

**Sharks, sea slugs and skirmishes: managing marine and agricultural resources on small, overpopulated islands in Milne Bay, PNG.**

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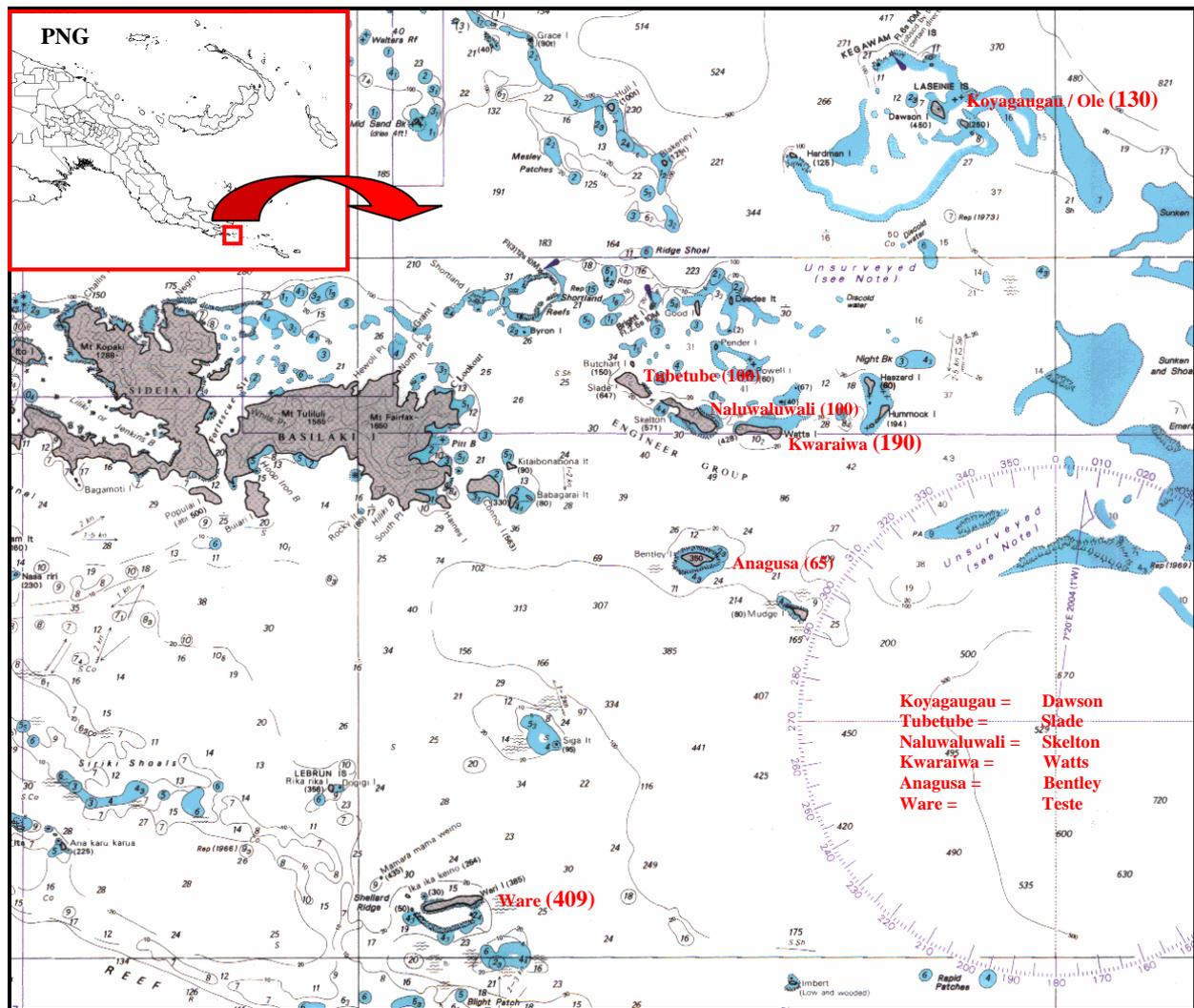
## **Abstract**

This paper presents data from the first period of fieldwork for the Small Islands in Peril (SMIP) Project, which is located in Milne Bay, at the eastern end of the island of New Guinea. The central aim of the SMIP Project is to generate policies for sustainable coastal and marine resource management via an analysis of the responses of people on small, overpopulated islands to pressure on subsistence resources. On such islands the swidden agriculture system tends to be under stress as indicated by shortening fallow periods, increased use of crops that are tolerant to low nutrient levels such as cassava and sweet potato, and in some cases the expansion of grasslands. People on these islands appear to be increasingly reliant on commercial fishing, primarily for beche-de-mer and shark-fin, both of which are exported to China. Income from these fisheries enables them to supplement the subsistence economy with imported food. However, despite the vast area of marine resources available to these people, there is now clear evidence of overfishing for the higher priced species of beche-de-mer. Shark fisheries are also prone to rapid overfishing and unlikely to last long under current levels of fishing pressure. In this paper I give an overview of the relationship between the cash and the subsistence economy for six small islands in the Bwanabwana language group in Milne Bay. I also present interview data on local understandings of stock status and dynamics for the shark, beche-de-mer and fin-fish fisheries, and the implications these have for management, along with a description of marine tenure regimes, and disputes over marine resources. Given the strong likelihood that stocks of shark and the remaining high-grade beche-de-mer species will be depleted within a decade, if not less, other economic alternatives for the islanders, including migration, are discussed. The impact of overfishing on ecosystem function and resilience is also discussed.

## **Introduction**

Helen Hughes (Hughes 2003) has asserted that rural Melanesians' level of commitment to engaging with the global market-place is always going to be inversely proportional to the level of food security they enjoy. In other words, if the availability of land and the supply of women's labour for subsistence production are high, people are unlikely to work terribly hard at making environmentally and economically sustainable cash-generating enterprises succeed. This is in part due to the greater amount of work involved in the sustainable types of enterprise (as opposed to the unsustainable ones like mining, industrial logging and various forms of commercial fishing). In many cases it is also due in part to the difficulty of generating sufficient economies of scale to overcome obstacles such as poor communications and the very high transport costs that are faced by people living on remote islands. The many flaws in Hughes' responses to this and other development conundrums in Melanesia have been identified by a number of authors, most recently in the collection edited by Jim Fingleton (2005). However the importance of the 'subsistence backstop' is interesting and will be explored here in the 'laboratory' of small, densely populated islands in Milne Bay, PNG (Map 1). The SMIP program is aimed at examining what happens when food security can no longer be guaranteed, which is what we expect to see on small islands with population densities greater than 100 people per square kilometre.

While the average population density for the nation of Papua New Guinea as a whole is around 12 people per square kilometre, it tends to be much higher on many small islands, and most of these islands are in Milne Bay (Tables 1 and 2).



**Map 1.** A section of the marine chart ‘Aus 381’ showing the Bwanabwana group of islands, also known as the Engineer Group, showing the islands visited by the author during fieldwork (named in red). English names of the islands are given at bottom right. Numbers adjacent to the names of the islands are population densities (see Table 2). Depths are in fathoms.

**Table 1: Small islands in peril in Milne Bay Province and the rest of PNG.**

SMIPs	Islands with area of 1-10 km <sup>2</sup>		Islands with area of 10-100 km <sup>2</sup>	
	No. of islands	Est. 2000 pop'n	No. of islands	Est. 2000 pop'n
Milne Bay Province	44	11,468	1	7,200
Rest of PNG	75	23,030	19	48,603
<b>TOTAL PNG</b>	<b>119</b>	<b>34,498</b>	<b>20</b>	<b>55,803</b>

(From (Filer 2002))

The conceptual framework and background to the SMIP study has been described in detail by Filer (2002). A description of fieldwork methods for this study is presented

in Appendix 1. Inevitably a number of changes have been necessary to the methodology. A key methodological tool was the use of photographs to stimulate narratives about the topics of interest for the study such as trends in ecosystem and other services such as garden productivity, fishery production, housing, health, education and water supply. This methodology while effective, was less useful than anticipated, partly because people showed a much greater interest in photographs of people they recognised than of subjects such as gardens, wells and houses. Nevertheless the tool will be used again in a more limited way. The study of disputes and conflicts over marine resources was to be undertaken by Mike Fabinyi (see Appendix 2) but will now need to be performed by another student, as Mike has had to relocate his Ph.D. study to the Philippines for health reasons.

This paper examines the following:

- a) The relationship between the subsistence economy and the cash economy, the latter being dominated at present by revenue from fisheries. I compare six densely populated islands which are experiencing various levels of pressure on terrestrial subsistence resources;
- b) Allocation of earnings from fishing among imported food, services (health and education), transport, and the ceremonial economy (expenditure on alcohol is significant but the data is largely qualitative);
- c) Scope for improvement in the management and performance of fisheries and factors governing allocation of revenue from fisheries on services and other expenses.
- d) Local attitudes to future sustainability of ecosystem goods and services in Milne Bay, particularly fisheries and swidden agriculture.

One of the rationales for the focus on the relationship between subsistence pressure and level of engagement with the cash economy is that at present remittances are likely to be either stagnating or drying up, due to the declining economic performance of the nation as a whole (Filer 2002). Geoff Hayes (1993) estimated cash remittances for Ware Island in the early 1990s to be 33.1% of average household income (which was equal to income from marine resources at the time), but no reliable data exist for the other islands in this group. Given this recent constraint on peoples' economic options, this project will attempt to determine what flexibility exists for people to move away from the SMIPs as pressure on subsistence resources increases. Can they invoke kin or trading ties to move to larger islands or the mainland where pressure on staple food production is lower? Given that the population of Tubetube has fluctuated quite dramatically over the past century (Macintyre 1983), it seems reasonable to assume that movement of people between islands may still be relatively fluid. However changing economic contexts and social mores stemming from the rapid monetisation of the economy in the past ten years (Kinch 2001) might have limited this fluidity to some extent.

The following sections will present data generated by surveys conducted in April 2005, and a review of the literature, followed by an analysis of what these data can tell us about the above questions, and what remains unresolved.

## Results

### Population and Services

Using population data from the 2000 census and land areas calculated by Conservation International (Mitchell *et al.* 2001), four of the islands have population densities of 100 or more people per square kilometre, and updating the data with recent estimates given by local ward councillors, Tubetube's density goes from 73 to 100 (Table 2). Ware had the highest density at 321 in 2000 and around 409 at present. This is followed by Kwaraiwa with 190, then Koyagaugau and Ole (combined, because people living on Ole make gardens on Koyagaugau) with 133.

**Table 2. Population density**

Island	Total population			Land area (km <sup>2</sup> )	Density			
	Year:	1981 <sup>#</sup>	2000		2005	1981	2000	2005
Tubetube		104	184	252	2.4 + 0.12 = 2.52*	41	73	100
Kwaraiwa		218	358		1.88*	115	190	
Naluwaluwali		132	282		2.8*	47	100	
Ware		498	707	ca 900	2.2*	226	321	409
Anagusa		70	85		1.3	53	65	
Koyagaugau + Ole		118	187	ca 200	1.4	84	133	142

- <sup>#</sup> (From Macintyre 1983: 16)
- \* The second figure for Tubetube land area is for the small neighbouring islands that people on that island had access to for gardening. People on Kwaraiwa, Naluwaluwali and Ware, also had access to small neighbouring islands for gardening, but there appear to be inconsistencies with data (Mitchell *et al.* 2001) on the area of these islands so they have not been included.
- Part or all of each of the above populations are able to access land on other (mostly very small) islands close to the island on which they live.
- The figure given for Koyagaugau includes the population on Ole island, many of whom have gardens on Koyagaugau.
- The ratio of arable land to total land area is likely to vary dramatically among islands.
- Populations on some of the islands have increased dramatically since 2000. Ware is believed to now have at least 900 people, and Koyagaugau / Ole probably has over 200.

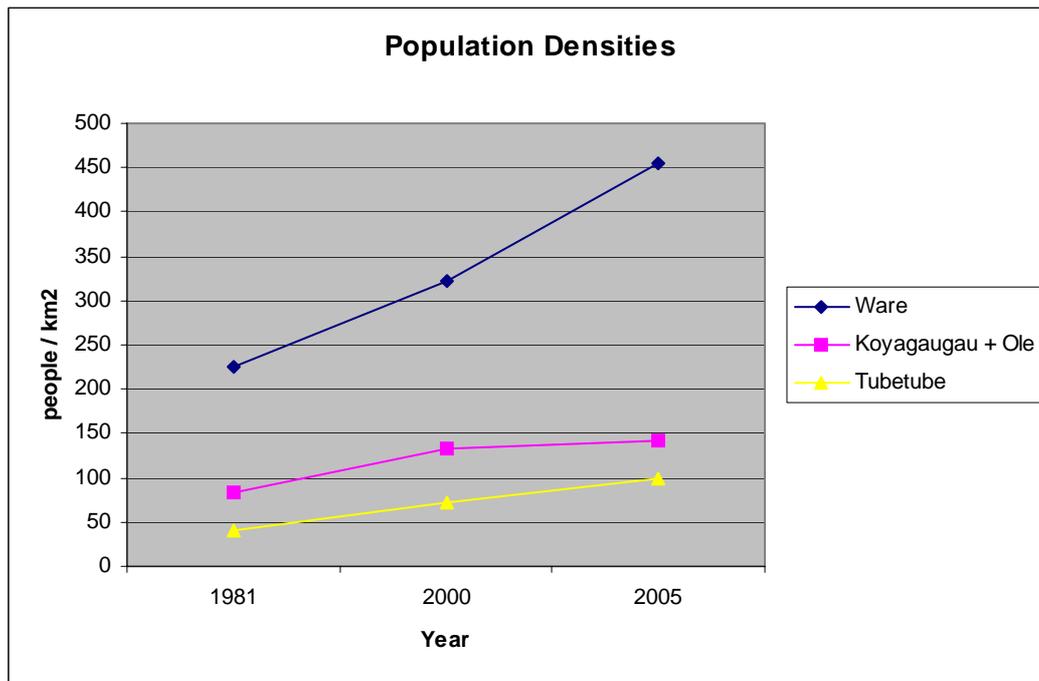
Figure 1 below shows the trajectory of population densities for three of the Bwanabwana islands since 1981. It should be noted that despite the apparently inexorable increase indicated by the graph, the population of Tubetube has undergone large fluctuations since the late 19th Century (Macintyre 1983). For example, at the time of the arrival of the Methodist mission in 1892, the population of Tubetube was over 400. The following passage by Martha Macintyre, who lived on Tubetube from 1979 to 1981, sheds an important insight into the complex and dynamic nature of residency of people on islands in the Bwanabwana region:

The changes in the population of Tubetube are accounted for in the following ways during the two-year period: six children left the island to attend high school; eleven people moved to other hamlets on Naluwaluwali and Koyagaugau; five people who had been temporarily residing on Tubetube returned to Koyagaugau; four children who had been living there as foster children of relatives returned to their home village hamlets having completed their primary education; and one woman went to live on Duau (south-eastern Normanby Island) to care for a sick relative. In all, thirty-one people left the island. In that same period five people arrived from Ferguson Island and settled on land belonging to affines; three babies were born and three people

died; and an Anagusa man married a woman on Tubetube and moved there to live. At any given time as many as twenty people are away on trading voyages or extended visits to relatives on other islands (Macintyre 1983).

