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Editor's note

It is my profoundly sad duty to inform those who have not yet heard that Robert E. Johannes has passed away. Bob died on 4 September 2002, after a long and valiant struggle. All of us miss him deeply, but none more than his wife Christa and son Greg. We send them our deepest sympathy.

Many things are being planned in Bob's memory. One is that the next issue of this information bulletin will be devoted to him. Many contributions have been already promised, and we invite all readers who wish to contribute something about Bob to e-mail their contribution to me at ii3k-rddl@asahi-net.or.jp. Please send it as soon as possible, as we'd like to have the next issue ready by the end of the year.

Bob Johannes contributed greatly to the establishment of this Information Bulletin, and he was a frequent contributor. So it is fitting that he is an author of two of the three articles in this issue.

In the first, 'Did indigenous conservation ethics exist?', Bob re-addresses one of his strongly held beliefs, that establishing whether a conservation ethic exists in an indigenous culture is a vital first step in determining how to help its people live within their natural resource limits. Some societies understood that their marine resources were limited and introduced appropriate marine conservation measures, whereas others had no need to because their abundant marine resource base always exceeded harvesting pressure. 'A worldwide survey of relevant literature would show', Bob suggests, 'that societies that developed conscious conservation practices were usually small and relied on natural resources that were circumscribed and thus easily depleted.' Would somebody kindly undertake this topic as a doctoral dissertation?

Inside this issue

The second contribution is 'Evolution of village-based marine resource management in Vanuatu', by Francis R. Hickey and Bob Johannes. This article is condensed from their report to Environment and Development in Coastal Regions and Small Islands platform, UNESCO.

In l993 a study of coastal villages in Vanuatu revealed that within the previous three years there had been a rapid increase in marine resource management activities. The initial impetus for this was the Vanuatu Fisheries Department's promotion of a voluntary village-based trochus management programme. Initially the programme involved only a few fishing villages out of a total of several hundred. The l993 study revealed that villages that followed the Fisheries Department's advice found it so profitable that other villages quickly followed suit. Many villages decided to implement their own conservation measures to protect other marine animals. In 2001, the authors resurveyed 21 of the villages surveyed in 1993, to determine how successful these community-initiated management measures had been in the eyes of the villagers. The results revealed that village-based marine resource management measures had more than doubled between 1993 and 2001. There was a total of 40 MRM measures in the 21 villages in 1993. By 2001 five of these had lapsed but 51 new ones had been implemented.

The third article is by Armagan Sabetian, entitled 'The importance of ethnographic knowledge to fishery research design and management in the South Pacific: A case study from Kolombangara Island, Solomon Islands'. Armagan Sabetian recorded the structure of a traditional Solomon Island village fishing system to demonstrate the value of ethnographic knowledge in fishery research design and management. The purpose of conducting a baseline ethnographic study within an indigenous Melanesian village was first to record traditional fishing knowledge and behaviour through systematic interviewing, and second to record fishing activity through a CPUE survey.

Please keep you contributions coming. We need your news and announcements too.

Kenneth Ruddle

Did indigenous conservation ethics exist?

R.E. Johannes

Abstract

Despite the common assertion that some indigenous peoples were conservationists, a number of authors have claimed that persuasive evidence for this is lacking. They have, apparently, overlooked such evidence. It is well documented, for example, that centuries ago Pacific Islanders invented and employed all the basic marine conservation measures that Europeans began to use only in the early 1900s. For islanders to have devised and employed deliberate conservation measures, they first had to learn that their natural resources were limited. They could only have done so by depleting them. Evidence that a culture overharvested or otherwise damaged its natural resources at some period in its history is no proof that it was, for all times, non-conservationist. Some Pacific Island cultures learned that their marine resources were limited and introduced marine conservation measures accordingly. Others never learned this lesson because their marine resources always exceeded harvesting pressure. I suggest that a worldwide survey of relevant literature would show that societies that developed conscious conservation practices were usually small and relied on natural resources that were circumscribed and thus easily depleted. Today, in an era of shrinking natural resource frontiers, establishing whether a conservation ethic exists in an indigenous culture is a vital first step in determining how to help its people live within their natural resource limits.

Introduction

The widespread assertion that some societies possessed a conservation ethic — an awareness of their ability to deplete or otherwise damage their renewable natural resources, coupled with a commitment to reduce or eliminate the problem — is being questioned increasingly (Smith and Wishnie 2000). But the evidence used to support this negative view has been selective. Ignored, for example, has been the considerable published historical and anthropological evidence that centuries before the arrival of Europeans, a variety of Pacific Island cultures invented most of the marine resource management measures western countries use today — limited entry, closed seasons, closed areas, size limits, gear restrictions and the protection of spawning aggregations (Johannes 1978, 1981).

To be sure, Pacific Island fishers' actions were not always ecologically wise. Their fishing taboos did not always have conservation as their objective, nor did their explicit conservation measures always work (Johannes 1978). But this does not negate the considerable and widespread evidence that various Pacific Island fishing cultures possessed a marine conservation ethic and put it into practice (Johannes 1978, 1981).

However, Diamond (1986) in an article entitled 'The environmentalist myth' dismissed the notion that pre-industrial societies lived in harmony with nature. Many of his examples concerned Pacific Islanders. And recently, Jackson et al. (2001) published an article in *Science* implicating aboriginal cultures in the near-extinction of marine species, and disparaging the 'supposedly superior ecological wisdom of non-western societies'. How can we reconcile these assertions with the evidence for the existence of traditional marine conservation practices in Oceania?

Jackson et al. (2001) provided only two examples of the environmental excesses of indigenous marine fishers: one where they 'may have' contributed, along with fur traders, to the extinction of one marine mammal, and one where they brought about the severe depletion of another. To extrapolate from a sample size of two to a general dismissal of the ecological wisdom of non-western societies is not persuasive.

In discussing Pacific Islanders' environmental problems, Diamond (1986) focused on the terrestrial environment. His list of extinctions of terrestrial fauna that occurred after human occupation of these islands — but prior to western impact — has since been extended. Not a single paleontolog-

ically explored Pacific Island escaped a recent mass extinction of its larger fauna. In Hawaii alone, over 50 species of birds disappeared after human colonisation (Diamond 1991).

How could Pacific Islanders have developed complex marine conservation practices if their record in conserving terrestrial animals is so bad? The answer lies in both biology and human behaviour.

Birds were by far the most important endemic terrestrial animal food source on most tropical Pacific islands; on most of these islands the only indigenous mammals were bats. In much of Oceania, birds evolved in the absence of mammalian predators and showed no fear of humans. In addition, many were flightless. Coupled with their very low reproductive rate — as few as one egg per clutch — these characteristics suggest that some birds could have been eliminated so fast that some islanders failed to comprehend the need for their conservation until it was too late.

In any event, human harvesting was not the sole cause of these extinctions; there were other major, unintended and irreversible ecological consequences of human activities (Steadman 1997; Kirch 1983). One of the most ecologically devastating of their actions was the introduction of other mammalian predators — dogs, rats and pigs, whose ecological impacts were unlikely to have been anticipated (Kirch 1983). Birds were easy targets for these invaders — especially for the rats. So were bird eggs, especially those of the species of terns, boobies and tropicbirds that were ground-nesters.

The destruction of habitat of the native fauna was also extensive on some islands, due to land clearing for farming. This seriously accelerated erosion from elevated areas and soil deposition in lowland areas, greatly modifying both habitats (Olson and James 1984). In addition, the introduction of alien plants blanketed large areas at the expense of endemic species that had provided local fauna with food and habitat (Kirch 1983).

Once full awareness of the ecological consequences of such problems developed, there was little or nothing that could have been done to reverse them, no matter how concerned about them islanders might have become. Moreover, the depletion of terrestrial sources of animal protein would have posed in itself no great nutritional threat to islanders living near the sea as long as their reefs, lagoons and nearshore pelagic waters continued to yield plenty of seafood.

Marine fauna harder to deplete

Few of the terrestrial ecological changes brought about by the islanders had any marine counterparts. There were, for example, no known introductions of foreign marine species into Oceania until after European colonisation (Eldredge 1994). Technology, moreover, was unavailable to affect the marine environment nearly so dramatically as the islanders affected their terrestrial environments. There was no underwater equivalent to land clearing through cutting trees or the use of fire.

As human populations increased on many islands, seafood often became a vital source of animal protein.[1] Pressure on marine resources intensified. We can see this reflected in the decline with time in mean sizes of marine species in Pacific Island middens. There are also declines with time in shallow water species easily harvested on foot, along with increases in species requiring greater efforts to harvest in deeper water (Dalzell 1998).

Whereas it was possible to severely *deplete* some nearshore marine species, it was nearly impossible to *exterminate* the great majority of them.[2] Because of the high fecundity and pelagic larvae characteristic of tropical marine fish and invertebrates, a single spawner can often spread thousands to millions of its progeny over thousands of square kilometres. Thus, even after severe overharvesting, populations of tropical marine fish and invertebrates will often rebound when given adequate protection (McKinney 1998).

So the time available for islanders to develop an awareness of the need for conservation of their seafood stocks would have been far longer than it was for their indigenous land animals. And conserving their marine fauna was not nearly so impeded by the unintended, irreversible consequences of some of their activities as was conserving their terrestrial fauna.

Discovering resource limits

It is sometimes said that island peoples discovered their environmental limits more easily than did continental peoples (Roberts and Hawkins 2000). This seems likely, but it would have almost

1. Dalzell and Adams (1996) have calculated that annual 'finfish yields in the range of 5–20 t/km^2 are probably sustainable in Pacific Island coral reef fisheries in the long term'.
2. McKinney (1998) reviews data indicating that 'marine taxa tend to have consistently lower extinction rates (than terrestrial taxa) during geological time as well as the current extinction crisis'.

certainly been only because they *exceeded* those limits more easily; it is a maxim among natural resource biologists that, even today, it is not possible to know a renewable natural resource's sustainable yield without first exceeding that yield (Brower 1974; Walters and Hillborn 1976; Ludwig et al. 1993).

When islanders' coastal populations increased to the point where they began to push their marine harvest limits, either they took steps to address the problem or they faced much more serious food shortages than the decline of their terrestrial fauna would have posed. They could not simply move on like many continental dwellers.

Yet some Pacific Island societies never became aware that their seafood supply was limited. Indeed, until about a century ago, Europeans did not foresee the limits of *their* marine fisheries either, because the available supply was so much greater than the demand. This is encapsulated in T.H. Huxley's much-cited statement, made in 1884, that 'all the world's great sea fisheries are inexhaustible'.[3]

Some islanders, likewise, lived in areas where marine resources always exceeded their needs; they literally could not deplete them (Huxley 1884; Chapman 1985). This is because their marine resource needs were kept low in relation to their supplies by: warfare and disease; living on a large island with plenty of terrestrial animal protein, such as on mainland Papua New Guinea; or possessing a small land area — and thus limited scope for human population growth — but large fishing grounds.

The inhabitants of the tiny islands in Torres Strait, for example — whose population apparently never exceeded about 5000 until very recently — have lived surrounded by 30,000 km^2 of shallow, productive marine waters. Their marine resources were thus functionally unlimited. Not surprisingly then, these islanders show no evidence of having possessed a traditional marine conservation ethic (Johannes and MacFarlane 1991).

The continuing debate about whether indigenous peoples in general had or did not have a conservation ethic is a waste of time, as well as a descent into stereotyping. Clearly some did, some didn't.[4] Those who did conserve their natural resources at one stage in their history almost certainly did not at an earlier stage before they learned that their natural resources had practical limits. Yet some authors have been moved to generalise freely on this question based on evidence too limited in time, space and/or in terms of numbers of cultures studied.

The recent example of Jackson et al. (2001) has already been mentioned. Another extreme example is Kay's conclusion that 'Native Americans had no effective conservation practices' based on his studies of their harvesting of ungulates in western North America (Kay 1994). Kirch (1984) stated that 'recent evidence shows this view — that prehistoric Pacific Island peoples practised conservation — to be false'. But he considered only their impacts on terrestrial environments. Yet it was the outer edge of their fishing grounds, not the water's edge, where islanders' food resource frontiers ended.

In short, if a culture never exceeded the sustainable limits of its natural resources then we should not expect it to have developed a conservation ethic. Moreover, those cultures that did possess such an ethic must have overharvested their natural resources earlier in their history. How else could they have learned that their natural resources had limits? This is not knowledge our species is born with.

