

Village-Based Marine Resource Use and Rural Livelihoods



Kimbe Bay, West New Britain, Papua New Guinea

Prepared for The Nature Conservancy by:
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Report of a study conducted between 2005-2006 of village-based marine resource use, management and rural livelihoods in Kimbe Bay, West New Britain Province. The research was a collaborative project between The Nature Conservancy, Kimbe Bay and Curtin University of Technology and funded by The Nature Conservancy.

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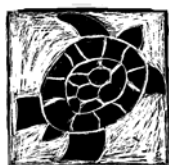
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ABBREVIATIONS & ACRONYMS

CDF	Community Development Facilitators
CMB	Copra Marketing Board
FFB	Fresh Fruit Bunches
ILG	Incorporated Land Group
KBSA	Kimbe Bay Shipping Agency
LLG	Local Level Government
LMMA	Locally Managed Marine Protected Area
LSS	Land Settlement Scheme
MPA	Marine Protected Area
NBPOL	New Britain Palm Oil Limited
PNG	Papua New Guinea
PNGOPRA	Papua New Guinea Oil Palm Research Association
PRA	Participatory Rapid Appraisal
SBLC	Stettin Bay Lumber Company
SLA	Sustainable Livelihoods Approach
SPAGS	Spawning Aggregation Sites
TNC	The Nature Conservancy
VOP	Village Oil Palm
WNB	West New Britain



EXECUTIVE SUMMARY

This report presents the findings of a socio-economic study conducted in six coastal villages in Kimbe Bay, West New Britain Province, Papua New Guinea. From west to east around the Bay the study villages were Kulungi, Gaungo, Tarobi, Baikakea, Potou and Baea. The central aims of the study were to provide information for the design and implementation of a network of Marine Protected Areas (MPAs) within Kimbe Bay and to give direction for future marine education and awareness campaigns for Kimbe Bay's communities.

Kimbe Bay coastal village communities rely on both land and marine resources to meet everyday subsistence and cash income needs, and much of their cultural identity, beliefs, and ancestral stories draw on elements from the marine environment.

Excluding the densely populated offshore islands of Bali Witu and Arawe, the coastal plain between Kimbe and Biella has the highest population densities in the province at 130 persons/km². Over one-third of the population have migrated to the area from elsewhere in the province and mainland PNG. Resource owners in Kimbe Bay are facing several challenges such as changing village socio-political systems, high population growth rates (both urban and rural), poaching of marine resources, increasing use of destructive fishing methods, rising cash needs, and, in some areas, the loss of traditional income sources like cocoa and copra.

Two key intersecting processes affect the use of marine resources in Kimbe Bay: the high rate of population growth and rising cash needs of villagers which are changing people's relationships with land and marine resources, leading increasingly to the commercialisation of natural resources throughout the Bay. Together these two processes are exerting pressures for change, a force that will continue to build with the rising material aspirations of this rapidly growing population.

Despite a decreasing reliance on a subsistence-based economy, fish and shellfish are major dietary items, alongside garden produce, in all six study villages. The most frequently consumed fish species reported by coastal communities in declining order of importance were Trevally, Mullet, Rabbit-fish, Tuna and Surgeon Fish. Trevally was consumed by 77% of households across all villages, while Mullet, the second most frequently consumed species, was mentioned by half of sample households. Compared with fish catches, a much larger proportion of shellfish meat is for subsistence purposes rather than for cash income generation. In declining order of importance, the most important types of shellfish consumed across all villages were: Kina, *Strombus* spp, Burrowing Giant Clam and Ark Clam.

It is the balance of terrestrial and marine-based livelihood strategies that varies amongst the six study villages. While terrestrial subsistence activities do not vary greatly amongst villages, the utilisation of marine resources and the types of cash income activities pursued in each village reflect, to an extent, the degree of accessibility of each village. Villages which are relatively remote from towns and markets are more dependent on marine resources for their subsistence needs and cash incomes than those with high market accessibility. Highly accessible villages tend to rely on terrestrial sources of cash income such as export cash cropping and production of garden foods for local markets.

There tends to be an inverse relationship between dependence on export cash crops and exploitation of marine resources for cash income (which also relates to the accessibility of each village). Oil palm/cocoa was the most frequently top ranked income source for both men and women in the three most accessible villages of Kulungi, Baikakea and Gaungo. For Tarobi Village, which was fourth on accessibility, oil palm was the most frequently top

ranked income source for men, and beche-de-mer for women. Fish sold at local markets was the most frequently top ranked income source for both men and women in the two most isolated villages of Potou and Baea. The commercial fish trade is not well developed in Kimbe Bay. Fish sales to commercial buyers were low across all six villages.

In all six study villages, people perceived, to varying degrees, a reduction in the abundance of commonly harvested marine resources. Trochus and beche-de-mer (both sold commercially), were the only marine species identified across all six villages as declining significantly in numbers. The commonly harvested Kina shell, from mangrove habitats, although still widely available, was recognised as declining in abundance by Gaungo, Tarobi, Baikakea and Baea villagers.

The most common explanations given for the decline in the abundance of specific species were the over-exploitation of marine resources, changes to marine habitats and destructive fishing methods. The poaching of marine resources by 'outsiders' was thought to be a factor explaining declining stocks of marine resources by people living in villages near urban centres, land settlement schemes or oil palm plantation compounds where large numbers of migrants reside.

The relative importance of the factors explaining the decline in species abundance differs between the more accessible and less accessible villages. The least accessible villages of Potou and Baea were the only villages where marine habitats were perceived by the residents to be in good condition. In the more accessible villages of Kulungi, Baikakea and Gaungo, marine resources are now of less importance in the cash income strategies of villagers (they have a wider range of income options) than in the more remote villages of Baea, Potou and Tarobi. So, the perceived decline in the abundance of some species in high accessibility villages is probably less to do with over-exploitation of those species, and more to do with habitat degradation associated with general population growth and changing land use practices (e.g., road infrastructure, urban and agricultural development). Conversely, in the less accessible villages where habitat quality is still perceived to be good, the decline in the abundance of some species may reflect over-exploitation of these species for cash income. The relative importance of these factors (impacts on marine habitats resulting from changing land use practices and direct over-exploitation of marine resources) requires further investigation by TNC.

While there is a perception among coastal communities that the over-exploitation of some marine resources, the use of destructive fishing methods and certain land-use practices are leading to declines in the abundance of marine resources and reduced quality of marine habitats, few strategies have been implemented to address these problems. This is despite many villagers' acknowledgement that these problems require urgent attention. All coastal communities visited during this study showed support for further conservation awareness programs and the potential adoption of LLG Marine Environment Law.

Key strategies and recommendations for the design of a network of locally managed marine protected areas:

- develop participatory decision-making relationships with marine resource holders;
- incorporate local knowledge and local management and tenure systems into measures to protect and conserve the marine biodiversity of Kimbe Bay;
- develop marine conservation strategies that accommodate the economic requirements of people resulting from population growth and the rising material aspirations of the population;

- reduce dependence on marine income sources by encouraging the rehabilitation of cocoa and coconut smallholdings in isolated villages now that new buyers (e.g., KBSA and Agmark) are entering the market;
- continue and expand conservation awareness campaigns in Kimbe Bay;
- identify conservation champions in the community and villages to engender community support for the design and introduction of local MPAs; and,
- conduct further fisheries research and livelihood studies to improve understanding of how different livelihood strategies and market accessibility influence villagers' dependence on marine resources for subsistence and cash income.

1. INTRODUCTION

STUDY BACKGROUND

This socio-economic study was conducted in six villages in Kimbe Bay (Figure 1.1) and was part of a larger project being undertaken by The Nature Conservancy (TNC) to understand the physical and biological aspects of marine ecosystems of Kimbe Bay and the socioeconomic issues influencing local marine resource use and conservation. The Kimbe Bay project aims to protect and conserve the biodiversity and marine resources of the marine environment from the pressures of population increase and economic development within the Bay.

Recent studies undertaken by TNC and partner organisations¹ have determined that Kimbe Bay, with its high diversity of coral and fish species, is part of the Coral Triangle. The Coral Triangle encompasses an area from Indonesia eastward to the Solomon Islands and is recognised as having the highest marine biodiversity in the world (Green and Mous, 2006). Being among the world's most biologically diverse marine areas and facing environmental and development pressures, TNC has identified Kimbe Bay as a "platform site" for marine conservation. The conservation program for Kimbe Bay includes the establishment of a:

- Network of Marine Protected Areas (MPAs) that are resilient to climate change.
- Local conservation non-governmental organisation.
- Research and conservation centre.
- Marine environmental education program.

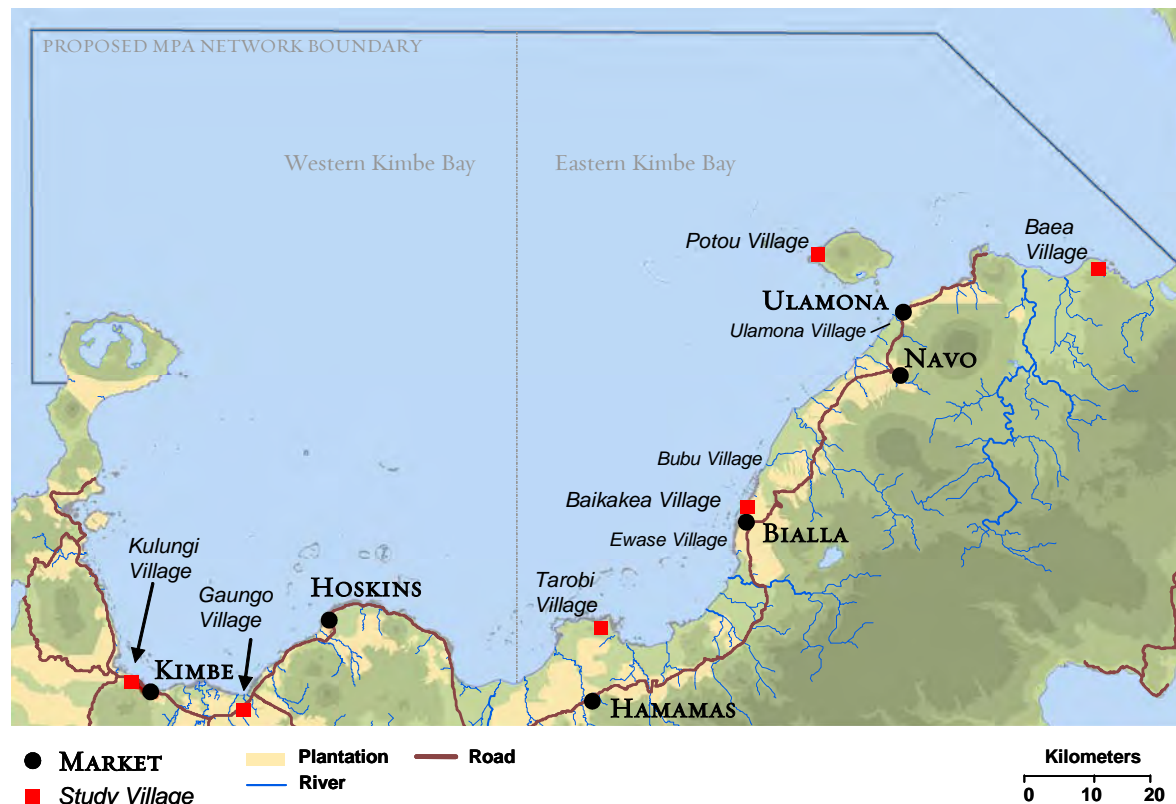


Figure 1.1 Location of study site villages and main informal markets.

RATIONALE & SCOPE OF STUDY

Until recently, TNC's research and conservation efforts were focused on the biophysical aspects of conservation, with less attention to the socio-economic factors impinging on biodiversity and conservation. It was recognised by TNC that conservation efforts could be enhanced by giving greater consideration to the social and economic dimensions of conservation to better understand how people use and value marine resources. This study addressed these issues through community-based research that sought to understand local:

- Marine tenure systems.
- Perceptions of marine reserves.
- Patterns of marine resource use and value.
- Issues of concern for marine resource use.
- Knowledge of the marine environment, resources and conservation.
- Livelihood strategies and how these interact with the utilisation of marine resources.

The study provides information for the design and implementation of a network of MPAs within Kimbe Bay and suggests strategies for future marine education and awareness campaigns for Kimbe Bay's communities.

MARINE ENVIRONMENT

Kimbe Bay is a deep, sheltered bay extending from Cape Hollman at Willaumez Peninsula in the west to Cape Deschamps at the eastern end of the Bay (TNC, 1994). Its underlying geology is predominantly volcanic, with river sediment deposited around river estuaries (Berger, 2002). The deep and sheltered waters of Kimbe Bay create ideal conditions to support a rich and varied coastal and marine ecosystem (Allen and Munday, 1994; TNC, 1994). Although information on the marine environment of Kimbe Bay is limited, ecological assessments indicate that habitat diversity is relatively high due to a combination of coral reef, shoreline, mangrove and seagrass habitats (Holthus and Maragos, 1994; TNC, 1994; Sheaves, n.d.). Coral species diversity is also high. It is estimated that Kimbe Bay supports approximately 860 fish species with the number of fish species increasing with distance from shore (Allen and Munday, 1994). Although similar faunal richness can be found in other parts of Papua New Guinea, Kimbe Bay fish communities have been described as having a "special mix" of fish communities worthy of conservation (Allen and Munday, 1994).

The fish fauna of Kimbe Bay is composed mainly of species associated with coral reefs and sandy/rubble bottoms, with Damselfishes (*Pomacentridae*) being the most abundant (Allen and Munday n.d; Berger, 2002). The most common food fish families include Surgeonfish (*Acanthuridae*), Wrasses (*Labridae*), Emperors (*Lethrinidae*), Snappers (*Lutjanidae*), Mullet (*Mullidae*), Parrotfish (*Scaridae*) and Groupers (*Serranidae*) (TNC, 1994). Assessments of fishing pressures in the Bay indicate relatively low pressures at present (TNC, 1994; Turak and Aitsi, 2002), with fishing concentrated on the accessible coastal reefs closest to the inhabited and more populated areas (TNC, 1994).

Despite the relatively healthy condition of the marine environment of Kimbe Bay, there are increasing pressures on the coastal systems of the Bay resulting from:

- Clearance of coastal forests and mangroves (Berger, 2002; Sheaves, n.d.).
- Changes in land use practices (Sheaves, n.d.).

- Destructive fishing practices (Seeto, 2001).
- Population pressures (Koczberski *et al.*, 2001).
- Elevated sedimentation rates on inshore reefs (Munday, 2003).

DEMOGRAPHIC ENVIRONMENT

Excluding the densely populated offshore islands of Bali Witu and Arawe, the coastal plain between Kimbe and Bialla (Figure 1.1) has the highest population densities in the province, at up to 130 persons/km² (Hanson *et al.*, 2001). Between 1980 and 2000, WNB's annual population growth of 3.7%, was amongst the highest in the country (National Statistical Office, 2001), and at this growth rate the population will double every 21 years. The high population increase is due to both in-migration and a high rate of natural increase. At the 2000 census, 31% of the WNB population were migrants and the province's Total Fertility Rate at over 6 was amongst the highest in the country (National Statistics Office, 2001).

The high migrant population is largely concentrated in the Hoskins and Bialla oil palm land settlement schemes (LSSs) which were established in the late 1960s and early 1970s and on oil palm plantation compounds. PNG adopted land settlement programmes to promote agricultural and economic development. Large numbers of migrants have settled in WNB since the schemes' inception (Curry and Koczberski, 1999), and population pressures on the settlement blocks are leading to second and third generation migrants settling on "purchased" customary land or squatting illegally on government land. The relatively prosperous oil palm belt from the Talasea Peninsula to Navo is also attracting many migrants from less well-off areas of the province and from other economically disadvantaged regions of PNG. Migrants take up residence on the fringes of urban centres, on plantation compounds, in rural 'squatter' camps, or on the land settlement schemes. Talasea Census District, which covers Kimbe Bay, has a migrant population of 38% of the total population. The large majority (79%) have migrated from another province (National Statistical Office, 2001).

The growing numbers of migrants located around Kimbe and Bialla have created a feeling among some customary landowners that they are being "swamped" by "outsiders". They blame the deteriorating law and order situation on the settlers and the transient youth population attracted by work opportunities. Intolerance of migrants is occasionally expressed as disputes over land and marine resources, as well as more violent conflicts (Koczberski and Curry, 2004).

ECONOMIC ENVIRONMENT

The majority of people living around Kimbe Bay are heavily reliant on local natural resources for their everyday survival, especially land for gardening and commercial agriculture and the ocean for marine products. Subsistence activities remain the cornerstone of daily life in villages where people rely on gardens and/or fishing/shellfish to meet most of their daily food requirements.

Increasingly, terrestrial and marine resources are being used to generate cash incomes as people's material aspirations rise and cash becomes ever more important for meeting everyday needs. The main avenues for generating cash income in coastal villages in Kimbe Bay include:

- Cultivation of oil palm, coconuts and cocoa on smallholdings.
- Local marketing of garden, tree and marine produce (mostly by women).
- Small business enterprises (e.g., village tradestores and poultry projects).
- Fishing and the sale of marine products.
- Wage employment.

Production of smallholder cocoa and copra has declined significantly in the past decade because of reduced access to markets (e.g., closure of the Copra Marketing Board in 2000 and the absence of cocoa buyers until recently). Most villagers hold a range of cash crops (including in the villages of Potou and Baea, the commercial timber species Kamarere (*Eucalyptus deglupta*)). Recent surveys of village oil palm growers in Kimbe Bay indicate that just over 83% and 14% of village producers in the Hoskins and Bialla areas respectively had two or more types of export cash crops (Koczberski *et al.*, 2001; Koczberski and Curry, 2003).

Oil palm is by far the most important commodity crop and dominates the rural economy of the Bay. Oil palm production in Kimbe Bay was 1.182 million tonnes in 2004, with approximately 64% of production coming from plantations and the balance from village and settler smallholders (Table 1.1).

Table 1.1. Oil Palm Statistics for 2004 for Kimbe Bay

OIL PALM STATISTICS	HOSKINS	BIALLA
Smallholder production (FFB)	286,145 tonnes	134,700 tonnes
Smallholder hectareage	23,233 ha	10,227 ha
Plantation production* (FFB)	616,135 tonnes	144,948 tonnes
Plantation hectareage*	30,447 ha	10,929 ha

Source: PNGOPRA data. *Mini-estates at Hoskins and Community Oil Palm Development estates at Bialla included in plantation statistics.

Informal markets are another key component of the economic environment of the Bay where women earn a regular income through marketing garden produce, tree fruits, betel nut, coconuts and marine products. Although the money earned is not large (see Koczberski *et al.*, 2001), income from local markets provides cash to purchase small household items like rice, tinned fish, kerosene and soap.

Logging is occurring in the Kimbe Bay region, but has been declining in recent years as companies have diverted their attention to the lowland areas of mainland PNG, particularly Western Province and Gulf Province (Warku, 2004). In Kimbe Bay, the main timber company, Stettin Bay Lumber Company (SBLC), has reduced its natural harvesting and is concentrating on its 10,000 ha of plantation forest. Present logging activities within the Bay are at Mataururu, Barema, Kikipuna, Ulamona and Mengan villages.

At present, apart from the commercial sale of beche-de-mer (Class Holothuroidea), trochus (*Trochus niloticus*), and shark fin there are no large-scale commercial fishing² operations within the Bay. According to the Fisheries Division in Kimbe, the last commercial fishing venture in the Bay was in 1999 when a small commercial Tuna operation by Hugo Tuna Exporters was exporting Tuna to Japan. There are virtually no data on artisanal³ fisheries in

the Bay, although preliminary investigations conducted as part of this study indicate that the extent of artisanal fisheries varies considerably amongst communities in the Bay (Chapter 5). In eastern Kimbe Bay, where the range of terrestrial-based income sources is limited, the sale of marine products at informal markets makes an important contribution to household incomes (Chapter 5). Villages closer to Bialla and Kimbe have greater access to terrestrial-based income opportunities (such as export crops and waged employment) and rely less on sales of marine products, although some communities close to Kimbe, such as Gaungo Village and Gigo Settlement sell fish to commercial retailers in Kimbe. Data from Kimbe Bay Shipping Agency (KBSA), one of the main fish buyers⁴ in Kimbe, indicate that most of the fish purchased (Barracuda, Red Emperor, Spanish Mackerel and Tuna) is supplied from Kombe people in the Kaliai-Kove LLG area, fishers at Gigo and Laleki settlements, with smaller quantities of fish purchased from Vavua, Koimumu and Mai villages in the Hoskins LLG, and from Gaungo in Mosa LLG (Elvis Mathias, KBSA, pers. comm.). KBSA fish data for 2005 indicate that 7.63 tonnes of fish were purchased from village fishers with an average sale weight per fisher of 13.41 kg of fish and income of K86.68.

A small-scale tourism industry is present in Kimbe Bay which focuses on nature-based activities such as diving, bird watching and fishing. Diving dominates the tourism sector in the Bay and is well serviced by the Walindi Dive Resort, an internationally renowned resort with several dive sites around the Bay. In 2004, a sports fishing lodge opened at Baea village in eastern Kimbe Bay and is attracting international visitors interested in Black Bass and blue water fishing. Coastal villagers are keen to see tourism development in their villages and in the wider Kimbe Bay.

SOCIAL ENVIRONMENT

Kimbe Bay remains an area where most people's identity remains firmly tied to their village and where customary obligations and kinship relationships are central elements of life. Like other parts of Papua New Guinea, Kimbe Bay is also undergoing immense social and cultural change. Social trends, such as changing household social relations, new consumption patterns and tastes, and a growing interest in charismatic religious movements are fostering considerable change in the lives of people (Sillitoe, 2000; Smith, 2002; Gewertz and Errington, 2004).

A significant socio-economic trend, mentioned above, is the growing reliance on the cash economy to meet customary obligations, everyday household needs, school fees and growing consumer aspirations. Young people in particular aspire to a better life materially than their parents, and there is a desire for more consumer goods and modern lifestyles. Access to cash is now essential for fulfilling customary obligations such as brideprices, mortuary payments and other community obligations.

It is to be expected that as population continues to grow rapidly and as people become increasingly tied into the cash economy their relationships and tenure rules to land and sea resources will change, with these resources increasingly viewed as commodities/assets to generate cash incomes. The most obvious current example is the change in peoples' attitudes to land and forest in Kimbe Bay where both are now increasingly being seen as commodities that can be exchanged for cash. Several customary landowning groups are receiving timber royalties and some are now selling customary land to migrants from outside the landowning group.

REPORT OUTLINE

Chapter 2 presents a description of the six study villages and methods used in the study, and Chapter 3 provides a brief outline of customary marine tenure and the marine cultural heritage of the Bay. Subsistence and economic livelihood strategies and how these interact with the utilisation of marine resources are presented in Chapters 4 and 5. A discussion on changing marine resources and habitats is provided in Chapter 6. Finally, Chapter 7 presents strategies and recommendations for the effective design and implementation of MPAs in Kimbe Bay.

NOTES

1. Partner organisations include Mahonia na Dari, Walindi Plantation Resort, James Cook University, and the University of Papua New Guinea.
2. Commercial fisheries refer to catch exported out of the local area.
3. Artisanal fisheries refer to catch sold in local markets and stores for local consumption.
4. Fish purchased by KBSA is distributed among KBSA-owned shops or sold to fast-food outlets in Kimbe where it is sold as fresh or cooked fish. KBSA also sells fish to the main hotels in Kimbe. In April, 2006, KBSA was purchasing Barracuda, Spanish Mackerel and Tuna for K6.00/kg and Red Emperor for K8.00/kg.

2. STUDY SITES & METHODS

STUDY SITES

Data were collected from six villages in three Local Level Government (LLG) areas of Kimbe Bay (Figure 1.1) from August 2005 to February 2006. The six villages from west to east were:

1. Kulungi Village in Talasea Rural LLG.
2. Gaungo Village in Mosa Rural LLG.
3. Tarobi Village in Bialla Rural LLG.
4. Baikakea Village in Bialla Rural LLG.
5. Potou Village in Bialla Rural LLG.
6. Baea Village in Bialla Rural LLG.

The six villages were selected based on two or more of the following characteristics:

- To reflect a geographical spread of villages around the Bay.
- Economic and livelihood characteristics. Villages were selected to reflect the diversity of economic and livelihood characteristics around the Bay, including their degree of reliance on marine resources and export commodity crops for their livelihoods. Other characteristics which were taken into consideration in village selection were access to markets, roads, and income-earning opportunities.
- Degree of familiarity with the conservation and education awareness efforts of TNC or Mahonia Na Dari (e.g., villages familiar with TNC conservation and awareness efforts through the RARE Pride awareness campaign using dugong as a flagship species).

A description of each village is provided below.

Kulungi Village

Kulungi Village is located approximately 2 km west of Kimbe town on the road to Talasea. The village population stands at 504 (Table 2.1), and residents claim to have adequate access to land for subsistence and cash cropping. Until recently, residential patterns in Kulungi Village were governed largely by one's clan affiliation, but church membership is also beginning to influence settlement patterns. Members of the Catholic Church tend to live near the main road and in close proximity to the village church, whereas Seventh Day Adventists live further away from the road. There are no government education or health services in the village. There is a Catholic run elementary school, and children attend Gigo Primary School on the outskirts of Kimbe town. Kulungi has telephone access and is connected to the electricity grid.

The main foods consumed at Kulungi are garden foods and store purchased rice, noodles and tinned fish. Tapioca is the main garden staple and is supplemented with bananas, taro, sweet potato and green vegetables. Ferns (*kumu gras*) are gathered from the bush and are consumed frequently. Villagers maintain that their livelihoods were more marine-oriented in the past, but over the last three decades their livelihood strategies have shifted to more terrestrial-based subsistence and commercial activities such as cash crop production (oil palm, cocoa and copra), small business enterprises and waged employment. Some Kulungi clans also receive royalties from logging and oil palm mini-estates.

Many villagers now purchase fish from the nearby migrant fishing communities of Gigo and Laleki settlements, or buy tinned fish rather than catch fish themselves. Some also have special exchange relationships with Gigo and Laleki settlers whereby settlers give a proportion of their catch (fish and shellfish) to Kulungi landowners in return for access to land for gardening (Chapter 4). Of all the communities visited, Kulungi had the least dependence on marine resources in terms of both subsistence and cash incomes.

Kulungi's marine territorial boundary extends from Kimbe wharf in the east (border shared with Raungo and Morokeya villages) to *Wara Ston* (Stone River) near Mt Krummel to the north in the Talasea Peninsula. The village has extensive reefs and access rights to Numondo Island, a mangrove island. There is a perception amongst village residents that the condition and productive capacity of their inshore sandy flats and inner reefs have deteriorated because of over-exploitation and the use of destructive fishing methods such as dynamite, derris roots (*posin rop* – poison rope), and small gauged fishing nets (see Chapter 6).

Some Kulungi residents resent the presence of settlers residing near the beach at Gigo and Laleki settlements. In meetings held during this study, several Kulungi residents expressed strong opposition to the settlements as the land was originally Kulungi customary land (now most of which is under state leases). Migrants at Gigo and Laleki settlements are predominantly from Kombe, Arawe, Gloucester, Gasmata, Bali/Vitu and mainland PNG. Settlers' livelihoods are highly dependent on night fishing in the vicinity of the outer reefs to where they travel in banana boats powered with outboard motors. Despite opposition within the Kulungi community to migrants residing in these settlements, some Kulungi villagers, as pointed out above, have informal 'rental agreements' with these migrants for access to land for food gardening.

Table 2.1. Population and demographic data for village study sites.

	KULUNGI	GAUNGO	TAROBI	BAIKAKEA	POTOU	BAEA
Total population	504	927	422	268	449	149
Percentage of population who are migrants (percentage of migrants who migrated between provinces)	32% (8.8%)	46.8% (82.3%)	7% (41.4%)	11.4% (50%)	12.6 (55.4%)	16.8% (44%)
Average household size	5.8	6.1	6.9	6.2	6.2	8.8
Median age	19	17	18.3	18	14	16.3
Proportion of population aged 10+ who have completed Grade 10	22.4%	12.7%	9.5%	5%	7.6%	4.5%

Source: National Statistical Office, Census Data, 2000.

Gaungo Village

Gaungo Village lies approximately 15 km east of Kimbe town and has a population of 927 (Table 2.1). The village population comprises of inland dwellers originating from the Mosa-Leim area and coastal dwellers from Talasea, Bakovi and Mai areas. More recently, migrants, mainly from mainland PNG, have been settling in the village and now comprise 47% of the village population (Table 2.1)

Over the last 20 years many Gaungo villagers have moved away from the seafront to reside on their oil palm blocks or on land bordering the main Kimbe-Hoskins road. The shift in residence patterns partly reflects the declining importance of marine livelihood activities, particularly amongst younger families who have switched to commercial agriculture and other terrestrial-based income sources.

Since about the mid 1980s, customary landowners have been selling land to “outsiders”. There are now between 150-200 families, mainly from mainland PNG, residing on customary land after ‘purchasing’ 2 ha blocks from the customary landowners to plant oil palm. As a group, migrant settlers have little reliance on marine resources, but some of their blocks are located close to the mangrove areas at the mouth of the Dagi River, and there is evidence of pressure on mangroves for house building and firewood. The growing population of migrants in the village is a concern to some of the younger generation of customary landowners, who feel they are beginning to be confronted with land shortages.

The village has an elementary school and children travel to Kapore to attend primary school. There is also an aid post at Gaungo.

The main foods eaten at Gaungo are garden foods and imported rice, noodles, tinned fish and tinned meat. The most commonly cultivated garden foods of customary landowners are sweet potato, bananas and tapioca and these are usually supplemented with store foods or other garden produce purchased at local markets, usually from the neighbouring migrant women. Marine resources, especially shellfish, are an important component of Gaungo diets (Chapter 4).

The people of Gaungo perceive considerable change in their marine environment over the last ten to twenty years (Chapter 6), especially to the mangrove systems and estuaries, and in the abundance of some shellfish species. They were also concerned that the condition of some inner reefs had deteriorated over recent times.

Tarobi Village

Tarobi Village lies on the coast approximately 55 km west of Bialla and is 25 km from the Hoskins-Bialla road, at the Mamoto junction. The village is relatively isolated. The village boundary is marked by Bilomi River to the west and the Ala River in the east. Tarobi has a population of 422 (Table 2.1) and informants claimed that village lands are extensive and more than sufficient for their needs. Forest clearance has occurred for commercial activities such as logging, an oil palm mini estate and smallholder commodity crops of oil palm, cocoa and copra. In recent years, oil palm has been replacing cocoa, partly because of the improved road infrastructure linked with oil palm development. Villagers also cultivate betel nut for bulk sale to people selling at town markets. At times, during the wet season, the road that links Tarobi to the main highway becomes impassable to oil palm trucks, compelling people to become more dependent on marine resources for their subsistence requirements.

The village has a primary school, but several families send their children to live with relatives at Mamota land settlement subdivision so that they can attend the Mamota Primary School.

Tarobi has an aid post and a house for the aid post orderly, but the position is currently vacant. The closest health centre is at Silanga Catholic Mission Station, some 30 km away.

The main foods consumed in the village are tapioca, taro, sago, fish, shellfish, green vegetables and rice. Sago is abundant and is a major staple for the people. Fishing and shellfish collection are important subsistence activities in the village.

The marine habitats are perceived by villagers to be in a relatively healthy condition, although some deterioration of mangroves and river systems was noted. Recently completed TNC surveys of the seagrass beds and mangroves indicate Tarobi has some relatively large areas of seagrass beds and coastal mangrove forests (J. Aitsi, pers. comm.).

Baikakea Village

Baikakea is about 7 km from Bialla township and has a population of 268 (Table 2.1). Despite its accessibility, only 5% of the population aged over 10 years has completed Grade 10. The village is very close to Wilelo LSS subdivision and 2 km from one of Hargy's main plantation compounds. Proximity to Wilelo LSS, plantation compounds and Bialla town provides Baikakea villagers with good access to government services, employment and marketing opportunities. The oil palm plantation also provides opportunities for full-time and part-time employment. Main income sources for Baikakea households include oil palm and the marketing of fish, shellfish, betel nut and sago. Due to the collapse of market access for copra, coconuts are now sold as 'dry' coconuts in the informal markets. Some clans also receive logging royalties.

The main subsistence food crops include tapioca, taro, banana, sweet potato and green vegetables. Sago is also an important staple for the community. With relatively high cash incomes, rice and store foods are consumed frequently.

Baikakea has large areas of mangroves and seagrass beds, which people claim have deteriorated over the years due to increased river sediment loads resulting from logging, oil palm development and the expansion of roads and infrastructure. There has also been some clearance of the mangroves for house building. Baikakea has a confirmed turtle nesting beach at the boundary between Bubu and Baikakea villages.

Potou Village

Potou Village is on the west coast of Lolobau Island approximately 40 km north-north-east of Bialla and 15 km northwest of Ulamona Village. Potou is thus relatively isolated and travel costs are high (boat fares are K30/per person from Potou to Ulamona). Potou has a resident population of 449 (Table 2.1), with many migrating away from the island seeking education and employment. The high out-migration probably explains the young median age of the population (Table 2.1). The United Church and the Catholic missions have been long established on the island and play a central role in the lives of villagers. The United Church provides primary school education and manages a medical aid post which was recently refurbished. The aid post has a VHF radio which serves as the main communication link with Ulamona, Bialla and Kimbe.

Marine habitats of Lolobau Island show little evidence of human impact, although over-exploitation of beche-de-mer, trochus and some fish species in the inshore area near Potou Village was reported by villagers (Table 5.2). Fishing is a major income source for villagers. Several sightings of dugong have been made around Lolobau Island (Joe Aitsi, pers. comm.) and, under an agreement between islanders and the Walindi Resort, the impressive reefs are visited by divers aboard one of the resort's dive boats. Apart from a 365 ha cocoa and copra plantation and smallholdings of cocoa and copra, much of the forest on the island remains intact.

The main foods eaten in Potou are taro, sweet potato, banana, sago, fish and shellfish. Garden food is cultivated for consumption only and generally is not sold at local markets. While pigs are hunted occasionally and supplement diets, they can cause serious damage to unprotected food gardens. There are only a few garden areas near Potou from which pigs can be excluded, and villagers claim they are a major constraint on subsistence food production.

