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Customary sea tenure in Oceania as a case of rights-based fishery management: Does it work?

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Contents

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Abstract

This paper outlines the general characteristics of customary sea tenure (CST) in Oceania and identifies areas in which these characteristics overlap with modern rights-based fisheries management systems such as ITQs and CDQs. It also examines the effectiveness of CST regimes at regulating marine resource use and access by focusing on a particular case from the Solomon Islands. The institutional robustness or vulnerability of CST is assessed by examining various performance criteria for two communities in the Roviana Lagoon, Western Solomons. These criteria include people's (1) settlement patterns in relation to their property, (2) cultural consensus, (3) cultural attitudes with regard to governance and management, and (4) fishing efforts and yields. The results show that a number of historical processes have shaped CST systems into heterogeneous and dynamic institutions, and that CST regimes can vary even on small geographical scales. Understanding the circumstances in which CST regimes are more likely to be successful has facilitated the design and implementation of co-management fishery prescriptions (MPAs) for protecting particular species and habitats in the region. More generally, the paper proposes that by discerning the effectiveness of local governance institutions at regulating resource use and access – taking into consideration that these are embedded in particular historical and political contexts – we can better predict whether or not an introduced fishery management system will work. This knowledge can also assist in designing hybrid

management schemes that cross-fertilize community-based management, modern rights-based fishery management (e.g., ITQs and CDQs), and other government regulations. This integration is particularly relevant when these policies are to be implemented in coastal communities that have or have had traditional rights-based fishery management systems of their own and/or are more socio-culturally homogeneous. Given the long history of failed fishery management, it is now of vital importance to design innovative fishery management prescriptions that integrate natural and social science research more comprehensively.

Introduction

It has been several decades since scholars urged economists and fishery scientists interested in allocating marine resources efficiently and avoiding overfishing to pay heed to existing and/or disappearing traditional rights-based fishery management systems (e.g., Johannes, 1978; Pollnac, 1984; Chapman, 1985; Nietschmann, 1985; Ruddle, 1988; Cordell, 1989). The rationale behind this appeal was that to effectively manage coastal marine resources in many regions of the world, local communities and their institutions of resource management had to be understood and subsequently incorporated into decentralized participatory fisheries management. These scholars argued: why impose government fishery policies on local communities when existing rights-based management frameworks could be used to the advantage of fisheries regulation and in a cost-effective way? Researchers began focusing on forms of marine territoriality, such as customary sea tenure (CST), and on describing how inclusive stakeholders enacted resource access and use restrictions, gear restrictions, minimum size and catch limits, protection of breeding aggregations, and temporal or permanent marine closures (e.g., Johannes, 1981; Christy, 1982; Dahl, 1988; Acheson and Wilson, 1996). Many current studies are focusing on how different socio-economic, demographic, and political variables affect human territorial strategies and how such influences determine forms of governance in informal customary rights-based fishery management institutions (e.g., Cooke et al., 2000; Aswani, 2002; Acheson and Gardner, 2004; Wagner and Davis, 2004; Cinner, 2005). Other studies have investigated ways to effectively integrate traditional sea tenure systems into modern fisheries contexts (e.g., Adams, 1998; Johannes, 1998; Ruddle, 1998).

Since the 1970s, fishery scientists and resource economists have discovered that rights-based fishery management schemes such as Individual Transferable Quotas (ITQs), Territorial Use Rights in Fishing (TURFs), and Community Development Quotas (CDQs) can be means for re-establishing economic efficiency in open-access managed fisheries. Remarkably, the forbearers of these same intellectual constituencies were instrumental in the demise of traditional rights-based, common-property fishery institutions around the globe during the 19th and 20th centuries (for explanations on why "commons" was confounded with "open access," see Ciriacy-Wantrup and Bishop, 1975). Today, proponents argue that rights-based fishery management, particularly when it involves ITQs, is conducive to resource conservation, capacity reduction, improved product quality, and the maximization of economic efficiency (e.g., Maloney and Pearse, 1979; Hannesson, 1991; Christy, 1996). Critics, on the other hand, argue that such systems lead to negative socio-economic and cultural impacts, increase management costs, encourage the monopolization of fishing quotas, and result in resource degradation (e.g., McCay, 1995; Palsson and Helgason, 1995; Schreiber, 2001). In either case, these empirical observations are based on research conducted on modern market-based ITQs, mostly in Canada, Iceland, and New Zealand that are only several decades old.

Significant insights can be gained from studying the socio-economic and cultural processes that make or break long-standing fishery rights-based systems. Yet, many fishery scientists and economists have, for the most part, ignored mounting ethnographic evidence that suggests that localized and largely community-oriented rights-based fishery management systems around the world, albeit context-dependent, can sustain biological

resources and be successfully adapted to modern fisheries management. Indeed, good bioeconomic science is indispensable for determining total allowable catches (TAC) and for efficiently allocating harvest rights in a market-based fishery. But sound social science is fundamental in the design of ITQ and CDQ programs if these are to be economically efficient while also not detrimental to fishing communities socially (e.g., avoiding the monopolization of ITQs by fishing barons or conflicting with existing tenure systems) (McCay, 1995; Palsson and Helgason, 1995; Young and McCay, 1995; Hanna, 1996; Orbach, 1996). Simply, why impose modern rights-based fishery management in places where a common property rights-based system already exists? The job is to work within existing frameworks not to replace them. Therefore, it is necessary that we study local fishery management systems carefully for their potential integration (if and when desirable) with modern fishery policies.

In this paper, I outline the general characteristics of customary sea tenure (CST) in Oceania and show areas in which these overlap with modern rights-based fisheries management. Then, I measure various performance criteria to appraise CSTs institutional robustness or vulnerability, by focusing on a particular case from the Solomon Islands (Figure 1). Finally, I show how analyzing CST can facilitate the design and implementation of rights-based and co-management fishery prescriptions for protecting particular species and habitats. While Oceania is significant because it has the world's largest surviving (Ruddle, 1998) and thriving (Johannes, 2002) concentration of sea tenure regimes, the Solomons are important because their long-standing rights-based fishery institutions have survived (notwithstanding colonial and post-colonial government disregard for their importance) the onslaught of changes brought about during the 19th and 20th centuries better than in some areas of the Pacific. Two questions are asked: (1) what are the historical, socioeconomic, political, and environmental conditions that encourage or fail to encourage social actors in long-standing rights-based fishery management institutions to develop cooperation and enforcement strategies so as to avoid having their resources become public goods? And (2) how flexible and adaptive are long-standing institutions, such as CST, when faced with contemporary changes? Answering these questions is important because ITQ/CDQ and Marine Protected Area (MPAs) schemes are increasingly being proposed for managing inshore marine resources in the Indo-Pacific region.

Customary sea tenure as rights-based fishery management

Traditionally, CST is a situation in which particular groups of people (e.g., individuals, clans, tribes, etc.) have informal or formal rights to coastal areas and in which their historical rights to use and access marine resources are, in principle, exclusionary, transferable, and enforceable (Ruddle, 1996), either on a conditional or permanent basis. Modern rights-based fisheries management, on the other hand, finds its origin in neo-classical economics, and thus it is market-based and highly regulated by governments. This differs from long-standing rights-based fishery institutions, such as CST, which tend to be more decentralized and locally managed (McCay, 1995), and embedded in indigenous socio-cultural practices. Indeed, the origins and socioeconomic objectives of these two rights-based systems are diverse and should not be conflated. Their operational principles, however, do intersect at various junctures. User rights in modern rights-based fishery management schemes can be characterized by a combination of various factors, including (1) *exclusivity/excludability*, (2) *controlled subtractability*, (3) *transferability*, (4) *durability*, (5) *the existence of property rights* (although many ITQs only entail allocation rights and not full ownership of the resource, as management rights are often controlled by governments) and (6) *the security of title* (Hannesson, 1991; Shotton, 2000). CST is obviously not market-based, but it possesses many of the same attributes as modern rights-based fisheries management systems. In addition, CST systems, like ITQs or CDQs (e.g., Mace, 1993) are not designed for conserving marine resources intrinsically. Rather, coastal communities created CST regimes, among other reasons, to appropriate the largest possible share of existing marine resources and to exclude non-members from accessing and using them (Polunin, 1984; Aswani,

