# 6 Biological Outcomes : Has customary management been successful? Discussion and Conclusions

## 6.1 Management Success : Discussion

The present study aimed to examine the success of customary management actions for fin-fish resources across a range of fishing pressures at different sites in Fiji and Vanuatu. In addressing the question, ‘Has customary management been successful’, the criteria used in this volume on biological outcomes relate to western notions of fisheries management success. Management success has not been measured against any community objectives for biological management, which were not explicitly stated.

A number of authors (Christy, 1982, Hviding and Ruddle, 1991, Pomeroy, 1994, Gadil *et al* 1993, Doulman, 1995) have proposed developing traditional management systems based on Customary Marine Tenure (CMT) combined with scientific advice. Others have questioned this notion (McCay and Acheson, 1987, Ruddle, 1998), whilst in Samoa a community management system has been established based on principles of customary tenure (King and Faasili, 1997), although that project did not examine the effectiveness of customary management. The present study addressed questions relating to the feasibility of developing customary management systems for co-management: ‘Exactly how effective are existing attempts at customary management?’. Volume 2 described the effectiveness of customary management in terms of social equity and the human community. The current Volume examined customary management success in relation to the fishery resource base.

The key finding from analysis of the social outcomes of customary management was that management activities related principally to political (e.g. land tenure) and cultural requirements of the community. Management actions were not defined by the biology of the resources. Thus, management boundaries are unlikely to relate to the biological distributions of fish stocks, and management actions are unlikely to recognise key life cycle events or be based on ’scientific’ criteria such as spawning seasons or size at maturity. This implies that whilst customary management interventions occur, any effects (beneficial or otherwise) on the fishery resource base are co-incidental. Resource management is not the primary aim of the customary management interventions, although it is apparent that one aim of management interventions is to amass (save-up) a ‘bank’ of resources for subsequent use related to social functions (see Volume 2 and 6.1.3 below). This Volume therefore investigated the status of fishery resources inside managed areas in order to establish whether customary management conferred any benefit compared to un-managed open access areas? Fishery indicators (e.g. mean length, catch rates, abundance, species assemblages) were also correlated with the level of fishing effort to see if this explained any observations.

Study sites were selected in Fiji and Vanuatu within which a number of sub-areas were identified including a managed (tabu) area and other un-managed areas. The principle customary management instruments studied at these sites were effort controls and closed areas. Gear controls have also been applied (Pellonk in Vanuatu, see Volume 2) but have generally been ignored. In Fiji explicit effort controls were applied in Verata and Naweni (both semi-commercial sites) where in order to protect native fishing rights non Vanua fishers are excluded. In Vanuatu there are implicit effort controls in that community fishing rights areas (CFRAs) are only fished by members of the community, although some illegal fishing and poaching activities do occur by outsiders. At commercial sites in Fiji, non Vanua fishers are licensed to fish within the CFRA, but there are currently no restrictions on numbers of fishers, and thus no effort controls. Closed areas were applied in both Vanuatu and Fiji.

Management actions limit the effects of fishing (which were described in Volume 3 Chapter 1), and thus in managed areas one would expect to observe a lower level of fishing mortality (F), higher population density and biomass, and larger mean length of fish. Differences in species assemblages and species richness may also occur. It would be expected that managed areas would have low or, in the case of closed areas, zero fishing effort. It is these indicators of the status of fishery resources that were examined, inside and outside managed areas, and in relation to fishing effort in order to judge the status of the resources and draw conclusions on management success.

### 6.1.1 Are management actions respected?

Since resource management is not the primary aim of customary management interventions, fishery management targets were not set by fishing communities in either Fiji or Vanuatu on which to judge management success. Some perception of potential biological management targets was apparently held in Vanuatu in relation to the number of fishers and extent of exploitation of the resources (see Volume 4), but this was not translated into management actions.

From the current study it was not possible to define management targets in terms of maximum catch or effort: The time-series of data gathered from the fisheries monitoring programme was insufficient to enable resource assessments; Whilst UVC studies enable the determination of mean biomass of fish for dive locations within each area, this related to a specific depth band and would not be universally applicable across the whole reef so it was not considered valid to apply such estimates to the whole reef at each area. However, in order to provide an indication of potential yield from CFRAs, it is valid to apply comparisons with similar reefs elsewhere. Dalzell (1996) indicated that typically yields from reef fisheries are in the range 4-5 t/km$^2$ per annum, but that in the Pacific yields of up to 36.9 t/km$^2$ have been reported. Tables 6.1-6.2 indicate the catch per unit area during the present study for Vanuatu and Fiji respectively, and the proportion of the potential yield this represents at 5 t/km$^2$ and 30 t/km$^2$.

