



## Evolution of the artisanal fisher: Case studies from Solomon Islands and Papua New Guinea

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### Abstract

In this article we describe the rapid uptake of technology that increases fishing efficiency in two parts of western Melanesia: Ghizo Island in Western Province, Solomon Islands, and Milne Bay Province in Papua New Guinea. We present evidence that demonstrates a disturbing lack of awareness among fishers of the finite nature of the stocks they are exploiting, and we argue that without corresponding systematic management interventions, the technological transformations we are now witnessing will accelerate the present pattern of sequential overfishing of commercially valuable species.

### Introduction

Effective management and conservation of coral reef marine resources in coastal tropical regions is increasingly the subject of discussion within scientific, political and economic realms. Simply put, the fundamental role that marine resources play in the social and economic well-being of developing nations makes it a topic of interest across many academic disciplines. In particular, the impact of subsistence and artisanal fishing is increasingly being investigated both by marine and social scientists.

The economic importance of artisanal fishing to developing tropical countries is increasingly being highlighted (Alison and Ellis 2001; Sadovy 2005). However, even with a growing body of evidence pointing towards adverse ecological and biological effects (Jennings et al. 1999; Hawkins and Roberts 2004; Tuya et al. 2006) there is still a widespread perception that artisanal fishing has little impact, and this is perpetuated by a myth that this form of fishing is pursued by small-scale fishers using traditional methods, which are viewed by some as environmentally benign (Hawkins and Roberts 2004). In this paper we describe the rapidity with which hitherto relatively benign fisheries in Melanesia are transitioning to enterprises that pose significant commercial and ecological threats. Fishers are increasingly incorporating the use of technologies such as outboard motors, handheld global positioning units and scuba, inevitably resulting in much heavier fishing effort.

The idea that some form of “traditional management” or conservation ethic will help prevent overfishing in areas where the “corrupting” influence of modernisation has not yet penetrated is in our view is misguided (Foale 2006). Probably the most important factor contributing to the persistence of many fisheries in the Solomon Islands and Papua New Guinea to date has been the very low human population densities of those countries (12 and 16 people per km<sup>2</sup>, respectively: Foale 2005). Despite this, the last two decades have seen the abrupt collapse of a number of formerly lucrative fisheries, including giant clam (*Tridacna gigas*), green snail (*Turbo marmoratus*), sandfish (*Holothuria scabra*) and black teatfish (*H. nobilis*), throughout most of Papua New Guinea and the Solomon Islands. We believe that the combination of increased access to improved fishing technologies and the expansion of export markets will rapidly reverse the protection that low human population densities have afforded fisheries in the region until now.

Scuba spearfishing in the Caribbean has been previously highlighted (NOAA 2002). However, until recently spearfishing on scuba was not considered an issue in the Pacific Islands as access to equipment, logistics and technical knowledge remained outside the reach of most people. Economic development, especially in the tourism sector, and the establishment of many dive outfits are increasingly changing this scenario.

The tourism boom has most notably been evident in Fiji, where in a global report on coral reef fish-

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eries (Wilkinson 2004), scuba spearfishing was highlighted as a serious emerging threat. The expansion of more efficient fishing methods, such as scuba spearfishing, is an inevitable evolution of artisanal fisher behaviour in developing countries where economic realities are dictating changes in the utilisation of marine resources.

In the Solomon Islands for example, where the majority of local artisanal fishers have access to motorised boats, the increasing use of air compressors (hookah) and scuba gear by untrained fishers targeting lucrative bech-de-mer species has been causing concern, and in some instances injury and death according to WWF's Bruno Manele (see also below).

However, the use of methods such as scuba and hookah would presumably be higher around densely populated urban centres, where demand for fish is higher and access to logistical support easier. A decade ago Adams et al. (1996) highlighted the fact that urban centres posed the greatest threat to nearby coral reefs fisheries in the Pacific Islands. However, because "total fishery crashes are unlikely due to excess demand being met from surrounding islands" (Adams et al. 1996), localised crashes in fish stock numbers are unlikely to attract attention from the wider community.