Thus, evidence for resource depletion during one time period cannot be used in isolation to argue that people were anti-conservationist throughout their history. Some learned their lesson in time to survive and prosper, like many Pacific Island fishing cultures. Others did not and paid the price. The Easter Islanders provide a striking Pacific Island example. They cut down every tree on their once-forested island. Among the penalties they paid was that they no longer had any logs from which to make canoes, and so not only depleted the land but also made their marine resources relatively inaccessible. The society disintegrated, there was starvation, warfare and cannibalism ensued and the population collapsed (Kirch 1984; Diamond 1988). Other cultures never learned the lesson because nature never taught it to them — such as the Torres Strait Island fishers mentioned above.

3. Today this does not always preclude roughly estimating one's natural resource limits using information derived from research done on sustainable yields of similar resources elsewhere, but such information was unavailable until recently.

4. Diamond seems to have changed his emphasis since he wrote 'The conservationist myth' (Diamond 1986). Five years later (Diamond 1991) he wrote, 'It is still true that small, long established egalitarian societies tend to evolve conservation practices, because they have plenty of time to get to know their local environment and to perceive their own self-interest.'

A hypothesis

Kay (1995) stated: 'The question of the conditions under which people conserve their resources, as determined from the historical record, remains a perplexing yet important one for future study. Obviously, we would like to learn from the past to avoid negative environmental impacts.'

The above discussion suggests a hypothesis with which to examine this question. As noted, it was necessary to exceed one's environmental limits before becoming aware of them, and this could only be accomplished if these resources were limited relative to demand. Historically, such conditions were most likely to be found in small, non-nomadic societies whose natural resources were circumscribed either by geography — obvious examples would be societies living around oases or on small oceanic islands or that were heavily dependent upon the resources of small water bodies — or by other hostile surrounding human populations. Conservation ethics were least likely to have evolved among those pre-industrial continental dwellers that had access to what seemed like limitless natural resource frontiers. A systematic survey of the relevant global literature should provide a test of this hypothesis.

Whether or not a culture has a conservation ethic is not just an academic question. Many efforts are being made around the world today to assist indigenous peoples to manage their marine resources better, such as in Southeast Asia and Oceania. And some of the results are promising (Alcala 1998; Adams 1998; Fa'asili and Kelokelo 1999; Johannes and Hickey 2001). How we best help to encourage people to live in better balance with their natural resources today depends on knowing their traditional attitudes towards these resources. Traditional resource management systems were not designed to cope with the stresses that the introduction of modern technologies, money economies and export markets has visited on indigenous cultures. But, where an indigenous conservation ethic exists, government agencies or NGOs that wish to help people live sustainably need to understand this ethic so they can help build on it. People are more likely to be receptive to suggested changes to their resource use patterns if these changes are founded on their own values and customs.

Where a conservation ethic is absent, outside agents of improved natural resource management must begin at the beginning and try to introduce one by means of education. Otherwise their efforts to encourage improved natural resource management are likely to fail. On the other hand, research may well reveal that newly developed conservation ethics are arising with increasing frequency among indigenous cultures, even without substantial outside encouragement, as awareness that their natural resources are limited is forcing itself increasingly upon them.

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Recent evolution of village-based marine resource management in Vanuatu

F.R. Hickey[1] and R.E. Johannes

This article is a condensed version of 'Evolution of village-based marine resource management in Vanuatu between 1993 and 2001', by R.E. Johannes and F.R. Hickey, a report to the Coastal Regions and Small Islands platform, UNESCO, available at http://www.unesco.org/csi/wise/indigenous/vanuatu.htm A full, illustrated version will be published by UNESCO as the first issue in its LINKS (Local and Indigenous Knowledge Systems) Series.

Abstract

In 1993 a study of coastal villages in Vanuatu revealed that within the previous three years there had been a rapid increase in marine resource management (MRM) activities. The initial impetus for these events was the Vanuatu Fisheries Department's promotion of a voluntary, village-based trochus management programme. Initially the programme involved only a few fishing villages out of a total of several hundred. The Department surveyed their community trochus stocks, advised the people that regular several-year closures of their trochus fishery, followed by brief openings, would generate far more profit than the usual practice of harvesting continually. They left it to the villagers to decide whether or not to act on this advice.

The 1993 study revealed that villages that followed this advice found it so profitable that other villages quickly followed suit. Moreover, seeing what conservation could do for their trochus stocks, many villages decided to implement their own conservation measures to protect other marine animals, including finfishes, lobsters, clams, beche-de-mer (sea cucumbers)[2] and crabs, as well as to ban or restrict certain harmful fishing practices such as night spearfishing and the use of nets, especially gill nets. One of the surveyed villages set up a marine protected area and stocked it with giant clams (*Tridacna* spp. and *Hippopus hippopus*).

In 2001, we resurveyed 21 of the villages surveyed in 1993 to determine how successful these community-initiated management measures had been in the eyes of the villagers. This was done by determining how many MRM measures had lapsed and how many new ones had been initiated. Our reasoning was that maintaining or increasing MRM measures, which all entail short- or medium-term sacrifices to fishers, would only happen if the fishers thought they were worth the longer-term benefits.

Our results revealed that village-based MRM measures had more than doubled between 1993 and 2001. There were a total of 40 MRM measures in the 21 villages in 1993. By 2001 five of these had lapsed but 51 new ones had been implemented.

While the Fisheries Department continued its seminal extension work in the villages, and broadened its scope, another potent source of motivation for village-based MRM that emerged in 1995 was the locally renowned travelling theatre group called Wan Smolbag (WSB). WSB brought to many villages a play on the plight of sea turtles. WSB's efforts were catalytic as 11 of the 21 villages we surveyed banned or restricted harvesting of turtles within the next several years**.** None of the villages controlled turtle harvesting when they were surveyed in 1993. WSB also encouraged many villages to select 'turtle monitors' to tag turtles and to help oversee the conservation of turtles and turtle eggs in their villages.

1. Vanuatu Cultural Centre, PO Box 1655, Port Vila, Vanuatu.

2. The term beche-de-mer more properly applies to the dried commercial product produced from various sea cucumbers, but is often also used to refer to the live animal in Vanuatu and some other areas. Trepang is another term commonly used in parts of the Indo-Pacific.

Several lessons emerged from our study:

1. When properly targeted, village education on marine conservation can be a very powerful tool. In addition to the proliferation of village-based MRM initiatives, the observance of national marine conservation laws was enhanced. An important reason for villagers disobeying these regulations in the past was found to be their widespread ignorance of them or of their rationale. Once informed of these laws and their justifications, villagers' observance of these regulations was reportedly much improved.

2. The initial focus of both the Fisheries Department and WSB on single important animals (e.g. trochus and turtle) seems to have been more effective in enhancing village conservation awareness than if the more complex goal of total coastal resource management had been targeted right away. This broader objective can be phased in later. This is now being done by both the Fisheries Department and WSB.

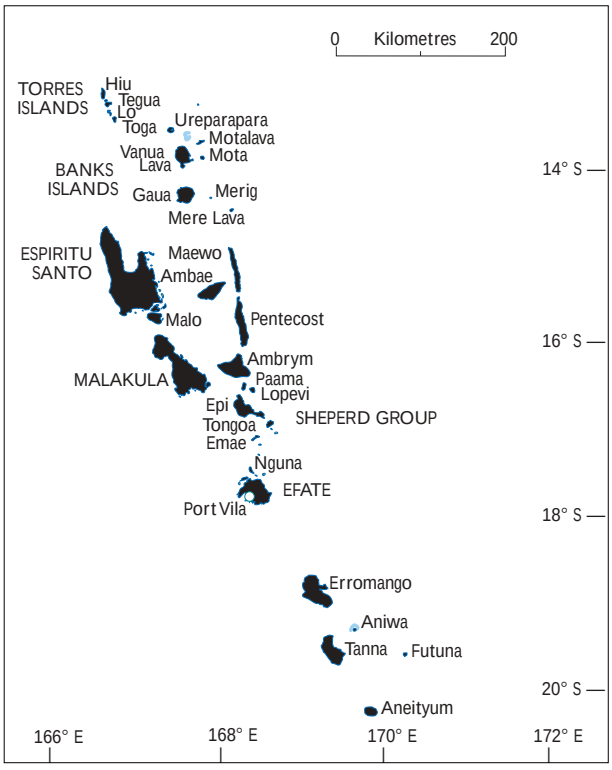
3. The Fisheries Department emphasises that customary marine tenure (CMT) — the traditional right of villagers to control activities on their traditional fishing grounds and to exclude outsiders — provides the essential foundation for nearshore MRM in Vanuatu. This study supports this contention. The mean number of MRM measures in effect in the eight villages that reported CMT disputes was less than half the number in the 13 villages that reported no such disputes, and the difference was highly statistically significant.

4. One way of encouraging the resolution of CMT disputes is the withholding of outside MRM assistance from villages where such disputes are active.

5. Government personnel and aid donors need to be aware of the fact that subsistence fishing in nearshore waters is worth more in almost all Pacific Island economies (including Vanuatu's) than nearshore commercial fishing. The distribution of government fisheries management resources often suggests government personnel and aid donors believe the opposite. Fisheries extension work targeting village-based MRM deserves greater support.

Introduction

Vanuatu is situated about 2000 km east of northern Australia between roughly 12°S and 22°S. There are over 80 islands, 67 of which are inhabited. The population is about 187,000, and 78.5 per cent live in rural areas. Seventy per cent live along the coast. Overall there are about 790 villages, with an average population of less than 200. Reefs, mangroves and other shallow nearshore habitats are important sources of animal protein for this population. A Vanuatu Statistics Department survey reveals that collectively, 67 per cent of the households in the 21 villages we discuss here carry out subsistence harvesting of fish and other seafood, and 23 per cent sell some of their catch.



Vanuatu

Some reef animals are exported, or sent for sale to urban centres. Trochus, a marine snail whose shell is used for making buttons and inlay, and as an ingredient in certain paints, has been the single most important commercial marine product for many coastal villages. Through the 1980s trochus populations were typically overharvested, and yields became very low. Responding to this problem in 1990, the Vanuatu Fisheries Department initiated a programme to encourage communities to manage their trochus stocks (Amos 1993). Initially the programme was introduced in five fishing villages, which had responded positively

to radio announcements stating the availability of the Fisheries Department for such activities.

Hearing reports of the success of this programme, in late 1993 Johannes (1998a) interviewed villagers in 26 coastal villages in Vanuatu about their marine resource management. (We define a marine resource management measure as a measure employed deliberately to reduce or eliminate overfishing or other damaging human impacts on marine resources.) Villages that adopted the trochus management measures suggested by the Fisheries Department (harvest closures followed by short harvest periods plus strict observance of size limits) often reported much improved subsequent harvests.

Observing these successes, other villages not only began to emulate the initial five villages, but many also extended their management efforts to other marine resources. Johannes (1998a) found that 25 of the 26 villages surveyed had implemented MRM measures since 1990. These measures varied from village to village, but covered trochus, lobster, octopus, beche-de-mer (sea cucumbers), green snails, various clams, crabs, various types of reef fishes, and/or marine resources in general. They consisted of closures of certain areas or taboos (bans) on taking various species or on the use of certain fishing gear including spearguns and nets, especially gillnets (Johannes 1998a). The results of this modest initiative by the Fisheries Department, costing a few thousand dollars in the initial years, had a more positive impact on marine resource use than a multi-donor, aid-funded Vanuatu fisheries development project that cost tens of millions of dollars (Johannes 1998a).

Customary marine tenure

Understanding traditional marine resource-use rights is central to understanding marine resource management in Vanuatu. Rights to coastal waters contiguous to traditional land holdings are usually owned by the clans, chiefs or villages that own the land. Rights may be subdivided and allocated to individual heads of families. These rights are recognised in Chapter 12, Article 73 of the Constitution of Vanuatu, which states 'All land in the Republic belongs to the indigenous custom owners and their descendants.' 'Land' here includes 'land extending to the seaside of any offshore reef but no further', under the Land Reform Act (Cap. 123). In addition to providing the foundation for all village-based MRM measures (see below), CMT also contributes to the equitable distribution of the harvest and spreads fishing effort.

The initiator of the Department of Fisheries trochus management programme (and now Director of the Department) is Mr Moses Amos. He stressed to the authors that the fundamental cultural institution that provides the foundation for village-based management in Vanuatu is CMT. He also stated that CMT forms the primary link between the Department and the communities. Where ownership disputes (see below) weaken CMT, the Department will not invest efforts in MRM support.

Methods

Here we describe the results of interviews carried out in 2001 in 21 of the villages studied originally by Johannes in 1993. We sought to determine the extent to which these management efforts were now perceived as succeeding or failing. Statistically sound before-and-after marine biological surveys in each of these villages' fishing grounds would have been extremely expensive and time-consuming. Villagers' testimony as to the effectiveness of these measures could sometimes be coloured by a desire to impress the interviewer. With these two problems in mind we used two criteria indicators to measure the perceived success of these MRM measures.