Baea Village

Baea is located near Open Bay at the border of East and West New Britain and has a population of 149 (Table 2.1). Geographically, the village is dominated by the surrounding marine environment and is accessible only by boat, with the nearest road access at Nantabu, approximately 5 km east of Bagada Station (Plate 2.1). Rapidly rising fuel prices and thus boat fares are placing substantial economic burdens on families (boat fares are K30/per person from Baea to Ulamona). The village is characterised by poor access to government services, markets and income sources. The decline in government services has meant many families cross the border to Matanakunai in East New Britain to seek education and health services. Others have moved to Noau Village and planted oil palm, returning to the village for special ceremonial occasions or during Christmas and school holidays.



Plate 2.1. Baea Village, eastern Kimbe Bay © G.N. Curry.

Baea has a strong subsistence fishing culture that has been orientated to generating cash incomes. The sale at informal markets and work compounds of fish and other marine products, sago and betel nut provide the main source of income for Baea households. Some villagers have oil palm and Kamarere (*Eucalyptus deglupta*) holdings in areas/villages that have road access, and many young males migrate from the village to find employment.

Unlike other villages in the eastern part of the Bay, Baea people have not extensively cleared their forests for logging or plantation crops, and the low population density places few stresses on the environment. A striking characteristic of the Baea area is its relatively pristine environment: waterways run clear; mangroves and forests are intact and the village seafront and inner reefs are clean and healthy with no obvious evidence of degradation of marine habitats (Table 6.2). Baea has seagrass beds and a relatively small area of mangroves. The pristine environment of Baea has encouraged the establishment of an eco-fishing lodge in the village with a focus on Spottail and Black Bass fishing in the nearby rivers. Game fishing is also organised within the Open Bay areas and towards Toriu and Pondo in East New Britain Province. The lodge is based on a partnership between customary landowners and the Liamo Reef Resort in Kimbe.

The main foods consumed by villagers are sago, fish, shellfish and tapioca. Pigs and other forest animals are hunted occasionally to supplement diets and for sale at informal markets at Ulamona. Crocodiles are also hunted and their skins sold to commercial buyers. People cultivate mixed gardens of tapioca, banana and taro and depend on fishing and harvesting of marine resources to meet daily household consumption needs. Sago is an important food source during the wet season when garden foods are in short supply.

RESEARCH DESIGN

The research framework used participatory rapid appraisal (PRA) techniques within a sustainable livelihoods framework. PRA is recognised as being highly suitable for improving community members' participation and involvement in research activities, and for giving local people a 'voice' in research activities (Chambers, 2002). The sustainable livelihoods approach (SLA) stresses examining all those activities that in combination make up the livelihoods of people. The SLA recognises the social as well as the economic dimensions of people's livelihoods (Ellis, 2000). These approaches generate a more informed and fuller understanding of the people and the socio-cultural environment in which projects take place.

Given the study involved a wide range of stakeholders, the use of multiple methods was considered most appropriate. Hence, a combination of methods involving household questionnaire surveys, local market surveys, semi-structured interviews, community group meetings and focus groups were employed. Secondary data sources were also consulted.

At the beginning of the study the socio-economic research team broadcast a *toksave* (announcement) on the radio to ensure people were aware of the team's arrival and program of meetings. Data collection commenced with a community meeting in each village. This was followed in the same field visit by village resources mapping and focus group meetings.

The initial community meeting in each village was to inform villagers of the aims of the study, confirm their willingness to participate in the research, and solicit their main concerns and views regarding the village marine environment. The meetings were also used to develop a brief inventory of the *tokples* (indigenous language) names of common fish and shellfish species utilised in the village to assist with conducting the household surveys. Together, the meetings and focus group discussions provided an opportunity for villagers themselves to raise issues which they thought important, and enabled the research team to further explore issues identified during the household interviews and surveys.

Household¹ questionnaire surveys and interviews formed the basis of data collection. The questionnaires consisted of two surveys. The first was conducted with 240 randomly selected households across the six villages (40 households in each village, with an approximately equal number of interviews with female and male household heads). These surveys gathered information on:

- Household demographic and economic characteristics.
- Subsistence production and household consumption of marine resources.
- Cash incomes from marine resources.
- Cash incomes from agricultural and non-agricultural land-based sources.

The second household survey followed the completion of the first survey and was conducted amongst 10 households in each of the six villages. The 60 households were a subset of the 240 surveyed households and were selected on the basis of their reliance on marine and terrestrial resources. The objective of the second household survey was to collect data on recent utilisation of marine resources (for consumption and sale), and to gain an understanding of the factors influencing the day-to-day decisions involved in marine activities. By visiting the household a second time the visits were also used to cross-check and clarify information collected from the initial survey round and interviews².

The two household questionnaire surveys were integrated with informal interviews with family members to gather information on more qualitative issues such as access rights to marine resources, perceptions of marine habitats and resources, local knowledge regarding

conservation and management issues. Due to the distinct gender division of most marine-based activities, most surveys and interviews were conducted by a male and female research team to ensure both men and women's perspectives were included in the study.

Two focus groups were held in each village by the male and female research team. Although women were encouraged to attend the focus groups, the majority of meetings were dominated by men at Gaungo, Tarobi and Baikakea. Baea and Potou villages had approximately equal numbers of men and women participate, and at Kulungi Village more women and children than men attended the focus group meetings.

Focus group discussions concentrated on the following topics:

- Perceptions of marine habitats, changes in the marine environment through time, including qualitative assessments of the extent of environmental change.
- Changes in the abundance and size of commonly utilised marine resources.
- Perceptions of causes (and potential solutions) of degradation of the marine environment.
- Local marine conservation and management practices.
- Marine resource conflicts.
- Local knowledge and use of Cetaceans.
- Perceptions of changes in the abundance and sightings of Cetaceans.
- Customary marine tenure and marine cultural heritage.

Informal market surveys were undertaken at Ulamona market in September, 2005, and at Kimbe market in February, 2006, to assess the range, quantity and source of marine products for sale. Kimbe and Ulamona markets are the two main markets in Kimbe Bay where a range of marine products are sold. The market survey at Ulamona was held on a Friday fortnight pay week of Hargy plantation workers when the market attracts many local fish sellers. Likewise the market survey at Kimbe was held on the Saturday following the fortnight pay week of New Britain Palm Oil Ltd.

Most of the survey data were entered in Microsoft Excel spreadsheet, from which tables and graphs were generated.

Secondary data were obtained from the Division of Fisheries of WNB Provincial Administration Office and from the fish purchase records of KBSA. Oil palm production data provided by PNGOPRA and various relevant reports were also consulted for the study.

NOTES

1. For the purposes of this report a household is defined as all those members of the family and extended family residing together in the same or nearby houses, and sharing household resources. Typically, meals are shared between household members even though members may live in adjacent houses.
2. The results of the second survey are not presented in this report.

3. MARINE TENURE & CULTURAL HERITAGE

CUSTOMARY MARINE TENURE

This chapter provides some contextual background information regarding customary marine tenure and marine cultural heritage for Kimbe Bay. Given the time limitations of the study, only a brief overview of customary marine tenure and marine cultural heritage was undertaken. However, acknowledging and understanding customary marine tenure is crucial for the effective design and implementation of MPAs in Kimbe Bay. In Papua New Guinea approximately 97% of the total land area is under the control of customary landowners and customary tenure is recognised in legislation. Thus, any type of development such as agriculture, tourism, mining, commercial fishing or conservation projects, requires direct dealings with customary resource owners.

In Kimbe Bay customary marine tenure is predominantly matrilineal and includes territorial and resource (fish, shellfish, seaweed and other marine resources) rights over reefs and seas which are controlled communally at the clan level. Access is through the mother's lineage so that a man has primary rights over his mother's property, and these rights pass to his sisters' children on his death (rights vested in his eldest sister's eldest daughter). Put another way, the eldest daughter inherits the resource tenure rights of her mother, but her brother is the primary person who speaks on her behalf on land and other resource matters (if her brother is too young, her mother's brother will speak on behalf of the resource-holding group). If a woman's first born daughter dies prematurely, or she does not have a granddaughter by her first daughter, the rights transfer to the woman's second born daughter. The matrilineal inheritance of resource rights is shown schematically in Figure 3.1.

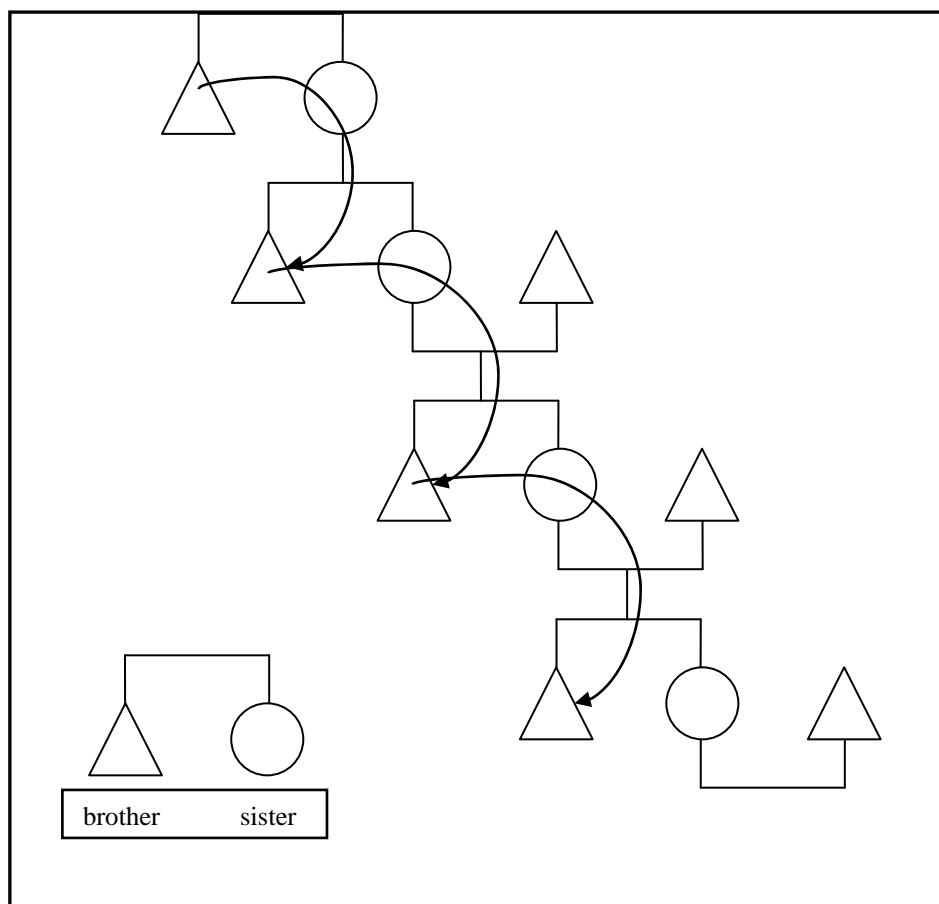


Figure 3.1. Transfer of resource tenure rights from men through sisters to sister's son.

Territorial boundaries on land at the macro scale (e.g., village level boundaries) are usually natural markers such as mountain ridges, rivers and streams. Within village territories, boundaries may be demarcated by trees or palms (e.g., mango, coconut and betel nut) and ornamental plants such as *tanget* (*Cordyline* spp). Access rights to terrestrial resources tend to be much more spatially differentiated than rights to marine resources, because tenure rights are conferred by the planting of garden crops, fruit trees and cash crops. By contrast, because marine resources are self-regenerating, resource tenure patterns tend to be less spatially differentiated.

Marine territorial boundaries are often demarcated by the seaward extension of terrestrial boundary markers such as large rivers and streams. Rights to outer reefs and islands are usually determined by distance from village (or evidence of prior occupancy and use, such as planting of coconuts on an outer island), with the nearest village usually possessing stronger claims¹. Thus, the marine environment can be envisaged as a series of parallel tenure zones running roughly at right angles to the coast, each with a particular clan holding primary access rights in each band.

These parallel bands of marine tenure rights running at right angles to the coast usually have a range of other tenure rights superimposed on them which allow clan or family groups from outside the village community access rights to all or some of the resources (e.g., fishing rights). These modifications to the basic band pattern are the result of marriage², the movements of people around the Bay, and the outcome of special customary exchange relationships that have, at some point in the past, conferred rights of access on non-resident groups. For instance, the people of Vavua and Koimumu Villages in Hoskins LLG have rights to fish the waters of Tarobi, Matilulu and Kaiamu villages in the Bialla LLG areas because they can trace their matrilineal lineage to a matrilineal ancestor shared in common with the people of latter three villages.

Tenure rights are usually flexible with overlapping rights, and generally they are pragmatic and able to accommodate the changing needs of the community and its component families. Decisions regarding access rights to resources such as mangroves, tidal zones, outer reefs, or the exploitation of specific marine resources for subsistence or commercial purposes must be agreed upon by all members of the resource-holding group.

There are few restrictions on members of the customary group engaging in everyday subsistence activities such as fishing or shellfish collection, and people who have secondary rights to these resources rarely face restrictions on their activities. Although access to fishing areas is open to the broader group, people have their preferred fishing spots, and other fishers will tend to avoid these locations. Incursions into the preferred fishing spots of others may lead to arguments between clans.

Access rights to commercial resources such as beche-de-mer and trochus appear to be more tightly controlled and limited to the children, brothers and maternal uncles of the women in whom these resource rights are currently vested.

Resource Tenure and Clan Leadership

The position of clan leader is tied to particular matrilineal lineages, which men inherit from their maternal uncles. Everyone knows his or her position in the clan and the identity of their clan leader. While clan leaders exercise a considerable level of authority over the clan's resources, this control is not absolute, and they should consult with and gain the consensus of the senior men of their clan when making decisions regarding the clan's resources. Because of the authority of clan leaders in matters of marine resource tenure, it is critically important for TNC to involve clan leaders in all aspects of the design and implementation of proposed

MPA networks. Without their active support, it is unlikely that the MPA network will succeed or gain the widespread support of the broader community.

Closures

There are two types of closures commonly found in Kimbe Bay that have potential conservation benefits:

1. Permanent closures, usually associated with *masalai* (spirit) areas in river deltas, offshore reefs and islands.
2. Temporary closures following a death. Each is discussed briefly below.

Permanent closures usually apply to sites which are considered sacred because they are spirit-dwelling areas. Normally, everyone in the village understands that the area is sacred or *tambu* (taboo) and disregarding a *tambu* risks the health and well-being of the trespasser and their immediate families. Sometimes a site becomes *tambu* if there is an unusual sighting (e.g., of a sealion) or several drownings at a locality. People come to believe that a malevolent *masalai* inhabits the site, and so avoid the location in case they anger the spirit. However, with rising education levels there is evidence of a decline in these beliefs, with the result that commercially valuable marine resources such as beche-de-mer are being collected in some customary *tambu* areas.

Temporary closures following a death suspend rights of access to the marine resources of a particular area or feature such as a reef for periods ranging from several months to a year. Typically, such *tambu* sites are places where the deceased used to frequent (e.g., favourite fishing reef) and it is believed that the recently deceased's spirit inhabits these sites and is therefore dangerous to the living³. For the *tambu* to be lifted the deceased's sons, brothers and other relatives must host/fund a large communal feast for the community, and this takes time to arrange because of the large quantities of food required. To help accumulate food resources for the feast, a separate *tambu* on fishing may be placed on other sites to allow fish stocks to build up for the feast. When the feast is over the deceased's spirit departs and the *tambu* is lifted.

These temporary restrictions on access to resources following a death remain strong amongst the Nakanai peoples of Hoskins and Bialla, but are weakening amongst the Meramera (Ulamona, Lolobau and Baea) and Bakovi (Gaungo, Kulungi and Talasea) peoples. The important point for MPA planning and design is that restrictions on access to the marine resources at particular sites are not new to the coastal communities of Kimbe Bay. Thus, the notion of limiting access to high conservation value sites to conserve and build up resources, provides a platform on which to develop an understanding amongst the coastal community of MPA concepts and principles.

In summary, some general characteristics of marine tenure in Kimbe Bay are:

1. Marine tenure around most of the Bay is predominantly matrilineal except for a small area on Talasea Peninsula.
2. Access and use rights to marine resources remain largely dictated by principles of marine tenure which tend to be flexible and adaptable to the needs of villagers belonging to the customary group.
3. People often have tenure rights to marine resources in different parts of the Bay which extend beyond their village boundaries.
4. Clan and subclan members generally have relatively open access to marine resources for subsistence purposes.

5. There are no significant tenure disputes over marine resources in eastern Kimbe Bay.
6. In the western part of the Bay there are some concerns amongst resource owners over poaching of marine resources.

MARINE CULTURAL HERITAGE

Much of the cultural identity, beliefs, and *tumbuna* stories/myths (ancestral and spiritual stories) of the coastal communities of Kimbe Bay draw on elements of the marine environment. In several villages this knowledge of their cultural heritage is being lost (Box 3.3). In focus groups the following cetaceans and other marine fauna were discussed: whales, dolphins, dugongs, turtles and crocodiles.

The role of cetaceans in the cultural heritage and folklore of communities varies between species and across the Bay (Table 3.1). Whales do not appear to hold a significant place in the marine cultural heritage of Kimbe Bay coastal communities (Table 3.1). Whale sightings were recorded by all study villages, although the study uncovered no *tumbuna* stories, songs or clan names relating to whales. The omission of whales in oral tradition may be due to the absence or infrequency of encounters people have had with whales.

Table 3.1. Cetaceans and cultural heritage.

Village	Whales hunted	Whales feature in <i>tumbuna</i> stories, songs, woodcarvings or clan names	Dugongs hunted	Dugongs feature in <i>tumbuna</i> stories, songs, woodcarvings or clan names	Dolphins hunted	Dolphins feature in <i>tumbuna</i> stories, songs, woodcarvings or clan names
KULUNGI	X	X	√*	X	X	√
GAUNGO	X	X	√*	X	X	√
TAROBI	X	X	√**	√	X	√
BAIKAKEA	X	X	√**	√	X	√
POTOU	X	X	X	√	X	X
BAEA	X	X	X	√	X	X

√ = yes X = no *hunting stopped due to reduction in sightings. **hunting banned following education awareness by TNC.

In contrast to whales, dugongs feature in the *tumbuna* stories of Tarobi, Baikakea, Potou and Baea villages (Box 3.1), but in some villages (Tarobi, Baikakea and Baea) these stories are being lost and/or are known only to a few elderly people. Until recently dugongs were hunted in all villages except Potou and Baea. In Tarobi and Baikakea villages where TNC has conducted education awareness, the community has agreed to ban dugong hunting. Gaungo and Tarobi villagers noted a slight fall in dugong sightings and this may also explain why the hunting and eating of dugongs no longer occurs or is very rare in these villages.

Box 3.1. Dugong *tumbuna* story, Lolobau Island

The people of Lolobau have a Dugong *tumbuna stori* and a song that follows from the story.

One day a mother was angry with her young daughter and scolded her in front of the mother's brother's wife. The young girl felt sad and ashamed that she had been scolded in front of her mother's in-laws and wanted to kill herself to end her misery. The opportunity came one day when her mother sent her to fetch salt water. The daughter took a water container and walked to the beach. When she arrived at the sea she decided to go to an outer reef to collect good salt water. In the meantime, the mother was waiting at the house for her young daughter to return with the saltwater.

When she didn't return, the mother went to the seafront to find her daughter to discover what was causing her delay. When the mother arrived at the seafront she spotted her daughter on the reef edge. The mother then called to her daughter to fetch the saltwater and return to the house. At that instant, the daughter dived into the deep sea and disappeared with a tail of a dugong splashing on the sea surface.

Therefore if you see a dugong, you will notice that they are just like humans, especially mothers, as dugongs also breastfeed and look after their young just like all mothers.

Recited by Robert Bia of Potou Village. Lolobau island.

Dolphin sightings are common throughout the year, and dolphins appear in the marine cultural heritage of the Bay. The significance of dolphins to the cultural heritage of the area is reflected in clan names and associated ancestral stories and songs. Dolphins are not hunted or eaten in the Bay. Similar to many other areas of the Pacific, dolphins are revered by people because of their power to rescue fishers at sea.

Several other marine fauna appear in the cultural heritage of the villages in the Bay. Although the list below is not comprehensive, other marine species that were found in the *tumbuna* stories, songs and legends or representing clan names in the surveyed villages included:

- Turtle (Baikakea, Potou, Baea).
- Eel (Gaungo, Tarobi, Baea).
- Puffer fish (*Ostracioa* spp) (Gaungo).
- Grouper (*Epinephelus* spp) (Tarobi).
- Shellfish (e.g., Vegi and Ravulu) (Box 3.2).
- Giant Clam (Tarobi).
- Squid (Potou).
- Crocodile (Gaungo, Tarobi, Baikakea, Baea).

Generally, where a marine species represents a clan name or totem, members of the clan do not eat the species. Eating the species of the clan name is taboo because it is perceived to be equivalent to eating your ancestors, which can cause misfortune or illness to befall the individual or clan as a whole.

Box 3.2. Ravulu shellfish *tumbuna* story, Kulungi Village.

Ravulu is a special shellfish found in the Numondo floodplain area between the Pusiki river delta and Nambodu River delta* The people of Kulungi believe that the great Daliavu/Kuludagi River in the past flowed through Pusiki and Nambodu until one day, Ravulu asked his cousin, Ture, if he could help him save his house that was beginning to be destroyed by the river. To help his cousin, Ture created a big earthquake which redirected the Daliavu/Kuludagi River to its current course. According to the people of Kulungi, if you go to the Numondo area between Nambodu Island (now known as Numondo Island) and the Pusiki river delta, you can see the old watercourse of the Daliavu/Kuludagi river. Therefore, some people of Kulungi do not eat Ravulu shellfish found in this area of the floodplain.

* Area now converted to oil palm plantation.

Apart from marine fauna, many marine physical features such as islands, reefs and lagoons have rich ancestral stories (Box 3.3). Typically, reefs are named after or have been named by ancestors, and sometimes *tumbuna* stories are attached to them. The marine environment is also made up of *masalai* sites associated with ancestral stories and particular beliefs. *Masalai* sites are generally avoided because the spirits dwelling in these sites can harm people. The belief in the power of *masalai* to cause harm is waning as young people become educated.

Box 3.3. The Valulu song and *masalai tumbuna stori* of Potou Village, Lolobau Island.

The following story recounts how Banban Island stone was broken into neat rows of stone pillars.

It is customary that first cousins respect each other, and this custom remains very strong today. If you hold food, protein (meat), money or anything else of value, you will have to give it or drop it if caught with it by your cousin.

In the past, parents on Lolobau Island chose the marriage partners of their children. However, one young girl didn't wish to marry the young man chosen by her parents. To improve the likelihood that the two would marry, the parents of both parties sat down together and hatched a plan that involved inviting all their relatives to Banban Island for a picnic (Banban is known as a nesting place for birds). The families paddled over to Banban Island and upon arriving, divided themselves into smaller groups: some men went to hunt birds, some went fishing, and some men built a hut while women went digging megapod eggs. The young girl was given a baby to look after while the women and men were away doing their tasks. However, while the girl was babysitting, the parents and relatives of the young girl and boy left the island silently in their canoes and headed back to Lolobau Island. It was getting dark and the young girl decided to return to the main camp where the men had earlier built a hut.

When she returned she discovered the food was cooked, the hut was completed but her parents and others were nowhere to be seen. Then suddenly, she heard a crackling sound and turned to see it was the boy her parents wanted her to marry. She was furious and ran to the beach with the baby to find a canoe to return to Lolobau Island. However, there were no canoes and the sun was setting much faster than she had expected and she returned with the baby to the camp. As dusk was approaching, the girl and young man heard the sound of people approaching. The trio hid inside the hut from where they witnessed a funeral ceremony for the young man's cousin who died at Potou Village a few days earlier. To their surprise the young man's cousin was leading the ceremony. The cousin was also surprised to see the trio and realising the urgency, quickly prepared some leaves and bark to give to them to rub on their skin, so that the devils didn't pick up their scent and kill them. To the dead, the trio would make a good meal for the feast. To ensure the trio were safe, the deceased cousin then sat at the corner where they were hiding so other devils didn't discover them. The ceremony went too long through the night, and weary from dancing the devils were caught by the sunrise and turned into pillars of rock. Below is the song sung during the night feast.

'Song'
Evah lona, evah lona
Pila, pila
Weh lona, liweh eh lona -eh
Lona liweh eh lona -eh

The couple lived on the island and had many children. One day, the husband decided to build a canoe to visit Lolobau Island with his children. On arrival he discovered that his parents and siblings were still alive.

(In the early 1980s Lolobau villagers performed the devil dance known as 'Evah Lona' at a cultural show at Ulamona. The people of Lolobau Island performed the last of these devil dances at Ulamona and their headdresses were made of fish assemblages such as Trevally, Tuna, Mackerel, etc. The headdresses were the same as those used in the dances referred to in the above story. After the dance ceremony, all headdresses were cast into the sea and it is said they washed up on the shores of Banban Island.

SUMMARY

The dominant tenure system governing both terrestrial and marine resources is matrilineal, with men inheriting rights from their maternal uncles. Land tenure is more spatially differentiated than marine tenure, partly because the planting of economic crops gives tenure rights to the cultivator. Marine tenure rights are also overlapping, so that people from major clans residing outside the village sometimes have access to the village's marine resources.

The overall system of marine tenure is quite flexible and adaptable and is able to accommodate the changing demographic circumstances and economic needs of village families. Whilst most villagers have unimpeded access to marine resources for subsistence purposes, there appears to be tighter control over access to commercial resources like beche-de-mer and trochus, though the degree of control appears to vary amongst villages.

Finally, there is a moderately rich marine cultural heritage amongst the Kimbe Bay community involving ancestral clan stories, *masalai* and *tumbuna* stories. However, with social and economic change there is evidence of an erosion of this cultural heritage.

NOTES

1. Kimbe Island is owned by Point Bulu (Buludawa and Bulumuri villages), but its ownership is contested by Kwalakessi and Casia villagers at Hoskins on the opposite side of the Bay.
2. The impact of second marriages on the resource tenure rights of children is important. Often when a woman remarries after the death of her first husband, the children will move to their deceased father's village to be cared for by his relatives. These children retain rights to their mother's resources, even though they live elsewhere.
3. Breaking of the *tambu* can lead to misfortune, illness and death befalling the individual (or a close family member). Nowadays, there is also the sanction of the village court, where offenders may be ordered to pay a fine.

4. SUBSISTENCE USE OF MARINE RESOURCES

INTRODUCTION

Chapters 4 and 5 present the key results from the household surveys conducted in the six study villages. The chapters describe each village in terms of the livelihood strategies pursued by village residents. This chapter discusses the utilisation of marine subsistence resources, while Chapter 5 describes the main terrestrial and marine cash income activities which sustain these communities.

Kimbe Bay coastal village communities rely on both land and marine resources to meet everyday sustenance and income needs. It is the balance of terrestrial and marine-based livelihood strategies that varies between villages. Overall, while terrestrial subsistence activities do not vary greatly amongst villages, the utilisation of marine resources and the types of cash income activities pursued reflect, to an extent, the degree of accessibility of each village as well as the particular assemblage of marine resources available to each village. Villages that are relatively remote from towns and markets tend to be more dependent on marine resources for their subsistence needs and cash incomes than those with high market accessibility. The one anomalous village in this accessibility schema is Gaungo Village where the survey profile suggests a much stronger fishing culture than would be anticipated on accessibility criteria. This is because the Gaungo sample consisted mainly of households residing in beachfront hamlets¹.

A ranking of the six villages from most accessible to least accessible would be as follows:

1. Kulungi (most accessible).
2. Baikakea.
3. Gaungo.
4. Tarobi.
5. Potou.
6. Baea (least accessible).

Two other key intersecting processes affect the use of marine resources in Kimbe Bay and they are important for understanding the context of change in the region. First, as highlighted in Chapter 1, is the very high rate of population growth in the oil palm belt of northern WNB. The second is the rising cash needs of villagers and their growing desire for modern consumer goods which are changing people's relationships with land and marine resources, leading increasingly to the commercialisation of natural resources throughout the Bay. Together the two processes are exerting dramatic pressure for change, a force that will continue to build with the rising material aspirations of this rapidly growing population.

Before describing each village's use of marine subsistence resources, a brief overview of marine activities by gender is provided.

LOCAL MARINE ACTIVITIES

In Kimbe Bay marine resource activities are distinctly gendered across marine habitat types, the range of species exploited and the techniques of catching/collecting marine resources (Table 4.1). Typically, men fish and dive for invertebrates on the outer reefs, engage in deep water fishing, night fishing and diving, and use fishing spears and spearguns. Women

dominate shellfish collection in the inshore areas and inner reefs, mangroves and estuarine habitats and fish from canoes close to shore and use scoop nets in shallow water. Women also harvest seaweed, crustaceans and other invertebrates in the near-shore coastal habitats and inner reefs.

Table 4.1 Marine activities by gender across Kimbe Bay

GENDER	MARINE ACTIVITY	HABITAT	EQUIPMENT
MALE	Deep dive fishing (day and night)	Seagrass beds, inner and outer reefs and islands.	Diving torch, fishing gun, spear, canoe, boat with outboard motor, pocket knives, paddle.
	Fish trolling	Outer reefs, open ocean, river delta and islands	Hooks and lines (of various sizes), outrigger canoe, boat with outboard motor, pocket knives, paddle, bait.
	Bottom-line fishing (jigging)	Open sea, inner and outer reefs and outer islands.	Hooks and lines (of various sizes), outrigger canoe, boat with outboard motor, pocket knives, paddle, bait and small stones or leaded bolts.
	Collecting trochus	Sea bottom, inner and outer reefs, and outer islands.	Bag, diving goggles and diving torch.
FEMALE	Gleaning and diving for shellfish	Mangroves, estuaries, rivers, seagrass beds, inshore tidal zone and inner reefs.	Canoe, pocket knives, dish, basket or bag.
	Harvesting seaweed/sea grapes and collecting crustaceans	Seagrass beds, mangroves and inshore reefs.	Canoe, pocket knives, dish, basket or bag.
	Net fishing	Beach, inshore tidal zone	Hand net, basket or bag.
SHARED MALE/FEMALE	Collecting beche-de-mer	Estuaries, seagrass beds, inner and outer reefs and islands.	Canoe, pocket knives, dish, basket or bag.
	Inshore fishing	Inner reefs and estuaries.	Diving torch, fishing gun, spear, canoe, boat with outboard motor, pocket knives, paddle.
	Netting	Inner reefs, seagrass beds and estuaries.	Seine net.

Typically, women do not go fishing on their own, and only occasionally do they use handlines in rivers, estuaries and inshore reefs. The exception is Potou Village where women regularly fish alone. More commonly, women will use small hand nets to catch fish in the inshore zone or will accompany their husbands and/or larger family groups in netting or harvesting activities. Sometimes a husband and wife team will go out on the canoe and the wife will paddle while the husband dives for trochus, beche-de-mer or to spear fish. This practice is more common among newly married couples who as yet have few young dependants. With the arrival of children, the wife's activities are restricted to shore. Seasonal fishing trips where extended families camp at favoured fishing spots for days or weeks, although still occurring, are not as common as in the past due to other demands on people's time such as cash cropping, school attendance and employment.

CONSUMPTION OF FISH

Fish is a major dietary item in all six study villages. Despite the decreasing reliance on a subsistence-based economy, fish continues to be an important food item (Figure 4.1). In contrast to the coastal villages, fish sourced from Kimbe Bay is only a minor component of

the diets of villagers living a few kilometres inland, residents of oil palm land settlement subdivisions and urban residents (see Koczberski *et al.*, 2001).

The most frequently consumed fish species reported by coastal communities in declining order of importance were:

1. Trevally.
2. Mullet.
3. Rabbit-fish.
4. Tuna.
5. Surgeon Fish.

Trevally was consumed by 77% of households across all villages in the study, while Mullet was mentioned by half of sample households² (Figure 4.1). Interestingly, villagers did not classify shark and stingray as fish but identified them as “other marine species”. Therefore, it is possible that shark and stingray were under reported in the data on fish consumption and sales.

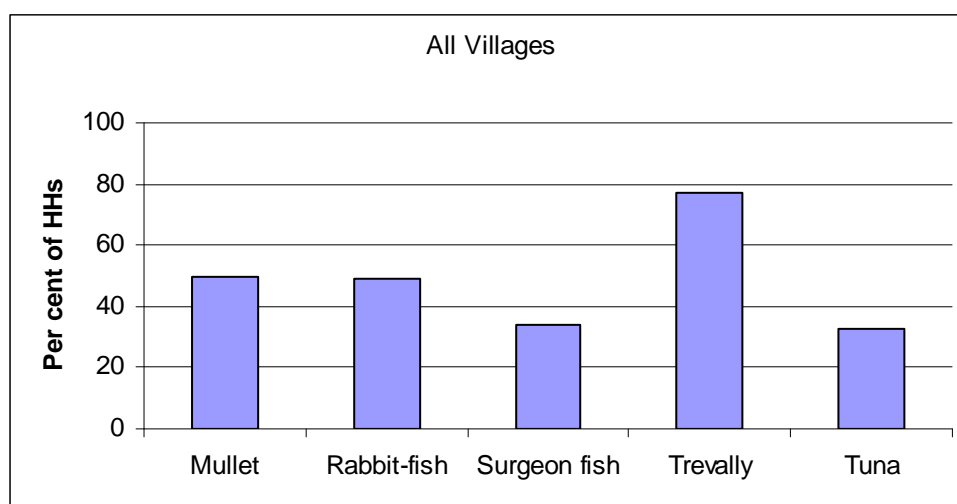


Figure 4.1. Most frequently consumed fish species across all villages.

There was considerable variation amongst villages in the frequencies of fish species consumed reflecting a mix of environmental, economic and accessibility factors. Trevally was common in diets across all villages, but Mullet was more common in the diets of people from villages near estuarine habitats. Around the mouth of the Dagi River, for instance, Gaungo villagers often use seine nets to catch Mullet, whereas at Potou Village on Lolobau Island, Mullet was not an important component of diets (Figures 4.1b to 4.1e). Tarobi, Potou and Baea villages consumed more of the larger pelagic species like Spanish Mackerel and Tuna than less isolated villages, probably reflecting the continuing importance of their fishing cultures.

