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Women, rural development and community-based resource management in the Roviana Lagoon, Solomon Islands: establishing marine invertebrate refugia

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Introduction

Marine protected areas (MPAs) and spatio-temporal refugia can be effective fisheries management initiatives, particularly for multi-species tropical fisheries where absolute yields are difficult to predict and where there are multiple users and fishing techniques (Man et al. 1995; Russ 1994; Russ and Alcala 1996; Wantiez et al. 1997). Researchers broadly agree that MPAs are beneficial in enhancing spawning stock biomass, and allowing for larval dispersal and export of adults to adjacent non-protected areas (Bohnsack 1993; Johnson et al. 1999; Roberts and Polunin 1991; Russ and Alcala 1999). Likewise, spatio-temporal refugia alleviate pressure on stocks by allowing depleted populations to recover during seasonal or episodic no-take periods; they may also allow for increased larval dispersal, particularly if the area is dotted with permanently closed source population zones (Quinn et al. 1993).

Robert Johannes (1998) has recently supported the application of “data-less” precautionary management in the tropical Indo-Pacific region where fisheries biologists have failed to forecast inshore fishery dynamics with any certitude. Johannes argues that the best way to manage inshore tropical fisheries is to partly devolve managerial responsibilities to local communities, since it is not cost effective for poor tropical countries to conduct science-based fisheries research. Local communities who still have customary control over their waters can enact managerial initiatives, such as restricting gear, protecting spawning aggregations, establishing temporal or permanent marine reserves, and imposing minimum size limits (see also Johannes 1978, 1981). This strategy, referred to as sea tenure, not only regulates marine resource use in lieu of limited scientific biological data, but also serves the social objective of guaranteeing traditional resource use (Agardy 1997). It empowers local communities by recognising their customary entitlements and by

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ensuring their participatory involvement in management. In fact, sea tenure is slowly gaining acceptance among some government and many non-governmental organisations. They view this type of property governance as having the potential to achieve sustainable resource use while empowering local communities. Anthropologists and experts in related fields are being drawn into grassroots participatory planning of regional projects owing to this awareness (Sillitoe 1998). This planning design assumes that the vested social and environmental interests of local populations supersede those of central governments or foreign agencies. It recognises that it will be impossible to enforce any managerial initiative if local stakeholders are not included and their resource stewardship acknowledged.

Sea tenure, however, like other forms of common property or community-base management systems, has a range of meanings to experts and can have diverse outcomes depending on the sociocultural, historical, political, economic, and ecological contexts in which an initiative is situated. Like

other types of property governance (e.g., private or state property), common property institutions can successfully regulate resource use and access in some circumstances, but may not succeed in others (Bromley 1992). The key is to discern the factors that determine different sea common property institutions and the parameters that produce either their robustness or vulnerability. In the Solomon Islands, for example, diverse endogenous and exogenous processes have created deep-seated asymmetries between sea tenure institutions that were more homogeneous in the past. Underlying tenurial transformations and peoples' ability to articulate their systems of property governance with effective management are various historical processes that emerge from the settlement patterns of regional populations, and from their dynamic systems of indigenous sociocultural rules (Aswani 1999). These variables can have significant environmental and policy repercussions, and understanding how different combinations of property governance contribute to environmental protection is an essential prerequisite to establish-