The first criterion was whether or not these measures were still in effect. Like most conservation measures, the ones implemented in the early 1990s involved sacrifices by fishers. Closing trochus harvesting, for example, involved forgoing — for up to five years (the length of the longest closure) — the money that could be made from selling the shell. Closing reef areas to other types of fishing or putting a taboo on the use of certain types of fishing gear similarly involved sacrifice. We reasoned that if, after eight years, such sacrifices were judged worthwhile, the relevant management measures would still be operating.

A second criterion of the perception of villagers of the value of marine conservation is the extent to which they implemented additional MRM measures since 1993.

In compiling the list of village-based MRM measures here, we did not include national conservation laws[3] that village leaders were widely reported to be enforcing more actively than in the past. Greater efforts to educate villagers about marine conservation have made villagers and village leaders more aware of the existence of these laws and of the reasons for them. This, we were often told by village leaders, made villagers more supportive of them.

3. These laws set, for example, size limits on trochus, crayfish and green snail and ban the taking of turtle eggs or crayfish with eggs, or the use of poisons or explosives for fishing.

Another objective of our research was to identify lessons that might be useful in future efforts in Vanuatu and elsewhere to facilitate community-based MRM management and learn how outside agencies (governments, NGOs, aid-donors) might better assist with these activities.

The present study was carried out by F.R. Hickey under the direction of R.E. Johannes over a period of five weeks between June and August 200l. It involved informal interviews with villagers and with government officers and NGO personnel assisting with MRM in Vanuatu villages. A set of general questions was used to focus the interviews loosely, but informants were encouraged to range well beyond the immediate subjects of these questions if they chose. Johannes et al. (2000) have described why formal questionnaires may limit the scope of information obtained when used as the main tool in interviews with local natural resource users that involve broad subject areas.

Results and observations

There were a total of 40 MRM measures in the 21 villages in 1993. By 2001 five of these had lapsed and 51 new ones had been implemented (Tables 1 and 2).

Village-based MRM measures more than doubled in the 21 villages we surveyed, rising from a mean of 1.9 per village in 1993 to 4.1 in 2001 (Table 2).

Table 1. **Marine resource management initiatives in 21 Vanuatu villages, 1993 and 2001.**

		TRO	F.C	TUR	BDM	SPR	NET	MPA	G.CL	CRA	HAB	MSC	#
Anelgauhat	D	•	•		o							•	4
Mele		•	•										2
Mangililiu		•	•	o		•							4
Tanolio			o	o	o	o			o				5
Siviri		•		o	o				o				4
Saama		o		o									2
Emua		o	x	o	•								3
Paunangisu	D		x	o	o			o					3
Epao			x	o	•						o		3
Eton	D		o		o		o						3
Erakor						o	o				o		3
Marae	D	•	•									o	3
Lamen Bay		•	•[2]	o								•	5
Pescarus		•	•	o	o	•	•	o	o*	•			8
Lutas		•	•	o	o	o	o			o			7
Pelongk		•	•			•	o	•	•*	o		•o[3]	10
Litslits	D		•o										2
Uri			•o[2]	o	o	•	•	o[2]	o*	•		o[2]	12
Uripiv	D		•o			o	o						4
Norsup	D	x	x										0
Tautu	D												0
TOTAL		11	18	11	10	8	7	5	5	4	2	9	**86**[+]

TRO	trochus
F.C	fishing ground closures
TUR	turtles
BDM	beche-de-mer
SPR	spearfishing
NET	use of nets
MPA	marine protected areas
G.CL	giant clams
CRA	crabs
HAB	fishing methods destructive of habitat
MSC	miscellaneous

D	Marine tenure disputes current
•	Operating in both 1993 and 2001
o	Operating in 2001
x	Operating in 1993 but since lapsed
#	Total number of village management initiatives in effect in 200
2,3	Numerals indicate more than one such initiative operating in a village.
*	Giant clam initiative that is also listed as MPA.
TOTAL	Total number of village management measures of each type in
+	This figure is 3 less that the sum of the totals for each MRM me because the 3 giant clam sanctuaries in which all other species protected are also listed as MPAs, but were not double-counted calculate the total.

Table 2. **Number of MRM measures in 21 Vanuatu villages, 1993 and 2001**

	1993	2001
Total MRM measures operating	40	86
Average number per village	1.9	4.1
Lapsed MRM measures since 1993		5

The most often used MRM measures in 2001 were fishing ground closures (18), trochus closures (11), taboos on taking turtles (11), beche-de-mer closures (10), spearfishing taboos (8) and taboos on using nets (7). All of the turtle taboos had been implemented since 1993.

Of the five measures that lapsed, three involved fishing ground closures. But during the same period six such closures were initiated in five other villages.

The three Maskelyne island villages we surveyed had an average of 8.7 MRM measures — more than twice as many as the mean number (4.1) of MRM management measures for all 21 villages surveyed. We surmise that this may reflect their relatively heavy dependence on their rich marine resources for subsistence and as a means to generate cash, which provides the incentive to manage the resources well. These villages are on small islands with limited agricultural potential. (They have additional agricultural land on the mainland but it is somewhat far from villages.)

A recurring theme among those interviewed was that the experience of the past decade has shown that if village reefs are divided into several sections with different owners, MRM measures will be more effective if the owners cooperate to manage the entire area as a single unit, rather than managing different sections independently.

Enforcement

The punishment for breaking MRM taboos ranges from simple admonition to fines in the form of money and/or food and kava.[4] The largest fine we heard of was in Pelongk — two pigs, two 25-kg bags of rice, six kava roots, some other food plus VUV 30,000 (about USD 200). This is a very high price to pay for the average rural villager. Some villagers also mentioned the shame and embarrassment involved in being caught and fined in village court. This comment applies mainly to villages where respect for traditional authority it still high. As mentioned earlier this respect tends to be weaker in peri-urban villages.

Trochus and green snail

Trochus is probably the most easily managed of all reef resources. The species moves only short distances during its adult life and its populations are relatively easy to census. It is also the single most profitable commercial marine product in rural Vanuatu.

The enthusiasm of villagers for the results of their trochus management is often based on easily measurable results (e.g. sales receipts). Fisheries Department surveys, or surveys made by villagers trained by them, can readily demonstrate when a trochus ground is ready to be harvested.

Green snails, another species whose shell is exported for inlay, are generally subject to the same village-based regulations as trochus. They had been heavily overfished in most areas in the 1980s. They reach maturity at about the same age as trochus and one individual can produce millions of eggs with larvae that, like trochus larvae, settle soon after they are released (Yamaguchi 1993). Under the circumstances one might expect green snail stocks to respond well to the same closure periods as trochus, but this does not seem to be the case. Yamaguchi (1993) refers to 'the rapid depletion of green snail in actively fished areas and the slow rate at which populations re-establish after termination of fishing'. Green snails have become so depleted throughout most of the area surveyed that some teenagers have never even seen one.

Sea turtles

Taboos on taking sea turtles constituted the largest fraction of the new regulations (11 out of 51) and involved the most villages (11 out of 21). Clearly there has been an unprecedented enthusiasm for turtle conservation in many villages since 1993.

Whereas it is against national law to dig turtle eggs, there is no national law in Vanuatu prohibiting the taking of adult turtles. Until recently in most coastal communities they were killed whenever the opportunity arose. In 1993 no villages sur-

4. Kava (*Piper methysticum*) is a large root from which an extremely popular and mildly intoxicating drink is made.

veyed mentioned a ban on the taking of turtles. Now more than half the communities interviewed did so. The reason for this striking change is unusual and instructive.

Many Vanuatu villages are visited periodically by a locally celebrated travelling theatre group called Wan Smolbag[5] (WSB). Operating since 1989, this group has made many village tours, putting on plays that simultaneously entertain and inform villagers about important issues such as HIV / AIDS, malaria reduction through mosquito control, etc.

In 1995 the theme of the main play they presented in the villages was the plight of sea turtles and the need to conserve them. The villagers were apparently receptive to this message in part because, as many informants told us, they were already aware of a marked decline in turtle numbers in their waters over the previous several decades.

Not only did WSB suggest that turtles should not be killed, but also that each village should select a 'turtle monitor' to help encourage turtle conservation and to tag nesting turtles and turtles caught in nets before they are released. There are now 150 turtle monitors in roughly 80 Vanuatu coastal villages. In 11 of the 21 villages where we interviewed, turtle monitors had been appointed. Two of these villages appointed two turtle monitors. Turtle monitors also report to village leaders anyone who is found taking turtles or turtle eggs. Some of them have taken it upon themselves to post signs at nesting beaches during the egg-laying season to remind people that it is illegal to take the eggs. Communities that do not have turtle monitors reportedly continue to take turtles whenever they can.

Some villages we surveyed now ban the killing of turtles outright. In general, only communities with turtle monitors have recently put taboos on their harvesting and in such villages compliance with the government prohibition on disturbing turtle nests has also generally increased.

In some other villages people are allowed by their leaders to kill one or more turtles only on special occasions. Where these regulations were in effect a number of informants reported now seeing many more turtles in their waters than they had seen for many years.[6]

A 'namele' leaf at Erakor used to indicate that all fishing has been recently closed in this area until the village chief removes the leaf.

A taboo leaf at Lamen Bay used to indicate that a clan's fishing area is closed due to the death of a clan member.

5. The name means 'one small bag' in Melanesian pidgin and refers to the fact that this is all the company needs for carrying its theatre equipment.
6. Due to these animals' low growth rates, adult turtle numbers in Vanuatu could not have increased significantly during just a few years' protection. But local numbers in protected village waters could be expected to increase within this time simply due to the turtles not being harvested and being quite mobile (i.e. moving in from elsewhere). Protecting turtle eggs could, of course, have an immediate positive effect on reproductive success.

Experience in many other Pacific Islands has been that protecting sea turtles is one of the hardest conservation measures to persuade islanders to observe. The World Bank (1999) 'found that the perceived compliance with turtle regulations was very low' and was perceived (during a survey of attitudes in Pacific Island communities) to be quite poor. Communities felt such rules conflicted with cultural obligations, such as the custom in some villages of giving turtles to chiefs, and that 'turtle meat was just too tempting to resist'. Wan Smolbag's accomplishments in this regard seem to be setting a new standard.

With World Wildlife Fund and European Union funding and Department of Fisheries participation, WSB now runs workshops to train turtle monitors. At their most recent meeting in June 2001, the turtle monitors voted to broaden their mandate to coastal resources in general, and to change their name to Vanua-tai Resource Managers (vanua = land, tai = sea). In addition, Wan Smolbag's latest play, still in the planning stages, concerns a wider range of issues of coastal resource management. WSB is shaping up to become an important conservation force in Vanuatu.

Finfish

The costs of obtaining statistically sound information on fisheries and fish stocks in so many villages would doubtless greatly outweigh the potential benefits (e.g. Johannes 1998b). Mees (1999) was unable to demonstrate differences in abundance of finfishes in open and closed reefs in five Vanuatu villages. But his data consisted of an average of only two underwater visual censuses per fishing ground, each of which consisted of counting fishes within a 7-m radius of a stationary diver. The statistical power of these data was thus very low.

Russ and Alcala (1996), however, present more persuasive data from the Philippines (and cite other studies) that support their statement that gains in biomass of finfishes 'of a magnitude potentially useful in fisheries management are likely to occur in reserves on scales of 5–10 years, rather than just a few years'.[7] With a few exceptions, total finfishing closures reported to us in 2001 in Vanuatu villages lasted from six months to three years, with a mean of about 1.5 years.[8] According to Russ and Alcala (1996) even the longest of these bans would be too short to be of much value as a conservation measure for large predatory reef fish.

Short closures, properly timed, could facilitate greater spawning. But the consequent potential for improved reef fish production would take even longer to manifest itself. In addition, much of it would generally occur outside the fishing grounds where the spawning occurred because of the small size of most of these tenured fishing grounds and the prolonged pelagic larvae stage of most reef fishes. Short closures of fishing grounds to destructive fishing methods, such as using small mesh nets or night spearfishing for bumphead parrotfish (*Bolbometopon muricatum*) could reduce their effects on stocks, but only where such destructive fishing practices occur.

Why, then, do Vanuatu villagers persist with relatively short closures for finfishing? The same answer to this question came up repeatedly in our interviews. When constantly pursued by fishers, reef fish tend to get 'wild' (i.e. harder to approach in order to spear them),[9] and harder to scare into nets. 'Resting' the fish for a period causes them to lose their caution and makes them easier to catch.