It is important to note that fish consumption does not necessarily equate with fishing intensity or reliance on fish as a subsistence resource. For example, whilst fish is consumed regularly by Kulungi villagers, a significant proportion of the fish consumed was purchased/bartered or received as gifts from their neighbours in the migrant settlements of Gigo and Laleki, where fishing is the dominant livelihood activity of residents. Kulungi villagers have largely abandoned fishing as a subsistence strategy and fishing had not emerged as a significant source of cash income (see below and Chapter 5 for further discussion).

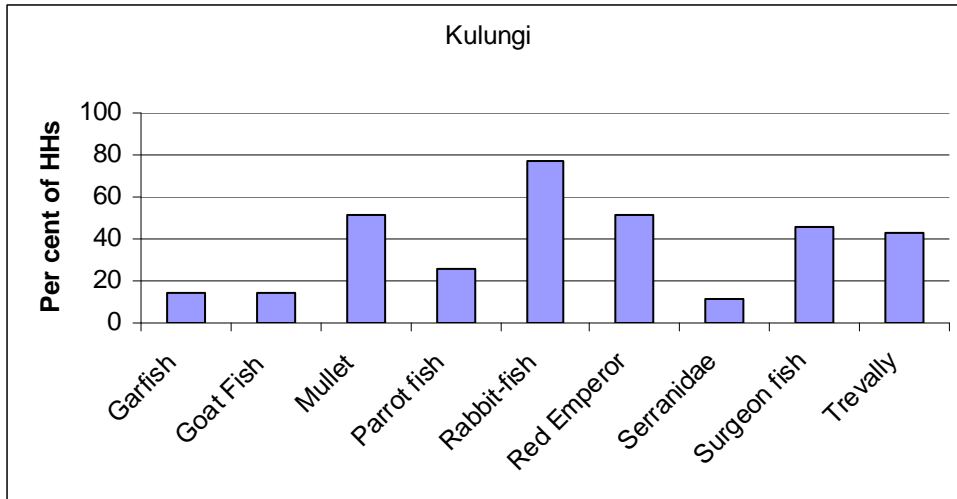


Figure 4.1a. Most frequently consumed fish species in Kulungi Village.

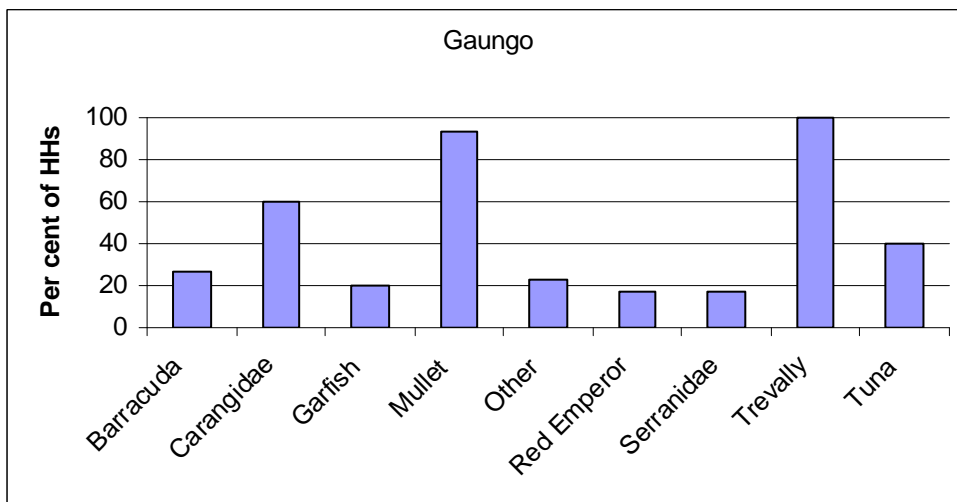


Figure 4.1b. Most frequently consumed fish species in Gaungo Village.

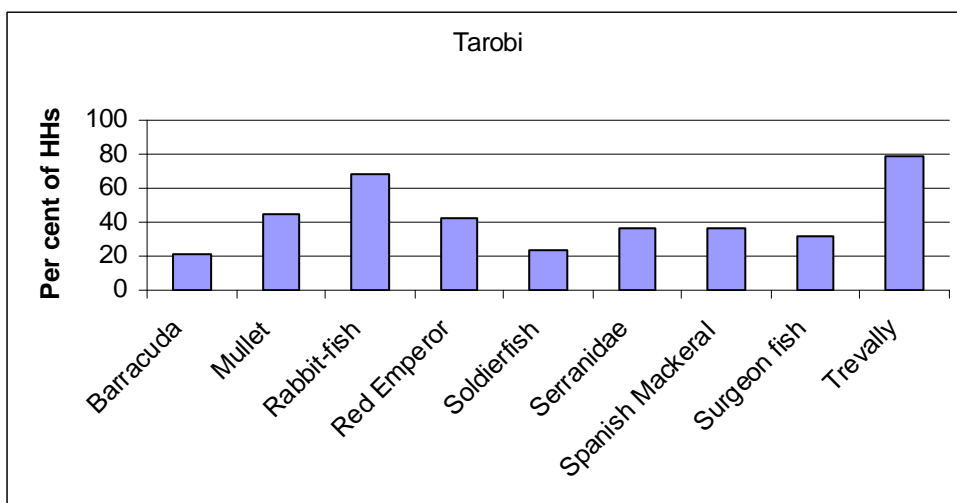


Figure 4.1c. Most frequently consumed fish species in Tarobi Village.

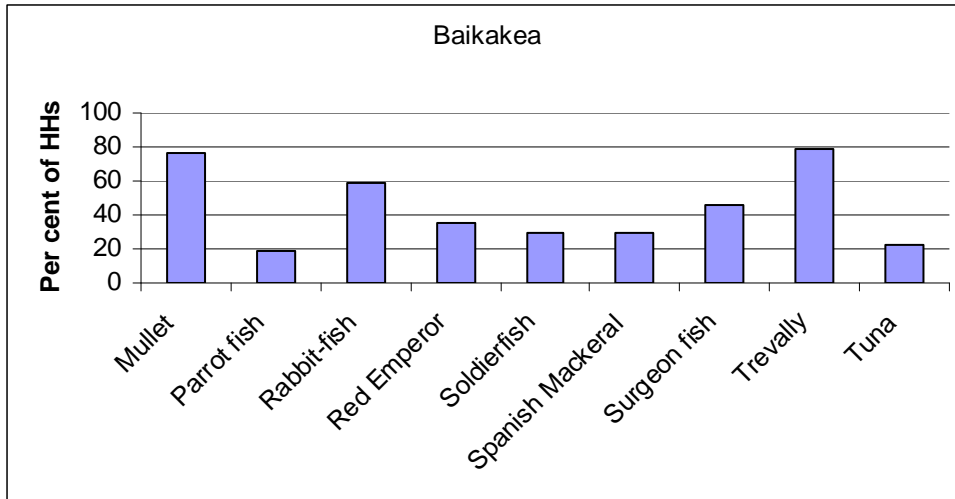


Figure 4.1d. Most frequently consumed fish species in Baikakea Village.

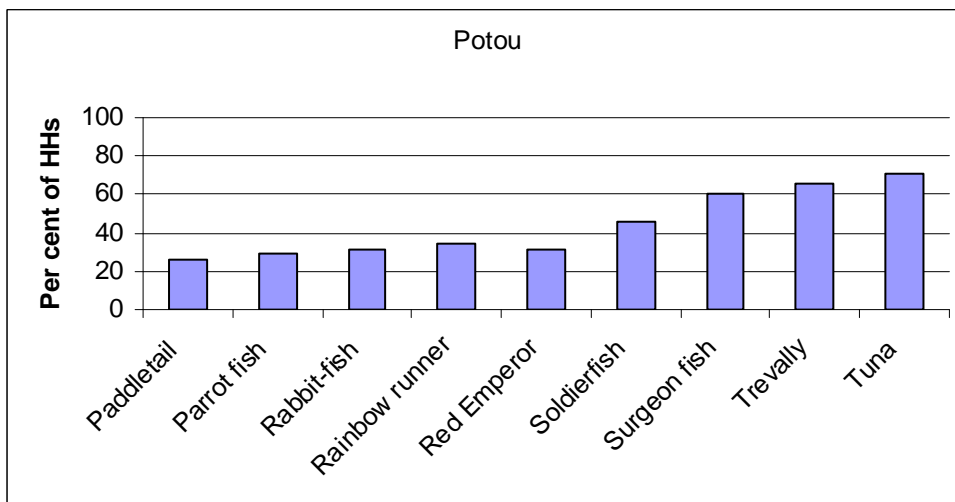


Figure 4.1e. Most frequently consumed fish species in Potou Village.

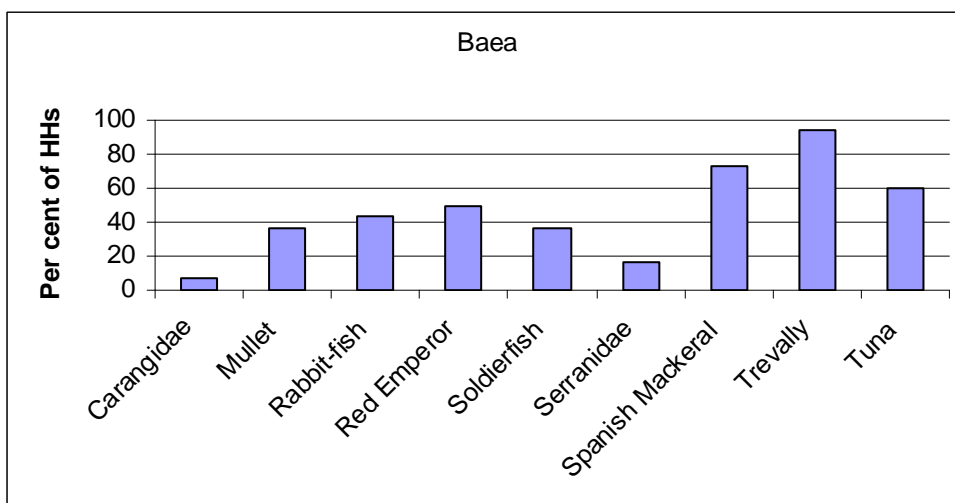


Figure 4.1f. Most frequently consumed fish species in Baea Village.

FISHING FREQUENCY

Fishing frequency provides a measure of the relative importance of fishing in villagers' subsistence livelihood strategies and is an indication of fishing intensity. Not surprisingly, dependence on fishing as measured by fishing frequency is strongly associated with the degree of accessibility of each village (Figure 4.2). With the exception of the sample from Gaungo Village which, as pointed out in the introduction to this chapter, was biased towards fishing households, fishing frequency (or fishing intensity) increases as village accessibility declines (Figure 4.2).

It is apparent from Figure 4.2 that Kulungi can no longer be considered a fishing village. Their livelihood strategies are more strongly based on terrestrial resources than the other five villages in the study, and villagers tend to purchase rather than catch fish. The very high fishing frequency recorded for Gaungo, while reflecting a biased sample, illustrates an important point applicable to all the coastal villages: fishing frequency/intensity does not decrease uniformly across all village households as a broader range of income alternatives becomes available as accessibility improves, but rather certain households gradually drop out of fishing leaving a smaller number of households engaged predominantly in fishing. For instance, it is probable that there are still a few households in Kulungi for whom fishing is their primary livelihood strategy.

The relationship between accessibility and fishing frequency/intensity is illustrated further by Baikakea Village where traditionally a strong fishing culture existed. However, a high level of accessibility to plantation compounds and Bialla town, and relatively good roads has reduced villagers' reliance on marine resources as a range of terrestrial-based income opportunities became available. Many young people do not fish as often as the older generation did in the past when they were highly dependent on marine resources for their livelihoods. Today, young people find jobs with the milling company (e.g., as drivers) or have their own oil palm blocks.

In the more remote villages of Tarobi, Potou and Baea where income from fish is important (Chapter 5), people claim that the fortnightly payday of the companies structures fishing activities both for subsistence and income generation. People will go fishing in the days leading up to a fortnightly payday but will not bother fishing for subsistence purposes in non-pay weeks. In other words, villagers intensify their fishing activities on pay weeks and reduce them in non-pay weeks. Fish consumption therefore also tends to be concentrated in pay weeks.

Households that Fish Regularly

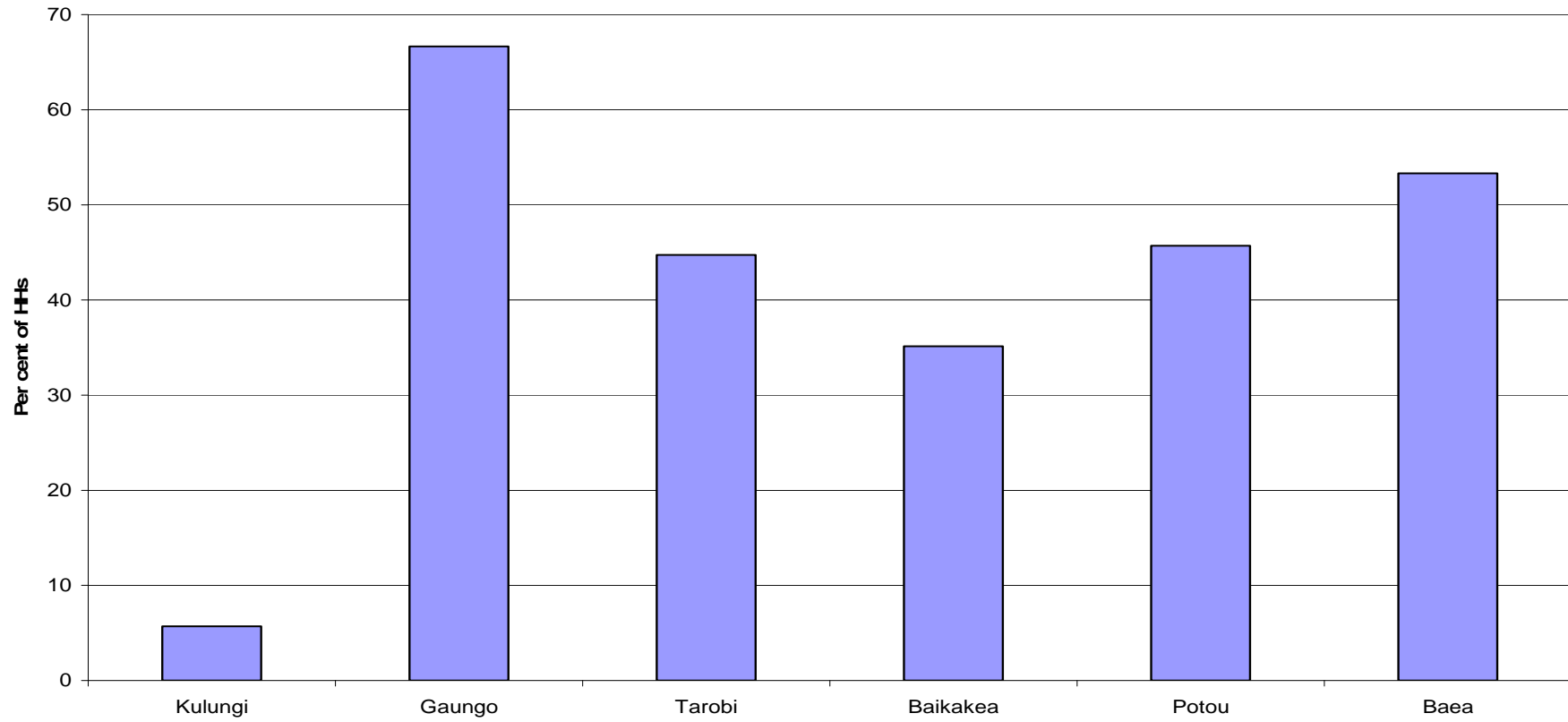


Figure 4.2. Percentages of households in each village that fish once a week, or more than once a week on a company pay week.

(Note: the figure for Gaungo is inflated because families living near the beach interviewed.)

FISHING EQUIPMENT

Villagers have access to a wide range of equipment to exploit marine resources including fishing spears and guns, nets (seine, gillnet and scoop nets), crowbars, axes, various traps, pressure lamps for night fishing, canoes and boats powered with outboard motors (Figure 4.3a-4.3f). Households also have access to a range of illegal and environmentally damaging fishing equipment such as bush poisons, manufactured chemicals (e.g., herbicides and pesticides) and dynamite. Although not shown in Figure 3.3, fishing lines and hooks were ubiquitous and nearly every household owned at least one handline and hook.

With the exception of Kulungi Village, the majority of sample households possessed several items of fishing equipment. The mean number of fishing equipment per household in each village was associated with degree of accessibility of each village, level of fishing intensity as well as reflecting the type of marine habitats present in or near the village. For example, household ownership of canoes and boats in declining order of highest to lowest rate per household were: Baea (2.4 per household), Tarobi, Potou, Gaungo, Baikakea and Kulungi (0.6 per household). Ownership rates of nets are more related to the type of fish species commonly exploited in each village. For instance, the beachside hamlet at Gaungo had the highest rate of fishing net ownership (Figure 4.3b); it also had the highest rate of Mullet consumption (Figure 4.1b), a species commonly exploited in estuarine habitats with nets.

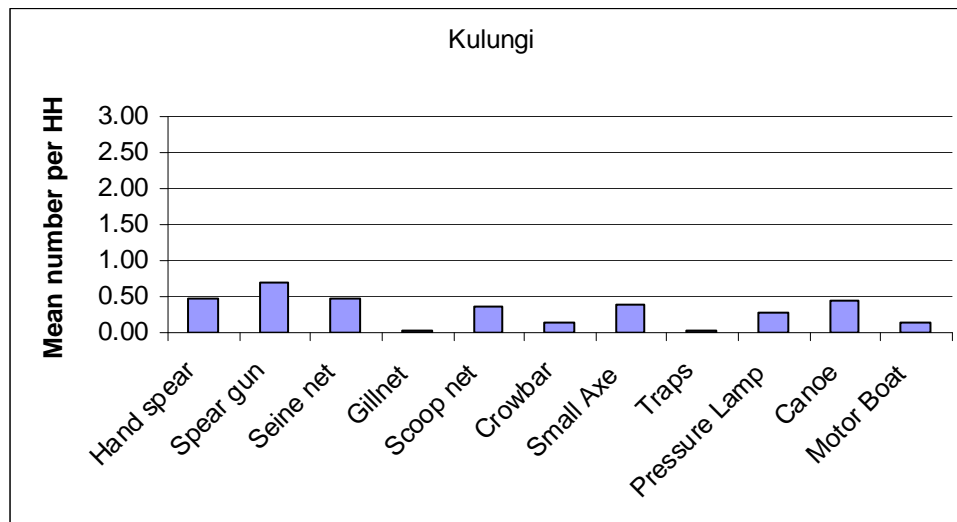


Figure 4.3a. Mean numbers per household of items of fishing equipment in Kulungi Village.

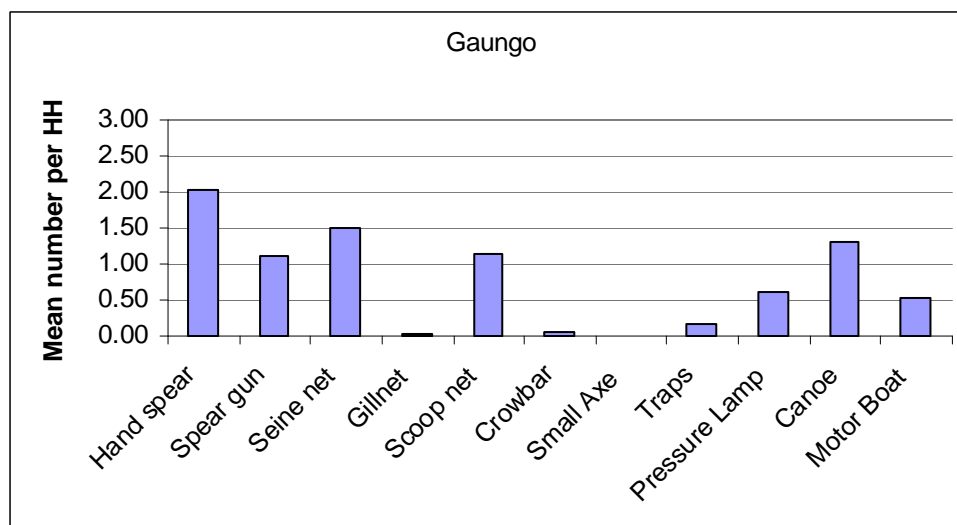


Figure 4.3b. Mean numbers per household of items of fishing equipment in Gaungo Village.

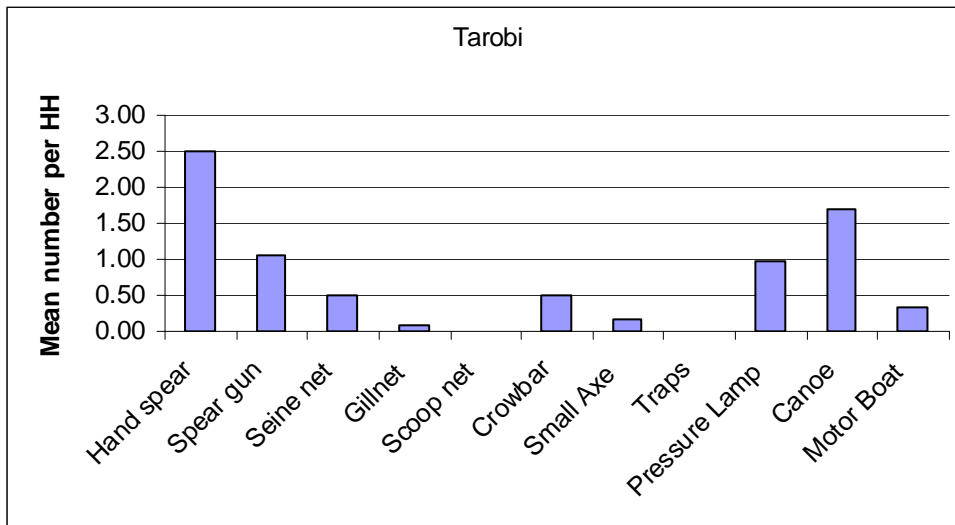


Figure 4.3c. Mean numbers per household of items of fishing equipment in Tarobi Village.

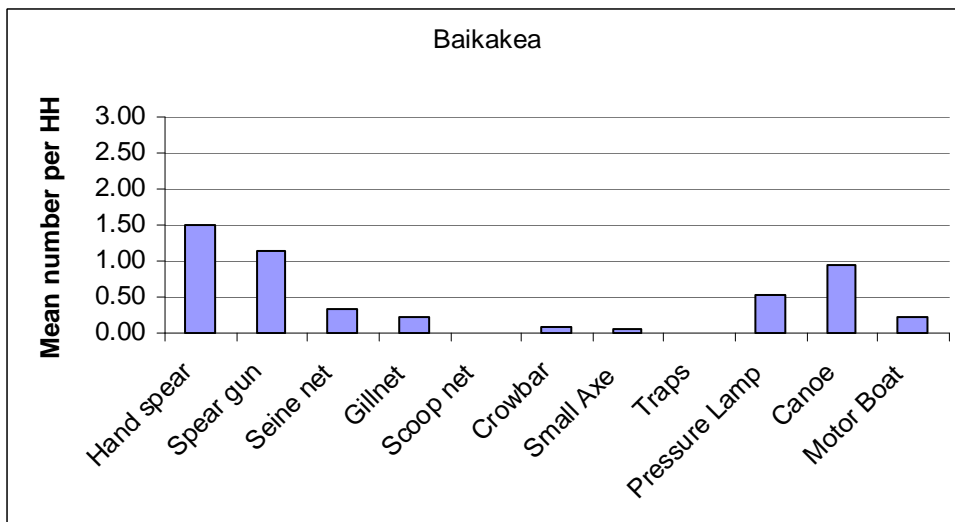


Figure 4.3d. Mean numbers per household of items of fishing equipment in Baikakea Village.

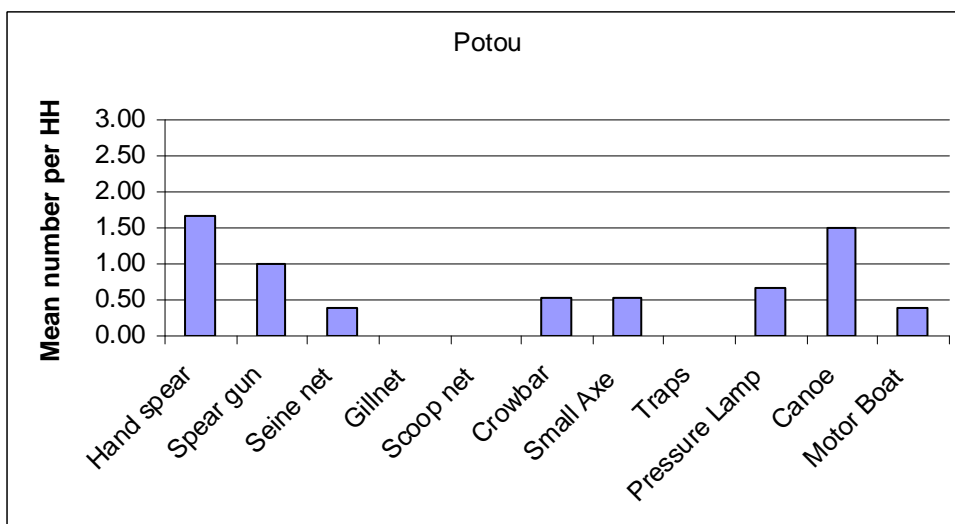


Figure 4.3e. Mean numbers per household of items of fishing equipment in Potou Village.

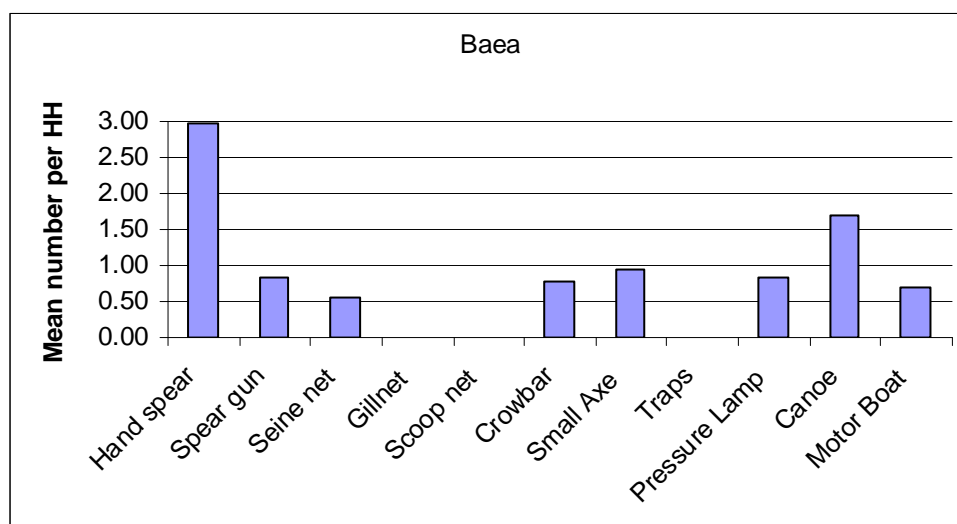


Figure 4.3f. Mean numbers per household of items of fishing equipment in Baea Village.

Table 4.1 shows the proportional breakdown of fishing techniques used in each village as reported by villagers. The table provides information about the relative importance of different fishing methods *within* each village. Care must be taken in interpreting this table because the data do not indicate fishing frequency or intensity. For example, all fishing techniques used in Kulungi, with the possible exception of dynamite, are used much less frequently than in all other villages surveyed.

Table 4.2. Percentages of reported fishing techniques used in each village.

METHOD	KULUNGI	GAUNGO	TAROBI	BAIKAKEA	POTOU	BAEA
Jigging	11	31	50	41	48	65
Trolling	0	0	0	0	20	7
Nets (seine & gill)	21	58	3	24	2	7
Spear (hand & gun)	60	10	46	30	28	18
<i>Posin rop</i>	5	0	1	3	2	2
Dynamite	2	0	0	0	0	0
Other	1	1	0	2	0	1
TOTAL	100	100	100	100	100	100

Jigging, or bottom fishing, from stationary boats or canoes was strongly represented in the suite of fishing techniques of Tarobi, Potou and Baea villages where fishing was an important source of household income. In descending order of importance in the fishing techniques of each village, the village ranking for jigging was:

1. Baea.
2. Tarobi.
3. Potou.
4. Baikakea.
5. Gaungo.
6. Kulungi.

Trolling was reported in only two villages, Potou and Baea, the only two villages without road access and therefore highly dependent on motorised boats for transport (Table 4.2). Trolling was an incidental activity for these villages and would be employed only when passengers or cargo were being ferried to and from these villages. Motorised boat trips solely for the purpose of trolling cannot be justified on cost grounds, probably explaining why trolling was not reported in any village with road access.

Nets were important in the suite of fishing techniques at Gaungo and Baikakea; the villages with access to estuarine habitats (Table 4.2) (Plates 4.1 and 4.2). As discussed above, the estuarine habitat at the mouth of the Dagi River attracts large schools of Mullet and other fish which, at times, are an important subsistence and cash income source for villagers.



Plate 4.1. Fishing nets drying at Gaungo Village © J. Warku.



Plate 4.2. Scoop net, Gaungo Village © J. Warku.

It is possible that destructive fishing techniques such as the use of derris root and dynamite were under-reported in the household surveys. For example, whilst few people openly admit to using derris root, most would say they know people in the village who use it (see Chapter 6).

CONSUMPTION OF SHELLFISH

Shellfish collection is strongly gendered (Table 4.1). Apart from the collection of trochus for sale to commercial buyers which is predominantly undertaken by men and boys, shellfish collection for home consumption is carried out regularly by women and young children. It is also a communal activity in which groups of women and their young children collect shellfish together, sometimes cooking a portion of the catch on the beach before returning to the village.

Shellfish were an important food item in all six study villages and they continue to be collected and consumed regularly even in those villages with relatively high cash incomes (Figures 4.4 and 4.5). Compared with fish catches, a much larger proportion of shellfish meat is for subsistence purposes rather than for cash income generation. In declining order of importance, the most important types of shellfish consumed across all villages were: Kina, *Strombus* spp, Burrowing Giant Clam and Ark Clam (Figure 4.5).

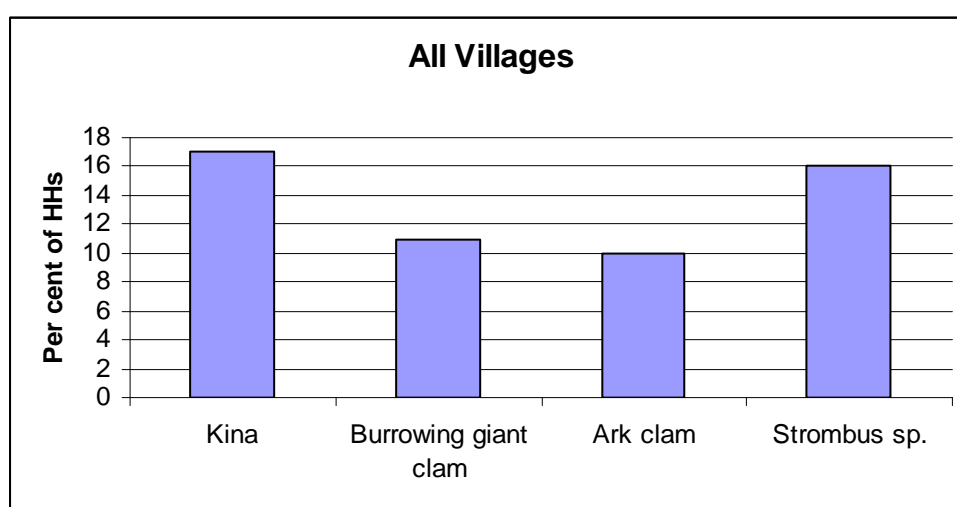


Figure 4.4. Most commonly reported shellfish consumed across all villages.

A wide range of shellfish species was consumed in all villages. The five most commonly reported shellfish consumed in each village are listed in Table 4.3 from most (“1”) commonly consumed to fifth (“5”) most commonly consumed. Several shellfish were not scientifically identified or specimens collected, hence only their local language names are given in Table 4.3.

Interestingly, a high proportion of Potou households reported consuming trochus, a species sold commercially for its shell. The meat is a by-product of shell collection where the primary purpose is to generate cash income from the sale of shell. Similarly, Kina which is found in mangroves was a commonly consumed shellfish in all villages except Potou (no mangroves) perhaps because the shell is processed and sold as lime, an accompaniment to betel nut.

Table 4.3. The top five most frequently consumed shellfish in each village* (per cent of households in brackets).

SHELLFISH	KULUNGI	GAUNGO	TAROBI	BAIKAKEA	POTOU	BAEA
Ark Clam	1 (97)	3 (63)	4 (58)	2 (73)	4 (40)	
Burrowing Giant Clam			2 (79)		2 (91)	2 (97)
<i>Gafrarium pectinatum</i>				5 (49)		
Goh (unidentified)			3 (68)	4 (54)		5 (33)
Kina Shell	2 (77)	1 (90)	1 (95)	1 (92)		1 (100)
Kitope (large bivalve unidentified)		3 (63)				
Kovakova (small bivalve unidentified)		4 (47)				
Rugose Giant Clam	2 (77)					
<i>Strombus Luhuanus</i>	3 (57)		5 (55)		3 (74)	4 (47)
<i>Strombus</i> sp.	4 (51)	2 (87)		3 (62)	3 (74)	3 (73)
Trochus Shell					1 (97)	

* 1 = most frequently consumed shellfish; 5 = fifth most consumed shellfish.

Whilst shellfish collection is a common activity of women in all villages, the frequency of shellfish collection is negatively correlated with village accessibility (Figure 4.5). Villages more remote from urban centres, labour compounds or with poor or no road access appear to be more dependent on shellfish for subsistence food requirements than more accessible villages where there is a greater range of potential income sources and access to retail outlets. The village ranking of frequency of shellfish collection from least frequent to most frequent was: Kulungi, Baikakea, Gaungo, Tarobi, Baea and Potou.