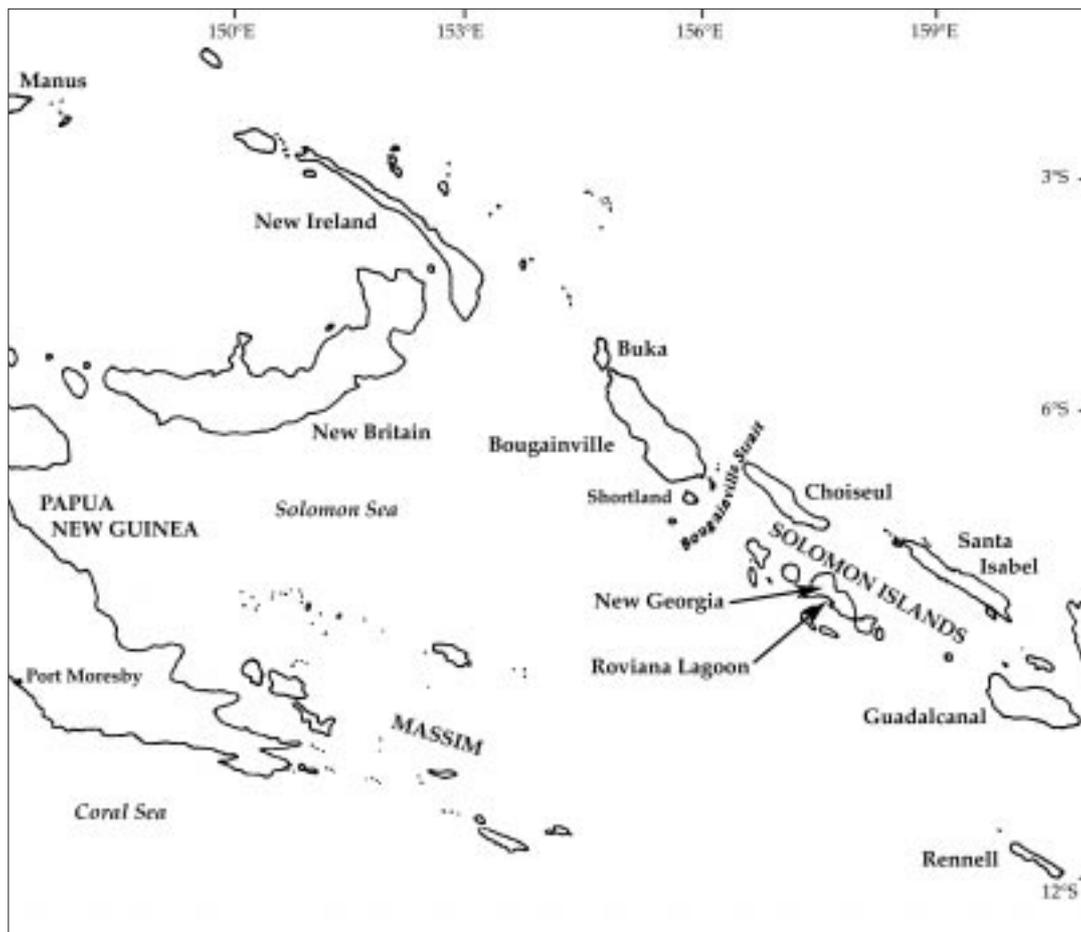


Figure 1. The Solomon Islands

ing managerial initiatives. Agardy (1997: 46) notes that there are areas of the world “where historical use, cultural affiliation and societal attitudes do set the stage for future effective management of marine areas”, and she cites sea tenure in Oceania as a clear example. In practice, however, different forms of sea governance and management can co-exist in a single region, and this raises a fundamental question: which institutional arrangements are best able to produce precautionary management programs such as marine reserves and spatio-temporal refugia?

To answer this question, I summarise a case study from Roviana Lagoon, in the Solomon Islands (Fig. 1). The case elucidates variables between different sea tenure institutions and core historical and social tenets that distinguish adaptable and successful regimes from those that are not. In addition, I examine a small-scale women’s rural development project that is involved in the establishment of spatio-temporal refugia and a marine reserve in a mangrove habitat. The project’s initial success indicates sea tenure governance arrangements that may favour the establishment of successful management regimes. Further, the case shows how anthropologists can integrate their empirical research results with the objectives of local people for the purpose of participatory environmental management.

Sea tenure

Sea tenure is a situation where a group of identifiable people have some form of informal or formal entitlement to sea space and where use and access rights are excludable, transferable, and enforceable (Ruddle 1996). This form of common property governance is a response to problems emerging from the use of common pool resources (CPR) in coastal marine environments. Research in this area has concentrated on Pacific Island institutions and their role in fisheries management (e.g., Johannes 1981; Foster and Poggie 1993; Ruddle 1998). Authors have generally accepted the assumption that sea tenure institutions are overwhelmed by wider global political and economic contests over natural resources (e.g., Graham and Idechong 1998; Mantjoro and Akimichi 1996), or by situations where the difficulties of exclusion and the subtractability of benefits are intensified. National and transnational political and economic processes are seen as profoundly shaping local environmental practice (Peluso 1992). It is assumed that the political and economic hegemony of state societies, articulated through disparate forms of juridical discourse and actions, disintegrate local common-property institutions transforming them into open-access systems. And yet when we closely

examine people’s concrete actions and concomitant events (Vayda and Walters 1999) within specific sea tenure institutions, we find that these are shaped by, and are embedded in, particular cultural and historical contexts. Indigenous practices combine with foreign economic influences to generate varying forms of governance and management. These institutional differences are not merely conceptual as they can have significant managerial implications and environmental repercussions.