After sufficiently long closures, marine protected areas (MPAs) have proven to benefit fisheries through the export of fish into adjacent fishing grounds (reviewed by Roberts and Hawkins 2000). Two of the villages we surveyed have declared portions of their fishing grounds as MPAs (Ringi te Suh of Pelongk and Narong Park of Uri) and two others, Mele and Paunangisu, were indefinitely protecting their marine resources in areas important to tourists. In addition, several other communities said they were planning to introduce MPAs.

The establishment of MPAs in countries such as Vanuatu, where traditional marine tenure exists, raises both novel problems and novel opportunities. Briefly, establishing MPAs in traditionally tenured Pacific Island waters requires obtaining the permission and cooperation of tenure owners after providing incentives to reassure them that they have more to gain than to lose from them. Larger MPAs would often require obtaining the permission and agreement of several groups of tenure owners. This would seldom be an easy task.

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7. Short-lived, faster growing herbivores and small predators would increase in biomass more quickly than this.
8. There are, however, two MPAs in the villages we surveyed that have been closed for periods of about 8 and 10 years.
9. As any spearfisher who has stalked reef fish in both fished and unfished waters quickly learns, fish in the unfished waters are far less wary of the approaching diver and present much easier targets.

On the other hand, once established, MPAs would be more likely to attract strong surveillance and enforcement by local people because of their traditional defence of local fishing grounds.

In developing countries where, unlike Vanuatu, local marine tenure does not exist, or is not widespread or not recognised by the government, surveillance and enforcement are typically weak to non-existent in MPAs. Hence the preponderance of 'paper' MPAs in some of these countries (e.g. Alder 1996).

What about the efficacy of taboos on specific fishing methods such as night spearfishing and netting? There is increasing circumstantial evidence that the banning of night spearfishing helps conserve parrotfish (especially the prized bumphead parrotfish, *Bolbometopon muricatum*), which sleep in shallow water during part of the lunar month and are then very easy targets for night spearfishers.

Fishers in many Pacific Islands are critical of the impact that night spearfishing has on these fish. For this reason, banning of night spearfishing is one of the most common management measures that have been implemented in the Pacific Islands in the past 25 years (Johannes 1978; Fa'asili and Kelokolo 1999; Hviding 1996; Dulvy and Polunin in revision; Johannes unpublished). Dulvy and Polunin (in press) have demonstrated that the bumphead parrotfish is probably extinct around at least six islands and rare around the six others they surveyed in an area of Fiji where it was once reportedly abundant. In some Vanuatu villages, night spearfishing is banned for part of the year; in others it is banned throughout the year. Obviously the second alternative is preferable although seasonal banning of night spearfishing during spawning aggregations would clearly help protect various spawning species.

Over the past 25 years the ban on gill nets and other nets has been another management measure often initiated in Pacific Island villages (Johannes 1981 and unpublished; Hviding 1998) including seven of those in the present survey. This undoubtedly helps protect against catching undersized fish, unwanted species and more fish than are needed. In Vanuatu it also protects against overharvesting mullet and rabbitfish on their spawning migrations and in their spawning aggregations; the locations and timing of these are sometimes well known to village fishers. Johannes (1981 and unpublished) has been told by villagers in Papua New Guinea, Palau, Solomon Islands and Vanuatu of mullet migrations/aggregations no longer forming, because of their elimination by gillnetting during these vulnerable periods.

One argument for allowing gill net fishing at certain times and places is that it facilitates the capture of some species that are not readily caught by other methods, including mullet, *Selar* spp. and some species of rabbitfish.

Beche-de-mer

In recent years interest in harvesting beche-de-mer has decreased in many of the villages we surveyed. This was due, at least in part, to some unusual beliefs that have recently emerged concerning the roles of beche-de-mer in the ecology of local waters. Because beche-de-mer are sediment deposit feeders, the belief has apparently been fostered by some conservation personnel that they 'clean up the reef'. Many villagers have taken this comment to heart. In several villages informants said that their waters had become cloudier since the beche-de-mer populations had been overharvested, or that their waters had become clearer because ceasing to fish for beche-de-mer had allowed their numbers to increase. In some villages there was a belief that if beche-de-mer were overharvested this was likely to cause ciguatera (the development of toxicity of reef fish to humans as a result of consumption of a toxic dinoflagellate directly or via the food chain. Ciguatera is not uncommon in Vanuatu). In several other villages it was said that when beche-de-mer were fished out, the white sand turned yellow with algae, and that slimy green algae also proliferated.

Many sea cucumbers feed by using their tentacles to gather and ingest particles in the top few millimetres of sediment and digest the microbial coatings on them. Perhaps this reduces microbial growth that might otherwise turn some sediments yellow. Other species feed on hard substrates such as dead coral or coralline-algal pavements by ingesting the thin dusting of sediment and associated microbiota on them. This activity may prevent green algal slimes from proliferating. It is not clear why the absence of either of these activities due to the harvesting of the beche-de-mer would result in greater turbidity of the overlying water. We know of no scientific research that examines these questions.

In one village the belief was expressed that beche-de-mer give birth to certain reef fish and it was good to protect them for this reason. This belief may have arisen from the fact that certain small fish of the family Carapidae actually live within certain sea cucumbers, exiting via the cloacal opening at night in order to feed. Finding these fish inside sea cucumbers when processing them for the beche-de-mer trade could logically lead to the above conclusion.

Department of Fisheries extension activities

Since 1993 the Department began to focus less effort on fisheries development and more on fisheries extension work. The new focus for fisheries extension officers (FEOs) was to assist with the management of nearshore resources by providing advice and information to fishing communities. FEOs were provided with preliminary training in cooperative management through a ten-day workshop. The Research Section of the Department played an active role in this training and followed this up by working with FEOs in the field to help introduce this cooperative management approach. The Enforcement Officer was also involved.

Since then FEOs have made numerous awareness tours to villages in most parts of the country and have broadened their focus from trochus to all nearshore living resources. Their work, says the Department, has been responsible for numerous communities revitalising their traditional system of putting taboos on select resources, reef areas and fishing methods. This process was in part constrained by the loss of some Department personnel following a civil service strike in late 1993 and some were not re-recruited until 1997.

Starting in 1999 the Extension Services decided to help provide alternative sources of income for rural communities, in part to compensate for the sacrifices required in order to rebuild nearshore seafood stocks through closures and other taboos. It now spends roughly half its time on cooperative management and the other half on promoting some new (and old) development initiatives. The Extension Services underwent a name change to reflect this shift in focus and is now called the Rural Fisheries Development Program. The new initiatives to date include the culture of *Eucheuma* seaweed, giant clams and blacklip pearl oysters, revitalising the canoe enhancement programme (using local canoes for the deepwater fishery), deploying new fish aggregation devices to promote the pelagic fishery, and the reseeding of reefs with juvenile and adult trochus. The Department has also purchased five new ice plants to be placed at provincial centres to help redevelop the deepwater and pelagic fisheries.

Most of the above-noted initiatives are donor-funded. Ongoing training will also be provided to FEOs to enhance their ability to continue to provide the cooperative management needs of communities. For example, a workshop to train FEOs in basic reef assessment techniques is planned in 2002. With these skills, FEOs will be able to better assist communities in monitoring the impacts of exploitation and in managing their reefs.

A local conservation ethic?

A conservation ethic can be defined as an awareness of one's ability to overharvest or otherwise damage one's natural resources coupled with a commitment to reduce or eliminate the problem. A marine conservation ethic can be found in some tropical fishing cultures but not in others. Determining whether it exists or not is important: it determines how one goes about education for conservation. If a marine conservation ethic does not exist then village educators, such as fisheries extension officers, must begin at the beginning — they must first inculcate this ethic, which can be a very challenging job. Only then can they take the next step and promote specific conservation measures.

A marine conservation ethic is clearly in evidence in Vanuatu today. Anderson (1999) summarised the reasons given in the mid-1990s by representatives of 12 Vanuatu fishing villages for employing a total of 48 individual MRM measures. 'Enhancing', 'preserving' or 'protecting' resources was the explicit reason given for 43 of these measures. To 'finance village development' was given for five, 'to protect spawning fish' was given by three and 'a source of occasional income' was given by one. (More than one reason was given in several instances.)

Anderson stated it was apparent that additional 'implicit' reasons were operative in six instances. All of these related to protection or establishment of property rights. Villagers' appraisals of the observance of the 48 measures by fishers was 'good' in 37 instances, 'fair' in 10 instances and 'poor' in one instance.

This offers independent support for our observations that most villages we surveyed did manifest a marine conservation ethic; they were not only aware of the need for marine resource management in their waters but were also taking concrete actions to address this need. (Young men were most often singled out as the group least imbued with this ethic, and were usually identified as the main breakers of MRM taboos and government regulations.)

Marine tenure disputes

While CMT provides the basic foundation on which sound, village-based MRM in Vanuatu can operate, it does not guarantee it. Johannes (1998a) reported that reef ownership disputes interfered to varying degrees with MRM in Vanuatu in 1993. Ownership disputes were reported in five of the 21 villages in 1993 and in eight in 2001. While the difference is not statistically signifi-

cant, it is consistent with the prediction made by some village leaders to Johannes during his 1993 study; namely, that such disputes will increase as cash economies become increasingly important in rural Vanuatu and export markets and local populations increase (i.e. that disputes over natural resources will increase as these become more valuable) (Johannes 1998a).

Such disputes sometimes related initially to land tenure but had spilled over into contiguous fishing grounds. Aswani (1997) and Foale and Macintyre (2000) report similar disputes in areas in nearby Solomon Islands.

In 2001 the eight Vanuatu villages reporting ownership disputes had a mean of 2.25 MRM measures in place. In two of these villages there were none. In the 13 villages where no management disputes were reported, the mean number of MRM measures was 5.3. The difference was statistically significant ($P<0.01$). Our findings thus provide strong statistical support for the conclusion of the Vanuatu Fisheries Department that village-based MRM is stronger in the absence of CMT disputes.

There are six levels of resolution of fishing disputes available to Vanuatu fishing rights owners, ranging from adjudication involving heads of families, clans or villages up to the Supreme Court of Vanuatu (Johannes, 1998 a). Certain disputes were being adjudicated at the time of Johannes' 1993 study as well as the present study. The Fisheries Department's decision to withhold its support from villages with unresolved marine tenure dispute provides one incentive for villagers to resolve them. (Readers should also see the Addendum in this paper for further relevant information, as some of the information described here has now been superseded with the recent passage of the Land Tribunal Act.)

Reasons for quick adoption of new MRM measures

Clearly the upsurge in community interest in village-based MRM in the early 1990s has not abated. Some readers may be surprised at the alacrity with which Vanuatu villagers have continued to introduce new marine resource management measures that entail reducing their own fishing pressure.

One reason, already discussed, is customary marine tenure, which provides the foundation for MRM in Vanuatu. Fishing by uninvited outsiders (mainly people from nearby villages) is a relatively minor problem in most communities (especially in those with easily monitored fishing grounds) because it is against cultural norms. Villagers thus tend to reap most of the benefits of their self-restraint on the fishing grounds. Improved trochus yields due to sound management is a good example.

In addition, because Vanuatu's nearshore habitat consists mainly of narrow fringing reefs, village fishing grounds are typically small enough and close enough to the village for surveillance to be relatively easy. (Nevertheless poaching among adjacent communities, especially for trochus and other commercial species such as lobster is reportedly increasing, although it is still not a major problem in most villages surveyed.)

Another reason is that most individuals, families and/or clans own their own land. Raising various vegetable crops, pigs, fowl and cattle is widely practised. Thus, villagers have other foods to fall back on when they forgo fishing. In addition, excess produce and cash crops such as kava, copra, cacao and nuts can be sold for consumption in the capital, Port Vila, and other district centres or for export. This provides money to buy such things as inexpensive canned mackerel and corned beef, which are often available in village stores and have the advantage of an indefinite shelf life. In addition, as mentioned above, the Department of Fisheries is helping some villages to set up additional alternative income projects.

Furthermore, over centuries the people of Vanuatu have developed strong traditions of community organisation, leadership and systems of decision-making that govern their use and allocation of natural resources. Development, westernisation and the introduction of a money economy are weakening this organisation to varying degrees, especially in urban and peri-urban centres. But traditional rules and customs still provide the foundation of rural community organisation, leadership and collective behaviour. Thus, when rural village leaders declare taboos relating to fishing they are usually respected and observed by most.

Finally, villagers are becoming increasingly aware of the relationship between maintaining resources and winning tourist dollars.

Police support for customary law

Another relevant and interesting trend we encountered in some villages during this study is the increasing use of state police to informally support and back-up decisions made by the chiefs in peri-urban villages. Individuals who repeatedly ignore their chief's rulings and fines for breaking village taboos, including taboos relating to MRM, may be turned over to the police.