The relationship between environmental and social factors in determining the movement of people among islands, and between SMIPs and the mainland or large islands, will be discussed further later in the paper.

**Figure 1**



The following table presents an overview of the main services available on each of the islands visited. Anagusa had the lowest service availability overall, with no school or aidpost, and no working dinghies.

**Table 3. Services**

	<i>Tubetube</i>	<i>Naluwaluwali</i>	<i>Kwaraiwa</i>	<i>Ware</i>	<i>Anagusa</i>	<i>Koya-gaugau</i>
<b>School</b>	Community	No	Community	Top-up	No	No
<b>Clinic</b>	Aid-post	No	Sub-Health Centre	Aid-post	No	Aid-post
<b>Radio</b>	Yes	Yes	Yes	Yes	No	Yes
<b>Trade stores</b>	4	2	3+	8+	1*	1*
<b>On shipping route</b>	Yes	Yes	Yes	No	No	Yes
<b>Resident workboats</b>	2 (2)	2 (2)	2 (2)	5 (7)	0 (1)	0 (?)
<b>Resident dinghies</b>	4+ (4)	2+ (3)	10 (7)	14+ (6)	1* (0)	2+ (?)
<b>Resident sailaus</b>	0? (1)	1+ (2)	6+ (8)	4+ (13)	3 (3)	4+ (?)

- The Plus (+) sign after number of dingies and sailaus means we were not able to obtain a reliable estimate of the number of resident vessels at the time of the survey.
- Figures in brackets are data from around 1999 reported by Mitchell *et al.* (2001).

## Health

Detailed case load data were collected for three clinics (Table 4 below) and a sketchy outline was obtained for the Tubetube aid post, which indicated similar ratios of diseases to the others shown in the table. The larger number of cases for the Kwaraiwa sub health centre is related to the fact that it serves all of the islands in the group, not Kwaraiwa alone.

**Table 4. Summary data on case loads for three clinics**

<b>Illness</b>	<b>Kwaraiwa sub health centre</b>	<b>Ware aid post</b>	<b>Koyagaugau aid post</b>
	2004	2003	2004
<b>Malaria (simple)</b>	1846	362	249
<b>Malaria (TFM*)</b>	<100	7	0
<b>Simple Cough</b>	334	51	54
<b>Other respiratory</b>	225	60	12
<b>Pneumonia</b>	226	30	3
<b>Diarhoea</b>	88	24	1
<b>Anemia</b>	1	3	0
<b>Malnutrition</b>	1	1	0
<b>Accidents and Injuries</b>	338	40	26
<b>Skin diseases</b>	464	245	43
<b>Genital disease</b>	12	1	0
<b>Ear infections</b>	ND	33	7
<b>Eye infections</b>	ND	19	26
<b>Measles</b>	ND	2	0
<b>Whooping Cough</b>	ND	0	0
<b>Other new cases</b>	ND	205	148
<b>Total new cases</b>	ND	1083	748

\* TFM = 'Treatment Failure Malaria' (i.e. patients returning for a second round of treatment).

The table shows that malaria is a major problem throughout the island group, despite reported increases in usage of bednets by the Provincial Health Department. Calculation of the proportion of the populations affected by malaria from the above case data is complicated by the fact that Kwaraiwa sub health centre serves all of the other islands in the Bwanabwana group (with the possible exception of Kitai) and there may therefore be some overlap in treatment. However it appears that the proportion of the population of Koyagaugau suffering from malaria is significantly higher than that of Ware.

The very low rates of malnutrition and anaemia indicate that people are not undernourished on any of these islands. Roughly the same proportion of people seems to be suffering from skin infections on Ware and Koyagaugau, while the rate of eye infection seems unusually high on Koyagaugau.

All of the staff interviewed at the aid posts complained about lack of government support. The Kwaraiwa sub health centre is supported by the Uniting Church, while the aid posts at Tubetube, Koyagaugau and Ware are government-funded. The large gulf in health support between church and government is obvious in differences between Kwaraiwa and the aid posts in infrastructure, equipment, travel support, and supply of medicines. The Kwaraiwa sub-health centre conducted monthly tours to

most of the other islands in the Bwanabwana group, mainly to perform immunisations. Kwaraiwa staff at the sub-health centre supervised 21 deliveries at the sub health centre, and supervised 5 village births in 2004. No data were available on unsupervised births. On Anagusa the magistrates wife assisted with births and had about five small bottles of medicines (Panadol, chloroquine and some antibiotics) in her house. For Naluwaluwali residents all health care had to be sought at Kwaraiwa.

### *Education*

The following enrolments data for 2004 are sourced from the Division of Education in Alotau:

**Table 5**

<b>Ware Primary</b>		
<b>Class</b>	<b>Male</b>	<b>Female</b>
1	18	15
2	19	13
3	15	25
4	25	19
6	19	24
8	16	17
<b>Total</b>	<b>112</b>	<b>113</b>
<b>Staff</b>	<b>4</b>	<b>2</b>

**Table 6**

<b>Tubetube Community</b>		
<b>Class</b>	<b>Male</b>	<b>Female</b>
1	12	11
2	11	4
3	5	11
4	9	13
5	0	0
6	0	0
<b>Total</b>	<b>37</b>	<b>39</b>
<b>Staff</b>	<b>1</b>	<b>2*</b>

\* One of the staff taught two classes

There is a large community school on Kwaraiwa but it appears that no enrolment data for this school are included in the government report from which the above data were obtained, and all teachers were off-island on holiday at the time of fieldwork.

If we assume that the current populations of Ware and Tubetube are 1000 and 250 respectively these enrolment figures indicate that 25% and 30% of their populations (respectively) are at school. Since there are six classes on Ware and four on Tubetube this suggests that there is a significantly higher rate of attendance on Tubetube. This contrasts with the assertion by the Ware school headmaster that almost all school-age children on Ware are at school, thanks to the increased capacity of Ware people to pay school fees as a result of high rates of income from fishing. Allocation of income from fishing to health and education on Ware is discussed further below.

## Agriculture

The agricultural systems on all the islands are based on a swidden rotation, usually with yams (*Dioscorea esculenta*) tending to dominate in the first year, and cassava (*Manihot esculenta*), bananas (*Musa* spp), and sweet potato (*Ipomea batatas*) making up most of the second year crop. A large number of other starch staples are also planted, including taro, which is usually planted at the bottom of slopes where soil is moister. The agricultural systems are described in detail by Hide *et al.* (1994) and the system used on each of the islands is given in Table 7 below. The agricultural systems on each island corresponded very closely to the descriptions published in this document, with a small number of minor deviations. The length of the fallow period reported by Hide *et al.* (1994) was between 5 and 15 years for most of the islands, including Ware, but this had, according to interviews with farmers (no detailed information was sought for individual garden plots), apparently reduced in length by the time of my fieldwork as shown in Table 7 below.

**Table 7. Change in fallow period.**

<i>Island</i>	<i>Ag. System</i>	<i>Fallow period 1994</i>	<i>Fallow period 2005</i>
<b>Tubetube</b>	12	5-15	3-6
<b>Kwaraiwa</b>	12	5-15	4-5
<b>Naluwaluwali</b>	12	5-15	3-5
<b>Ware</b>	13*	5-15	2-3
<b>Anagusa</b>	12	5-15	3-4
<b>Koyagaugau + Ole</b>	12	5-15	5-6

\* The Ware system has two subsystems – one for the grassland that dominates the upper slopes of the island, and one for the short bush-land on the flats and lower slopes. System 12 has no subsystem divisions.

A number of people expressed the opinion that many community members had not thought much about the recent reduction in fallow period and as such had not problematised it. However having discussed the matter they acknowledged that it was something that deserved more attention. Ware Island, as expected, had the shortest fallow period, at around 2-3 years. On Ware, mainly through the efforts of ex-Didiman Alby Kilo, a lot of legumes (*Pueraria*, *Leucaena*, *Glyricidia* and *Centrosema*) have been planted in and around the gardens, and on some of the extensive grassland, in an effort to improve the soil. However this strategy may not make the extensive grasslands on Ware any more cultivable than they are, mainly because the depth of the soil in these areas is very shallow as a result of soil erosion. Soil erosion from the grassland area, particularly following a fire, was a significant problem that was commented on by several people on that island. After Ware, the highest apparent land pressure is on Koyagaugau / Ole, followed by Kwaraiwa and Tubetube. Anagusa has a lot of unusable and unproductive land (limestone rock or grassland) but the population is also smaller than on most of the other islands. Macintyre (1983) reports that until the early part of the 20<sup>th</sup> Century all of the gardens on Tubetube were made on the flat land around the fringes of the island, but this land was subsequently planted with coconuts forcing people to make their gardens on the shallower, stony and less fertile soils of the slopes.

Throughout the Bwanabwana region, and perhaps especially on Ware, crops routinely fail in severe droughts (Macintyre 1983, Hayes 1993, Hide *et al.* 2002). Macintyre (1983) reports that crops fail on average once every decade in this region, and interview data from this work corroborate this view. Macintyre has photographs of food aid being distributed during the 1981 drought, the harvest on Ware failed in 1991 (Hayes 1993), and people on several of the islands reported receiving food aid during the 1997/8 drought. Informants on Tubetube, Kwaraiwa and Naluwaluwali reported that if there is no rain for six months, crops fail. On Ware, because of the shallow soils, the figure is closer to three months. The extent to which people are able to use kin, affinal and traditional trade relationships to obtain food and other resources on big islands such as Normanby or Bwasilaki, or on the mainland during crises such as droughts will be explored in forthcoming fieldwork.

Women on most of the islands gained access to income from fisheries through the marketing of garden produce. Assessing the extent of redistribution of income by this means was beyond the scope of the study.

Numbers of pigs have not changed significantly over the past decade in the opinions of most informants, apart from on Koyagaugau, where it has decreased, due to a reduction in traditional feasting and Kune-related trading. Informants related this to increased levels of formal education, greater involvement in the cash economy, and the recent (with the last two decades) death of a number of prominent big-men who had a strong influence on the ceremonial economy. Belshaw (1955) reports that in 1950 only 'one or two' pigs were present on Ware and these were kept in pens and hand fed. There were at least 30 pigs on Ware at the time of fieldwork, and all were kept in pens.

### **Contemporary use of magic in agricultural production in the Bwanabwana area**

Interviewees on Tubetube, Kwaraiwa, Naluwaluwali and Koyagaugau said that some farmers still used the palolo worm (*Palola viridis*) to enhance fertility and growth of subsistence gardens. Most people smirked or were circumspect when they spoke of the ritual practices associated with this animal, and said that it is mainly only used by older people these days. They usually burn the leaves in which palolo worms had been baked, in the garden. Macintyre (1990) notes the ritual importance of the worm on Misima, and (Fortune 1963: 259) mentions the importance of palolo worms as a seasonal marker, and as food, on Dobu but has no details about their ritual use in gardening. On Lihir in New Ireland Province, the palolo worm is regarded as a powerful but potentially very dangerous spirit, which if propitiated correctly can make gardens and children grow well.

On most of the islands in the Bwanabwana group, people use a variety of magical plant parts to enhance growth of yams and other staples, and also provide protection against theft. One method is to pour water on seed yams through a wad of these magical herbs and leaves, and another method is to place leaves of protective plants under the seed yam or seed banana when it is planted. Names for the magical plants were obtained from at two informants and it appears that the varieties used are by no means universal and most gardeners have their own preferred plants or combinations of plants for these purposes. It is unlikely that any functionalist interpretation (e.g.

that magic is used more where soils are less fertile or where population density is higher) could reasonably be drawn from these data.

## Copra

With the exception of Ware (Hide *et al.* 2002: 54), people harvested copra up until around 1999, when the price dropped to the point where it was no longer profitable. Copra production re-started in June in Tubetube and Naluwaluwali (Mike Fabinyi pers. comm. July 2005), probably due to a combination of recent price rises (K80/bag in Alotau in July 2005) and the fact that the beche-de-mer season had finished. The province as a whole had apparently exported 1,200 tonnes of copra, worth K80,000 since production recommenced (presumably this year), and while this was a small amount compared to the 14,000 tonnes of 12 years ago, the Governor was reported as expecting copra to earn K4.5 million (Faiparik 2005), though a time frame for this production is not given. The copra price subsequently dropped again to K40/bag, and people throughout the Bwanabwana Group had abandoned copra production by November.

Hayes (1993) noted that the copra plantation was already senile in 1991, and Hide *et al.* (2002: 54) also note that no copra was produced in 1994, three years after the 1991 drought. The fact that people are unwilling to use precious gardening land for planting new coconuts on Ware suggests it is unlikely that copra will make a return there. One informant believed that two small islands to the southeast of Ware, which have had plantations on them historically, could potentially be rehabilitated as copra plantations.

## Trade stores

See Table 3 (above) for summary data on the number of trade stores on each of the islands. Tables 8 and 9 below show annual turnover per store and per island. All of the trade stores on Kwaraiwa close down in the BDM closed season according to the Ward Recorder there. The legal stores on Tubetube stay open however. There are many black market stores in the BDM season. Most people who have a stock of store goods feel compelled to sell part of it and often do so out of fear of sorcery. The trade store data from this trip are not sufficient to derive a confident comparison of spending on each of the islands, for various reasons (see discussion) including the difficulty of separating income derived from sales of marine products from that derived from sales of store goods for the large store on Naluwaluwali. It may also be worth considering Tubetube, Naluwaluwali and Kwaraiwa as a single economic unit for the purposes of making such a comparison, since commuting between these islands can be done in a dugout canoe.

**Table 8. Annual turnover data for each store (2004)**

<b>Island</b>	<b>Turnover (K)</b>
Anagusa	3,500
Koyagaugau	676
Kwaraiwa	2,000
Kwaraiwa	2,000
Kwaraiwa	500
Naluwaluwali	1,300

Naluwaluwali	1,600,000*
Tubetube	1,000
Tubetube	2,000
Tubetube	15,000
Tubetube	1,000
Ware	1,900
Ware	1,980
Ware	3,000
Ware	5,000
Ware	6,000
Ware	7,000
Ware	20,000
Ware	22,333

\* This turnover includes sales of marine products and alcohol (which were not sold by any of the other stores) as well as store goods

**Table 9. Annual trade store turnover by island and inferred expenditure per head of population (2004)**

<i>Island</i>	<i>Total</i>	<i>Population</i>	<i>Expenditure/ head</i>
Anagusa	3500	85*	41.17647
Koyagaugau	676	200	3.38
Kwaraiwa	4500	358*	12.56983
Naluwaluwali	1601300	282*	5678.369#
Tubetube	19000	252	75.39683
Ware	67213	1000	67.213
<b>Grand Total</b>	<b>1696189</b>	<b>2177</b>	

(\* Year 2000 data. # The figure for Naluwaluwali is meaningless for this analysis)

## Workboats

A detailed survey of workboats is forthcoming and will be conducted by Conservation International staff. A few notes are pertinent here however. Workboats are typically small (ca 6-10m) displacement hull vessels powered by inboard diesel engines. They are more efficient in terms of fuel expenditure per weight of cargo than dinghies, particularly for carrying big loads, but we do not have direct comparative statistics on this at present.

