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Traditional knowledge possessed by the fishers of Marovo Lagoon, Solomon Islands, concerning fish aggregating behaviour

by Robert E. Johannes and Edvard Hviding

Explanatory note

Bob Johannes was asked by the Marovo Area Council to record important aspects of the traditional knowledge of Marovo Lagoon fishermen concerning their marine resources. His fieldwork was done during the last three weeks of May l987 with the assistance of Edvard Hviding. Hviding, who had been living in Marovo for a year, and was studying other aspects of traditional fishing and marine resource management, including customary marine tenure and its associated knowledge base (cf. Hviding 1988, 1996), had already gathered important information relevant to Johannes' study, so they combined forces to write the report on which this brief article is based.

Marovo marine lore is so exceptionally rich that full study of it would require an appropriately trained marine biologist to spend at least l8 months living in the Marovo area and in daily contact with Marovo fishers. However, because of the friendly and enthusiastic help of Marovo fishers and the village communities of Chea, Ramata, Keru, Tamaneke, Bili and Vakabo it was possible to make considerable progress during the necessarily short period of this preliminary study.

Introduction

The Marovo Lagoon of Western Province, Solomon Islands includes a wide range of marine community types, from mangrove estuaries and mudflats, to sandy or coral lagoon bottoms to the barrier reef, including the biologically important passages through the barrier reef, and the oceanic waters beyond. A great many different kinds of fish and shellfish are found in these different environments (cf. Hviding 1995). Marovo people probably eat or otherwise use a greater variety of species of marine animals than 99% of the world's fishers. Their knowledge of sea animals is therefore very impressive. Recently, Hamilton (1999) has shown, through a detailed, representative study of subsistence fishing for trevallies (Carangidae), that the knowledge of the fishers of nearby Roviana Lagoon is similarly rich.

Some of the most important practical information fishers possess concerns:

- where fish and other marine organisms are found in large numbers;
- when they are found there (that is, season, lunar period, tidal stage, time of day); and
- their behaviour and movements.

Many reef and lagoon fish come together in large numbers during particular months, during particular moon phases and at special places. Some of these aggregations are described in Marovo by such names as *bobili, baini, rovana,* and *sakoto,* the meanings of which are discussed below. Knowing this makes it easier for the fishermen to be at the right place at the right time for good fishing.

Sometimes these aggregations form for the purpose of spawning, as when groupers mass in certain reef passes, or mullet school and swim in tight circles (see below). In other cases, fish aggregate for the purpose of feeding, or for protection. In still other cases neither Marovo fishermen nor biologists know why the fish come together.

Marovo terms for different types of fish aggregations

Marovo fishermen have names for many different types of aggregations of fish. These names are based on the appearance of the aggregation, its apparent purpose, its movements, and the movements and behaviour of the fish within it. This system of names is more diverse than that used by marine biologists to classify fish aggregations.

Different villages in Marovo sometimes use different names for the same type of aggregation. In addition, the term for a certain type of aggregation by fishermen in one area will be used to describe a different type of aggregation in another village. Here we have chosen the names that, in our experience, seem to be most commonly used. These 15 major aggregation types are, listed alphabetically:

• *Ajara*

This word describes often large schools of fish, heads down sucking in sand (and filtering out and eating tiny plants and animals that live in it). Such fish include mullet and goatfish.

• *Avara*

Describes sea birds and skipjack or other tuna moving together close to the sea surface in pursuit of baitfish.

• *Baini*

Baini refers to moving, non-feeding schools of parrotfish, jacks (trevallies) and some surgeonfish. The term is specified according to type of fish, such as *baini mara* (trevallies) or *baini malakihi* (a certain type of parrotfish). Such schools swim in more or less straight lines, but sometimes reverse direction. When such schools stop to feed they are described by other terms such as *umoro, tupitupili* and *tore* (see below).