For Vanuatu, at the lower estimate of potential yield the level of catch is high, and exceeds sustainable limits in a number of areas (Table 6.1); 201, 204 in Atchin, 246T and 249 in Lelepa, 223 in Uripiv and 211 and 212 in Wala. Of the Tabu areas no catch or a very low catch was reported in Pellonk and Uripiv in 1997, and in 1998 only a very small catch was taken from 222T in Uripiv and 215T in Wala. However, at Emua and Lelepa the level of catch from tabu areas was relatively high as it was for Wala in 1997 (264T, Emua, 1998, 61.3% of lower estimate of yield; and at 246T in Lelepa, catches exceeded the lower estimate of sustainable yield in both 1997 and 1998; 215T Wala, 1997, 54.4%). As indicated in Volume 2, enforcement is highly variable. The fact that the level of catch taken from some of the areas was high is an important consideration when interpreting the results of Chapters 2-4 of this Volume. However, it does not necessarily mean in relation to the communities objectives, that tabus have not been respected (see Volume 2 and this Volume, 6.1.3). From a Western, fishery management perspective, however, we can conclude that Tabus were only respected in Pellonk, and Uripiv, and in Wala in 1998. In Wala in 1997, Emua & Lelepa, closures were not respected. Spear gun bans in Pellonk were not respected.

The level of catch from fishing areas in Fiji was small at all of the semi-commercial sites (Table 6.2). The level of exploitation from tabu areas was comparable with that from open access areas except for 201T in Naweni in 1998 when the tabu was apparently respected and the catch was small. The level of catch from commercial sites was low to moderate, with the exception of sites 2 and 8 where relative to the lower estimate of sustainable yield, catches were high (Table 6.2). Licensing may have acted to limit entry, but no limits were applied. Note, however, that the low catches from some areas in Fiji may be due to prior overfishing.

The question remains as to whether fishing intensity would have been even greater in tabu and licensed areas in Fiji and Vanuatu had these ‘management’ measures not been applied.

Table 6.1. The estimated catch per annum per unit area of reef within sub-areas of study sites in Vanuatu, and the proportion of the potential yield this represents at an estimated sustainable yield of 5 t/km$^2$ and 30 t/km$^2$. Tabu areas are indicated (T).

| Site Name | Subarea | Area (sqkm) | Minimum est’d total catch pa | Minimum est’d total mt per sq km/yr | Percent est’d MSY (5 mt sq km/yr) | Percent est’d MSY (30 mt sq km/yr) |
|---|---|---|---|---|---|---|
| Atchin 97 | 200 | 1.351 | 638.69 | 0.47 | 9.46% | 0.32% |
| Atchin 97 | 201 | 0.069 | 1376.08 | 20.06 | 401.25% | 13.37% |
| Atchin 97 | 202 | 0.075 | 125.63 | 1.68 | 33.50% | 1.12% |
| Atchin 97 | 203 | 0.115 | 186.22 | 1.62 | 32.50% | 1.08% |
| Atchin 97 | 204 | 0.119 | 561.37 | 4.73 | 94.67% | 3.16% |
| Atchin 97 | 205 | 2.090 | 16.00 | 0.01 | 0.15% | 0.01% |
| Atchin 97 | 206 | 0.929 | | 0.00 | 0.00% | 0.00% |
| | | | | | | |
| Lelepa 97 | 242 | 32.070 | 0.00 | 0.00 | 0.00% | 0.00% |
| Lelepa 97 | 243 | 0.588 | 169.22 | 0.29 | 5.76% | 0.19% |
| Lelepa 97 | 244 | 3.262 | 1289.77 | 0.40 | 7.91% | 0.26% |
| Lelepa 97 | 245 | 3.472 | 206.20 | 0.06 | 1.19% | 0.04% |
| Lelepa 97 | 246T | 0.132 | 709.57 | 5.39 | 107.84% | 3.59% |
| Lelepa 97 | 247 | 0.540 | 783.88 | 1.45 | 29.02% | 0.97% |
| Lelepa 97 | 248 | 0.935 | 180.10 | 0.19 | 3.85% | 0.13% |
| Lelepa 97 | 249 | 0.245 | 958.84 | 3.92 | 78.40% | 2.61% |
| Lelepa 97 | 250 | 18.100 | 179.55 | 0.01 | 0.20% | 0.01% |
| Lelepa 97 | 241 | 4.276 | | 0.00 | 0.00% | 0.00% |
| | | | | | | |
| Pellonk 97 | 231 | 0.958 | 45.15 | 0.05 | 1.00% | 0.16% |
| Pellonk 97 | 232 | 3.081 | 2244.98 | 0.73 | 14.56% | 2.43% |
| Pellonk 97 | 233T | | 18.65 | 0.28 | 5.60% | 0.93% |
| | | | | | | |
| Uripiv 97 | 221 | 1.038 | 625.24 | 0.60 | 12.05% | 0.40% |
| Uripiv 97 | 222T | 0.107 | | 0.00 | 0.00% | 0.00% |
| Uripiv 97 | 223 | 0.194 | 1074.90 | 5.54 | 110.81% | 3.69% |
| Uripiv 97 | 224 | 0.483 | 653.78 | 1.35 | 27.10% | 0.90% |
| Uripiv 97 | 225 | 0.412 | 55.66 | 0.14 | 2.70% | 0.09% |
| | | | | | | |
| Wala 97 | 211 | 0.122 | 2654.28 | 21.74 | 434.77% | 14.49% |
| Wala 97 | 212 | 0.223 | 1539.86 | 6.89 | 137.86% | 4.60% |