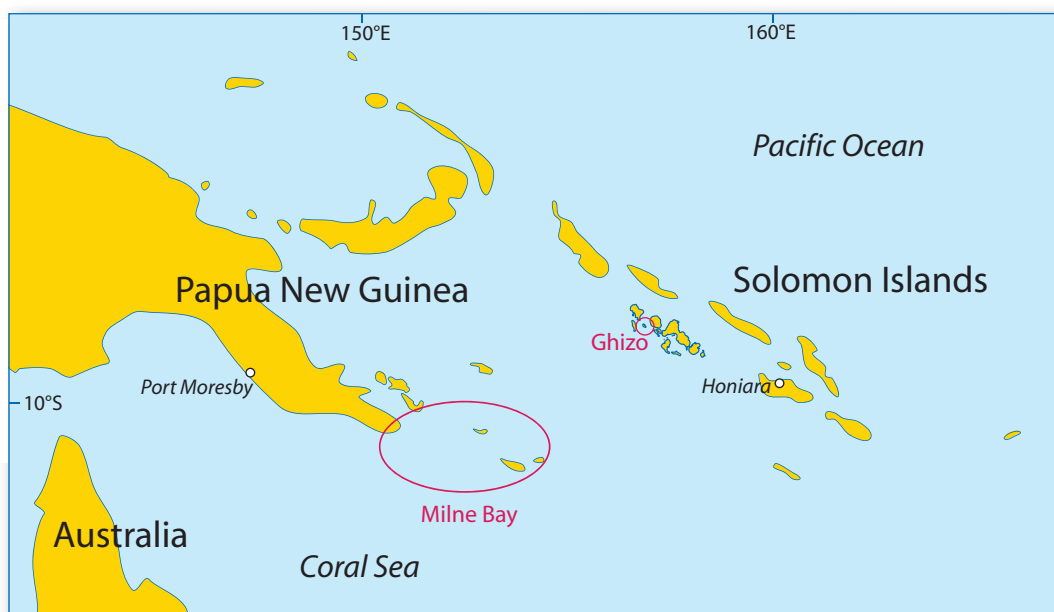
Here we present and discuss the findings of two separate studies carried out in the Solomon Islands and Papua New Guinea (Fig. 1).

## Part 1: Ghizo Island, Solomon Islands

### Background information

Over the past three years, one of the authors of this paper (Sabetian) has conducted a wide ranging investigation into the status of the parrotfish (Scarid) fishery around Ghizo Island, Western Solomon Islands (Fig. 2). For the purpose of this exercise "Ghizo reefs" refer to areas on the east and southeastern side of the island, which contain alienated lands and adjacent coral reefs that are now administered by the national government. As such, access to these reefs is open to all subsistence and artisanal fishers. Gizo town (note the difference in spelling between the town and the island) is the second largest urban centre in the Solomons, within which the last census in 1999 reported a permanent population of approximately 8000 individuals (Otter 2002).

Typical of urban centres described by Adams et al. (1996), Ghizo's population is gradually increasing through rapid immigration by people looking for employment. This has meant that the percentage of income generated from informal economic activities such as fishing is inevitably increasing (Otter 2002). Gizo town has by far the biggest fish and food market in Western Province. The local economy revolves around services and tourism, but the food market, which is open 24 hours every day, attracts people from all around the area, including fishers and agricultural produce sellers from other provinces such as



**Figure 1.** Papua New Guinea and Solomon Islands showing Ghizo Island and Milne Bay Province

Choiseul and Santa Isabel. In simple economic terms, the accumulation of wealth around urban centres such as Gizo is what prompts people to travel very long distances to sell their catches or produce. Furthermore, the ever-increasing necessity for money in a cash economy has inevitably led to the expansion of trading hours around the clock, which a few years ago were not in place.

Comparative analysis of catch and creel data has revealed localised declines in catch numbers, supported by declining estimates of parrotfish abundance and distribution between 2004 and 2005 (Sabetian, unpublished data). As part of this study, a survey was carried out through interviews with 15 artisanal fishers (see questions below). We discuss the results of this survey and investigate the implications of fisher behaviour and perception in relation to localised fishery crashes.

### Fisher survey

The purpose of this survey was to engage fishers in dialogue that covered topics such as their skills and knowledge, their perception of resource use and management, and speculation of future trends. Seven questions were asked in a semi-structured interview format and elaborated on where necessary.