There are two possible explanations for the reduced frequency of shellfish collection when accessibility improves. First, better accessibility may mean that shellfish resources are initially over-exploited (for sale at local markets or by outsiders) to the point that their declining abundance serves as a disincentive for women to invest their labour in shellfish collection. An alternative explanation, and perhaps working simultaneously, is that improved accessibility widens the range of potential income sources for women, leaving shellfish collection relatively less attractive than the new options that become available. Also, some of the new income activities associated with improved accessibility make demands on women's time (e.g., selling at local markets and cash crop production) thus limiting time available for shellfish collection. That women seem to reduce the amount of time they spend collecting shellfish when accessibility improves, suggests that some of the new options are preferable to shellfish collection.

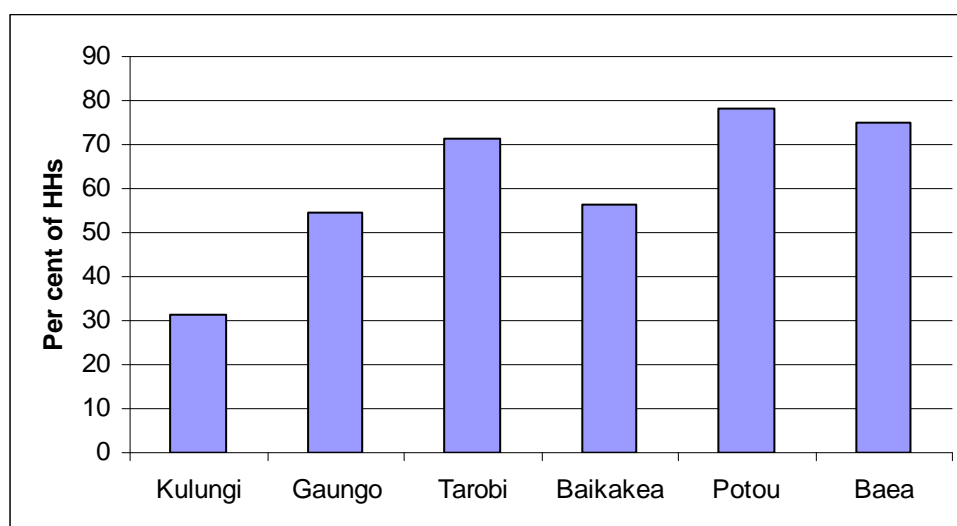


Figure 4.5. Percentages of households in each village collecting shellfish once a fortnight or more frequently.

Most shellfish were collected by hand without the use of tools (Table 4.4). Axes, crowbars, knives and digging sticks were used occasionally, and the use of axes/crowbars was reported at Baea, Kulungi and Tarobi villages.

Table 4.4. Most common methods of shellfish collection in each village (per cent of households).

METHOD	KULUNGI	GAUNGO	TAROBI	BAIKAKEA	POTOU	BAEA
Axe/Crowbar	18	4	12	1	11	16
Knife	4	2	2	1	7	4
Dig/Collect by hand	78	91	86	96	82	80
Dig with stick	0	4	0	2	0	0

CONSUMPTION OF OTHER MARINE PRODUCTS

Coastal villagers consume a wide range of marine products in addition to fish and shellfish (Figures 4.6a – 4.6f). The more commonly consumed marine products included seaweed, squid, crustaceans, turtle and beche-de-mer. There were also reports of dugong consumption in Tarobi Village and crocodile hunting at Tarobi and Baea. Tarobi villagers maintained that they have recently banned the hunting of dugong following advice from TNC.

Similar to the consumption of fish and shellfish products, the consumption of some other marine products is related to the accessibility of villages and habitat types. For instance, for turtle consumption the village ranking from most to least commonly consumed is: Baea, Potou, Tarobi, Baikakea, Gaungo and Kulungi. For some other marine products the consumption rankings are less clearly related to accessibility and are better explained by the particular assemblages of marine habitat types near each village.

The study is unable to conclude whether the high rate of consumption (and sale, see Chapter 5) of turtle in the more remote villages like Baea and Potou poses a threat to their local abundance. In focus group discussions in these villages (Chapter 6), people perceived a decline in their numbers. The possible decline in turtle abundance and reasons for their decline (e.g., sales of turtle meat at markets in workers' compounds) should be investigated further by TNC, including threats to their nesting sites.

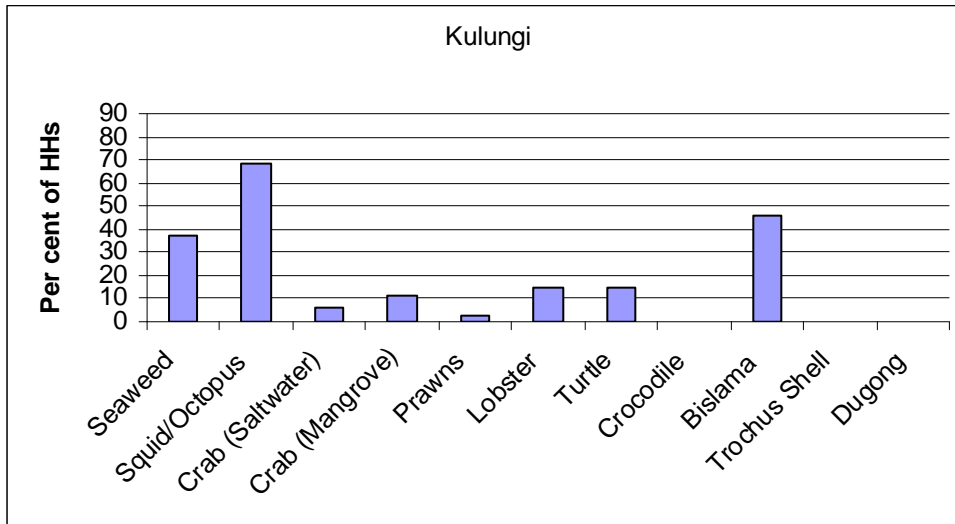


Figure 4.6a. Per cent of households at Kulungi Village consuming marine products other than fish and shellfish.

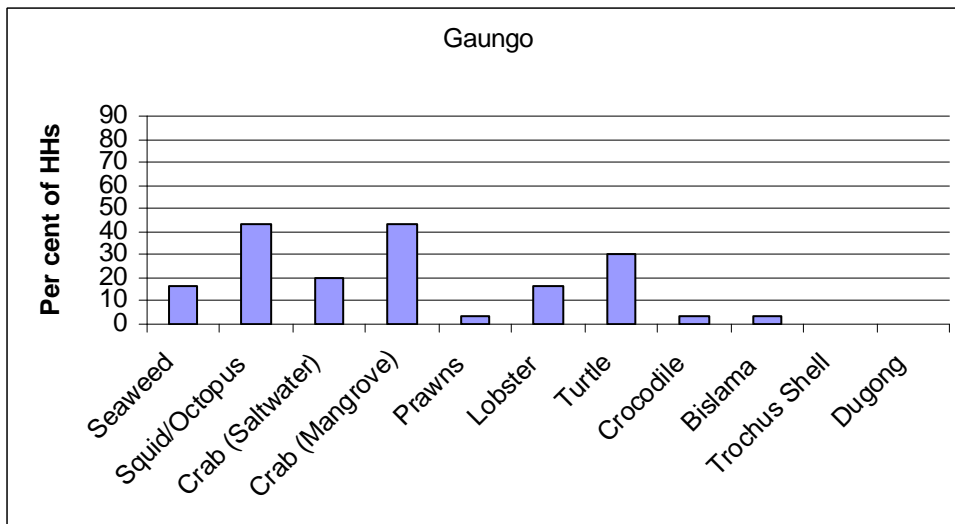


Figure 4.6b. Per cent of households at Gaungo Village consuming marine products other than fish and shellfish.

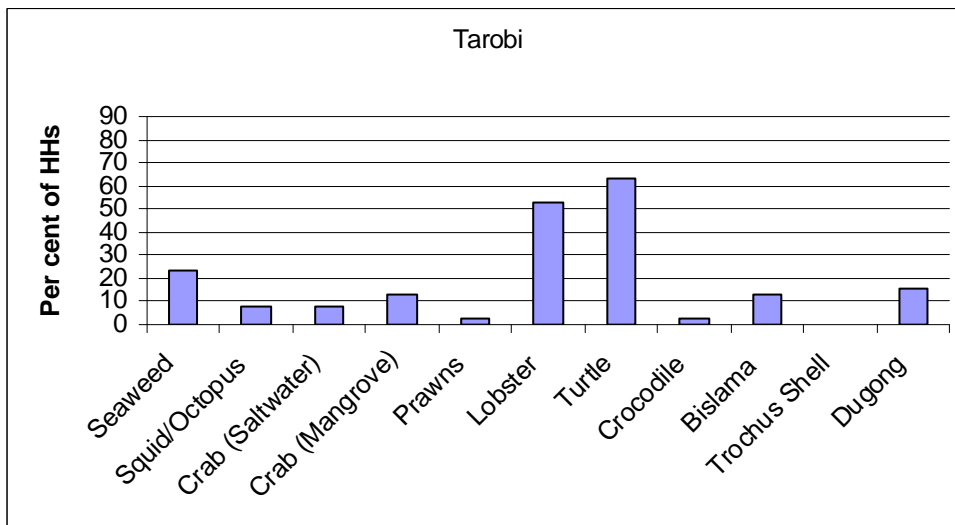


Figure 4.6c. Per cent of households at Tarobi Village consuming marine products other than fish and shellfish.

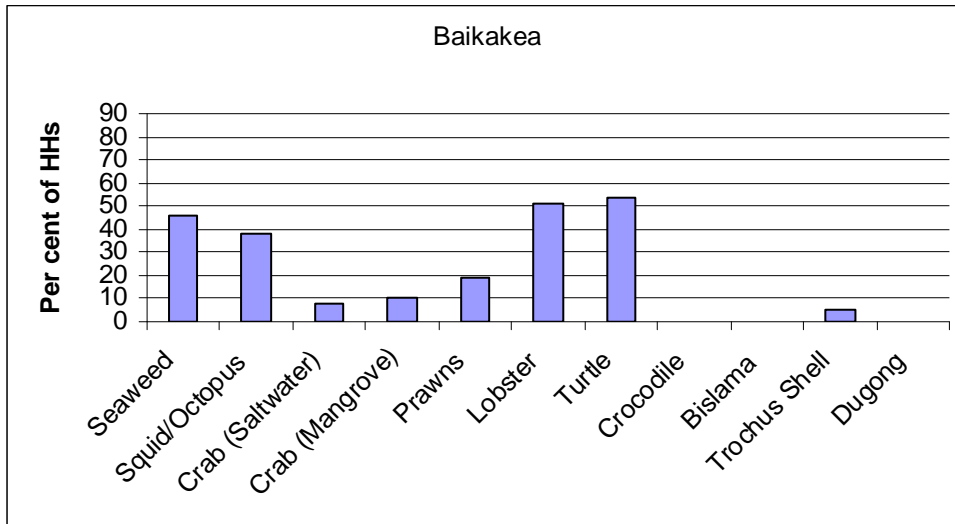


Figure 4.6d. Per cent of households at Baikakea Village consuming marine products other than fish and shellfish.

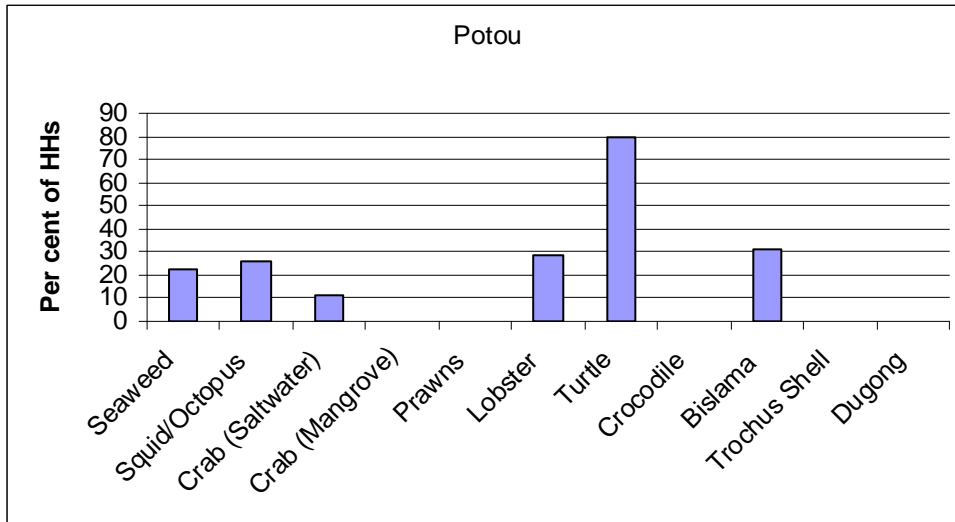


Figure 4.6e. Per cent of households at Potou Village consuming marine products other than fish and shellfish.

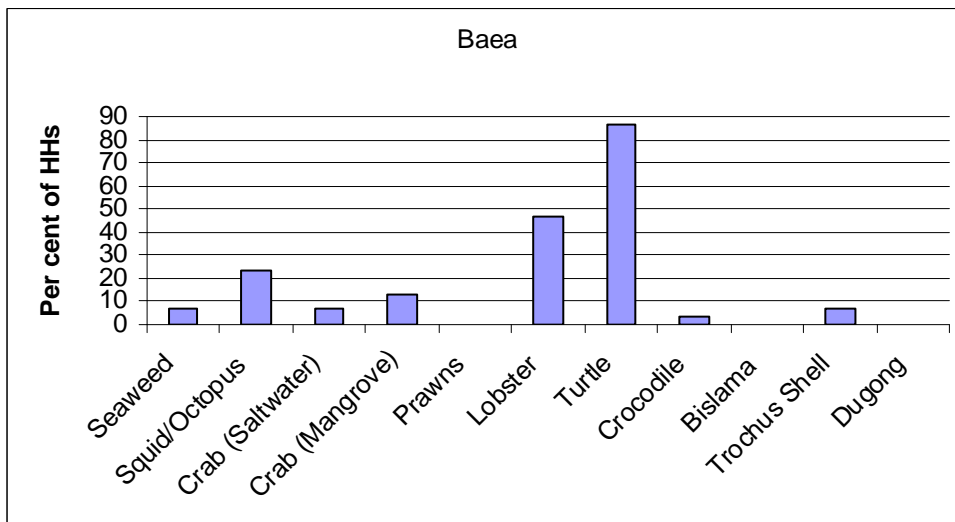


Figure 4.6f. Per cent of households at Baea Village consuming marine products other than fish and shellfish.

SUMMARY

Dependence on marine resources for subsistence tends to reflect the accessibility of villages, with more remote and isolated villages having greater reliance on marine resources (especially fish, shellfish and turtle) than more accessible villages. Site specific factors are also important as the range and quality of habitats present at each village also determines the subsistence resources available for exploitation.

The next chapter examines the cash income strategies pursued by each village.

NOTES

1. The Gaungo sample consisted mainly of households residing in the vicinity of the beachfront, and could therefore be considered more dependent on marine resources for their livelihoods than villagers living on their oil palm blocks. A significant proportion of Gaungo residents now reside on family oil palm blocks and this trend has been increasing over the years. These families are much more likely to pursue terrestrial-based livelihoods than families still living near the beach. Thus the data presented for Gaungo Village are probably biased towards households pursuing largely marine-based livelihood strategies.
2. Villagers often make a distinction between fish of the same species on the basis of size. For instance, small Trevally has a different name to large Trevally, and villagers associate the different sized fish with different habitats. (The same appears to be true of some shellfish species). Although this size classification was beyond the scope of the present study, it might provide a useful way to examine changes through time in the abundance of particular fish species by using local size categories associated with different habitat types.

5. MARINE RESOURCE USE & RURAL LIVELIHOODS

INTRODUCTION

This chapter describes the livelihood strategies pursued in each of the study villages to generate cash incomes. It complements Chapter 4 which examined the subsistence strategies of coastal villagers in terms of their dependence on marine resources. The chapter begins with a brief description of the main income sources for men and women in each village. This is followed by an assessment of the importance of marine resources for income generation in each village. Fish sales and the main outlets for marketing fish in each village are discussed, and other marine resources exploited for cash are identified in each village. A discussion of the main export cash crops in each village follows and their importance relative to marine-based sources of income. It appears there is an inverse relationship between dependence on export cash crops and exploitation of marine resources for cash income which relates to the accessibility of each village.

The chapter finishes with an overview of income sources other than export cash crops and marine resources. It is evident that like marine resources and export crops, the other income strategies pursued by villagers are influenced strongly by the level of village accessibility. Finally, it is also clear that villagers pursue a diverse range of livelihood strategies to generate incomes for their families. The notion that a villager is solely a cocoa farmer, oil palm grower or a fisher does not reflect the reality of the very diverse livelihood strategies pursued by most village families.

CASH INCOMES

Men and women were asked to rank their four main sources of cash income. The most frequently top ranked income sources by gender for each village are listed in Table 5.1, which also shows the accessibility ranking of each village. Oil palm/cocoa was the most frequently top ranked income source for both men and women in the three most accessible villages of Kulungi¹, Baikakea and Gaungo. For Tarobi Village, fourth on the accessibility ranking, oil palm was the most frequently top ranked income source for men and beche-de-mer for women. Fish was the most frequently top ranked income source for both men and women in the two most isolated villages of Potou and Baea (Table 5.1).

Table 5.1. The most frequently ranked top income source for men and women.

VILLAGE	ACCESSIBILITY RANKING*	PAPA	MAMA
Kulungi	1	Cocoa	Oil Palm
Gaungo	3	Oil Palm	Oil Palm
Tarobi	4	Oil Palm	Beche-de-mer
Baikakea	2	Oil Palm	Oil Palm
Potou	5	Fish	Fish
Baea	6	Fish	Fish

* 1 = most accessible; 6 = least accessible.

Figure 5.1 shows the most frequently ranked top four income sources for men and women in each village. In general, income sources which featured high in the rankings reflected the accessibility as well as the resources of each village. For instance, dry coconuts are an

important income source for women in the villages of Kulungi (Figure 5.1a) and Baikakea (Figure 5.1d), two villages with access to large markets: the former close to Kimbe town and on the main road; the latter in close proximity to Bialla, Wilelelo LSS and several plantation compounds.

Garden food, which has high transport costs relative to value, was an important income source for women from Kulungi (Figure 5.1a) and Gaungo (Figure 5.1b), two villages near major roads. Betel nut, a high value to volume/weight crop, was a significant income source for women in remote villages like Tarobi (Figure 5.1c), Potou (Figure 5.1e) and Baea (Figure 5.1f), and to a lesser extent in the more accessible village of Gaungo (men reported it as an income source in Gaungo).

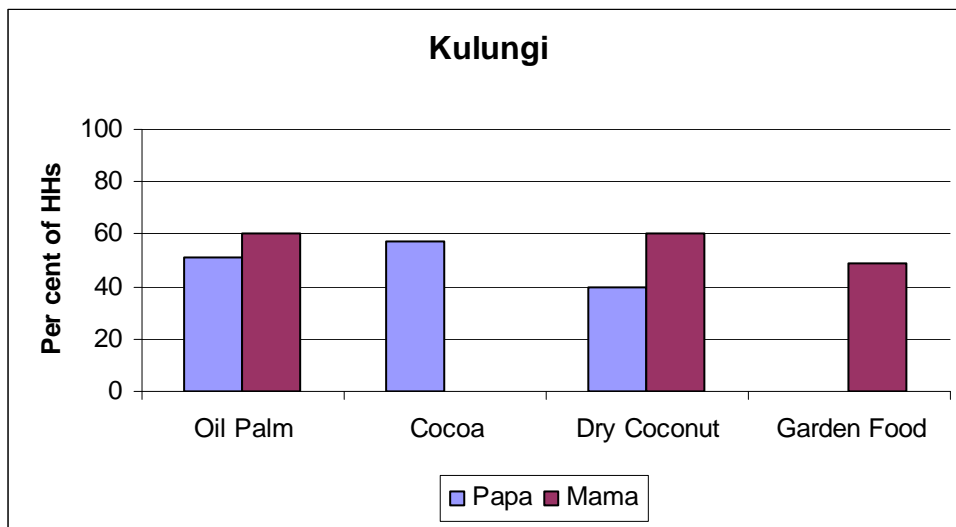


Figure 5.1a. Top four income sources in Kulungi Village for men and women (per cent of households).

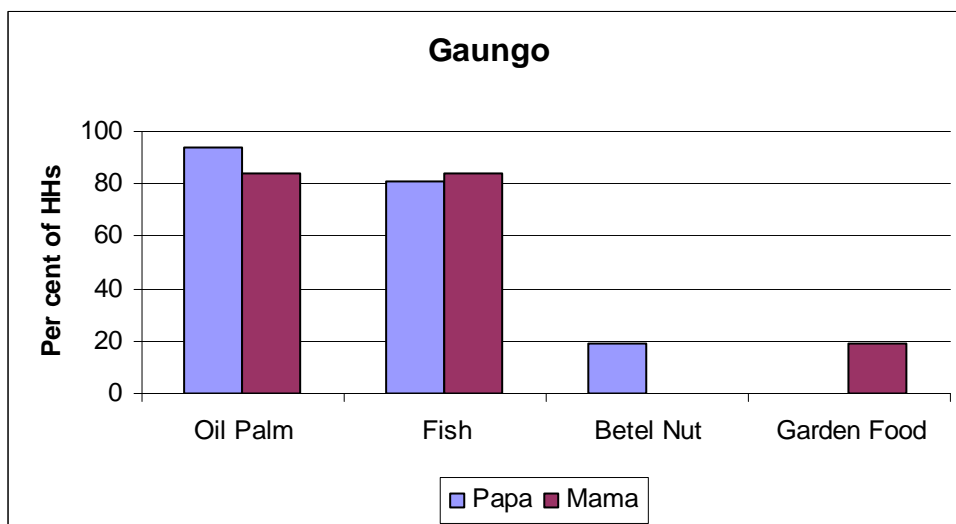


Figure 5.1b. Top four income sources in Gaungo Village for men and women (per cent of households).

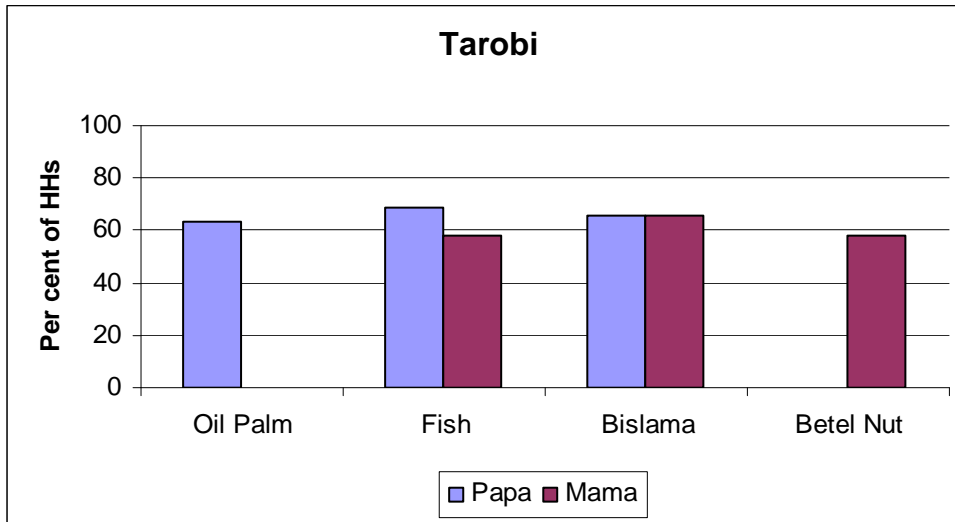


Figure 5.1c. Top four income sources in Tarobi Village for men and women (per cent of households).

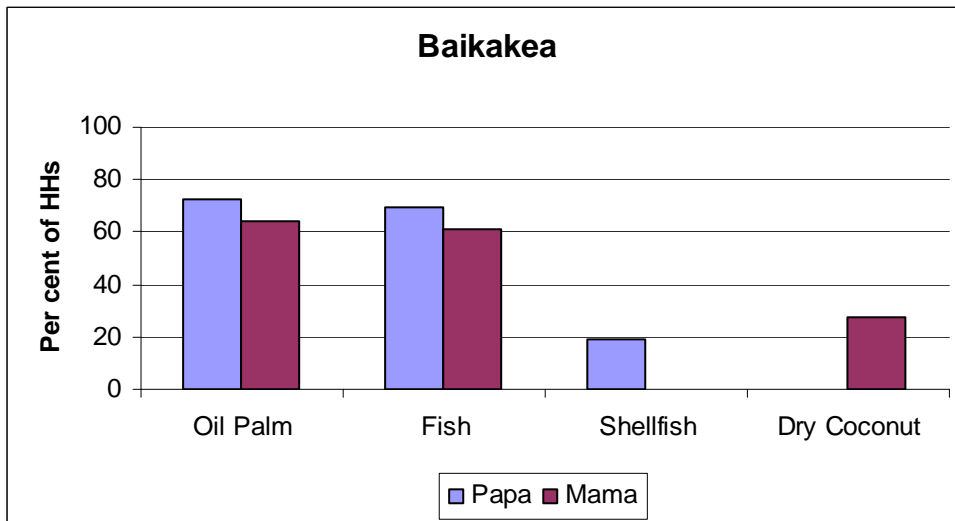


Figure 5.1d. Top four income sources in Baikakea Village for men and women (per cent of households).

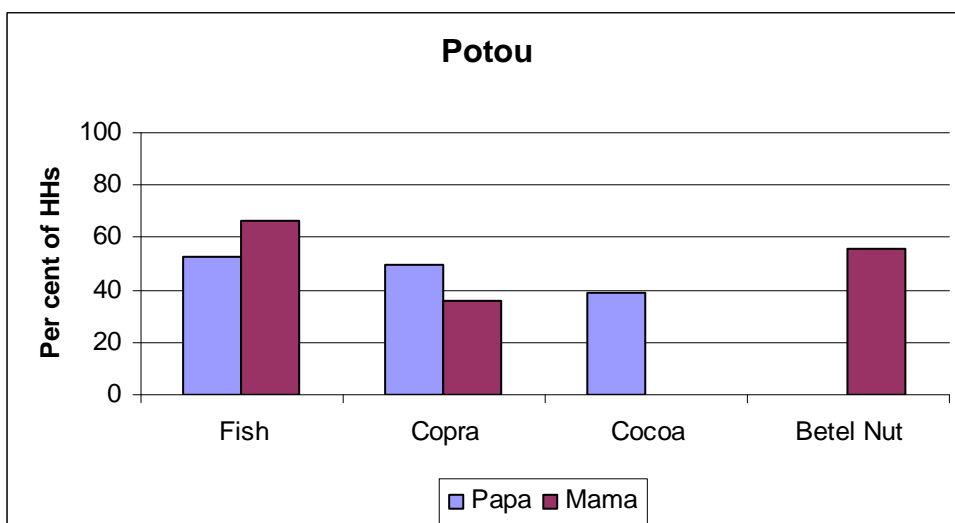


Figure 5.1e. Top four income sources in Potou Village for men and women (per cent of households).

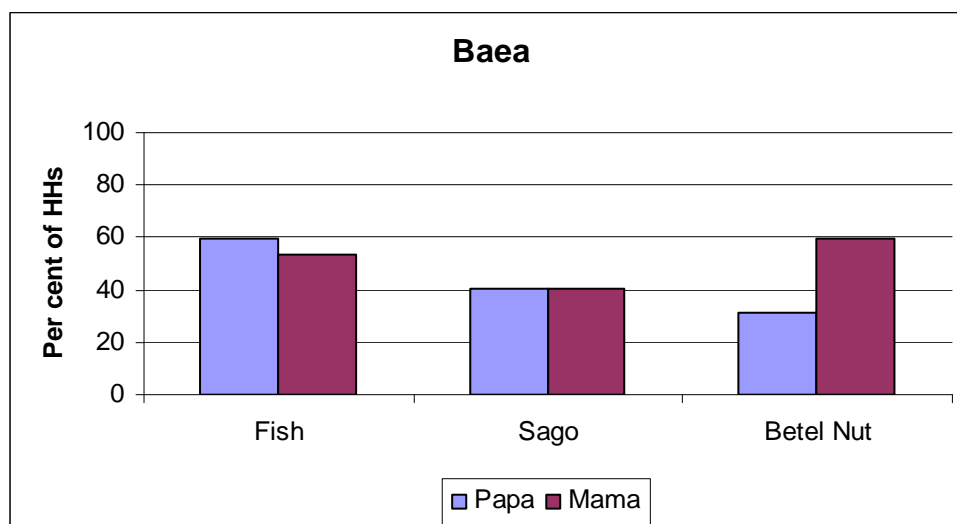


Figure 5.1f. Top four income sources in Baea Village for men and women (per cent of households).

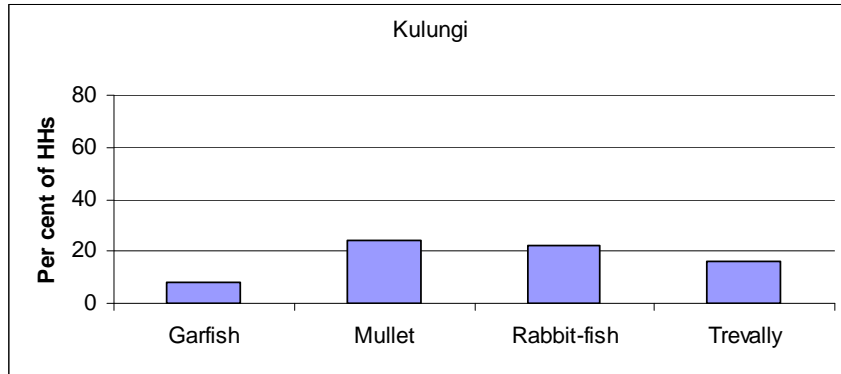
FISH SALES

With the exception of Kulungi Village (Figure 5.1a and Figure 5.2a) fish sales provide an important source of household income in the other five villages, especially for households in the more remote villages of Tarobi, Potou and Baea (Figure 5.1c, Figure 5.1e and Figure 5.1f). Villagers sell fish at several outlets including road-side and town markets, retail outlets, own village and work/labour compounds. The most important sales outlet for fish identified by villagers reveals the income opportunities for people in each village (Figure 5.3), and it is probable that the most important sale outlets identified by respondents is where they earn the most income rather than reflecting the frequency of selling. For example, a villager may sell fish several times each week in the village, but may earn more from marketing fish one day each fortnight at a workers' compound following the workers' fortnightly payday.

The local commercial retail fish trade in Kimbe Bay is not well developed, with wholesale fish sales low across all six villages (Figure 5.2). Potou reported no sales to wholesale buyers (Figure 5.2c) and wholesale fish sales at Baea village refer to the sale of fish to the fishing resort located in the village. One reason for the low wholesale fish sales is the limited number of commercial retail buyers in Kimbe Bay. There are only a few tradestores in Bialla and one at Mamota (see below) which occasionally purchase fish locally. Further, as mentioned in Chapter 1, the main fish buyer at Kimbe, KBSA, buys most of its fish from villagers west of the Talasea Peninsula and not from Kimbe Bay.

Supermarket sales were important for only two villages: Gaungo and Tarobi villages (Figure 5.3b and 5.3c), and Gaungo Village reported the highest rate of sales to local wholesale buyers (Figure 5.2a) with most sales to food outlets in town (Figure 5.3b). Supermarket sales are attractive to villagers because the catch is sold all at once rather than as multiple small sales to a relatively large number of buyers as occurs at local markets. When villagers have a good catch of the species bought by KBSA it is worth their while carting these fish to town for sale. At present the level of wholesale fish demand does not pose a significant threat to the marine fish stocks of Kimbe Bay.

FISH SOLD AT LOCAL MARKETS



FISH SOLD TO LOCAL WHOLESALERS

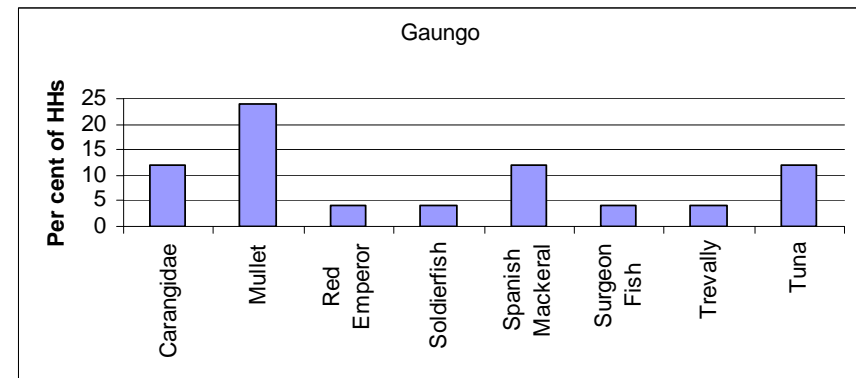
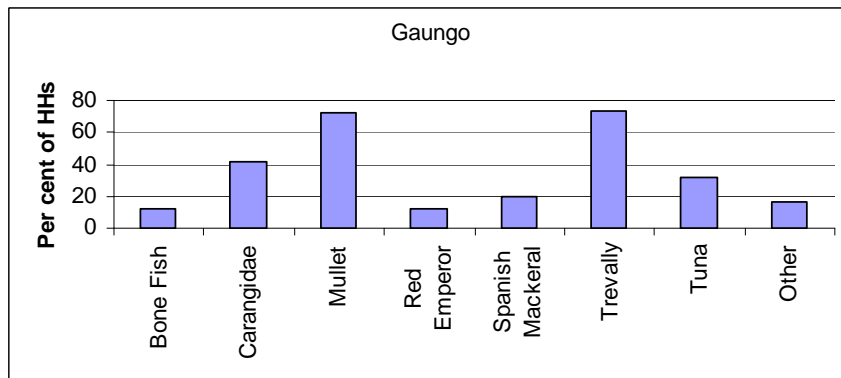
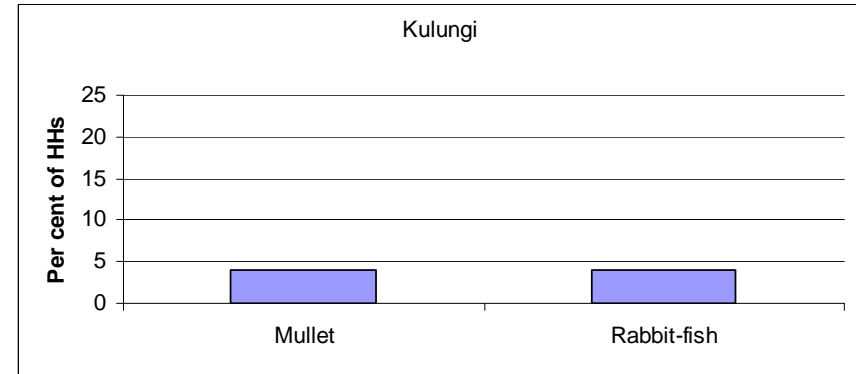
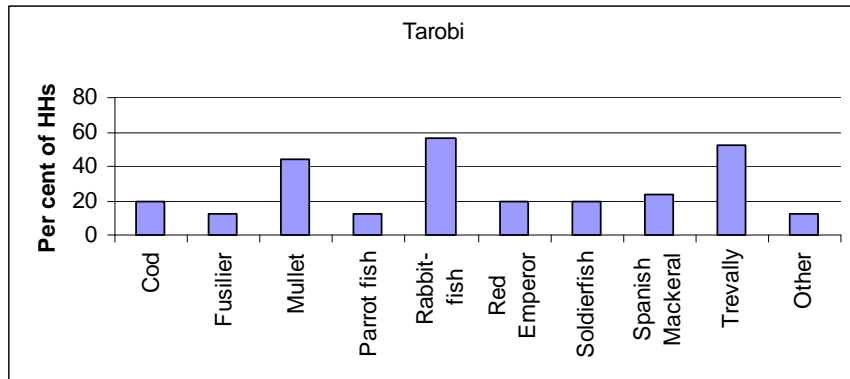


Figure 5.2a. Percentages of households selling fish at local markets and to local wholesalers (Kulungi and Gaungo villages). The category ‘Trevally’ is dominated by the species *Caranx melampygus* (Batbat – Melnesian Pidgin), and is therefore shown separately from *Carangidae*.