| Site Name | Subarea | Area (sqkm) | Minimum est'd total catch pa | Minimum est'd total mt per sq km/yr | Percent est'd MSY (5 mt sq km/yr) | Percent est'd MSY (30 mt sq km/yr) |
|---|---|---|---|---|---|---|
| Wala 97 | 215 T | 0.007 | 19.00 | 2.72 | 54.36% | 1.81% |
| Wala 97 | 216 | 0.008 | 32.84 | 3.97 | 79.45% | 2.65% |
| Wala 97 | 217 | 2.381 | 15.27 | 0.01 | 0.13% | 0.00% |
| | | | | | | |
| Atchin 98 | 200 | 1.351 | 114.32 | 0.08 | 1.69% | 0.06% |
| Atchin 98 | 201 | 0.069 | 577.85 | 8.42 | 168.49% | 5.62% |
| Atchin 98 | 202 | 0.075 | 111.26 | 1.48 | 29.67% | 0.99% |
| Atchin 98 | 203 | 0.115 | 220.18 | 1.92 | 38.43% | 1.28% |
| Atchin 98 | 204 | 0.119 | 212.29 | 1.79 | 35.80% | 1.19% |
| Atchin 98 | 205 | 2.090 | 40.43 | 0.02 | 0.39% | 0.01% |
| Atchin 98 | 206 | 0.929 | 233.11 | 0.25 | 5.02% | 0.17% |
| | | | | | | |
| Emua 98 | 262 | 0.667 | 821.45 | 1.23 | 24.65% | 0.82% |
| Emua 98 | 263 | 1.068 | 1482.46 | 1.39 | 27.76% | 0.93% |
| Emua 98 | 264T | 0.448 | 1373.36 | 3.06 | 61.26% | 2.04% |
| | | | | | | |
| Lelepa 98 | 242 | 32.070 | 845.89 | 0.03 | 0.53% | 0.02% |
| Lelepa 98 | 243 | 0.588 | 1731.62 | 2.95 | 58.95% | 1.96% |
| Lelepa 98 | 244 | 3.262 | 1661.10 | 0.51 | 10.19% | 0.34% |
| Lelepa 98 | 245 | 3.472 | 41.44 | 0.01 | 0.24% | 0.01% |
| Lelepa 98 | 246T | 0.132 | 1030.41 | 7.83 | 156.60% | 5.22% |
| Lelepa 98 | 247 | 0.540 | 354.86 | 0.66 | 13.14% | 0.44% |
| Lelepa 98 | 248 | 0.935 | 736.19 | 0.79 | 15.74% | 0.52% |
| Lelepa 98 | 249 | 0.245 | 1586.72 | 6.49 | 129.74% | 4.32% |
| Lelepa 98 | 250 | 18.100 | 368.98 | 0.00 | 0.00% | 0.00% |
| Lelepa 98 | 241 | 1.065 | 611.96 | 0.11 | 2.15% | 0.07% |
| | | | | | | |
| Uripiv 98 | 221 | 1.038 | 127.76 | 0.12 | 2.46% | 0.08% |
| Uripiv 98 | 222 T | 0.107 | 29.66 | 0.28 | 5.56% | 0.19% |
| Uripiv 98 | 223 | 0.194 | 731.62 | 3.77 | 75.42% | 2.51% |
| Uripiv 98 | 224 | 0.483 | 140.88 | 0.29 | 5.84% | 0.19% |
| Uripiv 98 | 225 | 0.412 | 124.76 | 0.30 | 6.06% | 0.20% |
| | | | | | | |
| Wala 98 | 211 | 0.122 | 521.25 | 4.27 | 85.38% | 2.85% |
| Wala 98 | 212 | 0.223 | 2508.59 | 11.23 | 224.58% | 7.49% |
| Wala 98 | 215 T | 0.007 | | 0.00 | 0.00% | 0.00% |
| Wala 98 | 216 | 0.008 | | 0.00 | 0.00% | 0.00% |
| Wala 98 | 217 | 2.381 | | 0.00 | 0.00% | 0.00% |

Table 6.2. The estimated catch per annum per unit area of reef within sub-areas of study sites in Fiji, and the proportion of the potential yield this represents at an estimated sustainable yield of 5 t/km$^2$ and 30 t/km$^2$. Tabu areas are indicated (T).