Two main parameters identify resource sustainability or depletion in any form of property governance, and particularly in common property institutions: the difficulty of exclusion and the subtractability of benefits (Becker and Ostrom 1995). The first refers to a group’s ability to control access to resources by its own members or outsiders. This ability depends on the social, economic, and political costs and benefits of defending a resource or territorial estate; on the group’s ability to legitimise territorial claims through their validation by neighbouring groups; and their ability to enforce these claims via either formal or informal means. Subtractability of benefits refers to a situation where individuals will obtain the benefits of harvesting finite resources – particularly under public good institutional circumstances – while concurrently decreasing their subtractability for other users. If resources are located within a bounded common property regime where participants can prevent non-member resource access while enforcing limits on resource use among themselves, the regeneration rate of resources is more likely to be sustainable (Aswani 1999; Becker and Ostrom 1995).

Elinor Ostrom (1990) has proposed a set of institutional characteristics that, when present, can mitigate free-riding, subtractability, and self-enforcing problems. These include: 1) the clear definition of boundaries; 2) equitable costs and benefits for all inclusive members; 3) participatory decision-making by all stakeholders; 4) the capacity to monitor; 5) the enforceability of collective action decisions; 6) the presence of conflict resolution mechanisms; and 7) the availability of formal or informal means for users to secure tenure and organisational rights. Institutions displaying all or most of these traits are generally robust and enduring (Bromley 1992; Becker and Ostrom 1995). Often, neighbouring tenure systems appear to have uniform use and access rules of governance, but the feasibility for the development and implementation of any of these regulatory mechanisms will depend on the historical, socioeconomic, political, and environmental conditions in which each common property institution is embedded. This context determines whether or not individuals can translate

governance (i.e., peoples perceived rights) into effective management regimes (i.e., the activation of those rights). Rational actors will choose to either free-ride or not depending upon a group's potential to develop monitoring and controlling mechanisms. This fluidity leads to various degrees of uncertainty and produces complex interactions between existing systems (Ostrom et al. 1999).

In the Roviana Lagoon (Fig. 2) several historical and cultural variables form a backdrop to peoples' contemporary choices within the existing sea tenure regimes. These include: 1) population mobility over the last two centuries and the resulting variegated distribution of those who hold title to various land/sea estates; 2) the political expansion and contraction of regional polities; and 3) a fluid cognatic kinship system (see Aswani 2000). The conceptual models of "territorial-enclosed entitlement," "mosaic-entitlement," and "transitory-estates" describe the tenurial differences across the region (Aswani 1999).

The territorial-enclosed entitlement model represents a condition where territorial boundaries are circumscribed, entitlement holders are nucleated, jurisdictional power over estates is centralised under a traditional authority, and sea entitlements

are regionally recognised. This model consists of various villages whose members have, through intermarriage, pooled their entitlement rights to the ocean and vested their village leaders and their polity's chiefly authority with control over their marine holdings. Participating members exploit resources without restraint, and non-members are generally allowed access to resources for subsistence purposes only. However, when valuable resources, particularly those that are predictable in space and time are commercialised, members become territorial and impose access and use restrictions on non-members (membership is defined by various kinship rules). Such a shift in strategy – from "cognised" recognition of entitlements to "effective" action – occurs because regional settlement patterns have lead to the nucleation of entitlement holders adjoining their marine holdings. This nucleation allows for the bounded enclosure of the commons and the development of monitoring and sanction mechanisms to address collective action problems.

The mosaic-entitlement model portrays a situation where territorial boundaries are contested, entitlement holders are dispersed, jurisdictional control over estates is decentralised, and different groups contest sea tenure entitlements. The core elements