• *Bobili*

Bobili is a term that describes non-feeding schools in which the fish mill slowly in a tightly packed circle, sometimes rising and falling as a group in the water column. Often the individual fish in such aggregations seem rather unconcerned about approaching danger, making them easy targets for sharks or spear-fishermen. In many instances, fish involved in *bobili* are ready to spawn; fishers notice that they are full of eggs or milt, although only a few fishermen we talked with had actually seen spawning occur. *Bobili* aggregations frequently occur only at special times and places. Fish involved in these aggregations are mullet, scad (*Selar* sp.), milkfish, bonefish, bony bream (*Nematolosacome*) and certain parrotfishes. More details about *bobili* are given below in sections concerning some of these fish.

• *Chapa*

Chapa refers to large schools of predatory fishes that patrol an area or drift near the surface apparently looking for food. *Chapa* typically occurs along the outer reef drop-off and in channels through the barrier reef. This behaviour is shown by garfish, barracuda, Spanish mackerel, (*Scomberomorus commerson*) and some shark species, and is sometimes indicated by frigate birds circling high above, waiting for the *chapa* to break into feeding action. When feeding starts, *chapa* is often replaced by *umoro* (see below).

• *Keli pajara*

This term refers to the aggregation in shallow water of groupers, at special places, times of the year and moon phases. It is described in more detail below under “groupers”.

• *Melamela*

This refers to small schools of fish whose heads can be seen breaking the surface as they feed on plant scum that has floated to the surface in certain seasons. Fish that do this include a large yellow-headed surgeonfish.

• *Rovana*

This refers to schools of mullet, usually numbering in the thousands, that migrate in long, narrow schools. Johannes was shown one of these in open water in the middle of the lagoon; the mullet swam past his canoe just below the surface in a

continual narrow stream only l–3 fish wide. Unless they are disturbed, mullet in *rovana* usually travel in one direction without pausing. *Rovana* is the form of aggregation that these fish take when they migrate between where they normally live and where they spawn. When they reach the spawning area they form *bobili* aggregations (see above). *Rovana* involving fish returning from the spawning ground were unknown.

• *Sae*

When fish move up from deeper water and aggregate this is referred to as *sae*. Such fish include red snapper (*Lutjanus bohar*) and blue-lined sea-bream *(Symphorus spilurus*). *Sae* aggregations appear to form, say fishers, for the purpose of spawning. The spawning aggregations called *kelipajara* (see above) are different from *sae*, however, in that the fish are spread out more and stay closer to the bottom.

• *Sakoto*

This term means 'mortuary feast' in the Marovo language, and describes quiet, almost motionless, resting schools of certain fish looking, say fishers, like a gathering of mourners. Certain snappers that feed at night, including Moses perch (*Lutjanus russelli*), are often seen during the day in such schools under the over-hanging branches of trees near shore, especially around new moon. Such aggregations are often attacked by barracuda. Small hussars (*Lutjanus amabilis*) and some other small red lutjanids form *sakoto* aggregations at middle depths on reef slopes, typically around full moon.

• *Tore*

When individual or small groups of predatory fish such as barracuda or jacks (trevallies) break the surface in shallow water near shore in pursuit of baitfish or aggregations of fish such as small snappers, it is known as *tore*. In some villages it is referred to as *rereghe* (a term from the neighbouring Roviana language) and applied to the specific predators giving chase, as in *rereghe mara*, 'trevallies in chase of baitfish'.

• *Tupitupili*

This term is applied to schools of parrotfish when they periodically stop moving along as *baini* (see above) in order to feed by nibbling at stones and coral, heads down and tails up.

• *Udumu*

Udumu is the name given to a large, tightly packed school moving slowly and looking almost like a single object. Several species of surgeonfish move in such packed groups, usually over sandy bottom. These schools stop periodically and members spread out a little to feed on the bottom. While *udumu* always involves periodical feeding, *baini* (see above) does not. Experienced Marovo fishermen reckon that some *udumu* schools of surgeonfish may consist of up to 1000 fish.