| Site Name | Subarea | Area (sqkm) | Est'd total catch pa | Est'd total mt per sq km/yr | Percent est'd MSY (5 mt sq km/yr) | Percent est'd MSY (30 mt sq km/yr) |
|---|---|---|---|---|---|---|
| **Semi-Commercial sites** | | | | | | |
| Verata 96-97 | 16 97 T | 27.95 | 4.31 | 0.15 | 3.08% | 0.51% |
| Viwa (E) 96-97 | 17 97 | 29.28 | 1.36 | 0.05 | 0.93% | 0.15% |

| Site Name | Subarea | Area (sqkm) | Est'd total catch pa | Est'd total mt per sq km/yr | Percent est'd MSY (5 mt sq km/yr) | Percent est'd MSY (30 mt sq km/yr) |
|---|---|---|---|---|---|---|
| Kubuna 96-97 | 18 97 | 85.65 | 26.84 | 0.31 | 6.27% | 1.04% |
| Naweni 96-97 | 20 97 | 9.526 | 2.92 | 0.31 | 6.13% | 1.02% |
| Naweni Tabu 96-97 | 201 97 T | 8.01 | 3.57 | 0.45 | 8.92% | 1.49% |
| Tacilevu 96-97 | 21 97 | 7.07 | 6.61 | 0.93 | 18.69% | 3.12% |
| | | | | | | |
| Verata 97-98 | 16 98 T | 27.95 | 5.76 | 0.21 | 4.12% | 0.69% |
| Viwa (E) 97-98 | 17 98 | 29.28 | 1.45 | 0.05 | 0.99% | 0.16% |
| Kubuna 97-98 | 18 98 | 85.65 | 26.17 | 0.31 | 6.11% | 1.02% |
| Naweni 97-98 | 20 98 | 9.526 | 7.50 | 0.79 | 15.74% | 2.62% |
| Naweni Tabu 97-98 | 201 98 T | 8.01 | 0.50 | 0.06 | 1.26% | 0.21% |
| Tacilevu 97-98 | 21 98 | 7.07 | 5.26 | 0.74 | 14.87% | 2.48% |
| | | | | | | |
| **Commercial Sites** | | | | | | |
| Vuda 97-98 | 2 | 55.56 | 358.01 | 6.44 | 128.87% | 21.48% |
| Vitogo 97-98 | 5 | 98.89 | 97.43 | 0.99 | 19.70% | 3.28% |
| Votua 97-98 | 6 | 71 | 18.12 | 0.26 | 5.10% | 0.85% |
| Naviti-Marou 2 97-98 | 7 | 38.41 | 41.41 | 1.08 | 21.56% | 3.59% |
| Waya-Naviti 97-98 | 8 | 8.81 | 41.55 | 4.72 | 94.33% | 15.72% |
| Naviti-Marou 97-98 | 9 | 84.84 | 36.99 | 0.44 | 8.72% | 1.45% |
| Cautata 97-98 | 19 | 3.289 | 3.13 | 0.95 | 19.03% | 3.17% |
| Tavua 97-98 (inner) | 121 | 88.23 | 132.74 | 1.50 | 30.09% | 5.01% |
| Tavua 97-98 (outer) | 122 | 98.615 | 230.48 | 2.34 | 46.74% | 7.79% |

### 6.1.2 Has management conferred any benefit compared to un-managed open access areas?

The results of UVC and univariate and multivariate analyses of fisheries monitoring data for Vanuatu and Fiji are summarised in Tables 6.3-6.4 respectively which compare resource indicators from managed and open access areas.

- Neither fisheries nor UVC data indicated any differences in mean length of fish in closed or licensed areas compared to open access for Fiji or Vanuatu.
- Mortality estimates were inadequate for comparison
- Species assemblages were not significantly different in closed and open areas of Fiji and Vanuatu from UVC or fisheries data from MDS analysis except for gill net caught fish in 1998 in Vanuatu. Fishery data indicated that the species assemblage was most different for 222 (Uripiv) and 264 (Emua) compared to open access areas, which is consistent with the observation that the level of fishing and catch from 246 (Lelepa) was high. The finding for Emua is perhaps surprising given that Table 6.1 indicated that considerable fishing had also occurred inside that tabu area. As in the example of Lelepa, this apparent anomaly may be explained by the pattern of resource use in the Emua closed area (see Volume 2, and below).
- Species assemblages at commercial Fiji sites were weakly correlated to number and cost of licences.
- Univariate UVC and fisheries analyses indicated some benefits to management with increased abundance (and cpue) of certain families / guilds or overall in Wala, Uripiv (UVC) and Lelepa (Fisheries) in Vanuatu, and in Naweni in 1998 in Fiji (UVC and

fisheries). The finding for increased catch rate (an indicator of abundance) in the tabu area in Lelepa (246) was surprising given the high catches taken from the tabu area (see Table 6.1). However, this is apparently explained by the pattern of resource use (see Volume 2 and 6.1.3 below).