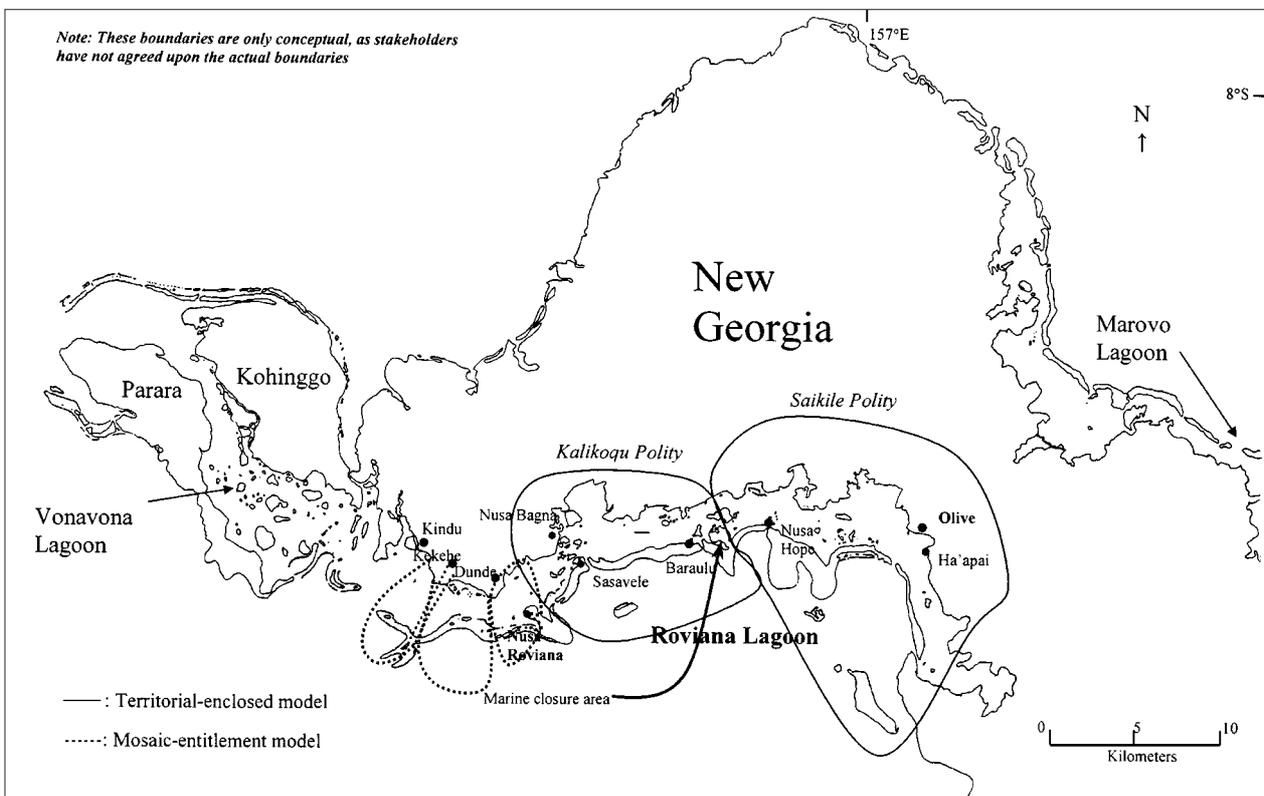


Figure 2. The Roviana Lagoon

in this model are single villages that unambiguously demarcate their marine holdings, which are controlled by a committee of local elders. However, because other stakeholders residing in neighbouring areas have use and access rights, tenurial authority is decentralised and boundaries are porous. Like the previous model, participating members exploit resources without restraint and non-members are generally allowed to use resources for subsistence purposes. Shell fishery commercialisation propels traditional authorities to try to enact control strategies. However, a shift in territorial strategy from cognised to effective action cannot take effect because past regional settlement patterns, political processes, and dynamic kinship rules have resulted in the dispersal of numerous entitlement holders away from their marine holdings. These stakeholders have increased their jurisdictional demands and interloping activities in waters that they consider to be theirs also. The regional variegation of entitlement holders not only engenders tenurial uncertainty, it also arrests the effective enclosure of the commons and the implementation of monitoring and sanction mechanisms to control resource subtractability and excludability. Lack of controls encourages both members and non-members to overexploit resources.

Finally, the transitory-estates model incorporates organisational elements of the other two models of sea tenure. This model depicts the situation in neighbouring Vonavona Lagoon, while the lagoon's western side fits within the mosaic model and the eastern sector the territorial-enclosed model. Vonavona can be portrayed using a transitory model because jurisdiction to sea space there is being conveyed and renegotiated as eastern and western polities continue to intermarry, changing the flow of entitlements and claims². This situation has several possible outcomes: inner lagoon polities may fuse and form a large territorial-enclosed chiefly district; village-centred territories might strengthen in response to increased fishery commercialisation; or the system may collapse due to sustained boundary transgressions and disputes, leading to a de facto open-access system (Aswani 1999). This model suggests that the other two conceptual regimes in Roviana are transitory and bound for further transformation and hybridisation, but this will not be pursued here.

Institutional differences are not only conceptual – they cause real environmental repercussions. In what follows, I compare time allocation, household income, and foraging returns data from Roviana villages that fit within the two major sea tenure models. The result shows that even under similar economic and, in part, ecological circumstances, local perspectives and actions regarding use and access to marine resources vary between sea tenure regimes³.