#### Questions:

1. How would you rate your knowledge of parrotfish behaviour, and ecology? Give examples.
2. What is the best method with which to target parrotfish? Why?
3. Are parrotfish popular with customers? Which species?
4. Which fishing grounds have you targeted over the years? Which ones are you targeting now?
5. How would you rate the parrotfish stocks around Ghizo?
6. What do you think of past, current, and future fishing trends around Ghizo?
7. Do you intend to continue fishing as a main source of income? What would you like to do or have to do to increase your fishing capacity?

The first two questions deal with ecological knowledge and most effective fishing methods. Detailed knowledge of parrotfish behaviour was observed.



**Figure 2.** Ghizo Island showing Gizo town and proximity to the large island of Kolombangara and the large village of Rarumana on Kohingo Island.

All (n=15) interviewees made reference to the fact that parrotfish are herbivorous and as such, netting and spearfishing are the only techniques that can be used efficiently. Twelve fishers made specific reference to the fact that some parrotfish ate corals, while some appeared to scrape at different surfaces. There was unanimous agreement that parrotfish are most feasibly targeted at night, using spears as they generally aggregate in sleeping groups.

Ten fishers rated parrotfish as equally popular with customers as other fish. All fishers rated the bumphead parrotfish (*Bolbometopon muricatum*) as the most desirable and highly profitable species with locals and commercial food outlets, such as restaurants and resorts. One fisher claimed to have a contract with a local resort, which required him to supply bumpheads to the resort's restaurant on a weekly basis.

Answers to the fourth question were varied, covering nearly all areas of Western Province, from Ghizo to the nearby Hapu Hapu reefs and also the uninhabited areas of Rarumana and north New Georgia. Six fishers claimed to be no longer targeting the Ghizo reefs due to low catch rates, while four indicated that they still accessed Ghizo reefs but also targeted other fishing spots. All fishers indicated that Ghizo was still popular with people who did not have access to motorised boats. Seven informants suggested that non-indigenous Gilbertese fishers were the most brazen at targeting customary owned fishing grounds as far as inner VonaVona Lagoon and even marine protected sites. Although anecdotal evidence appears to support this claim, it needs to be further investigated and validated.

The unanimous perception of the 15 fishers was that the size of fish across all families has been steadily declining over the past decade. Nine fishers claimed that fishing effort has significantly increased in the past three to four years, leading to noticeable declines in size and abundance of fish across the board. The overall sentiment was that more people are now resorting to fishing as a way to generate or supplement incomes. When fishers were asked to elaborate on the reasons for the increase in fishing pressure around Ghizo, the responses were more interesting. The ethnic Malaitan fishers blamed the civil unrest between 1999 and 2003. This event was responsible for significant numbers of Malaitans being intimidated and forced to either keep a low profile or leave their settlement on Ghizo. The Malaitan settlement on Ghizo is referred to as the "fishery" because the majority of inhabitants are artisanal or small-scale commercial fishers and as such are a major driving force behind Gizo's local fish market. The Malaitan fishers claimed that the demographic nature of the fishery changed during the height of violence and lawlessness (June 2000–late 2001) when some could no longer practice their trade. The gap left by the absence of some Malaitan fishers was largely filled by local Gilbertese fishers who met the demand for fish through the consequent intensification of fishing effort on the surrounding reefs utilising night-time spearfishing. Furthermore, night-time spear fishers have an added advantage of being the first sellers on the daily fish markets before the arrival of other fishers in the afternoon.

The next question asked each fisher about their perception of current, past and future fishing trends around Ghizo. There was unanimous agreement that parrotfish had become prominent in fish sales because of an increase in spearfishing. Eight fishers claimed that parrotfish numbers had noticeably declined within the market in 2005, with five fishers claiming to have noticed absence of specific species such as *Scarus ghobban* and *Chlorurus microrhinos*. Three fishers claimed of knowing crews of spearfishers who have spent 12 hours fishing the Ghizo reefs. In local parlance this is referred to as "six to six" where crews of spearfishers visit numerous reefs starting from 6 pm and lasting through to the early hours of the morning. Although we had been told of six to six fishing by a Gilbertese fisher, he did suggest that its persistence would not be long-term due to its strenuous and laborious nature.