## Sailaus

Table 3 above gives the number of sailaus on each island. Sailaus are an ancient and still very important means of transport for many people in Milne Bay (Smaalders and Kinch 2003). They tend to be used more for traditional trading activities, as well as inter-island commuting, than for commercial fishing, which is predominantly done from dinghies.

- 18 Sailau owners were interviewed in total. There were quite a few more on each of the islands that could not be interviewed because they were out at the time of our visit.

- Most were acquired from relatives, often for free. Most of those not acquired for free were paid for in pigs, yams, shell valuables, and pots, and occasionally things like plates and saucepans. Two payments included K50 in cash.
- Many trips were to acquire housing materials (especially sago leaves and spathes, and bamboo), food (yams and other starch) and betelnut from Normanby (Duau) or Bwasilaki. They were also regularly used as ‘taxis’ to take children to school or sick people to clinics. A small number of trips were for fishing (commercial and subsistence). See Table 10 below for summary data.
- About half of the sailaus came originally from Panaeati but several had been made in other places, including Duau, Woodlark (Murua), Kwaraiwa, and Ware.
- Many sailaus that are based in Duau sell or trade garden produce and betelnut in the Engineers during the BDM season. The trade slows considerably when the season closes.

**Table 10. Purposes for which sailaus were used on the last three trips**

	<i>Trip 1</i>	<i>Trip 2</i>	<i>Trip 3</i>	<i>Total</i>
<b>Commuting / taxi</b>	7	7	7	21
<b>Traditional trade</b>	7	7	8	22
<b>BDM fishing</b>	2	1	1	4
<b>Shark fishing</b>	0	1	0	1
<b>Subsistence fishing</b>	0	1	0	1
<b>Other</b>	1	0	1	2

## Dinghies

Dinghies are the most prominent form of transport in the Bwanabwana group at present. The number of dinghies present on each island is given in Table 3 above. A major feature of dinghy ownership is that many people (all men, and mostly young men) acquire debts to pay off their dinghies. This appears to be mostly done through an arrangement with the creditor where the debt is paid off with sales of marine products. We did not obtain data on whether prices paid for sales in a debt relationship are lower than they otherwise would be but this will be explored on the next field trip.

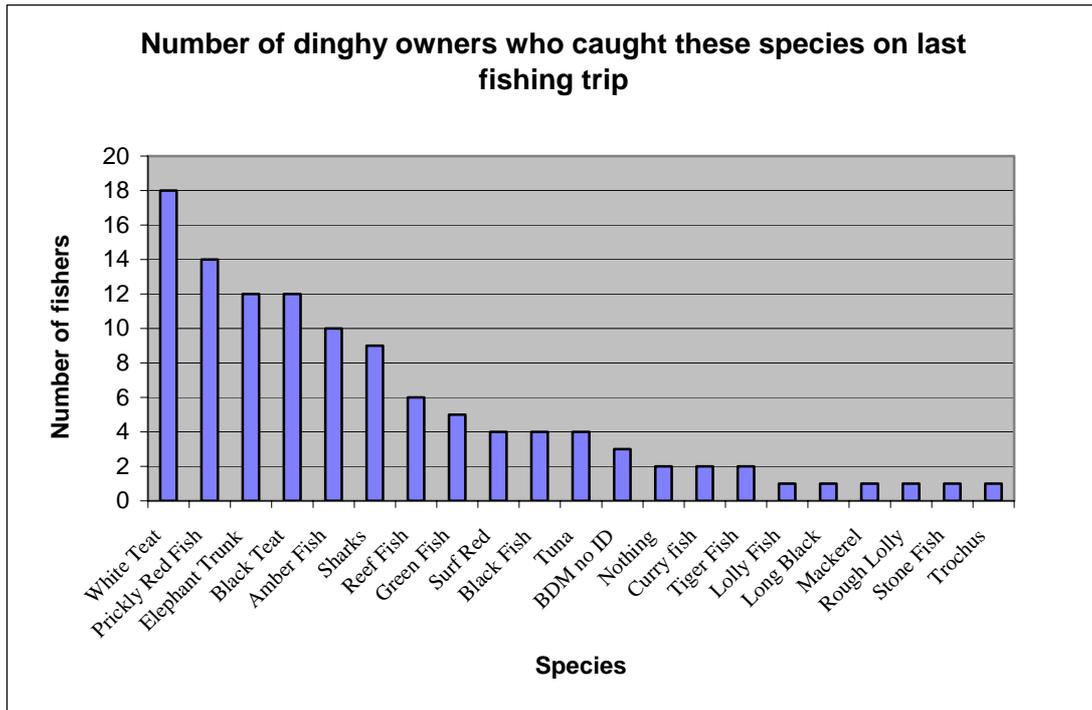
There appears to be a disturbing upsurge in levels of personal indebtedness across the region, much of which is presently unquantified but being actively researched. I have personal communications with Garry Preston for New Ireland, Warwick Nash for the Western Solomon Islands, Martha Macintyre for Port Moresby and various other parts of PNG, and Tom Therick and David Lawrence for Rote Islands in Indonesia, all of which suggest that this is a major socio-economic issue and deserves close scrutiny. Kinch *et al.* (2005) have also observed problems with debt repayment in the snapper fishery, and Jeff Kinch has already commented on the debt cycle with the beche-de-mer fishery in Milne Bay during his time at Conservation International.

The following points can be distilled from the current data:

- Most of the outboard motor powered dinghies were regularly used for BDM and/or shark fishing, and most (19/26) of their most recent trips were to Alotau to sell these products and return with food and petrol.
- 17 of the respondents gave a Kina value for the sale of marine products on their last trip. The average was K4363, but this is skewed by one fisherman's sale which was K57,000. The median, a more representative figure, was K1338. See Table 11 below.
- Only one of the 26 respondents claimed that their boat was *not* used for fishing.
- 8 dinghy owners reported charging a fee to passengers for transport on their last trip.
- 14 of a total of 26 dinghy owners were yet to pay off loans on their dinghy and/or outboard motor.
- The average length of time the engines had been owned by the respondents was 4 years. The longest ownership of an engine that had not yet been paid off was 9 years.
- New price of the average fibreglass dinghy and 40HP engine are around K6000 and K9000 respectively. See Table 11 below for more statistics on costs of ownership of dinghies.
- One dinghy owner on Anagusa had recently had his motor repossessed by Kiwali. He still had the dinghy.
- There many motor-less dinghies on all of the islands that appeared to not be in use.
- 21 of 26 owners regularly hired out their dinghy to others.
- Many of the dinghies on Ware were used only for fishing locally and the catch was then sold to boats owned by the fishing companies that called in.
- Most trips to Alotau were to sell BDM and (less commonly) shark fin, and to return with store food (mainly rice, flour and sugar) and petrol.
- Only one survey respondent reported purchasing beer in Alotau.
- Only one dinghy survey respondent reported acquiring housing materials and buai on his most recent trip.

**Table 11. Summary data on costs of dinghies, and proceeds from last sale of marine products**

	<i>Cost of engine</i>	<i>Cost of boat</i>	<i>Maintenance costs</i>	<i>Last sale</i>
Median	7,500	4,000	982	1,338
Mean	7,122	3,859	1,280	4,363
Range	0 – 12,000	0 – 6,400	0 – 4,000	0 – 57,000



**Figure 2. Summary data on numbers of dinghy owners who sold particular species on their last trip to Alotau**

- Note that there were 26 dinghy owners but 28 dinghy surveys completed – this is because one fisherman owned two dinghies, surveys for which were completed on Tubetube (where he resides) and then a second survey was completed for one of his boats while on Ware because the boat was there fishing at the time.
- Note that Long Black may be the same as Black Fish but this is not confirmed.
- Reef fish are fish and not a kind of beche-de-mer!

**Table 12**

<i>Boat vendor</i>	<i>Total</i>
2nd hand	1
Asia Pac	1
Boroko Motors	1
Chris Abel	1
Development Bank (Alotau)	1
Ela Motors	8
Found	1
Gift	1
Gift from relative	1
Gordon Wesley	1
Kiwali	6
Niugini Motors	1
Samarai Plastics	2
Toba Motors	2
<b>Grand Total</b>	<b>28</b>

Table 13

<i>Engine vendor</i>	<i>Total</i>
2nd hand	1
Asia Pac	1
Boroko Motors	1
Ela Motors	12
Ela Motors (2nd hand)	1
Gift	2
Kiwali	8
Niugini Motors	1
Toba Motors	1
<b>Grand Total</b>	<b>28</b>

Table 14

<i>Buyer of latest catch</i>	<i>Total</i>
Asia Pac	2
Chao Enterprises	1
Kiwali	11
No sale	10
RFI	3
RFI and Kiwali	1
<b>Grand Total</b>	<b>28</b>

Many interviewees commented on high levels of expenditure (by others!) on beer and unnecessary travel (in dinghies), including on Ware. Jack Wesley (who buys marine products, runs a large store, and sells beer on Naluwaluwali) said: “Two weeks after the close of the beche-de-mer season nobody will have any money”. A similar comment was made by Councillor Manase Lome on Tubetube. Some dissenting opinions were recorded, including one by an informant who had a reputation as a big drinker. It is clear that obtaining accurate information on beer consumption from interviews is problematic. However the majority of informants indicated that alcohol was a significant expenditure for most young men who earned money from marine products, and that most fishermen tended to run out of cash very soon after the end of the Beche-de-mer season.

Ware Island clearly had the highest level of capture of fishing revenue for services (education and health) of all six islands visited. The costs of four new weatherboard houses, part of the extension to the clinic, a significant contribution to the purchase of medicinal supplies, and K931 in support of a teacher in-service training event on Ware, were all generated by fund-raising activities on the island. Most of this money would have come from the sale of Beche-de-mer.

Future field research will investigate the extent to which the recent dramatic increase in dependence on cash will make it harder for people to invoke traditional ties to relatives or trading partners on other islands in the event that resource shortages force them to leave their own islands, whether temporarily or permanently. It is clear that within the Ware community there is a stronger sense of communality than on other islands and the reasons for this will be discussed below.

## Attitudes about fishery management

The interview questions on this subject aimed to explore the way islanders were thinking about the sustainability of the fisheries they were exploiting. They were asked the following questions:

1. Are there limits to populations of beche-de-mer, fin-fish and sharks? (i.e. can these stocks be overfished?).
2. How do marine invertebrates and fish reproduce?

People were also asked about the scale of movement various species were capable of (which can then be compared to the scale at which people conceptualise their territorial claims over fisheries) and whether particular species are confined to certain habitats (e.g. ‘reef’ fish vs tuna). In the course of these interviews an impressive list of local fish and invertebrate names was generated, but this will be presented elsewhere.

Important contextual points:

1. Highest grades of beche-de-mer - Sandfish (*Holothuria scabra*), and Black Teat (*H. nobilis*) - have been almost exterminated in Milne Bay and in most parts of Melanesia, and virtually everyone is aware of this. White Teat (*H. fuscogilva*) is the highest priced species (ca. US\$25/kg to the fisher), which is still present in reasonable numbers and is partly protected by its greater depth range (down to 40m).
2. Fin-fish are not yet subject to anything approaching the pressure that the above species of BDM have been under, and densities are still high for all species in most parts of the province. Sharks are still apparently abundant despite heavy fishing for the past four or so years. However no stock assessment has been conducted yet and there are some anecdotal reports of declines since the start of commercial fishing.
3. Conservation International’s extension workers have done seven environmental awareness tours since 2000 in the area I visited, and have had limited influence.

**Table 15. Results for question 1. “Qual” means that a qualified yes or no was given in response to the question.**

Island, & no. of Interviews	Limits to BDM?			Limits 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
<b>Totals (%)</b>	<b>54</b>	<b>28</b>	<b>18</b>	<b>97</b>	<b>&lt;2</b>	<b>&lt;2</b>

**Table 16. Responses to Question 2**

Island, & no. Interviews	How do Fish/BDM reproduce?		
	No idea	Partial explanation	Scientific explanation
Tubetube	15	0	0
Kwaraiwa	7	0	0
Naluwaluwali	5	0	0
Ware	21	1	0
Anagusa	11	4	0
Dawson	5	3	0
<b>Totals (%)</b>	<b>87.5</b>	<b>12.5</b>	<b>0</b>

*Other relevant information*

Given that the majority of the population is devoutly Christian (Macintyre 1983: 307-310, 320; 1989; 1990) and that beliefs about natural abundance are now expressed in terms of God as creator and provider, a smaller number of people were also asked to explain how they thought about God’s role in protecting marine resources including fish and beche-de-mer. This data is harder to summarise in table form, but the results ranged from a dogmatic belief that “God will provide” to a much more pragmatic position in which God is acknowledged as the creator but that humans have primary agency now over resource abundance. A relatively small minority of the interviewees held the latter view.

*Tridacna* clam populations, particularly *T. gigas*, have been devastated in Milne Bay over the past two decades and have mostly not recovered (Kinch 2001). A large proportion of the interviewees also recognised this.

*Comment*

What emerged repeatedly was an overriding concern about the *rights of access* to resources, and relatively little concern about *sustaining* the income. Many people expressed annoyance at the use of hookah gear by a minority of fishers, reasoning that the increased access that this equipment gave to these men was unfair as it allowed them to make large amounts of money and at the same time removed slugs that would otherwise be fishable by the majority who were forced to dive on breath-hold. It was clear that people were mostly *not* thinking about a) the rate at which depleted resources would recover, b) how the process of stock recovery actually worked (i.e. spawning, fertilisation, larval dispersal and settlement), and c) the impact of removal of a given species or group of species on the rest of the ecosystem. A number of Ware people commented that the fact that white teat (*Holothuria fuscogilva*) occurred at depths down to 40m, made it hard to overfish, particularly in difficult conditions such as strong currents, decreased visibility, and rough seas.

**Marine tenure and disputes over fishery resources**

Most of the Bwanabwana people interviewed about fishing reported that the basic unit of marine tenure was generally understood to be the island, such that anyone on a given island could freely do both commercial and subsistence fishing anywhere within the perceived territorial boundaries of that island (see also Hayes 1993). Such boundaries appear to be generally determined by the location of nearest neighbouring

islands. However there are some long-standing disputes, such as the one between Ware and Brooker Islanders, in which historical factors such as the names of small islands or reefs near the disputed boundary have some bearing (Jeff Kinch, pers. comm. 2003). People will usually tolerate fishing by other islanders within their territorial waters if it is for subsistence purposes only, and if permission is sought, or more commonly, if locals are invited to join the fishing enterprise or given a share of the catch. Of course many people have clan and/or affinal links to other islands and these would almost certainly be invoked to obtain access to marine resources.