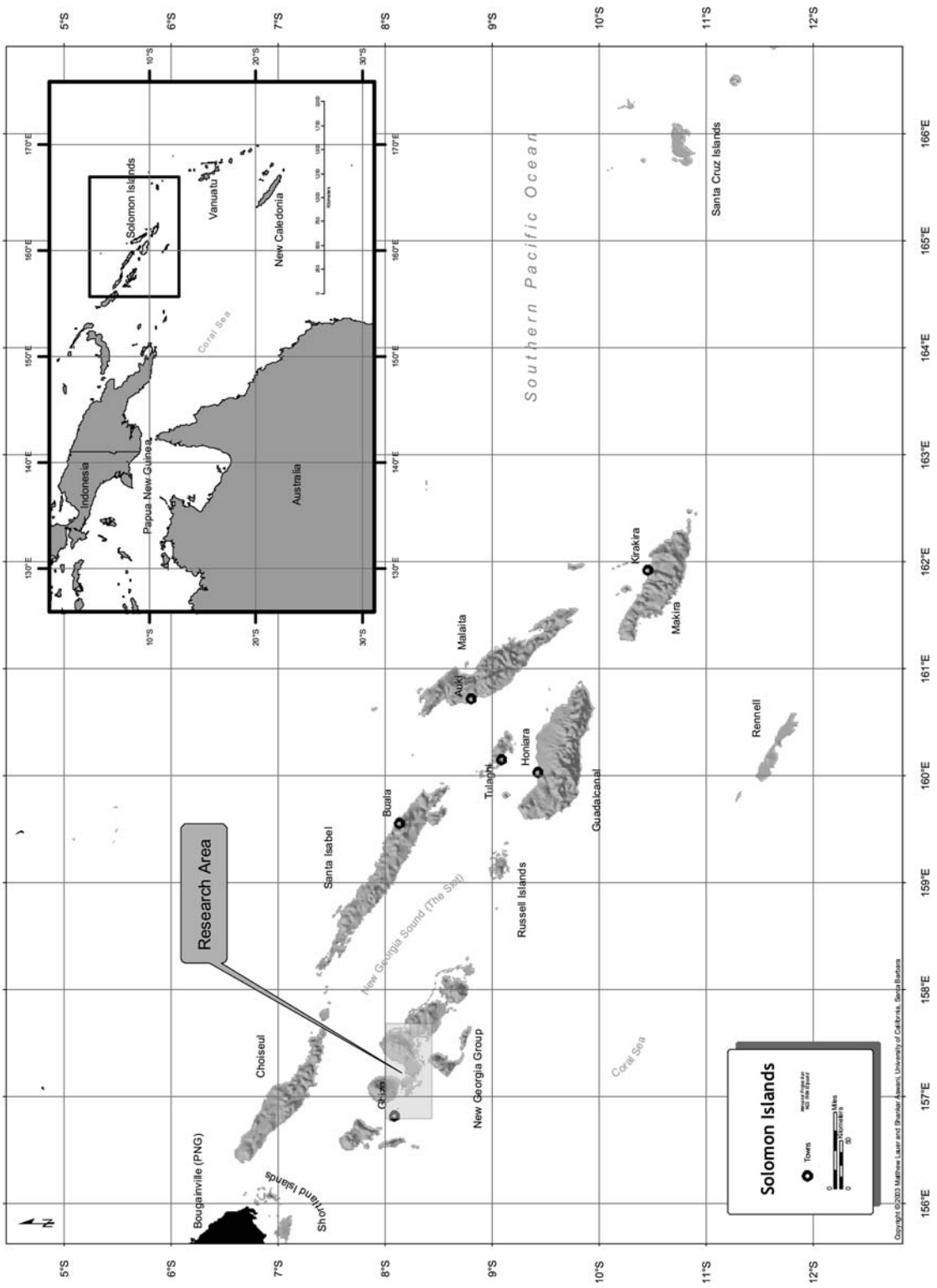

Figure 1. The Solomon Islands.

1998; Ruttan, 1998). Whether or not these diverse management regimes result in resource conservation is context-dependent (Steelman and Wallace, 2001). Clearly, if we are to cross-fertilize modern and traditional rights-based fishery management, we need to identify the governance and management mechanisms at various spatial and temporal scales that result in positive institutional outcomes in terms of environmental sustainability, social equity, and institutional endurance. What, then, is CST in Oceania? And how does it operate and overlap with modern rights-based fisheries management?

Studies of Oceania's customary sea tenure (also know as "customary marine tenure" (Hviding, 1989) or "traditional in-shore fishery management systems" (Ruddle 1988)) include cases from Polynesia (e.g., Levine, 1983; Toloa et al., 1991; Bess, 2001), Micronesia (e.g., Sudo, 1984; Foster and Poggie, 1993; Thomas, 2001), Melanesia (e.g., Akimichi, 1978; Taurakoto, 1984; Hyndman, 1993; Hviding, 1996; Aswani, 1999; Cinner, 2005), and Australia (Nietschmann, 1985; Peterson and Rigsby, 1998). Fishers often define CST as the way they "perceive, define, delimit, "own," and defend their rights to in-shore fishing grounds" (Ruddle and Akimichi, 1984: 1) in a historically and culturally situated context. Entitlements to sea space are not only characterized by rights to geographical space but can also encompass rights to specific habitats, technologies, and species, or a combination of these. CST studies have overwhelmingly shown that these institutions are diverse and dynamic and that they have emerged from the coalescence of traditional and foreign practices (Hviding, 1989; Aswani, 1997; Ruddle, 1998). Next, I show areas in which CST overlaps with modern rights-based fisheries management.

First, *exclusivity/excludability* (whether informally or formally recognized) identifies particular users as having exclusive rights over resources and the ability to exclude non-members from accessing and using them. This is a fundamental feature of CST institutions in the Pacific region. Rights of inclusiveness are distinguished according to various socio-cultural rules based on birth (primary rights), marriage and residence (secondary rights), and the direct transfer of rights by traditional authorities (usufruct rights). Entitlements, in any of these forms, allow users access to a benefit stream while excluding non-members. The degree to which entitlement holders can exercise their territorial rights to exclude interlopers and punish inclusive "free riders" varies from place to place and is often contingent upon regional settlement patterns, the strength of traditional self-governance, population pressure, fishery commercialization, and a country's legal recognition of customary sea tenure, among other things. Second, *subtractability* is when one's exploitation of resources discounts from those available to other potential consumers. CST's limited entry controls subtractability, which, in turn, results in more resources being available for inclusive consumers over the long term. Research in the Solomon Islands has shown that communities with effective marine territorial strategies – all else being equal (e.g., territorial size, population numbers, resource base, etc.) – have higher fishing yields than those who do not (Aswani, 2002). Third, *transferability* denotes the right to transmit one's property rights. In Oceania this is done to offspring, kin, or affinal members whether rights are primary, secondary, or usufruct in nature. In Oceania, myriad cultural rules define how, when, and where property rights are transferred. Smith (1991), for instance, reports that in Yap, patrilineal chiefs of land and sea estates, who are considered "high ranking," own particular species, methods, and territories, and confer upon lower-ranking villages usufruct rights to use marine resources in their chiefly territories. Fourth, *durability* is the time period for which the right is held. Individuals can hold entitlements to sea space either temporarily or in perpetuity depending upon their social status and kinship ties to the original claimants of a marine territory. Maritime peoples of Oceania kept their sea territories for centuries before their tenure rights were destroyed by colonial intervention. In fact, indigenous sea tenure institutions passed inadvertently to colonial governments who disregarded their managerial role in inshore fisheries management. This neglect, currently extended by post-colonial national governments, emanates from the influence of a long standing western juridical maritime tradition which, until recently, stressed open access to the seas (Cordell, 1989). Today, surviving CST institutions in Papua New Guinea, Vanuatu, and the Solomon Islands, for instance, are often demarcated by ancient coastal shrines and other

physical markers (e.g., Hyndman, 1993; Aswani and Sheppard, 2003), which attest to their durability in these locations. In Hawaii, by contrast, although the seascape is still dotted with old territorial markers (e.g., fish ponds), colonial land and sea alienation policies have nearly destroyed indigenous sea tenure (e.g., *konohiki* fishing rights) in most of Hawaii's islands. Fifth, *property rights* in CST institutions represent an array of different tenure claims. Both property composed primarily of natural resources and property governed as part of management systems are subject to *de facto* local controls, which are based on traditional norms and values. Jurisdictional powers to exercise one's property rights (i.e., to regulate access, use, and distribution of resources) generally are rooted in traditional law, which consists of a mix of customs from the pre-colonial period and foreign practices and ideas.