When pressed on their perception of the overall productivity of Ghizo reefs, respondents unanimously agreed that fish numbers had declined across all families. However, only three fishers perceived this to be a problem as the others pointed to the fact that demand was being met by an expan-

sion of fishing area to more productive reefs. Four fishers claimed personal knowledge that fish stocks, parrotfish in particular, are still very healthy around the uninhabited areas of Rarumana (20 km by sea southeast of Gizo town), but did concede that the most productive and cost-effective way to target the area was through mobilizing large crews (between 8 and 10 fishers) and utilizing nets as long as 200 metres.

The final question pressed interviewees on their chosen profession. Twelve fishers indicated that they were happy with fishing as a source of income and intended to continue in the future. The remaining three respondents displayed reservations, citing logistical restrictions. Interestingly, no one seemed to suggest that the apparent localised decline of fish stocks around Ghizo would force an early cessation of their fishing activity. All fishers indicated a strong desire for improvements in fishing technology, access to fibreglass boats, and bigger outboard motors. Nine fishers indicated their desire for independence, conceding that their inability to acquire fishing gears such as nets, boats and outboard motors on their own was the major reason why they still persisted with working in crews. One very interesting revelation from six respondents was their desire to learn how to scuba dive and also use hookah equipment. While others demonstrated reservations, these fishers indicated that the use of scuba, for example, would allow them to target known sleeping grounds of large fish such as the bumphead parrotfish and humphead wrasse (*Cheilinus undulatus*). This is an alarming development given the increasing anecdotal evidence of scuba spearfishing in the Pacific (Wilkinson 2004).

The above data point to two very important issues. The first concerns the inherent contradiction between a) the observations made by fishers concerning the marked declines in both size and abundance of fish within their own, often relatively brief careers, and b) their expressed desires to acquire further equipment that would enable them to increase their fishing effort and make more money. The almost complete absence of anything resembling a conservation ethic among the vast majority of fishers in the Solomon Islands is something we cannot emphasise too strongly here. There are of course a few enlightened individuals here and there who can clearly see what is happening to fisheries and are struggling to do something about it, but such people are in a tiny minority.

The second issue concerns access to reefs. Reef tenure around Ghizo Island, as far as we are aware, is quite problematic. Most of Ghizo Island, apart from one or two small parcels at the western end, is part of the 15% of land in Solomon Islands referred

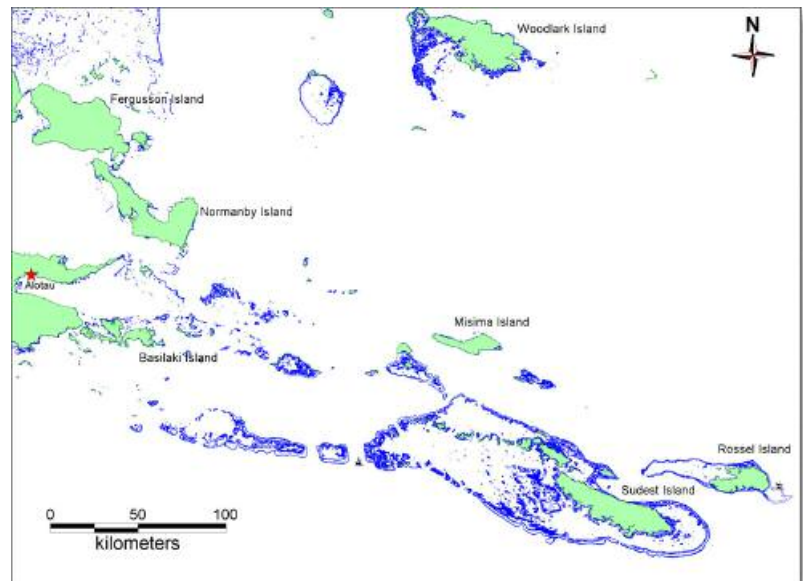
to as “alienated land” (the other 85% is held under various forms of customary ownership, which is endorsed by the state). This means that the land was purchased from its former traditional custodians during the colonial era, and was converted to leasehold land, often a 99-year lease. These leases are presently held by the government of Solomon Islands. Because most of the reefs in question are adjacent to alienated land, their legal status appears to be somewhat ambiguous, and at present most are nominally the possessions of the government. However enquiries to the Lands Department about this issue by the second author in 2000 yielded contradictory and confusing responses. It is very likely that, if large deposits of precious minerals were discovered under any of the reefs around Gizo, a number of competing claims from customary owners would be made. How such claims would be resolved would most likely depend on each individual case (Kabui 1997). Therefore, Ghizo currently represents a situation where there is essentially open access to reefs, and as such there is no customary (nor any other) mechanism for enforcing restrictions. However even if the will existed within the provincial government to exert fishing restrictions over reefs around Ghizo Island, there is no capacity to enforce them.