Commercial fishing on the other hand is thought about very differently, and transgressions of territorial boundaries for commercial fishing generally result in disputes, and even violent confrontations. One such confrontation had taken place between a group of Ware fishermen, and a party of hookah divers led by the (now estranged) Ware Councillor, shortly before the fieldwork for this paper was conducted. A more detailed description of this case (and others) is given in the report by Mike Fabinyi attached as Appendix 2. This behaviour is congruent with the attitudes about fishery management reported above, in that the more important issue in the minds of the islanders is to do with proprietary access to cash-generating opportunity, *not* the sustainability of the fishery. How effective the above-mentioned clan and affinal connections are for obtaining access to commercial (as opposed to subsistence) resources on other islands is a question that is worth pursuing in future work in the area.

#### *Tambus (traditional reef closures)*

Temporary closure of reefs had taken place on some islands in the Engineer Group following the death of a big man in the past, but is rarely or never practiced now. Wiyaloki is apparently one exception, according to one of the CI Village Entry Team officers who assisted with the fieldwork. On other islands fishing for trochus and clams is typically banned during a tambu.

#### *Comment*

I have followed the section on 'Attitudes about fishery management' with the section on Tenure because these are the two key factors upon which successful fishery management depends at the community level. Unless people are sufficiently aware of the limits to stocks *and* there is sufficient political cohesion at the same or larger scale than the scale at which the stocks are self-replacing, management is not possible (see (Foale and Manele 2004). There are of course various management options available at the government level, most of which would operate as point of sale regulations, and these will be discussed further below.

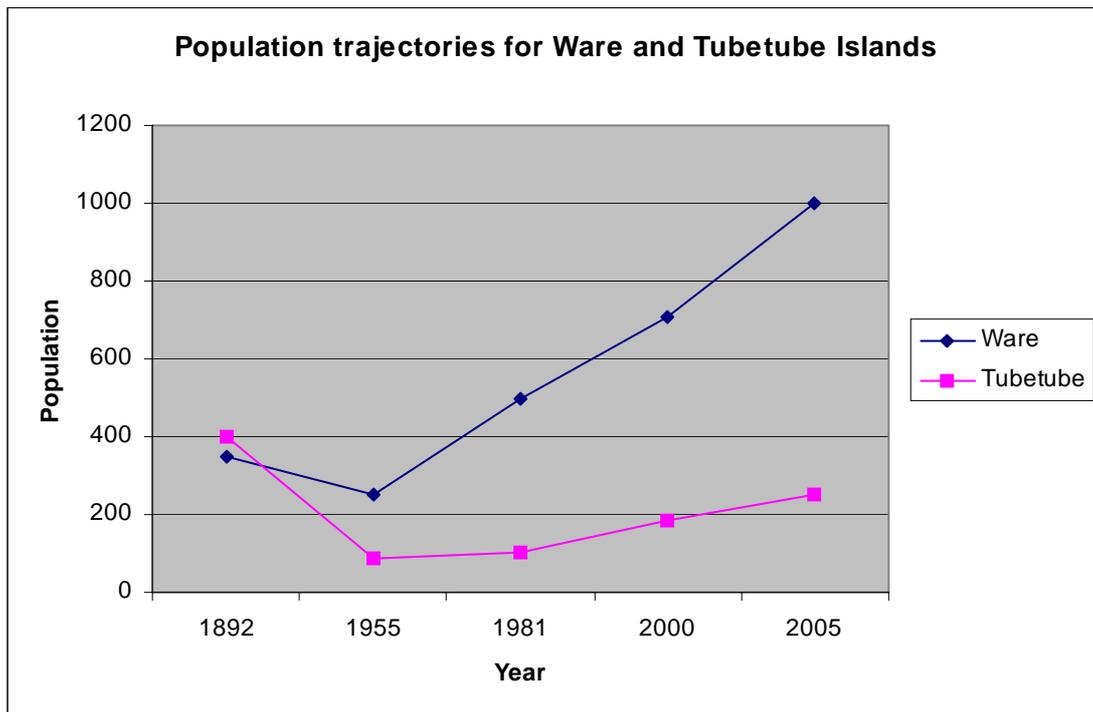
## **Discussion**

### **Population growth, land pressure, trade and movement**

The complex relationship between pressure on subsistence resources, trade (both traditional and modern, including commercial fishing and agriculture), remittances, and the capacity for inter-island movement, is what makes this study both challenging

and fascinating. Population trends for all of the islands visited in April have been increasing since the 1970s and probably earlier. However the fact that Tubetube's population is currently considerably less than it was over a century ago (Macintyre 1983: 21, Figure 3) highlights the importance of a careful consideration of the social underpinnings of the economies of these small islands. Tubetube at the time of missionisation was a powerful trading hub, and supported a population that was well beyond the subsistence capacity of the island, just as the population of Ware is now.

**Figure 3. Historical population trends for Ware and Tubetube Islands. Data were variously sourced from Belshaw (1955), Macintyre (1983: 26-21), Macintyre and Allen (1990), the PNG Government Census 2000, and personal communications from island representatives in April 2005.**



The population of Tubetube was supported by a highly complex trade network, which, unlike that of Ware, was not dominated by clay pot production (Macintyre 1983). Tubetube trade included a wide range of commodities, including fish, turtle shells, betelnut, coconuts, pandanus and sago leaves, various starch staples, tobacco, magical plants, dogs, pigs, shell valuables, shell ornaments and tools, various weapons, stone axe blades, pots, mats, baskets, fibre skirts, and sailing canoes (Macintyre 1983, Chapter 5; Macintyre and Allen 1990). Many, if not most of these items were acquired from other islands, often improved upon, and traded on.

Macintyre (1983: 21-22) speculates that the dramatic drop in Tubetube's population in the early 20<sup>th</sup> century as a result of emigration, a prolonged drought, and increased mortality due to various diseases following missionisation dealt a severe blow to their capacity to maintain their former economic power and influence. She believes that this should be considered as a significant factor contributing to the decline of Tubetube's role as a trading community. It is worth noting that when the population of Tubetube was 400, the populations of neighbouring Naluwaluwali and Kwaraiwa were 60 and 90 respectively.

The sailau data presented above show a strong persistence of traditional trade in a range of subsistence commodities. People from the big islands of Normanby and Bwasilaki still trade large quantities of betelnut, starch staples and housing materials with the Bwanabwana islanders, and the nexus between this form of trading and the cash economy appears to be particularly interesting for this study. The nature of traditional subsistence trading in 2005 appears to be strongly but not exclusively influenced by the cash economy. While a number of people commented on the fact that subsistence trading ‘dried up’ in the beche-de-mer off-season (as did a number of trade stores), it was also apparent that a certain amount of subsistence trading was insulated to some extent from the influence of the cash economy. A number of interviews indicated that the flow of starch and non-starch commodities between islands did not follow a Malinowskian functionalist logic (*sensu* Leach 1982: 30). For example, while people from land-rich Duau were trading sweet potatoes, bananas and other starch foods for fish, cash, store goods and dogs on Tubetube, Tubetube people were exchanging bananas for fish brought by Anagusa people. When Tubetube people were asked why they were trading scarce starch for fish, a commodity that they already had in abundance, they would reply that the Anagusa people needed the bananas. This suggests that a significant amount of traditional subsistence exchange is unrelated to, and unaffected by the cash economy, and the relative importance of these kinds of exchange will be scrutinized further in forthcoming work.

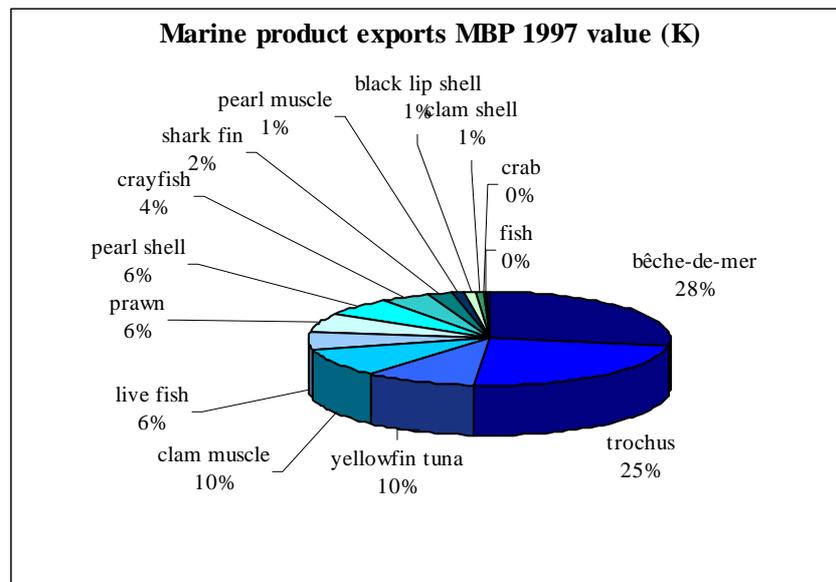
Movement of people is similarly influenced by a number of factors, including of course economic ones. However both Macintyre (1983, 1989) and Hayes (1993) emphasise the importance of social reasons for much of the inter-island movement in the region. Bwanabwana people typically exercise alternating residence within a marriage (Macintyre 1983; 1989), and at the time of missionisation Tubetube people had affinal links to Dobu, Duau, Suau, Logea, Panaeati, Bwasilaki and Wagawaga (Macintyre 1983). At the time of fieldwork there had been disputes on Koyagaugau between residents and people from Kwaraiwa who had moved there in order to gain access to what appears must be better stocks of beche-de-mer near that island. Fabinyi (Appendix 2) also noted that a number of Duau people had also moved to Koyagaugau recently. Interview data from Kwaraiwa reveal that a significant number of people living there now migrated from places such as Duau and Misima when copra was still lucrative between 10 and 20 years ago. On the other hand Hayes (1993) documents a net out-migration of 55 people from Ware in 1991, mainly to Alotau, Port Moresby, and Misima and Normanby Islands. However this figure is the product of a total in-migration of 49, and out-migration of 104.

In times of drought Tubetube people have often capitalised on affinal and trade connections to get access to better gardening land on larger islands. Forecasting the extent to which out-migration could constitute a ‘safety valve’ for SMIP residents in the event of for example stock collapse of the presently lucrative beche-de-mer and shark fisheries could be done more confidently with some fine-grained ethnographic data on the number and strength of contemporary affinal and clan connections among islands. The fact that subsistence pressure has increased significantly over the past ten years on *all* of the islands in this study suggests that out-migration options may now be fewer than they once were.

## Income and expenditure

The figure below taken from Mitchell *et al.* (2001) gives the relative importance of the various marine products for Milne Bay as a whole in 1997. These ratios have almost certainly changed quite dramatically in recent years, especially the relative contribution of shark fin.

**Figure 4. Relative contributions of various marine products to export earnings for Milne Bay in 1997 (Mitchell *et al.* 2001)**



Kinch (2001b) details the earnings by Brooker fishers, as recorded by Alotau-based buyers, from the sale of all major marine products, totalled K66,928.13 for the financial year 1998/99. This amount divided by 399 people (the population of Brooker then) gives a return of K167.73 per person on the island for that year. The biggest earner out of all the marine products for Brooker that year was beche-de-mer, totalling K32933.80, followed by trochus at K12736.58.

The figures shown in Table 11 on income from sale of marine products by dinghy owners are difficult to assess mainly due to the enormous variation (shown by the large difference between the median and mean) and the fact that the costs of purchases made on the same trip are difficult to calculate (this data has not been processed at the time of writing and is incomplete in any case).

Mitchell *et al.* (2001) also provide data on relative importance of non-fishery earnings for the same time frame and at that time copra was still important but declining. Around 1999 copra ceased to be a viable export commodity for PNG due partly to low market price and partly to problems with the management of the Copra Export Marketing Authority. At the time of fieldwork most copra plantations on the Bwanabwana islands were not being used and dense thickets of sprouting coconuts could be seen beneath most of them. Some of these were cleared in response to the brief increase in copra price around May and June of 2005 and were abandoned again after the price dropped again. The viability of coconut oil as an alternative source of income to fishing is clearly a function of external factors, including the price of fuel, since there are now a number of organizations and individuals using coconut oil as an

alternative to diesel. Although people on Ware Island interviewed for the study believed that rehabilitation of the copra plantations on some small islands southeast of Ware would be beneficial, data presented by Hayes (1993) indicate that copra only accounted for 0.5% of the island's income in 1991, when copra prices were presumably reasonably high. Marine products (33.3%), remittances (33.1%), Wages (16.6%), 'other cash' (8.6%) and clay pots (7.9%) constituted the remaining sources.

Unfortunately the expenditure per head data (Table 9) is insufficient for calculation of personal consumption of store goods since many purchases are made privately by dinghy, workboat, and (in a small number of cases) sailau, off-island. As noted above, quantitative data on off-island spending by dinghy owners was patchy and unreliable and could not be extrapolated to obtain a yearly figure in any case. Qualitative and anecdotal data indicate that most people on all of the islands in the study spend most of their money on food, though other expenses such as health, education, housing, fuel and alcohol are more or less significant for different island populations.

It is worth noting that the timing of the beche-de-mer fishing season (January – June) coincides with the 'hungry time' in the subsistence cycle, i.e. the season when yams are in the ground and growing, so that cash, which for many fishers appears not to last long after the beche-de-mer season, is available when it is most needed.

No quantitative data on alcohol consumption could be obtained during the fieldwork for this paper, however it is clear from interviews that, with the possible exception of Koyagaugau, a lot of money is spent on alcohol on some islands during the beche-de-mer season. Similar trends have been observed with coffee production the Papua New Guinea highlands (R.M. Bourke, ANU, personal communication). (See also Marshall 1982; Grossman 1984). Whether health and education would be improved if less money were spent on alcohol is a compelling but unanswerable question at this stage. The high rate of enrolment at Tubetube and Ware suggests that people are finding the money for school fees despite the high rate of misuse of fishing earnings remarked on by many of the people interviewed for this study. Spending priorities differ among demographic groups, and since a large proportion of the people earning money from fishing are young men it should come as no surprise that alcohol is prioritised over expenditures such as housing, education and health.

#### *Ware island social capital*

The conspicuously large capture of fishing revenue for investment in health, education and housing on Ware warrants some analysis here. Ware Island stands apart from the other islands quite dramatically in this respect. Ware is remote, but still closer to Alotau than Koyagaugau. It's subsistence resources may account for as little as one third of the food needs for the island (Hayes 1993). There were six operational work-boats based at Ware at the time of fieldwork, and one of the small number of active boat-builders in the Bwanabwana group was resident there and working on a new boat. There were around 20 operational dinghies though not all the owners of these could be interviewed for the study.