This is only done when a chief has exhausted other possibilities within the village to bring an individual into compliance. The miscreant is typically held by police overnight or longer in the local 'calaboose' (accommodation that is far from appealing) and encouraged to rethink their position on ignoring their chief's wishes. In this way, chiefs and police cooperate to maintain harmony within the village. The chief still makes the decisions, generally through consensus with his community, but the police are available to help enforce his rulings where necessary. This cooperation, to date, is done on an informal basis.

Most rural communities do not have police readily available to intervene in such situations. On most islands it is the chiefs that manage to maintain order and social harmony among their communities, as has been done for centuries. However, with the recent social changes brought about by the intrusion of western lifestyles and a shift away from respecting traditional institutions, many chiefs are feeling the need for some sort of support from the government to formalise their ability to enforce their rulings. As it is now, decisions made by chiefs in the village courts are not legally recognised. This situation is currently under review by the government, which has commissioned a 'Chief's Legislation Project' to explore this issue and survey the chiefs' viewpoints on this matter.

Their report was presented to government by the end of 2001. Depending on the recommendations of the project, the government may look toward enacting legislation to formally empower the chiefs' village court decisions. If this sort of formal recognition of village court is to eventuate, it would significantly strengthen the chiefs' abilities to enforce the communities' marine resource management decisions.

Conclusions

Our data indicate a high level of approval by villagers of their MRM measures; in the 21 villages surveyed only five out of 40 MRM measures had lapsed between 1993 and 2001 while 51 new MRM measures had been implemented. In only two villages were there fewer MRMs in 2001 than in 1993. One of those was one of the villages where there were marine tenure disputes. One way of encouraging the resolution of CMT disputes is withholding of outside MRM assistance from villages where such disputes are active. This is the policy of the Fisheries Department.

Reasons for success

There have been many attempts to generate improved MRM in Pacific Island villages and few seem to have achieved such widespread success as the turtle and trochus initiatives in Vanuatu[10].

Some of the factors that have influenced the growth in MRM in Vanuatu were already identified in the 1993 survey (Johannes 1998a). Customary marine tenure provides the foundation upon which MRM is built, refined and enforced in Vanuatu. Strong leadership and village cohesion are important in determining how well MRM functions. Villagers can benefit greatly from outside assistance to help focus and refine MRM initiatives to adapt to contemporary circumstances.

These conclusions are also relevant to a variety of other Pacific Islands where customary marine tenure is found (e.g. World Bank 1999). Are there, in addition, any unusual forces at work in Vanuatu in connection with MRM?

The upsurge in village-based MRM in Vanuatu since 1990 demonstrates clearly how outside assistance, when properly targeted, can generate major benefits. Certain elements of the assistance in Vanuatu are unusual and perhaps unique.

The demonstration of the value of trochus closures by the Vanuatu Fisheries Department was clearly the original catalytic influence on the growth of community based MRM — an influence that quickly motivated community experiments with other forms of MRM. The Department's extension work continues to the degree that its limited budget allows. Trochus management education has been carried out and juvenile trochus have been released in 25 villages around the country.

It has not been proven that trochus transplanting generally improves trochus populations any more than simple trochus ground closures would. However, the instigator of the programme, Mr Amos, says that trochus transplanting enhances communities' support for and compliance with trochus closures. This is due, he says, to the increased awareness associated with the training they get, along with their participation in restocking the reef with juvenile trochus and monitoring their stocks. Part of the increased commitment to trochus conservation seems also to be because the villagers were given something concrete (the juvenile trochus) and in return they feel more commit-

10. Samoa, using quite different extension methods has also seen a major upsurge in village-based MRM in the past few years (e.g. Fa'asili and Kelokolo 1999).

ted to regulating the resulting fishery. A strategy for further enhancing the feeling of community involvement in the trochus restocking is that the Fisheries Department actually borrows adult trochus from the community for breeding the stock they subsequently release there.

We suspect that an important common element in the Department of Fisheries' and WSB's catalytic initiatives[11] in village-based MRM is that both focused initially on a single important animal. Trochus are rural Vanuatu's most commercially valuable shallow water marine resource. Turtles are a highly esteemed food, and in some areas have customary significance. They are thus both of particular interest to coastal villagers.

Once villagers saw the benefits of trochus management, it encouraged them to think harder about how they could better manage their other marine resources. It would probably have been harder to motivate villagers, we suspect, if either of these initiatives had been based *from the start* on the more complex goal of improving MRM in general. WSB and the Department of Fisheries, as described above, are now heading in that direction, but only after having gained credibility through the turtle and trochus initiatives. (Perhaps noteworthy is the fact the play that WSB put on in the villages a year before the turtle play was entitled 'On the Reef' and was about the importance of protecting the total reef environment. It did not seem to have nearly the impact on village MRM as the turtle play, judging by villagers' comments.)

The effectiveness of enforcement of these regulations varies with the strength of village leadership, fishing ground geography (i.e. ease of surveillance) and presence or absence of tenure disputes. The fact that these regulations are not always effectively enforced, however, does not distinguish them from MRM regulation in most, if not all other countries, developing or developed.

Education — not just for villagers

Another lesson emerges from this study. Education is important in several ways. When national conservation regulations were explained to villagers and were perceived by them to coincide with village interests, they were often incorporated into village management. This greatly enhanced their observance, according to many informants. Ignorance of these laws and the reasons for them had previously been widespread in rural Vanuatu — as it was in the villages in five other Pacific Island countries surveyed recently by the World Bank (1999).

Effective enforcement of such regulations by central government agencies in developing countries such as Vanuatu is quite out of reach. In most cases they must be enforced by village authorities or not at all (see also World Bank 1999). They will not enforce them if they are not educated about their existence, their purpose and their ultimate value to the community. In managing coastal marine resources the villagers provide for free what the national government could not possibly afford to do itself. And even if it could, it would be extremely cost-ineffective (e.g. Johannes 1998b). This is why there is little effective government-based nearshore fisheries management in many Pacific Island countries.

Johannes and MacFarlane (1990) argued that Pacific Island fisheries extension work that focuses on fisheries management (in contrast to development) needed much greater emphasis. The present research reveals the benefits of this emphasis, along with the research of Johannes (1998a), Fa'asili and Kelokolo (1999) and World Bank (1999). Yet the World Bank's study of fishing communities in five Pacific Island countries in 1998 revealed that only 40 per cent of the 31 communities they surveyed had been visited by a government official to discuss coastal management issues during the previous decade, and that an average of only 25 per cent of fisheries department budgets were for extension work (including both management and development components).

Villagers are not the only ones needing more education concerning rural MRM. National governments need to realise that nearshore subsistence fisheries in almost every Pacific Island country are worth more than nearshore commercial fisheries (Dalzell et al. 1996). (The value of the subsistence catch was calculated by these authors as the price it would fetch if it were sold.) In the early 1990s according to these authors, subsistence fisheries in Vanuatu provided five times the catch of nearshore commercial fisheries and were worth almost l.5 times as much. If the foreign exchange

11. We do not intend to suggest that assistance by the Environmental Unit, The Vanuatu Cultural Centre and the Foundation for the Peoples of the South Pacific have not contributed significantly to village-based MRM in Vanuatu. They have. Their efforts have assisted certain villages to strengthen traditional management systems and to establish small MPAs, for example. But the two initiatives of the Fisheries Department and WSB have had by far the widest impacts on village-based MRM management throughout the country as a whole during the past decade.

cost of imports to support higher technology commercial fisheries were factored in, the benefit ratio of subsistence and commercial fishing would have increased further (Johannes 1998a). On economic grounds, then, extension work in rural fishing communities, where subsistence fishing usually dominates the catch, deserves a larger proportion of fisheries funding than it usually gets. Commercial fisheries almost always seem to get more attention when island politicians and aid donors decide on funding priorities.

Addendum

Commencing on 10 December 2001, the Land Tribunal Act was enacted in Vanuatu to provide 'for a system based on custom to resolve disputes about customary land' and including 'the waters within the outer edge of any reef adjacent to customary land'. This new legislation allows for the establishment of Village, Custom Sub Area, Custom Area and Island Land Tribunals to deal with all customary land disputes. Effectively, appeals of the Village Land Tribunal decisions can only go as far as the Island Land Tribunal, hence, under this new legislation, customary land disputes will be resolved through custom on the island where the dispute exists. Prior to the introduction of this legislation, most land disputes that could not be settled within the village were appealed all the way to the Supreme Court in the capital.

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The importance of ethnographic knowledge to fishery research design and management in the South Pacific: A case study from Kolombangara Island, Solomon Islands

Armagan Sabetian[1]

Introduction

The successful management of a multi-species reef fishery in a contemporary Pacific Island setting cannot solely be based on a purely ecological approach. Charles (2000) for example, states that 'Success in the pursuit of sustainability is closely linked to adoption of a sufficiently broad conception of the fishery as a system of interacting ecological, biophysical, economic, social and cultural components'.

Ethnographic knowledge is an integral component of any holistic approach and can provide fisheries managers with potentially critical information. Researchers working in traditional subsistence village settings would be wise not to disassociate the role of the local inhabitants with the marine environment. After all, it is the villagers that depend on the sustainability of management measures for their own long-term survival. They are also the people who are in constant contact with the marine environment and have access to a wide variety of knowledge, which may not be easily accessible to a visiting researcher.

Many traditional Pacific Island communities that exploit marine resources are guided by deeply entrenched customary marine tenure (CMT) systems, which are based on traditional marine knowledge (TMK). The benefits of local CMT systems and their ability to have a management impact are important issues that need to be researched and analysed if fishery officers are to be effective in implementing localised management strategies.

Ethnographic research, however, should not be limited to the investigation of CMT systems or traditional knowledge. Although potentially accurate and detailed ecological knowledge can be accessed from indigenous fishers, their fishing skills and behaviour also have an equally important role to play in the design of management systems, and these should be investigated.

Jentoft (1998), states that 'fisheries is an industry and fishing is a human activity, and it is through regulatory measures of fishing behaviour that we attempt to secure the viability of fish stocks'. Therefore, to manage well, you need to know not only the fish, but also the fishers and their fishing behaviour. Ethnographic studies clearly have an important role to play in understanding fisheries and in implementing effective management policies (Charles 2000).

Traditional marine knowledge is a term that refers to the customary knowledge of marine life within traditional indigenous communities. It is part of CMT systems, and the importance of this knowledge is increasingly being recognised by fisheries managers and integrated into biologically based management programmes. The volume of literature on TMK is increasing rapidly as researchers record and examine its accuracy. In the case of TMK in Solomon Islands, various authors (Lahn 1998; Lam 1998; Johannes and Lam 1999; Aswani 1999; Hamilton 1999; Hamilton and Walter 1999; Johannes and Hviding 2000) have been conducting research to show how it can be used within contemporary management systems.

Because of the enormous biodiversity of tropical marine life in the Pacific, scientific knowledge about many species is inadequate and so TMK has also proven to be a useful tool for providing baseline data for marine research programmes (Ruddle et al. 1992). Research carried out in Solomon Islands shows that the level of detailed knowledge held by some fishers about the ecology of many species is almost encyclopaedic (Aswani 1997;

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Hamilton 1999; Johannes and Hviding 2000). In particular this knowledge can be separated into three categories:

1. The location of fish aggregation areas and explanations of aggregating behaviour;
2. The behaviour of various species in relation to time, tide, lunar phase and depth; and
3. The use of appropriate fishing methods to capture particular species at particular times and places.

The basis of TMK is long-term observations of ecological conditions, coupled with mechanisms for relaying this information across generations. The fact that ethnographic knowledge is gained through experiences and passed down the generations also requires special consideration. By taking into account the length of time people have lived in the Pacific it can be appreciated that TMK has been well refined and perfected over many generations.

The core of TMK is held by experienced and usually older fishers who possess it in its richest form (Johannes and Hviding 2000). Changing socioeconomic factors have resulted in more and more people leaving their villages in search of work and moving away from a subsistence way of life. This presents a great risk where practical knowledge concerning the behaviour of many marine species may be lost if it is not recorded.

Taking heed of the integrated approach that many fishery researchers are advocating, the aim of this study is to record the structure of a traditional Solomon Island village fishing system in order to demonstrate the value of ethnographic knowledge in fishery research design and management. The purpose of conducting a baseline ethnographic study within an indigenous Melanesian village was, first, to record traditional fishing knowledge and behaviour through systematic interviewing, and second, to record fishing activity through a catch per unit of effort (CPUE) survey. The information gathered from these exercises has been used to satisfy the aim of this project, and also to highlight and discuss various issues with regards to ethnographic research in general.