Finally, *security of title* is the recognition of rights to sea space either informally (e.g., by neighboring communities) or formally (e.g., by provincial or national governments). Such recognition varies from country to country. For instance, in countries like Samoa, Fiji, Palau, PNG, the Solomons, and Vanuatu statutory law recognizes indigenous tenure over sea space, although the state's protection of indigenous tenure rights varies from place to place. In sum, CST does not merely entail ownership of resources but also implies a shared socio-cultural identity and requires communal self-governance by those who hold them (Durrenberger and Palsson, 1987; Jentoft et al., 1998). CSTs operational principles, however, are comparable to those of ITQs and CDQs. Under certain circumstances, both can potentially resolve gear externalities, overcapitalization, and allocation problems (Ruddle, 1998), thus providing a fertile ground for the cross-fertilization of traditional and modern rights-based fisheries management in particular fisheries contexts (e.g., Trochus and bêche-de-mer fisheries).

The transformation of customary sea tenures

Customary sea tenure regimes are rapidly being transformed in the Pacific region. On the one hand, institutional erosion is attributed to historical and contemporary processes such as neo-colonialism, demographic changes, urbanization, economic development, technological innovation, commoditization of fisheries, and indigenous socio-cultural transformation. CSTs deterioration is further amplified by inherited Western legal systems that encourage land privatization while turning the ocean into an open-access resource. This situation has encouraged some to argue that CST is fated to become a *de facto* open-access system unless protected by national or provincial legislation (e.g., Mantjoro and Akimichi, 1996; Graham and Idechong, 1998). On the other hand, many CST systems are being reinvigorated by improved environmental awareness, NGO and government intervention (e.g., the Locally Managed Marine Area [LMMA] network, which is currently being promoted by various NGOs across the region) the resilience of traditional political systems (Ruddle, 1998), the frequent inability of command-and-control regulations to stop resource degradation, and growing local perceptions of resource scarcity (Johannes, 2002).

CST's increasing popularity among experts stems from the perceptions that it can contribute to natural resource sustainability, that it can be adapted to modern fisheries management, and that it is a cost-effective way of regulating tropical multi-species fisheries in a "dataless" context (Johannes, 1998). These perceptions are reinforced by scholarly works that identify design principles of governance in common-property institutions, including the demarcation of boundaries, the capacity to monitor activity, and the existence of conflict-resolution mechanisms that, when present, can mitigate free riding, subtractability, and self-enforcement problems (e.g., Ostrom, 1990; Stevenson, 1991; Bromley, 1992; Dietz et al., 2003). Because these institutional arrangements are commonly present in many CST regimes across Oceania, it is believed by many scholars that CST is robust enough to be integrated with government regulations to safeguard tropical multi-species fisheries (e.g., Johannes, 1998; Ruddle, 1998). This is an important endeavor indeed. However, we need to go one step further and identify which CST institutional arrangements are best suited to being combined with other management schemes. Simply describing the

parameters that identify long-lasting and robust systems is not enough. Research in the Solomon Islands (e.g., Hviding, 1996; Aswani, 2002), for instance, has shown that neighboring sea tenure systems often appear to have uniform use and access rules of governance; yet, the possibility of governance translating into actual management depends on the historical, socioeconomic, political, and environmental conditions within which each common-property institution is embedded.

To grasp this process, one needs to identify how people's understanding of their territorial rights (i.e., what is claimed, or property rights) translates into an effective activation of those rights – that is, actual behavior – through the control of participating members and exclusion of interlopers (Casimir, 1992). Further, as Ruddle (1998) has pointedly noted, the environmental outcomes and consequences of different management responses need to be assessed. Ethnographic research in the Western Solomon Islands suggests that current differences in management strategies across CST systems often result (among other factors) from people's historical and spatial patterns of settlement across the landscape and adjoining seascapes and the concomitant impact of these patterns on property relations. Historical processes (e.g., inter-island trade, inter-marriage, warfare, missionization, and urbanization) have often determined whether entitlement holders to a sea territory are nucleated or dispersed geographically today. Settlement patterns as an underlying organizational principle, therefore, influence how entitlement holders respond to changing demographic and socioeconomic forces. I address this possibility by presenting a case study from the Roviana Lagoon, Western Solomon Islands (Figure 2) that illustrates the conditions that allow some villages to effectively deploy their property rights while barring others. In particular, I compared two communities, Baraulu and Dunde, which appear to have similar CST governance structures but different managerial responses to management challenges. Anecdotal evidence suggests that Baraulu has an effective marine territorial control whereas Dunde has more difficulties in controlling interloping. Both communities are undergoing similar developmental and demographic processes, albeit economic transformation is more acute in Dunde.

The objective was to evaluate various performance criteria to identify whether or not CST in these two villages differed in any way and to gauge the circumstances in which CST's institutional success (i.e., when CST stakeholders can control interloping, avoid resource conflicts, and halt resource over-exploitation) or failure (i.e., when CST stakeholders cannot curtail interloping, engage in sustained resource conflicts, and cannot control resource subtractability) are more or less likely. Four criteria are presented here to evaluate stakeholder responses to contemporary managerial challenges: (1) their geographical location in relation to their property claims, (2) people's differences and similarities in CST's cognition (as a proxy for "cultural consensus"), (3) cultural attitudes regarding interloping and good governance (as a proxy for "enforcement of access"), and (4) fishing return rates and effort (as a proxy for "harvest limitations"). A combination of social and natural science research methods were employed to collect and analyze these data. This comparison extends a preceding analysis of two other communities in this region (Olive and Nusa Roviana) (Aswani, 2002; Aswani and Hamilton, 2004a).

Methods

Study site

The Roviana Lagoon in the Western Solomon Islands extends from the Munda Bar to Kalena Bay near Viru Harbor (Figure 2). The lagoon is sheltered by a series of raised offshore coral islands that developed during the Pleistocene period from sea-level changes and the accretion of coral limestone, organic debris, and volcanic detritus (Stanton and Bell, 1969; Stoddart, 1969). A variety of habitats, including grass beds, mangroves, freshwater swamps, river estuaries, shallow reefs, and outer reef-drops characterize the ecology of the lagoon. Over 12,000 people inhabit this cultural region (National Census, 1999). Net population growth in the Western Solomon Islands is one of the highest in the world, with women bearing an average of five children and the population increasing at the rate of 3.0% per annum. On the east, Roviana is divided into two main political