• *Ukuka*

Ukuka describes the behaviour of groups of fish when individuals drift, circle and float as if drunk. One form of *ukuka* occurs when a heavy rain is followed by hot, still weather. At such times, many types of fish (including also large fish such as trevallies) drift in shallow water and act as if drunk, or as if they have been poisoned by custom leaves (*Derris* sp.). At this time they can easily be caught by hand. On other occasions fish such as a species of small black surgeonfish are seen behaving "drunkenly" in pairs within a school. We think this form of *ukuka* may be courtship and spawning behaviour.

• *Umoro*

This term describes schools of predatory fish when they are in the act of driving baitfish to the surface that will be fed upon both by their pursuers and seabirds overhead. Fish that do this include tuna, schooling jacks (trevallies) and leatherskins (*Scomberoides commersonianus*). Watching the behaviour of the birds provides clues concerning what predatory fish and baitfish are involved and whether they are accompanied by sharks. The *umoro* concept integrates Marovo knowledge of seabird and fish behaviour (especially the many different types of tuna school) with knowledge about baitfish seasonality and availability.

Some of the species that aggregate: times and locations

Marovo fishers' knowledge of the whereabouts and timing of predictable fish aggregations applies to a substantial number of important food species. The following selection briefly exemplifies the extent of this knowledge:

• Blue-finned jack (*Caranx melampygus – marabalibalighutu*)

Blue-finned jacks are usually seen swimming alone. But for two to three days around the new moon throughout the year some do form groups. These are commonly seen in and near passes through the barrier reef and along the outer edge of the barrier reef. At this time the fish are full of

eggs and are unusually easy to approach and spear underwater.

• Giant jack (*Caranx ignobilis – marabatubatu*)

Normally this fish, like its smaller cousin *C. melampygus*, travels alone or in pairs. But for two or three days, starting around new moon, these fish can be seen travelling in groups of around ten. Such groups may be seen in any month but are especially numerous in March.

• Rabbitfish (*Siganus punctatus* and possibly *S. vermiculatus – dudu*)

These rabbitfish form *bobili* type aggregations at certain locations in shallow water near mangrove areas in the lagoon. At this time, usually only on the seventh day (*juapa ta omina*) of certain lunar months, their schools may contain thousands of fish. The fish are swollen with eggs.

• Barracuda (*ghohi*)

There are at least four types of barrracuda in Marovo. The two largest species (probably *Sphyraena jello* and *S. barracuda*) are often found in passes through the barrier reef or along the outer reef drop-off. They take bait best at night starting at full moon for the next three or four days, whether the moon is shining or hidden by clouds. During this time schools of barrracuda are often found near the edges of the barrier reef passes at the seaward end during ebbing tides. As the tide changes and starts to flood, they move slowly through the pass to the inner end. They are full of eggs during the period around full moon in September to December. Then they are caught at shallower depths than at other times.

• Hussar (*Lutjanus amabilis – heheuku*)

These fish are said to come together in large numbers along the edges of passes through the barrier reef and along the outer reef drop-off for two or three days around full moon during certain months. At this time they are easy to spear. When one is speared, the others crowd in to eat fragments of flesh from the spear wound. When the tidal currents stream through a certain shallow passage between two islands in the lagoon, hussars will often aggregate at the downstream end of this current where it slows down. When the tide changes the fish will move, over a period of about half an hour, through the channel and will stop again on the other side where the current slows down. Good Marovo line fishermen know this and thus know where the good fishing spots for hussar can be found.

• Moses perch (*Lutjanus russelli*, as well as perhaps certain similar species – all *koasa*)

This fish forms *sakoto* aggregations during the day underneath the overhanging branches of trees near the shore especially along the lagoon-facing beaches of the barrier reef. When the tide drops the fish move into deeper water. Around new moon the aggregations of these fish can easily be approached without disturbing them. Once they cease to *sakoto*, move to deeper water and spread out, they regain their wariness. These aggregations are referred to as *sakoto koasa* and occur predictably during three days from the Marovo 'new moon' (*ta omi paleke*), during four days around full moon, and during the final three days of the last quarter.

• Maori seaperch (*Lutjanus rivulatus – sina*)

These snappers aggregate starting on full moon, for one to three nights inside passes through the barrier reef and at particular places along the outer and inner edge of the barrier reef. During this time they have well-developed eggs. February to May and (particularly) September through December are said to be the best months for these aggregations.

