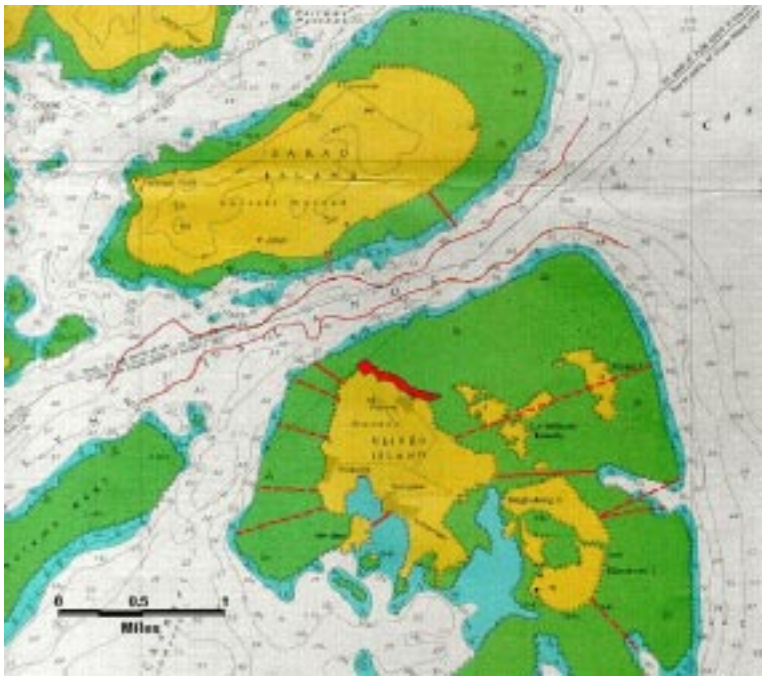
The Performance of Customary Marine Tenure in the Management of Community Fishery Resources in Melanesia

VOLUME 2a

Vanuatu
Country Report



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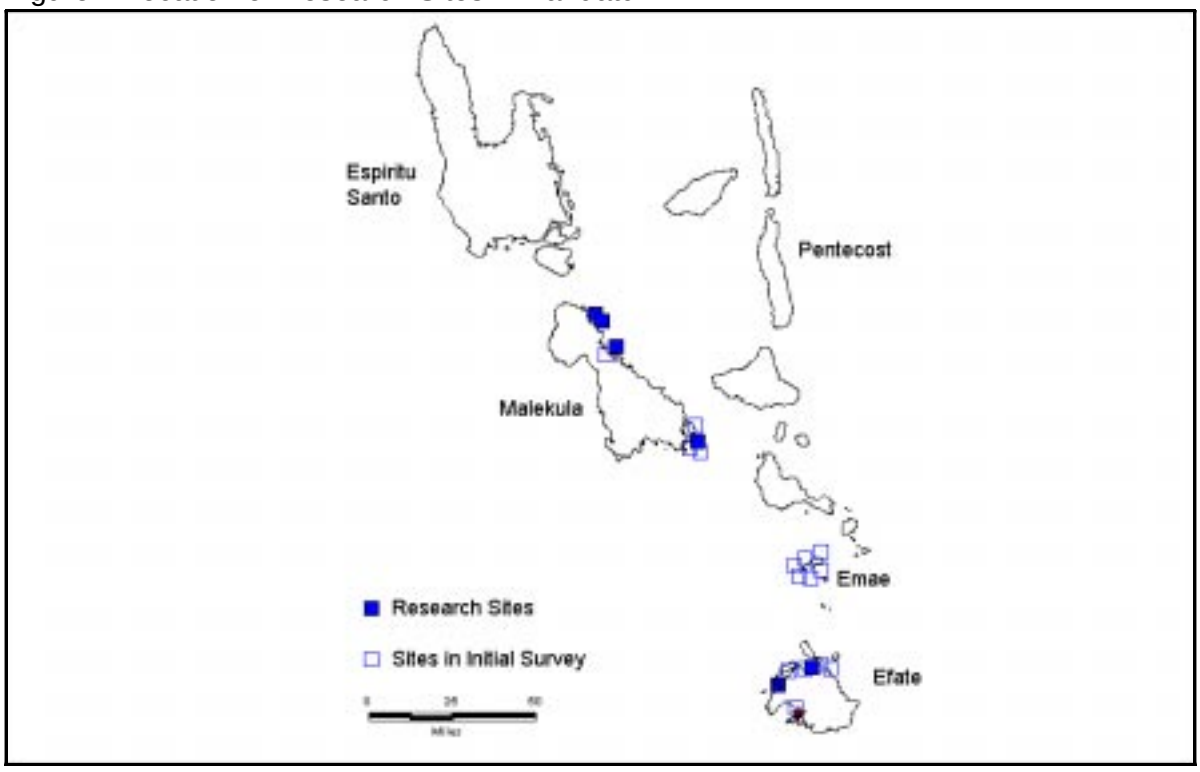
1 Vanuatu Country Report

1.1 Introduction

A series of rural appraisals (Townsley, 1993; Pido et al, 1996) were undertaken in 21 communities in Vanuatu. Six communities were selected for more detailed research activities. (See Volume 1 - Project Background and Methodologies for more details on country background and site selection criteria). Four of these sites, Atchin, Wala, Uripiv (off the NE coast of Malekula Island) and Lelepa Island (off Efate Island) were monitored for the full two-year period of the field research programme; Pellonk Village (southern Malekula Island), was monitored for one year only and replaced by Emua Village (Efate Island) in the

Figure 1 Location of Research Sites in Vanuatu



second year. Figures 1-3 present the location of these sites.

Figure 2 - Location of Research Sites on Malekula Island

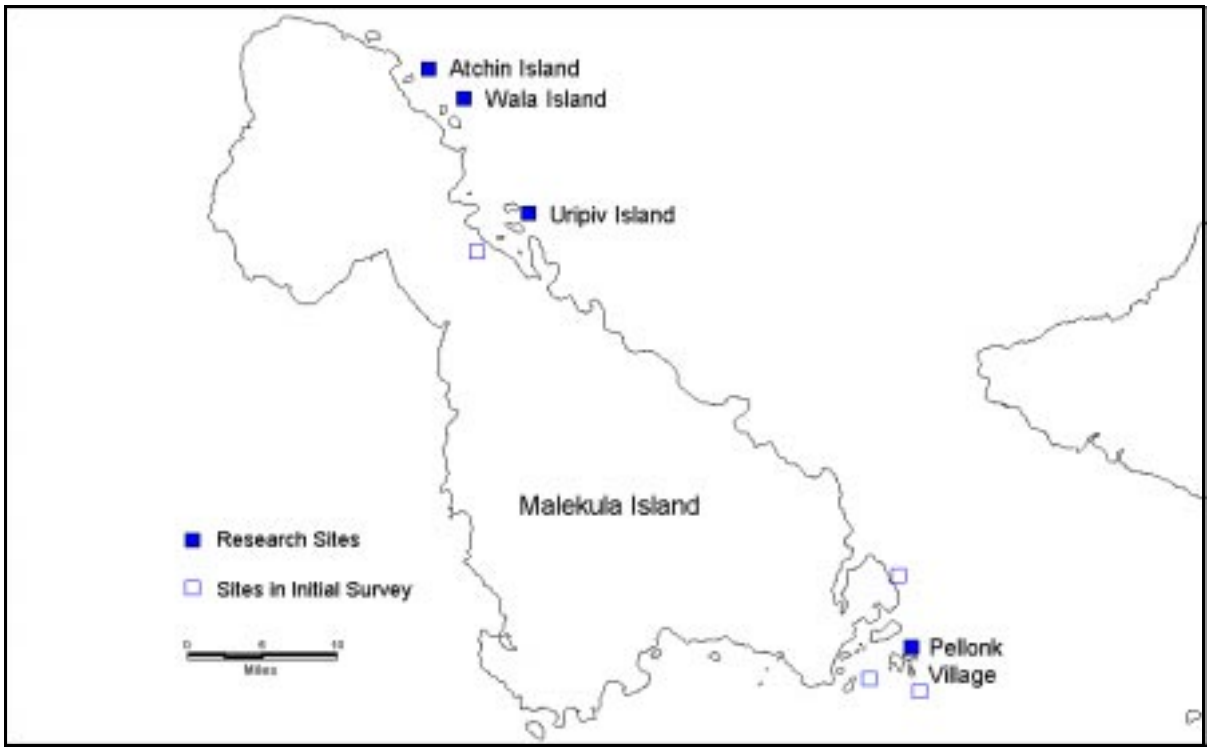
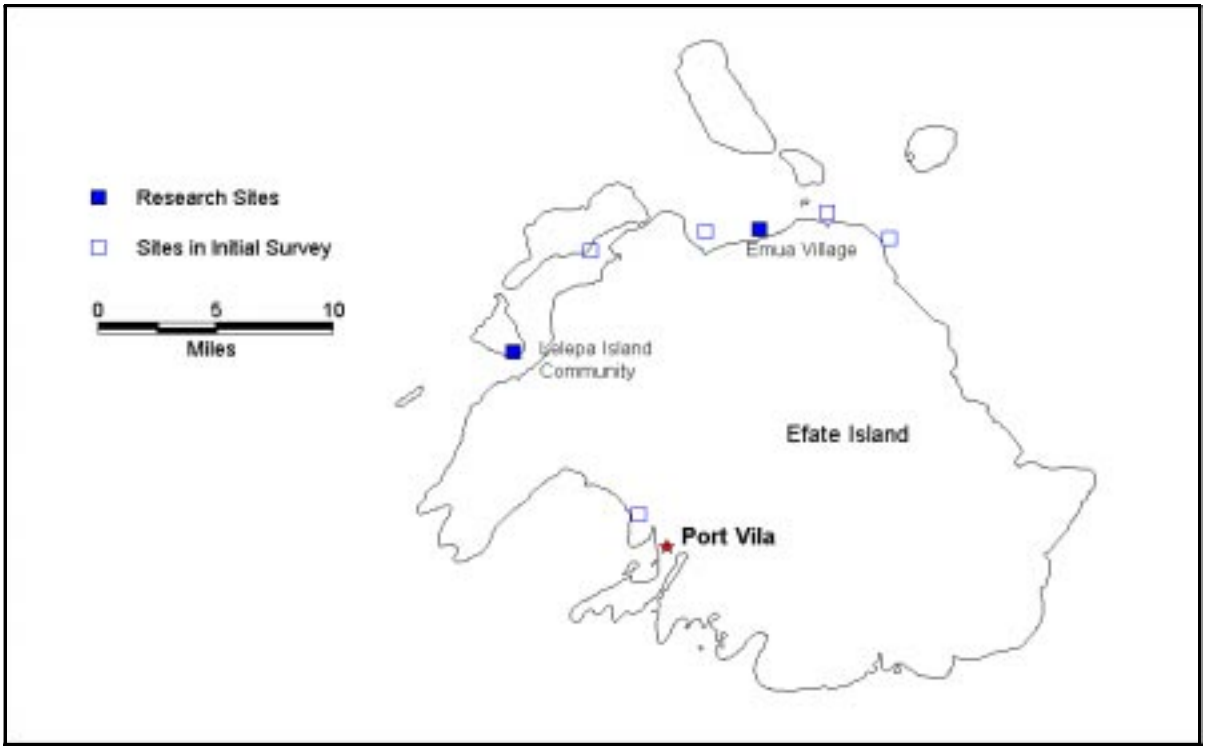


Figure 3 - Location of Research Sites on Efate Island



1.1.1 Site Characteristics

Table 1 presents background characteristics for the six community sites chosen for the longer-term monitoring programme in Vanuatu.

Table **1** - Background characteristics of the six research sites in Vanuatu *

Site	Position (Lat/Long)	Island Area ($sqkm^{-1}$)*	Reef Area ($sqkm^{-1}$)**	Population (1999 est)	Pop'n Density (persons/ $sqkm^{-1}$of reef
Atchin	167.33E 15.94S	0.7	1.73	1046	605
Emua	168.37E 17.54S	n/a	3.47	176	51
Lelepa	168.22E 17.61S	7.5	5.70	381	67
Pellonk	167.83E 16.52S	n/a	4.04	313	77
Uripiv	167.46E 16.10S	1.0	2.23	417	187
Wala	167.37E 15.99S	0.8	0.36	237	658

* Emua and Pellonk are villages located on larger islands.

** All these sites include deeper, open-water areas which are fished by stakeholders from the adjacent communities. The demarcation of the boundaries of these areas is as yet undefined in legislation. Atchin Island as a community maintains access rights to a sunken off-shore reef, Melveveng. Lelepa Islanders, in addition to tenure of the reefs around the Lelepa itself, also hold tenure of reef along the adjacent coast Efate (through their possession of lands on Efate) and the reefs of Eretoka Island (an uninhabited, island located 5kms south-west of Lelepa Island which is the burial site of an historically important tribal leader, Roi Mata who died in the 17th century).

1.1.2 Characteristics of Stakeholder Groups

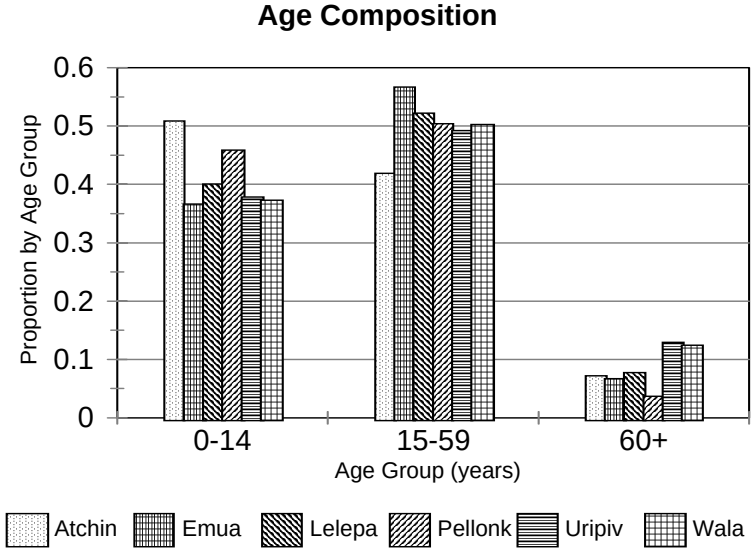
The current population of Vanuatu is estimated at 157,000 (National Population Census, 1999) and is a relatively homogenous group, both economically and racially. The majority of the population (97%) are indigenous Ni-Vanuatu, 82% of whom live in rural areas, the other 18% live in the two urban centres of Luganville (Santo) on Espiritu Santo Island) and in the capital, Port Vila, on Efate Island. The remaining population comprises Chinese, Vietnamese and Europeans who are generally concentrated in the two principal towns of Santo and Port Vila.

The history of population change in Vanuatu is of interest given concern over current use rates of marine resources. In 1800 the population was estimated at 1 million, in 1846 the figure was estimated at 650,000 (Dan), in 1882 600,000 (Speiser), in 1883 250,000 (Thomas), in 1892, 100,000 (The Colonial Office) and in 1911 just 65,000 (The Colonial Office). The reasons for this catastrophic decline in population all relate first to raiders by Peruvian slavers, to western diseases and to 'blackbirding', the process by which Ni-Vanuatu were taken to work the sugar-cane plantations of northern Queensland, Australia. During this period of population decline there was significant amalgamation of neighbouring clans that had been decimated by disease and loss of adult males to the blackbirding trade (Deacon, 1934). This would have had significant implications for land and marine tenure. The arrival of

missionaries who attempted, with some success, to amalgamate communities into a single village that could be controlled was also important factor in any dilution of tenure.

The growth rate of the population in Vanuatu is estimated at 2.8% per annum. Figure 4 below presents data on the age composition of the population of the six communities in which the research was undertaken. Given the high rate of population growth communities have a high proportion of children and young people, with between 37% (Emua) and 50% (Atchin) of the population being under 15 years of age.

Figure 4 - Population Demography at the Six Research Sites



Source of data for Figure 4: National Population Census (Statistics Office, Port Vila)

The majority of Ni-Vanuatu are engaged in agricultural for both subsistence and planting cash crops. Agriculture contributes approximately 23% of the gross domestic product. Within this sector subsistence agriculture accounts for 47% of the gross value, copra 22% and cattle farming 13%. In addition to agriculture, industry contributes 14% of the GDP and financial and tourist services the remaining 62% (Source: Vanuatu Agricultural Census, 1994. Vanuatu Statistics Office). Subsistence agriculture typically involves inter-cropping of cocoa, coconuts, kava, banana (all cash crops) as well as food crops including yam, taro and cassava. The 1994 Agricultural census revealed that 35% of *rural* households were engaged in fishing activities of some form. The Census also revealed that this percentage represented a decline on the 50% that was recorded in the 1983 Census. On Malekula the decline was from 64% to 42% of households and on Efate the decline was from 86% to 46% of households.

1.1.3 The Institutional Context

1.1.3.1 Land Tenure Institutions

Clan identity in Vanuatu is closely linked to the historical habitation of their land. The boundaries between land claimed by each clan tended to use natural geographical features

such as ridges, rivers or ravines. Bonnemaison (1984) summarized the strength of this relationship between identity and land: ‘Each man must have some place, some land which belongs to him, which is his territory. If he does not control any land, he has no roots, status or power.’ In 1983 an attempt was made to codify customary traditions and this defined the area of land under any particular ownership as extending as far as the edge of the reef or stone (Kastom Polisi blong *Malvatumauri*, 1983).

There is some variation in tenure system between island groupings within Vanuatu. In the northern cultural grouping (including the sites of Pellonk, Uripiv, Wala and Atchin) land was held as an entity by the clan (*nasara*). In the southern grouping (including the sites of Emua and Lelepa) the land area of the clan (*naflak*) was divided into titles. The descent line for *naflak* is matrilineal, the descent line for land is patrilineal (Douglas Meto, pers comm). Bonnemaison (1984) reported that traditionally up to 15 titles would be held within a single clan with individual titles being held by ‘big men’, the patriarchs of an important family grouping. This system is somewhat more formal and rigid than the northern system. Within a clan, the traditional or ‘kastom’ owner would grant, almost as a moral obligation, permission to fellow or neighbouring clan members to work small-holdings. This would act to reinforce clan ties and to foster reciprocal relationships and also represents a nesting of land rights. Land was used in rotation so the area allocated a family would exceed their requirements for a single year’s agricultural production. This type of allocation presented individuals with the opportunity to gain prestige and status within the community through redistribution of land at their discretion. The distribution of land at this tier of institutional structure has some flexibility.

Land rights may be alienated through a purchase following customary tradition. For example respondents on Wala Island reported the exchange of land and marine tenure between clans. Respondents reported that a small section of the Melnator clan’s land had been “given” to an family from the Hama clan. This has been done through a custom ceremony, reportedly at the turn of the last century. At some point in the last century clans from the interior of Malekula Island fled the head-hunting Big Nambas tribes (a *nambas* is a penis-sheath) and settled on Atchin Island. The immigrant population were divided amongst the five clans on the island. Each clan then gained access to the land held by the immigrants on Malekula. A more recent example of exchange of land rights rights was reported from Emua. The traditional lands and marine space under tenure of the Emua people extended from a place known as Kiliarova, just east of the present-day location of Undine Bay Plantation east to Laonkarai settlement approximately 300 metres east of Emua Jetty. In 1926 Undine Bay Plantation brought in workers from the northern island of Pentecost to work the plantation. They settled at Saama on land they bought from the Emua people; the transaction was completed with a traditional ceremony and a plaque stands in Saama village honouring this event. It was reported that the Saama community were not permitted to actually purchase land for agriculture, they could only lease the ‘gardens’ under the tenure of the Emua community.