Environmental and social background

Solomon Islands (Figure 1), the second largest archipelago in the southwest Pacific, consists of two roughly parallel island chains with six major island groups (Johannes and Lam 1999), lying between 5°S and 11°55'S, and 155°30'E and 162°55'E. The major islands in the north are Choiseul, Santa Isabel and Malaita and, in the south, New Georgia, Guadalcanal and San Cristobal (Makira). The nearest neighbours are Vanuatu to the southeast, and Papua New Guinea (Bougainville Island) to the west.

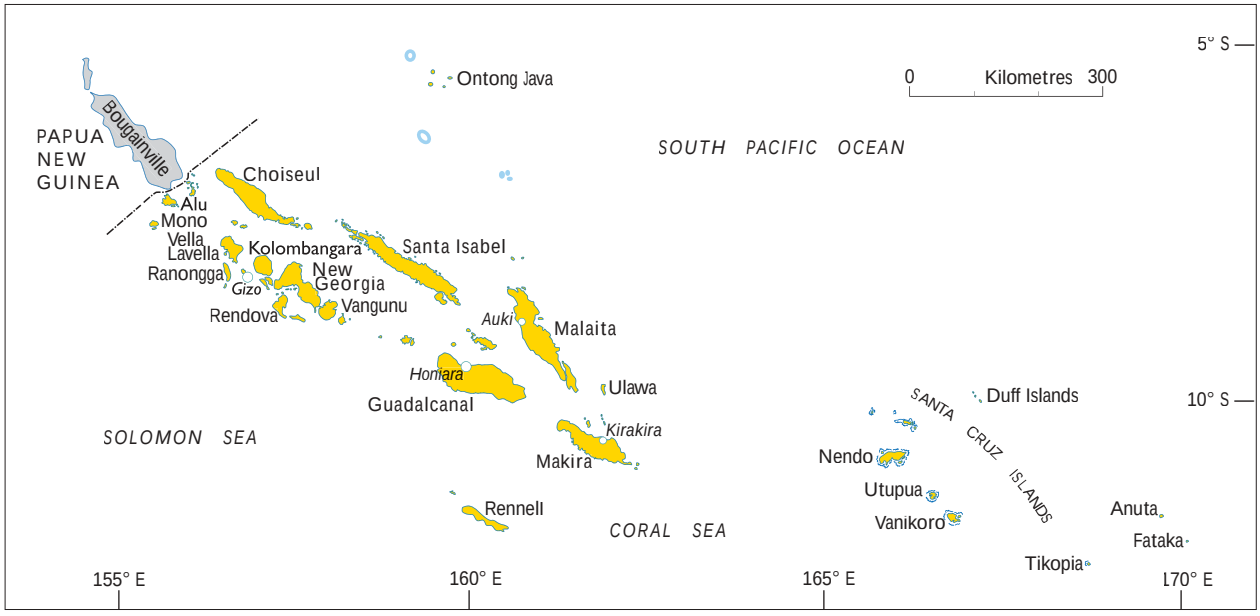

Figure 1. **Solomon Islands**

There are approximately 992 islands in the Solomons, giving a total landmass of about 28,000 km^2 (UNEP 1998). Tropical rainforests cover about 40 per cent of the landmass and the climate is predictably hot and humid. Solomon Islands displays a high rate of marine and terrestrial biodiversity, with a variety of small mammals such as opossums and bats, over 150 species of birds and a great abundance of tropical marine life (Leary 1993).

Kolombangara Island (Figure 2) is situated in the Western Province of the Solomons, at 7°55'S and 157°05'E. It is an extinct Pleistocene volcano, with an area of approximately 680 km^2, and a maximum elevation of 1768 m above sea level (UNEP 1998).

Burslem and Whitmore (1999) describe Kolombangara as having a tropical lowland evergreen rainforest, an aseasonal climate, an annual mean rainfall of 3150 mm, and an annual temperature range of 23 to 26°C. The local people speak *Nduke*, an Austronesian language, but Pijin can be used to communicate with most individuals.

Kolombangara means the 'water god', a reference to the plentiful supply of fresh water from rivers on the island. The island has a long history of logging and reafforestation, which began in the early 1900s. It was extensively logged during the last century after native timber was completely logged out on the nearby island of Ghizo, capital of the Western Province (Figure 2).

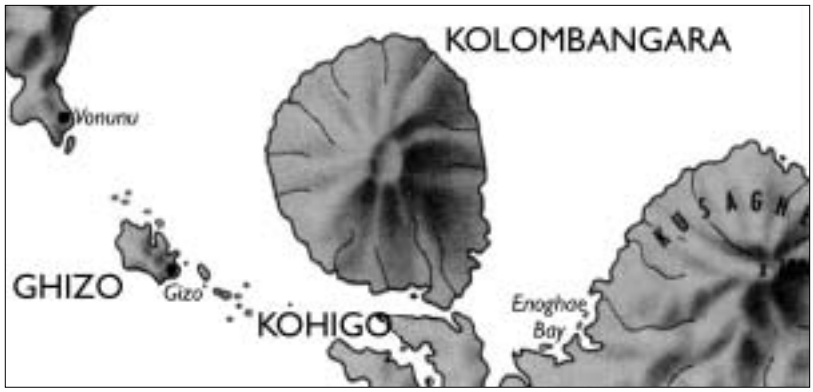

Figure 2. **Kolombangara Island**
(Source: Survey and Mapping Division, Honiara)

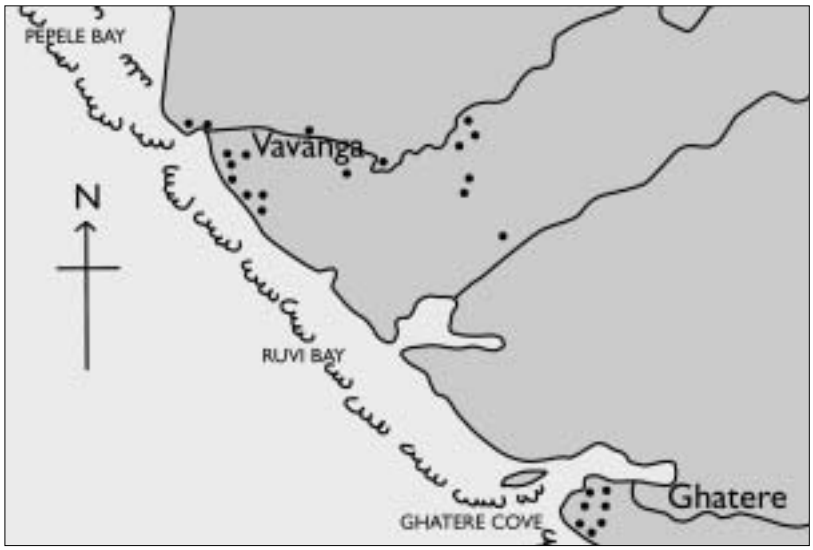

Figure 3. **Vavanga village**
(Source: Survey and Mapping Division, Honiara)

The study site

The study was conducted at Vavanga, a village on the southwest coast of Kolombangara (Figure 3).

Vavanga village comprises approximately 30 households, with most people living in temporary structures that last an average of 8–10 years. More permanent timber structures are continually being built to replace the old houses. At the time of study, Vavanga had a population of approximately 100 individuals, 20 per cent of whom did not live permanently there because of employment or other commitments elsewhere.

Religion plays an important role in the daily life of the villagers, and like most communities on Kolombangara, the Seventh Day Adventist (SDA) church is followed in Vavanga. This is of great significance to the relationship between the villagers and their environment. In accordance with SDA doctrine, restrictions exist on the consumption of various foods such as some meats, pork, coffee or tea.

More importantly, there are strict laws governing which marine products can and cannot be eaten. For example, the trade or consumption of all shellfish, crustaceans, cephalopods, marine reptiles, marine mammals, sharks and fish that have no scales on their outer skin is prohibited. In addition, SDA doctrine states that all activity, including fishing, is prohibited on the Sabbath, from sunset Friday till sunset Saturday. All of these rules have profound implications on the potential possession of traditional ecological knowledge by the villagers and also the health of the marine ecosystem.

Methodology

Ethnographic data were collected between July and September 1999. Prior to leaving New Zealand, a questionnaire was prepared, which included open-ended semi-formal interview questions. The questionnaire was structured in two parts: first, asking about the fisher's general fishing activity and knowledge, and the second, recording their knowledge about groupers (Serranidae, *pazara)* in particular.

Groupers were chosen as a case study species because of their commercial importance to the live reef fish trade (LRFT), and their ecological importance as high trophic level predators within the reef ecosystem. Through personal observation prior to the study it was discovered that in some instances locals felt uneasy or embarrassed (particularly women) when put in a formal interview situation. For this reason the use of video or audio recordings was deemed inappropriate. A total of 30 men and women were interviewed during three months. All interviews were conducted in Pijin.

CPUE data was collected and recorded in a number of survey handbooks prepared in New Zealand. To make it easy for villagers, each page of handbooks was labelled with essential information, such as name, gender, fishing method, time went fishing, time spent fishing, tide, ecological zone, species caught and frequency of catching them. The fishers filled in the necessary information next to the labels. By minimising the effort needed to fill in the CPUE handbooks I hoped to encourage regular participation by the fishers. A number of scales and watches were purchased and given to every major fishing household in Vavanga. The responsibility of recording fishing trips was given to each household, and I made regular visits to check on progress or answer any queries.

The handbooks were collected at the end of the study and brought back to New Zealand. An MS Excel spreadsheet was used to record and calculate various parameters. A total of 93 separate fishing trips were recorded from 1 July 1999 until 30 September 1999, and 49 separate fishing trips were recorded from 30 July 2000 until 10 November 2000. Unfortunately, the second data set was not suitable for CPUE analysis owing to several inter-related factors. Most important among them was that civil unrest in Solomon Islands during the collection of this data set meant that many male fishers did not fish, so most of the catch data came from females. Second, general security risks from the surrounding area meant that the number of fishing trips were drastically reduced. For these reasons it was not possible to obtain a representative sample.

Results

The Kolombangara lunar cycle

The lunar cycle is an integral part of traditional fishing knowledge in Kolombangara because the success rate of fishing depends highly on the behaviour of some species during certain lunar periods. However, traditional fishers do not usually have easy access to watches or calendars, and tend to treat time with less accuracy than westerners. For example, a New Zealand fisher may say that they went fishing on the 3rd day of the new moon, whereas a Kolombangara fisher will simply say that they went fishing during *enga rea*, referring to any day within the new moon period. Also, Kolombangara people do not label the lunar phase with terms

such as 1st or 2nd quarters, but rather describe or relate the state of the moon to the environment. Table 1 describes this local lunar vocabulary.

Description of fishing methods and ecological zones

Five different fishing methods and four different ecological zones were used by local fishers during the collection of CPUE data.

The five fishing methods described by local fishers were:

Dropline — using a fishing line, hook, sinker and bait. This method is used when targeting deep-water fish by lowering the fishing line from a canoe.

Gill net (drive) — setting a gill net in shallow water and chasing the fish towards it.

Spear — shooting fish using a locally made speargun.

Throwline — casting a fishing line without a sinker. This method is used when targeting fish on the shallow reef flat.

Towline — or trolling, is where a non-weighted fishing line with synthetic bait (e.g. lure, cotton) is dragged behind a canoe.