For instance, people in Olive, a village located within the Saikile territorial-enclosed regime, are quite adamant about not allowing interlopers access their commercial marine resources (Fig. 2). Economic activities here are less diversified than in other villages and most households depend on a single marine resource, *Nassarius camelus*, for income (Fig. 3). The shells are harvested from nearby reefs and sold to local buyers. They are then marketed to the Tolai of New Britain who use them as a traditional currency. Adult members (between 17–65 years) of most families dive four to five times a week with a weekly average of twelve hours labour for men and fourteen hours for women. The greater effort toward this activity has resulted in neglected gardens and coconut plantations and a greater reliance on imported foodstuffs. Results show that 86 per cent of households participate in diving and that for 75 per cent of them this is the most important economic activity. Subsistence fishing returns are high with an estimate mean return rate of 2360 kilocalories per hour of fishing (Aswani 1997). Hamlets are quite territorial and 84 per cent of households assert that neighbouring villages (within the Kalikoqu polity) should ask chiefly permission before accessing their commercial marine resources. Fishery commercialisation has transformed peoples' enactment of territorial rights from a mere recognition of sea tenure rights to actual territoriality, thus strengthening the common property institution and possibly mitigating resource abuse.

Nusa Roviana, by contrast, is a village we would classify within the mosaic entitlement model (Fig. 2). Like Olive, many adults dive often for trochus shells, with an average of twelve hours labour for men and three hours for women⁴. Fully 88 per cent of households participate in diving

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2. Contemporary intermarriages between members of the illustrated models in Roviana are not yet having the same jurisdictional effect as in the smaller Vonavona Lagoon (see Aswani 1999).
 3. These data represent a summary of research conducted from March 1994 to December 1995 in the Roviana and Vonavona Lagoons. Additional research has been conducted since 1998 until the present. Detailed research results will be published later.
 4. Women at Nusa Roviana do not dive as much as women in Olive because many work at a nearby cannery, making wage labour an important source of income. However, most of these are young women who independently spend their money, and only a fraction of their incomes enters the household.



Figure 3. Drying *Nassarius camelus* shells at Olive village.

and that this activity is paramount for 76 per cent of households. Fishing returns are relatively low in this part of the lagoon owing to widespread intrusion by neighbouring villages, with an estimate mean return rate of 891 kilocalories per hour of fishing (Aswani 1997). Marine environments are overexploited and people have reported a significant decrease in catches. Notwithstanding the importance of shell diving to the local economy, hamlets are hardly territorial, with only 10 per cent of households asserting that neighbouring villages should ask chiefly permission before accessing commercial marine resources. Shellfishery commercialisation has in effect resulted in a weakening of the common property institution and has led to *de facto* open-access and attendant resource degradation. This has not resulted from fishery commercialisation per se, but rather from the local inability to effectively close their commons.

Olive and Nusa Roviana villagers' economic dependence on commercial shell should make them reluctant to allow outsiders to exploit their resources. Naturally, there are other variables that pattern peoples' economic activities and their concomitant opportunity costs, including seasonal economic and ecological changes which affect the cost-benefit ratio of territorial behaviour. But considering that the exploited resources in both villages are available throughout the year and are predictable in space and

time, we would expect that both villages would implement regulations to control use and access to their marine resources. But instead there exists a clear asymmetry between each village's territorial strategies and the villagers' cultural attitudes regarding use and access to marine resources. This is despite the fact that people in both areas cognise their entitlement rights to sea space in a similar fashion. The differences have resulted from different historical trajectories that have shaped diverse institutional situations: in one, systems of governance can translate into systems of management; in the other, they cannot.

This example indicates that when territorial-enclosed sea tenure regimes are confronted with economic and social pressures they do not inevitably fall into institutional decay evolving into open-access. It further suggests that in the case of mosaic-entitlement sea tenure institutions the open-access commons are not necessarily the result of institutional breakdown caused by the market economy, but can result from endogenous processes.

In other words, the present asymmetries between these common property institutions manifested in their varied organisational and managerial responses to exogenous agency, challenge the assumption that fishery commercialisation will linearly transform community property governance into open-access. Further research will be needed to develop a comprehensive account of

common property institutions and their contemporary transformations.