Land may also be given away as reward in a number of circumstances; for helping to care for a sick or elderly person, as part of the ‘naming’ of a friend’s or relations’s child (the family of the child then receives some land). It can be gained through the adoption of a child whose parents have died, of it can be given by the Chief to families that do not have sufficient land to survive on.

1.1.3.2 Marine Tenure Institutions

As with land tenure, marine tenure rights are also nested. The lowest tier is the tenure of canoe landing sites claimed by individual families (although these are sometimes difficult to

distinguish from clan tenure). These were traditionally allocated to the heads of each family as a means by which they can secure access to the sea, important both for fishing and for transporting agricultural produce from distant small holdings. It appears that this level of nesting is largely irrelevant in contemporary Ni-Vanuatu society at least in the sites visited during the frame survey. The reason for this is the coalescing of communities that previously were more diffused along the coastline. The maintenance of such nested rights are not practical where the population is now aggregated and the village shores and beaches shared by all members of the community. In addition many communities have (been) relocated from the interior where this form of rights were obviously not required. Such 'migrant' communities faced quite a different set of circumstances than traditional coastal peoples. The translocation to a foreign environment and the physical structure of the communities (for example the layout of villages, often constructed by plantation-owners or missionaries) would not always have naturally promoted the development of such rights.

The second tier of marine tenure is the clan level. This tier would have been the operational level for most daily fishing activities with clan-members having primary access rights to clan reef areas. By the same token this was also the institutional level at which specific ceremonial or community activities involving marine resources would be initiated. The majority of cooperation at the clan level was traditionally established for ceremonial purposes. For example, closures of a particular area of reef would be called to honour the death of a chief; the waters in which the body was washed would be closed. On Atchin Island this period was stated as being one month. Closures were also associated with the traditional *namangki* or grade-taking events, typical only of the northern cultural grouping. Traditional culture in this part of Vanuatu was very much centred around secret societies (Deacon, 1934). Status within the community in general, and in the secret societies in particular, was achieved by the accumulation of wealth in the form of pigs. Secret societies were also important in political life within the community, Deacon (1934) wrote of a village in south Malekula, 'There is no chieftanship. Authority is vested in the higher *namangki* ranks and is a corollary also of the prestige conferred by the higher nalawans and the nevimbur'. (*Nalawan* and *Nevimbur* were secret societies particularly noted for their spiritual focus). To achieve a new grade a long and complex period of ceremonies lasting up to 3 years had to be observed by the individual seeking to change his status (*namangki* were reserved only for men). In the culmination of this process an individual would request of the chief that some part (or all) of the reef of the *nasara* (clan) to which he belonged be closed for a period of between 100 days and six months (Deacon, 1934; Silas Nicholson pers comm). The *namangki* ceremony would culminate in the opening of this reef area to provide for the final *namangki* celebration feast. The accumulation of wealth was balanced by the importance of reciprocity amongst Ni-Vanuatu peoples. Although straight exchange of land/marine space occurred in response to various incentives there was also a degree of reciprocity. This provided the background for the transfer of marine space (wealth) to neighbouring clans; Oakerson (1992) describes this exchange as being based on *ex post* conditions whereby the conditions that are sought by the initiator are anticipated to be met at some future time.

There are numerous forms of action at this level. In historical times there was some trade between communities living in the interior and coastal peoples, often living on drought-prone corraline islands with poor soils and limited space of agriculture. Deacon (1934) reported evidence from south-west Malekula Island where markets, known as 'pulsavi' (lit: pay and gather together), developed. A sign would be left at a traditional location indicating that trade was sought and a verbal contract was drawn up whereby the islanders would agree to provide a certain quantity of fish some days later in return for an agreed quantity of root crops, fruits etc to be furnished by the party from the interior. This form of trade required the

organisation of the community into fishing parties using a variety of fishing gears including corralling, fish-fences and spear-fishing parties. A distinctly pulse form of fishing.

Taurakoto (1984) reported that on Lelepa Island 'the reefs were regarded as the property of the six chiefs who would notify each other of people fishing outside the village boundary and arbitrate disputes'. The contemporary situation on Lelepa is somewhat different; the previously quasi-independent clans have coalesced effectively into a single settlement along the south-western coast. Although clan rights to land are still clearly demarcated and recognised within the community individual claims to reef and canoe landings have been aggregated (Douglas Meto, pers comm). This single community now has only one (hereditary) chief.

Although the traditional structure of traditional marine tenure systems persists in Vanuatu, there has evolved a third tier of tenure. This 'community-based tenure' is not seen in the land rights arena. By community we are referring to the loose arrangements of clans that now exist as communities in Vanuatu. The extent to which clans cooperated in historic times is open to conjecture. The point is that in many regions of Vanuatu there has been an aggregation of settlements. The institutions of which now function as political entities overlaying the existing clan-based institutions. This appears to have evolved in response to alterations of the socio-economic and authority relationships between individuals, partially as a result of religious denomination and because of changes in political relationships between formerly more independent clan units.

Respondents on Atchin Island reported that although land rights continue to be inherited through descent the use of marine space is to all intents and purposes held at the community rather than clan level (Chief Martino, pers comm). In the wider political context, a Council of Chiefs, with a member representing each clan, is now the largest political unit on the island. Decision made by individual chiefs that may affect other clans are passed through this council. This arrangement was also reported for Uripiv and Wala Islands. On Pellonk Island respondents reported that there used only to be one clan in the village but this divided up into five at some point in the past, when they also lived separately. The contemporary situation is that the clans are once more together in a single community although the separate clans are still recognised. Four of these clans (Pellonkapan, Pellonkmaghat, Tahambeun and Unarek) have agreed to manage the reef under their collective tenure as a single unit. The fifth clan (Torhorhilau), members of which are somewhat physically separate from the other clans (they are located closer to Lutes village), manage their marine space independently (Townsley, Anderson and Mees, 1997).

In Lelepa Island the former politically independent and geographically isolated clans now inhabit a large single settlement on the south-east shore opposite the Efate coastline. Although land rights remain defined along clan (and family) lines, marine tenure has been amalgamated into 'community' tenure. In Emua marine tenure also operates at the community level. The marine space associated with the land leased to Saama is under the control of the Saama community although respondents from Saama village reported that the Emua community maintains the right of access, although this right was rarely exercised.

Table 2 presents the data on the contemporary structure of the communities at the six research sites in Vanuatu.

Table **2** - Community structure at the six research sites

Site	Number of Settlements*	Number of Political Units with Marine Tenure	Size range of *nested* tenured areas (sqkm reef)
Atchin	16	5 (Ruar, Melparu, Melep, Senar, Melmaru) *	0.015 - 0.105
Emua	1	1	none
Lelepa	1	1	none
Pellonk	1	2 (Pellonkapan + Tahambeun + Pellonkmaghat + Unarek);Torhorhilau.	0.028 - 0.79
Uripiv	4	8 (Tevri, Lowi, Potun, Malisa, Potnambe, Wilavi, Jimes, Emilchiluwamb)	0.11 - 0.45
Wala	6	5 (Sanaliu, Pelut, Melnator, Hama, Lowo/Asop,)	0.0075 - 0.223

* Several other *nasara* were mentioned as sub-groups of these principle *nasara* on Atchin. For example, within Senar *nasara* there are said to be two smaller *nasara*, Amantara and Miluangala. In Ruar, another two were mentioned, Petertutse and Olep.

The following four figures display the clan boundaries for the four sites on Malekula. A range of presentations are shown here including aerial photographs and charts. The choice of presentations medium depended on the availability of aerial photographs that covered the entire area of interest. Where these were not available charts are used. Figure 5 presents Atchin Island, Figure 6 Wala Island, and Figure 7 Uripiv Island. The dashed line on Figure 5 displays the boundary of a sub-unit of the Melep clan which declared a closure (covering an area of 0.015sq.km.$^{-1}$ of reef) in August, 1998.

The eastern boundary of the closed area on Wala (Figure 6) is marked as a dashed line in the Lowo-Asop clan CFRA and extends west to the Sanaliu boundary.

Note the locations of the centres of population on these figures which show up as white patches on the aerial photographs. On each case the population is largely concentrated on the lee-ward shore close to the mainland. Only on Atchin Island is there a substantial population located on the wind-ward shore of the island. The closed area on Uripiv Island (Figure 7) equates to the boundary of the Malisa clan. Figure 8 presents the boundaries for Pellonk village, with the area collectively managed by the four clans (Pellonkapan, Tahambeun, Pallonmaghat and Unarek) displayed.

Figure 9 presents a map of Emua Village. The closed area that was in force during 1996/97 is to the west of the Jetty; the closed area of 1997/98 to the east of the Jetty as far as the solid (red) line.

Figure 10 presents a chart of Lelepa Island. The CFRA is defined as Lelepa Island and Eretoka Island and the coastla rea of Efate Island.

Figure 5 - Clan CFRA Boundaries on Atchin Island, North Malekula

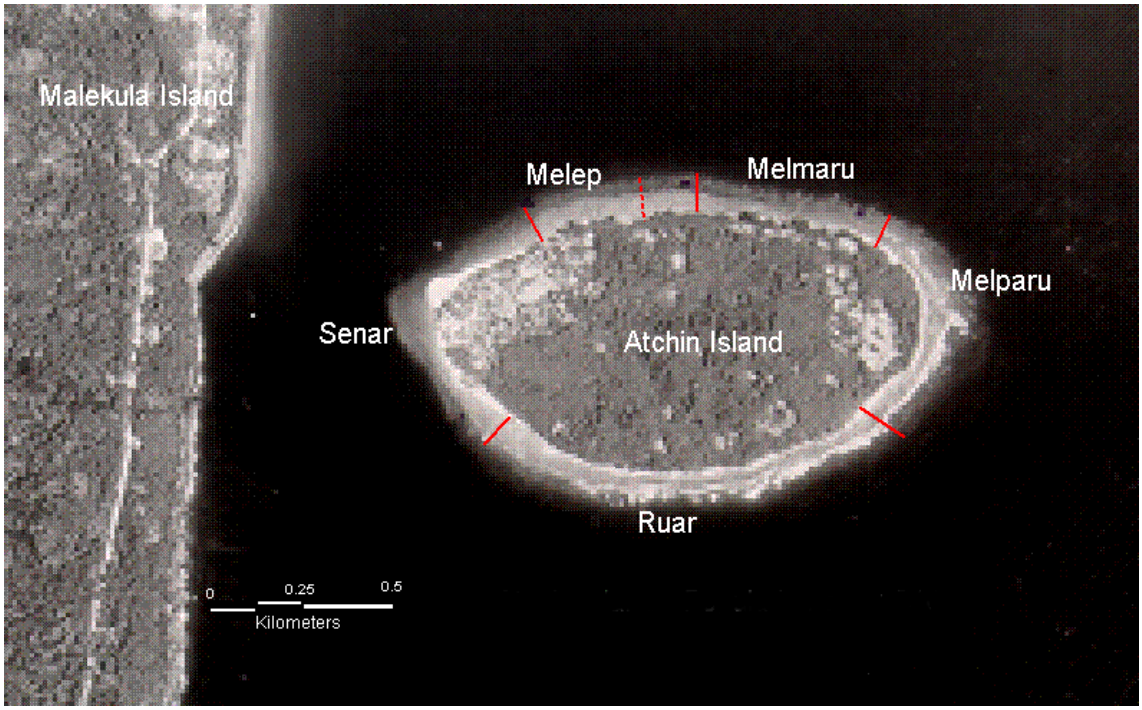


Figure 6 - Clan CFRA boundaries on Wala Island, North Malekula

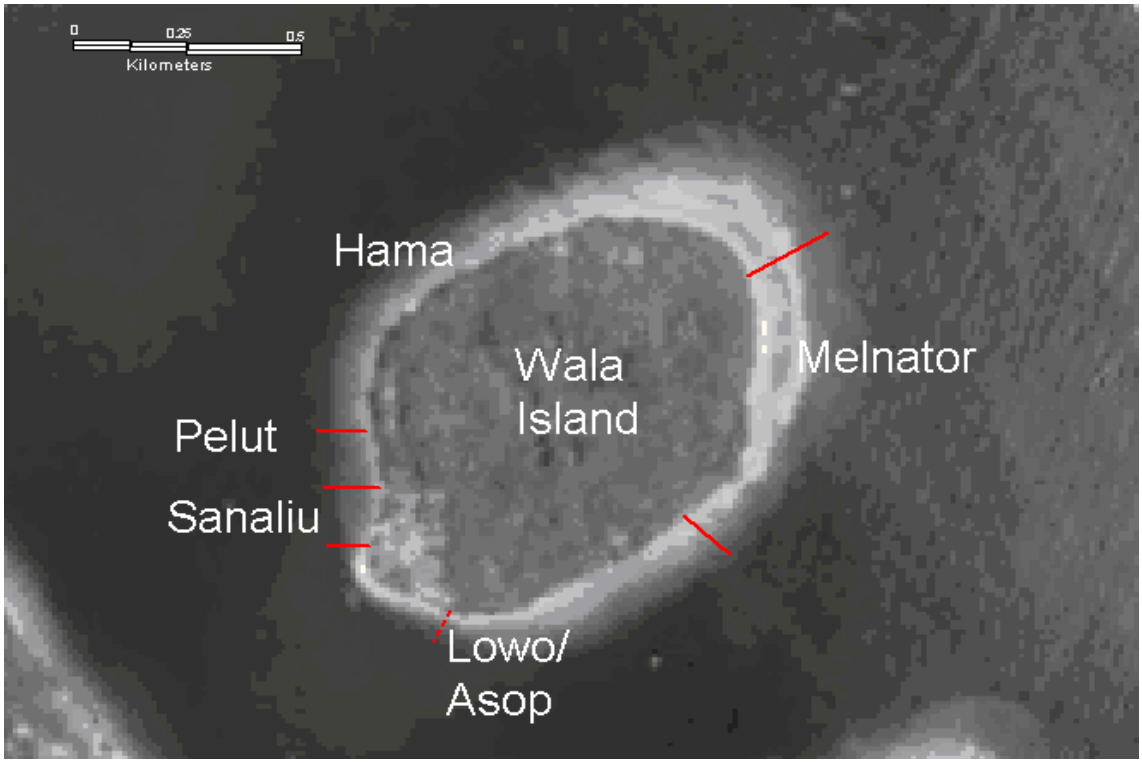


Figure 7 - Clan CFRA Boundaries on Uripiv Island, North Malekula

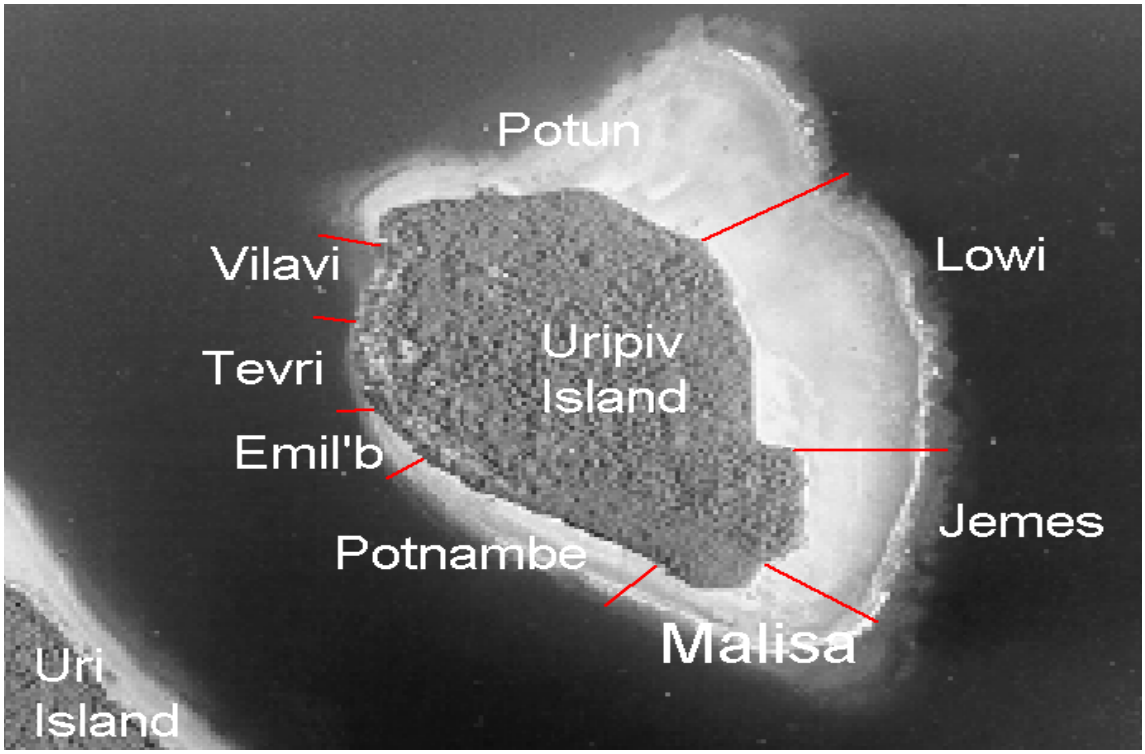


Figure 8 - Clan CFRA boundaries around Pellonk Village, Uliveo Island, S.Malekula