The ecological zones targeted by the local fishers are (Figure 4):

1. Reef dropoff;
2. Reef flat;
3. Passage; and
4. Mangrove .

Table 1. **The Kolombangara lunar vocabulary**

Local terms	English translation	Translation in lunar periods
Lana rea	No moon	New moon
Enga rea	Starting of new moon	New moon period
Enga kale rea	Looking at half moon	First quarter
Tata behi sope	Nearly as big as the sun	First quarter period
Behi sope	As big as the sun	Full moon
Hitele rea	Moon getting smaller	2nd quarter
Tata lana rea	The moon is nearly gone	2nd quarter period

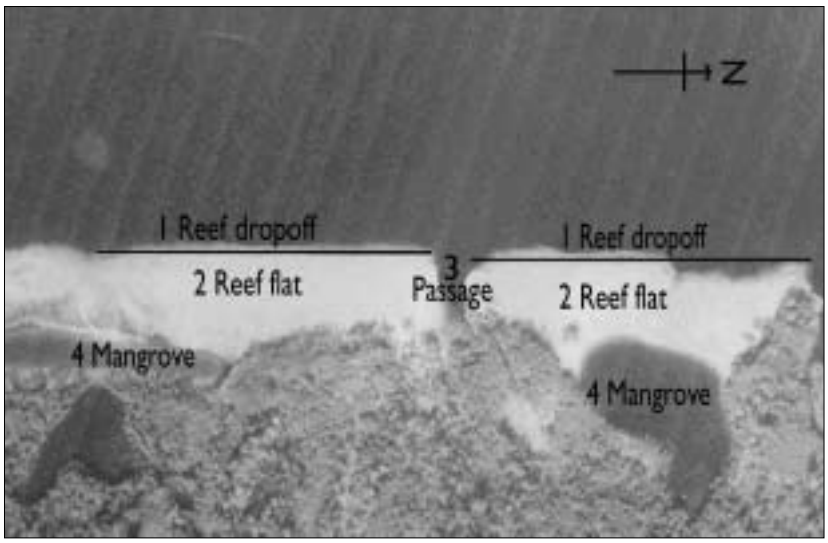

Figure 4. **Ecological zones targeted by local fishers (Source: Survey and Mapping Division, Honiara)**

Ethnographic knowledge

In the first part of the interview fishers were asked about their general fishing knowledge and behaviour. Ninety per cent (N = 27) of the subsistence fishers interviewed said that they fished at least four times a week, using a variety of techniques. When asked to choose their most preferred ecological zones for fishing, 76 per cent (N = 23) said that although not exclusively, they usually target the passage and reef flats. However, female fishers (N = 10) said that they mostly preferred using the throwline technique and usually leave the more labour intensive fishing methods, such as netting or spearing, to the men.

Although there was no consensus, when asked to rank families of fish from most favourite to least favourite, four fish families were described by 80 per cent (N = 24) of the interviewees as common species caught, and thus were important target groups. They are parrotfish (Scaridae), emperors (Lethrinidae), snappers (Lutjanidae), and trevallies (Carangidae). When asked to elaborate on their knowledge about some of these families, the interviewees gave some interesting answers. For example, 66 per cent (N = 20) said that the best time for catching trevally is during a light rain. The same number also said that the best time for catching snapper is during *beita longe*, referring to the few days immediately preceding the full moon, when the moon rises shortly after sunset.

Thirty-three per cent (N = 10) said they have caught parrotfish using potato or tapioca as bait on a hook. In addition, there was unanimous agreement on two pieces of fishing knowledge. The first is that during *saghe ondo* (high tide) most fish swim closer to the surface and are thus easier to catch. And the second is that spear fishing is most successful at night on *lana rea* (no moon) and fairly successful during *enga rea* (new moon). They attributed this to most fishes being asleep or not very active during this period, making them an easy target to spear.

All fishers (N = 30) said that they used their catch for consumption, but indicated that they would be interested in selling their catch if logistical obstacles, such as canoes for droplining, availability of fishing gear, or transport to the market at Gizo, could be overcome. With only a handful of local inhabitants owning outboard motors and canoes, the possibility of moving from a subsistence to an artisanal fishery is remote. However, if transport was available and local catch could be sent to Gizo market, fishing activity would increase markedly. This would mean that some sort of community-based management strategy would be necessary to protect the resource. All interviewees (N = 30) agreed on this.

In the second part of the interview, fishers were asked to demonstrate their individual knowledge of *pazara* (groupers, Serranidae). Sixty per cent (N = 18) reported that their catches of groupers are mainly dominated by *Epinephelus merra* (honeycomb grouper) and occasionally *Cephalopholis miniata* (coral hind).

All fishers (N = 30) claimed that droplining is the best method for catching most species of grouper, as they stay close to the reef wall where holes and crevices are easily accessible. When asked questions on the behaviour, movements and characteristics of various grouper species, the responses were fairly unanimous. For example, one female fisher described *Epinephelus merra* as being abundant on the reef flat during high tide. A male fisher said that *Cephalopholis miniata* are easily caught with a 30-m fishing line on the outer reef slope. All fishers, including women, possessed knowledge on the whereabouts of groupers in relation to the reef, the use of appropriate baits on hooks and the most effective method of fishing. For example, it was claimed by 33 per cent (N = 10) of fishers that groupers preferred freshly killed bait, especially skipjack tuna (*Katsuwonus pelamis*).

However, when asked about the seasonality of groupers with regards to spawning aggregation times and locations, or the effects of lunar cycles on their movements, there was no clear consensus and the answers became more vague. Seventy-six per cent of fishers (N = 23) could not answer all the questions on the above topic, whereas the others gave conflicting information.

This lack of knowledge may have many causes, including the absence of any large grouper spawning aggregations around Vavanga, the reluctance of local fishers to frequently target known grouper habitat, or, it might simply be a case of gathering unreliable information from untrained fishers. This will be discussed further below.

Although testing the accuracy of the data described above may require extensive research by a marine biologist with anthropological training, some of the ethnographic knowledge and behaviour of local fishers can be validated through CPUE analysis.

CPUE data

In this exercise I describe the catch rates, catch composition and elaborate on fishing methods and the ecological zones where fishing occurs. The

CPUE data for this study:

1. Shows the ratio of each family of fish caught by subsistence fishers;
2. Shows what species are being caught and in what ratios;
3. Provides baseline data against which a variety of factors, such as seasonality, can be compared in the future;
4. Helps to document the fishing behaviour of local fishers; and
5. Provides an opportunity to validate some of the ethnographic data obtained from local informants.

It is unrealistic to expect all informants to contribute fully to the CPUE exercise. However, the data received came from sources that contributed accurately and regularly. This enabled me to achieve a representative sample of the total fishing activity at Vavanga. However, it is also imperative to keep the results, analysis, and conclusions from the CPUE data in perspective, given the short length of the sampling period. The result of the CPUE data analysis are displayed below.

Apart from the obvious shortcoming of the CPUE exercise, namely the relatively short sampling period during the middle of the year, Table 2 contains other anomalies created by the following three factors. First, there was only one fisher within the whole village who was contributing to the CPUE data from his skipjack tuna (*K. pelamis*) trips. He was the only one with an outboard motor and fuel money to target the open seas, thereby distorting the results so that the Scombridae family represent over 50 per cent of the total catch. Second, 35 kg of the total 35.2 kg from the Sphyraenidae family came from one species, the great barracuda, which was caught during two fishing trips to outer islands. This created a bias, as transport to fishing trips on outer islands is rarely available to local villagers. Both of the above factors represented results that were not representative of normal fishing activity, which created anomalies. Finally, the Scaridae family was biased by an experienced visiting fisher who, while a guest for a short time at the village, followed a few local men to a night fishing expedition. He managed to spear the only three green humphead parrotfish (*Bolbometopon muricatum*) during the whole CPUE survey. In total they weighed 27.9 kg, which had to be deducted from the total weight of the Scaridae family. The final number of fishing trips was recalculated to 71 expeditions. Given the above considerations, the CPUE data for Vavanga is recalculated in Table 3.

Table 2. **Total weight for each family of fish (kg) caught at Vavanga**

Family	Total weight (kg)	Percentage
Scombridae	255.4	53.5
Scaridae	48.0	10.0
Carangidae	41.1	8.6
Sphyraenidae	35.2	7.4
Lutjanidae	30.9	6.5
Lethrinidae	16.2	3.4
Mugilidae	10.3	2.2
Serranidae	7.7	1.6
Acanthuridae	7.6	1.6
Holocentridae	6.7	1.4
Balistidae	5.8	1.2
Labridae	2.9	0.6
Ephippidae	1.5	0.3
Gerreidae	1.5	0.3
Nemipteridae	1.4	0.3
Nephropidae	1.4	0.3
Mullidae	1.3	0.3
Haemulidae	0.9	0.2
Caesionidae	0.8	0.2
Siganidae	0.8	0.2
Scorpaenidae	0.2	0.1
Total	**477.4**	**100.0**

Table 3. **Total weight for each family of fish (kg) caught at Vavanga after corrections**

Family	Total weight (kg)	Percentage
Carangidae	41.1	25.3
Lutjanidae	30.9	19.0
Scaridae	20.1	12.3
Lethrinidae	16.2	10.0
Mugilidae	10.3	6.3
Serranidae	7.7	4.7
Acanthuridae	7.6	4.7
Holocentridae	6.7	4.1
Balistidae	5.8	3.6
Scombridae	3.5	2.2
Labridae	2.9	1.8
Ephippidae	1.5	0.9
Gerreidae	1.5	0.9
Nemipteridae	1.4	0.9
Nephropidae	1.4	0.9
Mullidae	1.3	0.8
Haemulidae	0.9	0.6
Caesionidae	0.8	0.5
Siganidae	0.8	0.5
Sphyraenidae	0.2	0.1
Scorpaenidae	0.2	0.1
Total	**162.7**	**100.0**

In Table 3, Carangidae (trevallies) are the commonest species caught in Vavanga, followed by Lutjanidae (snappers), and Scaridae (parrotfish).

CPUE data in Table 4 show that Scaridae (parrotfish) are the most productive species in terms of meat weight per unit of effort from a fisher's perspective.

In order to include Serranidae, families that made up more than four per cent of the total catch were further scrutinised. Table 5 shows the species that made up more than 50 per cent of the total reported catch within those families.

In Table 5 one species dominates the catch in each family. Pacific longnose parrotfish and fringelip mullet are shown to be the dominant species within their respective families. Interestingly, honeycomb grouper is shown to have contributed approximately 60 per cent of the total grouper catch in Vavanga, confirming its commonly caught status as previously indicated by local fishers.

Table 4. **CPUE values for families that made up more than 5% of the total catch**

Family	Grams/hour/fisher
Scaridae	1790
Carangidae	734
Mugilidae	468
Lutjanidae	431
Lethrinidae	294

Fisher behaviour

The data in Table 6 display some interesting characteristics. Vavanga fishers conduct most of their fishing activity during the evening, and also during the 2nd quarter and new moon period. In accordance with their statements, the data also show that they mostly target the passage and reef flats,

Table 5. **Species that made up more than 50% of the total catch within their respective families**

Family	Species	% of total weight
Scaridae	Pacific longnose parrotfish (*Hipposcarus longiceps*)	93.3
Mugilidae	Fringelip mullet (*Crenimugil crenilabis*)	90.1
Carangidae	Yellowstripe scad (*Selaroides leptolepis*)	71.6
Lethrinidae	Pink-ear emperor (*Lethrinus lentjan*)	68.0
Serranidae	Honeycomb grouper (*Epinephelus merra*)	59.3

Table 6. **Breakdown of the 71 fishing trips**

Time of day	Mid-day	Afternoon	Evening	Night
	2	21	46	2
Lunar stage	2nd quarter	New moon	1st quarter	Full moon
	23	23	10	15
Ecological zone	Passage	Reef flat	Reef dropoff	Mangrove
	26	28	14	3
Tide	High	Low	Between	
	47	16	8	

and conduct most of their fishing expeditions during high tide.

The data in Table 7 show that the throwline and towline methods are predominantly used by Vavanga fishers. Given the lack of emphasis on droplining in order to catch bigger fish, one should not be surprised at the low total weight of catch by each family in Table 3.

Table 7. **Breakdown of fishing methods**

Fishing method	Fishing trips
Throwline	27
Towline	23
Spear	13
Dropline	6
Netting (drive)	2

The data in Table 8 show that males, fishing alone, contributed highly to the CPUE exercise.

Table 8. **A breakdown of fishing trips by fishers' gender**

Gender classification	Fishing trips
Single male trips	41
Single female trips	15
Multi female trips (2 or more)	9
Multi male trips (2 or more)	5
Mixed gender trips	1

Discussion

Although Vanvanga fishers displayed great flexibility in using a wide spectrum of fishing techniques, their effort mostly concentrates on the dropline and throwline methods. In addition, effort is not distributed evenly across the available ecological zones. The passage and reef flats have been shown to take priority over other available areas, with most fishing expeditions conducted during the evenings.

Vavanga fishers also displayed a noticeable lack of interest in night fishing. Given the mostly rough, open sea conditions and the small fishing area available to local villagers, their predictable and unchanging practices should be of no major surprise.

However, environmental knowledge has been shown to play an important role in their decision-making process with regards to appropriate fishing practices at certain time. This is reflected in their preference to go fishing during high tide or the first two weeks of the lunar cycle (Table 6), or the unanimous agreements on when or how to target certain species.

Traditional marine knowledge at Vavanga is very extensive and impressive. Although there was no consensus in ranking the four most important families, it was claimed by a majority of local fishers that parrotfish (Scaridae), emperors (Lethrinidae), snappers (Lutjanidae), and trevallies (Carangidae) were the most common families of fish caught within Vavanga. The total weight data in Table 3 proves this claim to be true. In addition, CPUE values for Scaridae in Table 4 show it to be by far the most productive family (1.79 kg/hr/fisher) as far as a Vavanga fisher is concerned. Carangidae was a distant second (0.734 kg/hr/fisher), followed by Mugilidae (0.468 kg/hr/fisher), which was helped into third place by catches from the only two netting trips in the CPUE exercise. These netting trips helped to inflate the true importance of the CPUE value for Mugilidae, given that it ranked lower in total catch weights (Table 3).