To that end, myself and students at the University of California, Santa Barbara and University of Otago, New Zealand, in partnership with WWF-Solomon Islands, have begun a multidisciplinary research project funded by the John D. and Catherine T. MacArthur Foundation that will study the following:

- changing regional demographic patterns and their impact on sea tenure;
- spatial patterns of settlement;
- cultural competence regarding tenure across the region;
- time-allocation and income generating patterns;
- correlations between Western science and indigenous ecological knowledge; and
- spatio-temporal patterns of marine harvest efforts.

It is expected that this research will result in a theoretically driven understanding of how common property institutions are transformed in situations of rapid demographic, economic, and political change. The study will also elucidate relationships between indigenous and Western ecological epistemologies, and will contribute to the development of a comprehensive theoretical model of human adaptive foraging strategies in marine ecosystems.

What are the local environmental and policy repercussions of the documented variation in sea tenure? Understanding how different combinations of property governance contribute to or perhaps hinder environmental protection is an essential prerequisite to establishing any form of effective management. Conservation practitioners must ask which institutional arrangements are most appropriate for creating marine reserves and spatio-temporal refugia. Preliminary results indicate that of the three arrangements modelled here, the territorial-enclosed model of sea tenure is most suitable because it is not adversely affected by fishery commercialisation. Indeed, in this system such pressures can actually strengthen resource use and access controls. Its power centralisation, nucleated stakeholders, and uncontested boundaries facilitate co-managerial schemes between conservation practitioners and local people. Moreover, managerial success in these areas is likely to encourage villagers living in other areas that are more vulnerable to resource overexploitation to negotiate with neighbouring groups toward natural resource management.

Policy makers in the Solomon Islands and elsewhere where customary sea tenure persists can make informed managerial decisions by recognizing that different tenure arrangements may exist within their countries. For example, by identifying differences between local tenure regimes and how these come into existence and respond to changing circumstances, policy makers can better determine where formal codification of customary law and resource use and access rights is necessary for better resource management. Further, this can provide a road map to identify economic and social circumstances that generate tenurial regimes that are most and least vulnerable to transformative processes such as economic development and population growth. This, in turn, will facilitate implementation of sounder regional economic schemes such as aquaculture and ecotourism.

Finally, by recognising the importance and variation of tenure systems, planners gain a better basis on which to select sites where managerial initiatives are more likely to succeed. As described in the next section, in Roviana the ethnographic study of sea tenure has been useful towards selecting an institutional context that is less vulnerable to resource abuse and is more likely to produce sound resource management in conjunction with a small-scale development and conservation project. The project has a better chance of success due to the institutional stability provided by the community's territorial-enclosed model of sea tenure. The lack of territorial disputes and interloping together with demarcated territorial boundaries and traditional power centralisation can assure the success of closures if monitoring and sanction mechanisms are developed and enforced to address collective-action problems.

Women's rural development and the establishment of marine invertebrate refugia

The fishing activities of Pacific Island women are, without a doubt, crucial in providing a source of protein and income to thousands of coastal villages in Oceania (Chapman 1987). Regional fisheries development plans, however, have usually focused on men and ignored the role of women in artisanal and small-scale commercial fisheries; this notwithstanding that in many areas women spend as many hours fishing and gleaning as men do. Because women are so important for household resource procurement, any attempt to develop long-term sustainable artisanal fisheries in the region will require their participation (Bidesi 1994). Certainly, sustainable development can only be achieved through the social and economic empowerment of women and other marginalised groups

(Overton and Scheyvens 1999). And yet, women's voices concerning sustainable development, the environment, and the health of their communities continue to go unrecognised (Griffen 1994).

Roviana women's fishing and gleaning activities are vital to the nutritional and economic needs of most lagoon households (Fig. 4). The maritime activities of men and women merge in the angling inner lagoon fishery, but they diverge when conducted in the barrier islands/outer lagoon (*vuragarena*) and in the mainland or barrier island mangrove forests (*petupetwana*). The former is the domain of men, where big game fishing is carried out, while the latter is where most significant women's gleaning activities take place. These, however, are only generalisations since women frequent barrier intertidal zones for gleaning and angling and men do visit mainland mangrove habitats for spearing, netting, and line fishing. Roviana women have a deep awareness of the biological rhythms of their lagoon and the creatures that inhabit its numerous habitats. This ecological knowledge is rooted in the maritime experiences of the ancestral coastal peoples who inhabited the lagoon. Their close contact with the environment has led women to recognise the ill effects of logging on estuarine invertebrates and coral communities, and has made them increasingly aware of human-induced decreases in shell stocks. In particular, women have noticed a significant reduction in the abundance and size of *Anadara granosa* (blood cockle) (*riki*) and various *Polymesoda* (mud clams) (*deo*) bivalves (e.g., *Batissa fortis*) (Aswani 1997; Hviding 1995).

