, and will cease hitting the stones and only watch over the dolphins. *Tolo agatai* is the state in which dolphins panic and swim in many directions. In this condition it is very hard to control and drive them.

Su munumuno is the state in which all the dolphins remain submerged for a long time, generally more than one minute. When hunters drive the school near the land, *su munumuno* is liable to happen. When dolphins are *su munumuno*, the hunters cannot judge where the school will emerge. In this case, all the hunters will hit stones to make the dolphins surface.

Tara means stranding. One elderly man told me that when a dolphin is getting old, it would go to a particular beach to die. (Old tunas do the same.) The beach in front of Fanalei is one such place.

Knowledge concerning the dolphin species: their classification and characteristics

In Fanalei Village dolphins are classified into 15 types related to the type of teeth. Each type and its characteristics attributed by the village people are listed below. Species are identified in some cases.

Raa is the spinner dolphin (*Stenella longirostris*). It has a long beak, a small body, a white belly and a black back. Its teeth are the smallest of all dolphins in this area and number about 160. It swims relatively close to shore, can twist in the air, and occasionally does not flee from the sound of the stones.

Raa matakwa is a colour variation of the spinner dolphin (*Stenella longirostris*). Its characteristics are almost the same as *raa*, however, the belly is red and it swims relatively offshore. (The word *matakwa* means "open sea".)

Subo raa is also a variety of spinner dolphin with a slightly bigger body but with the same coloration. It swims relatively offshore.

Unubulu is the pantropical spotted dolphin (*Stenella attenuata*). The body is larger than *raa*, has many spots and the belly is sometimes white. The teeth are also a little larger than those of *raa.* It swims in the open sea, and when it jumps, the caudal fin bends strongly. It flees quickly at the noise made with stones, to which it appears to be sensitive.

Robo tetefe is the striped dolphin (*Stenella coeruleoalba*). The belly is white, and the roundish, smooth-skinned body is striped on both sides. The

beak is small. It has flat-sided teeth, and it is said to jump the highest of all. Each school of *robo tetefe* has an individual who appears to lead the others when they attempt to escape. It flees quickly in the open sea when stones are hit together, but is very hard to drive into the shallow water.

Robo manole (*Delpinus delphis*?) has a beak like that of *raa* and *unubulu*. The body is the largest among the types, and it has a slightly backward-curving dorsal fin. When it flees, the hunters describe it as sometimes splashing on the surface of the sea like a garfish (*manole*).

Robo au, also called *robo tafungai* or *robo gou tori*, has the most valuable teeth. *Au* means sharp, *tafungai* means "real" and *gou tori* means "flat head". The last *robo au* catch was recorded in 1978 by Walande and Sulufou villagers. For the last 100 years *robo au* have been hunted very little. From some sample teeth I identified *robo au* as the melon-headed whale (*Peponocephala electra*).

The melon-headed whale is a very rare species. They often strand in a group and show no evidence of migration (Martin 1990). It was reported that melon-headed whale were killed in fisheries in several regions, although human activities do not have a significant impact on this species (Northridge and Pilleri 1986). However, off Malaita hunting may have reduced the population of melon-headed whale.

In the old stories, Fanalei villagers say that the school size of *robo au* was usually more than one hundred individuals and when fleeing they sometimes leap a very long distance. The colour around the mouth was said to be pink and the back black. This suggests that *robo au* represents the melon-headed whale. Villagers also say that the beak of *robo au* is only the size of a human hand, and there is a white stripe on both side of the body. This suggests that *robo au* may be Fraser's dolphin (*Lagenodelphis hosei*), and recent studies found that melon-headed whales are occasionally associated with Fraser's dolphins (Perryman et al. 1994). These two dolphins have very similar teeth, so possibly *robo au* is the local name for both the melon-headed whale and Fraser's dolphin.

The teeth of the following dolphins have no value for the Malaita people, apart from the To'ambaita-speaking people in the northern area. So these dolphins are not hunted in Fanalei. They are occasionally seen stranded on the beach or are inadvertently caught with other valuable species. Descriptions of these unimportant dolphins types vary from hunter-to-hunter, especially in regard to the following *robo* (big tooth) type dolphins. The following descriptions of these dolphins were mostly related to me by experienced hunters.

Olo folosi walo is the bottlenose dolphin (*Tursiops truncatus*). It has a flat, duck-like beak and a large body. The teeth are also large and spindle-shaped. Usually 2–5 individuals swim together near the coral reef, and they are not often seen jumping. The hunters say they cannot catch *olo folosi walo* because they are not frightened by the sound of stones. *Olo folosi walo* means "stay near the reef", this dolphin is also known by the name of "*dakdak*", which means "duck" in Solomon pidgin.

There remain some *robo*-named dolphin teeth, as in *robo baa*, *robo*, *robo fouboso*, *robo matakwa*, *robo sarae bina*. Fanalei villagers say that both the shape of the teeth and the types of dolphins are different. However, they cannot distinguish them as well as the other types, such as *raa, robo tetefe* or *unubulu*. I identify these *robo*-named teeth as variants of bottlenose dolphin teeth.

Gwou mudu is Risso's dolphin (*Grampus griseus*). It is sometimes seen to remain quiet on the surface of the sea for more than one hour and it lands on its belly after jumping. The body exceeds 3 m and the teeth are large.

Ga ia robo may be the false killer whale (*Pseudorca crassidens*). The body length exceeds 5 m. It seldom jumps, but rather raises its head above the surface of the sea and moves up and down.

Acknowledgements

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Women, rural development and community-based resource management in the Roviana Lagoon, Solomon Islands: establishing marine invertebrate refugia

Shankar Aswani[1]

Introduction

Marine protected areas (MPAs) and spatio-temporal refugia can be effective fisheries management initiatives, particularly for multi-species tropical fisheries where absolute yields are difficult to predict and where there are multiple users and fishing techniques (Man et al. 1995; Russ 1994; Russ and Alcala 1996; Wantiez et al. 1997). Researchers broadly agree that MPAs are beneficial in enhancing spawning stock biomass, and allowing for larval dispersal and export of adults to adjacent non-protected areas (Bohnsack 1993; Johnson et al. 1999; Roberts and Polunin 1991; Russ and Alcala 1999). Likewise, spatio-temporal refugia alleviate pressure on stocks by allowing depleted populations to recover during seasonal or episodic no-take periods; they may also allow for increased larval dispersal, particularly if the area is dotted with permanently closed source population zones (Quinn et al. 1993).

Robert Johannes (1998) has recently supported the application of "data-less" precautionary management in the tropical Indo-Pacific region where fisheries biologists have failed to forecast inshore fishery dynamics with any certitude. Johannes argues that the best way to manage inshore tropical fisheries is to partly devolve managerial responsibilities to local communities, since it is not cost effective for poor tropical countries to conduct science-based fisheries research. Local communities who still have customary control over their waters can enact managerial initiatives, such as restricting gear, protecting spawning aggregations, establishing temporal or permanent marine reserves, and imposing minimum size limits (see also Johannes 1978, 1981). This strategy, referred to as sea tenure, not only regulates marine resource use in *lieu* of limited scientific biological data, but also serves the social objective of guaranteeing traditional resource use (Agardy 1997). It empowers local communities by recognising their customary entitlements and by

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