- Such increases in abundance were not related to growth of fish (no size differences), and thus may indicate an aggregation effect in less disturbed areas. The behaviour of fish subjected to consistent fishing may also change, affecting their catchability.

Table 6.3. Summary results of analyses of indicators of the status of fishery resources in open access and managed (*tabu*) areas in Vanuatu, and correlation of these indicators with fishing effort and abundance.

| Analysis performed | Overall Observations | Tabu areas vs open access areas |
|---|---|---|
| **UVC analyses** | | |
| Habitat | Habitat differences occurred between areas and sites from the MDS ordination, but ANOSIM indicated these were not significant. | MDS showed that two tabu areas (246T at Lelepa and 263T at Emua) differed from open access areas, but ANOSIM showed the differences to be insignificant. Habitat was comparable in studied closed and open areas. |
| Species assemblages | Certain species, family and trophic group differences in abundance occurred between sites and between areas within sites.<br>At family and trophic group level there was a weak trend for increasing biomass at low levels of effort, but this was not shown to be significant across areas except for Serranidae and Kyphosidae with ln transformed data.<br><br>Across dive-sites a significant negative trend for biomass with effort occurred for Balistidae, Lutjanidae, Serranidae and Siganidae only. Multiple regression indicated that habitat variables played a more significant role in determining fish abundance than fishing effort. | Univariate analyses indicated that differences in species abundance were not consistent inside and outside tabu areas: some species were more abundant in tabu areas, but the reverse was also true. At family and trophic level, Lethrinids were more abundant in 215 T (Wala), as were planktivores; Lutjanidae and Mullidae were more abundant in 222 T at Uripiv as were piscivores. These differences in biomass were consistent with expectation for the level of fishing at each area. No differences between closed and open areas occurred in Lelepa or Emua at family or trophic level.<br><br>Multivariate analyses with MDS suggested that 263T in Emua differed from the open access sites in Emua, but ANOSIM indicated no significant differences for any closed areas vs open areas. Open area 247 in Lelepa differed from other areas, but but the Tabu area 246T did not differ. |
| Mean length | | Wala, Uripiv,Lelepa, Emua - no differences in mean length between closed and open areas for any species. |

| Analysis performed | Overall Observations | Tabu areas vs open access areas |
|---|---|---|
| **Univariate analyses** | | |
| Mean catch rate by area (index of abundance) | Within sites few significant differences occur in cpue. The differences were greater across sites | Data were available for 3 tabu areas 222 (Uripiv), 246 (Lelepa) and 264 (Emua). Only 246 had a significantly higher catch rate than open access areas within the relevant site. |
| Correlation of catch rate with fishing intensity | Catch rate data were poorly correlated with fishing intensity | Relative to the level of fishing effort, area 222 had low/expected catch rates, those at 264 were as expected, those at 246 tended to be high. |
| Mean length of key species by area | Few differences in mean length between sub areas occurred for fish caught within sites with any gear. there were significant differences between sites. | No significant differences in mean length occurred for fish caught in tabu areas compared to open access areas. |
| Correlation of mean length with fishing intensity and abundance | Although not ubiquitous, a significant negative correlation existed between mean length and fishing intensity, and positive correlation with abundance for some species and gears. | Mean length of fish in tabu areas varied, but did not differ from expectation. |
| Correlation of fishing mortality of key species with fishing intensity and abundance | Total mortality was not correlated to fishing intensity or abundance except for *Lethrinus harak* | Insufficient data were available except for *Ctenochaetus striatus* at 246, where total mortality was low. |
| **Multivariate analyses** | | |
| Species assemblages | No correlation existed between species assemblages and fishing intensity, reef area or distance from landing site. These variables were strongly inter-correlated. | No significant differences in species assemblage occurred between tabu and open access areas, except for fish caught with gill nets in 1997/8. Species assemblages were most different at 222 and 264, whilst at 246 they were more similar to other areas. |

Table 6.4. Summary results of analyses of indicators of the status of fishery resources in open access and managed (*tabu*) areas in Fiji, and correlation of these indicators with fishing effort and abundance.