## Part 2: Milne Bay, Papua New Guinea

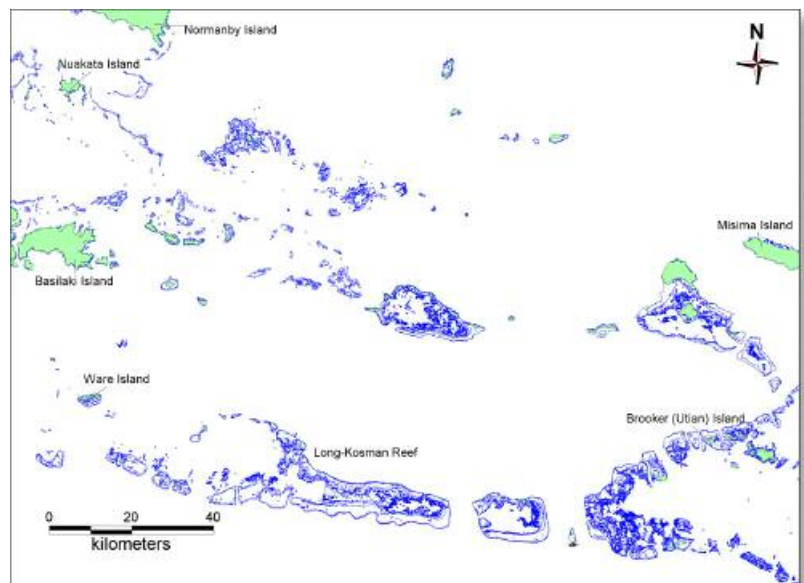
The material for the second part of our analysis comes from the “Small Islands in Peril Study” (SMIP), which focussed on marine and coastal resource management issues on small islands in Milne Bay (Fig. 3) that have population densities higher than 100 people per km<sup>2</sup>. At these densities it is no longer possible to support the population with swidden agriculture, and food produced by subsistence farming is usually therefore supplemented by food obtained with cash, and the cash is mostly obtained by artisanal fishing. The most important artisanal fisheries at present in Milne Bay are beche-de-mer and shark fin.

The people living on SMIP with the highest population densities mostly happen to be those with access to

very large marine territories that include vast expanses of coral reefs. The two most important examples are Ware Island in the Bwanabwana group and Brooker Island in the Louisiade group (Fig. 4). Most of the findings from the SMIP study have been published (Foale 2005) but recent unpublished data on catch per unit of effort (CPUE) for beche-de-mer give useful insights on the impact of increased use of modern technologies in artisanal



**Figure 3.** Milne Bay Province, showing all the major islands, with the exception of the Trobriands and Goodenough (to the northwest). The reef layer in this map was kindly provided by Tom Taranto of CSIRO, Cleveland Marine Laboratories, Australia.



**Figure 4.** Southwestern Milne Bay showing Ware and Brooker islands, and the very large reef complex stretching between these two islands, which is claimed and fished by people from them. The exact location of the territorial boundary bisecting Brooker and Ware marine territories is still under dispute. The reef layer in this map was kindly provided by Tom Taranto of CSIRO, Cleveland Marine Laboratories, Australia.

fisheries in Milne Bay, which we will briefly summarise and discuss below.

Over the past five to ten years, the beche-de-mer fishery in Milne Bay has undergone rapid modernisation. When Kinch (1999, 2002) measured the CPUE of beche-de-mer fishers from Brooker Islander in 1999 (see also Allen et al. 2003), diving done from traditional sailing vessels, *sailaus*, (Fig. 5), using cheap plastic Chinese goggles and little else apart from the weighted spike that is dropped on the slugs from above. Now the same fishers are diving from far more manoeuvrable outboard-powered fibreglass dinghies (Fig. 6), using modern diving masks, fins, wetsuits, and in some cases (even though it is illegal) hookah gear. Pressure on the remaining high-grade species (mainly white teatfish, *Holothuria fuscogilva*, and prickly redfish, *Thelenota ananas*) has escalated to the point where territorial clashes between Brooker and Ware fishers have become increasingly common, often with violent altercations.