FISH SOLD AT LOCAL MARKETS



FISH SOLD TO LOCAL WHOLESALERS

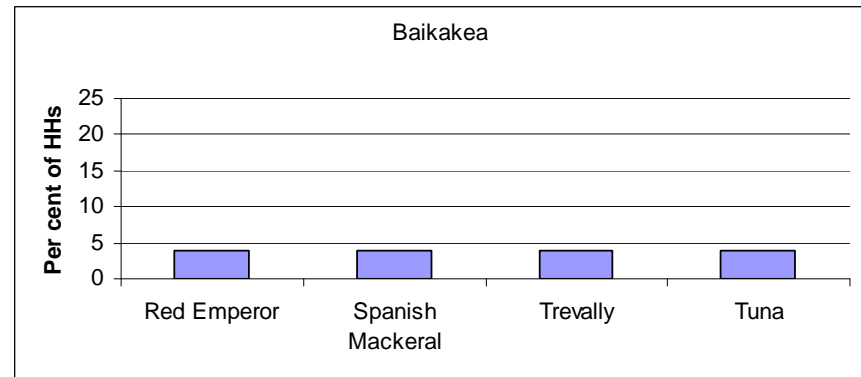
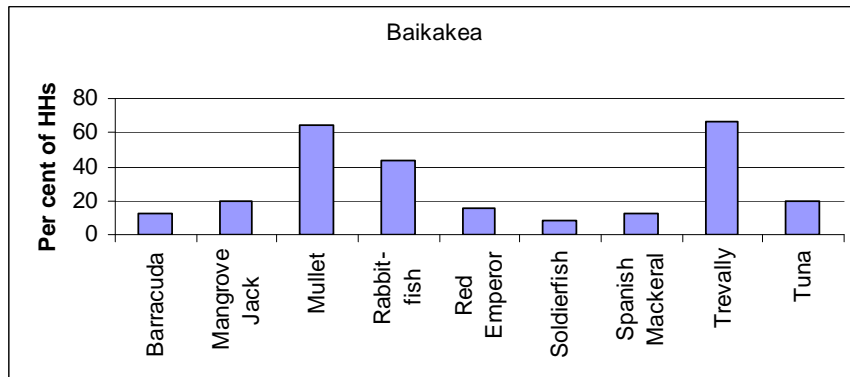
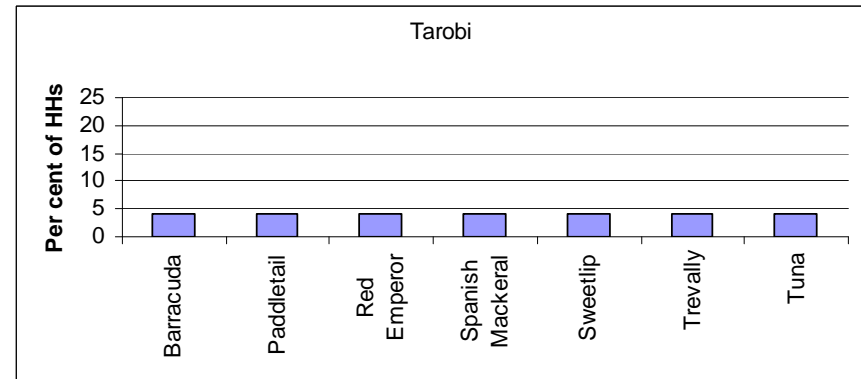
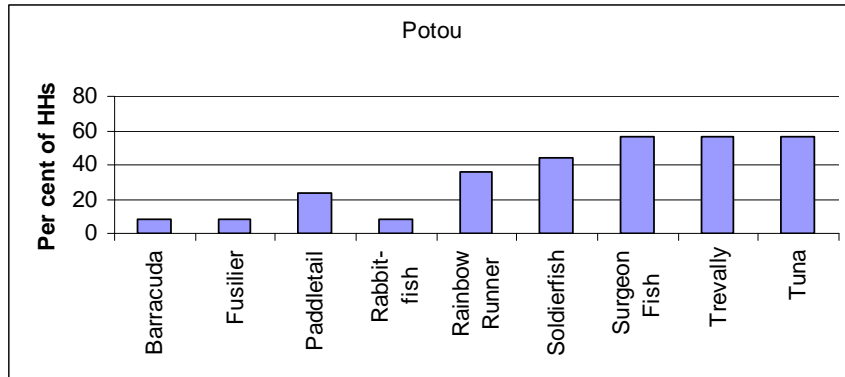


Figure 5.2b. Percentages of households selling fish at local markets and to local wholesalers (Tarobi and Baikakea villages). The category ‘Trevally’ is dominated by the species *Caranx melampygus* (*Batbat* – Melnesian Pidgin), and is therefore shown separately from *Carangidae*.

FISH SOLD AT LOCAL MARKETS



FISH SOLD TO LOCAL WHOLESALERS

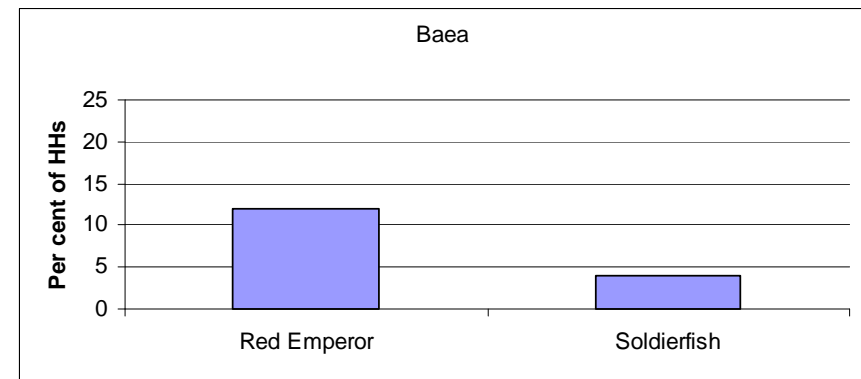
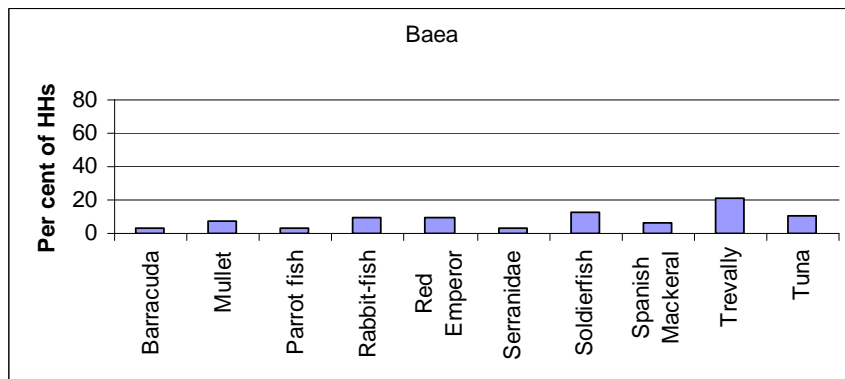
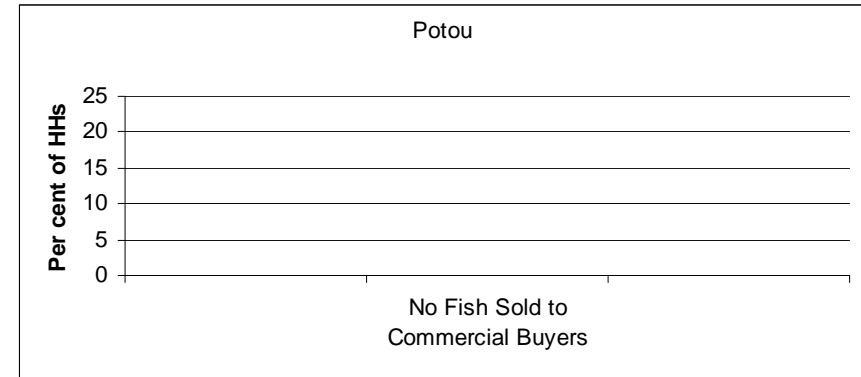


Figure 5.2c. Percentages of households selling fish at local markets and to local wholesalers (Potou and Baea villages). The category ‘Trevally’ is dominated by the species *Caranx melampygus* (*Batbat* – Melnesian Pidgin), and is therefore shown separately from *Carangidae*.

While local retail fish sales were insignificant across all six villages, there was considerable variation amongst villages in the importance of fish sales at local markets (Figure 5.2). Levels of fish sales at local markets tended to reflect the degree of accessibility of each village. Kulungi, the most accessible village, had very low levels of fish sales at local markets with few species sold (Figure 5.2a).

Local markets were relatively important sale outlets for fish for Gaungo and Tarobi villages (Figures 5.3b and 5.3c) (Plate 5.1). These markets are located on main roads. At Gaungo, the Kimbe–Hoskins Road borders the village and is a half-hour walk from the coastal hamlet where the survey was undertaken. Few women from Gaungo and Tarobi sell food at the large urban Kimbe market².



Plate 5.1. Smoked fish for sale at Kimbe Market © G.N. Curry.

It may seem surprising that the local market for Tarobi Village, which lies 25 km from the village on the Hoskins–Bialla road, should be so important given the village’s relative isolation (Chapter 2). This is explained by an agreement made in 2003 between Tarobi landowners and an expatriate businessman to establish a supermarket (Hamamas Trading) on Tarobi customary land bordering the Kimbe–Bialla road. According to villagers, part of their agreement with Hamamas Trading was for the latter to provide transport from the village to a newly created market outside the Hamamas Trading supermarket for market vendors. During 2004 until mid 2005, Hamamas Trading provided free transport every Tuesday and Saturday from the village to the Hamamas market for women to sell fish, shellfish, other marine products and betel nut. Tarobi villagers also sold fish to the storeowner which is recorded as “supermarket” in Figure 5.3c³.

The more remote villages with strong fishing cultures (see Chapter 4) tended to be more dependent for income on fish sales at local markets and sold a wider range of species than more accessible villages. The number of fish species sold at local markets ranged from ten to four species in the following order: Baea (10), Tarobi (10), Potou (9), Baikakea (9), Gaungo (8), Kulungi (4).

Women from Potou and Baea villages visit Ulamona market and occasionally the more distant Navo market to sell fresh and cooked fish and other marine products such as lime,

shellfish, turtle, octopus, squid and lobster. Whilst fish are plentiful, the remoteness of these two villages means that market access is a major constraint on livelihood opportunities. Not only are the number of boats for hire limited (hire cost of K150 per day), but the passenger fare is costly, at K30 and K60 for a return trip to Ulamona from Potou and Baea respectively.

The Ulamona and Navo markets operate on pay weekends of Hargy Oil Palm Ltd. and the major logging companies, and most of the customers are workers from nearby logging camps, labourers from the Navo Mill and plantations or public servants. Other buyers at Ulamona market include migrant women (often the wives of plantation labourers) who later resell smoked or cooked fish at Navo market. These markets are major economic hubs in the area and it is not uncommon for Baea and Potou villagers to prepare for two or three days in advance of the market. Potou and Baea women prefer to sell at Ulamona market rather than pay the additional transport cost to the more distant Navo market. Also, they can go shopping at Ulamona after the market. As pointed out in Chapter 4 in the days preceding the market, villagers will often make multiple fishing trips, and smoke the fish caught earlier in the week while selling fresh the fish caught the night before market day. Typically, villagers do not go fishing for subsistence or cash income purposes in the weeks between pay weeks (*lus wik*).

Village sales of fish are relatively important at Baikakea (Figure 5.3d) and Potou (Figure 5.3e). Baikakea Village is close to Wilelo LSS subdivision and settlers from Wilelo frequent the village market to buy fish. Also, the relatively high number of people in employment in Baikakea Village means that some of them can purchase fish from their fellow villagers rather than fish themselves (see Chapter 2 for an outline of the economic opportunities available at Baikakea). There is also a small market for fish at Potou Village but it is much less important as a sales outlet than work compounds. It is likely that some of the 'village' sales at Potou are to villagers who on-sell the fish at Ulamona market on the mainland.

Work compounds of the oil palm and logging companies are very important sales outlets for fish for villagers from Baea (Figure 5.3f), Potou (Figure 5.3e) and, to a lesser extent, Baikakea (Figure 5.3d). The compounds provide access to relatively large concentrations of cashed-up workers on paydays. The high value to weight/volume of fish together with the fact the fish will keep when smoked, means that it can be transported over relatively long distances to market. Villagers close to retail fish buyers, with the exception of Kulungi, sell predominantly to supermarkets/stores and local urban markets.

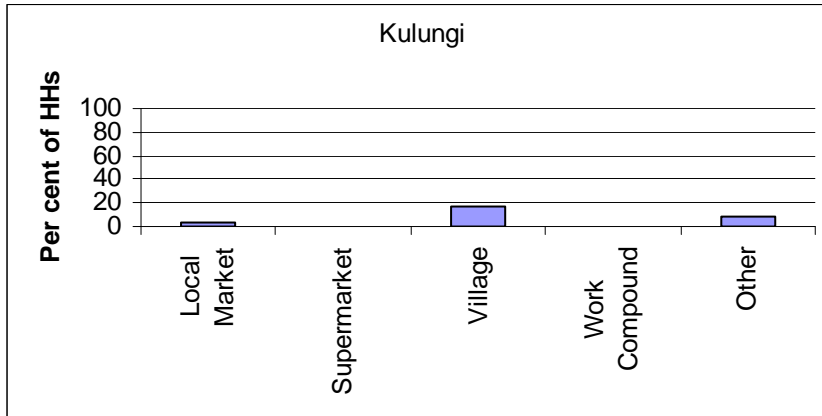


Figure 5.3a. Most important sales outlet for fish for Kulungi Village (per cent of households).

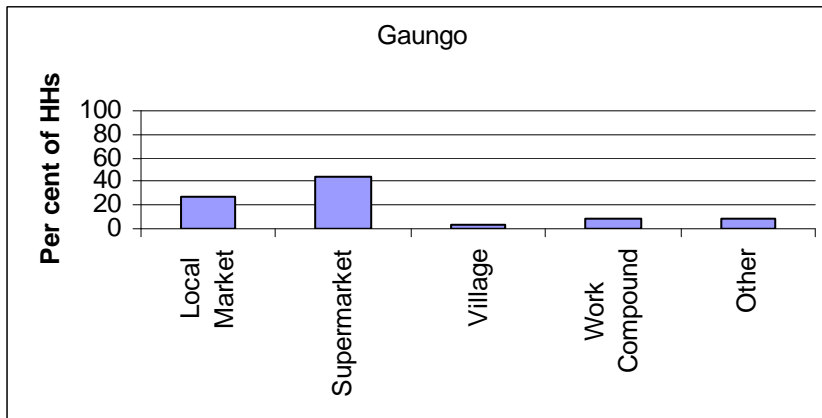


Figure 5.3b. Most important sales outlet for fish for Gaungo Village (per cent of households).

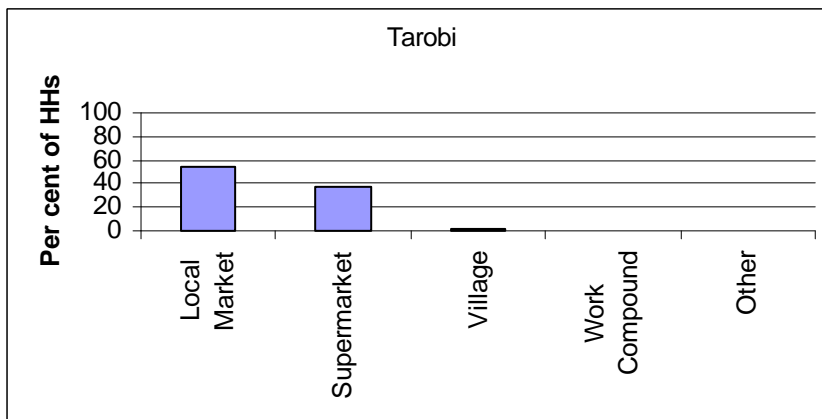


Figure 5.3c. Most important sales outlet for fish for Tarobi Village (per cent of households).

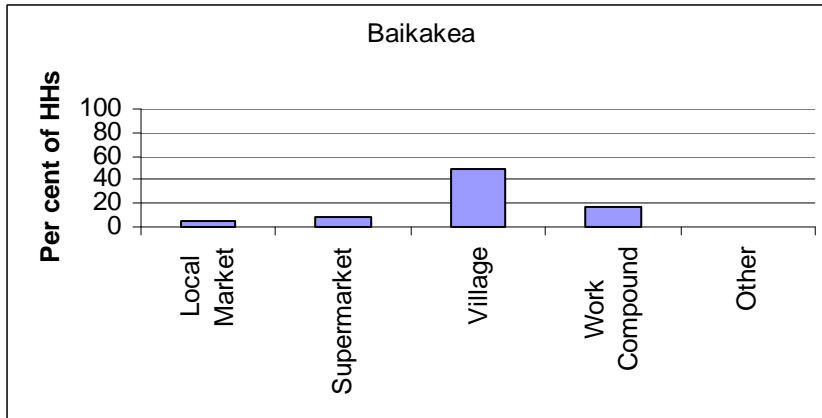


Figure 5.3d. Most important sales outlet for fish for Baikakea Village (per cent of households).

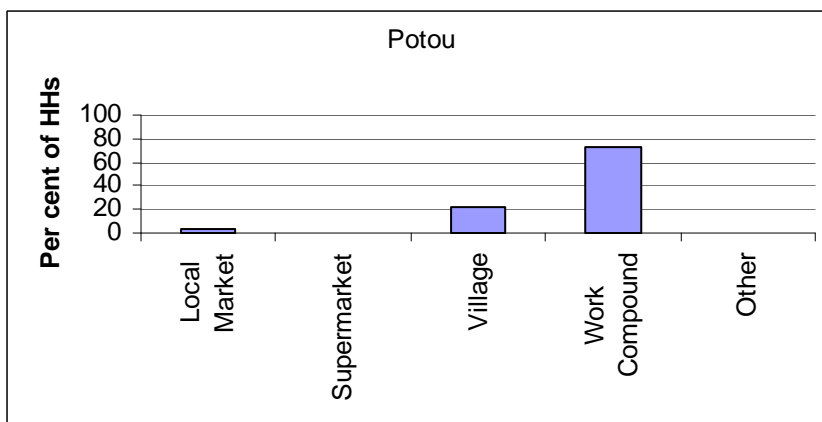


Figure 5.3e. Most important sales outlet for fish for Potou Village (per cent of households).

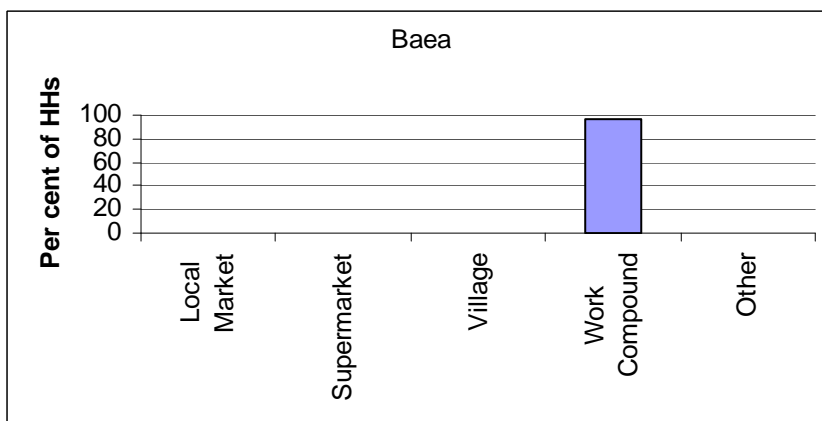


Figure 5.3f. Most important sales outlet for fish for Baea Village (per cent of households).

SALES OF OTHER MARINE PRODUCTS

As well as consuming a wide range of marine products in addition to fish and shellfish (Figure 4.6a – 4.6f), coastal villagers of Kimbe Bay derive cash income from a broad range of marine products in addition to fish and shellfish (Figures 5.4a – 5.4f). These income sources include seaweed, squid/octopus, various crustaceans, turtle, crocodile, lime, beche-de-mer, trochus and shark fin.

Like consumption and sales of fish, the importance of income from marine products other than fish and shellfish, as measured by the percentage of households in each village pursuing these income activities, appears to increase with distance from markets. Generally, the percentage of households engaged in these income activities in the more remote villages of



Plate 5.2. Turtles for sale at Ulamona Market © J. Warku.

Baea (Figure 5.4f), Potou (Figure 5.4e) and Tarobi (Figure 5.4c) is higher overall across a range of income sources than in the more accessible villages of Kulungi (Figure 5.4a), Baikakea (Figure 5.4d) and Gaungo (Figure 5.4b). When the rankings on each item are averaged for each village, the overall ranking for income from marine products other than fish and shellfish produces three groups:

GROUP 1
(mean rank = 2)
Potou
Tarobi
Baea

GROUP 2
(mean rank = 4)
Gaungo
Baikakea

GROUP 3
(mean rank = 5)
Kulungi

Overall, these average rankings which reflect village accessibility are sufficiently strong to override the effects of habitat specificity that may affect the local distribution and abundance of particular marine resources.

The village rankings of individual items of marine *cash income* sources other than fish and shellfish reflect, to a fairly large degree, the intensity of *subsistence use* patterns of these marine products. For instance, the proportion of households in each village reporting *sales* of turtle meat gave the following ranking: Potou, Baea, Tarobi, Baikakea, Gaungo and Kulungi.

For turtle *consumption*, Potou and Baea changed places in the rankings but the rest of the villages were ranked in the same order (Chapter 4).

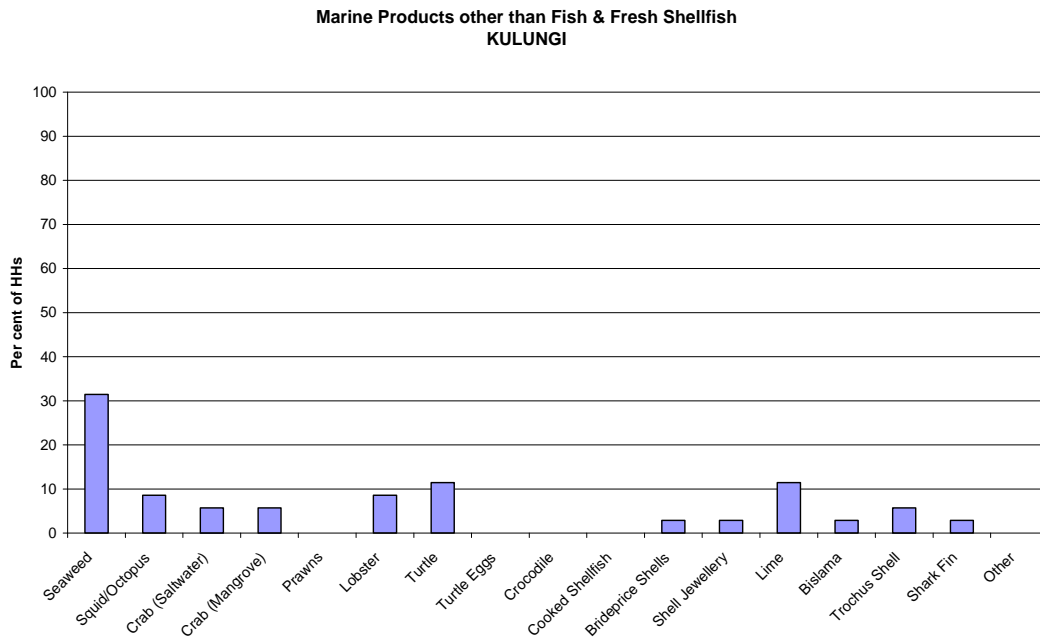


Figure 5.4a. Percentages of households in Kulungi Village reporting sales of marine products other than fish and fresh shellfish.

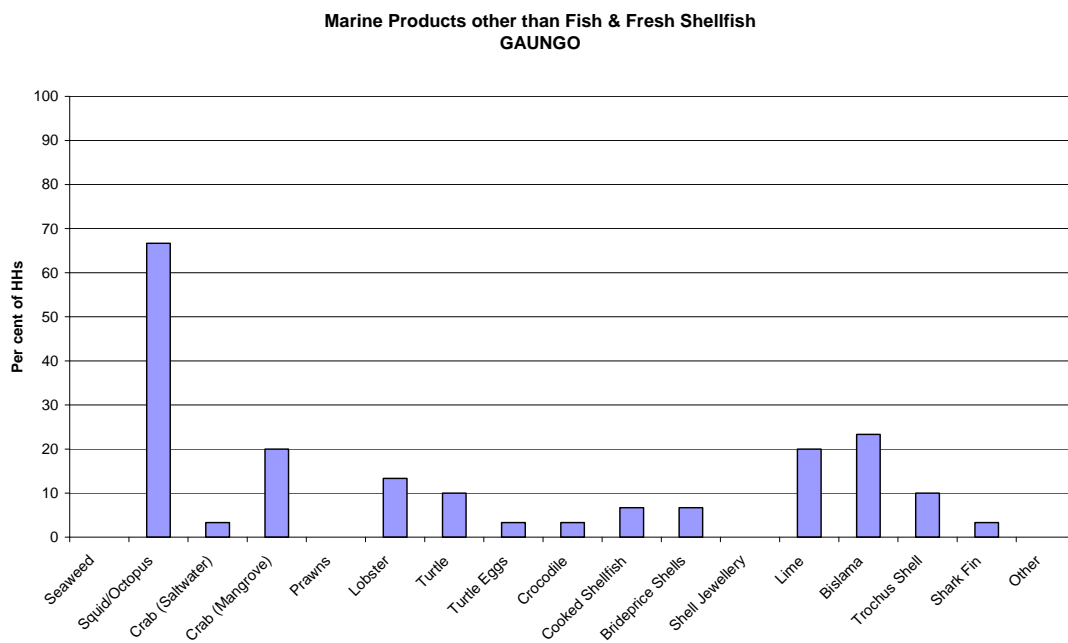


Figure 5.4b. Percentages of households in Gaungo Village reporting sales of marine products other than fish and fresh shellfish.

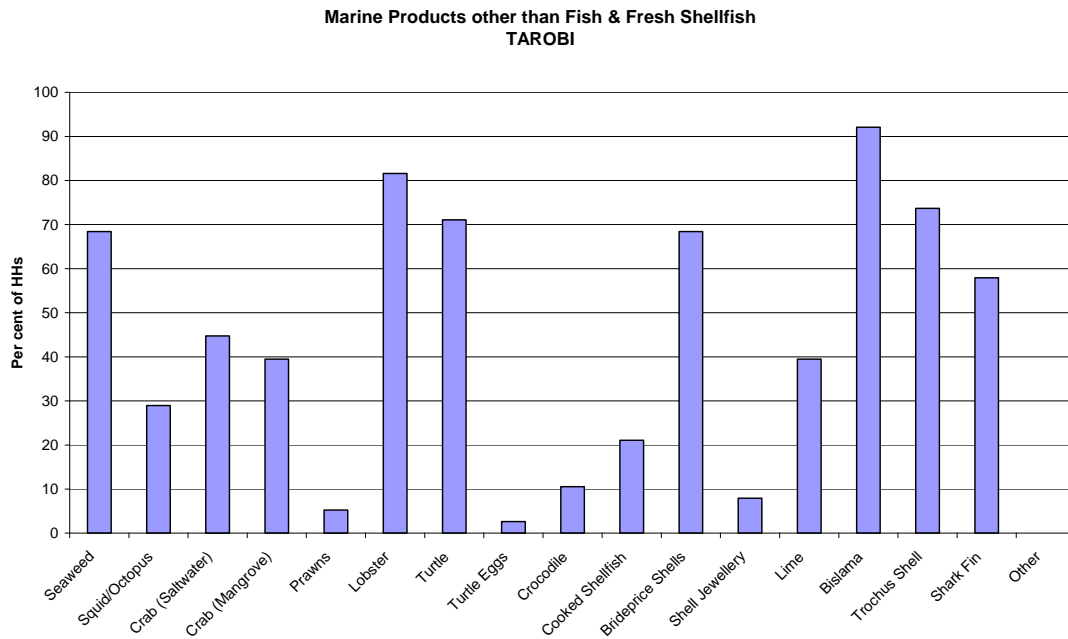


Figure 5.4c. Percentages of households in Tarobi Village reporting sales of marine products other than fish and fresh shellfish.

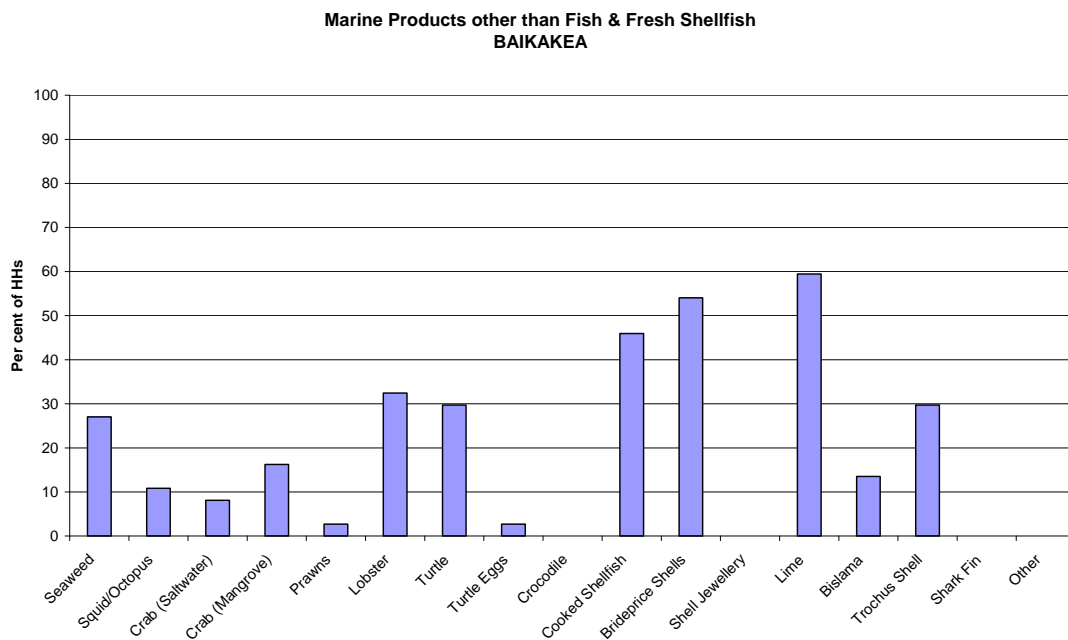


Figure 5.4d. Percentages of households in Baikakea Village reporting sales of marine products other than fish and fresh shellfish.

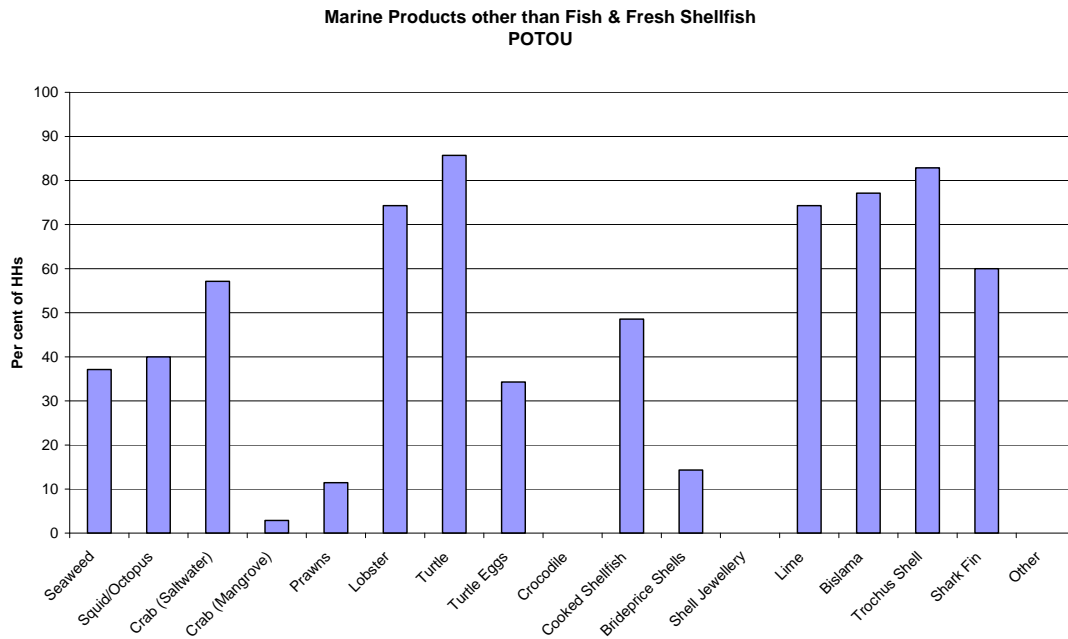


Figure 5.4e. Percentages of households in Potou Village reporting sales of marine products other than fish and fresh shellfish.