| Analysis performed | Site status | Overall Observations | Tabu areas vs open |
|---|---|---|---|
| **UVC analyses** | | | |
| Habitat | | Habitat differences between sites were not significant, but significant differences occurred between areas across sites : Tacilevu differed from all other areas, but those within Tavua and Naweni were similar | Tabu areas did not sl access areas. |
| Species assemblages | | Certain species, family and trophic group differences in abundance occurred between sites and between areas within sites, but fishing effort did not contribute significantly to explaining variation in mean biomass. In Tavua inshore reefs (121) had greater biomass than offshore reefs. MDS plots indicated offshore reefs separated from inshore reefs at this site. | Uni-variate tests indic invertebrate feeding a open access areas a conclusive.<br>Multivariate tests sho open access area 20 differences was not s |
| Mean length | | Two parrot fishes, *Clorurus bleekeri* and *C. sordidus*, had greater mean lengths on inshore reefs in Tavua compared to offshore reefs. | No significant differen detected in the close areas. |
| **Uni-variate analyses** | | | |
| Mean catch rate by area (abundance) | Semi-commercial | | No difference betwee 201 (Naweni) in 1997 |
| | Commercial | | No differences in cat |
| Correlation of catch rate with fishing intensity and abundance | All sites | No correlation with any gear/year combination | |
| | Semi-commercial | No correlation except for gillnets in 1997/8 | No consistent trend f when 16, 201 were c |
| | Commercial | No correlation with any gear/year combination | No consistent trend f |
| Mean length of key species by area | Semi-commercial | Few differences in mean length by area were observed, but fish caught at 18 and 21 tended to be larger. | No evidence that len those in open access access areas) |
| | Commercial sites | No consistent differences in mean length within or across commercial sites, except fish at 122 (offshore reef) which were larger | No consistent trend f |
| | Semi-commercial vs commercial sites | Fish caught by handlines from commercial sites were larger than those from semi-commercial sites. | |

| Analysis performed | Site status | Overall Observations | Tabu areas vs open |
|---|---|---|---|
| Correlation of mean length with fishing intensity and abundance | All sites | Few species indicated significant correlations between mean length and fishing intensity and abundance, and except in two cases observations were inconsistent with expectation. Environmental differences or fishing practices (especially between commercial / semi-commercial areas) may have a stronger influence than fishing intensity. | Mean length of fish ir |
| Correlation of fishing mortality of key species with fishing intensity and abundance | | For some species, fishing mortality was positively correlated to fishing intensity and negatively correlated to abundance | Limited data was ava species from tabu are consistent with the le for one observation o |
| **Multivariate analyses** | | | |
| Species assemblages | All sites | No correlation existed between species assemblages and fishing intensity or reef area. | |
| | Semi-commercial sites | Species assemblage was not correlated to fishing intensity. There was no apparent difference in species assemblege across all areas, but this could not be statistically tested. | Species assemblage significantly different |
| | Commercial sites | Species assemblage was not correlated to fishing intensity. | Species assemblage licences per area, an |
| | Semi-commercial vs commercial sites | Family assemblages caught by handlines were significantly different between commercial and Semi-commercial sites. | |

### 6.1.3 Explaining the observations

Tables 6.3-6.4 compare resource indicators from managed and open access areas and correlate them with fishing effort in order to explain observations reported in Section 6.1.2 above. The key findings were:

- Mean length, mortality, abundance and species assemblages at Fiji and Vanuatu showed no, or only weak correlation with fishing effort. The abundance of few species, families or guilds was correlated to effort.
- Managed areas were generally consistent with expectation relative to the level of effort applied in them, with few exceptions.
- Such differences as occurred could be attributed to other factors such as habitat (Vanuatu), inshore or offshore reefs (Fiji), or level of commercialisation (Fiji)

Mean length was not significantly corelated with fishing intensity or abundance, and such variations as did occur were believed to relate to environmental or fishing practice differences between areas and fishing sites. This was especially the case in Fiji where there was a division between semi-commercial and commercial fishing sites and fish from the latter were larger. Fishing mortality was not correlated with fishing intensity or abundance in Vanuatu, and weakly correlated for certain species in Fiji. The mortality of fish from Tabu areas was consistent with expectation however.

Species assemblages were examined in both UVC and multivariate studies of fishery data. Species assemblage was not correlated to fishing intensity in either Fiji or Vanuatu for either UVC or fishery data. Jennings and Polunin (1996) in a similar UVC study in Fiji found that at very low levels of fishing effort, species assemblages were significantly different, but that at higher levels of effort there was no difference. The fact that species assemblage and fishing effort were not correlated in the present study suggests that fishing effort at all the study sites in Vanuatu and Fiji was above a threshold level at which these changes in species assemblage occur. Tabu areas were subject to significant fishing also. However, it will be recalled that gill net data for 1998 did indicate species assemblage differences between tabu and open access areas in Vanuatu. The species assemblage in Lelepa (246) where high catches were taken, did not differ markedly from open access areas, whilst that in Uripiv (222, low catch) and Emua (264, high catch) did.

Catch rate data as an indicator of abundance indicated little correlation with fishing effort in either Vanuatu or Fiji. Catch rates in tabu areas were generally consistent with expectation for the level of fishing applied. Exceptions were 246T at Lelepa in Vanuatu, where catch rates were higher than expected for the level of effort, and 201T in 1998 at Naweni in Fiji.