Groupers, however, are shown to only make up 4.7 per cent of the total catch and consequently ranked sixth in Table 3. Table 5 shows that nearly 60 per cent of the grouper catch was dominated by one species, *Epinephelus merra*. This validates the claim by 60 per cent of fishers interviewed, that catches of groupers were mainly dominated by *E. merra*.

Although the traditional marine knowledge from the first part of the interview seemed impressive and detailed, the results from the second part of the interviews showed that local fishers only possessed basic knowledge about the habitat of groupers, or the use of appropriate bait and fishing methods for catching groupers. As mentioned previously, the lack of detailed knowledge on grouper ecology, such as spawning aggregation seasons or lunar movements, may be the result of several factors, one of which may be the issue of labour and cost. Another possible reason for the lack of detailed grouper knowledge in Vavanga could be that no large-scale spawning aggregations occur around its reefs.

Table 7 shows that droplining was the second least preferred method of fishing, indicating that known grouper habitats were not being targeted by local fishers. The reason droplining was rarely used may

be due to two interrelated factors; cost and labour. The average cost of a canoe is around SBD 300[2] and not every household possesses one. Also there is the added cost of fishing gear such as lines, hooks and sinkers. Second, fishing on the reef dropoff is labour intensive as the fisher has to try to steady the canoe against breaking waves and also hold on to the fishing line. Results from Tables 6 and 7 show that even when the reef dropoff was targeted 14 times, only 6 times were actually spent droplining. Thus, it is not surprising that groupers only rank sixth in Vavanga's total catch records (Table 3). Given these factors, the villagers seemed to find it easier to use less labour intensive fishing methods, as shown in Table 7.

There is, however, one other probable explanation for this apparent lack of detailed knowledge, which highlights several important aspects of methodology structure in ethnographic research. The data collected may have come from untrained or inexperienced fishers, been reported incorrectly, or been misunderstood by the researcher. These sampling factors are sometime overlooked when gathering and processing ethnographic data. The collection of ethnographic data is not just a matter of interviewing villagers and recording their answers. Most fisheries scientists do not have the appropriate anthropological experience or knowledge to conduct an ethnographic survey. Therefore, the usefulness of such data in fishery research design and management plans may be compromised by the collection of inaccurate data. Here, the precision of traditional marine knowledge becomes an important issue.

More increasingly, the value of TMK has been noticed, highlighted by a lack in formal long-term data sets in most artisanal and some industrial fisheries (Johannes et al. 2000). Because TMK has been refined and passed down through many generations, recognition is also being given to its potential as an important source of baseline data and knowledge, which may be useful from a management perspective.

However, the value and accuracy of TMK cannot be taken for granted. Ruddle et al. (1992) elaborate on this point by stating that the romantic and uncritical acceptance of traditional knowledge is almost as unfortunate as that of totally dismissing it.

By virtue of the word 'traditional', we can be sure that this knowledge is also interwoven with Solomon Islands culture and religion, and cannot be separated. This is because culture and religion play an important and integral role in the preservation, interpretation, and passing on of knowledge. The SDA faith in Vavanga is one example of how religious doctrine can restrict and control marine life consumption and fishing behaviour. Therefore, by trying to separate and structure one component of this knowledge in a scientific form, we may be reducing or simplifying its value. However, once this data has been appropriately collected, interpreted, and its accuracy tested through scientific fieldwork, we can begin to analyse its true value.

Conclusions

One of the most dynamic and important components of ethnographic research is the fishers, their knowledge and their behaviour. Many Pacific Island communities exploit marine resources under the guidance of deeply entrenched CMT systems, which are often concerned with traditional rights of access, enforcement and compliance of cultural or religious regulations, acquisition and preservation of ecological knowledge, and the survival of the resource.

The most obvious benefit of CMT systems is their ability to have a management impact by restricting access to traditional fishing grounds. In addition to this, traditional knowledge of the marine ecosystem is an integral part of CMT systems and has the potential to be directly beneficial to fishery management models.

Traditional marine knowledge in some Pacific Island fishing cultures is remarkably rich, offering resource managers access to some vital, basic, natural history data for managing inshore marine fisheries (Johannes 1992; Calamia 1999). In particular, its value as a management tool cannot be underestimated.

For example, knowledge about the location or movement of reef fishes in response to physical, biological, and environmental stimuli is often available from local fishers. Johannes (1992) uses the example of grouper spawning aggregations, which provide a useful focus for management. Because high catch numbers are often made from them, the opportunity to regulate fishing pressure is easily available. In this case, Johannes acquired the location and times of the spawning aggregations from local indigenous fishers.

2. SBD 1.00 ≈ USD 0.14 (August 2002)

Information about the movement of certain species, optimum fishing periods, or appropriate fishing methods, are just some of the vast array of knowledge held by Vavanga fishers. In addition, the collection of CPUE data proved to be very useful in providing me with important knowledge about the villagers' fishing patterns and behaviour.

The success of an inshore reef fishery undoubtedly depends on the marine knowledge and behaviour of local fishers, who are directly involved with the catching, consumption, redistribution, and management of the resource. Therefore, it is imperative that we as scientists do not dismiss this source of knowledge from the outset, and endeavour to collect and analyse it appropriately, in order to see how best it can be used.

This is often easier said than done, especially if the researcher is not trained in anthropological methods. As the analysis in this study has shown, among various other reasons, the failure to collect detailed local knowledge on grouper was perhaps due to my naive attitude towards ethnographic research. In the midst of the interviews, I may have collected accurate and potentially important information from one or two experienced fishers, but because there was no consensus on some questions about groupers, these answers were not noticed. Thus, as researchers we have to shed our romantic attitudes about indigenous life and be careful not to treat every native person as a potential source of accurate ethnographic information.

Although thirty fishers agreed to be interviewed for the collection of ethnographic data, I was not vigilant enough in checking their background, or observing their daily fishing routines. In hindsight, I think it would have been better to ask the majority of the villagers to nominate fishers who they perceived to be the most appropriate informants.

Johannes et al. (2000) argue that researchers should seek out fishers with local reputations as experts. In these cases, considerable time and effort will be saved as information from a handful of 'experts' may be more useful than information collected from a number of local fishers chosen at random. We do not seek random advice in other facets of research, and acquiring ethnographic data is no different.

In summary, the benefit of considering ethnographic knowledge in fishery research design and management is three-fold (see also Hamilton and Walter 1999):

1. Baseline ecological data can be extracted from CMT systems and used to define research methodologies;

2. Because indigenous fishing communities interact daily with their local environment, the ecological knowledge base is constantly being updated and revised; and

3. CMT systems can be used as the basis for the management of inshore fisheries.

So far, this study has demonstrated that marine research and management in a coastal Solomon Islands setting could benefit from a holistic approach that considers the integration of ethnographic data. However, this source of knowledge continues to be treated with suspicion or used inadequately by some fishery researchers and policy makers (Christie and White 1997; Hamilton and Walter 1999; Kile et al. 2000). There are several reasons for this:

1. Traditional environmental knowledge is sometimes seen as inaccurate, unsophisticated, or not scientific enough to be incorporated into western-based fishery models (Kile et al. 2000);

2. Customary management measures are seen as highly locally specific, and of little use on a national level (Kile et al. 2000);

3. Indigenous people and their institutions are sometimes seen as unsophisticated or problematic (Hviding and Ruddle 1991);

4. The uncritical and romantic espousal of indigenous knowledge can lead to a situation where the data or observations are taken out of their historical and cultural context (Hamilton and Walter 1999); and

5. Indigenous knowledge is contained within complex cultural or religious systems and requires 'anthropological methods to describe and interpret this information in a meaningful manner' (Hamilton and Walter 1999:13).

The first three points are based on ignorance and highlight the exclusively quantitative scientific focus and formalised management strategies in western training curricula (Kile et al. 2000).

The last two points highlighted by Hamilton and Walter (1999) suggest that ethnographic knowledge, when it is used by fisheries scientists, is often misunderstood because of the researcher's inexperience in ethnographic research methods.

The successful operation of an inshore reef fishery in a Pacific Island village must take an integrated approach by combining the research of customary and scientific management systems. The justification for promoting a holistic approach lies in the nature of the Pacific's coastal systems, which involve complex cultural, religious, socio-political and economic components. In most areas of Solomon Islands, for example, there is a long history of communal use of marine resources under the guidance of CMT systems, thus attempts to disassociate their role and influence in any fishery operations may seriously jeopardise the physical or economic survival of the people (Donnelly et al. 2000; Lam 1998).

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Community policing in the Portland Bight Protected Area, Jamaica

Peter Espeut[1]

Source: UNESCO Wise coastal practices for sustainable human development — forum of discussion[2].

Efforts to conserve the natural environment often fail — even where there is adequate environmental legislation — because of non-compliance with regulations, and the high cost of enforcement. Non-compliance may have a variety of causes, e.g. profit, lack of environmental awareness, a don't-care attitude towards the environment, lack of an alternative, damaging behaviour may be cheaper or easier than environmentally-friendly behaviour, and the absence of deterrence due to the lack of enforcement.

In Jamaica, environmental degradation and a lack of compliance with environmental regulations has taken place in the context of the traditional top-down approach, and must be viewed against the historical background of a slave society dominated by plantation owners. Distrust of the police and a desire to beat 'the system' are almost written into the genetic code of working-class Jamaicans. And so the challenge of natural resource management is not just to deal with biophysical issues but also to contend with socio-cultural problems, which underscores the point that natural resource management is more of a social science than a natural science.

People seek to beat a regulatory system that belongs to somebody else, and operates in someone else's interest, or is perceived to do so. So a first strategy towards increased compliance is to create, within the users of the natural resources, a sense of ownership of the laws and regulations. This was achieved in the Portland Bight Protected Area of Jamaica by getting the fishers to prepare their own fisheries management regulations using the local fisheries associations and the Fisheries Management Council. Thus the fishers now feel they own the regulations rather than viewing them as a system of rules being imposed on them

1. Caribbean Coastal Area Management (C-CAM) Foundation, Jamaica, West Indies
2. All contributions to the forum can be viewed on the Internet at: http://www.csiwisepractices.org/ (enter the name: csi and the password: wise). You can also participate to the forum by sending an e-mail to: moderator@csiwisepractices.org

from above. (For more information on the process, go to the full paper at http://www.unesco.org/csi/act/jamaica/HGwardens.htm).

Even when the local community owns the regulations, some may still resent outsiders coming in and arresting their relatives and friends for non-compliance. A better way to cement a new culture of compliance and natural resource management is to empower the community leaders as enforcement officers. In the Portland Bight Protected Area, some 50 fisherfolk were officially appointed 'Honorary Game Wardens' and 'Fishery Inspectors' under the Wildlife Protection Act and the Fishing Industry Act, thereby providing them with powers of search and arrest. All the enforcement officers are given training and they are informed that compliance is the objective, not making arrests.

One of the fears with this approach was that the community enforcement officers might abuse their authority. Careful selection of suitable persons, thorough training, and close supervision have resulted in not one case of abuse of authority, or false arrest, since 1996, and a 100 per cent conviction rate in those cases which have gone to court.

Another fear was that Honorary Game Wardens and Fishery Inspectors would excuse their friends and relatives and harass their enemies, or take bribes. No such cases have been observed; in fact the reverse. The community enforcement officers advise their relatives and friends not to embarrass them by committing an offence, as they would be forced to personally arrest them so as to prove they are not corrupt. This is especially true of the female Honorary Game Wardens and Fishery Inspectors, who have warned their partners, sons, sons-in-law and nephews.

It should be pointed out that the 'hard' enforcement cannot be done by these community volunteers. Already some have been threatened with bodily harm, and they are advised in such cases to make a full report of all observations. At the present time they are not insured. The protected area will benefit from full-time Protected Area Rangers with full police powers who will follow up on the intelligence provided by these local 'eyes and ears'.

In many parts of the world, getting communities to police themselves is being encouraged. The approach being taken in the Portland Bight Protected Area is a version of this, and should advance the discourse. This approach has the potential to be effective for other types of offences such as traffic violations and breaches of health and planning regulations.

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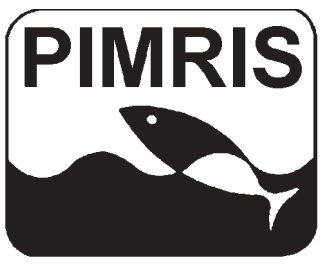

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