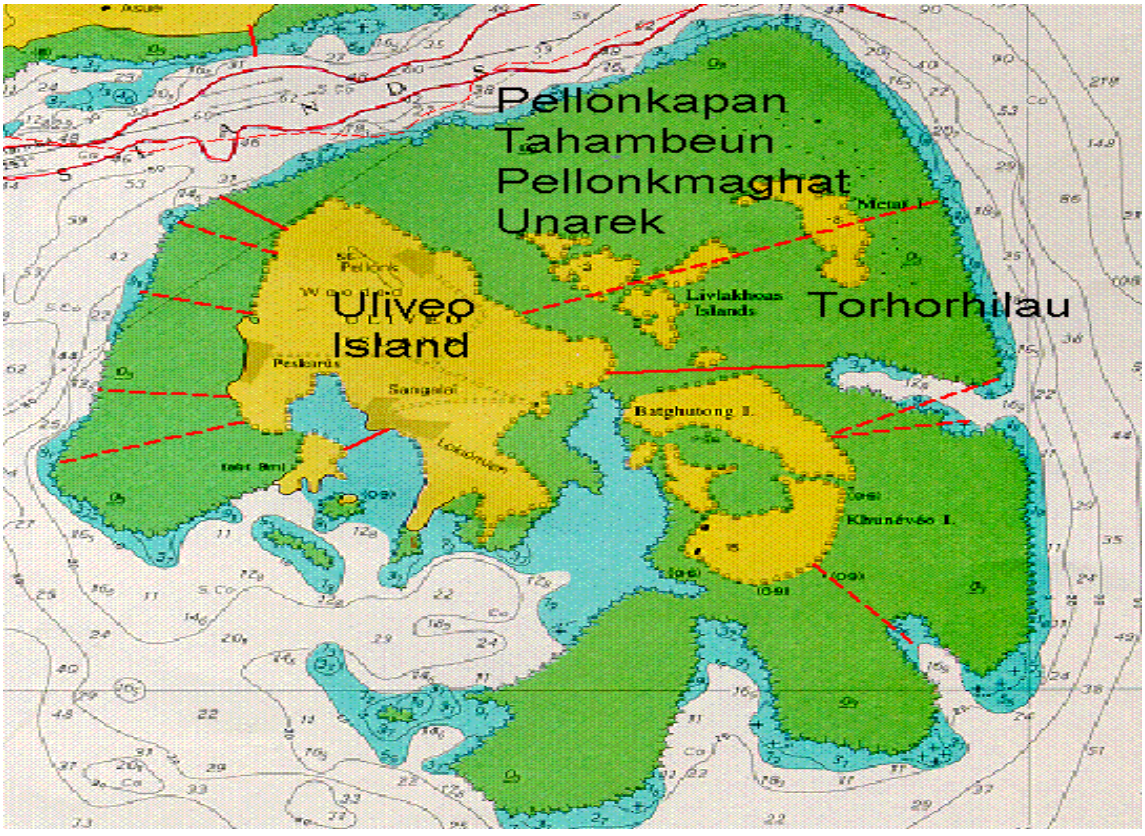


Figure 9 - CFRA Boundary, Emua Village, North Efate Island

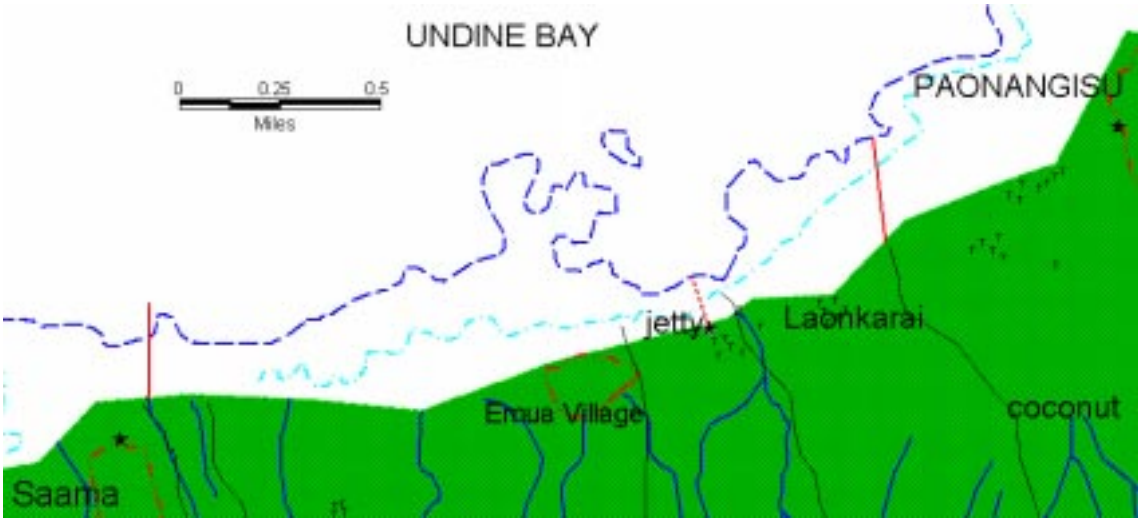
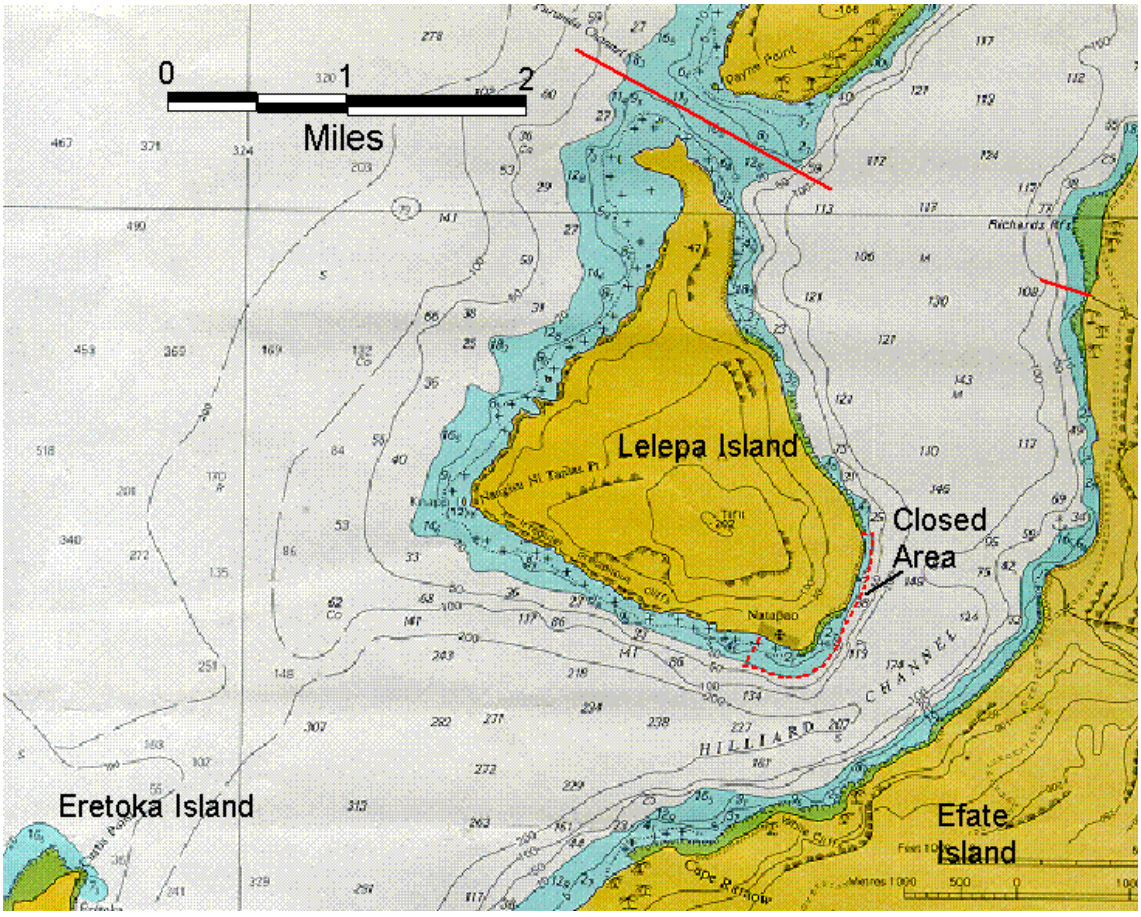


Figure 10 - Lelepa Island and CFRA area



1.1.4 Scale of Analysis

The very small scale of CFRAs constrained the scale of analysis. The number of nested CFRAs within the community was impractical for individual assessment. It was anticipated that insufficient data for comparative length-frequency analysis Would be collected for each CFRA and only where closures were established by particular clans or families was analysis undertaken at the scale of individual CFRAs. Site selection for the underwater visual census (See Volume 1), which was undertaken early in the research programme, was based on the findings of the rural appraisals that indicated that fishing grounds were utilised reciprocally by the entire community. Respondents indicated that the use of particular fishing grounds was determined not by clan membership but by issues such as whether the shore was windward or leeward and the distance from the village. Subareas where therefore defined according to environmental criteria rather than following the numerous CFRA boundaries. This protocol was subsequently utilised for scaling the analysis of fisheries monitoring data with additional analysis also undertaken at the community level. Table 3 presents the summary characteristics of these subareas.

Table **3** - Identification of Analytical Sub-Areas for each Community

Research Site Sub-Area	Area of Reef (sq.km)	Aspect	Distance from Landing Site (km)	Reef Type
Atchin				
200	1.35	n/a (offshore reef)	1.9	Patch
201	0.07	NW (leeward shore)	0.5	Fringing
202	0.08	NE (leeward shore)	1.5	Fringing
203	0.12	SE (windward shore)	1.2	Fringing
204	0.12	SW (windward shore)	0.1	Fringing
Wala				
211	0.12	NW (leeward shore)	0.5	Fringing
212	0.22	NE (windward shore)	1.5	Fringing
215 - Closed	0.007	SE (leeward shore)	0.5	Fringing
Uripiv				
221	1.04	North Coast (windward)	2.5	Fringing
222 - Closed	0.11	SE (windward)	1.7	Fringing
223	0.19	WNW (windward)	0.7	Fringing
224 (Uri Island)	0.48	ENE (windward)	1.0	Fringing
225 (Uri Island)	0.41	WSW (leeward)	1.5	Fringing
Pellonk				
231	0.96	Sakao Island (windward)	1.5	Fringing
232	3.08	NE (windward/leeward)	0.5-2.5	Fringing/Lagoon
Lelepa Island				
241 (To Moso)	5.70	Moso Island (leeward)	5.0	Fringing
242	n/a	Open-water (windward)	n/a	n/a
243	0.59	Eretoka Island (leeward)	7.0	Fringing
244	3.26	Efate Island (leeward)	1.5-4.3	Fringing
245	n/a	Open-water (leeward)	n/a	n/a
246 - Closed	0.13	SE (leeward)	0.132	Fringing
247	0.54	East Coast (leeward)	2.5	Fringing
248	0.94	NW (leeward)	5.3	Fringing
249	0.24	SW (windward)	2.0	Fringing
250	18.0	Lelepa Channel	n/a	n/a
Emua				
261	n/a	Open-Water (leeward)	n/a	n/a
262	0.67	Leeward	2.4	Fringing
263 - Closed*	1.07	Leeward	0.2	Fringing
264 - Closed	0.45	Leeward	0.7	Fringing

1.1.5 Analytical Framework

A central feature of both artisanal fisheries and the customary systems of marine tenure that evolved to manage them is that they are extremely complex. Key influences include exogenous cultural, political and macro-economic characteristics of the nation as well as the attributes of a specific community and the local environmental and biological components of

the resource system. In order to make sense of this complexity the application of a framework to structure the data and subsequent analysis is essential. This work utilises an institutional analysis and design framework developed by Ronald Oakerson (Oakerson, 1992) which is applied in a diagnostic manner to analyse and attempt to explain the performance of the community management institutions. The reader is referred to Chapter 1 - Project Background and Methods for a more detailed introduction to the theory and structure of Oakerson's framework. In summary the diagnostic approach works backwards through the framework. The following section (Section 1.2 - Outcomes) opens the diagnosis with an analysis of the fishery itself, or more specifically, the *outcomes* observed in the fishery. The section includes a summary of attributes of the research sites and the national and local management regulations (*operational rules*) in order to provide an immediate context to the outcomes. The outcomes include the yields and revenues as well as the biological and social effects of the fishery and its management system. In this research outcomes are analysed using, where possible, the criteria of biological sustainability and the criteria of equity. In addition, at least where they differ from sustainability and equity, analytical criteria will include the objectives of the management authority.

In Section 1.3 (Patterns of Interaction) the analysis seeks first-order explanations for the outcomes observed in the fishery. Patterns of interaction summarises the choices and behaviour of stakeholder groups that lead to these outcomes. This section is focussed on the degree to which fishers cooperate or conflict with each other and with other stakeholder groups, in particular the custodians or resource managers. Oakerson suggests that a key question is whether 'members of the community [are] competing with one another to maximse their individual 'take' from the commons? Are there asymmetries among users that allow some to 'raid' the resource and then move on?' (Oakerson, 1992, p.54).

Fishers' choices are made in response to interpretation of the physical and technical attributes of the resource systems and the decision-making arrangements that are in place to manage these resources. If the effect of these characteristics on choice can be identified then it may be possible to change them to promote choices that produce the required outcomes. In Section 1.4 analysis focusses on the influence of physical and technical attributes on fishers choices and the outcomes observed and covers environmental and technical attributes of the fishery. Finally, Section 1.5 focusses on the role of decision-making arrangements in influencing fishers choices and subsequent actions. Are the operational rules that have been implemented sensible given a particular set of environmental, resource, technical and economic characteristics of a site? How are decision made and to what extent are decision-making processes likely to promote cooperation or conflict between fishers and managers? What is the influence of the legal context of fisheries management (the external arrangements)? Key issues relevant to the development of co-management in Vanuatu are reported in Section 1.6.

An idealised theoretical example of the diagnostic application of Oakerson's Framework is as follows: the analysis of fisheries data suggests that there is a problem with, for example, over-fishing in the fishery (the outcomes). Subsequent analysis of the patterns of interactions between stakeholders indicates that fishers are in conflict with the management authority and ignoring their regulations. Further analysis of decision-making arrangements may indicate that these regulations were drawn up without consultation and without adequate explanation to the fishers of the reasons for their imposition. The regulations are also deemed inappropriate by fishers because they apply to an area of reef which is important to fishers whose access to other grounds is seasonally restricted. (Ostrom describes this as a lack of congruence between the physical and technical attributes of the fishery and

operational rules devised to manage the fishers actions (Ostrom, 1991).) If the situation is to be remedied it may be appropriate for fishers to be included in the decision-making process to permit some adjustment of rules that create initially unforseen problems for fishers. A fisheries extension programme may also be warranted explaining what the regulations are designed to achieve (in terms of improved fishing over the longer-term) if they are adhered to. Fishers may then be more willing to cooperate and thus unsustainable fishing practices could be reduced or even eradicated.

1.1.6 Fisher Context: Operational Rules

Operational rules directly affect the potential behaviour of fishers by setting out how, where, when and by whom resources may be harvested. In some situations these rules may simply ban the use of a particular gear or they may enact a temporary closure on a certain area of the fishing grounds, perhaps linked to some cultural event. Operational rules are the easiest facet of the decision-making arrangements to describe and to change (although enforcement may be a problem). From the perspective of both the stakeholders whose behaviour the rules seek to constrain or change, and from the manager who seeks a beneficial (or at least non-negative) outcome from the new rule, there needs to be some confidence that the rules will work. Table 4 lists the types of operational rules observed during the research.

In addition to those specific rules reported in Table 4 there is an additional 'rule' related to controlling the access permitted for non-locals. This rule evolved at the local level amongst communities seeking to control access to their natural resources but it has since been incorporated into national legislation. Article 74 of the Constitution states that 'The rules of custom shall form the basis of ownership and use of land in the Republic of Vanuatu'. The implication of this Article for individuals or companies who do not have primary access rights (i.e they are not members of a clan or community) is that the resource custodian must be consulted and his permission sought prior to access being granted.

Table **4** - Local Operational Rules in place during the research period

Site	Area Closures	Gear Restrictions	Trochus/ Shellfish Bans
Atchin	✔	✘	✘
Emua	✔	Poison	✘
Lelepa	✔	Night-Diving	✔
Pellonk	✔	Night-Diving/Gill-net*	✔
Uripiv	✔**	✘	✔***
Wala	✔	✘	✘

* This restriction is seasonal only, for six months from October to March.

** This restriction, of an area of 125m^2, under the tenure of one family, was established in the last month of the monitoring programme.

*** This restriction is not on Uripiv Island placed over an area of mangrove located on the east coast of the Uri Peninsula and is referred to as the Narong Park ('*Narong*' is local language for mangroves).

1.2 Outcomes in the Fishery

A set of outcomes will include some yield from the resource base, biological (and even physical) effects resulting from the extraction of that yield, and economic and social effects. To determine the outcome of management, evaluative criteria are employed as standards (Oakerson, 1992).

Typically a modern assessment is undertaken in terms of the efficiency of resource use and the equity (or fairness) of the return obtained by stakeholders from cooperating with the management system. It does not necessarily follow, however, that traditional management objectives mirror those of the State fishery managers. Table 5 presents a summary of the objectives that were reported from the 21 communities visited during the frame-survey appraisals. The table is divided into explicit objectives (the objectives that were officially stated by community leaders) and implicit objectives (objectives mentioned 'off the record'). There is no clear hierarchy of importance between explicit and implicit objectives.

Table **5** - Examples of Management Objectives Reported During Rural Appraisals

Explicit Objectives	**Implicit Objectives**
Ceremonial Purposes	Prevent access to neighbouring village
Preserve resources for future generations	Restrict access of immigrant community
Rehabilitate resources	Protect source of income for custom owners
Conserve resources for community income	Establish property rights to reef/land areas
Ear-mark resources for specific project	Protect Coastal Environment
Enhance resources for tourist visitors	

1.2.1 Equity Outcomes

The analysis of equity seeks to determine whether a significant proportion of stakeholders are receiving a '...reasonable and fair return on their contribution to a collective undertaking that regulates behaviour.' (Oakerson p.52, 1992). At the research sites the 'collective undertaking' is the management system of a CFRA or in particular the community's group of CFRAs. To determine whether 'a fair and reasonable return' is being enjoyed by stakeholders, analysis should investigate the presence of asymmetries in the exploitation of resources and the presence of asymmetries in the application, or the effect of the application, of management regulations. These potential asymmetries may be related through a cause-effect relationship. For example regulations unfairly applied to a sector of the stakeholder community may result in the affected group experiencing a reduced capacity to exploit marine resources.

1.2.1.1 Equity of Access to Marine Space

The use of marine space by fishers was recorded by data collectors on maps of the fishing grounds. These data were then entered in to a geographical information system (GIS) (Map-X™; Mapinfo *Professional*™). Each location that was entered onto the computer-generated map was automatically allocated a geographical position (latitude and longitude). These positional data were then attributed data on the catch, effort and gear-type utilised using a unique trip identifier in a Microsoft Access™ database. An ODBC link was utilised to export/import the GIS data. In addition to data generated from the fisheries monitoring programme data from the socio-economic monitoring programme were also attached to the GIS data. Of particular relevance to equity issues was the use of marine space at sites where individual clan tenure exists namely the northern sites of Atchin, Wala and Uripiv. The clan identity of each fisher was therefore also attached to the GIS data. What we sought to confirm was the stated claim from respondents across these sites that although tenure is held by individual clans (and in some cases families) the entire marine space around the islands was available to all fishers, whatever their clan. The following three figures (Figures 11,12 and 13) display data on the location of fishing trips for three clans from each of Atchin, Wala and Uripiv Islands. The figures have the location of fishing trips for example clans superimposed over aerial photographs of the islands which were scanned, imported as raster images and their geographical position registered in the GIS.

It is clear from the preceding three figures that there is no limits on the use of the 'community' marine space around these three islands with the exception of sub-areas declared as marine protected areas.

1.2.2 Fishery Outcomes

1.2.2.1 Summary of Fishing Activities

Table 6 presents data on the use of gear as recorded from sampled fishing trips (where gear type was recorded).

Table **6** - Use of Fishing Gears

Fishing Gear	Atchin (n=906)	Emua (n=207)	Lelepa (n=1201)	Pellonk (n=187)	Uripiv (n=762)	Wala (n=2046)
Gill-net	21	29	21	55	39	19
Handline	75	30	54	24	43	50
Spear-gun	4	35	25	21	18	24
Throw-net		4	25			7

1.2.2.2 Illegal Fishing Gears

The most common illegal fishing gears reported during rural appraisal interviews were natural poisons. Fishers utilise poisons (plants of the genus *Barringtonia*, *Derris*, *Euphorbia*, *Pittosporum* or *Tephrosia*) in shallow tidal pools to capture small fish and invertebrates. No data was collected on the characteristics of the yields typical from the use of poisons or the extent to which they were used by fishers but they are believed not to be significant.