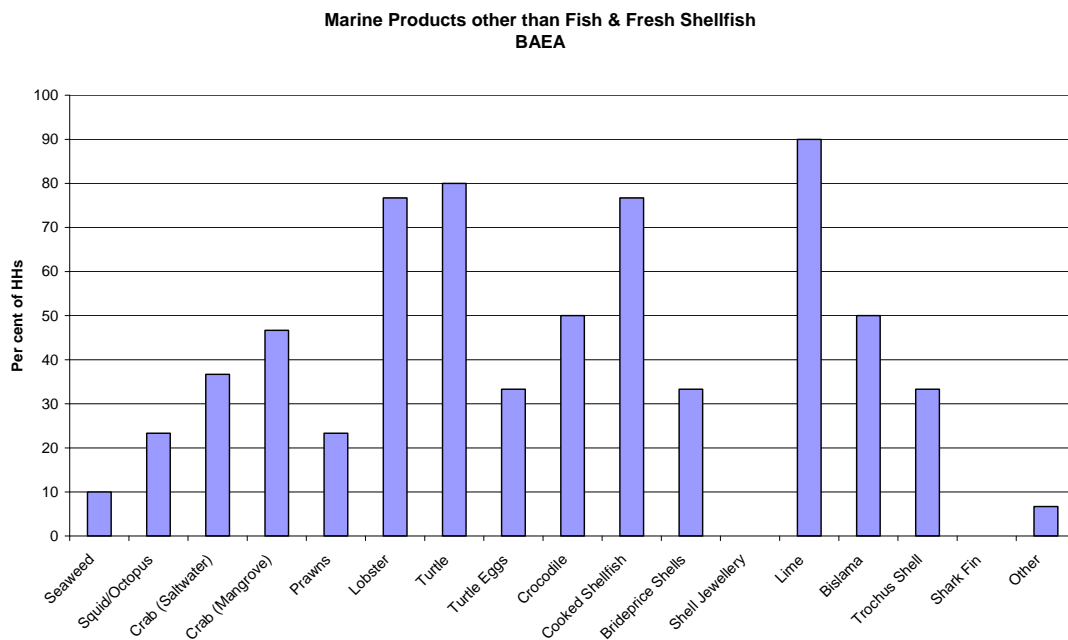


Figure 5.4f. Percentages of households in Baea Village reporting sales of marine products other than fish and fresh shellfish.

EXPORTS OF MARINE PRODUCTS

Commercial sales of beche-de-mer, trochus and shark fin provide important income for villages, with a larger proportion of households in the more isolated villages having these

income sources. Table 5.2 outlines the income ‘intensity’ ranking for these three commercial marine products.

Table 5.2. Income ‘intensity’ ranking by village of the sale of commercial marine products*.

MARINE PRODUCT	KULUNGI	GAUNGO	TAROBI	BAIKAKEA	POTOU	BAEA
Beche-de-mer	6	4	1	5	2	3
Trochus	6	5	2	4	1	3
Shark fin	4	3	2	-	1	-

* 1 = Highest intensity 6 = Lowest intensity

While the ranking in part reflects accessibility, the presence of buyers is also important in this ranking. At the time of the study, there were two commercial buyers of beche-de-mer, trochus and shark fin in Kimbe town. Trochus was being purchased at K8-10/kg and beche-de-mer at K40-K100/kg depending on the species and grade. Also, coastal communities are visited by occasional beche-de-mer buyers travelling around the Bay and some store owners and overseas workers at the logging camps in eastern Kimbe Bay buy beche-de-mer.

The sedentary nature of beche-de-mer and trochus also makes them easy to collect by hand, so men, women and children are able to harvest them. As shown in Table 5.1 beche-de-mer was the main income source for women at Tarobi Village. In addition, at Tarobi, Baikakea and Baubau (near Baea Village) villages the night-time collection of some species of beche-de-mer was facilitated by the issuing of free lanterns to villagers by beche-de-mer buyers. Also, the marketing of beche-de-mer is made easy for villagers because buyers will often visit villages to purchase the product.

EXPORT CASH CROPS

The main export cash crops cultivated by Kimbe Bay communities are oil palm, cocoa and copra (Figure 5.5). As pointed out in the introduction to this chapter, there appears to be an inverse relationship between dependence on export cash crops and the exploitation of marine resources, and such a relationship has been detected in other studies (e.g., Kinch, 2003). There is also evidence that when cash crop prices fall below a certain level, such as in 2000 when oil palm prices dropped to K50/tonne, fishing assumes more importance in income strategies than when prices are higher (Koczberski *et al.*, 2001). For example, in 2000 several Gaungo villagers abandoned oil palm production temporarily to take up fishing which became their dominant livelihood strategy during the low price period (Koczberski *et al.*, 2001). Further, preliminary data from Baikakea and Tarobi indicate that the closure of the Copra Marketing Board (CMB) in 1999/2000 together with low oil palm prices, led villagers to increase their incomes from fishing as well as a range of other incomes sources such as sales of betel nut and dry coconuts (Scott Kimpton, pers. comm.). It is unclear if the importance of beche-de-mer sales in Tarobi Village reflects the collapse of traditional income sources such as copra.

Figure 5.5a shows holdings of the main export cash crops that were in production at the time of the household surveys. A large proportion of households in the villages of Gaungo, Baikakea, Kulungi and Tarobi had oil palm, while Kulungi, Potou and, to much lesser extent, Gaungo, had holdings of cocoa that were in production. The proportion of households that

were active in copra production was low across all villages except Potou where there has been a recent resurgence in copra production (Figure 5.5a).

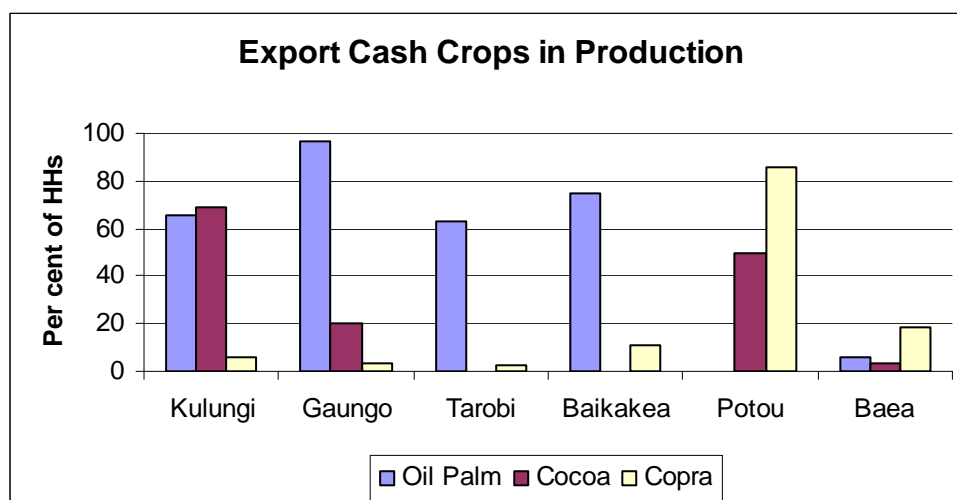


Figure 5.5a. Percentages of households in each village holding export cash crops that were in production.

With the closure of the CMB and few cocoa buyers in the province⁴ income from these cash crops virtually ceased, compelling villagers to seek new income opportunities to maintain their livelihoods or to place more emphasis on existing income sources. For the less accessible villages, such as Potou with high transport costs, fishing became more important as an income source. Villages with better accessibility (lower transport costs to market) had a greater range of income options. Some villages compensated for the loss of cocoa and copra income by increasing the production and sale of betel nut, while others, with access to sago (e.g., Baikakea Village), increased their output and sales of sago. Villages close to plantation compounds or town (e.g., Baikakea and Kulungi) began selling more dry coconuts as well as a range of other products at local markets (e.g., firewood at Kulungi – interview data). Sales of dry coconut were not an option for remote villages because of the high transport costs. Thus, while a large proportion of the coconut holdings in the relatively accessible villages of Baikakea and Kulungi were not producing copra (Figure 5.5b), villagers earned a significant proportion of their income from the sale of dry coconuts. Women also claimed that sales of dry coconuts generated a better return than copra production and was much easier work.

Previously at Potou Village, the church-owned cocoa and copra plantation (now handed back to local landowners) had provided access to employment for islanders. Production ceased with the closure of the CMB buying point at Ulamona in 2000. To compensate for the loss of cocoa and copra employment, villagers with few potential alternative income sources, claimed they increased sales of marine products. However, when Kimbe Bay Shipping Agency (KBSA) entered the cocoa and copra market in mid 2005, Potou villagers recommenced production of copra and cocoa. The KBSA ship has now begun calling at the island at regular intervals to buy copra and cocoa dry beans.

While nearly all of Potou's holdings of coconuts are back in production, a significant proportion of cocoa holdings have yet to be rehabilitated and remain unharvested (Figure 5.5b). It is too soon to determine if the resurgence of cocoa and copra production is leading to a reduced dependence on marine resources for income, but it is an area worth monitoring by TNC.

The other two remote villages of Baea and Tarobi have relatively large proportions of their holdings of coconuts not in copra production (Figure 5.5b). In Baea several coconut blocks were converted to Kamarere (*Eucalyptus deglupta*) plantation timber after an agreement with the Open Bay Lumber Company. However, high transport costs means it is unlikely that the remaining coconut stands will provide a significant source of income from the sale of dry coconuts. If buyers such as KBSA, Agmark and Malama Trading (which recently purchased a ship for cocoa and copra buying) were to include these villages in their shipping schedules, it is probable that, like Potou, they would recommence production of copra and cocoa, thereby reducing their need to exploit marine resources for cash income.

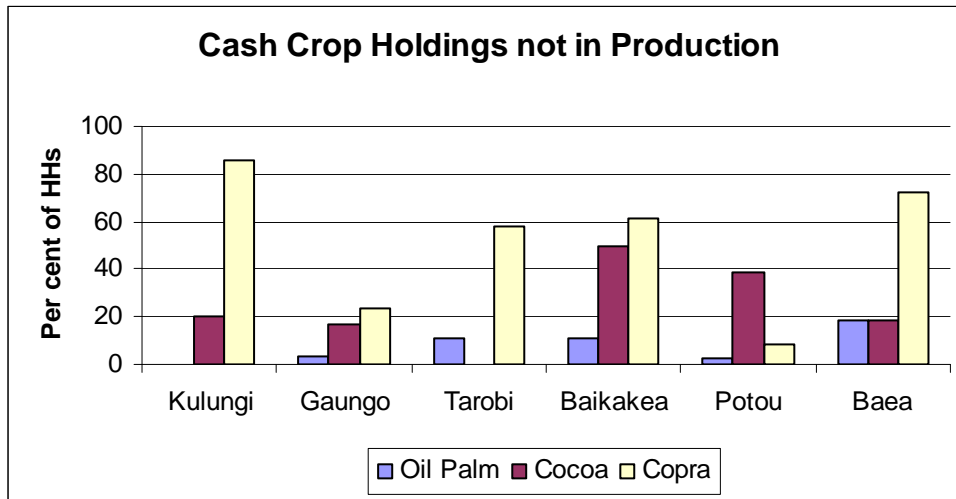


Figure 5.5b. Percentages of households in each village holding export cash crops that were **NOT** in production.

OTHER NON-MARINE INCOME SOURCES

The chapter finishes with an overview of income sources other than export cash crops and marine resources. Table 5.3 shows the diverse income sources which villagers identified from a list of potential income sources excluding marine products and export cash crops. Dry coconut was inadvertently omitted from this list of income sources, but was, as discussed earlier in the chapter, an important income source for women in Kulungi (Figure 5.1a) and Baikakea (Figure 5.1d).

Table 5.3. Percentages of households in each village earning incomes from a range of sources other than export cash crops and marine products*.

INCOME SOURCE	KULUNGI	GAUNGO	TAROBI	BAIKAKEA	POTOU	BAEA	COMMENTS
Garden Foods	86	50	37	64	46	48	Sales of fresh garden foods higher for villages close to markets
Cooked Foods	57	43	42	58	66	77	
Betel Nut	66	63	84	83	89	97	High value to weight/volume crop
Sago	0	13	76	61	3	97	High value to weight/volume crop
Tobacco	20	37	24	11	31	23	High value to weight/volume crop
Firewood	83	0	0	0	0	0	Close to large urban centre (Kimbe)
Poultry	14	7	3	6	0	0	Large workforce nearby provides good market
Pigs	14	20	8	0	77	87	High value product – Potou and Baea
Tradestore	3	0	8	17	11	6	
Kerosene	14	13	8	19	14	10	
Cigarettes/Beer	14	23	11	0	0	3	
PMV (truck/ boat)	3	0	5	3	9	19	Boat access important at Potou and Baea
Diesel/Petrol	6	0	0	6	3	10	
Land Rents	0	7	0	3	0	0	
Remittances	54	63	21	64	37	55	
Other	17	17	18	22	17	29	

* The top three incomes sources other than export cash crops and marine products are in bold.

It is evident that like marine resources and export crops, the other income strategies pursued by villagers are influenced strongly by the degree of market accessibility of each village. Remote villages confronted with high transport costs tend to specialise more in high value to weight/volume products whereas villages with a high degree of accessibility are able to generate income from low value to weight/volume products such as garden foods.

The relationship between village accessibility and the type of income source in terms of value to weight/volume ratio can be illustrated by the village rankings in the importance of several income sources. For instance, garden foods which have low value to weight/volume ratio and therefore cannot be transported over long distances, are more important income sources in relatively accessible villages like Kulungi and Baikakea. The village ranking for garden foods was Kulungi, Baikakea, Gaungo, Baea, Potou and Tarobi. In contrast the high value to weight/volume ratio of betel nut yielded the following village ranking: Baea⁵, Potou, Tarobi, Baikakea, Kulungi and Gaungo.

Pigs, which have a very high value to weight/volume ratio, were a very important income source in Baea and Potou (87% and 77% of households in each village respectively), and much more so than the third ranked village of Gaungo (20% of households) (Table 5.3). It might seem paradoxical, therefore, that chickens, also undoubtedly a high value to weight/volume ratio, gave a village ranking the opposite to the one expected: Kulungi, Gaungo, Baikakea, Tariobi (not an income source in either Potou or Baea). The reason is the high cost of transport for stockfeed. Chicken production is simply not viable in remote villages when stockfeed must be transported long distances to the village. Pigs, on the other hand, are raised on locally produced food so the transport cost of stockfeed is not a factor.

Some other village rankings of the importance of income sources while reflecting the influence of accessibility, also reflected the local abundance of resources. With processed sago, for example, a high value to weight/volume, Potou was ranked second from last (no sago on the island) while Baikakea a highly accessible village was ranked third. Baikakea has abundant sago resources and there is a large population of Sepiks in the adjoining land settlement subdivision of Wilelo for whom sago was a staple. This tended to override the accessibility factor.

SUMMARY

Villages which are relatively remote from towns and markets are more dependent on marine resources for their cash needs than those with high market accessibility. The two polar examples are Kulungi Village located less than 2 km west of Kimbe town which can be considered to have a high degree of accessibility, and Baea Village in eastern Kimbe Bay that is accessible only by boat. The former village is marginally involved in fishing, and the livelihood strategies of residents are focused on cash crop production and income strategies servicing the urban centre of Kimbe. In contrast, Baea Village has a strong subsistence fishing culture that has been orientated to generating cash incomes.

The one anomalous village in this accessibility schemata is Gaungo Village where the survey profile suggests a much stronger fishing culture than would be anticipated on accessibility criteria¹⁰. However, with this caveat in mind regarding Gaungo, the data show that Kulungi, Gaungo and Baikakea villages which are located relatively close to urban centres, food markets, or large, readily accessible workforces and employment opportunities (e.g., plantation compounds), are less dependent on marine-based incomes than more isolated villages. Although some households in Gaungo and Baikakea may continue to identify more with fishing than commodity crop production, overall, marine-based incomes in these villages

are irregular and relatively minor compared with income derived from other sources such as cash crops (including betel nut and dry coconuts), vegetable production for local markets and waged employment.

Finally, villagers are involved in a diverse range of cash income activities, which in combination make up their livelihood strategies. These are not fixed but highly variable through time reflecting household labour availability, the seasonal abundance of particular subsistence and income-generating resources, prices, transport costs and cash demands (e.g., school fees and brideprices) to name just a few of these factors. A shift in the factors affecting one livelihood strategy can therefore be expected to influence how other types of resources are utilised. For example, as discussed above, commodity prices and market access can influence other livelihood activities, and low commodity prices can result in villagers increasing their incomes from fishing and other income sources⁶.

NOTES

1. Cocoa has recently re-emerged as an important cash crop in Kulungi with the energetic promotion of the crop by a village resident.
2. Most vendors of marine products at Kimbe Market are from west of the Talasea Peninsula, mainly the Kombe area, with some vendors from the small informal beachside settlements of Gigo and Laleki (near Kulungi). Also, given the population size of Kimbe and the large number of coastal villages in the Bay, the quantity and variety of marine products sold at the market is small in comparison with other local markets in coastal towns and cities in PNG such as Alotau, Madang, Rabaul and Port Moresby.
3. A dispute between Tarobi landowners and Hamamas Trading in mid 2005 led to the suspension of free transport, and women now sell at other local markets such as Silanga.
4. Wesfarmers, a business arm of the provincial government that bought cocoa, also closed its doors around 2000-2001 leaving no buyers in the province.
5. Baea has a local advantage in betel nut production because it has a later season than the central Nakanai areas, and so can command high prices.
6. The links between commodity crop prices and marine exploitation have been observed in other coastal areas in PNG. For example, Danzell and Wright (1990) showed that fish landings in New Ireland were negatively correlated with the mean annual copra price, and reports from Milne Bay indicate that exploitation of marine resources increased significantly following the collapse of the Copra Marketing Board in that province (Kinch, 2003).

6. CONSERVATION & RESOURCE MANAGEMENT

INTRODUCTION

This chapter outlines the changes to and pressures on the marine resources and habitats of Kimbe Bay. The chapter draws on interviews and focus group discussions with local resource owners in the six study villages to assess the condition and status of marine habitats and resources. Information was gathered from local people on their perceptions of changes occurring to their immediate marine environments and their understandings of the causes of these changes. Many villagers perceived a reduction in the abundance of some of their commonly harvested marine resources and, in the more accessible villages, some decline in marine habitats. Some of the key issues to emerge from the focus groups and interviews and discussed in this chapter include:

- Declines in the abundance of marine resources.
- Over-exploitation of marine resources.
- Destructive fishing methods.
- Alterations to marine and terrestrial habitats.
- Local conservation efforts.
- Local perceptions of marine reserves.

DECLINES IN THE ABUNDANCE OF MARINE RESOURCES

To assess people's perceptions of changes in marine resources emphasis was given to changes in the abundance and size of marine species. People assessed abundance in three ways: declines in the abundance of species in particular locations; the increased need to travel further or to different areas to access specific resources, and the increased time spent fishing/collecting particular species from specific locations. All villagers perceived, to varying degrees, a reduction in the abundance of commonly harvested marine resources (Appendices 1-6 list the main species in each study village that people identified in focus group discussions as declining in abundance). Several general points emerged from the discussions. These include:

- Trochus and beche-de-mer, both sold commercially, were the only marine species that were identified across all six villages as declining significantly in numbers. A reduction in the size of beche-de-mer was also noted in several villages. For example, Kulungi and Gaungo villagers indicated that the size and abundance of beche-de-mer and trochus had declined significantly (Appendices 1 and 2).
- The Kina shell commonly harvested from mangrove habitats, although still widely available, was recognised as declining in abundance by four of the six villages (Gaungo, Tarobi, Baikakea and Baea). The meat is collected both for consumption and for sale at informal markets, while the shell is processed into lime (eaten with betel nut) for home consumption and sale at informal markets.
- Most molluscs identified as declining in abundance are found in mangroves and inshore sandy flat habitats (Appendices 1-6).
- The villages that perceived the greatest decline in shellfish and other invertebrates included those villages closest to urban centres, namely Kulungi, Gaungo and Baikakea villages.
- With the exception of Baea village, declining stocks of Giant Clams were recognised in the remaining five villages.

- Lobster was identified by four of the six villages as declining in abundance (Gaungo, Baikakea, Tarobi and Potou villages).
- A slight reduction in the abundance of turtles was noted by villagers at Potou (red turtle), Baea, Gaungo, Kulungi and Tarobi. Turtle is an important consumption item as well as cash income source in some villages (Chapter 5).
- Declining stocks of squid were reported at Gaungo, Baikakea and Potou villages.
- Declining abundance of mangrove crabs at Kulungi, Gaungo, and Baikakea.
- Villagers at Baikakea and Tarobi reported an increase in crocodile numbers, while those at Gaungo and Baea noted a decrease.
- Some fish species associated with seagrass habitats and in-shore areas were identified as declining in numbers, including Rabbit-fish, Mackerel Scad, small Trevally and small Mullet, Long Tom, and Yellow Tail Scads.
- Barracuda (Gaungo and Tarobi villages) and Red Emperor (Potou and Baea villages) were reported to have declined in abundance.

The most common explanations given for the decline in the abundance of specific species are grouped into three broad categories (Table 6.1). These are:

- Over-exploitation of marine resources.
- Changes to marine habitats.
- Destructive fishing methods.

OVER-EXPLOITATION OF MARINE RESOURCES

The most common reason cited by villagers to explain the decline in species abundance was over-exploitation of resources for subsistence, artisanal and commercial purposes (Appendices 1-6). In the more isolated villages of Tarobi, Potou and Baea, where there are few terrestrial-based livelihood opportunities and access to store and market foods is limited, villagers gave more emphasis to the over-exploitation of particular species such as turtles, squid and crocodile than less isolated villages nearer to town with greater access to terrestrial-based income sources and to store foods.

Baikakea and Tarobi villages cited growing population pressure to explain over-exploitation of resources, especially shellfish in habitats close to the village. As mentioned in Chapter 1, WNB has a high population growth rate and while in-migration accounts for part of the growth, there is also a high rate of natural increase, which is placing greater pressure on terrestrial and marine resources.

Table 6.1. General explanations for the declining abundance of marine species in each village.

PERCEIVED CAUSAL FACTORS	KULUNGI	GAUNGO	TAROBI	BAIKAKEA	POTOU	BAEA
OVER-EXPLOITATION						
Over-exploitation for subsistence by resource owners (especially shellfish and some fish species).	√	√	√	√	√	√
Over-exploitation for artisanal and commercial fisheries by resource owners (especially trochus, beche-de-mer, shellfish, turtles and fish).	-	-	√	√	√	√
Overexploitation of resource habitats close to village (e.g. mangroves & coral reefs).	√	√	√	√	√	-
Poaching by non-resource owners.	√	√	-	√	-	√
CHANGES TO MARINE HABITATS						
Deterioration of mangrove systems.	√	√	√	√	-	-
Clearing of mangroves by settlers.	√	√	-	-	-	-
Deterioration of seagrass beds.	-	√	-	√	-	-
Deterioration in quality of estuaries and inshore areas due to land-based activities.	√	√	√	√	-	-
DESTRUCTIVE FISHING METHODS						
Use of <i>posin rop</i> by resource owners (for fish and squid).	-	-	√	√	√	-
Use of <i>posin rop</i> by poachers.	√	√	-	-	-	-

In all six study villages where harvesting of beche-de-mer and trochus has been occurring people reported depleted stock numbers, especially in habitats close to the village. The presence of commercial buyers of beche-de-mer and trochus is an important factor in the over-exploitation of these marine species (Plate 6.1). As discussed in Chapter 5 it is also possible that the collapse of the Copra Marketing Board (CMB) and the absence of cocoa buyers in the province for several years exacerbated these pressures in villages where alternative terrestrial-based income sources were limited.



Plate 6.1. Drying beche-de-mer at Uval Limited, Kimbe © G.N. Curry.

Only one village, Baikakea, follows the PNG National Fisheries Authority restrictions on the harvesting of beche-de-mer from October to February. In Tarobi and Potou villages, despite village efforts to ban the collection of beche-de-mer, people continued to harvest them to earn income. The study was unable to quantify the size of the market in these species because the Fisheries Department at Kimbe does not hold collated data on catches/exports of marine products including trochus and beche-de-mer, and there appears to be several illegal buyers visiting coastal communities. Like other areas of PNG and Melanesia (e.g., Milne Bay and the Solomon Islands), commercial fishing places new challenges on traditional management systems which are often unable to control the increased exploitation of resources. Also, it appears that the growing need and desire for cash is leading to the increasing commercialisation of resources, thereby altering how people perceive and value terrestrial and marine resources.

The poaching of marine resources by ‘outsiders’ was also considered to be an important factor explaining declining stocks of marine resources by people living in villages near urban centres, land settlement schemes or oil palm plantation compounds where migrant settlers reside. For example, Kulungi villagers are concerned with the number of poachers encroaching on their marine territory, particularly those residing at the nearby informal urban settlements of Gigo and Laleki. Many of these settlers have migrated from coastal areas of WNB where economic opportunities and services are limited (e.g., from Kombe, Arawe, Gloucester, Gasmata, Bali, Vitu) and from other coastal and island provinces of PNG. For many, fishing is their primary income source as they have very limited access to land. Several residents at Gigo and Laleki own boats with outboard motors which they use to travel to the outer reefs and islands to fish. Gigo settlement has the largest weekly fish market in Kimbe where traders, market vendors and local people come to purchase fish (Plate 6.2). Apart from the weekly market, settlers also sell to KBSA (Chapter 5). Although Gigo and

Laleki settlers are exploiting the marine resources of Kulungi resource owners, there is little competition with Kulungi villagers because fishing as a livelihood strategy has declined in importance at Kulungi (Chapters 4 and 5).

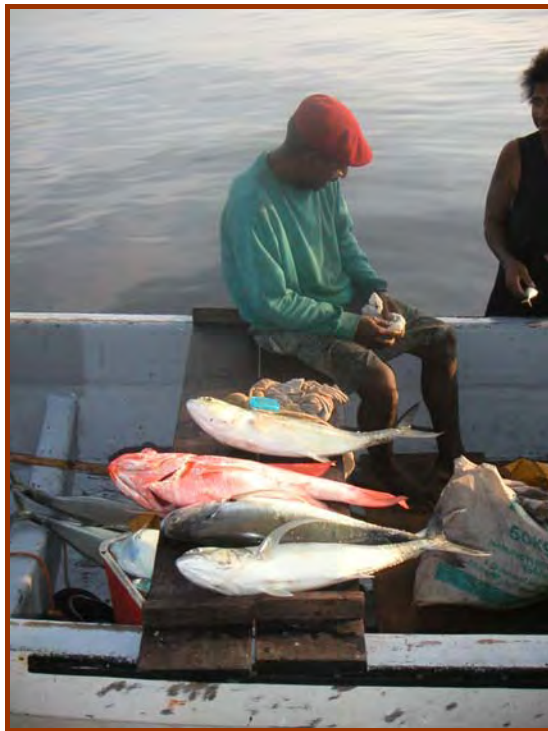


Plate 6.2. Fish sales at Gigo Settlement © G.N. Curry.

DESTRUCTIVE FISHING METHODS

With the exception of Baea Village, all villages partly attributed the decline in species abundance to destructive fishing methods. Indeed, during fieldwork, the researchers came across several incidences of destructive fishing methods being used (Plate 6.3). The most common destructive fishing methods used in Kimbe Bay include the use of:

- Derris root.
- Herbicides and pesticides.
- Dynamite.

Many villages raised concern over the widespread use of *posin rop* in fishing. We were unable to determine the extent of use of derris root, though villagers maintained that people were more selective with its use in the past. A common method in the past of catching large fish such as Tuna or Trevally was to place derris root inside a small fish which was used as bait. The baitfish laced with derris root was cast into an area where large fish were feeding, making the large fish easier to spear. Today, people, especially young men, use it less selectively to catch both large and small fish by dissolving the sap of the derris root in the water. The use of *posin rop* by poachers (claimed by village respondents to be ‘outsiders’) is also a major concern to the people of Gaungo and Kulungi village, though it should be noted that the traditional resource owners also use derris root.



Plate 6.3. Derris Root (*posin rop*) © G.N. Curry.



Plate 6.4. Fish caught using herbicide at Ulamona Wharf © J. Warku.

Herbicides and pesticides, although not as widely used as derris root, are used occasionally, though no-one reported it as a fishing method in the household surveys. However, as shown in Plate 6.4 herbicide is still used for fishing in Kimbe Bay.

The casting of small mesh size fishing nets along the beach fronts and inshore reefs is also a common method of catching fish. Although the topic of small mesh fishing nets was rarely raised in focus group discussions, it can be observed in the Bay and was noted by Seeto (2001) in his study at Patonga Village, Kimbe Bay.

ALTERATIONS TO MARINE & TERRESTRIAL HABITATS

The deterioration of marine habitats noted by several villages to explain species depletion is notable for its geographical concentration around villages close to urban centres, major waterways, large oil palm holdings (both estate and smallholders) and areas experiencing other significant land-use change, particularly forest clearance (Table 6.2). In contrast, the less accessible villages of Potou and Baea (Figure 1.1) were the only villages where marine habitats were perceived by village residents to be in good condition (Table 6.2).

Table 6.2. Villagers' perceptions of marine habitat status and causes of habitat change*.

HABITAT	STATUS OF HABITAT: IMPACTS, PERCEIVED CAUSES AND ACTION TAKEN
INSHORE SANDY FLATS	<p>Kulungi: Poor condition. Less fish species. <i>Perceived causes:</i> overuse of <i>posin rop</i> and dynamite and poachers. <i>Action:</i> use of dynamite has been controlled.</p> <p>Gaungo: Poor condition. Loss of big fish. <i>Perceived causes:</i> land use change, mangrove clearance for housing purposes and increased sedimentation. <i>Action:</i> no action taken.</p> <p>Tarobi: Poor condition. Less fish and shellfish. <i>Perceived causes:</i> logging and oil palm development causing increased sedimentation, resulting in harder surface. Overuse of <i>posin rop</i>, over-exploitation and development-related activities. <i>Action:</i> village-based ban on <i>posin rop</i> and fishing in the area east of Bilomi river to village seafront.</p> <p>Baikakea: Poor condition. Loss of some shellfish. <i>Perceived causes:</i> growth of Bialla town and urban development, logging activity around Bialla region, pollution of waterways. <i>Action:</i> complained to oil palm company regarding water quality.</p> <p>Potou: Good condition. Loss of some fish and shellfish. <i>Perceived causes:</i> over-exploitation and use of <i>posin rop</i>. <i>Action:</i> no action taken.</p> <p>Baea: Good condition.</p>
MANGROVES	<p>Kulungi: Poor condition. Less species of shellfish found. <i>Perceived causes:</i> mangroves cut for housing by settlers at Wandoro and Gigo/Laleki Settlement. <i>Action:</i> no action taken.</p> <p>Gaungo: Poor condition. Less species of shellfish found. <i>Perceived causes:</i> expansion of VOP and clearance of mangrove trees by settlers living at Gaungo. <i>Action:</i> no action taken.</p> <p>Tarobi: Fair condition. Less shellfish, especially kina shell. <i>Perceived causes:</i> mangrove mudflats hardened and reduced flow rate in river. <i>Action:</i> no action taken.</p> <p>Baikakea: Fair condition. Less shellfish, especially kina shell. <i>Perceived causes:</i> Mangrove mudflats hardened, increased sedimentation. <i>Action:</i> no action taken.</p> <p>Potou: No mangroves present.</p> <p>Baea: Good condition.</p>
ESTUARIES	<p>Kulungi: Fair condition. Less fish found. <i>Perceived causes:</i> chemical pollution and <i>posin rop</i>. <i>Action:</i> No action taken.</p> <p>Gaungo: Poor condition. Less shellfish and shallower water. <i>Perceived causes:</i> mudflats hardened, less trees, dirty water, chemical and fertiliser pollution. <i>Action:</i> no action taken</p> <p>Tarobi: Fair condition, no great change. Water flow slowed. <i>Perceived causes:</i> logging. <i>Action:</i> no action taken</p> <p>Baikakea: Poor condition. Reduced fish and increase in numbers of crocodiles. Dirty water and mudflats hardened. <i>Perceived causes:</i> urbanisation and forest clearance. <i>Action:</i> no action taken.</p> <p>Potou: No estuaries.</p> <p>Baea: Good condition.</p>
SEAGRASS	<p>Kulungi: Poor condition. Inshore area increased sedimentation, and seawater dirty.</p> <p>Gaungo: Poor condition: seagrass dieback. Less fish species and dugong less common. Sea front: sedimentation has increased, and area affected by sedimentation has increased. <i>Perceived causes:</i> land-use activities. <i>Action:</i> no action taken.</p> <p>Tarobi: Fair condition. Change has been gradual: area of seagrass increased. <i>Perceived causes:</i> Increased sedimentation. <i>Action:</i> no action taken.</p> <p>Baikakea: Fair condition. No more small seagrass, only big seagrass, some dieback. <i>Perceived causes:</i> increased sedimentation. <i>Action:</i> no action taken.</p> <p>Potou: Good condition.</p> <p>Baea: Good condition.</p>

HABITAT	STATUS OF HABITAT: IMPACTS, PERCEIVED CAUSES AND ACTION TAKEN
REEF SHALLOW	<p>Kulungi: Poor condition. Small fish only, less shellfish. Less species of shellfish found at inshore reefs, and at Numondo Island. Reefs covered in mud and dirty. <i>Perceived causes:</i> use of <i>posin rop</i>, poachers exploiting the reefs and urban development. <i>Action:</i> no action taken.</p> <p>Gaungo: Poor condition. Reefs dirty and colour of corals has changed. <i>Perceived causes:</i> chemical pollution, use of <i>posin rop</i>, and over-exploited by settlers and locals. <i>Action:</i> no action taken.</p> <p>Tarobi: Good condition. Only minor changes to fish stocks. <i>Perceived causes:</i> use of <i>posin rop</i>. <i>Action:</i> <i>posin rop</i> banned.</p> <p>Baikakea: Fair to poor condition. Sedimentation and some loss of fish and shellfish species. <i>Perceived causes:</i> flooding due to forest clearance and town development, oil spill pollution. <i>Action:</i> complained to oil palm milling company.</p> <p>Potou: Good condition. Some reduction in fish abundance. <i>Perceived causes:</i> over-exploitation. <i>Action:</i> no action taken.</p> <p>Baea: Good condition.</p>
REEF DEEP	<p>Kulungi: Poor condition. Less species found. <i>Perceived causes:</i> overexploitation. <i>Action:</i> tried to place restrictions but no cooperation.</p> <p>Gaungo: Fair condition. Change in colour of corals. <i>Action:</i> no action taken.</p> <p>Tarobi: Good condition. No changes.</p> <p>Baikakea: Fair condition. No more big fish. <i>Perceived causes:</i> use of <i>posin rop</i> and poaching. <i>Action:</i> no action taken.</p> <p>Potou: Good condition</p> <p>Baea: Good condition.</p>

* To assess people's perceptions of marine habitat status, villagers were asked to rank habitats by: 1) Good condition: no perceived significant change in habitat; 2) Fair condition: some loss of habitat quality, but not significant; and 3) Poor condition: perceived decline in habitat quality.