Thus, few indicators of the status of resources revealed differences between managed and open access areas (Section 6.1.2). Benefits of closed areas were apparent where effort was low, and resulted in higher abundance of fish recorded at the family and trophic level, when making direct comparisons between tabu and open access areas. However, generally the value of indicator variables for managed areas were consistent with expectation for the level of effort applied in them. This suggests that where closures may be enforced, and effort controls applied, management benefits will occur. Furthermore, however, there remained cases of where management had apparently conferred some additional benefit:

- Species assemblages at commercial Fiji sites were weakly correlated to number and cost of licences. This assumes that the resulting species assemblage is beneficial -

In fact, this relates to targeting effects by commercial fishers rather than effort limitation (species assemblage was not correlated with effort), and the benefits to the community would be reduced competition for reef fish. Volume 2, chapter 2 indicates the markedly different species composition taken by commercial and semi-commercial fishers in Fiji;

- Species assemblages in 222 in Emua (Vanuatu) differed from open access areas despite high catches from that area (this assumes that the resulting species assemblage is beneficial - in terms of conservation and bio-diversity this is the case, but no analysis was performed of the relative value of the different catches likely to result from these different species assemblages);
- Catch rates in 246 in Lelepa (Vanuatu) and 201T in Naweni in 1998 (Fiji) exceeded expectation relative to the level of effort.

In relation to the closed areas, the observations may be explained by the pattern of resource use (see Volume 2). In Vanuatu, the community utilise the resources in the 'closed' area in a different way from those in open access areas, which may be fished at any time. In the closed areas, apart from one illegal invasion in area 246 in Lelepa, the tabus were respected by the communities of Emua and Lelepa, with the intention of allowing the resource to 'build up'. Then at special events (such as the visit by the Prime Minister who was from Lelepa, or Christmas, for example) the community will fish the resource. Thus pulsed fishing occurs and apparently higher catch rates were achieved at Lelepa. This relates to the fact that any aggregation or increased catchability effects result in high catch rates initially. Since only a short pulse of fishing occurs, catch rate decreases are not apparent and catch rates are not averaged over a long time period as they are for the open access areas. Hence relative to the level of effort, the catch rate is high. The effect of the pulsed fishing at Emua was a different species assemblage. In relation to this site, it should be noted that surrounding areas had also been closed prior to the study, and the aggregate effect of these closures may have resulted in the benefits described. In the case of Naweni in Fiji, the catches recorded occurred after re-opening of the closure. This indicates that short term closures lead to short term measurable benefits above expectation for the level of effort. Longer term benefits would not be expected.

## 6.2 Management success : Conclusions

Customary management measures that were studied related to short term closures and effort controls (unrestricted licensing).

### *Closed areas*

Polunin (1984) referring to Indonesia and Papua New Guinea, suggested that conservation is not the intent of many traditional closed areas and that the resulting management actions are the outcome of conflict over scarce resources. Similarly in Fiji and Vanuatu, conservation was not the primary aim, and management actions were related to land tenure, cultural and political issues rather than to western notions of sustainable resource use. The results of this study have indicated that limited evidence for the benefits of customary management can be shown from the western perspective. The status of fishery resources inside tabu areas was generally consistent with the level of exploitation of those areas. Benefits from fishery closures were not comparable to those reported by other authors in relation to long term marine protected areas (e.g. Watson et al 1998, Russ and Alcala, 1998. See also Chapter 1, this Volume). However, benefits from short term closure were detected at two levels:

- Closures resulted in reduced effort in tabu areas, and it was shown that abundance and catch rates were higher at low levels of fishing effort.
- The pattern of use of closed areas resulted in short term benefits to the community through increased catch rates and species assemblages.

Apart from the fact that closures studied were short term, the limited evidence for benefits of management also relate to the size and location of tabu areas (no striking differences were observed in terms of abundance, size of fish, mortality of fish or species assemblages and richness inside tabu areas compared to open access areas). Frequently these were very small (see Volume 2) and were located to maximise political and cultural aims rather than in relation to the distribution of resources.

From these findings, it would appear that whilst customary management, due to its short term nature, does not result in the long term benefits associated with western or centrally managed long term marine protected areas, it does result in short term benefits. These benefits satisfy the community objectives of 'saving up' resources for social functions. Providing that the period that fishing is permitted within such areas is limited, it may be that such a pattern of resource use could provide long term benefits for overall resource sustainability, and provide short term benefits to the community. The short term benefits also act to provide an incentive to maintain the closure during the remainder of the year. Further investigation is warranted to establish if such forms of closure are an appropriate model for closed area management.

***Effort controls and Licensing***

Effort controls were exercised at three levels:

- Protection of native fishing rights ie. exclusion of non community members from fishing within Customary fishing rights areas (explicit, as in semi-commecial sites in Fiji, or implicit as in Vanuatu, see Volume 2 and 6.1.1);
- Licensing of non community members to fish within CFRAs, as in commercial sites in Fiji, although there are currently no restrictions on the number of fishers;
- Closed areas, which, in the way they have been applied in Fiji and Vanuatu, restrict effort for part of the year.