Figure 11 - The location of fishing trips for three clans around Atchin Island

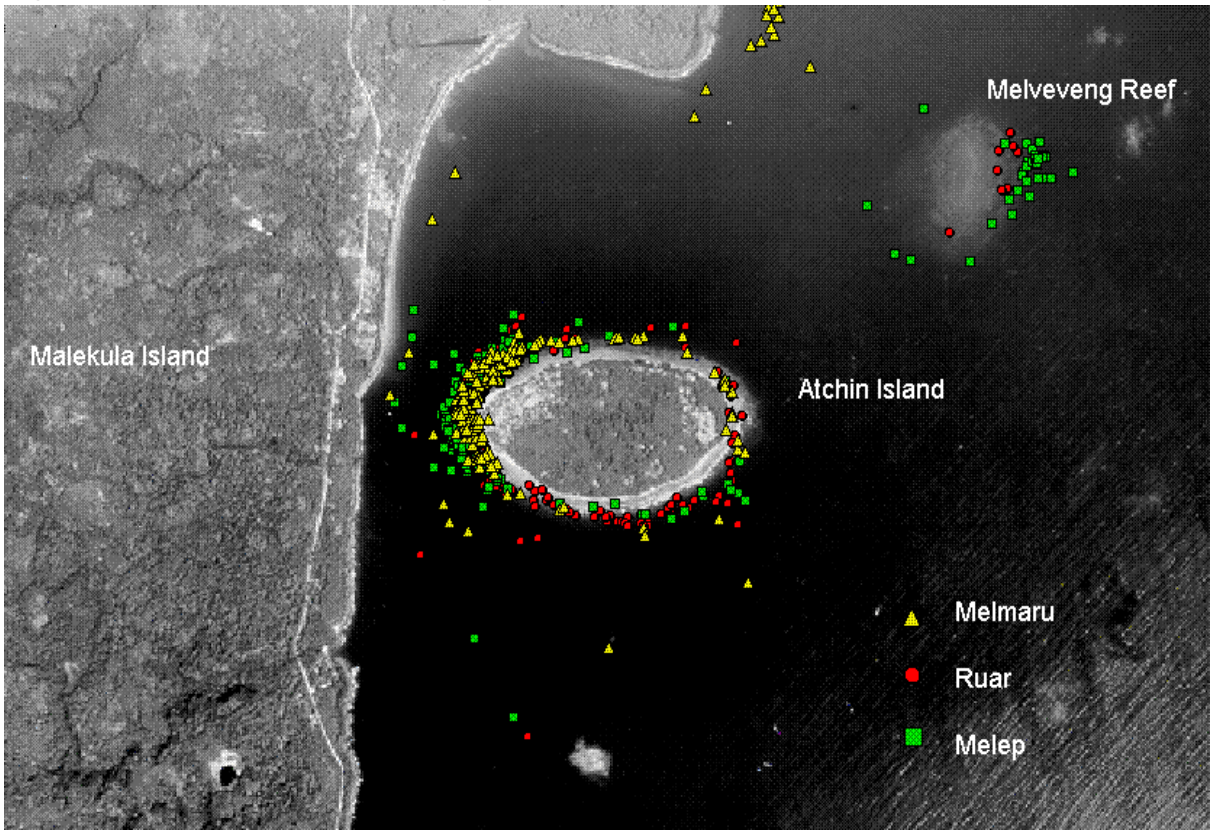


Figure 12 - Location of fishing trips for three clans around Wala Island

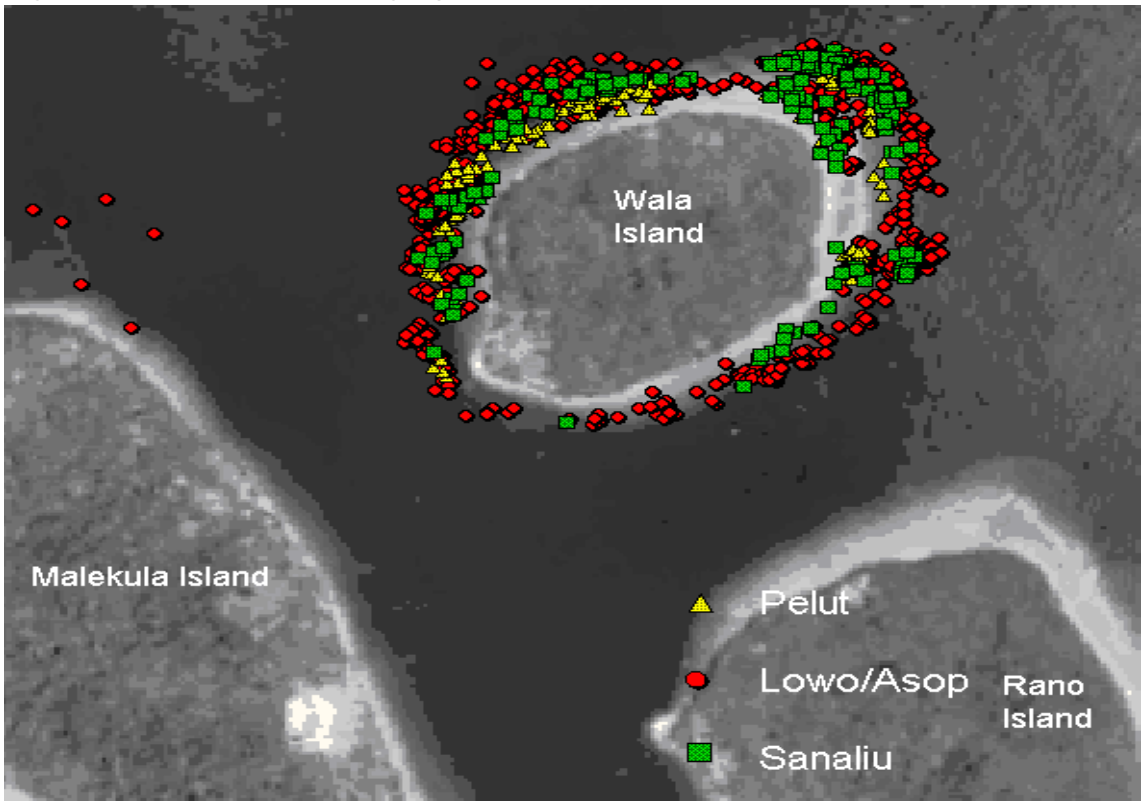
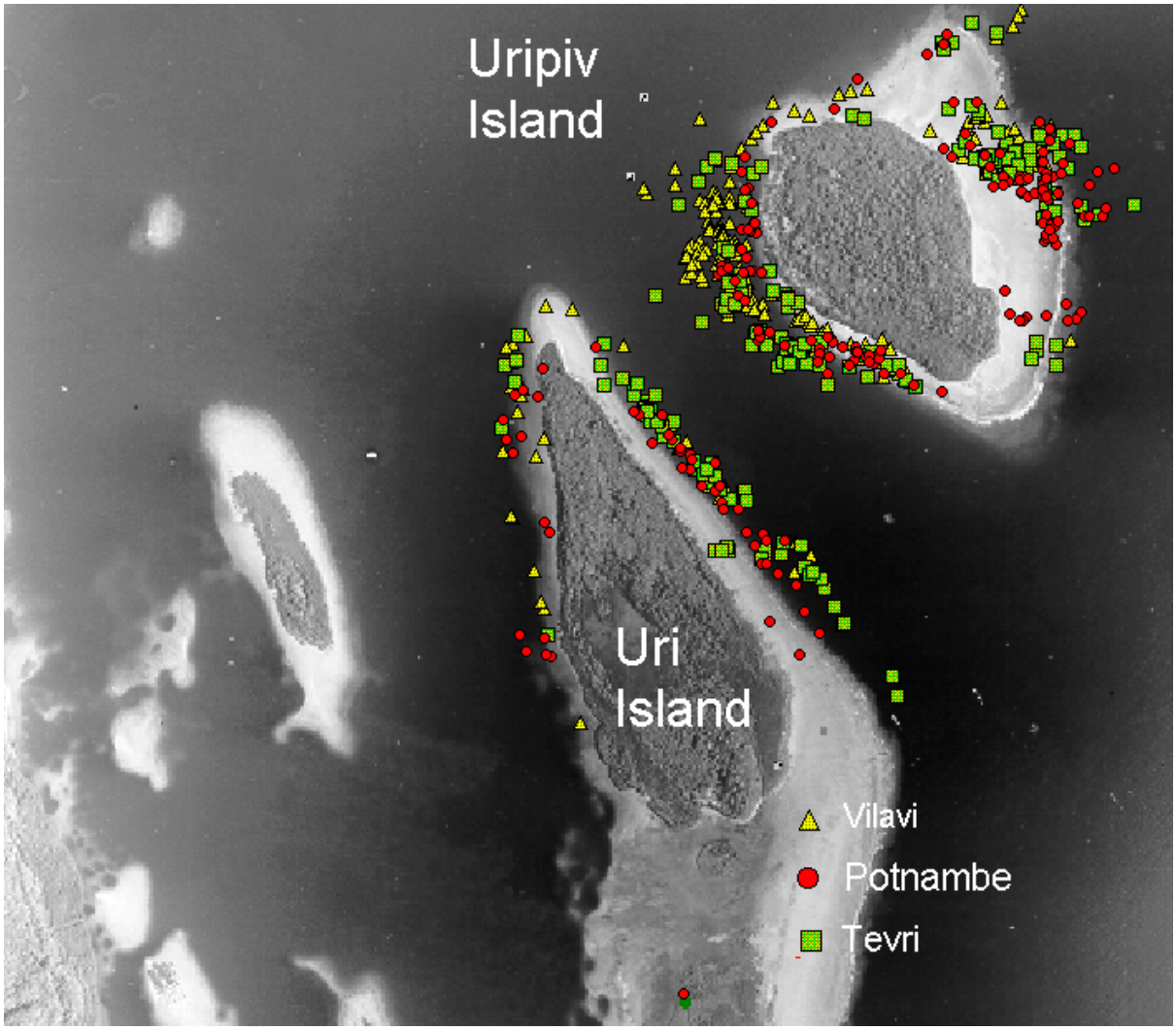


Figure 13 - The location of fishing trips for three clans around Uripiv Island



1.2.2.3 Yields by CFRA and Family

Table 7 presents summary data on the catch composition, by site and (key) family, of the sampled fishing trips. Data are presented as the proportion of the total sampled weight.

There is a significant level of variation in the relative contribution of the different parts of the total marine space potentially available to the fishers. This is determined by factors including seasonality in access which will be discussed in detail in the later sections (see Section 1.4).

Table **7** - Percentage Catch Composition by Site and Key Family

Family	Atchin	Emua	Lelepa	Pellonk	Uripiv	Wala
Acanthuridae	12	9	16	8	8	9
Lethrinidae	12	6	13	13	26	17
Siganidae	12	23	2	21	3	18
Sphyraenidae	9		2			2
Scaridae	9	15	27	27	13	20
Lutjanidae	9	6	3		3	2
Kyphosidae	6		2		4	5
Carangidae	5	4		4	19	4
Mugilidae					7	
Gerridae		11				
Scads			5			
Etelidae			18			
Mullidae		4	3	13		
Weight of Sampled Catch (kg)	2849	573	7992	799	6077	952

The previous figures describing the equity of access graphically displayed the use of marine space by the community. How does this patchy distribution of effort look in terms of yields from each site and from subareas within each site. Table 8 presents the range of yields as a percentage of a hypothesised MSY of 5mt / sq km of reef. It is clear from Table 8 that a significant range of yields are taken across all sites. On Atchin Island, which recorded the highest average yield across all subareas (82%), yields ranged to 401% of the 5mt MSY. The location of this very high rate of exploitation was the area of reef adjacent to the village. Pellonk in contrast recorded an average of 8% of the 5mt MSY figure.

Table **8** - The spatial variation in yields across each site

Site	Catch as % of MSY at 5mt/km2	
	Range of Yields- Unrestricted Areas	**Yields - Closed Area**
Atchin 97	0-401% (Av.82%)	
Atchin 98	1-168% (40%)	
Emua 98	25-28% (26%)	
Lelepa 97	0-78% (14%)	108%
Lelepa 98	0-130% (26%)	157%
Pellonk 97	1-15% (8%)	
Uripiv 97	3-111% (38%)	0%
Uripiv 98	2-75% (22%)	6%
Wala 97	0 -435% (163%)	54%
Wala 98	0 - 244% (77%)	0%

1.3 Summary biological outcomes

This section summarises the results of biological analyses for Vanuatu presented in Volume 3, which aimed to assess the status of fishery resources inside managed areas and draw conclusions on management success. Management success was examined across a range of fishing pressures at different sites. Underwater visual census (UVC) and fisheries monitoring programmes were conducted in order to derive data enabling investigation of the effects of fishing, and how management actions have moderated those effects. Comparisons were made between closed areas (managed) and areas (within the communities grounds) to which access was unrestricted, and the variables examined were correlated with fishing pressure. Of course access to all community grounds (and the individual CFRAs within them) is generally restricted to members of the community.

1.3.1 Summary results of Underwater Visual Census studies

Underwater Visual Census (UVC) was employed to examine :

1. Basic habitat characteristics;
2. Species and family abundance, and species assemblages;
3. Species length differences. Table 9 presents a summary of these analyses.

Table **9** - Summary of Results of Underwater Visual Census (UVC) Studies in Vanuatu

1. Habitat characteristics - Results
No significant differences in habitat characteristics were detected within or between sites
Closed areas were not significantly different from unrestricted areas
2. Abundance and Species Assemblages - Results **Multivariate analyses with MDS and ANOSIM**
No significant differences occurred in abundance or species assemblage for any closed areas compared to areas without restrictions
3. Univariate analyses of Abundance - Results
Emua Village - No significant differences between closed and unrestricted areas No significant difference in species assemblage
Lelepa Island - No significant difference between closed and unrestricted areas No significant difference in species assemblage
Uripiv Island - Lutjanids, mullidae and piscivores more abundant in closed area (222T) than in unrestricted areas
Wala Island - Lethrinids and planktivores more abundant in the closed area (215T) than in unrestricted areas
4. Univariate analyses of Species Assemblages - Results
Emua Village - No significant difference in species assemblage between closed and unrestricted areas
Lelepa Island - No significant difference in species assemblage between closed and unrestricted areas
5. Univariate analyses of the significance of Fishing effort on Abundance
Weak trend for increasing biomass at low levels of effort. This relationship was only significant for the families Serranidae and Kyphosidae across areas. Habitat was more significant than effort in explaining abundance
6. Univariate analyses of Mean Length
No significant differences in mean length of any species were detected in closed areas in Emua, Lelepa, Uripiv or Wala compared to unrestricted areas
7. Univariate analyses of Mean Length versus Fishing Effort and Abundance
For some species and gears a significant negative correlation existed between mean length and fishing intensity, and a positive correlation with abundance. Mean length of fish in closed areas was consistent with expectation relative to fishing effort and abundance

1.3.2 Summary results of the fisheries monitoring programme

Data generated from the fisheries monitoring programme was used to examine:

1. Species length, growth and mortality differences;
2. Species and family abundance, and species assemblages. Table 10 presents a summary of these analyses.

Table **10** - Summary Biological Results from Fisheries Monitoring Programme Data in Vanuatu

1. Analysis of Mean Length by Species - Results
No significant difference in mean length between closed areas and unrestricted areas occurred for any species at any site (but between site differences occurred)
2. Mean length and Fishing Effort / Abundance - Results
For some species and gears a significant negative correlation existed between mean length and fishing intensity, and a positive correlation with abundance. Mean length of fish in closed areas was consistent with expectation relative to effort and abundance
3. Fishing mortality - Results
Total mortality was not significantly correlated to fishing intensity or abundance for any species studied, except *Lethrinus harak* (Lethrinidae). This probably reflects inaccuracies in mortality estimation using length based methods of assessment. Insufficient data were available to determine mortality estimates in closed areas except for *Ctenochateus striatus* (Acanthuridae) in the closed area of Lelepa (Area 246T), where total mortality was low
4. CPUE (index of abundance) - Results
Within sites few significant differences occurred in CPUE. The differences were greater across sites. Data were available for 3 closed areas Uripiv (Area 222T), Lelepa (Area 246T) and Emua (Area 264T). The Lelepa closed area had a significantly higher catch rate than unrestricted areas within the relevant site
CPUE data were poorly correlated with fishing intensity in both 1997 and 1998 and for each gear type examined. Relative to fishing intensity, the Uripiv closed area (Area 222T) had low/expected catch rates; those at Emua (Area 264T) were as expected. Only those at Lelepa (Area 246T) tended to be high relative to the fishing intensity recorded in the area
5. Species Assemblages - Results
No significant differences in species assemblage occurred between closed and unrestricted access areas, except for fish caught with gill nets in 1997/8. Species assemblages were most different in the closed areas of Uripiv and Emua, whilst in the Lelepa closed area they were more similar to other areas
No correlation existed between species assemblages and fishing intensity, reef area or distance (of fishing ground) from the main landing site. These variables were strongly inter-correlated

1.4 Conclusions on Biological Outcomes for Vanuatu

Table 11 presents a summary of the findings of the biological analysis from Vanuatu.

Table **11** - Summary of Performance of Closures (Sustainability Criteria)

Site	Increased Mean Length	Increased Species Diversity	Increased Abundance‡
Atchin	n/a	n/a	n/a
Emua	✘	✘*	✘
Lelepa	✘	✘	✔ (CPUE Data)
Pellonk	✘	✘	✘
Uripiv	✘	✘*	✔ (UVC Data)
Wala	✘	✘	✔ (UVC Data)

* Species assemblages in the Emua and Uripiv closed areas differed most from the adjacent (un-restricted) areas.

‡ There was no significant increase in mean length inside the closed areas. The increased abundance was therefore not related to the growth of fish and may indicate aggregation effects in less disturbed areas.

1.5 Economic Outcomes

1.5.1 Contribution of Fisheries to Community Economy

A socio-economic survey (utilising ranking) was undertaken to assess the relative contribution of different activities to the economy of the communities at each research site. The survey was a random survey of households in each village. The data presented in Table 12 covers the dry (cold) season only. Data for the wet season is similar with the exception of fish sales which assume a slightly greater proportional contribution (for Lelepa fish sales rise from 35% in the dry season to 43% in the wet season) and agricultural sales (which include yams, cassava, taro etc) a slightly lower contribution.

Table **12** - Ranked income by source

Income Source	Atchin	Emua	Lelepa	Uripiv	Wala
Cacao	21				16
Cattle Farming				2	
Sales to Aquarium Trade			20		
Copra	47			32	53
Family Remittances				7	1
Fish Sales	12	30	35	12	11
Handicraft			4		1
Kava			2		1
Other Agriculture	9	58	25	27	13
Miscellaneous	8	4	4	5	4
Salary	3	8	4	15	
Tourists			5		

Table 13 presents data on the source of food supplies for 5 of the 6 research sites. Data collected from Pellonk was not included in this table.

Table **13** - Source of Food Supplies (%) by Site

Food Source	Atchin	Emua	Lelepa	Uripiv	Wala
Local Agriculture	47	37	43	54	42
Local Marine Products	17	6	18	18	24
Local Store	27	37	24	18	23
Town	9	20	14	10	11

Table 14 presents estimates for the value of fin-fish resources landed during the period of monitoring. The values are in Vatu (£1 = 206.5 VT, June, 1999).

Table **14** - Estimated total value (Vatu) of fin-fish resources by site and year [§]

Site	1996/97 (1996 Prices)	1997/98 (1997 Prices*)	Mean
Atchin	638881	332079	485480
Emua	-	809000	
Lelepa**	984969	1973216	1147093
Pellonk	507934	-	
Uripiv	530108	254024	802023
Wala	937479	666566	392069
Total	VT 3,599,371	VT 3,558,190	

§ The monitoring programme commenced in November, 1996. Annual estimated revenues are based therefore on 12-month periods from that date rather than on calender years.

* Prices are based on the mean price recorded for mixed reef-fish quoted at the markets at each site.

** The estimated value of fin-fish resources landed at Lelepa in 1997/98 includes a 1.3mt contribution from the developing Eteline snapper fishery which is included in the total figure presented in the table. The estimated value of Eteline snapper was VT476,700.

1.6 Meeting Management Objectives: A summary of Performance

What is the performance of customary tenure in the management of community marine resources? The objectives of management as defined by the communities are listed in Table 15. The objectives of conservation and ear-marking of resources for religious festivals or community development are self-explanatory. It was reported in Table 6 that management objectives can be include implicit as well as explicit objectives. It is for this reason that a management action can have a number of objectives. In general the primary explicit objective was conservation. But implicit objectives are also important. For example, the closed area around Wala Resort on Wala Island was explicitly declared for conservation of resources (to promote tourism). But the custodian also stated that he was invoking the closure out of respect for the traditional actions related to specific ceremonial events (in this case the grade-taking ceremonies described by the custodian's grandfather). In addition the closure was also aimed at strengthening the claim to land adjacent to the closed area. A final objective was political. The creation of the Wala Island resort was accompanied by some political rumblings within the community; the custodian believed a declaration of a closed area would act as strong statement of intent to the wider community (Song-Luke Siptiley, Wala Island Resort, pers comm). Another example of politics as the implicit objective to management action was reported by members of the community of Poangnisu Village, a village adjacent to Emua (Ben Norman, pers comm; Kalmasai Kalsakau, pers comm). An individual who was seeking to promote his claim to be the chief declared a 12-month closure over the entire area of fishing grounds held by the community. It is impossible to know exactly what contribution this action made to his ultimately successful claim but it was clearly an attempt to disrupt the counter-claim of his opponent. Further analysis of the decision-

making process is presented in Section 1.5.