The greater depth range of white teatfish (down to 40 m) has afforded it a significant refuge from fishing pressure, as it is difficult for even the best divers on breath-hold to catch animals at these depths, even in calm conditions with no current. This means that white teatfish stocks will probably take longer to deplete than species with shallower depth ranges, such as sandfish and black teatfish, which are already commercially extinct throughout most of Milne Bay (Skewes et al. 2002). Indeed this is likely to be one of the main reasons (along with

the government-enforced six-month closed season) that there are still fishable stocks of white teatfish in Milne Bay. Based on data from 58 diver-days in the first half of 2006, CPUE for Ware Island fishermen was 0.37 white teatfish slugs per diver-hour, with standard deviation of 0.40. The average CPUE obtained by Kinch for Brooker divers in 1999 (Allen et al. 2003, pp. 67–69) was 0.2 white teatfish slugs per diver-hour.

It is worth observing that current levels of beche-de-mer fishing have resulted in the deforestation of several cays along the Long-Kosman Reef complex for firewood. Beche-de-mer are cooked on these small uninhabited islands, which are used as camps for one to two-week-long fishing trips, made mainly by Ware and Brooker Islanders (Geoff Callister, pers. comm.). Apart from the six-month closed season, and what appear to be increasingly frequent and acrimonious territorial disputes between Brooker and Ware Island fishers, the fishery is essentially unregulated. There is very little in the way of local level management initiatives, and one of the reasons for this is an apparent lack of awareness of the limits of stocks. Foale (2005) presents interview data from islands in the Bwanabwana language group (which includes Ware Island) on the topic of perceived limits to fished stocks (reproduced in Table 1 below). Foales demonstrates that there is relatively low awareness of limits to beche-de-mer, even despite the common knowledge of sandfish and black teat overfishing, and an almost total disbelief that there might be limits to finfish populations.

We believe the apparent lack of awareness of the limits to fished populations is largely (though not entirely) related to a lack of knowledge about the ways in which populations of marine organisms replace themselves, particularly the process of broadcast spawning, larval dispersal and settlement. Table 2 below (also from Foale 2005) shows answers to interview questions about modes



**Figure 5.** Milne Bay *sailau*.

**Figure 6.** Modern fibreglass dinghy with beche-de-mer divers from Ware Island on board. Photo kindly provided by Geoff Callister.



of reproduction in fished organisms such as beche-de-mer and fish.

Given the high variance in our CPUE data, it is unlikely that the current average CPUE is significantly different from Kinch's data, and without other contemporaneous fishery-independent data on stock densities<sup>3</sup>, we cannot quantify fishing efficiency of the more recent, dinghy-based diving system relative to the older *sailau*-based one. However we can at least speculate that since fishing efficiency is almost certainly significantly higher, and CPUE not significantly different, that white teatfish stocks are likely to have declined in density since the late 1990s. This is hardly a surprising conclusion given the recent complete closure of the beche-de-mer fishery in Solomon Islands due to massive and widespread overfishing.

### Shark fin

The artisanal shark fin fishery is expanding rapidly in Milne Bay, and is presently being pushed along by unscrupulous Asian businessmen who are quickly establishing patron-client relationships with local fishers, with striking parallels to the Indonesian model (Fox and Sen 2002). This involves providing vessels, fishing equipment and fuel on loan, and requiring that the debt is repaid in shark fins — this system helps to ensure that the fisher does not sell his product elsewhere, and also generates pressure to continue fishing even after the CPUE drops below a level at which most fishermen might be inclined to earn cash via another activity. It effectively locks fishers into a system that is inevitably destructive of the fishery, and in most cases is unlikely to be of lasting benefit to the fishers.