• Red snapper (*Lutjanus bohar – ringo*)

Red snappers come together in large *sae* aggregations in the passes and at certain places along the outside edge of the barrier reef from the eleventh through the fourteenth days of the lunar month. Aggregations break up after the night of the full moon. During this time they are full of eggs. June and July are said to be the months of the biggest aggregations of this fish in some parts of Marovo.

• Emperors (miscellaneous smaller lethrinids – several Marovo names)

Unidentified small- to medium-size emperors of perhaps more than one species form *sakoto* aggregations in daytime around new moon (for about two days), over sandy bottoms near river mouths. This especially occurs during the months of May and June. They are full of eggs and are very easy for fishers to approach at this time. At other times these fish are usually easily frightened, although some such aggregations may also occur around full moon.

• Blue-lined sea bream (*Symphorus spilurus – hirapa*)

These fish form *sae* aggregations in mid-water over sandy bottoms near passes through the barrier and along the outer reef for long periods of the lunar month from about August to January. These

aggregations usually develop at the first quarter (*juapa ta omina*) and break up at the time of full moon. The largest *saehirapa* aggregations are said to occur in November and December. The fish contain plenty of fat at this time, as well as developed eggs. They are unusually easy to approach and spear, especially during the last three days of the aggregation period just before full moon. (Palauan fishermen gave Johannes (1981) very similar information about this species, and Johannes observed one such *sae*-type aggregation there). Certain aggregations of this fish have disappeared in Marovo in recent years. This is probably a result of overfishing with spearguns. In Palau spawning aggregations of this fish have disappeared for this reason, according to fishermen (Johannes, unpubl.).

- Mullets (Mugilidae – *lipa*, several types)

There are several species of mullet in Marovo, and it is clear that Marovo people know a great deal about their movements. (Johannes encountered similar extensive knowledge about mullet among nearby Roviana fishers in 1998). But because different names seem to be used for the same species of mullet in different villages, we did not have time to sort out all the information we received. But this much is clear: some kinds of mullet make migrations around the time of full moon and new moon. Such migrations take the form of *rovana*, described above. One very large type of mullet migrates into river mouths and some distance upstream as the tide rises on the nights around full moon. This species also aggregates at certain spots in the wider, shallower parts of the lagoon, to spawn in certain months. At least one, and probably more than one type of mullet migrates to special areas near barrier reef passes or into pockets of deeper water on the outer barrier reef flat, where they form *bobili* and spawn. Some mullets make similar migrations around the time of the full moon.

The mullets are extremely important food fishes in the tropics, especially for low-income coastal peoples. Most, if not all the species of mullet found in Marovo Lagoon are widely distributed in the tropics. This fact, plus the extensive knowledge of mullet habits possessed by Marovo (and Roviana) fishermen provide an outstanding opportunity to increase scientific understanding of the biology of this important group by carrying out the appropriate research there.

- Yellowmargin triggerfish (*Pseudobalistes flavimarginatus – makoto lilio*)

This large triggerfish gathers in large loose aggregations over sandy bottoms in barrier reef passes and near the inner and outer entrances of these passes. These aggregations commonly occur during the seven days leading up to new moon. The aggregations are for the purpose of nesting. At this time the fish behave in a 'playful' manner called *varikilihi*. They dig nests in the sand and lay fist-sized clusters of eggs in them. Some nesting also occurs just before full moon. At these times the fish are unusually easy to catch with a speargun, line or trap.

These spawning aggregations reportedly occur somewhere in Marovo during every month except February through April. In the southern Bili area they are particularly large during the months of May through October. Farther north, along the barrier reef, the largest aggregations reportedly tend to occur progressively later in the year.

During the nesting period the fish protect their eggs from being eaten by other fish during the day, and will even rush divers that come near their nests. They sleep at night. They have become more cautious over the years since underwater spearfishing has made this behaviour dangerous to them. (Very similar behaviour was reported by fishers and observed by Johannes (1981) in Palau).