Table **15** - Summary of Management Objectives

Site	Conservation	Ear-Marking Resources	Ceremonial	Land Claims	Clan Politics
Atchin*	✔				
Emua	✔			✔	
Lelepa	✔	✔			
Pellonk	✔			✔	
Uripiv	✔			✔	✔
Wala	✔		✔	✔	✔

* A closure was initiated in August, 1998, at the end of the monitoring programme, by one of the 3 chiefs of the Melep clan. The period of closure was not defined by the chief. Because the performance of this closure is unknown it is not included in this table.

The primary means by which custodians seek to meet these objectives is through the declaration of closed areas. Table 16 presents a summary of the performance of the closed areas according to the criteria of sustainability as measured by scientific quantitative methods by the research team. A qualitative measure of the performance is also presented. This was assessed from the rural appraisal interviews and relates directly to the perceptions of the resource custodians.

Table **16** - Summary of Performance of Community Management Activities

	Performance of Closures	
Site	Quantitative	Qualitative*
Atchin	n/a	n/a
Emua	✘	✔
Lelepa	Variable	✔
Pellonk	✘	✔
Uripiv	Variable	✔
Wala	Variable	✔

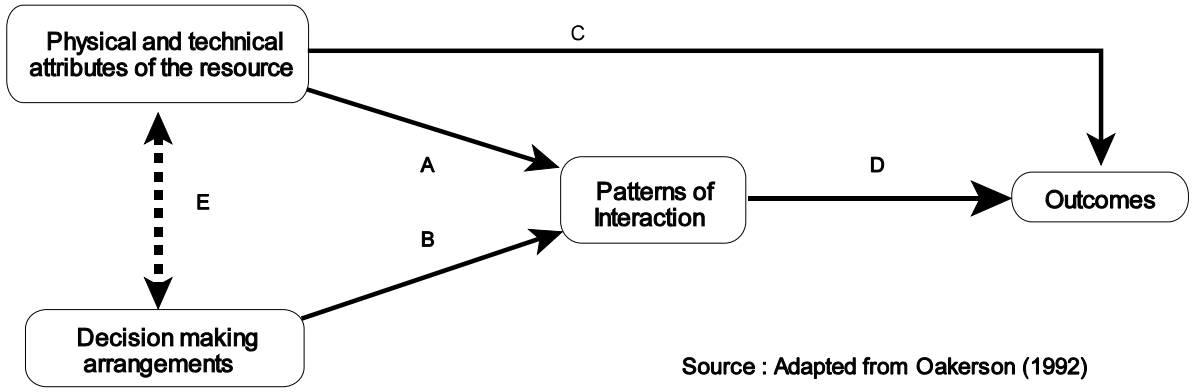
* From the perspective of the custodians the closed areas were successful in the short-term at least. However, the reasons for this perceived success are complex. There was agreement that fish were aggregated (this was suggested by the biological data in Lelepa, Uripiv and Wala). But there were additional perspectives. One important factor was the belief that fish become ‘wild’ after prolonged periods of fishing activity, particularly those that are targeted by methods that demand a significant level of fairly direct interaction with humans; in particular this applies to spear-fishing but also includes gill-nets. Fishers stated that closures allowed fish to become ‘tame’ and this explained the higher catch-rates that could be realised after only a relatively short closure (and which were confirmed in the one closure, at Lelepa

Island, which experienced significant levels of fishing effort).

1.7 Understanding the Fisheries (1) : Patterns of Interaction

The outcomes described above are largely the result of choices made by fishers about how, where and when they fish (subject to the constraints of the environment, marketing opportunities and the technology available). In turn the choices made by fishers are dependent on the perception of the costs and benefits associated with the different types of action available to them. The perception of potential costs and benefits of a particular choice of action will be influenced by fishers' understanding of the physical and technical attributes of the resource system and by the management institutions that govern them as stakeholders. A fishery is not static nor are the fishers necessarily uniform in their interpretation of the operational boundaries to their choice of action. Individual choices therefore vary and decisions taken (or at least reported to be taken) by one fisher may be influenced by (or influence) the actions taken by other fishers. Figure 14 presents the Oakerson Framework and indicates the position of Patterns of Interaction in the overall framework. Patterns of interactions (Line D in the figure) represent strong causal relationships because once choices have been made by fishers the outcomes are not determined by human discretion (Oakerson, 1992, p52).

Figure 14 - The Oakerson Framework



One of the most important aspects of this analysis is to determine the extent to which the choices made by fishers engender cooperation or conflict within the fisher community and/or between fishers and the management authority. Conflict will necessarily reduce the likelihood that the objectives of management are met. A key manifestation of this form of interaction is the so-called 'free-rider' problem. The problem (for an individual wishing to maximise his own catch) is that most management rules and regulations necessarily restrict the rewards available, at least in the short-term, for benefits to eventually accrue to all. Free-riding refers to the idea that some individuals will ignore the rules to maximise their individual benefit while relying on the fact that (most) other individuals will adhere to them. The free-riding individual therefore suffers no loss of benefit from imposition of rules and in fact should gain additional benefits as yields improve as a result of the restraint of others.

This section divides the analysis into a number of components which relate to the different stakeholder groups previously identified in Section 1.1.3. Cooperation and conflict *within* the stakeholder group that actually fishes is described in Section 1.3.1 and cooperation and conflict *between* the fishing community and the management authority in Section 1.3.2 and

Section 1.3.3.

1.7.1 Interactions within the Fisher Stakeholder Group

Community politics, choices of gears and the technical development of the fisheries at the research sites tends to either conflict-neutral behaviour or to foster active cooperation between fishers. A range of fishing gears and fishing techniques are employed at the six communities. There were no substantive differences in the techniques by which these gears were deployed at the different sites. It is worth pointing out however that gill-nets are generally not set in the 'traditional' manner as set nets (left over a tide's rise and fall) but are used as corrals into which fish are actively herded by fishers. The precise manner in which the gear is deployed varies depending on the depth of water.

Table 17 presents data on the level of cooperative fishing recorded during gill-net fishing activities (where the number of fishers participating was recorded).

Table **17** - Cooperation by fishers using Gill-nets

Fisher Number	Atchin	Emua	Lelepa	Pellonk	Uripiv	Wala
1						
2	98	38	136	31	146	194
3	27	7	25	23	50	58
4	23	4	18	18	23	34
> = 5	31	2	56	30	11	55

Analysis of these data indicates that gill-net fishing frequently involves a cooperative effort and coordination of individuals. The explanation for this level of cooperation derives primarily from the technical issue of use gill-nets as corrals rather than setting as static gear. The catch is subsequently divided on a equal share basis, again a cooperative action. There were no reports of conflict either within gill-net teams or between gill-net teams.

Monofilament handlines was the most commonly used fishing gear at Atchin, Lelepa, Uripiv and Wala and also contributed significantly at the remaining sites. The use of this gear can be broadly characterised as inshore and offshore. The inshore handline fishery targets small reef-dwelling species dominated by Lutjanidae, Lethrinidae, Nemipteridae, Balistidae, Sphyraenidae and Labridae. Fishing usually takes place from a canoe; fishers travelling from the mainland garden sites to the island would often fish on their return home in the late afternoon. As a result of the village-fisheries development project (Lindley, 1992) there has also been attempts at the development of the offshore fishery targeting deep-water Eteline snappers in particular. The continental shelf around Vanuatu is very narrow therefore suitable habitat for Etelidae can usually be found a relatively short distance (<1km) from the shore. Depending on weather conditions this fishery is prosecuted by fishers using traditional out-rigger canoes but there is also use of larger craft, most commonly 5-metre (loa) marine-ply craft known as 'Hartleys', and Yamaha fibreglass skiffs, both powered by outboard engines. Table 18 presents data on the cooperative fishing choices made by fishers using handlines.

Table **18** - Cooperation by Fishers using Handlines

Fisher Number	Atchin	Emua	Lelepa	Pellonk	Uripiv	Wala
1	560	45	404	8	179	384
2	30	3	79	34	35	407
3	15		25	1	13	76
4	3		13	1	4	34
>= 5	1		5		2	24

Modern spear guns are utilised at all the research sites. These gears are used in the normal way although the relatively high cost of spear-guns relative to available income limits their availability. Table 19 presents data on the cooperative choices made by fishers using spear-guns. Again there is cooperation between fishers using this gear.

Table **19** - Cooperation by fishers using Spear-guns

Fisher Number	Atchin	Emua	Lelepa	Pellonk	Uripiv	Wala
1	31	32	184	3	65	132
2		5	60	29	14	94
3	1	4	13	3	9	31
4			7	1	3	67
>= 5			6	4	2	143

Reef gleaning is also an important activity, particular for women fishers who collect shellfish, crabs and octopus. The use of poison plants (eg *Barringtonia*, *Derris* etc) with which the majority of fishers appeared familiar was not recorded during the monitoring activities but most respondents reported that poisons were used at least occasionally during reef gleaning for invertebrates.

Table 20 presents a summary of the main interactions observed during the research programme.

Table **20** - Summary of Interactions between fishers

Site	Non-Reciprocal Cooperation	Reciprocal Access to CFRAs	Economic Exchange
Atchin	✔	✔	✘
Emua	✔	n/a	✘
Lelepa	✔	n/a	✔
Pellonk	✔	✔	✘
Uripiv	✔	✔	✘
Wala	✔	✔	✘

1.7.2 Cooperation between Fishers and CFRA Custodians

Cooperation between fishers has already been noted in Section 1.3.1. This refers to cooperative behaviour *between* fishers. The relationship between fishers and the CFRA custodians at the research sites was also largely, but not exclusively, cooperative. Table 21 presents data on the summary interactions reported between fishers and managers.

Table **21** - Summary Interactions between Fishers and CFRA Custodians

Site	**Management Observed?**	**Reciprocal Access to CFRAs**
Atchin	n/a	✔
Emua	✔	n/a
Lelepa	✔✘	n/a
Pellonk	✔✘	✔
Uripiv	✔	✔
Wala	✔	✔

In Emua village and on Lelepa Island tenure of the fishing grounds utilised by the community is held under one authority, that of a single 'community' chief. The entire marine space belonging to the community is open to all fishers from that community. At Pellonk, although tenure is technically held at clan level, the community has agreed to place individual clan tenure under the authority of the community chief. At the sites of Atchin, Wala and Uripiv tenure remains at the clan level. What was the extent of cooperation between these clans in the sharing of fishing space? Reference to Figures 5, 6 and 7 presented in Section 1.2.1 indicated that fishers utilised all the fishing grounds belonging to adjacent clans. At Pellonk, in addition to the two small closed areas, there was a seasonal ban on the use of gill-nets extending from 5th October, 1996 to 5th March, 1997. Data from the fisheries monitoring programme was equivocal. Thirteen fishing trips were recorded using gill-nets during the period of the ban out of a total of ninety-two recorded for gill-nets over the one-year period of monitoring at Pellonk.

Management activities usually have multiple objectives. One of these objectives is the ear-marking of resources for particular community events. At the Lelepa site the long-term closure was in fact punctuated by a series of harvests that were sanctioned by the chief (and the community). These harvests provided the community with marine products for religious and other celebrations.

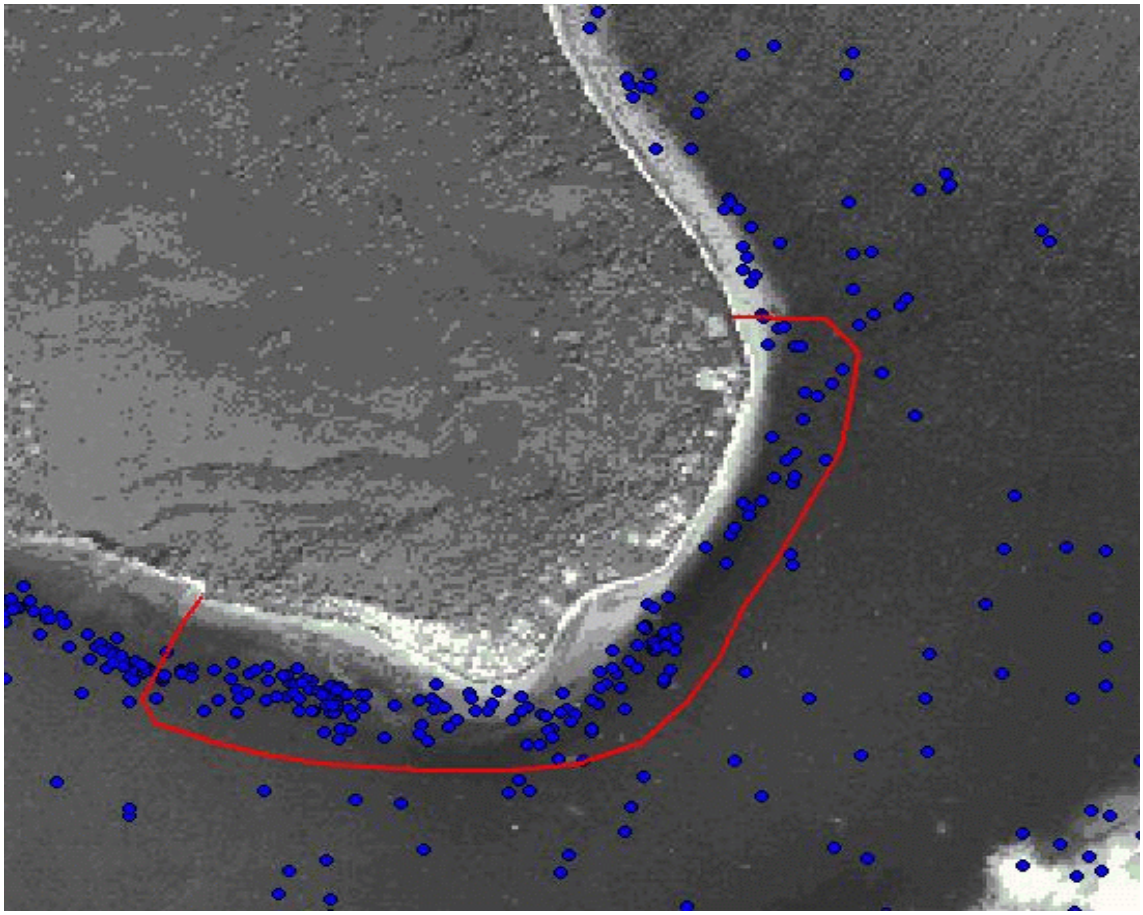
1.7.3 Conflict between Fishers and Management Authorities

The analysis to date has indicated that there is cooperation within the wider stakeholder community. However, respondents from many communities also reported that decision-making arrangements were not transparent. One aspect of this lack of transparency was that the time-frame over which the success of management action was to be judged was often vague or simply not-stated. Respondents on Uripiv Island, where the closure of the Malisa family CFRA has been in place for 8 years, indicated that this could potentially cause conflict.

In one clear-cut case was conflict reported. The community of Lelepa has established a working relationship with an aquarium fish exporting company belonging to Australian expatriate Wayne Armitage (Douglas Meto, pers comm; Wayne Armitage, pers comm). Armitage's company works with the community in two ways. Firstly it may send requests to the community for clams or aquarium fish which the islanders then catch. Armitage arranges collection from the community's landing site on Efate Island for transport to the companies holding facilities in the capital, Port Vila. Individuals are paid a pre-arranged price per unit of clam or fish supplied. In addition to this, Armitage pays a monthly access fee to the community that allows his team of divers (using Hookah) to take fish from the reefs of the CFRA. The arrangement was that the fee would be paid into a community bank account to which the Chief had access. After some months of this arrangement working smoothly an audit of the account by the community revealed that some of the funds had been embezzled by the Chief for his own purposes. The response of some members of the community to this revelation was to enter and fish the closed area. This lasted only one day and the situation resolved itself without further conflict.

Figure 15 presents data on the invasion of the closed area around Lelepa Island. These data include both sanctioned and non-sanctioned fishing trips. The closed area is highlighted in red.

Figure 15 - Fishing trips recorded from inside the Lelepa Closed Area (1996-1998)



Other examples of conflict between the management institution and the stakeholders were less clear-cut. Fishers from Wala Island reported that Atchin Islanders fished around their island, usually at night and without their permission. Although there are strong clan links between the two communities, Wala Islanders described this fishing in terms of poaching. Poaching by Atchin Islanders was also reported by respondents from Uripiv. No data was gathered to support these claims although Atchin Islanders did report (admit) that they sometimes fished off Atchin 'towards Wala' for deep-water snappers (e.g. Belden Ham, pers comm).

The marine environment can also be the theatre of conflict over land rights. The marine protected area declared adjacent to Wala Island Resort was declared for two reasons (Song-Luke Siptiley, (Wala Island Resort Landowner) pers comm). The land-owner stated that it was a measure designed to enhance the marine environment for visiting tourists. He reported that he had heard stories from his grandfather about the abundance of fish in the area. In fact, he had initially declared a 3-month closure over the area during the previous year (1995) which he believed had led to an increase in the abundance of fish. The apparent success of this closure led to him initiating the closure currently in operation. But the closure was also partly an attempt to further strengthen the families claim to the land which for complex reasons was open to challenge. This was especially the case since the resort had been successfully developed and was now highly valuable (Song-Luke Siptiley, pers comm).

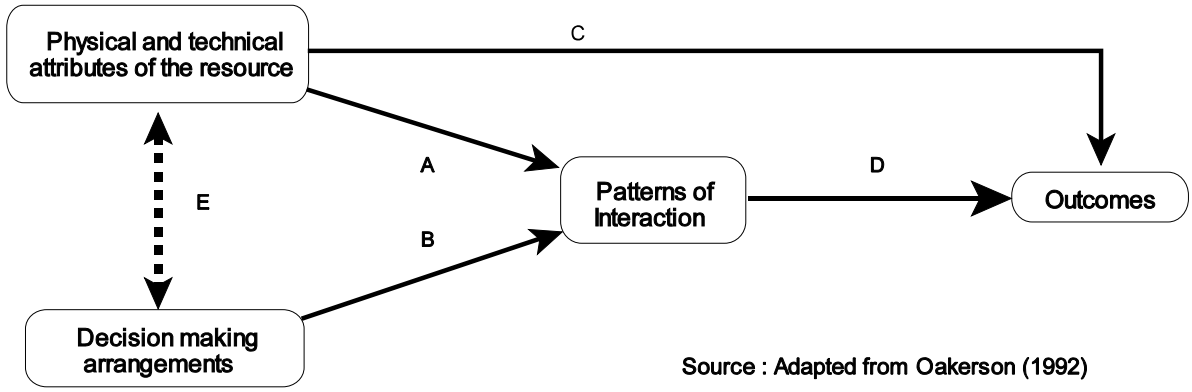
The closed area extended along a beach front of approximately 300 metres but was remarkable only for the fact that the habitat in this area consisted largely of a steeply sloping sand bank with only very small thickets of *Acropora* coral and a very low abundance of resident fish (J.Anderson, pers obs; Polunin, unpubl).

1.8 Understanding the Fisheries (2) : Physical/Technical Attributes

This section seeks explanations, in the physical and technical attributes of each CFRAs, for the outcomes reported in Section 1.2 and the patterns of interactions reported in Section 1.3.