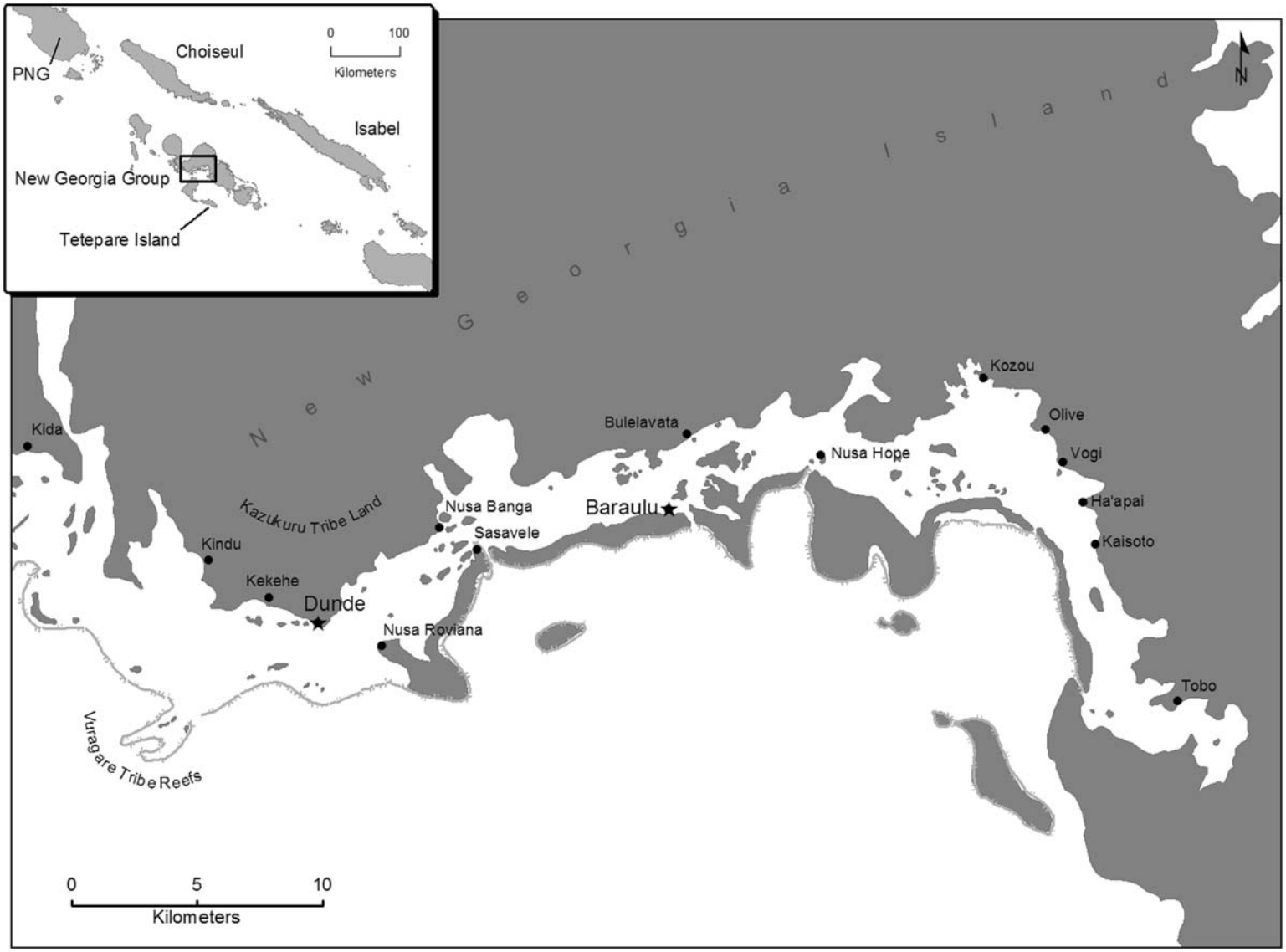

Figure 2. The Roviana Lagoon, Western Solomon Islands.

districts, Saikile and Kalikoqu (each formed by a group of villages) which are under a centralized traditional authority. On the west, Roviana is composed of the independent hamlets of Nusa Roviana, Dunde, Kekehe, Lodu Maho, and Kindu in the Munda area, each controlled by a council of elders. Throughout Roviana and adjacent Vonavona (see Aswani, 1999 for discussion on Vonavona) people share kinship ties originating from a common ancestry and a long history of tribal inter-marriage, and thus there are shared rights to various land and sea estates.

Property rights are best understood by studying the local kinship system. Roviana kinship is cognatic, which means that individuals are allowed to trace their descent via either or both parents and accumulate entitlement rights to the estates of either or both parents. That is, people residing in one village often have rights to fish in neighboring territories (i.e., depending on the number of rights that they inherit from their parents). Such practices are not uncommon in Pacific Island CST systems and do not generally result in governance and managerial troubles (i.e., widespread interloping and resource over-exploitation). However, problems can arise if the spatial distribution of individuals with overlapping rights to one or more sea estates is uneven. If it is possible for members of one village to fish in their neighbors' waters but not the other way around, then possibilities for abuse and conflict intensify. In Roviana and adjacent Vonavona, members of villages with multiple access rights often fish in their neighbors' waters while denying their neighbors access to their own resources (because the distribution of dual rights is often asymmetric). Refusal of access is particularly binding when resources are perceived to be economically valuable.

Data collection

The first step was to map the tenurial landscape by counting the proportion of members within each village with overlapping rights to neighboring estates. The research population was established through a population census conducted in 1994 and again in 2001. A majority of the households in the principal Roviana villages were sampled. To identify the spatial distribution of entitlement holders, two approaches were used: (1) a qualitative study of historical settlement patterns using various ethno-historical and archaeological methods (see Aswani and Sheppard, 2003), and (2) a quantitative measure of the geographical distribution of households having members with tribal affiliations to the major sea estates of the region. This was elicited through open-ended and structured interviews. A chi-square test was employed to test the association between households in major contemporary Roviana villages and central tribal affiliations to sea estates (Aswani and Hamilton, 2004a).

Cultural knowledge was measured using cognitive anthropological techniques, which are used to investigate the extent of shared knowledge among human communities in order to provide understanding of the underlying assumptions that inform people's decisions (D'Andrade, 1995; Holland and Quinn, 1987). The objective was to outline a cultural model utilized by Baraulu and Dunde people for understanding the operation of, and threats faced by, their CST institutions, and to assess whether differences existed among them in their cultural perceptions regarding property rights and management strategies. Standard ethnographic methods of participant observation and informant interviews were paired with cognitive anthropological methods that included agreement questionnaires, free lists, and pile sorts (Bernard, 2000). The questionnaires and interviews were designed to provide understanding of local concerns regarding the state of local fisheries within the sea tenure institutions and to elicit definitions of problems and possible solutions. Free listing generated lists of words pertaining to property rights that helped to identify underlying ideas and notions about CST. In the pile-sorting exercise, informants were given a set of cards inscribed with words in English and Roviana (which were formulated from the free-listing exercise), and they were asked to divide the cards into piles consisting of the most similar concepts. Final groupings were expected to reflect implicit classification elements for a specific cultural domain.

For data analysis, we converted the survey results into an "agree/disagree" format and subjected them to a consensus analysis. This method compares answers to a "test" through a matrix of numerical values within a pair of vectors. The assumption is that agreement among informants

implies a degree of shared knowledge (Bernard, 2000). The pile sort results were analyzed using multi-dimensional scaling, which transforms a matrix of similarities and dissimilarities into a map with coordinates in Euclidean distances. A value known as "stress" represents the degree of correspondence between the distances (similarities or dissimilarities) among points shown in the multi-dimensional scaling and the matrix input. A stress level of 0 is ideal, but it is generally acknowledged that levels below 0.15 are acceptable. Note that the lower the stress, the more likely is that the MDS graph shows some reality about people's shared knowledge (Bernard, 2002: 649). Then, the grouping of terms, or "clusters," allows identification of the terms that were most frequently associated with one another, which reflect implicit knowledge shared by informants (Aswani et al., 2004).

Next, cultural attitudes regarding interloping and good governance were examined for members of Baraulu and Dunde. To gain an understanding of how people's cognitive map translated into their beliefs, structured interviews were conducted in the two communities. Around 8% of the adult inhabitants (18 and older) of Baraulu were randomly selected for these interviews ($n = 42$), and about 4% from Dunde were selected ($n = 47$). The interview inquired about interloping, governance, membership, and use and access rules, including boundary delineations, monitoring, and enforcement. For each measure of interloping and good governance, differences between villages were determined with simple between-groups ANOVA (Baraulu versus Dunde), with alpha set at $p < 0.05$ for each comparison.