- Oxeye scad (*Selar boops – mamanga*)

Schools of oxeye scad move into shallow water, especially near islands in the lagoon, throughout the year starting three days before new moon. The fish form *bobili*-type aggregations at this time and they are full of eggs. Around the time of the full moon during the months when land crabs come down to the shore to release their eggs into the water, schools of oxeye scad come into shallow water at night to feed on the larvae that hatch from these eggs.

- Groupers (Serranidae; coral trout, coral cod – *pajara*, more than 20 Marovo names for subtaxa)

For several days before new moon several species of groupers (especially *Epinephelus fuscoguttatus*, *E. polyphekadion* and *Plectropomus areolatus*) come up into shallow water in large numbers. They always come up at the same places. At this time they are full of eggs or milt. This phenomenon is known as *keli pajara*, or 'rising of groupers'. Probably the best-known fish aggregation in the southern and central parts of Marovo is that of *P. areolatus*. This species comes up in large numbers, along the edges of the outer part of certain deep passages through the barrier reef. This occurs for about seven days during the last lunar quarter, during which time these fish are unusually easy to

spear, especially at night. On the day of new moon (*omia mago*, cf. Note 7) these fish leave the area.

Because of heavy spearfishing since just after World War II, these fish are not as 'tame' as they used to be during aggregations, and do not come into water as shallow as they once did. In the mid to late 1990s the spawning aggregations of these species have come under extremely heavy fishing pressure in Marovo due to the live reef food fish trade (Johannes and Lam 1999).

The spawning aggregation months for *P. areolatus* at the deep passes of central Marovo are February to June, with March to May being the best months. Aggregations form at a northern passage two or three days later than they do in the southern passes, but disappear on the same day as they do in other passes (Johannes (1989) describes these aggregations in some detail). Surprisingly, the season for spawning aggregations of this and the other two species mentioned above is quite different only a few tens of kilometers away in Roviana Lagoon (Johannes and Lam 1999).

- Goatfish (Mullidae – *pakao*)

Pakao, large goatfish, aggregate near coral reef areas in the middle of shallow sandy areas in groups of 20 to 30 around new moon. At this time they are full of eggs.

- Sweetlips *(Plectorhinchus gibbosus* and *P. obscurus* – both *pehu*)

Both species are said to form *sae* aggregations in and near passes through the barrier reef over coral bottoms for about three days around full moon. During this time they are full of eggs. The largest numbers are found in these places between March and May.

- Bony bream (*Nematolosa come – susuri*)

Bony bream aggregate in the *bobili* form over shallow sandy areas around new moon near mangrove areas. They move into rivers along with mullet around full moon.

- Spanish mackerel (*Scomberomorus commerson – tangiri*)

In the northern part of Marovo Lagoon a particularly good time for catching Spanish mackerel is after heavy rains and flooding. At this time, baitfish that normally live close to shore inside the lagoon move out (probably to escape the layer of muddy freshwater on the lagoon surface) and into the passes through the barrier reef. The Spanish mackerel move into these passes to feed on the migrating baitfish and are easy to catch by trolling. In general, Spanish mackerel are most abundant and easy to catch when 'the moon is small', during the final and first days of the lunar month, over a period of about eight days.

- Bumphead parrotfish (*Bolbometopon muricatum – topa*)

During the first seven nights of the lunar month bumphead parrotfish come in groups into shallow water in certain coral reef areas to sleep. At this time they are very easy to spear using a short speargun with the aid of an underwater torch. During the rest of the lunar month this species usually sleep in deeper water where they are harder to find. In daytime, slow-moving groups of large bumphead parrotfish (referred to as *hebala topa*, the former word meaning 'band of warriors') may be encountered along the barrier reef drop-off around new moon and around the first and last quarters.

- Sharks (*kiso*)

Many Marovo fishermen say that during the period of the lunar month, during which there is bright moonlight, sharks of several different species bite more than at other times. This period is known as the time when these sharks *vilu livono* ('sharpen their teeth'). At this time they tend to make line fishing difficult by stealing hooked fish, and to act more aggressively toward spearfishers.