Analysis of physical and technical attributes seeks to explain two aspects of the fishery. As direct or '*hard*' constraints these attributes determine the outcomes by creating the boundary conditions to outcomes. Whatever choices are made, these attributes still affect the outcomes. For example, the outcomes presented in Section 1.2 include yields of particular families. The physical attributes will determine what families will be available through it's influence on climate and habitat and, indirectly, on the types of gears that are appropriate. The technical attributes (particularly the level of macroeconomic development and its influence on communications, marketing opportunities and types of gear available) will also directly constrain the yields and revenues generated from the fishery. This relationship is represented by line C in Figure 16 below.

Figure 16 - The Oakerson Framework



Physical and technical attributes will also influence the mutual choices made by fishers and the subsequent patterns of interaction (of all the fishers) observed (line A in the figure). The strength of influence will depend on the fishers perceptions of the advantages offered or constraints imposed by these attributes. For example, although fishers may be limited by physical and technical attributes to targeting a particular range of families they still have a choice to make about when, where and how to target these resources on any particular fishing trip. It is important to bear in mind that some choices will be influenced by a number of different attributes in addition to the influences of political and social contexts of a fishery. Furthermore, that these different influences will interact in quite individual ways according to the particular circumstances of each location. The final relationship to identify is that represented by the dashed line E. This relationship describes the influence of physical and technical attributes on the types of community institutions that have developed and the rules and regulations that they may operate. In fact, from the perspective of the stakeholders there exists a feedback mechanism. The size of CFRA for example will determine what the carrying capacity of the CFRA's resources area. Further to this, the rules and regulations will

(or at least should) determine the level at which the resources are exploited.

The re
source manager, whether customary or a State agency, is primarily interested in the following three attributes of the physical and technical attributes of a fishery:

1. The Capacity of the Resource to Support Multiple Users.

It is clear that a finite resource base will have a finite level of exploitation. It is essential that the capacity of a resource is, from the perspective of sustainable exploitation, as best understood as is possible given prevailing knowledge and financial conditions. Theoretically at least this information should provide the basis for taking a precautionary approach to management with an adaptive long-term view. A fishery only exists when fishers capture living resources. For fisheries managers (again whether customary of state-appointed) their responsibilities lie also with the fishers themselves and they may seek to maximise individual revenues for fishers within the boundaries of sustainable production. Fishers themselves, especially commercial fishers, adapt their activities as individuals and groups to suit local conditions. In fact a good deal of cooperation was observed between fishers, notably at the artisanal and small-scale commercial sites. This cooperation in some part is due to the physical and technical attributes of these particular fisheries. At more commercial sites, the cooperation tends to be purely based on economic exchange and conflict between stakeholder groups intensifies due to perceptions of an imbalance in the benefits being extracted by the different groups. The manager again needs to be aware of the different ways in which fishers adapt as these not only affect cooperation and conflict within the fishery but may potentially affect management actions to be invoked by the managers.

2. The Control of Access

All inshore fishing grounds in Fiji are demarcated as belonging to a particular *vanua* or *yavusa*. Despite this level of sub-division access controls are less important, at least amongst tribal groups, than one might expect. Some of the reasons for this are discussed in more detail in Section 1.5. However, where commercial fisheries are being developed by stakeholder groups (Indo-Fijians) without the traditional family and cultural links, access control is becoming a more important issue. The reverse, of course, is also true. Indo-Fijians, who legitimately purchase access rights (licences), are equally concerned that the value of their investment is not reduced by levels of fishing effort above that which they paid to compete with. (And that their rights of access are not constrained). The ability to control access is central to the success of management actions (to sustain the resources and benefit from the resource rent available from a well-managed resource) and to the success of fishers. The attributes of each site will be identified *viz-a-viz* their ability (and success) to control access. For this section we expand slightly the original use of this term in Oakerson to include all monitoring, control and surveillance (MCS) activities.

3. The Scale of Management

This section will consider the influence of the scale of existing management units (which, in Vanuatu, are defined by the politics of land use) on current interactions. The scale of management is often a thorny issue; on the one hand one wants to maintain small-enough units that the process of management (the gathering of data for example) is practical, on the other hand one needs to consider the underlying distribution of the stocks that one seeks to manage. For example, myriad small management units acting independently along the

migratory route of a valuable species, will probably not effect useful management. This section considers the attributes of the research sites in relation to underlying resource distribution and the response of fishers to this distribution. In Vanuatu management units, the CFRAs, are based not on biological considerations but largely on historical political (and land resource) consideration. A more detailed analysis of the formation of the CFRAs of Vanuatu is presented in Section 1.5 and this section will therefore confine itself to observations on the physical and technical attributes of the resource system with regard to efficient management.

1.8.1 The Capacity to Support Multiple Users

The Environment

The predominant habitat targeted by fishers in Vanuatu is coral-reef, in particular fringing reefs. The existence of this habitat is itself determined by the tropical climate of Vanuatu. Yields are dominated by reef-dwelling species (e.g. members of the Acanthuridae, Scaridae and Labridae families). Yield composition is also determined by the technical attributes of the gears utilised although the three main gears, spear-gun, gill-net and handline, can be employed, through subtle differences in deployment techniques, to target the vast majority of the species normally associated with coral-reefs. Again there is a feedback loop. There is a degree of family or species selectivity to many gears. For example, Scaridae are not usually (but occasionally can be) caught with handline because of their feeding ecology (and hence their oral morphology). Within the Scarid family there exists differences in their vertical distribution, some typically associated with the surf-zone, others living deeper. Again, those that live deeper would not typically get caught by gill-nets deployed as corrals on the rising tide, but would be targeted by spear-fishers, potentially leading to gear-effects on species' relative abundance. Seasonality also plays a role in determining yield composition through its impact both on abundance of some resources and on fishing practices as was described in the previous section. Abundance, particularly of neritic species (e.g. *Selar* spp, *Decapterus* spp; Belonidae) can be strongly seasonal through the effect of season on migratory behaviour.

Vanuatu experiences two distinct seasons. The wet (hot) season occurs approximately between November and April, the dry (cold) season between May and October. The dry season is characterised by prevailing South-East Trade winds; the wet season by North-Westerlies. During the period of fisheries monitoring, from March to September 1997 the Pacific region experienced a severe El Nino event. This resulted in mean water temperature increasing by approximately 4^{o} Celsius above seasonal average (NOAA, 1999). Figures 17 and 18 present mean climate data for the nation's capital, Port Vila, located on the south coast of Efate Island.

Figure 17 - Mean Monthly Temperature, Port Vila

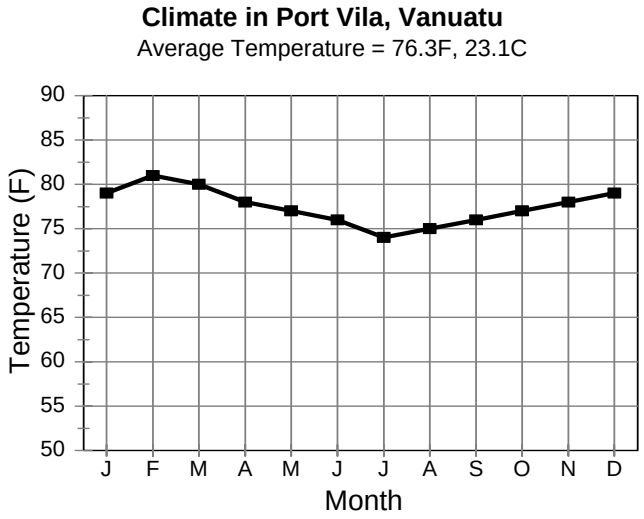
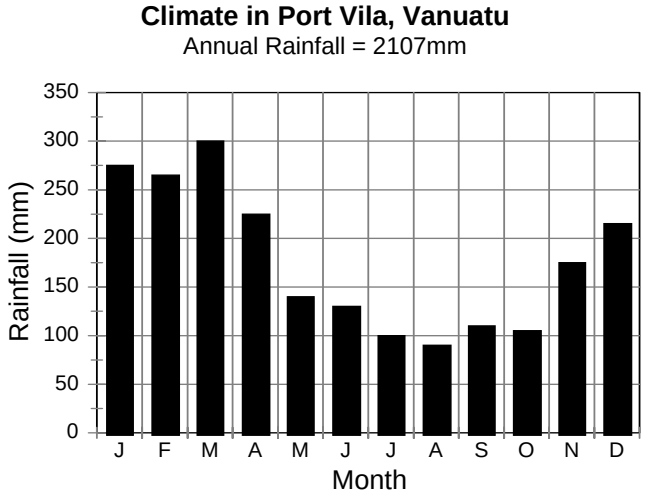


Figure 18 - Mean Monthly Rainfall, Port Vila



The use of marine space can be strongly influenced by climate, in the short-term by daily weather variations, and on a longer-term by seasonal variations in conditions. These interact with the geography of the CFRA (i.e. the aspect). These attributes further interact with technical attributes (level of vessel and gear technology and marketing) to influence patterns of use of marine space. This section will seek to present data that explains some of the use of the different areas of marine space around the research sites; the implications for the reciprocal benefits of sharing marine space through the year is clear. If areas of community grounds are only seasonally accessible it makes sense for each clan to reciprocate in permitting access across all grounds to maximise the capacity of the *community* resource to support multiple users. Those that are unable to fish the wind-ward side during certain months may fish in the lee-ward side. Those whose clan fishing grounds are on the lee-ward side gain reciprocal access to the wind-ward coast. This may be simply be a pragmatic response of the community as a whole to conflict reduction. The analysis of the fisheries and UVC data did not indicate that catch-rates (as an index of abundance) or species diversity

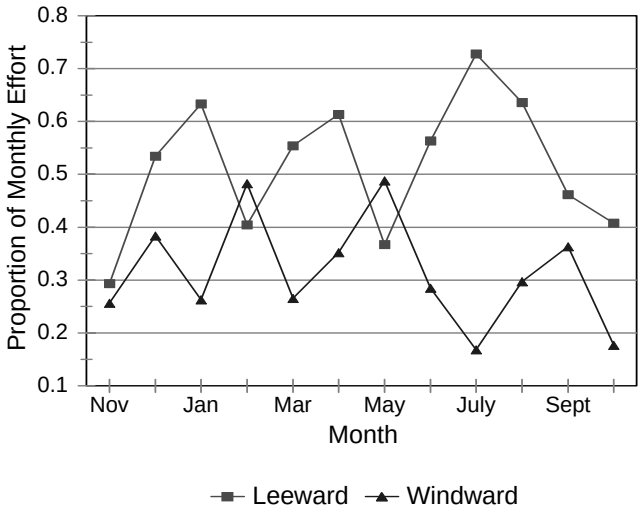
was significantly higher on the windward coast suggesting that there may not be any clear advantage in terms of improved yields for fishers from the lee-ward coast. In addition, the communities are physically located on the lee-ward side so permitting un-restricted access to all fishers is another pragmatic response of the community in general and individual CFRA custodians in particular.

All stakeholders therefore have the option to share the collective resources of the community. But perceptions by some custodians of the adverse affect of increasing pressures has encouraged them to attempt to control access, a situation already evident across many communities in Vanuatu (eg. Amos, 1994; Johannes, 1994; F. Hickey, pers comm; J. Anderson, pers obs). This creates complexity in the reciprocal arrangement generally in place situation. A short-term closure (for whatever reason) by one clan will concentrate effort in adjacent clans' marine space. In the short-term adjacent clans would expect to gain advantage when a short-term closure is lifted from whatever increase in catch-rates is realised. But when closures are of longer duration, or open-ended (as is the case in Uripiv and Wala) there is a potential for an asymmetry to develop. Much depends on perceptions amongst the clans adjacent to a closed area of the potential effects of a closure on resources in waters surrounding the closure. There were no clear observations or reports from any site of significant conflict arising as a result of these closures although discontent was reported amongst clans neighbouring a closure in Uripiv that was lifted prior to this research programme.

A perception of asymmetry may result in a management response designed to improve the equity of the situation or at least to preempt actual conflict. When the Emua community declared a closure of a large area of their fishing grounds, the neighbouring Saama community (which purchased land from Emua and with it nominal tenure over the adjacent reef areas) feared that fishers from Emua would invade their marine space; an action that was theoretically permitted according to the administrative arrangements of the initial sale of land. In order to preempt this action the Saama community declared their fishing grounds closed for the duration that the Emua closure was to be operational.

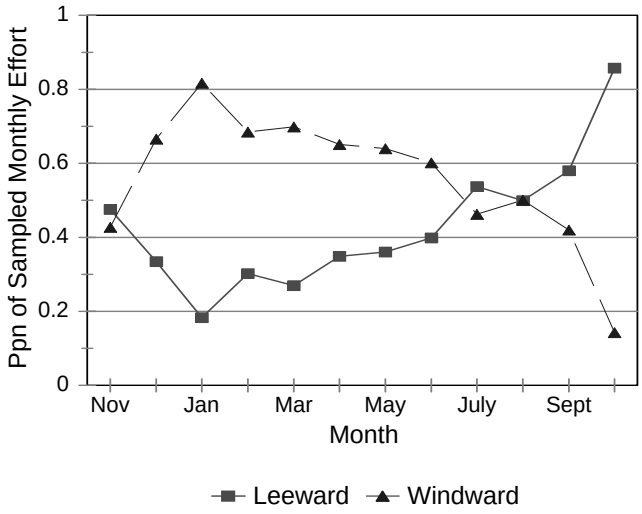
Figure 19 below presents data for the mean proportion of sampled fishing effort by month (over the two years) and aspect recorded for Atchin Island on the North-east coast of Malekula Island. The south coast of Atchin is relatively exposed to the South-East Trade winds. The period when the majority of effort was focussed on the leeward shore was during the cold (windy) season (May to October) although there is inevitably some variation through the year as weather conditions vary. Overall, 50% of total recorded effort was expended on the leeward side of Atchin and 34% on the windward side (the remaining 16% was expended on Melveveng submerged reef and on the Malekula coast).

Figure 19 - Location of Effort for Atchin Island



For Wala Island (Figure 20) the pattern was somewhat clearer than for Atchin with a strong trend towards fishing effort targeted on the leeward shore during the period of the South-East Trades. Overall, 42% of recorded effort was expended on the leeward shore and 56% on the windward shore of Wala Island.

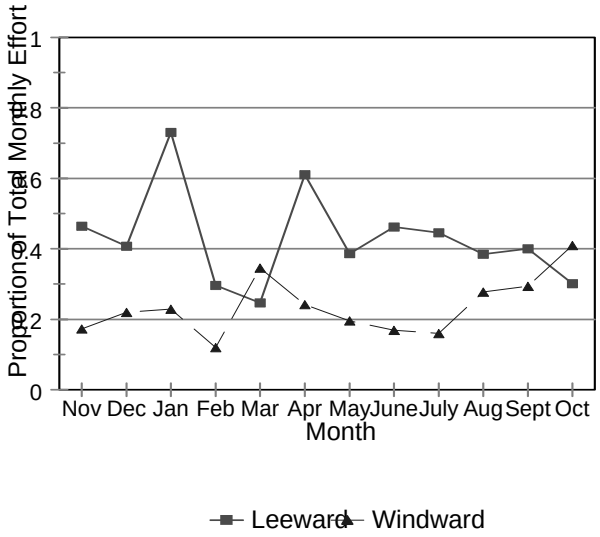
Figure 20 - Location of Effort for Wala Island



The pattern in the location of effort around Uripiv Island varies less with season (see Figure 21). The windward shore (recording 23% of total effort) being used less than the leeward shore (recording 43%) through almost the entire period of monitoring. The remaining effort recorded for Uripiv fishers was expended around Uri Island. The explanation for the relatively constant contribution to overall fishing activities on the windward shores stems from the geography of the area which is dominated by an extensive reef flat. The reef flat dries at low

tide and floods to a depth of 3 metres. Fishers are able to fish gill-nets in virtually all conditions. At the other sites mentioned such extensive reef flats do not occur and fishers are more frequently unable to operate effectively in a narrow and hostile shoreline during periods of the south-east trade winds. Data indicated that 60% of all fishing effort on the windward side of Uripiv was undertaken by gill-nets. In contrast, on the leeward shore only 21% of the fishing effort was undertaken with gill-net, 65% by handline.

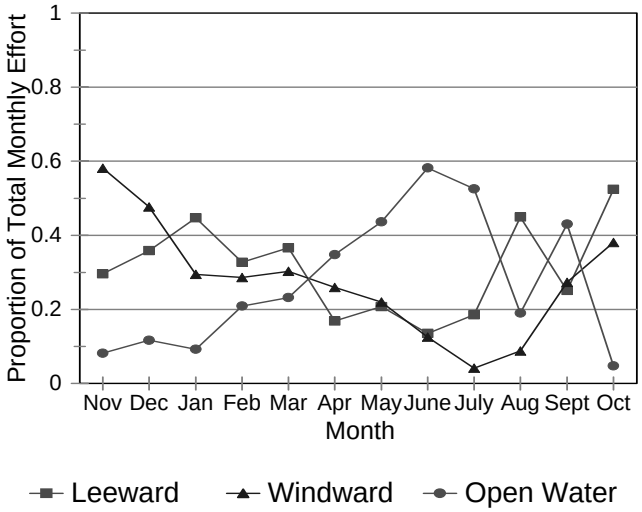
Figure 21 - Location of Effort for Uripiv Island



In all three sites described in the previous figures an additional factor should be mentioned here at that is the influence of the physical location of the settlements on the islands. In all three cases, the major settlements are located on the leeward shore, closest to the mainland of Malekula where the agricultural small-holdings of these communities are situated. The distance to travel to the windward shores also plays a role in restricting the amount of fishing that takes place on these shores. Fishing trips often take place after work has been completed on planting, maintaining or harvesting their gardens.

Figure 22 displays the mean monthly proportion of effort expended in the three areas around Lelepa; leeward and windward shore and open-water sites used to target the Eteline snappers.

Figure 22 - Location of Effort for Lelepa Island



For Lelepa Island the situation is a little more complex. Again the community is located in a single (extended) settlement on the shore closest to the mainland of Efate Island, where again the community has the majority of its small-holdings. However, there are no independent CFRAs currently in operation on Lelepa so the sharing of marine space between members of CFRAs is not an issue. However the use of marine space remains as important for Lelepa as it does for other islands given the resulting constraints on the placement of closed areas. On Lelepa there are two main factors accounting for the pattern of use of marine space described in Figure 22. The bathymetry of the area (see Figure 9) allows fishers relatively easy access to waters of sufficient depth for Eteline snappers. In addition the location of Lelepa Island, situated somewhat in the lee of Efate Island creates a marine environment that is more accessible (and safer) to fishers using the traditional out-rigger canoe. The close proximity of Port Vila offers a relatively unique (for Vanuatu as a whole) market potential. This potential has been realised by some individuals in the community who target deep-living Eteline snappers. It can be observed that the distribution of effort between leeward and windward sites is relatively similar through the year although effort did focus on the leeward shores during July and August.

Another area of response of fishers to the capacity of the resource to support multiple users is the seasonal use of gears.

The significant difference between Lelepa Island and the other sites is the switch from the inshore fishery close to the shore to a fishery in the open-water areas around the island. Again this occurs during the dry (windy) season. In fact what this represents is a response to conditions in the water as much as on the water. Weather conditions effect the performance (catchability) of fishing gears. The dry season is characterised by cooler sea temperatures (4-5^{o}C lower than in the wet season). Colder waters are perceived by fishers to affect the behaviour of fishes and hence the catchability of gears, in particular the use of spear-guns is adversely affected. Analysis of two sites where spear-fishing was important did not reveal significant seasonal variation in catch-rates for spear-guns. Figure 23 presents data for

Lelepa Island. For spear-guns an ANOVA of catch-rates by season was not significant (P=0.22).