Finally, creel surveys were used to examine differences in fishing yields and levels of effort between Baraulu and Dunde fishers (as a possible proxy for harvest limitations). Two research methods were employed: focal follows and self-reporting diaries. Focal follow analysis involved keeping *in situ* time-motion records for fishers and measuring their catches. The diary method consisted of recruiting randomly selected subjects to keep diaries of their fishing activities. A dataset encompassing over 4000 fishing events and extending for more than 5300 h of fishing for the entire Roviana Lagoon was collected over a two year-period (1994–1995) to explore the effects of village and habitat type on mean net return rates and fishing event duration. The "mean net return rate" measure, which was used to estimate relative abundance, is similar to a catch-per-unit-effort (CPUE) concept. The mean net return rate is equivalent to the energy gained during fishing (the kcal value of the edible catch) minus the labor input (labor costs incurred during foraging, including travel, search, and handling times) divided by the total residence time at a fishing ground. Labor cost is factored by multiplying minutes spent in a certain activity (e.g., paddling a canoe or hand lining) by standardized measures from published sources (indirect calorimetry measurement for various activities adjusted to age, weight, and sex (i.e., Basic Metabolic Rate)) (Aswani, 1998). To determine inter-village differences unrelated to the effects of habitat, habitat was nested within village in nested-factors ANOVA. Findings from nested-factors ANOVA were confirmed via 2×8 (village$\times$habitat) factorial ANOVA. Alpha was set at $p < 0.05$ for each comparison.

Results

Spatial patterns of settlement

The qualitative results suggested a clear asymmetry in the distribution of entitlement holders to the principal sea estates across the Roviana Lagoon. Informants generally agreed that people in Saikile and Kalikoqu (e.g., Baraulu) have rights to the estates of Munda-area hamlets (e.g., Dunde) but not vice versa. This idea was supported by the quantitative analysis illustrated previously in Aswani (2002), which showed a significantly non-random association between households in major contemporary Roviana villages and key tribal affiliations (Table 1). Members of the Kalikoqu and Saikile chiefly districts had a high proportion of affiliations with their own estates while holding a considerable proportion of entitlements to the sea territories of Dunde and Nusa Roviana. Inhabitants of Dunde and Nusa Roviana, conversely, had a strong affiliation only with the Kazukuru estate, which covers land and some reefs adjoining the Munda area, and only half of the households had rights to the estates of

Table 1. Percentage of households in main villages with at least one member (either spouse) with affiliation to the major tribal groups in Roviana (villages from west to east) (Aswani, 2002)

Major tribes	Dunde (Munda area) ($n=35$)	Nusa Roviana (Munda area ($n=22$)	Sasavele (Kalikoqu) ($n=22$)	Baraulu (Kalikoqu/Saikile) ($n=38$)	Nusa Hope (Saikile) ($n=49$)	Olive (Saikile) ($n=15$)	Ha'apai (Saikile) ($n=14$)
Kazukuru	100	95	73	76	39	33	83
Vuragare	46	50	77	95	71	53	83
Kalikoqu Tribe[a]	14	32	100	100	43	13	14
Saikile Tribe[a]	23	23	14	84	98	100	79

[a]Each of these is an amalgam of several tribes.

Vuragare, which covers all the reefs neighboring the Munda area through Rarumana in Vonavona. The qualitative and quantitative results also showed that low proportions of households in Dunde and Nusa Roviana had entitlements to the property of the Kalikoqu and Saikile. In sum, there are clear tenurial asymmetries between these communities. Kalikoqu (e.g., Baraulu) and Saikile residents have exclusive rights over their respective estates while concurrently having potent rights to the estates of Dunde and Nusa Roviana. The inverse, however, is not true (Aswani, 2002) (Figure 3). The particular historical processes that have led to the variegation of CST entitlement

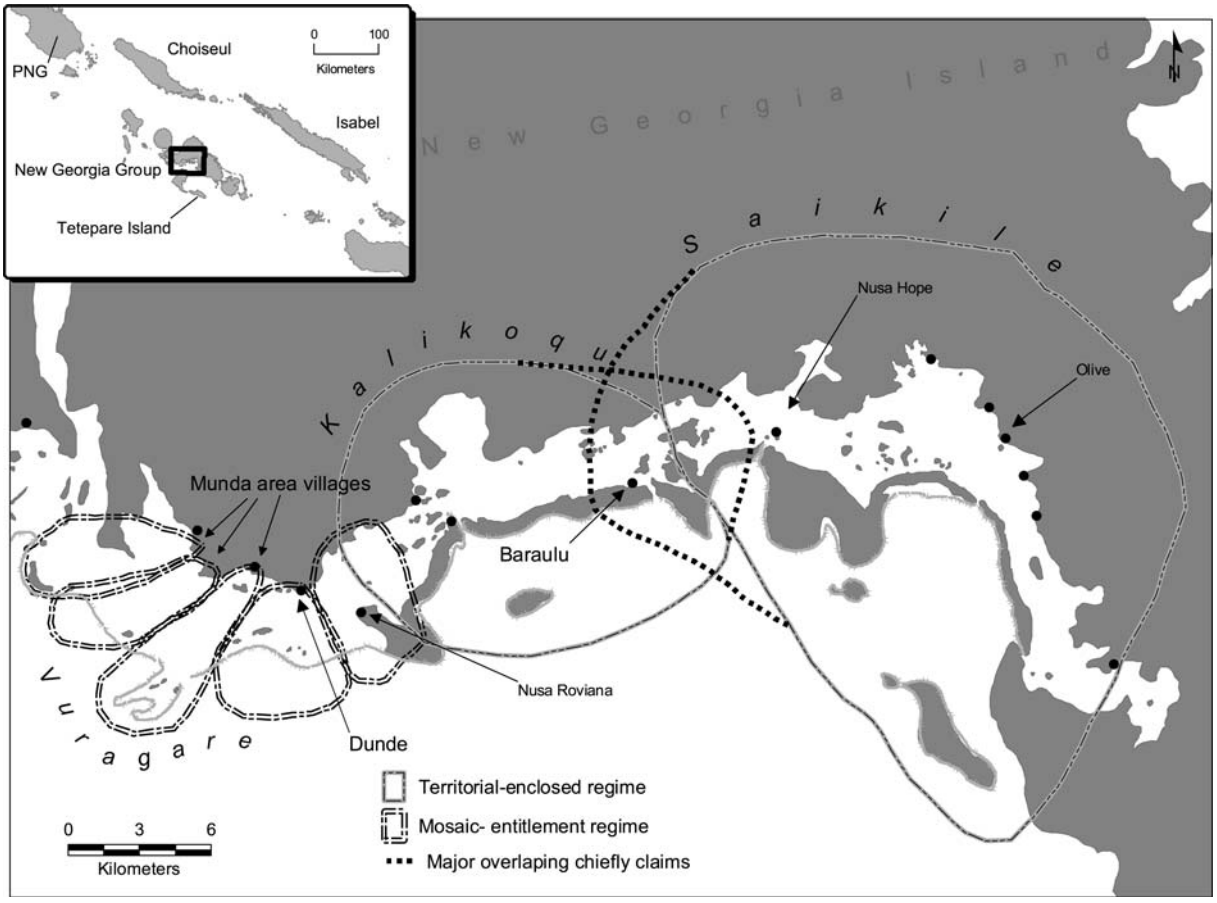

Figure 3. Customary sea tenure regimes in the Roviana Lagoon.

holders are discussed at length elsewhere (see Aswani, 1999, 2000; Aswani and Sheppard, 2003).