Mangroves, estuaries and inshore sandy flats were identified by Gaungo, Baikakea and Tarobi villagers as those habitats undergoing most change (Table 6.2). In general, villagers attributed the degradation of these habitats to a set of interrelated human-induced factors including:

- Expansion of oil palm (Gaungo and Baikakea).
- Logging (Tarobi and Baikakea) and associated increased soil erosion.
- Reduced flow rates of waterways (Gaungo, Tarobi and Baikakea).
- Increased sedimentation (especially of seagrass beds at Tarobi, mangroves at Gaungo and Baikakea, and estuaries at Gaungo).
- Clearing of mangroves (Kulungi and Gaungo).
- Pollutants, such as chemicals, waste effluents and occasional oil leakages (Gaungo and Baikakea).

Mangroves which are commonly exploited for shellfish and are important fish breeding grounds, were observed to have undergone modification through clearing (Kulungi and Gaungo) and what villagers described as a hardening of the mangrove mud flats resulting from increased sedimentation (Gaungo, Tarobi, Baikakea) and reduced flow rates of mangrove waterways (Tarobi). The hardening of the mud is perceived to be causing the decline in the abundance of several mangrove shellfish species, especially Kina shells, *Suba*, and *Makiri*. Mangrove clearance near the Ganuka and Dagi Rivers has increased over the years as customary landowners 'sold' land to migrants who cut mangrove timber for housing. Similarly, Kulungi villagers complained that mangrove clearance by settlers near Namodu River delta has led to declining shellfish stocks.

The 'sale' of customary land to migrant settlers by some Gaungo clan members and the informal 'rents' collected from Gigo and Laleki settlers by some Kulungi clan members, creates divisions within the host village which make it difficult at the village level to develop a coordinated response to environmental problems.

The people of Kulungi, Gaungo, Tarobi and Baikakea, have observed a gradual loss of water clarity and reduced flow rates in some of their estuaries (Table 6.2) which they associate with local industries such as oil palm and logging. Other changes to marine habitats are more difficult to explain. For example, Tarobi villagers reported that the area of seagrass has increased, while Gaungo and Baikakea villagers reported some contraction in the areal extent of seagrass beds. Villagers could not explain why these changes had occurred, although Gaungo villagers thought the increased muddiness of water resulted from land use change associated especially with logging and oil palm. High levels of sedimentation in estuaries, mangroves and tidal flats have been identified in earlier studies in Kimbe Bay (see TNC, 1994; Jenkins, 2000; Munday, 2003).

LOCAL CONSERVATION EFFORTS

While there is a perception among people in all six study villages that the over-exploitation of certain marine resources and destructive fishing or land-use practices are leading to declining stocks of some species, few strategies are in place to address the problem (see Appendices 1-6 and Table 6.2). For example, at Gaungo, although there is widespread awareness that the clearing of mangroves is among one of the major causes of the depletion of mangrove invertebrates, no restrictions have been imposed on felling mangrove trees. Similarly, although community discussions have highlighted the need to address over-harvesting of shellfish (e.g., Gaungo, Baikakea and Baea villages), minimal action has been taken. Thus, there are few commonly practiced conservation measures in place despite observations by villagers that certain marine resources are disappearing and some marine habitats are under stress.

Only Tarobi and Baea villages have introduced specific regulations to prevent excessive harvesting or to assist replenishment of resources. Tarobi Village has imposed a prohibition on fishing and using derris root in the inshore coastal zone east of Bilomi River to the village seafront where most impact has been observed. Tarobi Village has also introduced temporary closures of mangrove sites where shellfish abundance is declining. Recently, following awareness programs by TNC, Tarobi Village has imposed a ban on hunting dugongs. Likewise, Baea Village has introduced prohibitions on the use of dynamite for fishing.

Like other Melanesian societies, Kimbe Bay communities do not have a tradition of a strong conservation ethic. Several studies across Melanesia and beyond show that indigenous local knowledge and customary marine tenure principles have not always developed with conservation of resources in mind. Rather, as Aswani *et al.*, (2004, p.71) note, they are more likely to "have emerged from the need to increase fishing success and to appropriate the highest possible share of existing marine resources".

In Kimbe Bay, historically low population densities were likely to have lessened the need to develop conservation methods or a conservation ethic among coastal communities, especially if marine resources were perceived to be abundant and pressure on resources was low. Population density in the 1960s, prior to the establishment of land settlement schemes was estimated to be as low as 14 persons/mile² (Fleming and Kimble, 1980, cited in Torrens, 2000). Presently, with an average density of 130 persons/km² (Hanson *et al.*, 2001) and an annual population growth rate of almost 4%, together with rising material aspirations, communities have yet to develop measures to deal with the increasing pressures on both marine and terrestrial resources. Clearly, there is a pressing need to do so.

There are several other factors that partly explain why community efforts to save depleting resources are minimal. One reason relates to village hierarchy and authority. It is often difficult for people to suggest changes to marine practices because they lack the perceived status, skills, knowledge or authority in the village. In suggesting change, such people may be open to criticism and risk being humiliated by fellow villagers (usually more educated or those in paid employment) who may question their authority to comment by asking “*yu kisim dispela save bilong yu long wanem hap?*” (where did you obtain this knowledge?). The risk of public humiliation or ridicule makes it difficult for the community to collaborate to improve marine management practices, particularly when the required changes to fishing practices are large. Changes to marine practices are more likely to be endorsed and adopted by the community if the community and clan leaders support them (Chapter 3).

A further and related reason that partly explains the lack of strategies to address declining marine resources is the cultural trait amongst Kimbe Bay communities not to openly criticise the actions of others, even if wrongdoings are observed. Contemporary examples are the unfair distribution of royalty payments among landowning members that often occur with oil palm and logging, and the occasional ‘sale’ of land to non-clan members without the consent of all clan members. In a similar way, if a villager recognises a marine resource is being over-harvested by someone (e.g., for personal commercial gain) he/she will rarely raise the issue at a community meeting or forum. These underlying tensions within and between clans can create difficulties for projects that require the village as a whole to work together collaboratively.

Finally, Kimbe Bay communities display limited local knowledge of stock replacement processes. Local knowledge is not fully comprehensive in its understanding of the biological life cycle or concepts of population replacement of species such as beche-de-mer, trochus or some of the heavily exploited shellfish species. Hamilton *et al.* (2005), also note that in local knowledge surveys conducted on Grouper aggregation sites (GAS) in Kimbe Bay, peoples’ knowledge of GAS was minimal and contrasted greatly to the more detailed local knowledge of GAS found among other PNG coastal communities in Manus and Kavieng provinces. However, whilst detailed indigenous knowledge about the biology or ecology of local marine species may exist in other Melanesian communities, there are often gaps about important aspects of the life cycle of certain species and the relationships between over-exploitation and species decline (see Felt, 1994; Johannes, 1998; Foale, 2002). Knowledge of these relationships is crucial for the management and conservation of species.

LOCAL PERCEPTIONS OF MARINE RESERVES

Yet, despite few strategies in place to conserve marine habitats or resources under stress, all coastal communities in Kimbe Bay showed an interest in conserving their marine resources, and in establishing marine reserves within their marine territory (Box 6.1). Indeed, all coastal communities visited during this study showed support for the LLG Marine Environment Law, which enables resource owners to prosecute illegal poachers, fishers using illegal fishing methods, illegal buyers of beche-de-mer and trochus and buyers purchasing undersized beche-de-mer and trochus.

Box 6.1. Mr. Nick Buo, Gaungo Village Councilor: thoughts on conservation (recorded interview).

My name is Nick Buo and I am originally from Mai Village and because there were some minor problems in Mai, I came over and settled here at Gaungo with my relatives and I've been here for quite a long time. I have recently been voted in as Gaungo's Councillor and I am very happy that the officers of The Nature Conservancy have come to our village and made us aware of conserving our marine resources and mangroves. Today, our water and marine resources are not in good condition because the area is used by the wider public and that is not good because these areas were once sacred according to our customs and it is also our customary area where our people collected marine resources for custom work or other rituals and ceremonies. But today, it is very difficult for us to find some marine resources like big fish and shellfish, especially certain shellfish in the river which our ancestors used in the past. There are many different people who have settled with us and in our area and this has created competition for marine resources, so we are very glad and I thank TNC for working together with us and supporting us in trying to restore our disappearing marine resources - especially the creation of the LLG Marine Law or other things that will try to restore our marine resources to their original state. So on behalf of myself and my people of Gaungo, I'd like to thank Joseph and his officers from The Nature Conservancy for trying to get the conservation message across and support us and work with us to preserve our resources. We cannot do much about it because we do not have the money and expertise to help do this kind of task and I thank your group for similar support in the future. And I would like to thank your group once again for their good work in our community. And we, especially me, believe that in the future, there will be good results from this work. This is the first time we have experienced or received this type of help. Many men and women today do not see how important conservation is so we are happy and thank you for choosing Gaungo to support us to achieve harmonious living with nature in the future. That's all and thank you very much.

Villagers' interests in marine reserves are diverse and include desires to:

- Control illegal poachers who fish and harvest marine resources within their customary marine areas.
- Establish permanent closures in potential spawning aggregation sites (SPAGS), tourist dive sites, sites of high cultural heritage value and areas of high value endemic species.
- Apply half closure or semi-permanent closure regulations in regular fishing areas.
- Identify open access areas for fishing.
- Have access to research and information on marine issues important to improving their understanding of the relationships between the various marine habitats and ecosystems. For example, requests have been made for scientific studies to be conducted on the reproduction cycle of some of the heavily exploited fish (e.g., Red Emperor, Grouper and Trevally) and shellfish (e.g., clam shells and Kina shells).

SUMMARY

People perceived a decline in the abundance of the most commonly exploited marine resources across all villages which they commonly attributed to over-exploitation for subsistence, artisanal and, to a lesser extent, commercial purposes. Alterations to marine and terrestrial habitats and destructive fishing methods were also seen as contributing to the decline of certain marine species.

The relative importance of the factors explaining the decline in species abundance differs between the more accessible and less accessible villages. In the more accessible villages of Kulungi, Baikakea and Gaungo, marine resources are now of less importance in the cash income strategies of villagers (they have a wider range of income options) than in the more remote villages of Baea, Potou and Tarobi. So, the perceived decline in the abundance of some species in high accessibility villages is probably less to do with over-exploitation of those species, and more to do with habitat degradation associated with general population growth and changing land use practices (e.g., road infrastructure, urban and agricultural development). Conversely, in the less accessible villages where habitat quality is still perceived to be good, the decline in the abundance of some species may reflect over-exploitation of these species for cash income. The relative importance of these factors (impacts on marine habitats resulting from changing land use practices and direct over-exploitation of marine resources) requires further investigation by TNC.

7. CONCLUSION & STRATEGIES FOR DESIGNING EFFECTIVE MPAS

INTRODUCTION

Resource owners in Kimbe Bay are facing several challenges including changing village socio-political systems (undermining of traditional structures of village authority), rapidly expanding urban and rural populations, the encroachment of poachers of marine resources from outside the customary resource-owning groups, growing use of destructive fishing methods, rising cash needs and, in some areas, the recent collapse of established income sources such as copra. Further, the exploitation of land and sea resources by coastal communities is shifting from a subsistence orientation to a market orientation and this is changing how people value resources. These environmental, social and economic changes are impacting on local marine management systems and therefore present challenges for the design of effective MPAs.

Previous studies in Kimbe Bay (Allen and Munday, 1994; Cinner *et al.*, n.d.) concluded that fishing pressure is relatively low. The evidence from this study concurs with this view. The study shows that, generally, subsistence fisheries are not placing too much pressure on the marine resources of the Bay (see below for further discussion). Also, brief surveys carried out at the Kimbe and Ulamona markets together with fish sales data from KBSA indicate that the quantities of fish sold locally in formal and informal markets are not substantial.

However, this is not to suggest that localised pressure on marine resources does not exist. There is considerable pressure on exportable marine resources, such as beche-de-mer and trochus, which provide income for a large proportion of households in Tarobi, Potou and Baea villages, and therefore can be considered at risk. Also, in all six study villages, people perceived to varying degrees a reduction in the abundance of the most commonly harvested marine resources. Shellfish in particular were considered to be under pressure from over-exploitation for subsistence and artisanal purposes, and declining stocks of crustaceans (particularly lobster and mangrove crabs) were reported among several communities, including Gaungo, Kulungi, and Baikakea villages. Several fish species associated with seagrass habitats and in-shore areas were identified as declining in numbers (including Rabbit fish, Mackerel Scads, small Trevally, small Mullet and Yellow-Tail Scads). Over-exploitation of marine resources (by both resource owners and poachers), degradation of marine habitats, and destructive fishing methods were seen as the main causal factors in the declining abundance of the above mentioned marine resources.

The deterioration of marine habitats is notable for its geographical concentration around villages close to urban centres, major waterways, large oil palm plantings and logging activities, or in those habitats that are frequently utilised by villagers (e.g., mangroves, inshore sandy flats and inner reefs). Mangrove systems, estuaries and inshore sandy flats were identified by people at Kulingi, Gaungo and Baikakea as those habitats experiencing most change as evidenced by one or more of the following: increased sedimentation levels, reduced flow rates of waterways, mangrove clearance or reduction in water clarity. These villages also perceived the greatest decline in shellfish abundance. In contrast, villagers reported less or no decline in habitat condition in the remote villages of Potou and Baea, and to a lesser extent Tarobi. Yet, these villagers are placing greater pressure on marine resources through direct exploitation for subsistence and particularly cash income.

MPA DESIGN STRATEGIES

The key strategies outlined below to assist in the design of a successful network of locally managed marine areas draw on local knowledge and information gathered during this study. In this study local people have:

- Identified several marine species they claim to have declined in abundance and they suggested possible causes for the decline (Appendices 1-6 and Table 6.1).
- Identified the marine habitats under greatest pressure (Table 6.2).
- Identified potential causes of ecological decline (Tables 6.1 and 6.2).
- Outlined local marine management practices (Chapters 3, 4, 5 and 6).
- Described the main principles of customary marine tenure (Chapter 3).
- Documented some aspects of their cultural marine heritage (Chapter 3).

This local knowledge and information should be incorporated into the design of MPAs and be used as a basis to formulate conservation strategies and management systems including monitoring tools to conserve and improve stock abundance and reduce the deterioration of marine habitats.

Further, in the process of developing and designing MPAs with Kimbe Bay communities, it is necessary to develop effective and participatory decision-making relationships with marine resource holders. As customary marine resource holders, villagers will expect to fully participate in any decision-making concerning the design and implementation of marine reserves. They will also expect to continue to maintain and exercise control over their marine resources should a marine reserve be established. Thus, it is important that these expectations are recognised and accommodated by TNC to ensure a strong cooperative working relationship between TNC and resource holders.

Also, a likely question that will be on resource owners' lips will be "what will we get out of this marine reserve concept?" There may be an expectation placed on TNC of an element of reciprocity for granting assistance with the project or complying with whatever regulations or practices eventuate regarding the use of marine resources. This may raise expectations of some financial assistance such as a boat or boat engine so that villagers can police their MPA. Indeed, villagers' expectations may sometimes not match those of TNC. For example, in discussions with people in villages where poaching occurs, MPAs are viewed as a means to exclude outsiders from local fishing grounds, and this control over fishing rights may be driving villagers' desire to work with TNC rather than conservation *per se*. For instance, Kulungi villagers are resentful of Laleki 'squatters' who go night fishing on distant reefs and who earn a good income from fishing, even though Kulungi villagers do not fish these reefs themselves. Some Kulungi villagers see the MPA as a way to curtail the activities of 'squatters' who they believe are earning money from their resources.

Moreover, it is likely a marine reserve will only be successful if villagers see that they can accommodate it without too much disruption to their subsistence and cash income activities and their aspirations for better living standards. If a significant proportion of the village population feels that an MPA may undermine their livelihoods (e.g., reduced income from fishing or from hunting turtles), then the MPA is unlikely to be sustained in the longer term. It is also important for TNC to recognise at the time of designing a MPA, that villagers may not fully appreciate how, or the full extent of the impact of an MPA on their livelihood options. The potential impacts of MPAs on the livelihood options of villagers should be explained fully before reaching MPA agreements. For example, the likely impact of

particular restrictions on the livelihoods of particular village families should be determined, together with an assessment of potential alternative income sources for affected families.

Drawing on the work of Chapman (1991), Ruddle (1998), Johannes (1998), and Aswani (1999), this study identifies the following elements as essential for an effective marine management system:

- Traditional resource tenure boundaries are well defined and upheld (Ruddle, 1998; Aswani, 1999).
- Fishing rights and regulations are accepted and not disputed (Ruddle, 1998; Aswani, 1999).
- Access by outsiders is regulated (Ruddle, 1998; Aswani, 1999).
- Traditional management systems are compatible with government policy (Ruddle, 1998).
- Resource owners' recognition of and commitment to conservation is high (Chapman, 1991; Johannes, 1998; Ruddle, 1998).
- Community cohesiveness (Johannes, 1998) and consensus on management issues is present (Chapman, 1991; Johannes, 1998).
- Respect for village leadership and authority is upheld (Chapman, 1991; Johannes, 1998).

The strength of these elements in the six study villages is summarised in Table 7.1. Where these essential elements are absent or weak, it is likely that the objectives and implementation of the MPA will be compromised. In these situations, strategies must be devised to address these potential barriers to the design and implementation of an effective MPA system.

Yet, addressing some of these elements is not easy nor without risks. For example, despite community-wide prohibitions on using *posin rop* in some villages such as Tarobi and Baea, evidence of its continuing use by Tarobi villagers was observed during fieldwork. Similarly, one of the difficulties of community-imposed restrictions and other control measures are the overlapping secondary rights to marine resources across the Bay which allow widely dispersed clan members and local minor clan members to freely pursue subsistence and artisanal fishing or the collection of marine invertebrates (Chapter 3). For instance, as explained in Chapter 3, a member of a major clan in the western part of Kimbe Bay may have stronger rights to the marine resources in a village in the eastern part of Kimbe Bay than a resident from a minor clan in the eastern Kimbe Bay village. Thus, without strong leadership and endorsement by major resource-owning clans, compliance with fishing/harvesting regulations will be difficult to enforce.

Table 7.1. Effectiveness of local management and tenure systems for Kimbe Bay villages.

	KULINGI	GAUNGO	TAROBI	BAIKAKEA	POTOU	BAEA
Traditional boundaries well defined and upheld	* **	* **	* **	* **	* **	* **
Fishing rights and regulations enforced	*	*	**	**	**	* **
Exclusion of outsiders is controlled	*	*	**	**	**	**
Resource owners' commitment to conservation	**	**	**	**	**	* **
Community cohesiveness and consensus on management issues	*	*	**	**	* **	* **
Respect for village leadership regarding marine management	**	**	**	**	**	* **

*
*=weak **=moderate **=strong

Likewise, regulating outsiders' access to marine resources is fraught with difficulties and attempts to do so through an MPA must be handled sensitively to prevent existing tensions between customary landowners and outsiders from worsening. This is particularly an issue in Gaungo and Kulingi villages where large numbers of migrants are either living on customary land or on nearby State land that has been alienated from customary ownership.

Moreover, addressing the issue of poaching is made more difficult by the range of relationships (e.g., friend, land buyer and seller, or 'rent' collector) that have developed between individual members of resource-owning groups and outsiders. At Kulungi, for example, some clan members were collecting 'rent' for access to garden land and were regularly receiving 'gifts' of fish from settlers at Gigo and Laleki. These sorts of relationships make it difficult to reach community consensus on enforcing fishing rights and regulations with regard to outsiders. Finally, it must be remembered that many residents of Laleki and Gigo settlements are almost totally dependent on fishing for their livelihoods. These communities are atypical, in the sense that their land tenure is insecure, the area of land to which they claim rights is extremely limited (sometimes just a house site), and the range of livelihood options is very narrow. Restrictions imposed by landowners on the livelihoods of settlers as a result of MPA agreements are unlikely to be accepted passively by settlers.

Other management-related issues that should be considered for each surveyed village when designing MPAs are summarised in Table 7.2. Village accessibility has been highlighted in the table because acknowledging the role of accessibility on marine resource use, income opportunities and quality of marine habitats is necessary for designing sustainable TNC MPA agreements and setting priorities for conservation awareness in the Bay.

Table 7.2 Management issues for consideration in the design of Marine Protected Areas for Kimbe Bay villages.

VILLAGE CHARACTERISTICS	KULINGI	GAUNGO	TAROBI	BAIKAKEA	POTOU	BAEA
Location accessibility	Urban village close to Kimbe and markets. Accessibility ranking=1	Near Kimbe and urban markets. Accessibility ranking=3.	Remote from major population centres. Accessibility ranking=4.	Close to Bialla and workers compounds Accessibility. ranking=2.	Remote with no road access Accessibility ranking=5.	Remote with no road access Accessibility. ranking=6.
Marine customary tenure	Operational	Operational	Operational	Operational	Operational	Operational
Range of economic livelihood options	Diverse	Diverse	Moderate	Diverse	Limited	limited
Top four income sources	Oil palm Dry coconuts Cocoa Garden food	Oil palm Fish Betel nut Garden food	Oil palm Beche-de-mer Fish Betel nut	Oil palm Fish Dry coconuts Shellfish	Fish Betel nut Copra Cocoa	Fish Betel nut Sago
Access to markets and employment	High	High	Moderate to high	High	Low	Low
Economic dependence on marine resources	Low	Low, but varies among households.	Moderate to high.	Low, but varies among households.	High	High
Subsistence dependence on marine resources	Low	Medium	Medium to high	Medium	High	High
Top three most frequently consumed fish	Rabbit fish Mullet Red Emperor	Trevally Mullet <i>Carangidae</i>	Trevally Rabbit fish Mullet	Trevally Mullet Rabbit fish	Tuna Trevally Surgeon fish	Trevally Spanish Mackerel Tuna
Top three most frequently consumed shellfish	Ark Clam Kina shell <i>Strombus Luhuanus</i>	Kina shell <i>Strombus Luhuanus</i> Ark clam	Kina shell Burrowing Giant Clam Goh (unidentified)	Kina shell Ark Clam <i>Strombus</i> sp.	Trochus shell Burrowing Giant Clam <i>Strombus Luhuanus</i>	Kina shell Burrowing Giant Clam <i>Strombus</i> sp.

VILLAGE CHARACTERISTICS	KULINGI	GAUNGO	TAROBI	BAIKAKEA	POTOU	BAEA
Marine habitats areas perceived to have deteriorated	Inshore sandy flats, Mangroves.	Inshore sandy flats, Mangroves, Estuaries.	Inshore sandy flats, Mangroves.	Inshore sandy flats, Mangroves, Estuaries.	None	None
Marine resources perceived to have declined most in abundance	Giant clam; kina shells; other shellfish found in inshore sandy flats, inner reefs & seagrass beds; seaweed; lobster; turtles; crabs; eels; turtle eggs; Stingray; crocodiles.	Giant clam; kina shells; shellfish found in mangroves; sea urchins; Rabbit fish; Barracuda; Shark; Stingray; Saw Shark; lobster; turtles; turtle eggs; squid; seaweed; mud crab; prawns.	Kina shells; Giant Clam; clams; other shellfish found in mangroves, inshore sandy flats, & inner reefs; sea urchins; Trevally; Tabule (unidentified fish); lobster.	Giant clam; kina shells; other shellfish found in inshore sandy flats, & inner reefs; large Mullet; Rockcod, Long Tom; Stingray; lobster; crabs; prawns; seaweed; squid; turtles; turtle eggs.	Giant clam; other shellfish found in inner & outer reefs; Red Emperor; Rainbow runner; Spanish Mackerel; Snapper; Surgeon fish; Scad, Flying fish; lobster; prawns; squid; turtles; crocodiles.	Kina shells; Red Emperor; Redtail.
Over-exploitation of commercial marine species	Trochus, beche-de-mer (low pressure).	Trochus, beche-de-mer (low pressure).	Trochus, beche-de-mer (high pressure).	Trochus, beche-de-mer (low pressure).	Trochus, beche-de-mer (high pressure).	Trochus, beche-de-mer (high pressure).
Perceived pressures on marine habitats	Mangrove clearance. Use of <i>posin rop</i> . Increased sedimentation. Urban development.	Mangrove clearance. Increased sedimentation. Expansion of oil palm. Polluted waters. Over-exploitation.	Use of <i>posin rop</i> . Over-exploitation. Increased sedimentation.	Over-exploitation. Increased sedimentation. Urban development. Forest clearance. Expansion of oil palm.	Over-exploitation.	No perceived pressures.
Measures taken to halt decline in marine resources or habitat destruction	Minimal	Minimal	Minimal	Minimal	Not yet perceived as a problem.	Not yet perceived as a problem.

VILLAGE CHARACTERISTICS	KULINGI	GAUNGO	TAROBI	BAIKAKEA	POTOU	BAEA
Interest in preserving marine resources	Moderate	High	High	High	High	High

The relationship between village accessibility and the type and range of income strategies pursued can be demonstrated by the distance decay model in Figure 7.1 where the example of garden foods like sweet potato is compared with betel nut and fish. Sweet potato (and many other garden foods) is more profitable than betel nut when cultivated within a certain radius of the market, beyond which betel nut becomes more profitable. This is important for ascertaining the likely sustainability of MPAs. For example, villages with high accessibility will find it easier to reduce their subsistence and cash dependence on marine resources than isolated villages because they have a greater range of income options open to them. Thus, an MPA agreement to ban the hunting and sale of turtle meat, for example, may be more difficult to achieve in Potou, Baea and Tarobi than in Baikakea or Gaungo because the former villages are much more dependent on sales of turtle meat, and have fewer alternative options for earning cash income.

Similarly, the promotion of garden crops as an income source to reduce dependence on income from marine resources is less likely to succeed in Baea and Potou, because of the high cost of transporting these crops to market. Strategies that promote the cultivation and sale of high value to volume/weight products like betel nut and tobacco are more likely to be sustainable because they generate viable incomes for people that can replace reduced income from marine products.

The accessibility criterion should also help predict the types of pressures present in particular villages. While fishing intensity/frequency to earn cash income may be higher in low accessibility areas, pressures on habitats will increase with accessibility. High accessibility areas have more infrastructure (roads, cash crops and urban developments, etc.) and larger populations (people migrating into the area because of employment opportunities) than low accessibility areas and therefore will generate greater impacts on habitats (e.g., cutting of mangroves for timber, and sedimentation of estuaries). Thus, the conservation pressures are different between low and high accessibility areas, and these should be taken into account in MPA planning and education campaigns (see below for further discussion).

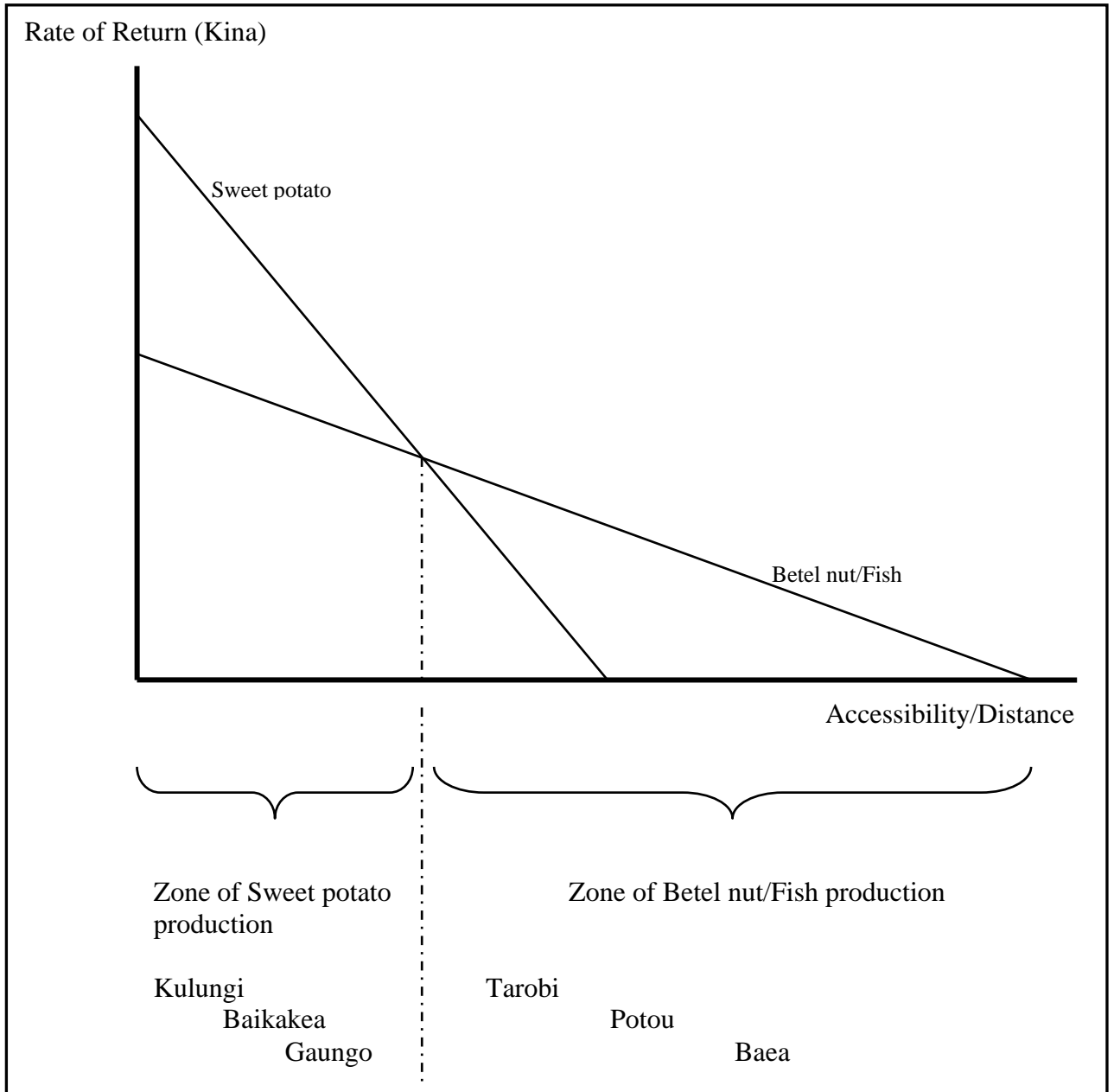


Figure 7.1. Distance decay model depicting potential returns from various income sources at different levels of accessibility.

Other recommendations to assist in the design of a successful network of locally managed marine areas are to:

1. Expand conservation education campaigns in Kimbe Bay.
2. Identify conservation champions in the community and villages to spearhead conservation efforts.
3. Conduct further social research on marine resource utilisation to monitor changes in livelihoods resulting from TNC-led initiatives to establish MPAs.

Expand conservation education campaigns in Kimbe Bay

The continuation of educational campaigns is essential for raising local awareness of marine conservation issues in Kimbe Bay. As outlined in Chapter 6, concepts of conservation, knowledge of species population dynamics, and strategies to preserve marine resources and habitats under pressure are minimal amongst villagers. However, despite the lack of action to overcome environmental pressures on marine resources and habitats, many villagers acknowledge that these problems require attention, but are unclear how to tackle them.

To date, educational awareness by TNC has received much community support, as evidenced by the 2006 Clean-up Kimbe Bay campaign conducted on World Environment Day and led by TNC in association with private businesses and the provincial government. The impact of environmental education has also proven effective in several villages including Tarobi, Potou, and Baea where villagers have recently agreed to impose restrictions on the harvesting of certain marine species following TNC environmental awareness programs. The Pride Campaign to protect the dugong has also successfully raised awareness and support for conservation of this mammal. Although not all villages have imposed restrictions on fishing or harvesting shellfish, there have been notable changes in some areas regarding their appreciation of marine environments, especially amongst school children. The current strong support for the work of TNC indicates that future educational awareness programs in the Bay are likely to be successful.

Some new directions for future educational awareness in the Bay include expanding the target groups for awareness programs. To date, the educational campaigns conducted in Kimbe Bay have targeted primary and secondary school children with only a limited amount of work conducted at the village level. However, there is a need to involve people in the village including younger families and especially women. As discussed elsewhere in this report, women are heavily involved in the utilisation of marine resources, especially the harvesting of marine invertebrates. By involving a broader cross-section of the community in each village, it is more likely that people will begin to feel that they have the capacity to instigate changes to conserve marine resources rather than be passive bystanders as the quality of their marine resources is eroded.

In addition, there is a need to involve other stakeholder groups such as people from the informal settlements, plantation compounds, oil palm companies, logging companies, other private sector enterprises and church groups. This would help make conservation issues in the Bay a priority for the whole community, not just the coastal villagers and resource owners. It would also validate the conservation efforts of villagers, by highlighting its importance to all members of the broader Kimbe Bay community.