This growing awareness has prompted some women around the lagoon to encourage traditional authorities to impose some form of management regime. In July of 1999, I, in collaboration with WWF-Solomon Islands, established "The Baraulu/Bulelavata Women's Sewing Project" to assist women in this effort⁵. This is a small-scale sewing project designed to provide local women with a measure of financial independence to support local enterprises such as the construction of a permanent facility for women's activities, sending local women to nursing and vocational schools in Honiara and other initiatives. The proposed activities are directly linked to a resource-management plan, but unlike most conservation initiatives that focus exclusively on conservation it also works towards local developmental needs. The project is linked to a resource-management initiative concerned with the temporal closure of selected mangrove habitats to protect various crustaceans and



Figure 4. Roviana women fishing

bivalve species. The long-term goal is to create a permanent marine reserve. The income that women lose by not selling shells is compensated for by the sewing project's cash profits. Because of this incentive and their genuine concern for their resources, women have agreed to temporarily ban from September to May the collection of overexploited mud clamshell, blood cockles, oysters, and all other invertebrates in this habitat (for a trial period of two years). The closures began in September of 1999 and reopened in May of 2000, and then closed again in September of 2000 to reopen in May of 2001.

The restricted areas are Rereghana and Duduli near Baraulu village, which encompass several km² of mangrove habitat (Fig. 5). Mangrove ecosystems are well established in the region and are extremely important as nurseries for juvenile fish, as spawning grounds for numerous species, and as major feeding zones for reef and pelagic species alike. The most prevalent mangrove species found in Roviana and Vonavona are *Rhizophora* species in the low mangrove forests, and *Rhizophora* mixed with *Dolichandrone* and *Bruguiera* species in taller stands (D.O.S 1974). The substrate of adjacent waters is fine silt and clay with colonies of *Thalassia* and *Enhalus* sea grasses.

5. The New Zealand High Commission, Solomon Islands, WWF-Solomon Islands, and Danish churches have provided funds for this project.

Scattered dead and living *Porites* coral colonies dot these areas and provide good spots for fishing for small reef and pelagic species. These areas are regularly used for several activities, including gleaning shells, spearing fish, collecting crabs, and finding bait. Women frequently visit them for gleaning during the *masa rane* season from mid-May till the end of August (Aswani 1998). The closed sites are the most frequented and overexploited of the harvesting areas available to Baraulu/Bulelavata women⁶. The period of habitat closure, however, coincides with a decline in gleaning activities (although the areas are still heavily exploited), making the initiative more acceptable to local women. Further, other mangrove areas remain open throughout the year to compensate for the loss of access to Rereghana and Duduli grounds.

Roviana women have a staggering understanding of the invertebrate fauna with which they interact, including knowledge on spawning seasonality, feeding habits, and temporal periodicity. Their anecdotal accounts suggest an increase in abundance and size frequency of both mud clams and blood cockles as a result of last year's closure. However, at the time of the ban no studies were conducted to determine the conditions of the shellfish grounds or the potential outcomes of the spatio-temporal refugia. Moreover, there is little scientific data on the demography and life history of the targeted bivalve species. This year, UCSB students and WWF personnel will conduct field studies to assess population abundance and distribution prior to the opening, during the har-

vesting season, and after the closure in September. A control site that has not been subject to any closures will be also monitored. In addition to studying harvesting patterns within the closures, field studies and a literature review will explore the aptness of placement and size of the preserve and other biological factors. We hope that this will help enhance the initiative and prepare the way for a permanent marine reserve to harbour a source population.

This initiative, however, is not without risks. Poaching by participating members could undermine the project's managerial goals. Through the involvement of traditional and church authorities, members of the community have been encouraged to respect the women's project and to endorse the resource-management initiative. To foster this process, WWF, the Western Province Fisheries Division, and UCSB will develop a series of workshops to assist local communities in monitoring and enforcing the closures and to check for changes in the resource base. There are also social risks to this project. A myriad of problems may arise ranging from disputes among women to a boycott of the project by men. In fact, there are signs amongst Baraulu/Bulelavata women of a dependency on capital assets and growing tensions and disorganisation. To mitigate this tendency, WWF personnel are helping Baraulu/Bulelavata women to improve their finance management, equipment maintenance, and leadership skills (Simon Foale, pers. comm.). What is more, Baraulu/Bulelavata men have agreed: 1) to medi-