Figure 23 - Catch-rate (kg/manhr^{-1}) for Lelepa Island

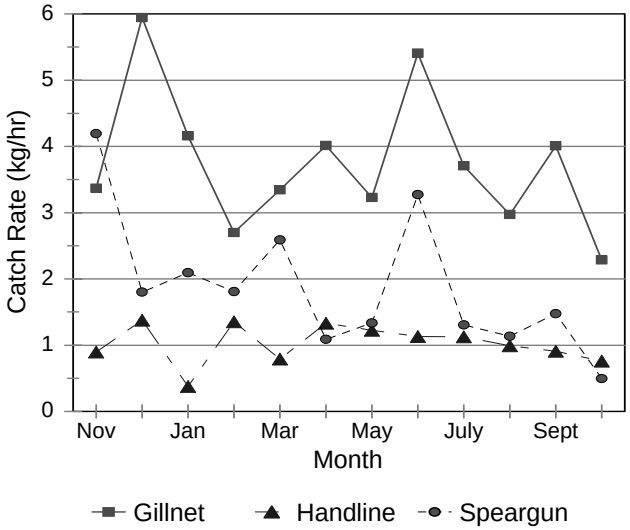
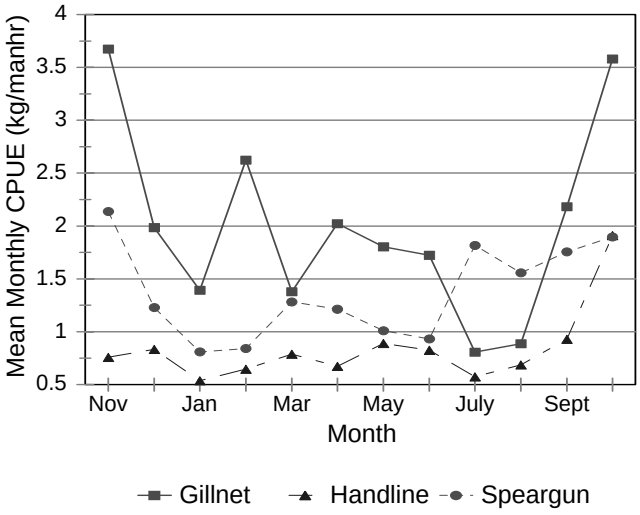


Figure 24 presents equivalent data for Wala Island. An ANOVA on seasonal catch-rates for spear-gun was again not significant (P=0.31)

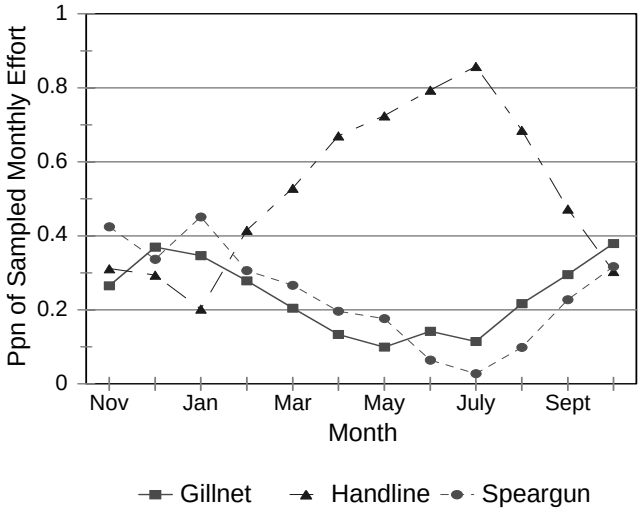
Figure 24 - Catch-rate (kg/manhr^{-1}) for Wala Island



However, fishers also reported that the colder waters affects their own behaviour; they are less inclined to use methods such as gill-nets or spear-guns which involve lengthy periods of time in the (colder) water. These attributes constrain the choices fishers can make on the

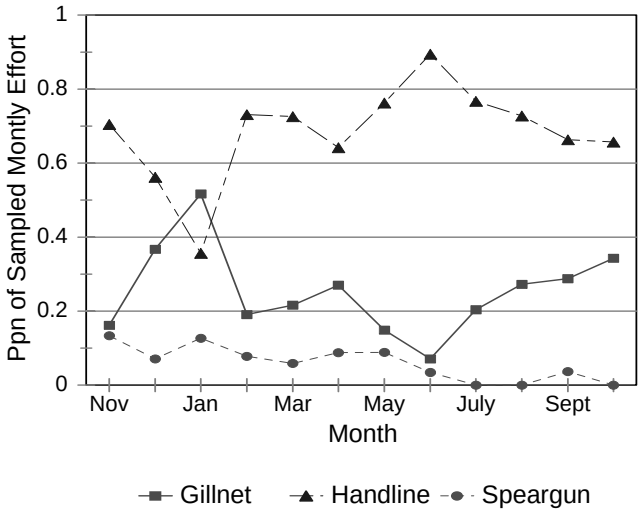
use of gear (and the likely location of effort). Figure 25 presents data for Lelepa Island. The graph shows the strong seasonal use of the different fishing gears with handline dominating fishing activity during the cold season. It is during this period that the fishers target Eteline snappers.

Figure 25 - Use of Gears on Lelepa Island



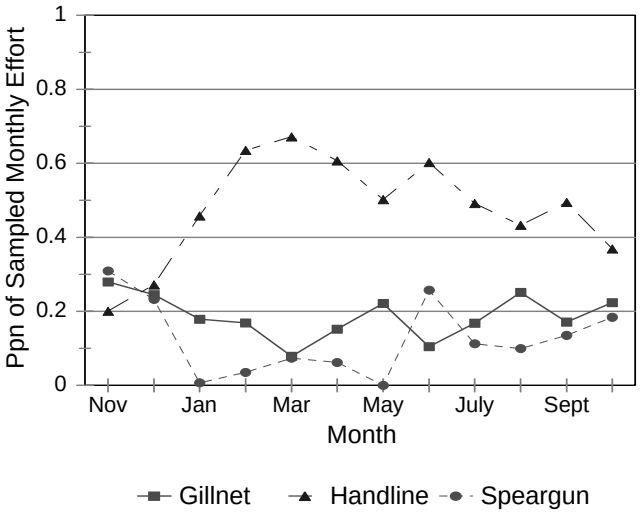
Data for Atchin Island (Figure 26) also indicates some switching of gears between seasons. The use of gill-nets and spear-guns is more extensive during the wet (hot) season although the declines in the use of gill-nets in particular is early relative to the timing of the dry (cold) season. Atchin Island lacks a significant reef platform, a habitat for which gill-nets are highly suited. The use of handline is marginally more significant during the dry (cold) season except for the short-peak during the wet (hot) season. The presence of tiger sharks (*Galeocerdo cuvier*) in the vicinity of Atchin understandably constrains the use of spear-guns around Atchin which has somewhat of a reputation for shark attacks. Respondents believed that the tiger sharks in the area were predominantly pregnant females moving to sheltered waters prior to giving birth.

Figure 26 - Use of Gears on Atchin Island



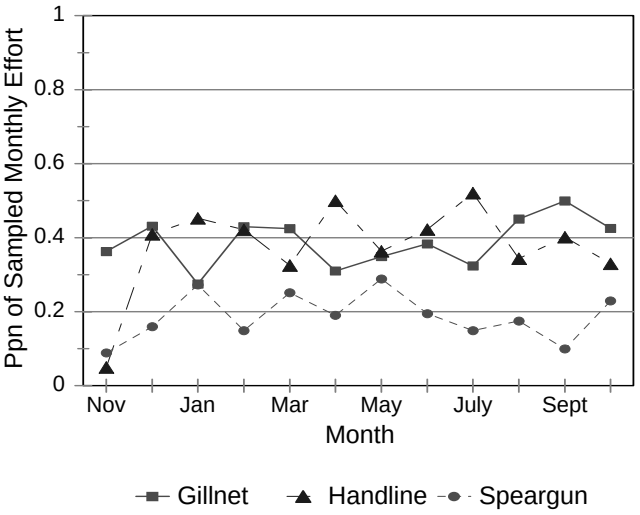
For Wala Island (Figure 27) the pattern is somewhat similar. Again the use of gill-nets and spear-gun is at a peak during the hot season but declined early relative to the onset of the cold season before increasing once more during the dry season itself. Wala Island, which has a fledgeling tourism industry, is not known for shark attacks.

Figure 27 - Use of Gears on Wala Island



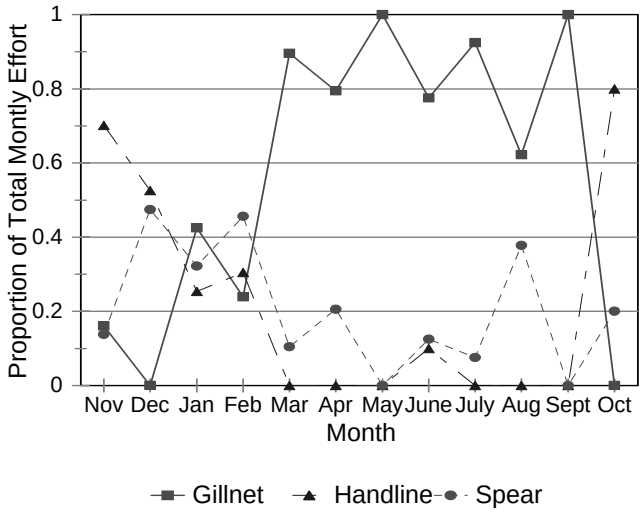
The picture for Uripiv is somewhat different however. Figure 28 presents data on the mean monthly proportional contribution of the three main gear types used to target fin-fish species. Fishers rely less on handline on Uripiv than observed in Wala and Atchin with both spear-gun, and in particular, gill-net more commonly used. The environmental conditions of Uripiv, with the wide lagoon/reef flat on the eastern coast providing a habitat well suited, in a range of weather conditions and tides, to the use of gill-net.

Figure 28 - Use of Gears on Uripiv Island



A similar situation occurs at Pellonk village (Figure 29). Gill-nets are the most common gear used particularly during the cold season. Again, the environment of Pellonk fishing grounds explains this feature with a large area of shallow lagoon suitable for gill-net deployments. The major difference between Pellonk and Uripiv, is the increased use of handline and spear-guns during the hot season.

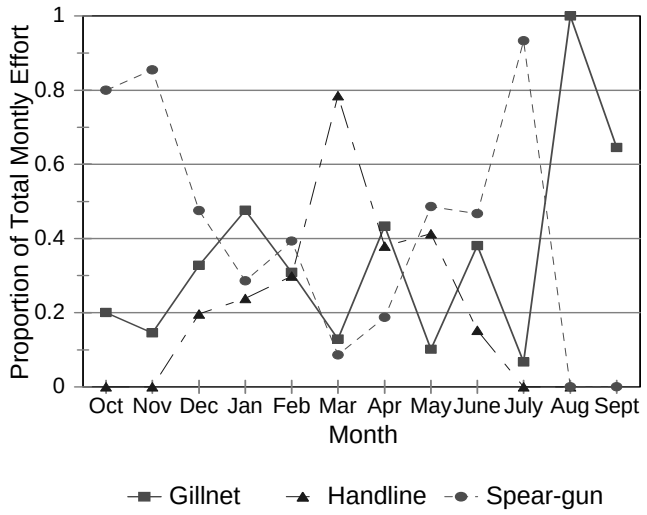
Figure 29 - Use of Gears at Pellonk Village



The final graph in this series relates to Emua village on Efate Island (Figure 30). The pattern here is not particularly obvious. Spear-gun use was recorded as being the most important gear during the hot season but was again important during the early cold season. Handline increased in its contribution to the total fishing effort during the late hot season. Gill-net use was variable through the period with a peak recorded in August when the closed area was lifted.

In Section 1.3 (Patterns of Interaction) it was reported that a significant amount of cooperation exists in the use of spear-guns. There are two main reasons for this; ownerships of spear-guns is limited and sharing of the gear tends to be more common for this reason. Sharing (and cooperation) is also common because spear-fishers often use a second individual to paddle a canoe near by to take the fish onboard after each successful diving event. Because spear-fishing is a highly energetic activity fishers usually have to swap duties, the canoeist taking over from the spear-fisher when the latter becomes exhausted. For gill-nets the situation is similar; again they are relatively expensive items and they are shared amongst fishers. In addition, the techniques required to deploy them rely on more than one individual for them to work effectively. One implication of this sharing and cooperation is that fishers share knowledge and direct experience as they fish together. This will promote consensus amongst fishers on the state of the fish stocks which they target. It also reduces the likelihood of individuals breaking the rules of the community.

Figure 30 - Use of Gears at Emua Village



1.8.2 Control of Access

The control of access is a critical issue for managers and fishers. Table 22 presents a summary of the relevant characteristics of the six research sites with regard to controlling access.

Table **22** - Summary characteristics of the six research sites in Vanuatu

Site	Community Population (1999 est)	Number of CFRAs	Size (Range) of CFRAs (sq.km)	Range of Perimeter Lengths (km)	Distance to CFRA boundary (km)
Atchin	1046	5	0.015 - 0.105	0.26 - 1.09	0.09
Emua	186	1	3.47	1.23	0.79
Lelepa	381	1	5.7	9.0	4.20*
Pellonk	313	2	0.028 - 0.79	4.12	1.38
Uripiv	417	8	0.11 - 0.45	0.1 - 1.14	0.32
Wala	237	5	0.0075 - 0.223	0.08 - 0.82	0.07

From the perspective of control of access the majority of these CFRAs are so small that the entire area is easily visible from shore. The only caveat to this is where settlements are concentrated on the lee-shore but there are usually people moving about the island, fishing etc for surveillance not to be an issue. Again, for Lelepa Island (perimeter length 9.0km) there

is little chance that encroachment, at least during the day-light hours, would go unnoticed. The only potential problem for the Lelepa community is that part of it's CFRA (Eretoka Island) is located some distance (4.2km) from the village. For all these sites then, control of access is not a problematic issue.

1.8.3 The Scale of Management

The size of a CFRA may be influenced by a number of attributes. Physical and technical attributes represent hard constraints on size but social, human geography and political factors are also important. These important influences (particularly on the long-shore extent of CFRAs) are discussed in Section 1.5 (Decision-Making Arrangements). The primary attribute to mention in this section is the bathymetry of the coastline of Vanuatu which is typically relatively precipitous and determines the sea-ward extent of a fishing rights area. All CFRAs in Vanuatu extend only to the outer reef edge which in Vanuatu is close to shore (<1km). Although historically fishers almost certainly targeted pelagic species the homogenous nature of the environment beyond the outer reef, the problem of enforcement and the dangers of fishing in open waters given the level of vessel technology mitigated against establishing tenure over the high seas.

We have seen in the discussion on the use of marine space (as an adaptation to the capacity of the resource to support multiple users) that there is a degree of reciprocity to the use of adjacent fishing grounds, at least in communities where there are numerous small CFRAs (Atchin, Wala, Uripiv and Pellonk). Given that this reciprocity is essential (particularly given the contemporary distribution of settlements in relation to the location of CFRAs) it would appear sensible that consideration be given to increasing the scale of management. The presence of councils of chiefs on these islands presents managers with an institution already in place that may act in fisheries management and take the role of the institutional entry point in a co-management partnership with the Department of Fisheries. We have also observed both aggregation and dis-aggregation of CFRAs in Vanuatu. In Lelepa and Pellonk, clans have (under various circumstances) unified their individual CFRAs under one management umbrella. In Atchin, Wala and Uripiv we have observed increasing reduction in the coverage of independent management actions such that the smallest closed area covers just 0.015 sq.km. The efficacy of such a small closed area in terms of its conservation value is doubtful, especially given the tendency for them to be in place for relatively short periods. The effect of such management actions, bearing in mind the imperative of reciprocal access across the community as a whole, may be to promote conflict.

1.9 Understanding the Fisheries (3) : Decision-Making Arrangements

Decision-making arrangements are the sets of rules or norms that define the boundaries for legitimate individual and collective choice within a community, ie what is obligatory, permissible or prohibited in any given situation. In a strict sense these rules are established to achieve certain objectives and include *operational rules* (that may set limits on the level or form of resource exploitation) and *conditions of collective choice* (that define the protocol for decision making). The term *conditions of collective choice* is perhaps a little unwieldy, in this report the term *community institutions* is used as an alternative. Decision-making arrangements also include wider legal, political and even economic factors (*external arrangements*) that can influence the functioning and behaviour of local management.

Table 23 presents the key attributes and interactions observed in the fishery and identifies the relevant explanatory component of the decision-making arrangements.

Table **23** - Key attributes and patterns of Interaction with explanatory component of DMAs

Attribute/ Pattern of Interaction	**Explanatory Component of Decision-Making Arrangements**
Physical & Technical Attribute	
1. CFRA Potential Yield	Size of CFRA
Interaction	
1. Reciprocal Use of CFRAs	Size of CFRA / Clan Relationships
2. Cooperative Gear Use	Community Norms
3. Cooperation with Management	Community Norms
4. Conflict with Management	Lack of Consultation in Institution

The Influence of DMAs on Physical / Technical Attributes

1.9.0.1 CFRA Potential Yields

The sea-ward extent of a CFRA is constrained by the physical environment interacting with the level of technology that constrains exploitation as well as control of access. The long-shore extent of a CFRA on the other hand is generally constrained by the political environment. These two constraints act in concert (with natural production limits etc.) to limit the potential yields of a particular CFRA. Note, this of course does not imply that the potential yield of the underlying resources are constrained by CFRA size, only the potential yield of the CFRA *unit* from the perspective of the resource custodians and other stakeholders.

1.9.1 The Influence of DMAs on Patterns of Interaction

What characteristics of the decision-making arrangements can account for the patterns of interaction observed in the fishery? This section will seek to draw links between the extensive cooperation reported in this document. Cooperation that promotes reciprocal access to the 'community' marine space; that allows for individual fishers to cooperate with gears and that permits independent closures to be effectively established with limited encroachment (or free-rider behaviour). The section will also include reference to characteristics that promote conflict, albeit limited, between stakeholders and custodians.

1.9.1.1 The Reciprocal Use of Marine Space

The necessity to share marine space (where clan boundaries persist) relates to a number of physical and technical attributes of the fishery. Primarily this stems from the effect of seasonality on access to windward sites. A second important issue relates to the current aggregated settlement patterns. The tendency of communities to live on the lee-ward shore stems from a range of attributes. Historically, (and the archaeological evidence for this can be seen on these islands today) many of the individual clans lived in the interior of the various islands. Missionary activity encouraged them to abandon their villages and sacred dancing grounds (you will recall that a clan is known as a *nasara* in northern Malekula, the dancing

grounds are also called *nasara* reinforcing the strong link between land and identity). This aggregation has created a practical imperative that fishers, particularly those that live in communities of a number of clans, share fishing grounds. The influence then of decision-making arrangements is clear. Whether one describes this as an external arrangement, an exogenous influence, or whether one describes it as a function of the wider-community's evolving institutional organisation (an operational rule that encourages reciprocal access) could be argued, either way it doesn't alter the fact that access is shared. Given the physical attribute of the community's *new* location, this operational rule is clearly a sensible response.

1.9.1.2 Community Institutions: Accounting for cooperation and conflict between Stakeholders

Community institutions determine the rules for *how* decisions can be made and give a mandate to those entrusted with the management of the resource. The specific form of these institutions will generally be determined by the cultural and social traditions of each community. At the six communities that cooperated with the research there were no specific fisheries management institutions or organisations. Given the fact that fisheries do not play a central role in the community economy (although clearly they are important) this is not surprising. Although the transaction costs would be minimal to set up some sort of committee, the existing committees and forums do take on fisheries issues according to the wider institutional framework that exists at each site and according to the personalities involved. In some cases a single individual (such as a tribal chief) may hold sole responsibility for decision-making. In other cases, an elaborate network of councils and feedback mechanisms combine to produce a more democratic process. The key aspects of this section of the analysis, besides covering the basic functioning of decision-making, is the need to understand the efficiency and equity of the institution of the CFRA. What opportunities does it offer to individuals to participate in decision-making, how does it glean information by which to make or adapt rules and regulations and to what extent do the principles of good governance manifest themselves in its behaviour? The question must be raised; is good governance, as an absolutist concept, relevant?