Gear controls would also act to limit effort but in the study site where these were nominally applied (Pellonk, Vanuatu), they were not enforced.

The results of this study have indicated that limited evidence for the benefits of customary management and effort controls can be shown from the western perspective. Explanatory variables were only weakly correlated with fishing effort and the more obvious differences between areas could be attributed to other factors such as habitat (Vanuatu), inshore or offshore reefs (Fiji), or level of commercialisation (Fiji). Nevertheless, managed areas were generally consistent with expectation relative to the level of effort applied in them. Species assemblages at commercial Fiji sites were weakly correlated to number and cost of licences.

In relation to effort controls, despite the weak correlation, the fact that the results of this study were consistent with expectation in relation to the level of fishing implies that where effort limitation is practical and can be enforced, then it can be a useful management tool.

The lack of evidence for substantive fishery and conservation benefits from customary management actions, when measured against Western values and objectives for management, is consistent with a similar study of customary management in Kenya by Mclanahan *et al* (1997). That study indicated that 'Presently, traditional management (*in Kenya*) is not effective in protecting species diversity or ecological functions, which was probably never the intention of the customs'. Some of the most degraded reefs in Kenya are those subject to customary management, whilst centrally administered national parks have performed significantly better. That study also highlights the dangers of researchers with different academic foci (e.g. biologists and anthropologists who have different views on human organisation and its effect on common resources) working independantly, and stresses that a multidisciplinary approach is required as was the case with the present study.

### *Concluding Remarks*

Little evidence for the success of customary management against western objectives of the long term benefits to resource sustainability could be demonstrated from this study. Short term benefits, which meet community objectives were, however, apparent. Both Fiji and Vanuatu are signatories to the United Nations Convention on the Law of the Sea and the FAO code of Conduct for Responsible Fisheries which, from a national perspective, define the obligations of governments related to conservation, management and development of natural resources (see Mees, 1999). Thus governments need to ensure that fishery resources are managed for long term sustainability, not just short term gain. The customary management practices (or, forms of 'human-resource organisation') applied at study sites in Fiji and Vanuatu are compatible with national policies and could be adapted to achieve long term benefits. The community institutional structure for resource management exists. Thus given this situation, there is a role for government to provide scientific advice in a co-management partnership in order to enable sustainable resource management. Government and NGOs would be involved particularly in:

- Ensuring an integrated approach so that marine resource management does not occur in isolation from that of other activities in the coastal zone and beyond;
- Co-ordinating co-management activities involving all the stakeholders, including interactions with resource users outside the CFRAs;
- Identifying sites most at risk from overfishing and resource degradation, in order to target these for immediate management action - Government management actions should be pro-active rather than reactive, and should be based on the best available information and not deferred until more is available;
- Working closely with fishing communities through the extension services and providing a training curriculum for those extension workers;
- Generating public awareness and education programmes to inform the public and resource stakeholders on issues relating to resource sustainability;
- Providing scientific advice to resource custodians on appropriate management actions, noting that for small scale artisanal fisheries in particular, some areas should be closed to fishing to provide refuges for fish stocks and to protect habitats.In the context of the study locations this could include, for example, advice on factors such as the optimal size, location, number and duration of closures to achieve conservation goals; on optimum gear sizes and deployment; and on licensing strategies to optimise revenue and limit effort; on the scale of management area appropriate for different resources;
- Undertaking targeted research and pilot scale adaptive management / demonstration

projects in order to enable the provision of appropriate management advice, and test its application;

- Implementing a monitoring programme, and one suitable at the community level;
- Ensuring legal support for areas under tenure and for any management actions including enforcement by communities.

Communities would be involved in:

- Defining, in the light of advice, management actions for the different resources or CFRAs - management actions need not be the same within each CFRA (particularly for sedentary species), but for certain resources, such as migratory pelagic species, it may be appropriate for common management actions, and for co-ordinated, joint management action amongst CFRAs, requiring co-operation amongst resource custodians;
- Providing the instituional framework for management;
- Implementing and, within appropriate limits, enforcing management actions;
- Working co-operatively with adjacent fishing communities to jointly develop management strategies
- Monitoring the fishery and effects of management.

There are a number of implications to developing a system of co-management, not least the implicit and potential change in emphasis of management actions to promote their biological function above that of their socio-political functions. These are discussed more fully in Volume 2 and in the Guidelines for co-management, Volume 5. Whilst there are clearly limitations on the extent to which communities will change in order to adopt human-resource centred organisational patterns rather than, or in parallel with human-social (self) organisational patterns, cultural systems in Fiji and Vanuatu are dynamic, and have in the past adapted to changing circumstances. This suggests that there is good potential to develop resource management strategies, mutually acceptable to fishing communities and national government, based on the principle of co-management in relation to areas of customary marine tenure.

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