Ware appeared to be the only island where a significant number of people were still able to make money from the sale of fresh fin-fish using eskies – a difficult and risky enterprise given the very low price offered by most of the buyers (between K2 and K4

/ kg for high-grade fish such as mackerel [*Scomberomorus commerson*]) and one that, according to those interviewed about it, could only succeed with an economy of scale afforded by the use of a workboat, and thus the cooperation of a large party of fishers on the venture. Such levels of collaboration seemed rare or absent on the other islands. Village meetings are a common sight, and when currents carried a young Beche-de-mer diver away from his fishing party a few weeks before our visit, every dinghy on the island was deployed in a massive search for him. He was eventually found alive and well on one of the Dumoulin Islands, after having drifted at sea for at least 12 hours.

When asked about why their community appeared to enjoy such a high level of communality and economic collaboration, people gave the following responses: 1) everyone lives in one contiguous village and therefore communication is more effective across the entire community, and 2) everyone goes to the same church, which has a strong unifying effect on the community. It is also hard to rule out the sheer necessity of successful entrepreneurship given the relatively low level of subsistence production, though nobody on Ware made this observation. Ware women earned money from the manufacture of clay pots and baking bread, and the church actively engaged them to generate funds for community expenditures by setting monthly fund-raising targets. There is a striking parallel here with the Langalanga people of Malaita Island in the Solomon Islands, a group forced (by pre-colonial warfare) to live on artificial islands along a barrier reef stretching southeast from the town of Auki. These people are highly entrepreneurial compared to their more landed compatriots on neighbouring islands such as Guadalcanal and Isabel, and have also been successful boat builders for several decades. They also regularly financed their boat-building operations with fishing revenue, often invoking affinal connections to gain access to fish stocks around other islands.

The first of the above two points made by the Ware people I interviewed, that of contiguous habitation, appears to resonate with Patrick Kirch's (1997) analysis of the different ecological and social fortunes of Tikopia (Solomon Islands) and Mangaia (Cook Islands) islands. Kirch argues that one of the reasons that Tikopia enjoyed a relatively harmonious transition (pre-historically) to a population density significantly greater than could be supported by swidden agriculture was that owing to its relatively small size the population lived in one village and thus were in a better position to develop social institutions that facilitated the increased cooperation necessary for such a mode of living. Mangaia, being around 100 times the size of Tikopia, had a population divided into many hamlets, which eventually become locked in a pattern of chronic warfare as resources dwindled relative to the population (Kirch 1997).

While such an analysis is both impossible to prove, and is based on unreliable assumptions about the early level of arboriculture on Tikopia (Jean Kennedy Personal Communication 2005), it may shed some light on the social underpinnings of Ware's remarkable economic success in spite of its inadequate subsistence base. However it is clear that Ware depends very heavily on its marine resources and if these were to collapse the island's population would inevitably face considerable hardship.

While the Ware community presently exhibits a remarkable level of social capital, it seems unlikely from the data presented above on attitudes to fishery management that this social capital can be deployed to more effectively (and profitably) manage their

fisheries. The most lucrative fishery species at present, apart from sharks, is White Teat (*Holothuria fuscogilva*), and this is presently protected from overfishing primarily by a depth refuge. However it may be unwise to rule out some level of concern for the management of the stocks as representing one motive for the strong stand the community has taken against the use of hookah equipment there.

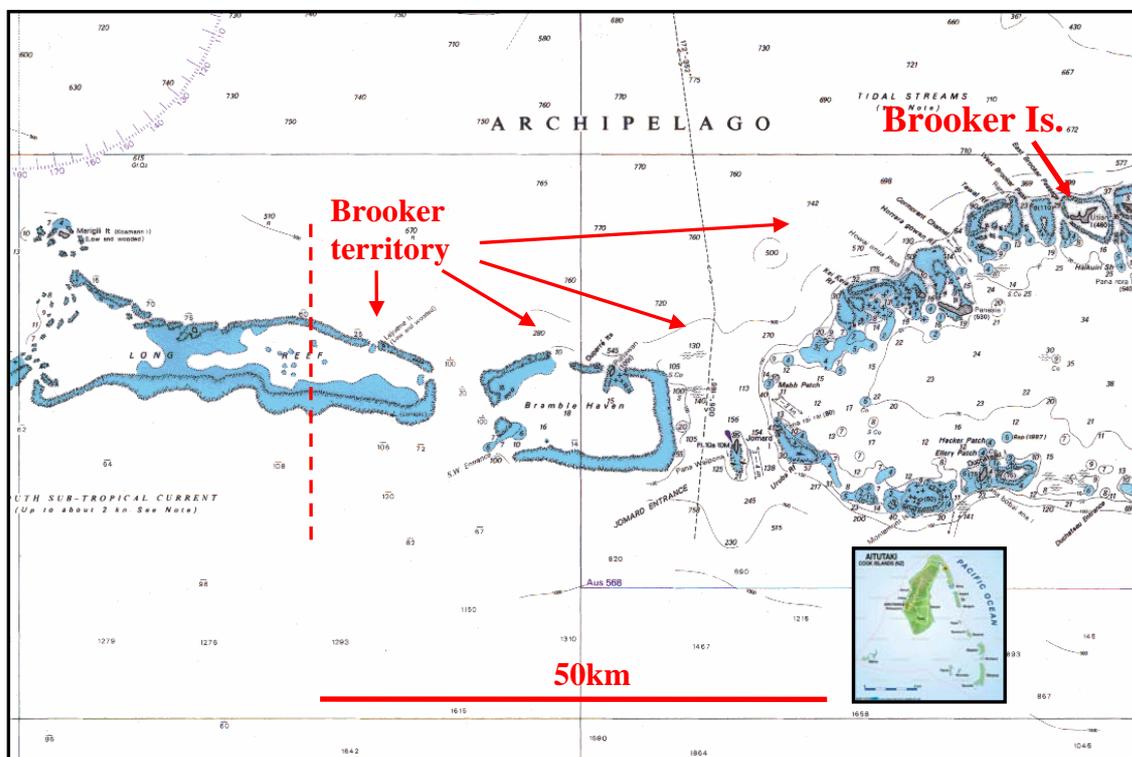
*Social capital and fishery management*

By way of exploring the difference a well-managed fishery can make to an island economy, the table below compares the production of trochus on Brooker (Milne Bay) and Aitutaki (Cook Islands). Trochus is a commodity that has hitherto contributed significantly to the income of Brooker, Ware and a number of other islands. The data for Aitutaki is sourced from Nash *et al.* (1995) and the Brooker data is sourced from Kinch (2001b).

**Table 17. A comparison of trochus production on Aitutaki and Brooker Islands**

	<i>Aitutaki</i>	<i>Brooker</i>
<b>Annual trochus harvest (kg)</b>	13,600	1,157
<b>Value of harvest (AUD)</b>	87,964	6,368
<b>Population</b>	2332	399
<b>Return per person</b>	A\$37.72	A\$15.96
<b>Reef area available km<sup>2</sup></b>	4.627	? (very large)

**Figure 5. A comparison of reef area available to Brooker and Aitutaki Islanders (Aitutaki is shown to scale in the inset at bottom right).**



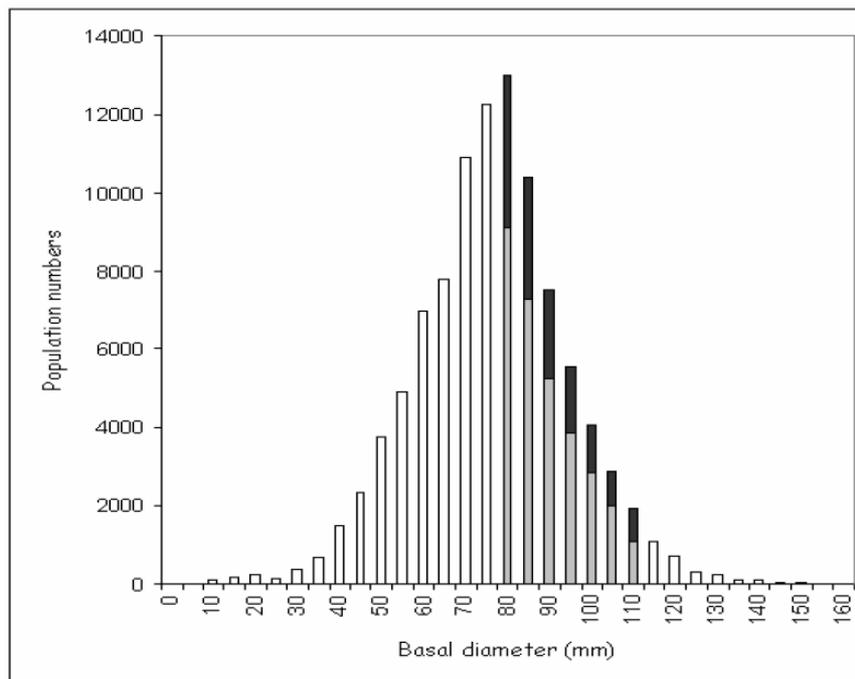
The Aitutaki trochus fishery is very strictly managed and is based on a ‘Community Transferable Quota’ system in which each family is allocated a transferable quota

based on family size. The quota is calculated as 30% of the legal sized individuals in the stock (see Figure 6 below). People are allowed to harvest their quota only when the stock size is deemed large enough based on regular stock assessments (Adams 1998).

**Figure 6. Size distribution of a trochus population at Aitutaki, showing in black the proportion of the population (30% of animals in the size range 8-11cm basal diameter) harvested under the quota system.**

Source: SPC Trochus Information Leaflet:

[http://www.spc.int/coastfish/countries/cookislands/mmr/industry\\_leaflets/trochus.htm](http://www.spc.int/coastfish/countries/cookislands/mmr/industry_leaflets/trochus.htm)



The impressive fishery management capacity on Aitutaki is probably largely due to overseas aid (mostly from New Zealand) enjoyed by the Cook Islands government and its Fisheries Department. There may also be demographic and economic factors such as level of education and the existence of other sources of income, e.g. tourism, that have in part facilitated the development of this management system on Aitutaki. The Nash *et al.* (1995) report details the long and fascinating history of the Aitutaki trochus fishery and it is clear from this history that the fishery would not be quite so well managed had not such a large amount of funding and research effort been applied over the 10-15 years after the fishery commenced in the early 1980s. Two other important factors are the hierarchical social structure and the strong local government on Aitutaki, which together appear to be responsible for the high levels of compliance to the fishery regulations.

The small trochus catches of the Brooker Islanders may be explainable by other factors, such as the greater amount of work involved in harvesting (which involves travelling larger distances) which would mean that the fishery is in fact under-exploited rather than over-harvested. However anecdotal and size-frequency data given by Kinch (1999) indicate that the latter is more likely the case. Size frequency distributions skewed towards smaller sizes indicate heavy fishing pressure because trochus are being harvested before they reach the upper end of their size range (Foale

and Day 1997). Densities of trochus on Brooker reefs around 1999, as reported by Kinch (2003) were 9.91/Ha, which are dwarfed by densities at Aitutaki (in the early 90s, but they are unlikely to have changed much) of between 325/Ha and 723/Ha (Nash *et al.* 1995). This also suggests heavy and sustained pressure at Brooker.

If we assume that the difference in the performance of the trochus fisheries on Aitutaki and Brooker are explained by differences in management, the obvious question is, could such a management regime be achievable on Ware and Brooker and what magnitude of changes to present governance structures and social attitudes would be necessary to reach such a point? Or might these communities instead simply fish down their remaining beche-de-mer and shark resources until they collapse and then either emigrate (a limited option, as discussed above, and by Filer 2002), or find other means to survive (pearl farming? seaweed culture?) on their islands? What would be the ecological impact of this business-as-usual scenario if it were to eventuate? The following sections discuss the likely trajectory of the shark fishery in Milne Bay and the potential ecosystem impact of overfishing of sharks, as well as beche-de-mer.

### **Shark Fisheries.**

Shark fisheries are extremely vulnerable to overfishing primarily due to the long life-span, late maturation, slow growth rate and low fecundity of most shark species (Musick *et al.* 2000; Barker and Schluessel 2005). The rapid depletion of shark populations by industrial long-lining around the world has been amply documented with data-rich historical fishery research by Ransom Myers and his colleagues (Baum *et al.* 2003; Myers and Worm 2003; Myers and Worm 2005; Worm *et al.* 2005). This work, and the recent strong evidence for rapid depletion of shark populations by Indonesian fishers off north-western Australia (Meakin and Cappo 2004) should ring loud alarm bells to those involved in the management of this fishery at all levels of government. In addition a small number of Bwanbwana fishers indicated in April that catch rates of sharks had already slowed in their recent experience.

The National Fisheries Authority has published a Shark Management Plan (Kumoru 2002) but there is at present no indication of how well, if at all, this is being implemented in Milne Bay. There are two primary difficulties in devising a management strategy for artisanal shark fishing in Milne Bay: **a**) there is no data at present on the actual abundances of sharks in the area, and **b**) there is a clear presence of industrial shark longlining in the region and separating the impacts of these fishers from those of local artisanal fishers would be necessary before any province-based management plan could be formulated. This is made more difficult by the many local reports of industrial longliners fishing well inside the legal boundaries around reefs and islands (see below). The table below shows the only available data on industrial fishing licences.

**Table 18. Summary of Fishing licences as reported by the NFA on 27<sup>th</sup> August 2005**  
[http://www.fisheries.gov.pg/dbsummaryhtm/Vessel\\_Licences\\_Current.htm](http://www.fisheries.gov.pg/dbsummaryhtm/Vessel_Licences_Current.htm)

<i>Type of Fishery</i>	<i>Licences</i>
General Fishing	18
Live Reef Food Fish Fishery	4
Lobster Fishery	16
Pearl Fishery	1
Prawn Fishery	20
Shark Longline	8
Tuna Longline	48
Tuna Purse Seine	255
<b>Grand Total</b>	<b>370</b>

There is no data on the above website about where in PNG the vessels are allowed to operate. Consequently it is impossible to know **a)** how many Port Moresby-based licensed shark long-line boats are operating in Milne Bay and **b)** how many tuna long-line boats may also be taking significant numbers of sharks, whether targeted or as by-catch, in Milne Bay. According to the PNG Fisheries Act tuna long-liners cannot operate within 6 nautical miles of the shore or a ‘declared reef’, and both the Provincial administration and local landowners should be consulted over any fishing within 3 nautical miles of the shore. However authority of the state overrides that of provinces or landowners in the event of disputes (Maurice Brownjohn, pers. comm. 2005).