Conclusion

Clearly Marovo fishers possess a great deal of practical knowledge concerning the fishes of their waters that is unknown to science, putting them in the same league with Palauan fishers (Johannes 1981) and, for that matter, the nearby fishers of Roviana (Hamilton 1999).

It should be noted that the knowledge of predictable patterns in fish behaviour, held predominantly by men, has a counterpart in Marovo: women's knowledge about important shellfish resources gathered mainly by them, such as mud crab (*Scylla serrata*) and the mangrove bivalves *Polymesoda* spp. Additional field work in 1987 by Hviding among villagers of mangrove-rich northern Marovo gave insights into how women make accurate predictions in the changing availability of these resources, perceived to be migratory on a seasonal, lunar and tidal basis.

For example, mud crabs are known to occur in large numbers at certain places during the full

moon nights of months characterised by low tide at night; they then sprawl passively on exposed mud flats and can easily be caught (see also Hviding 1996: 195). Interesting patterns of mobility and aggregation are pointed out by Marovo women for the two species of *Polymesoda* bivalve which are abundant in mangroves; they move in and out of the mud and migrate across submerged mud flats on a diurnal basis to follow the tides and to escape the hot sun. Locations and times are pinpointed for the most efficient gathering of these far-from-stationary molluscs, which can be caught in huge quantities over and over again from select sites at the right time, yet appear to be almost non-existent in mangrove areas chosen arbitrarily. Later fieldwork in Marovo, together with Karen Leivestad, has expanded this focus on molluscs (Hviding 1993; Hviding and Leivestad 1992).

Obviously, the study reported here just skimmed the surface of what Marovo people know about their marine resources, and we hope it will encourage others to follow up with more detailed research in this biologically diverse region, such as that represented by Hamilton's work (1999) concerning Carangidae in Roviana Lagoon and the wide-ranging investigation of artisanal fishing, also in the Roviana area, by Aswani (1997). Time is of the essence: some of this knowledge is disappearing as the older people who possess it in its richest form are dying.

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New publications

Traditional marine resource management and knowledge

Protected marine reserves: a guide

By Callum M. Roberts and Julie P. Hawkins

Fully protected marine reserves are areas of the sea completely protected from fishing and other extractive or harmful human uses. Since the first fully protected reserves were established, more than two decades ago, they have stimulated a wealth of research and intense interest. Recent scientific evidence indicates that reserves are not only powerful tools for conservation, but can also provide much needed support for fisheries. There is an urgent need for more reserves in order to address the developing crisis in the oceans. Worldwide, fisheries are in trouble, and habitats and species are being lost at an alarming rate. However, decision-makers need good scientific information on how to make reserves work successfully. Questions such as 'how do reserves function?', 'how many should we have?', and 'where should we put them?' are challenging the minds of scientists, conservationists and managers everywhere. The case for marine reserve establishment gets stronger with every new study published and scientists are making good headway in developing a detailed theoretical basis for fully protected reserves, supported by good quality data.

People responsible for establishing marine reserves are rarely scientists. Few of those who lobby hardest will have a doctorate in fisheries biology or ecology, nor will the people who decide whether or not to implement protection. People who fish and whose livelihoods will be directly affected by reserves, are educated by the sea itself. Yet all of them, be they fishers, conservationists or government ministers, need clear answers to basic questions and concerns about reserves. For any non-specialist, whatever their level of education, this can be problematic. Scientific papers are difficult to read and can be hard to acquire. Scientific research can also take years from completion to publication as it grinds through peer review, then joins the queue for a journal slot. The most recent research, while much talked about among scientists, is thus generally inaccessible to those who need it most. The aim of this information pack is to summarise the scientific case for fully protected reserves in a way that is easily understood by everyone. Our objective in producing it is to speed up the process of translating scientific research into action. The pack is particularly aimed towards people who need information to inform and persuade others of the benefits of reserves. They include, for example, those working to set up community-based management of marine resources, park or fishery managers, and policy makers. Since people who will be affected by reserves must be willing to place their faith, and possibly risk their livelihoods, on conclusions