At the time of writing, it has been impossible to obtain information on the relative impacts of the artisanal shark fishery and the industrial longline shark fleet in Papua New Guinea. Although there are only around nine licensed shark longline vessels on the National Fisheries Authority's records, there is considerable anecdotal evidence from residents of small islands in Milne Bay that many tuna longliners may still be using shark gear and fishing in close to reefs to target sharks at night. Many people comment on the common sighting of longliners closely approaching reefs such as the Long-Kosman reef complex and the Conflicts reefs at night in

**Table 1.** Responses to the question: "Are there limits to beche-de-mer (or fish/sharks)?" "Qual" means that the answer was a qualified yes or no (from Foale 2005).

| Island, and<br>no. of interviews | Limits<br>to BDM? |      |     | Limits<br>to fish/sharks? |      |     |    |
|----------------------------------|-------------------|------|-----|---------------------------|------|-----|----|
|                                  | No                | Qual | Yes | No                        | Qual | Yes |    |
| Tubetube                         | 15                | 10   | 3   | 2                         | 15   | 0   | 0  |
| Kwaraiwa                         | 7                 | 5    | 2   | 1                         | 17   | 0   | 0  |
| Skelton                          | 5                 | 1    | 4   | 0                         | 5    | 0   | 0  |
| Ware                             | 21                | 14   | 2   | 5                         | 21   | 0   | 0  |
| Anagusa                          | 11                | 5    | 2   | 4                         | 9    | 1   | 1  |
| Dawson                           | 5                 | 0    | 5   | 0                         | 5    | 0   | 0  |
| Totals (%)                       |                   | 54   | 28  | 18                        | 97   | <2  | <2 |

**Table 2.** Answers to the question: "How do fish and beche-de-mer reproduce?"

| Island, and<br>no. of interviews | How do fish/BDM reproduce? |                        |                           |   |
|----------------------------------|----------------------------|------------------------|---------------------------|---|
|                                  | No idea                    | Partial<br>explanation | Scientific<br>explanation |   |
| Tubetube                         | 15                         | 15                     | 0                         | 0 |
| Kwaraiwa                         | 7                          | 7                      | 0                         | 0 |
| Naluwaluwali                     | 5                          | 5                      | 0                         | 0 |
| Ware                             | 21                         | 20                     | 1                         | 0 |
| Anagusa                          | 11                         | 7                      | 4                         | 0 |
| Dawson                           | 5                          | 2                      | 3                         | 0 |
| Totals (%)                       |                            | 87.5                   | 12.5                      | 0 |

Milne Bay. While a number of the artisanal shark fishers in the Bwanabwana group have obtained their shark lines, hooks and floats from traders in Alotau, a surprisingly large number obtained their gear from an Asian longline vessel that ran aground on one of the reefs in the area and was abandoned by the crew. The vessel also had a large quantity of shark fin on board, hidden underneath the tuna catch.

### Discussion

Pressure on Melanesian reef fisheries has been extremely low until very recently, and this can be attributed in the main to the unusually low human population density of the region, combined with the relatively weak penetration of Asian marine commodity markets. Some commodity markets, such as trochus, beche-de-mer and pearl-shell, have been around for a very long time, but since the embrace of capitalism by mainland China over the

3. Skewes et al. 2002 provide the best available data from surveys conducted in late 2001, but there is no subsequent or earlier data to provide a time-series comparison.

last decade, these markets have accelerated rapidly, and the shockwaves of this titanic increase in consumption is now being felt throughout the region. Melanesian aspirations for development, combined with a widespread lack of awareness of the limits of coastal fisheries, are willing but disastrous bedfellows of the increased Asian demand for marine products. A sobering aspect of this global market system is that as the supply of each commodity declines with dwindling stock densities, the demand drives the price up, providing greater incentive for fishers to wipe out the remaining vestiges of each fishery. When the sandfish fishery was destroyed by overharvesting in Milne Bay in the late 1980s, the price was a paltry 12 kina (PGK)<sup>4</sup> per kg. Now it is over PGK 150 per kg, but there are very few sandfish to be found any more.

The past decade has also seen the rapid uptake of various forms of technology that make fishing more efficient, and inevitably increase pressure on stocks. In the absence of any form of routine stock assessment and management (compare the level of inshore fishery management in Melanesia with the Aitutaki trochus fishery: Nash et al. 1995) such developments do not bode well, and in the absence of widespread and systematic intervention, the only uncertainty at present is how long it will take for each fishery to collapse.

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4. PGK 1.00 = USD 0.33 (December 2006)