In the northern sites of Atchin, Wala and Uripiv where independent clan tenure persists, decisions to restrict access appear to be taken unilaterally by the clan chief. The most recent closure, and currently the only closure on Atchin Island (declared at the end of the completion of the field research), was placed over the grounds known as *Sarame* within the Melep clan's CFRA on August 8th, 1998 for an open-ended period (Chief Wilfred Rori, pers comm). The area under Chief Rori's direct tenure stretches along approximately 100m of coastline encompassing an area of just 0.015 sq.km of reef. Marker sticks were placed at each boundary to identify the area of the closure which was situated directly in front of the Chief's house. Chief Rori stated that the closure resulted from his own observations of poor catches. Although fishers state that fish becomes 'wild' when subject to overfishing, Chief Rori has a slightly different perspective; he said he wanted to let the fish '*run wild*', without pressure from fishers. The decision to close this area was taken unilaterally by the Chief although the cross-clan Council of Chiefs was subsequently notified and the decision announced in church services on the island.

On Wala Island the Resort closure was declared for the reef area adjacent to a small, locally-operated tourist resort. The land on which the resort was built is owned by an individual family and originally met with some hostility amongst the community as a whole (Song-Luke Siptiley (the land owner), pers comm; David Kalorip, pers comm). The closure commenced in August, 1996 and was originally due to run only until August, 1997 but was

still in place in October, 1998. The closure was again unilaterally declared by the family without the explicit permission of the Lowo/Awop clan chief. In fact clan Chief Kasi claimed that it was he who initiated the closure. In the final month of monitoring at Wala, Song-Luke initiated an extension to the original closure, again a unilateral decision extending the area to include the waters in front of his family's houses.

On Uripiv Island there were further examples of unilateral decision-making by land-owners. On Uripiv Island there have been a number of closures in recent years. Including one year closures on the northern shore of the Potun/Lowi clan fishing grounds in 1991, although this closure permitted hand-lining and invertebrate collection. The declaration of the closure followed *kastom* by including a pig-killing ceremony. In fact some respondents on Uripiv, stated that one factor influencing the placing of closures was the cost of killing. This was said to be one reason why people 'lost interest' in declaring closures. The Jimes clan also declared a closure in 1991/92. The current closure of the reef under the tenure of the Malisa clan was reported to have been decided first by the Malisa family (some respondents described it as a family not a full-blown clan) and then presented to the Council of Chiefs, as much to inform them of the decision as to obtain their support. This closure was declared in 1990. The objective of the closure appeared to have an important implicit objective (beyond the explicit objective of conservation). The custodian stated that he was also interested in protecting the trees on the shore. He reported that people would go fishing on the reef and then come ashore and light fires to cook what they had caught; these fires were burning out areas of his land.

Although it is sometimes difficult to ascertain exactly the process that led to the declarations because of the attempts of the different parties to present themselves as the instigators and the relevant authority. The Malisa closure is a complete ban on all fishing activities including the gathering of shellfish. There were reports that this closure was not popular. In Pellonk, there were a number of closures involving a range of resources and fishing gears. The declaration of the gear-restriction was reported by respondents as being the decision of the Chief only but there was little apparent resentment. In stark contrast to this was the declaration of a long-term closure of a small pool in the centre of the lagoon. This closure was established in cooperation with the Government's Environment Unit at the instigation of the a village school teacher who is also the head of one of the four clans managing this part of the reef. Although a plaque was placed on the beach front heralding the community's actions, there was apparently violent opposition to the setting up of the sanctuary within the village. Staff of the Unit reported that they had stones thrown at them when they attended the ceremonial declaration of the closure. There were also some ambiguous references to a single clan taking responsibility of the management of the sanctuary.

On Lelepa Island the 'new' institution of the community-based tenure very much reflect wider changes in the political relations within the community although again there are no fisheries specific institutions. Perhaps Lelepa Island is a special case, at least compared to the northern sites, because of its proximity to the influences of the capital Port Vila and the employment and marketing opportunities that exist there. In particular the most significant difference between Lelepa and the other sites was the extent to which the community can become involved in management decisions. The Lelepa closed area has been in force since 1993 subject to periodic reviews and extensions. According to male respondents the chief held a community meeting to which individuals of all ages of both genders were invited following consultation with the Fisheries Department and representatives of the Environment Department in Port Vila. The chief of the community still remains the ultimate authority but the degree to which the wider community is active in the management process clearly

strengthens the mandate of any decision he might take. Female respondents reported however that this was not the case. Representatives of the community's Women's Group reported that they had discussed the proposed declaration of the closed area on the island each time it came up for renewal but this discussion was largely confined to themselves. None reported that they felt that their opinions had been taken into account during the decision-making process even though they believed themselves to contribute significantly to the overall fisheries production of the community. This division was further apparent when young men were interviewed. They reported that they too had not been consulted and that the closed area was an important location because it was safe and sheltered, especially for younger boys who reportedly used the area to learn to spear-fish. They reported that the resources were 'money in the bank' but they were now tied up and inaccessible.

In Emua the chief (Chief Raymond) reported that although the decision to close part of the communities fishing grounds was his, there was a group of informal advisors that he worked with on community-related issues. The decision was then announced it to the wider community during a village meeting. Although he admitted that there had only been limited consultation within the community prior to his decision. His stated reason for the closure (translated from Bislama) '...when you are gardening you plant things, you put things in knowing you'll get something back later. But if you just go on fishing every day, every day, you'll use all the fish up. You don't put anything back.' (Chief Raymond, pers comm). He believed that this was a belief held by all members of the community.

Across all sites there was by no means universal understanding of what period a particular closure was for, what it's specific objective was and by what criteria the success of the closure would be measured. In some cases, for example on Atchin Island, many (fishers) respondents claimed total ignorance of the actual existence of the closure. This issue extends further when one considers the involvement of women and youth who may not have an opportunity to contribute either because they are not party to discussions or because their potential contribution is ignored simply as a result of their position in the hierarchy of the community. Both these groups represent a valuable resource-base. Women fishers are generally not involved and even actively discouraged from joining in the evening socialising and yet they contribute to fisheries production and are therefore direct stakeholders in the resource base. Their contribution to the knowledge-base of conditions within the tenured area is therefore, albeit to varying degrees, wasted. The youth represent the educational elite of the village. Their experience of formal education and skills they acquired through this experience represents an important local potential to interpret inputs from external agencies. The shifting focus of the village economy towards creating a surplus for sale tends also to be of more importance to the younger groups of the community who seek to acquire 'western' goods. Management institutions that do not incorporate the opinions of the wider stakeholder group are less likely to willingly recruit the cooperation of the sector that is disenfranchised.

Implications of Contemporary Institutional Performance

Despite the apparent lack of democracy in the operation of community institutions the level of conflict is low. There are a number of characteristics of Ni-Vanuatu culture and society that explain this including the small size of communities and the concomitant strength of community sanction; a respect for elders (who typically are responsible for decision-making) and, importantly, the numerous opportunities for opinion to be expressed in informal situations. Compared with Fiji, where the chief's are revered, the authority structure in Vanuatu is less rigid and the chief is more likely to be an active member of the community rather than an isolated political figurehead. The small size of community/clan fishing grounds

also promotes surveillance and enforcement. From a different perspective, and one that was often reported during the rural appraisal work, the fact that closures tended to cover only a small proportion of the available grounds provided areas of reef which remained open for fishers to exploit. This strategy reduced the likelihood of conflict.

Enforcing Management

One of the key aspects of the idea of developing cooperative management between communities and the State is local responsibility for management. It is clearly more efficient that issues of daily significance be managed by the community itself without the need for assistance from the State. A fundamental aspect of this relates to the sphere of local enforcement. To what extent can decisions taken at the local level with varying degrees of consensus be enforced by the stakeholders themselves? In Vanuatu, the majority of communities operate their own policing of the community. Community sanction is a powerful tool although there were no reports of sanctions being effectively applied at the research sites. Table 24 presents a summary of the Community Institutions.

Table **24** - Summary data on Community Institutions

Site	Community or sub-group closure	Decisions made unilaterally	Decision-making tiers available	Council of Chiefs	Fisheries Council/ liaison officer?
Atchin	Family	y	3*	y	n
Emua	Community	n	1	y	n
Lelepa	Community	n	1	y	n
Pellonk	Community	n	1	y	n
Uripiv	Clan	y	2	y	n
Wala	Family	y	3*	y	n

The closures at Atchin (towards the end of the monitoring period) and Wala were taken not by the clan but by families within the clan. Indeed at Uripiv there seemed some question as to whether the Malisa clan was actually that or a powerful unit within a clan. For this reason there are effectively three tiers of decision-making, the clan sub-unit (or family), the clan itself and the Council of Chiefs.

1.9.2 External Arrangements : The role and influence of State management authorities on interactions between stakeholders

The management objectives and any rules devised to achieve these objectives cannot usually be viewed in isolation of the national legislative environment. National legislation seeks to establish the boundary conditions within which communities usually (but not always) operate. In Vanuatu there are two tiers to the legal system. Vanuatu's official national law is largely derived from British legislation and is statute based. But there is a second law based on 'traditional' morals, customs and ownership that is referred to as custom law. The recognition of this law is explicit through the Island Courts Act which provides for village

courts to rule on local disputes providing it does not conflict with national law. In fact custom law does regularly conflict with national law (Holmes, 1996) but the Island Courts Act is a very pragmatic response to the fact that Ni-Vanuatu communities are highly dispersed across 80 islands. Providing a presence for the national law (through a police force) would be prohibitively expensive even assuming that they could function effectively. Custom law is not codified primarily because it is site-specific but also because it is flexible and capable of new interpretation. In fact, no Government has consulted with the Council of Chiefs (*Malvatumauri*) on any Bill brought before Parliament (Holmes, 1996). However this is not to say that custom does not play an important role, Article 74 of the Constitution states that 'The rules of custom shall form the basis of ownership and use of land in the Republic of Vanuatu'. This statement has direct influence on fisheries. The Fisheries Act (1989 - Cap 158) is the principle national legislation related to marine resources; the main features of this legislation are indicated in Table 24.

Table 25 - Fisheries Act, 1989 - Cap 158

Species-specific Size Restrictions
1. *Panulirus* spp. - To be taken only when greater than 22cm overall length or carapace length greater than 7.5cm
2. Slipper lobster (*Parribacus calendanicus*) To be taken only when greater than 15cm length
3. Coconut Crab (*Birgus latro*) To be taken (according to season) when greater than 9cm carapace width
4. Green Snail (*Turbo marmoratus*) To be taken when greater than 15cm in its longest dimension
5. Trochus (*Trochus niloticus*) To be taken when greater than 9cm diameter
6. Trumpet Snail (*Charonia tritonia*) To be taken when greater than 20cm length

Restrictions on taking berried females
1. *Panulirus* spp.; *Parribacus calendanicus*; *Birgus latro*

Species Restrictions
1. No species of rock lobster to be taken

Other Restrictions
1. Corals restricted to three pieces in twenty-four hours
2. Aquarium Fish
    2.1 Export only with Minister's approval
    2.2 A permission granted under this regulation shall not affect any obligation to reach agreement with custom land owners regarding the use of land and waters for the catching of aquarium fish
3. No marine turtles can be taken

The most significant component of this legislation, which clearly follows from the previous statement in Article 74, is that which relates to the exploitation of aquarium fish. Although not a significant national industry (there is a single company operating out of the capital, Port Vila) the key aspect of this is the precedent it sets for the exploitation of marine resources by individuals or companies who do not hold primary access rights. Traders must respect the claims of tenure by land-owners whose resources they intend to exploit and enter into agreements that are not prescribed in any form by legislation. This legislation therefore has enormous implications for both commercial exploitation of coastal marine resources by outsiders and by other members of the local community.

Activities by State agencies are important in the actions of resource custodians in Vanuatu. Conservation-based education is increasingly having an influence on the stated objectives of

community managers. The stimuli for this emanates from various governmental organisations (especially the Fisheries Department and the National Cultural Centre and through the State education system) and from non-governmental organisations (for example, GreenPeace; the Foundation for the Peoples of the South Pacific etc.) and from research programmes active in the country. Workshops, site visits, radio programmes and poster campaigns all act to promote conservation-based thinking within the community which further prompts individuals to raise conservation issues both in informal gatherings as well as during community meetings.

1.9.2.1 Commercial Development

Marketing arrangements are also important in the context of management because they may be 'relevant in establishing economic parameters within which the management of the commons can be undertaken' (Oakerson, 1992). Fishers exploit marine resources for three reasons; to provide for themselves and their families, to catch fish to sell for cash or to barter with, or to provide fish for a community event. What determines their decision-making in the case of commercial activity includes a number of peripheral factors (their current economic status, any forthcoming expenses such as school fees etc) but the boundary conditions for fishing commercially is the presence of market opportunities. There is a variety in the marketing opportunities available to each community that cooperated with this research. Table 26 presents data indicative of these different marketing opportunities.

Table **26** - Marketing opportunities for fishers at the research sites

Site	Internal Marketing*	External Market Type	Distance to market/ice (time/transport)	Market Consumer Base*
Atchin	N	Norsup Market; Small Retail	3hrs (Private Boat; Public/ Private Truck	1250
Emua	Co-operative	Port Vila Market; Large Retail; Wholesale	1hr (Private & Public Truck)	25,000 & Export
Lelepa	Individual & Commercial	Port Vila Market; Large Retail; Wholesale	2hrs (Private Boat; Private & Public Truck)	25,000 & Export
Pellonk	N	Market; Small Retail	2hrs (Private Boat; Private Truck)	224
Uripiv	N	Norsup Market; Small Retail	1hr (Private Boat; Private Truck	1250
Wala	Local Resort	Norsup Market; Small Retail	2hrs (Private Boat; Private Truck)	1250

* Excludes the informal marketing sector within the community.

Of the six sites, Lelepa Island and Emua village possess the greatest opportunities for marketing fish commercially. In Lelepa, there are a few individuals (one to three, the number varies) who act as fish-buyers or middle-men providing ice storage and who then transport the catch to Port Vila where it is sold to one of the many retail outlets including the large superstores (e.g. Au Bon Marche) and fish dealers (e.g. Augustine Fiu and Eric Festa, Port Vila). Both these communities also have good access to the weekly market in Port Vila.

However, the relatively developed local economy of Lelepa Island, with concomitant access to good quality fishing vessels, fuel and fishing gears appears better placed to exploit the marketing potential. The Emua community are well-known for their production of pre-cooked meals (known as *toluk*) which are sold in Port Vila market. The remaining sites all suffer from the lack of significant local markets; storage and transport on site also represent a significant constraint.

The effect of the marketing potential can be clearly observed in the data presented in Section 1.2.4 - Economic Outcomes. For Lelepa and Emua fish sales represent 30% and 35% respectively of family incomes in the community. For Atchin, Uripiv and Wala the figures are 12%, 12% and 11% respectively.

1.10 Recommendations

The complexity and scale of community tenure systems in Vanuatu presents those seeking to manage fishery resources with a number of advantages and constraints. This section will identify the basic recommendations to managers (community and State) arising from the analysis of the data generated from this research project. These recommendations are developed in Volume 6 of this report.

Implications of Institutional Characteristics

1. CFRAs Based on Cultural Politics

Because CFRAs are based on cultural politics the relationship between the area under the coverage of a CFRA and the underlying ecology and distribution of the resource base is negligible. To counter thise constraint and the constraints imposed by seasonality and the tendency towards aggregation of communities, there has evolved reciprocal access arrangements. For effective management, based on the premise of sustainable exploitation, consideration should be given to the promotion of more effective coordination of management actions where communities possess numerous nested CFRAs of small size. This aggregation would rely on the same relationships that permit the reciprocity already in place. The responsibility of individual custodians (and fishers from their clans) in whose area a management action is to be undertaken would have to be stressed and the (long-term) reciprocal arrangement clearly stated.

2. Management Objectives and Responsibilities

Management objectives are not always conservation based, at least the majority have multiple objectives. It is the role and responsibility of the Fisheries Department to continue their work in promoting sustainability as being of central importance. For fisheries located close to marketing outlets (eg. Lelepa and Emua) the requirement is of greater urgency as these are the fisheries most likely to become over-exploited. These fisheries are important contributors to the supply of (affordable) animal protein to the growing urban population. The interdependence of the economy across Vanuatu, with trade between village and urban centre, communities now have a responsibility not only to themselves but to the wider populace to sensibly manage their resources.

3. Management Rules

Advice needs to be available on request, and the extension service is the obvious avenue for

this. It is essential that custodians are fully aware of the potential management actions available and the requirements for their effective application. In particular the area and duration of closed areas (currently the most popular tool employed by custodians) should be set subject to advice from the Fisheries Department. Advice from Fisheries, through a process of participatory appraisals, would identify the most suitable areas for closure (or alternative management actions). A useful model for this approach has been developed in Samoa (eg King and Faasili, 1997).

4. Changing Institutional Dynamics

The need for a recognition of the changing institutional dynamics in many communities across Vanuatu is urgent. Although the traditional authority structures remain intact in less developed communities, the younger generations are increasingly becoming economically and politically independent as a result of educational opportunities. The dominant force in the commercial fisheries are the younger generation. The strength of community sanctions are no longer what they were. If management for sustainable resource use is to be effective the skills and energies of these generations must be harnessed effectively. The likelihood of cooperation across a community is enhanced by the expansion of representation and opportunities to contribute to decision-making processes. For the State fisheries agency too the need for change is urgent. Along with a shift in emphasis by the donor agencies, the Fisheries Department have moved away from a purely production focus such as was typical during the period of the Village Fisheries Development Project (eg. Lindley, 1993). The Department has recently emphasised cooperative management with communities, an excellent example of this being their work with communities on trochus fisheries (eg. Amos, 1991, 1993). Some of the incentive for this change derives from the increasing external pressures from performance-related funding (eg. Vanuatu National Planning Office, pers comm; Moses Amos, pers comm). An area in particular that should received priority attention, and an area that the National Planning Office have also stressed, is an examination of the future role of the fisheries extension service. The need for the information exchange between State and community places the extension service in a pivotal role in the future of fisheries management in Vanuatu. A note of caution on co-management. This research project demanded that (the multi-disciplined) staff spent time in villages collecting a wide range of information and data on the fisheries. One of the least discussed area of co-management is the so-called ‘transaction costs’. Raja et al (1998) identified three cost areas: information costs, collective decision-making costs and collective operational costs. A possible defence for co-management (as opposed to central management) is the lower costs (Raja et al, 1998). Managers, especially the State authority that would deal with many communities, must attempt to evaluate these costs (to include staff re-training costs where necessary) and such an evaluation may demand that, initially at least, activities are concentrated on those areas with high fishing effort and (/or) domestic/export marketing potential. It does not follow that these sites would be the cheapest to operate although marketing potential does imply proximity to centres of population and likely proximity to fisheries offices and staff.

Implications for Co-Management - Physical & Technical Attributes

Fishers in Vanuatu function under a set of physical and technical constraints including seasonal access to certain grounds and the use of particular gears, often limited avenues for regular marketing of their catches and limited financial resources for harvesting alternative resources or fishing grounds. The physical attributes of the environment and resource system are fixed, and in the short-term so too are the marketing and technological attributes.

For management to be effective rules must be developed that fit, or are congruent (Ostrom, 1994), with the constraints resulting from these attributes. Again, participatory activities are essential for assessing the most appropriate type, timing and location of action at any one community.

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