The accessibility criterion discussed above is also relevant for guiding the focus of educational campaigns in different areas of the Bay. For example, the educational awareness programs in highly accessible villages such as Kulungi, Gaungo and Baikakea should focus on habitat conservation and emphasise relationships between land-use practices and impacts on marine habitats. In the more remote villages like Potou and Baea, where habitat

disturbance is minimal, more emphasis should be given to issues concerning the over-exploitation of particular species for commercial gain. In these villages, conservation awareness should place a strong focus on population dynamics and sustainable harvesting of commercial species.

In summary, the broad areas of education and training which could be pursued to assist with the success of MPAs include the following:

- Improve peoples' knowledge of conservation concepts and the need for conservation (focus on generational obligations to maintain marine resources intact for future generations).
- Develop a more detailed knowledge among resource owners of stock-recruitment dynamics and the relationship between exploitation of a particular resource and its future supply/yields (sustainable yields).
- Promote and support the implementation of sustainable management practices for commercial exportable marine products.
- Increase awareness of the environmental impacts of destructive fishing methods by highlighting how such methods erode the productive capacity of marine habitats.
- Improve awareness of the impacts on marine resources of mangrove and forest clearance.
- Identify conservation priorities in each area so that the most at risk habitats and marine species are targeted for protection.
- Stress the ecological value and role of over-exploited species and marine habitats (e.g., the role of mangroves as fish nurseries).

Identify conservation champions in the community and villages to spearhead conservation efforts.

Community support and participation in the design and implementation of local MPAs may be enhanced through the identification and support of local 'Conservation Champions'. Conservation champions may be people chosen from the village or wider local community who are respected and trusted in their respective communities and who will work to promote the conservation of marine environments and resources. Two categories of conservation champions have been identified by those working in the Kimbe Bay Marine Conservation Project:

- Decision makers/local level government and ward councillors.
- Community development facilitators.

The first category involves people employed in the community who are recognised for their managerial or decision-making skills and who are willing to contribute time voluntarily to support local conservation efforts. Such people may include local councillors, village court magistrates, village committee members, school teachers, church leaders, environmental officers, local politicians, fisheries officers and other government officials. As leaders with authority and respect, these people will be in a strong position to mobilise community support for TNC initiatives, and their endorsement of TNC activities will give credibility to these activities.

The second category are community development facilitators (CDF), drawn from local resource owners at the village level. CDFs should be trained and employed by TNC to conduct regular biological monitoring and reporting, and to act as TNC village representatives in their respective communities. By nominating a CDF in each village where an MPA is proposed, community ownership of the project would be enhanced.

Conduct further social research on marine resource utilisation to monitor changes in livelihoods resulting from TNC-led initiatives to establish MPAs.

The diverse factors villagers identified to explain the decline of certain marine resources and the deterioration of marine habitats (Chapter 5) require scientific investigation. Although the information gained from the focus group discussions was based on villagers' long-term observations and personal experiences (Chapter 6), empirical data are required to assess the validity of their claims. In particular, research should be conducted on those shellfish and fish species (e.g., Kina shells, Mullet, etc.) and commercial sedentary resources identified by villagers as declining (Appendices 1-6). Further, a scientific assessment of shellfish biodiversity and the status of shellfish in Kimbe Bay is necessary given the importance of shellfish in diets and as a cash income source for women. Many shellfish noted in this study remain unidentified.

Further, the perceived pressures on mangrove habitats near urban centres require further investigation, given the strong connectivity of the Kimbe Bay mangroves with adjacent coastal habitats. As Sheaves, (n.d., p. 9) notes:

... the most obvious and important feature of the biology of Kimbe Bay mangrove systems is their strong connectivity with adjacent sand, seagrass and freshwater habitats. Although Kimbe Bay mangroves support a typical assemblage of vertebrates and invertebrates, these assemblages overlap greatly with the fauna of the other three habitats. Given the extensive usage of coastal habitats in Kimbe Bay by small juvenile fishes, and the clear faunal overlap between habitats, it is clear that processes occurring in one habitat must impact strongly on the others.

During this study, villagers from Kulungi, Gaungo, and to a lesser extent Tarobi and Baikakea, claimed that their mangroves were under direct pressure as a source of timber and firewood, and from the over-exploitation of species dependent on mangrove habitats. At this stage, it is difficult to determine the extent of degradation of this resource, and it is an area requiring urgent investigation.

Finally, it would be useful for future planning of TNC to monitor changes in livelihood strategies following the introduction of MPAs in the Bay. Such monitoring would provide data about the livelihood impacts of MPAs and help identify social and economic factors that affect the sustainability of MPAs. Such information would be useful for planning future activities in Kimbe Bay and elsewhere.

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APPENDICES

APPENDIX 1

KULUNGI VILLAGE MARINE RESOURCES FOCUS GROUP

VILLAGERS' PERCEPTIONS OF THE MARINE RESOURCES THAT HAVE CHANGED IN ABUNDANCE AND SIZE

RESOURCE	CHANGE IN ABUNDANCE	CHANGE IN SIZE	PERCEIVED CAUSE OF CHANGE	LOCATION OF GREATEST CHANGE	ACTIONS TAKEN TO ADDRESS PROBLEM
SHELLS					
TAVURE (Reefs: deep and shallow, open bottom)	Decreased Uncommon	Not sure	Urban village: the public uses the habitat to collect shellfish spp.	Numondo to Gigo	No action
TROCHUS	Decreased Uncommon	Not sure	Urban village: the public uses the habitat to collect shellfish	Numondo to Gigo	No action
VAIKE (Reefs: shallow, seagrass)	Decreased Uncommon	Reduced	Urban village: the public uses the habitat to collect shellfish	Numondo to Gigo	No action
KUKU (Seagrass)	Decreased Uncommon	Reduced	Urban village: the public uses the habitat to collect shellfish	Numondo to Gigo	No action
MEKI (Reefs: shallow)	Decreased Uncommon	Reduced	Urban village: the public uses the habitat to collect shellfish	Numondo to Gigo	No action
LEMU (Inshore sandy flats)	Decreased Uncommon		Urban village: the public uses the habitat to collect shellfish		No action
GIANT CLAM	Large decrease Rare	Not sure	Urban village: the public uses the habitat to collect shellfish	Outer reefs	No action
FISH					
PALO (big fish) (Reef: deep, open sea)	Decreased Uncommon	Reduced	Overfishing by outside fishermen <i>Posin rop</i> Chemicals	Numondo to Gigo	No action
LOGOLOGO (snake type fish) (Reefs)	Decreased Rare		Cause Not known	Numondo to Gigo	No action

RESOURCE	CHANGE IN ABUNDANCE	CHANGE IN SIZE	PERCEIVED CAUSE OF CHANGE	LOCATION OF GREATEST CHANGE	ACTIONS TAKEN TO ADDRESS PROBLEM
STINGRAY	Decreased. Uncommon		Poaching by outside fishermen	Kimbe Island to Gigo	No action
CRUSTACEANS AND OTHER SPECIES					
LOBSTER	Decreased	Reduced	Overharvesting <i>Posin rop</i>	Numondo reefs to the reefs outside of Gigo	No action
CRABS	Decreased greatly	Reduced	Overharvesting by both locals and outsiders	Numondo reefs to the reefs outside of Gigo	No action
CRABS MANGROVES	Common	Reduced	Overharvesting	Numondo	No action
PRAWNS	Common	Reduced	Overharvesting by locals themselves		No action
PISLAMA	Decreased Rare	Reduced drastically	Overharvesting by outsiders	Whole sea area belonging to Kulungi	No action taken but plans are underway
SEAWEED	Decreased Rare	Reduced	Sedimentation	Numondo to Gigo	No action taken
CROCODILE	Decreased Rare	Not sure	Not known		No action
RABOLOKEA (White eel) (Reefs and seagrass)	Decreased greatly	Same	Overharvesting by outsiders	Numondo to Gigo	No action
RABOLOKEA-MELEO (Black eel) (Reefs and seagrass)	Decreased greatly	Same	Overharvesting by outsiders at Gigo/Laleki settlements	Numondo to Gigo	No action
RABOLOKEA (unidentified)	Decreased greatly	Same		Numondo to Gigo	No action
TURTLES					
TURTLE	Less common	Not sure	Overharvesting	Need to go out further to find turtles	No action
TURTLE EGGS	Rare	Not sure	Overharvesting		No action
CETACEANS					
WHALES	Rare	Not sure	Mobile: see them only in deep blue sea	Further outside the ocean	Can't do anything No action

RESOURCE	CHANGE IN ABUNDANCE	CHANGE IN SIZE	PERCEIVED CAUSE OF CHANGE	LOCATION OF GREATEST CHANGE	ACTIONS TAKEN TO ADDRESS PROBLEM
DOLPHINS	Sightings less	Not sure	Mobile: see them only in deep blue sea	Further outside the ocean	Can't do anything No action
DUGONGS	Rare	Not sure	No more seagrass so less number of dugongs	Rarely seen today. Before sighted at Numondo	No action

APPENDIX 2

GAUNGO VILLAGE MARINE RESOURCES FOCUS GROUP

VILLAGERS' PERCEPTIONS OF THE MARINE RESOURCES THAT HAVE CHANGED IN ABUNDANCE AND SIZE (attendees = 22)

RESOURCE	CHANGE IN ABUNDANCE	CHANGE IN SIZE	PERCEIVED CAUSE OF CHANGE	LOCATION OF GREATEST CHANGE	ACTIONS TAKEN TO OVERCOME PROBLEM
SHELLS					
KASI (Mangroves)	Decreased substantially	Reduced	Mangrove mud changed from swampy and soft to hard. Mangroves cleared Public use – no control Over-harvested	Dagi – Takekel 1. Dagi, Tuvau, Kumandae, Lakatubu, Nahovi 2. Papuni, Nalukubauru, Balimu 1 & 2 3. Lilinakou, Nakumala 4. Takekele, NU	No action taken. No control
KITOPE (Mangroves)	Decreased substantially	Reduced	Mangrove mud changed from swampy and soft to hard Mangroves cleared Public use – no control Over-harvested	Dagi – Takekel 1. Dagi, Tuvau, Kumandae, Lakatubu, Nahovi 2. Papuni, Nalukubauru, Balimu 1 & 2 3. Lilinakou, Nakumala 4. Takekele, NU	No action taken. No control
KOVAKOVA (Mangroves)	Decreased substantially	Reduced	Mangrove mud changed from swampy and soft to hard Mangroves cleared Public use – no control Over-harvested	Dagi – Takekel 1. Dagi, Tuvau, Kumandae, Lakatubu, Nahovi 2. Papuni, Nalukubauru, Balimu 1 & 2 3. Lilinakou, Nakumala 4. Takekele, NU	No action taken. No control
LELEMO (Mangroves)	Decreased substantially Rare	Reduced	Mangrove mud changed from swampy and soft to hard Mangroves cleared Public use – no control Over-harvested	Dagi – Takekel 1. Dagi, Tuvau, Kumandae, Lakatubu, Nahovi 2. Papuni, Nalukubauru, Balimu 1 & 2 3. Lilinakou, Nakumala	No action taken. No control

RESOURCE	CHANGE IN ABUNDANCE	CHANGE IN SIZE	PERCEIVED CAUSE OF CHANGE	LOCATION OF GREATEST CHANGE	ACTIONS TAKEN TO OVERCOME PROBLEM
				4. Takekele, NU.	
BETA (Mangroves)	Great change. Rare	Great reduction	Mangrove mud changed from swampy and soft to hard Mangroves cleared Public use – no control Over-harvested	Dagi – Takekel 1. Dagi, Tuvau, Kumandae, Lakatubu, Nahovi 2. Papuni, Nalukubauru, Balimu 1 & 2 3. Lilinakou, Nakumala 4. Takekele, NU	No action taken. No control
KUMORO (Mangroves)	Decreased	Reduced	Unknown	Dagi – Takekel 1. Dagi, Tuvau, Kumandae, Lakatubu, Nahovi 2. Papuni, Nalukubauru, Balimu 1 & 2 3. Lilinakou, Nakumala 4. Takekele, NU	No action taken
RAMAI (redish purple shell) (Mangroves)	Decreased greatly	Reduced	Mangrove mud changed from swampy and soft to hard	Dagi river mouth	No action taken
GOH (Inshore sandy tidal flats)	Decreased greatly Rare				No action taken
SEA URCHINS	Decreased greatly	Reduced	Muddy reefs Reefs are covered with excessive mud and dusty Use of chemicals for fishing	Dagi River to Clean Wara	No action taken
GIANT CLAM	Decreased greatly Rare	Great reduction	Not known	Dagi – Takekel 1. Dagi, Tuvau, Kumandae, Lakatubu, Nahovi 2. Papuni, Nalukubauru, Balimu 1 & 2 3, Lilinakou, Nakumala 4. Takekele, NU	No action taken. No control
TROCHUS	Decreased greatly	Reduced	Over-harvesting	Greatest change from Dagi River to Clean Wara	No action

RESOURCE	CHANGE IN ABUNDANCE	CHANGE IN SIZE	PERCEIVED CAUSE OF CHANGE	LOCATION OF GREATEST CHANGE	ACTIONS TAKEN TO OVERCOME PROBLEM
FISH					
KALILI (Kupere) (Seagrass)	Decreased greatly Rare	Reduced	Less seagrass: no more kalali In the past sea fronts were clean now it is muddy and dusty.	Starting from Dagi River to Clean Wara	No action
MALISA (large) (Open sea)	Rare	Same	Habitats destroyed	Outer reefs	No action
SHARK	Rare	Same	Cause unknown	Open sea	No action
STINGRAY	Decreased greatly	Reduced	Not known		No action
BERE (Reefs, seagrass)	Decreased greatly		Sedimentation	Dagi River mouth to Clean Wara	No action
LALAI	Decreased greatly		Not known	Dagi River mouth to Clean Wara	No action
GAMANA WILWIL LU (Saw shark) (Open sea)	Decreased greatly		Cause unknown	Open sea	No action
CRUSTACEANS AND OTHER SPECIES					
LOBSTER	Decreased	Reduced greatly	Use of chemical (pesticides)	Natetele Pelelua Kamale Dike	No action
CRABS (Saltwater)	Decreased greatly	Reduced greatly	Same as above	As above	No action
CRABS (Mangroves)	Decreased greatly	Reduced	Clearance of mangroves Clearance for village oil palm Use of chemicals	Greatest change from Dagi River to Clean Wara	No action
PRAWNS	Decreased greatly	Reduced	Clearance of mangroves Clearance for village oil palm Use of chemicals	Greatest change from Dagi River to Clean Wara	No action
CROCODILES	Decreased greatly Uncommon		Mangroves cleared. Habitat disturbed by settlers and public River became shallow	Dagi River	No action
SQUID (two types)	Decreasing slowly	Same	Clearance of mangroves	Greatest change from Dagi River	Built platforms to bring

RESOURCE	CHANGE IN ABUNDANCE	CHANGE IN SIZE	PERCEIVED CAUSE OF CHANGE	LOCATION OF GREATEST CHANGE	ACTIONS TAKEN TO OVERCOME PROBLEM
			Clearance for village oil palm Use of chemical	to Clean Wara	back squid
SEAWEED	Decreased greatly Rare	Greatly reduced	Same as above The sandy beaches are now muddy Not known	Dagi – Takekel. 1. Dagi, Tuvau, Kumandae, Lakatubu, Nahovi 2. Papuni, Nalukubauru, Balimu 1 & 2 3. Lilinakou, Nakumala 4. Takekele, NU	No action taken. No control
PISLAMA	Decreased greatly	Reduced	Over harvested	Greatest change from Dagi River to Clean Wara	No action
TURTLES					
TURTLE	Decreased greatly	Reduced	Not known	Greatest change from Dagi River to Clean Wara	No action
TURTLE EGGS	Decreased	Reduced	Not known	Greatest change from Dagi River to Clean Wara	No action
CETACEANS					
WHALES	Sightings decreased		Kimbe Bay port busy with large ships and boats	Previously whales spotted in seafront close to village. Now need to travel to Kimbe Island or further out to sea	
DOLPHINS	No change			No damage to habitat	
DUGONGS	Sightings decreased		Reduction in the size and quality of the seagrass stands, and ocean now busy Hunting	Previously spotted in seafront close to village. Now need to travel to Kimbe Island or further out to sea	

APPENDIX 3

TAROBI VILLAGE MARINE RESOURCES FOCUS GROUP

VILLAGERS' PERCEPTIONS OF THE MARINE RESOURCES THAT HAVE CHANGED IN ABUNDANCE AND SIZE. (attendees = 30).

RESOURCE	CHANGE IN ABUNDANCE	CHANGE IN SIZE	PERCEIVED CAUSE OF CHANGE	LOCATION OF GREATEST CHANGE	ACTIONS TAKEN TO OVERCOME PROBLEM
SHELLS					
KASI (Kina shell) (Mangroves)	Decreased Not plenty like before	Reduced, now only small kina shells	Over harvesting as population of village has increased and change in mangrove systems	Close to village greatest change. Women need to go further distance to find kasi	Harvesting kasi further away from village to allow area of mangroves close to village to recover
SOKE (Clam shell) (Inshore tidal flats)	Previously abundant but gradually disappearing	Reduced	Over harvesting by villagers	Close to village greatest change	No action
SUBA (Clam shell) (Reefs)	Decreased. More difficult to find.	Reduced	Over harvesting by villagers	Difficult to find on the inner reefs. Now must go to outer reefs to harvest.	No action
GOH (unidentified) (Mangroves)	Increased		Change in mangrove systems. Goh can tolerate harder mud	Mangroves near village	
KEAKEA (Veneridae) (Mangrove, Inshore sandy flats)	Decreased	Reduced	Not sure, maybe over-harvesting	Mangroves and seafront near village	No action
GIANT CLAM	Decreased Rarely found		They believe it is a masalai. Some don't eat it because it's their clan's name.		No action
VEGI (unidentified)	Decreased Rarely found				
KABILASO (unidentified) (Reefs: deep and shallow, open sea bottom)	Decreased Rarely found		Unknown cause. Easily found in the past, today not anymore.	Reefs	No action
LATUALI (unidentified)	Rarely found		Mother of Pearl shell money used as		No action

RESOURCE	CHANGE IN ABUNDANCE	CHANGE IN SIZE	PERCEIVED CAUSE OF CHANGE	LOCATION OF GREATEST CHANGE	ACTIONS TAKEN TO OVERCOME PROBLEM
			brideprice .		
SEA URCHINS (Inshore sandy/tidal flats)	Still plentiful	No change	Used as cough medicine. Not part of their diet		No action
TROCHUS	Reduced in number	Reduced	Over-exploitation	Reefs along the village front	No action
FISH					
LABELEWI (Trevally family) (Seagrass)	Substantial decline	Reduced	They are unsure why fish has declined in abundance: possibly due to over-harvesting	Seagrass beds	No action
TABULE (Seagrass)	Substantial decline	Reduced	Over-harvesting	Seagrass beds	No action
CRUSTACEANS AND OTHER SPECIES					
LOBSTER	Reduced in abundance	Not sure by how much	Mostly favoured for consumption		No action
CRABS (Saltwater)	Still plentiful	No change	Have plenty of fish so don't bother harvesting crabs		Not a problem
CRABS (Mangroves)	Still plentiful	No change	Rarely harvested	Mangrove area in front of the village	Not a problem
PRAWNS	Still plentiful	No change	Only harvest prawns occasionally		No action
SQUID (two types)	Still plentiful	No change	Use it as bait only		No action
SEAWEED	Same as before	No change	They do not eat seaweed, only sell it	Found around Suale Island, front of the village	No action
BECHE-DE-MER	Reduced in number	Reduced	Commercial harvesting	Moimoi, Pai, Kausu, Suale Island, front of village	Follow Fisheries laws And village laws
CROCODILE	No decrease in number, but an increase in sightings	Increased	Not entirely sure why numbers have increased: some think that they are not hunted as heavily in the past because people now have plenty to choose from	Mangrove near the village and near the river mouth	

RESOURCE	CHANGE IN ABUNDANCE	CHANGE IN SIZE	PERCEIVED CAUSE OF CHANGE	LOCATION OF GREATEST CHANGE	ACTIONS TAKEN TO OVERCOME PROBLEM
TURTLES					
TURTLE	Reduced slightly in numbers		Over-harvesting. People hunt them because it is good meat	Kapiura river delta Bilomi river delta	No action
TURTLE EGGS	Reduced slightly in numbers		Over-harvesting	Liliwa (short) island. Turtle nesting island	No action
CETACEANS					
WHALES	No change	Not sure	Seen only once when travelling to Biialla	Deep Blue sea	
DOLPHINS	Not sure	Not sure	Still see them once during season	Deep blue sea	
DUGONGS	Decreased slightly	Reduced	Over harvesting. People hunt them because it is good meat	Open sea	Became a taboo after Dugong awareness program by TNC

APPENDIX 4

BAIKAKEA VILLAGE MARINE RESOURCES FOCUS GROUP

VILLAGERS' PERCEPTIONS OF THE MARINE RESOURCES THAT HAVE CHANGED IN ABUNDANCE AND SIZE.

RESOURCE	CHANGE IN ABUNDANCE	SIZE	PERCEIVED CAUSE OF CHANGE	LOCATION OF GREATEST CHANGE	ACTIONS TAKEN TO OVERCOME PROBLEM
SHELLS					
LAKATU (Anadara granosa) (Inshore sandy flats)	Decreased substantially Uncommon	Reduced	Over-harvesting. <i>Posin rop.</i> Oil leakage.	River Haba to Poipoi river	No action
PULETE (unidentified) (Inshore sandy flats)	Decreased substantially Uncommon	Reduced	Over-harvesting	River Haba to Poipoi river	No action
TILO (Chamidae) (Mangroves)	Decreased substantially Uncommon	Reduced	Over-harvesting	River Haba to Poipoi river	No action
KASI (Kina) (mangroves)	Decreased	Reduced	Increased sedimentation Flooding. Over-harvesting	River Haba to Poipoi river	No action
KASI (Kina) (Reefs)	Decreased	Reduced	Sedimentation of reefs	River Haba to Poipoi river	No action
ETU (unidentified)	Decreased			River Haba to Poipoi river	
LALOPA (small) (Tridacnidae) (Reef: deep and shallow, open bottom).	Decreased substantially	Reduced	Over harvesting and increased sedimentation	Open sea to seashore of village front	No action but blame Hargy Oil Palm Company
POI BUBU (big, Tridacnidae) (Deep reefs and Open bottom)	Decreased substantially	No change	Sedimentation	River Haba to Poipoi river	No action
BEAU (Pearl oyster) (Inshore sandy /tidal flats, seagrass)	Decreased substantially	Reduced	Overexploitation (used for peeling root vegetables)		No action
GIANT CLAM (Tridacna spp.)	Decreased substantially Rare			River Haba to Poipoi river	Did not pay attention because of no use
SEA URCHINS					

RESOURCE	CHANGE IN ABUNDANCE	SIZE	PERCEIVED CAUSE OF CHANGE	LOCATION OF GREATEST CHANGE	ACTIONS TAKEN TO OVERCOME PROBLEM
TROCHUS	Decreased	Reduced	Over-harvesting for commercial and local market sales	River Haba to Poipoi river	No action
TUALI (Shell money) (unidentified)	Decreased		Over-harvesting to use shells for brideprice payments		No action
FISH					
LARGE MULLET (with big scales)	Decreased substantially	Reduced	Sedimentation from floods inland Over-harvesting	River Haba to Poipoi River	No action taken, but blame the Oil Palm Company
ROMO (Eyeglass)	Decreased substantially	About the same	Disappeared over the years. Don't know the cause for the decline in numbers		No action
SAKURI (Rockcod unidentified)	Decreased substantially	No change	Slowly Disappearing		No action
TIATILI (Rockcod unidentified)	Decreased substantially		Unknown		
TALELE (Long Tom)	Decreased substantially				
KOI PIS (Estuaries)	Decreased substantially	Reduced	Constant harvesting	River Haba	No action
STINGRAY (large)	Decreased substantially				No action
CRUSTACEANS AND OTHER SPECIES					
LOBSTER	Decreased	Reduced	Sedimentation Overharvesting	River Haba to Poipoi river	No action
CRABS (red, big claws) (Saltwater, reefs)	Decreased substantially	No change		Reefs	
CRABS (Mangroves)	Decreased	Reduced	Mud becoming dry and hard	River Haba to Poipoi river	No action
PRAWNS	Decreased	Reduced	Constant harvesting because easy to catch	River Haba to Poipoi river	No action
SQUID (two types)	Decreased. Uncommon	Reduced	Seafront and beaches muddy and mangroves cleared	Changed location, not where they use to be. River Haba to	No action

RESOURCE	CHANGE IN ABUNDANCE	SIZE	PERCEIVED CAUSE OF CHANGE	LOCATION OF GREATEST CHANGE	ACTIONS TAKEN TO OVERCOME PROBLEM
				Poipoi river	
Eel (Reef)	Common	Not sure	Occasionally harvested	Reefs both shallow and deep	No action
SEAWEED	Decreased	Reduced	Sedimentation from flooding	River Haba to Poipoi river	No action, blame the company
BECHE-DE-MER	Decreased	Reduced	Overexploitation	River Haba to Poipoi river	No action
CROCODILE	Increased in numbers		Unknown	River Haba to Poipoi river	
TURTLES					
TURTLES	Decreased	Not sure	Sedimentation and chemicals Overharvesting	River Haba to Poipoi river	No action
TURTLE EGGS	Decreased	Not sure	Overharvesting	River Haba to Poipoi river	No action
CETACEANS				River Haba to Poipoi river	
WHALES	Not sure	Not sure	Unlikely to see whales	Seen only in deep ocean	
DOLPHINS	Not sure	Not sure	Rarely seen	Seen outside deep blue sea, doesn't come near land	No action
DUGONGS	Not sure	Not sure	Rarely seen	Seen outside deep blue sea, doesn't come near land	No action

APPENDIX 5

POTOU VILLAGE MARINE RESOURCES FOCUS GROUP

VILLAGERS' PERCEPTIONS OF THE MARINE RESOURCES THAT HAVE CHANGED IN ABUNDANCE AND SIZE. (attendees = 35)

RESOURCE	CHANGE IN ABUNDANCE	CHANGE IN SIZE	PERCEIVED CAUSE OF CHANGE	LOCATION OF LEAST/GREATEST CHANGE	ACTIONS TAKEN TO OVERCOME PROBLEM
SHELLS					
LALAI (trochus)	Decreased substantially	Reduced	Over harvesting. Sold commercially	Village sea front and Banban and Muli Islands	No action
SOHE (Clam shell) (Reefs: deep and shallow)	Decreased, but still common	Reduced	Over-harvesting for consumption and sale at local markets	Village sea front and Banban and Muli Islands	No action
MUE (<i>Stombus luhuanus</i>) (Reefs: deep and shallow)	Decreased, but still common	Reduced	Over-harvesting for consumption and sale at local markets	Village sea front and Banban and Muli Islands	No action
ULPAGOGO (small) (<i>Arcidea</i>) (Inshore: seagrass and sandy flats)	Decreased Uncommon	Reduced	Over-harvesting for consumption and sale at local markets	Village sea front and Banban and Muli Islands	No action
NGALA (<i>Arcidae</i>) (Reefs: deep and shallow, seagrass)r	Decreased substantially	Reduced	Over-harvesting for consumption and sale at local markets	Village sea front and Banban and Muli Islands	No action
SEA URCHINS	No change		Not harvested or hunted	Village sea front and Banban and Muli Islands	
GIANT CLAM	Decreased	Reduced	Over-harvesting for consumption and sale at local markets	Village sea front and Banban and Muli Islands	nil
FISH					
POIYAH (Red Emperor) (Reefs: deep and shallow, seagrass)	Decreased, but still common		Over-harvesting for consumption and sale at local markets	Loiloi reef to village sea front	No action
LAU NA MALE (Rainbow runner) (Reefs: deep and shallow, Seagrass)	Decreased, but still common		Over-harvesting for consumption and sale at local markets	Loiloi reef to village sea front	
E EHU (Spanish Mackerel) (Open bottom and surface)	Decreased, but still common		Over-harvesting for consumption and sale at local markets	Village sea front	

RESOURCE	CHANGE IN ABUNDANCE	CHANGE IN SIZE	PERCEIVED CAUSE OF CHANGE	LOCATION OF LEAST/GREATEST CHANGE	ACTIONS TAKEN TO OVERCOME PROBLEM
MATULU (Snapper)	Decreased, but still common		Over-harvesting for consumption and sale at local markets	Village sea front	No action
MALESI (Surgeon fish) (Reefs: deep and shallow, seagrass)	Decreased, but still common		Over-harvesting for consumption and sale at local markets	Village sea front	No action
MALABUR (Scad)	Decreased		Use of <i>Posin rop</i> . Scad used for bait	Village sea front	No action
TALAI (Flying fish)	Decreased		Use of <i>Posin rop</i> . Associated with Scad.		No action
CRUSTACEANS AND OTHER SPECIES					
LOBSTER	Decreased. Uncommon	Reduced	Over-harvesting for consumption and sale at local markets	Village sea front Island Banban and Muli	No action
CRABS (Saltwater)	Decreased but still common	Reduced	Over-harvesting for consumption and sale at local markets	Village sea front and Banban and Muli Islands	No action
CRABS (Mangroves)	No mangroves				
PRAWNS	Decreased. Uncommon	Not sure			No action
SQUID (two types)	Decreased substantially Uncommon	Reduced	Continuous harvesting for food and bait. Use of <i>Posin rop</i>	Village sea front	No action
SEAWEED	No change		Not generally favoured as food		
BECHE-DE-MER	Decreased. Uncommon	Reduced	Heavily harvested for commercial sale	Village sea front Island Banban and Muli. Taeule, Bongo, Sinali	No action
CROCODILE	Uncommon	Not sure	Not known		No action
TURTLES					
MAGELGELE (Red turtle)	Decreased.	Reduced	Over-harvesting for consumption and sale at local markets	Village sea front Island Banban and Muli. Taeule, Bongo, Sinali	
POLOU (big, more smell)	Decreased.		Continuous harvesting for food and	Village sea front Island Banban	No action

RESOURCE	CHANGE IN ABUNDANCE	CHANGE IN SIZE	PERCEIVED CAUSE OF CHANGE	LOCATION OF LEAST/GREATEST CHANGE	ACTIONS TAKEN TO OVERCOME PROBLEM
			market	and Muli. Taeule, Bongo, Sinali	
TURTLE EGGS	Decreased		Over-harvesting for consumption and sale at local markets	Village sea front Island Banban and Muli. Taeule, Bongo, Sinali	No action
CETACEANS					
WHALES	No change	No change	Sighted but not hunted	Seen at the open sea and around Banban and Muli Island	
DOLPHINS	No change	No change	Sighted but not hunted	Seen at the open sea and around Banban and Muli Island	
DUGONGS	No change	No change	Sighted but not hunted	Seen at the open sea and around Banban and Muli Island	

APPENDIX 6

BAEA VILLAGE MARINE RESOURCES FOCUS GROUP

VILLAGERS' PERCEPTIONS OF THE MARINE RESOURCES THAT HAVE CHANGED IN ABUNDANCE AND SIZE. (attendees = 20)

RESOURCE	CHANGE IN ABUNDANCE	CHANGE IN SIZE	PERCEIVED CAUSE OF CHANGE	LOCATION OF LEAST/GREATEST CHANGE	ACTIONS TAKEN TO OVERCOME PROBLEM
SHELLS					
TUHE (Kina) (Mangroves)	Decreased, but still common	Reduced	Outsiders collecting shells, especially for fundraising	River delta: Elete, Torue, Sai, Pale Mangroves	Need to find some control measure to solve these problems. Put stop to collecting in some areas
SOHE (unidentified) (Inner & outer reefs)	Decreased, but still common	Reduced	Over-harvesting Population increase	The following reefs: Nabunga, Nuhu, Ovo, Halahio, Mapalatu, Nasisini, Sahalunepoho, Lolo, Gio, and Bau Bau village	No action taken, but plan to control harvesting
TROCHUS	Decreased Uncommon	Reduced	Over-harvesting Sold commercially	Reefs (shallow) Seashore	No action taken
GIANT CLAM (Halavu)	No change. Still abundant		Found only in the deep ocean, so its still abundant	Found in all the deep reefs	No action necessary
SEA URCHINS	No change			Not harvested so its still plentiful	
FISH					
TAGLABU/POUA (Red Emperor)	Decreased, but still common	Size still the same	Over-harvesting for consumption and sale at local markets	Nasisini, Nadudu, Mavulu, Pale, Sai	No action taken but request for more awareness
REDTAIL	Decreased, but still common		Over-harvesting for consumption and sale at local markets	Nasisini, Nadudu, Mavulu, Pale, Sai	No action taken
CRUSTACEANS AND OTHER SPECIES					
LOBSTER	No change		Hardly sold at markets	No change, still abundant	
CRABS (Saltwater)	No change		No change because not much harvesting of sea crabs	No change, still abundant on reefs	No action but need for more awareness
CRABS (Mangroves)	No change		Harvested regularly but still plentiful		

RESOURCE	CHANGE IN ABUNDANCE	CHANGE IN SIZE	PERCEIVED CAUSE OF CHANGE	LOCATION OF LEAST/GREATEST CHANGE	ACTIONS TAKEN TO OVERCOME PROBLEM
PRAWNS (Koha)	No change		Harvesting pressure low		
SQUID (Nuso)	No change		Harvesting pressure low		
PISLAMA	Decreased. Uncommon	Reduced	Sold commercially	Reefs (shallow) Seashore	Presently no market
CROCODILE	Decreased, but still common	Reduced	Sold commercially	River delta	No action
SEAWEED	No change		Hardly eaten around the area	Reefs (shallow) to seashores	
TURTLES					
TURTLE	Decreased, but still common	Unsure	Harvested for food and sale at local markets	Reefs (deep) to inshore sandy/tidal flats.	No action
TURTLE EGGS	No change	Unsure			
CETACEANS					
WHALES	Rare	Not sure	Not sure	Not sighted in area	No action because not found in that area.
DOLPHINS	No change		Not sure	Not sure because they do not study their movements.	Open sea to seashore
DUGONGS	No change			No harvesting	

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