Figure 5. Rereghana and Duduli marine closure areas (far left)

6. Baraulu village is the core community while Bulelavata is a nearby settlement formed by Baraulu people.

ate any internal disputes; 2) to support their spouses; 3) not to interfere in the project's finances, except when women request their assistance; and 4) assist in constructing a permanent facility for women. This project has the potential of empowering local women by encouraging them to manage their shellfish resources while developing a long-term community-cash enterprise. Overall, we are optimistic that the project will attain its goal of better resource management, primarily because the closure is in a sea tenure regime where boundaries are well defined, where there are no poaching pressures from neighbouring groups, where there is a capacity to monitor and enforce rules, and where the closures have been established through the participatory decisions of all stakeholders.

Conclusion

Pacific Island sea tenure systems are presently being promoted by outside experts and increasingly by national fishery policy makers, as alternative managerial tools to state centralised systems of coastal management. Many governments are slowly realising that it is more cost-effective to keep inshore artisanal fisheries management decentralised; under the control of local people rather than understaffed and poorly funded government agencies (Ruddle 1998). The endorsement of sea tenure institutions and indigenous knowledge as managerial tools, however, has often proceeded without adequate consideration of their transmutability. If we attribute the transformations of sea tenure exclusively to exogenous agencies, we ignore the centrality of local praxis, embedded as it is in local culture and history. By carefully analysing local practices and events and the circumstances that may encourage individuals to free-ride, a clearer picture emerges of the causative chains that transform sea tenure governance and management rules. Researchers must avoid the temptation to simply cast sea tenure as a single model of "community-based resource management." Sea tenure systems have emerged from diverse historical trajectories, and the result has been wide-ranging and dynamic managerial systems.

The essentialisation of sea tenure systems by some conservation practitioners is a flawed framework upon which to base resource-management policies. Roviana sea tenure regimes are institutional hybrids that are dynamic in nature and enmeshed in complex interactions. This recognition has allowed for the informed selection of a tenure regime where management initiatives are more likely to succeed. The initial success of the temporal closures in Baraulu/Bulelavata, Roviana, suggests that the territorial-enclosed model of sea tenure is the form that is most stable, and thus more

amenable to precautionary management programs such as marine reserves and spatio-temporal refugia. Future research must develop an adequate data baseline and the means to integrate indigenous institutional and ideational frameworks with government and non-government group's plans to protect insular Pacific marine ecosystems.

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Traditional knowledge possessed by the fishers of Marovo Lagoon, Solomon Islands, concerning fish aggregating behaviour

by Robert E. Johannes and Edvard Hviding

Explanatory note

Bob Johannes was asked by the Marovo Area Council to record important aspects of the traditional knowledge of Marovo Lagoon fishermen concerning their marine resources. His fieldwork was done during the last three weeks of May 1987 with the assistance of Edvard Hviding. Hviding, who had been living in Marovo for a year, and was studying other aspects of traditional fishing and marine resource management, including customary marine tenure and its associated knowledge base (cf. Hviding 1988, 1996), had already gathered important information relevant to Johannes' study, so they combined forces to write the report on which this brief article is based.

Marovo marine lore is so exceptionally rich that full study of it would require an appropriately trained marine biologist to spend at least 18 months living in the Marovo area and in daily contact with Marovo fishers. However, because of the friendly and enthusiastic help of Marovo fishers and the village communities of Chea, Ramata, Keru, Tamaneke, Bili and Vakabo it was possible to make considerable progress during the necessarily short period of this preliminary study.

Introduction

The Marovo Lagoon of Western Province, Solomon Islands includes a wide range of marine community types, from mangrove estuaries and mudflats, to sandy or coral lagoon bottoms to the barrier reef, including the biologically important passages through the barrier reef, and the oceanic waters beyond. A great many different kinds of fish and shellfish are found in these different environments (cf. Hviding 1995). Marovo people probably eat or otherwise use a greater variety of species of marine animals than 99% of the world's fishers. Their knowledge of sea animals is therefore very impressive. Recently, Hamilton (1999) has shown, through a detailed, representative study of subsistence fishing for trevallies (Carangidae), that the knowledge of the fishers of nearby Roviana Lagoon is similarly rich.

Some of the most important practical information fishers possess concerns:

- where fish and other marine organisms are found in large numbers;
- when they are found there (that is, season, lunar period, tidal stage, time of day); and
- their behaviour and movements.