In March 2005 the Governor of Milne bay Province issued a statement (Appendix 3) declaring a freeze on the number of province-based fishing licences. Reports from fishers on Ware and some of the other islands in both April and June (see Appendix 2) give strong indications that much illegal industrial fishing has been going on in Milne Bay. The following quote from the Governor of Milne Bay, Tim Neville, adds weight to these concerns:

“Our recent clashes with the National Government over the apprehension and release of 20 Chinese vessels and the influx of foreign business speculators of late with blatant breaches of the law with the knowledge of senior public officials should put us on notice that as the world’s natural resources are depleted, there will be a mad scramble for our own,” Mr Neville said.

He told the provincial assembly that the National Government had shown itself incapable of protecting “our resources and sovereignty”. “We in Milne Bay must stand up to such regimes that are being weakened by bribery and corruption at the very top,” he said.

**Post-Courier**, Thursday, 7 April 2005.

Data on the relative quantities of shark fin caught by local fishers out of dinghies, and by industrial fishers will be sought on the next field trip.

According to the IUCN Species Survival Commission (IUCN 2002), PNG exported 7560kg of dried shark fin to Hong Kong in 2000. This report had no data on landings in PNG. Interestingly the figure for exports to Hong Kong is dwarfed by figures from a number of other countries, such as Mexico (269,765kg), India (315,591kg), Ecuador (131,364), United Arab Emirates (498,863) and Australia (52,963), among many others.

The National Fisheries Authority's Shark Management Plan (Kumoru 2002) states that declared exports of *frozen* shark fin in 2001 totalled 134,400kg. While there is no data for *dried* shark fin in 2001, there is for 2000 – it was 10,000kg, worth K1.6 million. Since the frozen fins are probably hydrated, the equivalent dried weight would be a lot less. Shark meat exports in 2000 totalled 1,685,000kg. Shark oil is a product that peaked in 1992 (with a volume of 20,730kg and value of just over a million kina) but is no longer being exported. Unfortunately these figures give us a very poor insight into the nature of the shark fin export market in PNG; and despite the small volume of recent shark-fin exports compared to many other countries, the data tells us nothing about its present impact on stocks.

As noted already in the final comment in the Results section, management of any fishery in Milne Bay will depend on **a**) local fishers' appreciation of the temporal and spatial scales of stock replacement processes, and **b**) the presence of political unity at the same or larger scale as that at which fish populations replace themselves. It is therefore worth determining the scale at which commonly fished shark species migrate so as to learn whether they cross political boundaries and therefore render spatial closure-based management initiatives (i.e. MPAs) ineffective. A number of tagging studies provide such information for other locations.

1. Holland *et al.* (1999) tracked nine tiger sharks (*Galeocerdo cuvier*), most of which moved a linear distance of about 30 nautical miles (55.5km) over periods of around 30 hours. These sharks were all commuting between the point of capture (quite close to the shore of the island of Oahu) to a shallow bank habitat.
2. Klimley (1993) tagged scalloped hammerhead sharks (*Sphyrna lewini*) near Cocos Island (Eastern Pacific) and found that they commuted 20km each way on round-trip nocturnal foraging journeys.
3. Chapman *et al.* (2005) tagged nurse sharks and Caribbean reef sharks (*Carcharhinus perezi*) at Glovers Reef off Belize and looked at movement in relation to a reserve that was 10km in diameter. The mean minimum linear dispersal distance for the reef sharks was 10.5km and for nurse sharks 10.7km. Although most sharks were tagged within the reserve, individuals were detected outside of it on average 48 days out of the 150 days of observations.

The tiger shark and hammerhead shark studies show that these species (both of which are caught in Milne Bay) could potentially easily travel between marine territories in the Bwanabwana group (with the possible exception of the boundary between Ware and Brooker) over a short space of time and thus render conservation efforts by any one of these island communities ineffective if the other islands were not also exercising the same restraint.

Consequently it is imperative that, in the absence of (and unlikely prospect of obtaining in the near future) high-resolution stock assessment data, a conservative quota system is established at the provincial level for both local and industrial fishers. Adequate monitoring of industrial fishing is clearly necessary and may eventuate if

data from the proposed Vessel Monitoring System can be effectively integrated with catch statistics.

### **Ecological Impact of Shark Fisheries**

Given the immense complexity and relatively large horizontal breadth of coral reef fish food webs, removal of top predators tends not to have a dramatic impact on lower trophic levels (Kaiser and Jennings 2002; Polunin and Pinnegar 2002). Consequently it is unlikely that the removal of even the majority of sharks will result in ecological responses similar to the trophic cascades that have been reported for some relatively species-poor temperate systems (Strong 1992; Steneck *et al.* 2002). However Dulvy *et al.* (2004) provide evidence for a trophic cascade response where Crown-of-thorns starfish (*Acanthaster planci*) populations are negatively correlated to the abundance of a guild of predatory fish including Lutjanidae and Lethrinidae (c.f. Bradbury and Seymour 1997). Ongoing monitoring of fish communities around coral reefs such as Scott and Ashmore Reefs in the MOU Box, where shark stocks have already been severely depleted (Meakin and Cappo 2004) (see also <http://www.abc.net.au/catalyst/stories/s1256342.htm>), may provide the first insights into any ecological impacts of shark fishing in habitats similar to those in Milne Bay.

### **Ecological impact of BDM fisheries.**

Jeff Kinch has written comprehensive reviews of the beche-de-mer fishery for both Milne Bay Province and Papua New Guinea (Kinch 2002; Kinch 2004). His recommendations from the 2004 report are attached as Appendix 4. Surveys carried out by the CSIRO (Skewes *et al.* 2002) found that densities of the highest value species (Black Teat: *H. nobilis*; Sandfish: *H. scabra*; White Teat: *H. fuscogilva*; Prickly Redfish: *T. ananas*) were much lower than in Torres Strait, and similar to heavily fished areas such as the Timor MOU Box. Densities in 2000 were found to have declined to around 50% of 1990 densities. The same report found that *H. scabra* and *H. nobilis* were so rare that fishing on these two species should be prohibited until stocks recover.

Ecosystem impacts of beche-de-mer fishing are not limited to marine habitats. As much as 10kg of firewood are needed to process 1kg of BDM (Preston 1993). However much of the fuel wood used on many of the Bwanabwana islands is driftwood that originates on the mainland and the larger islands to the west and north.

Reports from the Solomon Islands hint that fish are consuming more of the benthic detritus that was previously consumed by BDM and are becoming poisonous themselves (Holland 1994). Unpublished data from Marovo Lagoon in Solomon Islands, generated by marine botanists from the University of Queensland (<http://www.marine.uq.edu.au/marbot/Solomons/overview.htm>) indicates that blue-green algal mats are forming on lagoon sediments in areas where beche-de-mer have been removed by heavy fishing pressure (see also Figure 7 below). Whether such responses also occur on the well-flushed shoals around Ware Island where much of the beche-de-mer fishing effort is presently concentrated can only be guessed at, but it is less likely than in habitats where water flow is more constrained.

Sandfish (*Holothuria scabra*), which are by far the highest price species at present (around K150/kg), have mostly been removed from the large lagoon systems of Woodlark, Sudest and Kirwina where they were once abundant. Tragically most of this devastation took place in the 1980s when the price was much lower than it is today. A small population apparently remains at Kiriwina (Jean-Luc Critten, pers. comm. 2005). There does not appear to have been any ecological monitoring that might have documented the impact of this removal on those habitats. Ongoing experimental work by Svea-Mara (Wolkenhauer *et al.* 2005) in Moreton Bay (the southern limit of this species' distribution) so far indicates that the rate of fouling on seagrass increases by about 10 percent in patches from which the slugs are excluded.

**Figure 7. Filamentous algal growth on the lagoon floor at Ware Island. According to a number of informants, the lagoon at Ware had large numbers of Beche-de-mer, mostly *Holothuria atra*, until relatively recently.**



### **A final comment on Marine Protected Areas**

Given the huge size of the marine territories of Brooker and Ware Islands, and the fact that these are the most vulnerable communities in terms of reliance on cash, MPAs may well be beneficial for these groups. They would help prevent recruitment overfishing for trochus, some species of BDM and clams. They would be less useful for sharks. MPAs also do not guarantee that the reefs will not be poached by either locals or outsiders. However if Ware people are capable of apprehending Tubetube hookah divers who were operating quite a long way from Ware Island, they are probably capable of enforcing MPAs.

Interview material on knowledge about reproduction and population replacement processes showed very clearly that most people do not understand the mechanics of

population replacement in marine organisms (with a few exceptions) and most people instead attribute control over the abundance of fished species to God. People acknowledge that fishing has depleted stocks of clams (*Tridacna*) but are more ambivalent about other species. They were mostly unsure about how long it would be before clam stocks recovered. Fish are universally believed to be impossible to deplete.

These social realities pose a serious challenge to the prospect of using MPAs as a fishery management tool and by consequence as a means of conserving biodiversity (Foale in press). Despite the apparent low level of absorption of the awareness material conveyed on several tours by the Village Entry Teams over the past three or more years, there appear few alternatives to continuing efforts to apprise people of the biology and ecology of stock replacement processes for economically important species in Milne Bay. Engendering political unity where there is currently entrenched conflict (see Appendix 2) would appear to be a far greater challenge. The one other set of strategies that deserve greater attention are point-of-sale regulations such as quotas, closed seasons, and size limits. Skewes *et al.* (2002) recommended an LLG-based quota system for beche-de-mer management. Enforcing the ban on hookah diving may prove to be at least as useful as a political panacea as it would a fishery management measure.

Establishing MPAs on some sections of the Bramble Haven / Long Reef complex would present the greatest chance of success given the ecological and political constraints outlined above (Foale and Manele 2004), however enforcement may be difficult. The Conflict Group presents a similar opportunity but given its isolation any benefit from export of larvae (or adults) to neighbouring reefs is likely to take quite a long time to materialise. Moreover a large number of fishers reported witnessing poaching activities by industrial long-liners there, which indicates inevitable problems with enforcement there too. Given the high species counts obtained at the Conflicts by the RAP surveyors (Allen *et al.* 2003) this may not present a significant concern to Conservation International. The MPA under development at Wiyaloki Island (near Kwaraiwa) on the other hand may well prove to be a success if the present collaboration of the reef owners is indeed motivated primarily by the desire to improve fishery management and preserve other reef-derived ecosystem services.

## **Conclusions and recommendations**

The relationship between the cash and subsistence economies is highly complex and not governed by economic factors alone, though these would appear to be significant in the case of Ware island. Unlike Tubetube in the late 19<sup>th</sup> Century, Ware's high population density is not supported by a diverse trading network, in which Ware people act as middle-men, but primarily by the extraction of marine resources from a vast territory of reefs and shoals. The present rates of extraction appear to be unsustainable. Remittances formed a large fraction of the income for Ware in 1991 but there is no data on contemporary levels.

Despite the difficulty of obtaining accurate data, the fallow period has almost certainly shortened on all islands. Apart from Ware Island however, it is not clear whether subsistence is failing to meet people's needs (other than in drought years) just yet.

The high level of social capital, whatever its origins, on Ware, has benefited the community significantly in terms of service provision and living standard, though it is clear that these benefits are ultimately derived from marine resources, and are unlikely to be sustainable without further management initiatives.

The apparent high level of indebtedness among dinghy owners is disturbing and warrants a separate study, which might include a broader investigation of attitudes towards money. Whether the price paid to indebted dinghy owners for their marine products is significantly lower than the standard price will be investigated in forthcoming fieldwork as well.

Income from fishing is distributed very unequally, with a small number of individuals, mainly based in Alotau, apparently having become very rich as a consequence. However the majority of fishers surveyed and interviewed were making sizeable incomes from fishing (Table 11), and Ware fishers appeared to be surviving well on their fishing incomes in spite of the poor subsistence capacity of their island. Gordon Wesley also has been redistributing some of his wealth in the form of church-building grants (ca K31,000 each) on each of the islands in his constituency, which includes most of the islands in the Bwanabwana-speaking group.

A key focus of forthcoming fieldwork will be to obtain interview data on the migration options available to people on the most 'imperilled' islands in the event of severe drought and/or the collapse of commercial fisheries.

The health data obtained shows a significant difference in malaria infection rates between Ware and Koyagaugau, which could reflect the higher standard of living on Ware, but may also be influenced by environmental factors such as standing water. The fact that there was a large swamp near the clinic on Ware at the time of our visit suggests that the difference may have more to do with standard of living. The case data from the clinics suggest that malnutrition is not a major problem on any of the islands.

There are no high schools on any of the islands but enrolment rates of primary-aged children on Ware and Tubetube appeared high.

It does not appear to be very likely that any of the communities in the study will embrace any form of community-based management so as to prevent the collapse of species that are currently threatened by heavy fishing - the shark fishery being perhaps of greatest concern. The data on attitudes to fishery management paint a rather bleak picture in this respect and it appears that there are few other options for assistance at the community level besides redoubling efforts to educate islanders about the impact of fishing on stocks. A thorough stock assessment of the shark fishery would assist immensely. The establishment of quotas, and adequate monitoring of the volumes of marine products handled by the buyers in Alotau may well prove to be easier and cheaper to achieve than community-based measures.

Charismatic and enlightened leadership, as has been shown to date by the Provincial Governor, would be highly effective if it could be fostered at LLG and Ward level as well. Reliable licensing information and catch data, an effective Vessel Monitoring

System, and greater overall transparency in the regulation of industrial fishing activity are also highly desirable.

Whether declining fishery stocks will exacerbate the current high levels of inequality in the island communities and contribute to political instability is a question worth consideration.

Marine Protected Areas are likely to have limited efficacy and the careful design and enforcement of point of sale regulations are likely to be more useful for the regulation of both shark and beche-de-mer fisheries. Energetic enforcement of the ban on hookah diving is strongly recommended.

The Live Reef Food Fish trade should remain banned in Milne Bay.

It is not clear from this analysis whether it is possible to obtain sufficient economic and other data to comprehensively describe the nexus between the subsistence and monetary economies on these small islands. The workboat survey, once completed, will certainly improve our understanding of the movement of commodities between the islands and Alotau. Some surveys did not yield adequate data on financial returns for marine products sold in town, and the reliability of data in a number of the surveys is questionable. Inevitable gaps in data, due for example to people being absent at the time of our visit, mean that it is difficult to confidently draw certain kinds of conclusions from them. On the other hand the data generated have given a number of valuable insights into the relationship between the cash and subsistence economies, and further fieldwork will certainly allow us to usefully build on this knowledge.

The two field assistants experienced some difficulties initially with the surveys but these were mostly ironed out after some feedback. However the importance of careful and regular checking of data sheets, during fieldwork, was made clear by this experience.

Contemporary data from either the Provincial Fisheries Department or the various buyers, on volumes of marine products bought in Alotau, would improve the analysis, and these will be sought on the next field trip. The accuracy of much of the data cannot be verified, and anomalous results such as the large difference in trade store turnover figures between Anagusa and Koyagaugau do not impart great confidence.