Cultural consensus

How did respondents cognize CST? The average estimate levels of CST knowledge for informants in Baraulu (Kalikoqu) and Dunde (Munda Area) and the corresponding eigenvalues are shown in Table 2. The eigenvalues (or *latent roots*) are the sum of squared loadings for a factor and indicate the amount of variation that every case has with that factor. Only one eigenvalue must be large in proportion to the remaining ones for the assumption of a consistent structure within a matrix to be valid. Results for both villages show very high ratios of first-factor eigenvalues to those of second factors. That is, informants, regardless of age, sex, education, etc., were using a single cognized model to answer the survey questions. Cultural consensus regarding the domain of ''property rights'' is represented graphically in Figure 4. To broaden the analysis, multi-dimensional scaling was used to identify some of the characteristics of the underlying cognized model, and, further, to gauge whether discrepancies existed between the mental maps of the Baraulu and Dunde communities.

The non-metric multi-dimensional scaling (MDS) for all respondents shows several noticeable clusters that represent terms that were most often associated with one another (Figure 5). In the right quadrants there are three distinct clusters:

Table 2. Consensus analysis results for Baraulu and Dunde (Aswani and Herman, unpublished data)

Village	Estimated level of knowledge	Estimated knowledge SD	Eigenvalues Factor 1	Eigenvalues Factor 2	Ratio of Factors 1 to 2
Baraulu ($n=30$)	0.735	0.176	17.139	2.706	6.334
Dunde ($n=30$)	0.784	0.210	19.740	1.330	14.839
Combined ($n=60$)	0.790	0.174	39.280	2.775	14.154

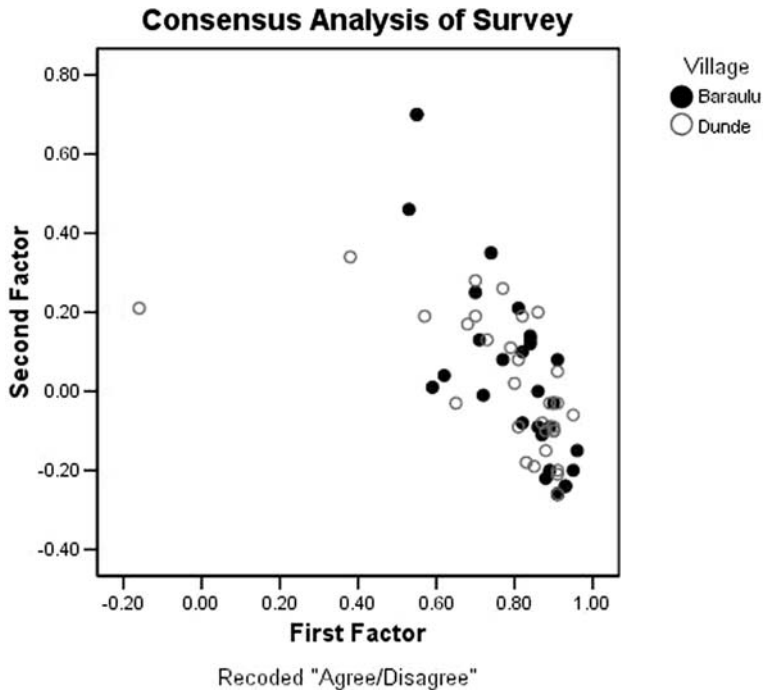

Figure 4. Consensus analysis for Baraulu (Kalikoqu) and Dunde (Munda) (combined).

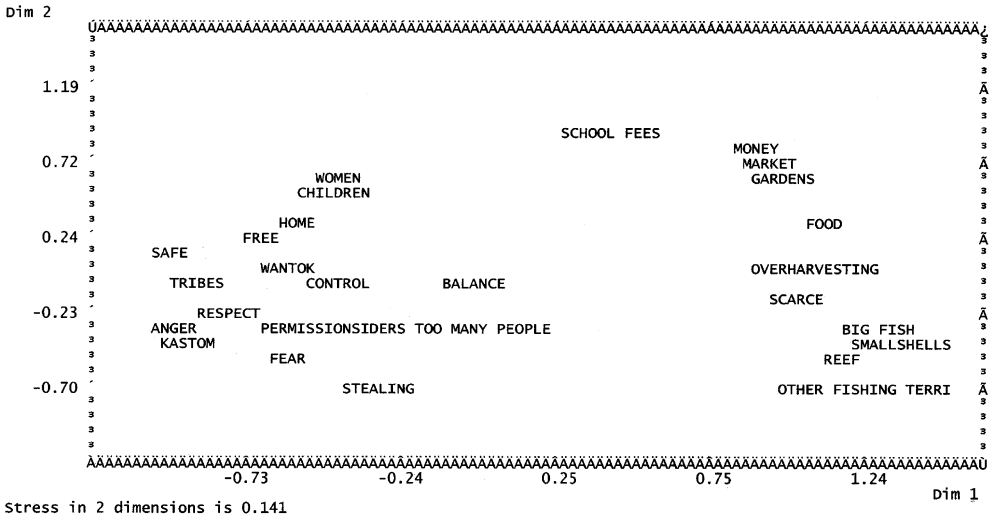

Figure 5. Multi-dimensional scaling for both villages (stress for the scaling was an acceptable 0.141). Note that the misspelled words and hidden terms result from term-clustering during data analysis

(1) "big fish – small fish – shells – reef – other fishing territory," (2) "food – over-harvesting – scarce," and (3) "school fees – money – market – gardens." To the left, the clusters are not as clear, but apparently fall into two groups: (1) "home – women – free – wantok, etc." (upper cluster), and (2) "anger – fear – stealing – permission – outsiders, etc." (lower cluster). The left cluster represented individuals with whom or conditions within which respondents feel comfortable – their immediate social world, feelings, people, etc. In contrast, the right cluster represented things that are beyond individual interactions or that are cognized as being distant, abstract, economical, or spatial. This axis basically marks a progression from the *intimate* to the *alien*. The MDS also reveals a second "upper-lower" dimension, or proceeding from that which is *benevolent* (upper extremity) to that which is *malevolent* (lower extremity). Terms such as "women," "children," and "home," were clustered with "safe," "free," "tribes," and "control," and "too many people" was associated with "fear" and "stealing" (Aswani and Herman, unpublished data).

So, how does this cultural model reveal differences in cognition between the people of Dunde and the inhabitants of Baraulu, if any? Multi-dimensional scaling was conducted separately for both villages to identify whether respondents plotted key terms differently. The dominant clusters were similar as those in the combined sample except for one key difference (Figures 6 and 7). In Baraulu, respondents clustered "too many people" with the *intimate* extremity, associating this term with "women," "children," "kastom," and "tribes." In contrast, Dunde respondents clustered "too many people" with the opposite *alien* extremity and associated the term with "small fish," "other fishing territory," and "over-harvesting." While the combined consensus and multi-dimensional scaling analysis suggested a high degree of shared knowledge for the domain of CST, the disaggregated data thus point to a difference for the categorization of "over-harvesting" and "too many people" by members of these communities (Aswani and Herman, unpublished data). This is a revealing and meaningful divergence and one that is important to understanding the mental processes (i.e., cultural consensus) that inform, among other factors, people's current governance and management decisions in these two communities.