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## Appendix 1



### RESOURCE MANAGEMENT IN ASIA-PACIFIC PROGRAM

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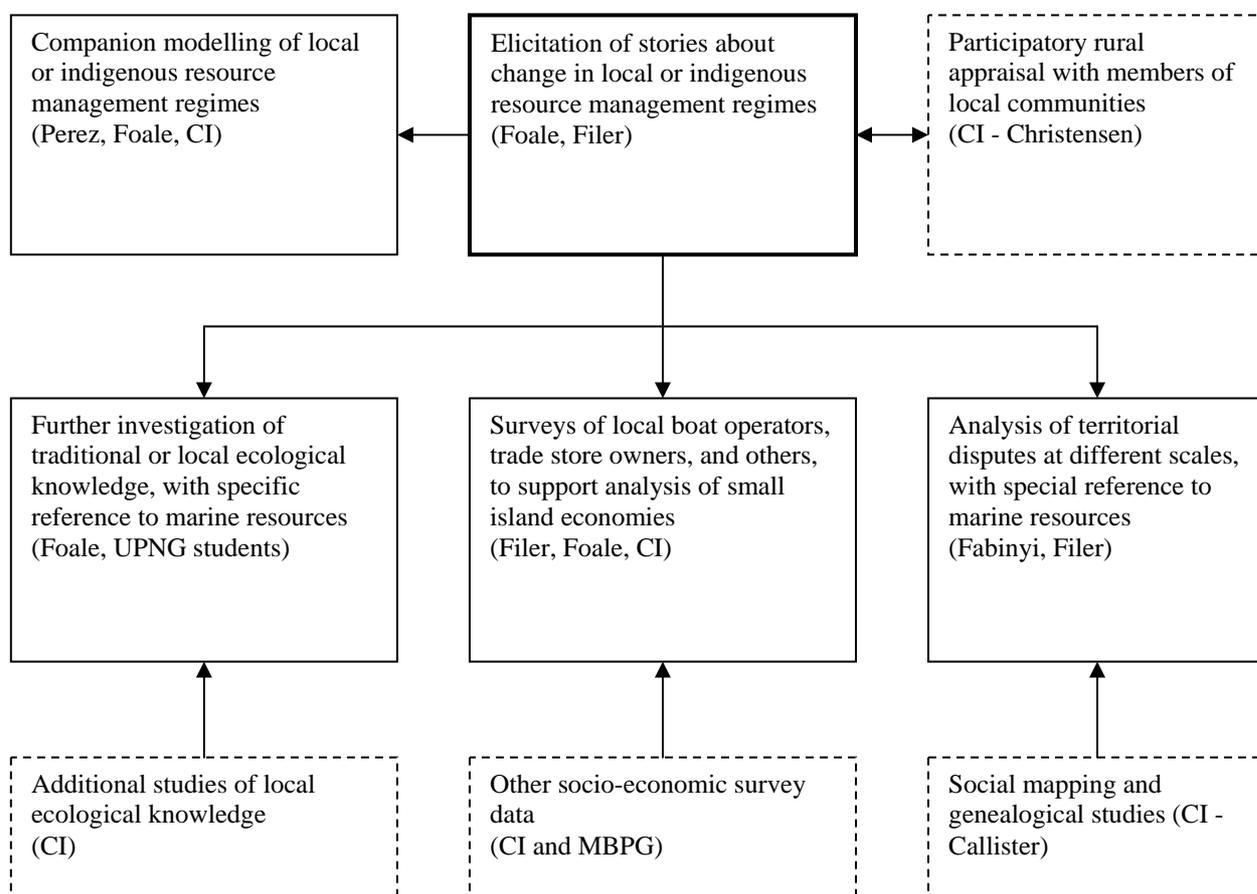
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## TOPICS AND METHODS FOR SMIP PROGRAM FIELDWORK 2005

Colin Filer

The following diagram shows our current understanding of the relationship between the SMIP Program fieldwork components and relevant components of CI's own fieldwork program. Boxes with unbroken lines contain fieldwork activities to be primarily undertaken by SMIP Program participants, while those with broken lines contain fieldwork activities which have already been undertaken, or may be undertaken in future, by other stakeholders. Arrows indicate the logical relationship between these activities.



## **Elicitation of stories**

This is the core element of the SMIP Program's fieldwork strategy (hence the solid black line). The main aim of the exercise is to elicit, record and transcribe stories about the dynamic elements of local or indigenous resource management regimes by prompting different members of a local community with questions about the difference between what 'people in this community' now do about the management of a particular type of resource, or a particular aspect of their environment, and what they used to do 'before'.

For this purpose, the interviewer will show respondents photographs of relevant activities or features of the local landscape from various archival sources in order to highlight any contrast with the present situation.

Respondents will be prompted for stories about the following themes or issues:

- food gardens (including soil fertility, fallow techniques, etc)
- coconuts and copra production
- trees or forests as sources of food, fuel and fibre
- wild and domesticated animals
- fresh water supplies
- solid and human waste disposal
- marine resource management

These themes or issues may be discussed in any order, but an attempt will be made to keep the discussion of marine resource management to the end of the interview in order to facilitate further discussion of local knowledge with respondents who seem to be experts on this topic (see below).

Interviews may be conducted with individuals or small groups of people, but it is important that the interviews conducted in any one community should try to canvas a range of opinions or 'voices' from people who occupy different positions within the community. Specific efforts will be made to ensure that the story-telling process is not monopolised by male 'office-holders' within the community, and that the voices of women and young people are also recorded.

The interviewer will be accompanied by a translator who is fluent in the local vernacular (initially the Bwanabwana language). The translator will be chosen in such a way as to minimise the risk of his or her own views interfering with those expressed by the respondents.

The interviewer will take care to ensure that respondents are not asked to describe their own attitudes or behaviour, but only their understanding of what other people do. That is because the aim of the exercise is to establish a general set of community values or 'collective representations' which can be used for the purpose of companion modelling, and when people are asked about their own attitudes or behaviour, they may not always say what they really think.

Personal details of the respondents (name, sex, age, position, etc.) will be recorded at the end of the interview if they have not already been provided at the outset.

An attempt will also be made to harmonise this collection of stories with whatever form of PRA is being practiced by CI's Village Extension Teams, so that each type of exercise may provide useful information to the people responsible for the other one.

### **Studies of local knowledge**

Those respondents who demonstrate a particular interest or expertise in telling stories about changes local marine resource management practices will be interviewed in greater depth to determine the nature of their understanding of this subject. A list of topics for discussion is shown in Appendix 1.

It is expected that respondents interview in detail on these topics will not only include experts in 'traditional' ecological knowledge, but also people who currently have the power to make significant decisions about the use of marine resources.

### **Economic surveys**

Separate questionnaires will be administered to the owners and/or operators of banana boats, traditional sailing canoes, trade stores and fuel retailing operations in each local community where the SMIP Program team is active. CI personnel will administer the same questionnaires in each community where they are undertaking other survey work and report the results back to the SMIP Program team.

These surveys are meant to support an analysis of the economic drivers of environmental change in different parts of Mile bay province, with specific reference to the small island economies which are the primary focus of the SMIP Program.

Any socio-economic survey data already collected by or on behalf of CI or the provincial government will be treated as a potential input to this economic analysis. This includes the survey of workboats and (some) PMVs which is being designed by the SMIP program team on behalf of the provincial government.

If an examination of provincial government records indicates that these are unreliable or incomplete in respect of health and education at LLG ward level, separate interviews may be conducted with local health workers and school teachers to obtain additional information, but no formal questionnaire has been designed for this purpose.

### **Analysis of disputes**

Michael Fabinyi (under the supervision of Colin Filer) will conduct a separate ethnographic study of territorial disputes, with specific reference to marine resources, as part of his PhD research program at the ANU. His fieldwork is expected to begin in August 2005.

This study aims to encompass a range of disputes involving members of local communities at different scales within the province. The study is provisionally

designed to focus on Ware Island in the first instance, then on the rest of the Bwanabwana language group, then on the rest of the Bwanabwana LLG area, then on the rest of the province.

Fieldwork will be conducted under the terms of a research visa approved by the National Research Institute and the Milne Bay Provincial Government.

This study is not formally part of the SMIP Program, because it is funded by an Australian government scholarship, but the student will have access to information collected by members of the SMIP Program team, and will be able to make use of this information in framing his own research strategy.

**Appendix 1.1: Sample topics for discussion of local knowledge of marine resources.**

1. Do you sell fish or invertebrates to people on other islands, or in town? (If yes, get details, including price).
2. Do you sell invertebrates (BDM, trochus, pearlshell), or other marine products?
3. Get a list of local language fish names, plus common invertebrates (if not already available). Ask about etymologies where possible.
4. Language name of palolo worm (take good pictures to show) and etymology. Ask about seasonality and lunar timing. Also ask about importance of harvest locally.
5. Ask about relevance of palolo worms to mortuary feasting/exchange cycles. Is palolo spiritually charged in any way?
6. Ask about any long term trends in abundance of palolo worms.
7. Ask about any supernatural influences on fish movement, abundance.
8. Ask about habitat range, and scale of movement for difference species (try *Acanthurus*, *Plectropomus*, *Kyphosus*, *Caranx*, *Scomberomorus*, *Mugil*, and the tunas).
9. How do fish and invertebrates reproduce?
10. Is it possible to finish the fish (or invertebrates)?
11. What controls fish abundance?
12. What would you do (to make money) if fish started to disappear?
13. Does anyone catch beche-de-mer here? What has been the trend with BDM populations here.
14. (If downward trend in BDM reported:) How long do you think it will take for the sandfish/black-teat to come back? Why?
15. Ask where the informant is allowed to fish for: a) finfish, b) trochus, c) beche-de-mer, d) *Tridacna*, e) *Strombus*.
16. Identify the interviewee's lineage territory (marine) and ask if there are any people from other villages or islands who can collect beche-de-mer there, and if so, why (i.e. how are they related?).
17. How are fishing rights distributed between clans or lineages within the community?

18. Are there any disputes within the community about access to marine resources? (If yes, ask for details of what the disputes are about.)
19. Are there any disputes with outsiders about access to marine resources? (If yes, ask for details of what the disputes are about.)
20. What are people doing to resolve these disputes?

## **Appendix 2**

### **DESCRIPTION OF PRE-FIELDWORK TRIP TO BWANABWANA REGION, JUNE-JULY 2005 – MIKE FABINYI, ANU**

#### **ITINERARY**

Tuesday 21/6-Thursday 23/6: Tubetube, staying with the councilor Manasseh Lome and family.

Thursday 23/6-Sunday 26/6: Naluwaluwali, staying with Peter Namuri and family.

Sunday 26/6-Tuesday 28/6: Kwaraiwa, staying with Gilmore Matieu and family.

Tuesday 28/6-Friday 1/7: Ware, staying with Mesigai Keni and family.

#### **INTRODUCTION**

The pre-fieldwork trip was primarily for me to make some personal contacts in the group of islands I intend to base myself in and to attain a closer understanding of the issues surrounding my topic, currently based around the question “what determines the nature of tensions about access to marine resources”? This brief description of my trip will categorize some of these tensions and overt disputes, point to some of their more obvious drivers and characteristics, and suggest areas that I wish to focus on and investigate thoroughly.

#### **BONES OF CONTENTION**

##### **1) Tensions about the use of hookah diving around the whole region**

There is a general underlying tension throughout the whole Bwanabwana-speaking region about the use of hookah gear to dive for beche-de-mer. Various individuals have been using hookah gear around the islands, while the majority of the people in the communities seem to oppose it.

Earlier this year, there was an incident when some of the hookah divers from Tubetube were invited by a group from Ware to come down to the disputed reefs between Ware and Brooker and dive for beche-de-mer using the Tubetube groups' compressor. There was a bit of a blue and the compressor was confiscated by other people from Ware. The man whose hookah gear was confiscated suggested the reason why the fight became so intense was because Ware is overpopulated and coming under increasing pressure regarding resources. He claims knives were held to his throat and he was threatened with axes. His rationale behind diving with hookah gear is that people should be allowed to go and dive all around the Bwanabwana region and that people are just getting jealous of his success, that people want to stop him just because they want a piece of the pie also. Other hookah divers cited paying off credits and loans as their primary motivation for using hookah gear.

Those who disagree with the use of hookah include the three members of the Ward Development Committee members for Naluwaluwali, most of the Ware community and leadership, as well as a significant number of people from Tubetube and Kwaraiwa. The WDC members for Naluwaluwali argue that the use of hookah around

Tubetube and Kwaraiwa has already severely depleted the stocks of beche-de-mer around those islands and that it is only strong leadership on their behalf that has prevented the hookah divers from coming in and depleting the Naluwaluwali stocks also. They say that the small island off Naluwaluwali, Natouli, has been dived with hookah but that the landowner feels powerless to stop them. One person strongly opposed to hookah diving claims that the hookah divers have a homemade gun to threaten people with and that he is making a homemade gun himself “just to bring a bit of balance”.

The people who have opposed hookah diving in this part of the Engineers were earlier this year linked with an entrepreneur from Singapore, Mr Lo, who was based at Naluwaluwali for several weeks or months. He fell out with the Nako group and became embroiled in a court case involving Nako and the governor. He is still rumored to be coming back at some stage; many of his supporters are still waiting for his return or “the coming of Mr Lo”, as one of his critics put it.

There are several underlying issues that this tension seems linked to and that I would want to explore further. The central theme I would want to study in detail here is the intersection of political power and marine resource management. In what way do the tensions between the hookah divers and other members of the community reflect other sorts of tensions, perhaps connected to how people feel about the political processes that are going on in the district? Is the tension simply about access to resources or does it reflect other sorts of contestation? What implications do the use of dinghies and hookah gear to dive for beche-de-mer have for social inequalities in the region? How does the level of control and political support held by those promoting hookah diving compare to the level of political power held by their opponents? How does the response of particular communities towards hookah diving reflect their leaders’ particular strategies? What are the processes that determine the ways decisions about marine resources are made in particular communities? Basically, what is the role of leadership and political power in the ways that tensions about hookah diving are formed in the Engineer group?

The intention of the hookah divers to dive around reefs other than their own suggests a higher value is placed on the other reefs further out. As with all the disputes, I would want to try and work out how the perceived value of a particular reef is related to the intensity and nature of the dispute. In order to do this, I would want to try and quantify to some extent where the best areas for getting beche-de-mer are.

## **2) Use of the reefs around Koyagaugau by divers from Kwaraiwa and other islands in the Engineers**

There is a lot of usage of the reefs around Koyagaugau predominantly by people from Kwaraiwa, but also from others in the Engineer group. Some people I spoke to would try and get permission from the councilor and magistrate at Koyagaugau, and if they refused, they would abide by that decision. Sometimes they refused, other times they let them in.

For other people from Kwaraiwa, they would just go and dive on the Koyagaugau reefs whether they got permission or not. Most of these divers admitted they did not have a claim over these reefs at all and they were blatantly stealing from the reefs at

Koyagaugau. The level of beche-de-mer around Kwaraiwa and the rest of the Engineers was said to be quite depleted, whereas the Koyagaugau reefs were supposed to still harbor plenty of resources. Earlier in June, there was an incident when raskols held up a Nako boat and stole their beche-de-mer money, injuring one of the crew members. People throughout the region suspect the raskols are from Kwaraiwa.