Enforcement of access

Do these divergences in cultural consensus translate into cultural attitudes and actual social behavior? Results show that the two communities significantly differed in their opinions regarding "outsiders" entering their waters for food, with 62% of Baraulu respondents being tolerant of interloping compared with 28% in Dunde, $F(1,87) = 11.7$, $p < 0.001$. Baraulu and Dunde also

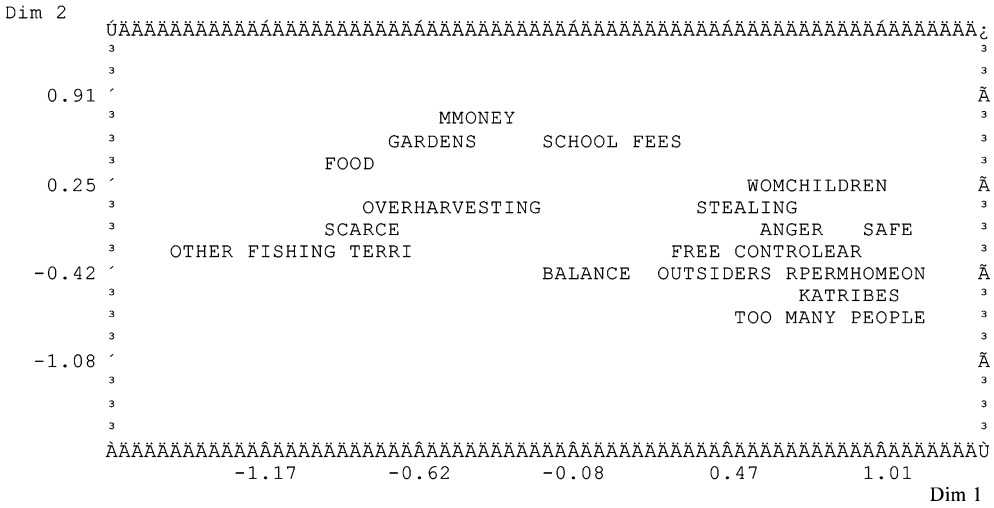

Figure 6. Multi-dimensional scaling for Baraulu Village (stress for the scaling was an acceptable 0.127). Note that misspelled words and hidden terms result from term clustering during data analysis.

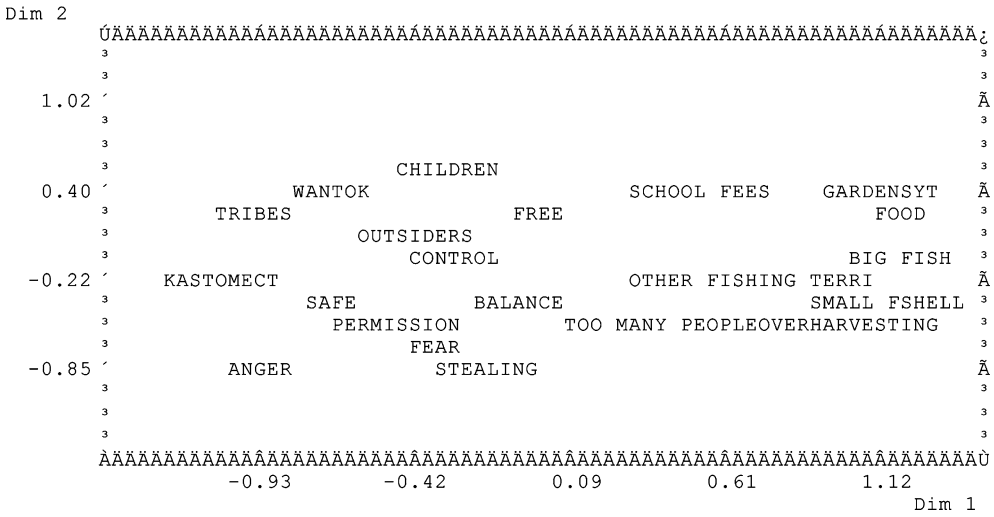

Figure 7. Multi-dimensional scaling for Dunde Village (stress for the scaling was an acceptable 0.136). Note that misspelled words and hidden terms result from term clustering during data analysis.

differed in their attitudes toward the interloping activities of outsiders for income, with 36% of Baraulu respondents tolerant compared with 17% in Dunde, $F(1, 87) = 4.1$, $p < 0.05$. Note that the proportion of altruistic Baraulu residents is still relatively small (36% of respondents) (Table 3). Most Dunde inhabitants had apprehension toward "outsiders," whether they were foraging for personal food or for income. The cultural attitudes of the Dunde respondents correspond with the MDS analysis, which shows that Dunde people tend to associate "too many people" with the alien and malevolent domain, and because of these beliefs, the Dunde residents are adverse to the appearance of outsiders. Note that there were no significant differences between the villages' views of neighbors fishing for food ($F(1,87) = 2.0$, $p = 0.16$) or income ($F(1,87) < 0.1$, $p = 0.87$). Tolerance for neighbor interloping, as we shall see, emanates from very different historical and contemporary processes.

Baraulu and Dunde differed significantly in their approaches to governance. Baraulu respondents overwhelmingly (95%) trust their traditional

leaders to control marine resource use and access, which is significantly more than Dunde respondents do, $F(1,83) = 15.1$, $p < 0.001$. Still, a majority of Dunde inhabitants (62%) trusted their leader's management abilities (Table 4). There was no significant difference between Baraulu and Dunde in their trust of the Provincial Government's ability to regulate marine resource use and access, $F(1,83) < 0.1$, $p = 0.98$. A majority of respondents in both villages accepted governmental intervention in managing marine resources. It is possible that the trust of Baraulu in traditional leaders and the erosion of chiefly respect in Dunde may impact how resources are used and managed.

Harvest yields

Do divergences in institutional strategies translate into differences in harvest yields between communities? Baraulu fishers averaged a significantly higher intake rate than Dunde fishers, $F(1, 2804) = 14.6$, $p < 0.0001$. However, this difference was no longer evident when habitat was removed by nested-factors ANOVA ($F(1, 15.3) = 1.3$, $p = 0.27$) or by 2-factor ANOVA ($F(1, 2786) = 0.4$, $p = 0.54$), and there was no village × habitat interaction for intake ($F(7, 2786) = 0.8$, $p = 0.61$). These findings are consistent with no difference in intake between villages when habitat was included in the analysis. This may be due to the fact that both communities exploit habitats with differential intensity, albeit with the same fishing methods. It is of major significance that the Baraulu fishers spent roughly one-third less time per fishing event than did the Dunde fishers, $F(1, 2804) = 99.9$, $p \ll 0.000001$. This difference remained significant when habitat was removed by nested-factors ANOVA ($F(1, 11.8) = 7.9$, $p < 0.02$) or by 2-factor ANOVA ($F(1, 2786) = 20.2$, $p < 0.000001$). These findings are consistent with an inter-village difference favoring Baraulu in fishing efficiency that is not accounted for by habitat. Further, there was a significant village×habitat interaction in time ($F(7, 2786) = 5.2$, $p < 0.00001$), further supporting an inter-village difference in efficiency (see summaries in Tables 5 and 6). These results may be employed as proxy measures for gauging the environmental outcomes and consequences of different management responses.

Discussion

Researchers have advocated for studying traditional rights-based fishery management systems across the world so that these may be adapted to modern fisheries management (e.g., Johannes, 1978; Pollnac, 1984; Ruddle, 1988; Pinkerton, 1989; Ostrom, 1990; Acheson and Wilson, 1996). Here, I have similarly argued that by discerning the effectiveness of local governance institutions at

Table 3. Cultural attitudes (in 2003) of Baraulu (Kalikoqu) ($n = 42$) and Dunde (Munda area) ($n = 47$) adults (18 and older) regarding interloping activities of outsiders and neighboring groups (in rounded percentages)

Access objectives	Baraulu (Kalikoqu)	Dunde (Munda Area)
Accept outsiders (non-Roviana) for food	62	28
Accept outsiders (non-Roviana) for income	38	17
Neighbors (Roviana) for food	88	77
Neighbors (Roviana) for income	64	66

Table 4. Cultural attitudes of Baraulu (Kalikoqu) ($n = 40$) and Dunde (Munda area) ($n = 45$) adults (18 and older) regarding concerning best ways for marine resource management

Governance strategy	Baraulu (Kalikoqu)	Dunde (Munda Area)
Chiefs can control resource use and access	95	62
Chiefs cannot control resource use and access	5	38
The Provincial Government can control resource use and access	63	62
The Provincial Government can control resource use and access	37	38

Table 5. Mean net return rate per fishing event for habitat types in Baraulu and Dunde (in kilocalories per minute of foraging)