People from Tubetube also talked a bit about conflict when they used the Koyagaugau reefs. They said that Tubetube people should be allowed to have access to the reefs, because Tubetube has certain traditional rights over Koyagaugau island itself, stemming from the relationship between the two islands. Examples were given of the same names given to places on both Tubetube and Koyagaugau as evidence. People said that because of people migrating from Normanby over to Koyagaugau however, this has made people less accommodating about these relationships.

As with other tensions but it seems to be especially relevant here, the thing I want to focus on regarding this disputed area is how the relationships between people and the boundaries between groups are changing as a result of the commercialization of resources. How has the relationship between groups of people from the Engineers and Koyagaugau changed as a result of disputing over boundaries, i.e. are people being classified as relatives or strangers? How has migration from other islands affected the ways in which people determine ownership over reefs? How are people using custom and identity to strategize their claims to resources? What is the nature of the social dynamics between different groups of people in the Engineers group and how is this being affected by the development of the high-value beche-de-mer industry, and vice versa?

### **3) Unresolved ownership and access rights over the Conflict group of islands**

The background to this area has a long history and needs a lot of pre-field research, but the Kasanalai clan people in Kwaraiwa are still claiming access over some of these islands. Panaeate people still use the area heavily, as do the people from Tewatewa (from the Kasanalai clan). I would want to examine in detail the history of ownership of these islands, focusing on uncertainty about the nature of alienated/customary ownership. I would also like to examine current resource use patterns by the people from the Engineers groups, if they are making claims in the area at all, and to what extent the beche-de-mer industry has exacerbated uncertainty about ownership and access rights. How have the claims made by different groups (i.e. the Kasanalai clan, and others from Tubetube) been affected by the presence of beche-de-mer around these islands?

### **4) Poaching within local boundaries by foreign fishing boats**

This issue still seems to cause a bit of concern among local communities. At night, plenty of boats come in and fish in local waters. Local boys often go out and cut the lines of fishing boats, whose crew sometimes carry guns. This was said to occur mostly around Brooker Island, where people are supposed to have fitted out their homes with stuff taken from boats that run aground on the reefs nearby.

This is related to the incident in February when more than 20 fishing boats were brought in by the provincial police. A lot of the questions I want to ask about this are to do with the inability of the state to enforce the law. I want to look at the processes that determine how licenses are granted, and the extent to which many of these vessels seem to operate outside of the law.

### **5) Court dispute between Ware and Brooker over Nagobi and Nabaina Islands and reefs.**

The background to this dispute has been well documented by Jeff Kinch, and I don't want to trawl over the same discussion of where the boundary lies and the basic causes. Instead, the thing that I want to focus on about this dispute is the way that Ware people have been able to so successfully mobilize themselves for this dispute. The key question that I want to address for the whole thesis is what the social and political processes are that determine the nature of tensions about access to marine resources, and so regarding this dispute I want to look at what the social processes are that have made the Ware people work well together in this regard and fight the dispute so persistently. The key thing therefore I want to examine is the nature of the decision-making processes and "social capital" that seems to be present in Ware.

Why has virtually the whole community united behind the 2 clans involved in the dispute? How have they been able to raise the necessary funds for legal and administrative costs? Is it because of the massive value that is placed on these particular reefs, due to lack of terrestrial resources and heaps of BDM on these islands? Or is it related to the particular culture of Ware that seems to promote a good community spirit? Why is this "good community spirit" there and how does it work? Is it related to the fact that they are a small, isolated community with relatively little access to other resources and socializing?

Another issue that I want to look at concerning this dispute is the actual procedure for managing these disputes when they go to court. Why is it that the dispute has dragged on for several years without satisfactory resolution? I will be looking at the legal framework that is currently in place to manage the dispute.

### **SUMMARY**

My "question" is "What determines the nature of tensions about access to marine resources"? As such, I want to focus on how the political, economic and social contexts at both higher and lower scales determine the ways in which marine resources are being contested. From my understanding so far, some of the things that are going on at a higher scale that feed into tensions at a local level include:

- the unresolved tension between alienated and customary land throughout the country (feeding into the unresolved dispute over the Conflicts from people at Kwaraiwa and Tewatera, feeding into potential tension over the alienated islands around the Engineers group);

- the inability of the state to enforce sanctions and properly regulate the fisheries sector (feeding into local anger about Asian fishing vessels and poaching in local waters, feeding into province-wide poor BDM management);
- the inability of the current legislative framework and legal context that is in place to manage disputes (feeding into the persistency of the Ware-Brooker dispute);
- the general lack of development and alternatives to raising cash in the region (feeding into the use of hookah gear and people stealing from the Koyagaugau reefs);
- the lack of clearly defined ownership and access rights over marine territories (feeding into the Ware/Brooker dispute who both can make an argument for having a claim, feeding into the dispute over Koyagaugau reefs where people from the Engineer group are staking access claims also, feeding into the dispute about hookah diving where the hookah divers can make claims in other reefs also);
- the “politics” of the fisheries industry at a higher level, i.e. the different interests of players like Jean-Luc Critten, Gordon Wesley, Tim Neville and the NFA (feeding into the dispute between the hookah divers and Mr Lo’s supporters, the more general tension between Gordon Wesley’s supporters and others and the tension about the presence of independent fishing vessels);
- the tension between conservationist and commercial discourse throughout the “Zone 1” (feeding into the dispute with the hookah diving);
- the rapid increase in price for beche-de-mer (feeding into all the disputes by increasing the value of contested resources).

Some of the local issues that I see as integral to shaping the nature of tensions include:

- the social dynamics among the people of Ware and their ability to work together;
- the social dynamics between people in the Engineers group; how people relate to other migrants from Normanby for example, how people relate to others from the island next door; the social fractures between different groups in the Engineers, what the issues are that shape these social relations;
- the relationship between tensions about access to marine resources in the area and other sorts of tensions between different groups;
- the ways in which leadership and decision-making processes in the local communities affect the ways in which tensions are borne out; i.e. how leaders’ personal strategies have created or minimized different tensions;
- the value of particular local reefs, i.e. the extent to which the amount and grade of BDM being collected from a particular reef correlates with the intensity/frequency/character of the dispute over it;
- population pressure and the extent to which population pressure correlates or does not correlate with the intensity/frequency/character of disputes around that island (already indications of some small land disputes within families on Kwaraiwa and Ware, the two most densely populated islands in the region).

## Appendix 3

### **Milne Bay 'freeze' on fishing licences**

THE Milne Bay Provincial Government has placed a moratorium on new fishery licenses to companies interested in fishing in the province's 200-mile economic zone. Making the announcement a month after he and Fisheries Minister Ben Semri clashed over a fishing deal that saw 20 Chinese fishing trawlers traverse the provincial waters, Milne Bay Governor Tim Neville said only 10 existing fishery license holders would be allowed to operate.

He said license holders who did not get approval from the provincial economic facilitation committee and the provincial executive council would not be recognised and have their licenses revoked.

"There are currently 10 fishery license holders operating in the province," Mr Neville said.

"These are Nako Fisheries Ltd, Kiwali Exports, Asiapac Pty Ltd, RFI Enterprises Ltd, Chao Enterprises Ltd, Coral Sea Mariculture, Ewena Business Group, Alkiki Seafoods Ltd, Milne Bay Seafoods Ltd and Niugini Islands Sea Products."

All buyers and exporters of shark fins, beche-de-mer and trochus shell must have approved export facilities and premises based in Alotau, approved by licensed fisheries officers of the Milne Bay provincial administration."

He expressed concern about an increase in attempts by foreigners to use indigenous Milne Bay people as "fronts" in order to obtain fishery licenses from the National Fisheries Authority (NFA).

"It is a worry to the Milne Bay Provincial Government that NFA may not be following the required procedures, especially in consulting the provincial government before considering the applications.

The restriction would protect the province's sea and reefs from scrupulous foreigners."

**The National**, Monday, 14 March 2005.

## **Appendix 4**

Recommendations for the PNG beche-de-mer fishery. From Kinch (2004)

### **Recommendations**

- 1** Conduct this review on an annual basis, preferably in the open season.
- 2** Involve beche-de-mer importers from Asia in management discussions of the PNG beche-de-mer fishery. At present there is widespread financing of PNG National/Citizens in the industry. Even though this is not a real issue, there are still equity concerns.
- 2.3** Develop guidelines for involving non-citizens in the beche-de-mer fishery to ensure equitable partnerships and transparency with PNG National/Citizens.
- 2.4** Conduct an analysis of which PNG companies consistently export to what import companies in Asia. This will assist in determining what companies are more likely to be financed by non-citizens. It may also be worthwhile also to have the Investment Promotion Authority conduct company searches, detailing involvement and crossreferencing this with NFA files.
- 3** Conduct a thorough economic analysis of the beche-de-mer fishery at all levels. This would include purchasing arrangements from fishers to exporter-importer relationships.
- 4** Conduct research for the purpose of obtaining further information on the size at first maturity for all commercially used beche-de-mer species in PNG. There is also a need for more information on asexual reproduction patterns, which would facilitate the interpretation of observed population parameters. Some populations seem to rely heavily on this mode of reproduction, which occurs seasonally for some species <sup>27</sup>
- 5** Conduct a thorough analysis on species composition and production trends at the company level and CPUE studies amongst fishers. This is important because as one species is depleted, fishing effort usually shifts to less valuable species, however, the CPUE may actually increase.
- 6** Introduce species-specific TACs for species that are showing signs of fishing pressure, or for trials on new commercial species. It is probably better, however, to set zero TACs for species under pressure given that the species value groups are not effectively monitored.
- 7** Effectively monitor each TACs value group. This is not being undertaken at present and the fishery remains opens.
- 8** Enforce TAC exceeding penalties. Again this is not being undertaken.
- 9** Conduct or obtain research on conversion factors for beche-de-mer in various product forms (e.g. wet, first-boiled and dry) to establish precise and accurate purchasing levels for monitoring TACs.
- 10** Conduct regular stock assessments to quantify population parameters and to develop sustainable management approaches and to revise TACs.
- 11** Review TAC limits for each Province.
- 12** Provide PFOs with export and TAC statistics.

**13** Revise and update the 'Specie Values' list. This has changed dramatically with some low value species now reaching 'high value' status (especially with the growing market in China). This is needed as some exporters tend to undervalue their stock or continue to buy at a low price from the fishers.

**14** Conduct awareness on standard trade names, currently there are some anomalies, such as yellowfish for curryfish, whitebelly for chalkfish, and moonfish for golden sandfish. There is also a need to determine what snackfish actually is.

**15** Conduct better awareness on the NBMP, particularly to companies.

**16** Increase licencing fees for export companies. This could then be used to finance stock assessments.

**17** Develop a review mechanism be put in place for renewal of export licenses. Currently, many companies that have export licenses do not export. They act more in a buyer's role, purchasing product and then selling it on to other exporters.

**18** Change the start month for all export licenses to be the same, for example from January to January, with all licenses applied for in the closed season. This may simplify the monitoring of the fishery.

**19** Disseminate information to industry and PFOs in relation to market trends, and the effects of unsustainable harvesting in other countries including other parts of PNG. A price register for marine resources (trochus, beche-de-mer and shark fin) could be developed and published monthly or quarterly in the local newspapers. The provision of a price guideline would help fishers and companies, particularly in Provinces where competition is very weak or non-existent.

**20** Notify companies and PFOs of intending NMAC meeting dates, to enable adequate preparation of stakeholder concerns.

**21** Disseminate contact details of all NMAC representatives, particularly the Business Representative.

**22** Disseminate the results of all key issues discussed at NMAC meetings to stakeholders. At present there is little or no real communication/linkages amongst stakeholders and the NMAC on a practical level.

**23** Actively support the establishment of PMACs, possibly with one representative from each company operating at that time to avoid monopolisation and to lessen political persuasion, either by direct financial or technical assistance. This may be possible through appropriate mechanisms that could be built into MOAs between Provinces and the NFA. Companies could also be approached to determine if they would provide logistical support for members, i.e. transport, accommodation and meeting venues.

**24** Adequately support PFOs, or at least prioritize the main aspects necessary for ensuring a sustainable fishery (develop some guidelines for inspections, analyse pricing structures, reporting patterns, spot checks, etc.). This again, could be achieved through appropriate mechanisms that could be built into MOAs between Provinces and the NFA.

**25** Promote the development of Provincial management schedules as detailed in the NBMP

or re-implementation of Provincial Beche-de-mer Management Plans. This is necessary as some Provinces have management issues specific to their Province. Unfortunately, in the absence of any PMAC meetings there are no avenues for this to be discussed.

**26** Conduct awareness on what the season opening and closing date actually means. Fishers need to understand that the opening date of January 16th actually means that this is when they can actively start harvesting. It has been observed in all Provinces that fishers harvest throughout the closed season.

**27** Enforce the ban and purchase on undersize product. Ensure gazetted Fisheries Officers seriously sample exports (companies should leave all bags packed for export open for inspection and then only with the clearance of the gazetted Fisheries Officer then seal it up).

**28** Ensure processing skills by fishers are upgraded through training, either through company, the NFA or PFOs staff. This is necessary to ensure equitable economic returns to the fishers<sup>28</sup> and to ensure less beche-de-mer is rejected because of bad processing, decomposition or undersize.

**29** Disseminate awareness on the use of lights at nights, hookah and SCUBA. The use of lights is widespread in all Provinces and hookah and SCUBA has been noted from some Provinces but not enforced.

**30** Conduct awareness on size limits, reproduction and sexual maturity of beche-de-mer amongst all stakeholders.

**31** Limit the number of export licenses in each Province, based on historical Provincial allocations and the number that have consistently exported since deregulation. Under the NBMP, a Province may recommend a limit for export licences. Unfortunately, in the absence of any PMAC meetings there are no avenues for this to be discussed.

**32** Reintroduce buyer's licenses for Provinces where is deemed necessary. Since the suspension of buyer's licenses there has been no way to monitor purchasing and movements along the custody chain. This could be done as a specific Provincial schedule under the NBMP.

**33** Reintroduce logbooks or simplify the Monthly Summary Reports, to make it practical, realistic and reliable<sup>29</sup>. This is necessary to enable analysis of the harvesting, buying and stock trends. At present, the reporting sheet is essentially a duplication of receipts given to fishers at the time of sale and consumes a considerable amount of company time.

**34** Monitor effectively the first shipment of each year to determine if export is of product held over from the previous year. If there are discrepancies, then it may suggest that fishers have been operating in the closed season.

**35** Monitor cross-Provincial border buying. Some Provinces actively promote this, and in one case a company from one Province has been granted to buy from another.

Unregulated buying will affect TACs and season closures.

**36** Promote co-management by fishers and the NFA and PFOs. This could also be assisted by the support of competent NGOs or other groups.