Habitats	Baraulu			Dunde/NR area[a]			Lagoon totals		
	Mean	SD	*n*	Mean	SD	*n*	Mean	SD	*n*
Mangroves	39.5	72.3	36	0.32	–	1	38.5	71.6	37
Grass beds	82.8	180.2	146	40.1	25.30	5	86.5	191.9	216
Inner lagoon shallow reefs	24.2	48.4	826	2.7	28.84	134	29.1	50.1	1473
Inner deep lagoon reefs	18.3	40.7	318	10.8	15.17	15	22.2	40.2	408
Lagoon passages	27.3	73.6	659	–	–	–	32.2	69.7	1001
Outer lagoon reef drop	21.8	47.2	216	23	34.09	63	27.3	60.2	429
Outer lagoon reef flat	–	–	–	11.1	149.04	183	12.4	141.7	203
Sand banks	–	–	–	8.2	13.31	2	31.2	51.8	10
Open sea	76.5	130.6	140	85.9	178.0	22	80	137.6	167
River mouth	17.1	19.6	10	–	–	–	27.9	56.8	17
Outer lagoon intertidal pool	95.7	93.1	6	–	–	–	75	82.2	9
Outer lagoon island	33.9	44.6	24	–	–	–	45.4	45.2	49
Total	31.2	78.6	2381	14.4	109.0	425	33.7	82.7	4019

[a]Dunde and Nusa Roviana share the same fishing grounds and their habitats are continuous. Therefore, mean net return rates per fishing event measures shows data from fishing diaries and focal follows collected for both communities.

Table 6. Mean time allocation per fishing event for each habitat type in Baraulu and Dunde (in minutes per patch visit)

Habitats	Baraulu			Dunde/NR area[a]			Lagoon totals		
	Mean	SD	*n*	Mean	SD	*n*	Mean	SD	*n*
Mangroves	65.6	45.4	36	126	–	1	67.2	45.8	37
Grass beds	63.6	52.7	146	59.2	53.6	5	59	53.1	216
Inner lagoon reefs	58.8	48.9	826	93.4	69.3	134	67.7	57.9	1473
Deep lagoon reefs	60.1	43.9	318	104.7	98.2	15	71.4	65.7	408
Lagoon passages	98.2	82.3	659	–	–	–	95.2	81.5	1001
Outer lagoon reef drop	96.3	73.9	216	173.2	139.3	63	103.5	88.4	429
Outer lagoon flat reef	–	–	–	102	60.4	183	101.2	61.6	203
Sand banks	–	–	–	45.5	7.8	2	62.4	40.8	10
Open sea	41.3	34.9	140	82.1	78.6	22	44.5	36.6	167
River mouth	53.8	32.8	10	–	–	–	76.5	61.3	17
Outer lagoon intertidal pool	69	29.7	6	–	–	–	85.1	75.6	9
Outer lagoon island	60.5	28.7	24	–	–	–	88.9	73.4	49
Total	72.7	64.2	2381	108.4	85.8	425	79.3	70.3	4019

[a]Dunde and Nusa Roviana share the same fishing grounds and their habitats are continuous. Therefore, the mean time per fishing event measures shows data from fishing diaries and focal forays collected for both communities.

regulating resource use and access – taking into consideration that these are embedded in particular historical and political contexts – we can better predict whether or not a CST system can adapt to contemporary transformations successfully and whether or not it can be hybridized effectively with ITQs or CDQs, and other government regulations (Pinkerton, 1989; Castilla and Defeo, 2001; Leiva and Castilla, 2002). Given the contemporary economic and social climate of rapid, and often rapacious, inshore fishery development, CST systems cannot be just ignored and, even if institutionally recognized, be left alone. Innovative approaches to fisheries management will be required as traditional systems become increasingly pressured by internal (e.g., population growth) and external (e.g., economic development) forces. For example, the people of Aitutaki in the

Cook Islands successfully incorporated the New Zealand ITQ system with their existing community-based CST system to regulate their Trochus fishery in the late 80s. Adams (1998: 131–32) notes that the hybrid ITQ and CST system has alleviated the pulse-fisheries problems caused by the earlier TAC system, distributed benefits across the community more equitably, and created "a very flexible framework for co-management." The system works because it has been adapted to follow local forms of management, fishery control rests in the hands of the Aitutaki Island Council, and cultural homogeneity has reduced the transaction costs of establishing and keeping management agreements.

Indeed, the Aitutaki case shows how Pacific Island CST and modern rights-based management systems might be combined successfully. Prior to such hybridization, however, we need to come to an understanding of how, when, where, and why local systems work (or do not work). Only then we can design hybrid institutions that adapt ITQ/CDQs and/or MPAs with CST in an effective and equitable manner (e.g., reserving ownership rights to Trochus or bêche-de-mer ITQs for certain disadvantaged indigenous communities, which may have less powerful sea tenure rights than other regional groups). We may also discern the institutional circumstances in which such integration is unnecessary or even precarious (e.g., pushing ITQ/CDQs in sea tenured areas in which entitlement holders cannot prevent interloping and resource over-exploitation). Or simply, we may recognize, that there are conditions in which such integration is unsuitable altogether (e.g., instituting ITQs for regulating small-scale commercial tropical multispecies fisheries, which lack scientific data on stock status and on landings (Allison, 2001; Adams et al., 1997)).

So, what does the Roviana case explain? Broadly, it demonstrates that institutional outcomes of sea tenure regimes are contingent upon a community's social organization. More explicitly, the case study indicates that the distribution of stakeholders in relation to their marine holdings appears to affect people's (1) cognition of CST, (2) corresponding cultural attitudes with regard to interloping by outsiders and neighbors, (3) views regarding the role of traditional and state governance in fisheries management, and (4) fishing strategies and their concomitant environmental impacts. Of course, there other variables that influence human territorial behavior, including the spatial predictability of resources and the cost-benefit ratio of territorial behavior, among other factors (Dyson-Hudson and Smith, 1978; Acheson and Gardner, 2004). In addition, it is difficult to ascertain a one-to-one relationship between divergent settlement patterns and current social, economic, and environmental outcomes. The data, however, suggest that spatial patterns of settlement across various territorial estates plays an important role in the development of territorial behavior because the payoffs of territoriality are contingent upon people's capacity to organize and cooperate, which, in turn, is enhanced or arrested depending upon the location of their residence vis-à-vis their property.

It follows that if most entitlement holders live next to their marine estates tenurial certainty increases, which in turn results in better governance and management. The inverse is also true. This state of affairs occurs between the Kalikoqu (e.g., Baraulu) and Saikile polities and those of Dunde and the rest of the Munda area. Tenurial differences give most inhabitants of the former groups exclusive rights over their respective estates while concurrently giving them powerful rights over those of the latter groups. Conversely, Dunde inhabitants (except for some prominent families), lack sufficient kin ties to Kalikoqu and Saikile estates to claim rights there, and, therefore, they must protect their own territories from Kalikoqu and Saikile territorial demands, particularly as prospects for future commercial fishing, logging, and tourism development increase in the Munda area.

Does tenurial uncertainty caused by the variegated distribution of sea stakeholders translate into cognition differences in CST? The disaggregated MDS graphs for Baraulu and Dunde suggests that it does. Differences in the MDS are significant for two reasons. First, given that Dunde has been in contact with Europeans and other Solomon Islanders for over 150 years, they are more prone to be concerned with interloping from foreign groups. In fact, resource competition is not perceived as being within the community as much as being between *alien* communities (i.e., migrant groups, other tribes, and "outsiders"). Second, the

close association between "over-harvesting" and "too many people" may represent a greater concern for population pressures, over-harvesting, and other human threats to Dunde fishing areas (Aswani and Herman, unpublished data). This is corroborated by the qualitative surveys, which indicate a higher degree of anxiety for interloping by outsiders and less credence in traditional institutions vis-à-vis those found in Baraulu. The latter are concerned with "too many people" within the *intimate* domain and seem to feel that expanding social networks is a positive development.

These cognitive frames help individuals to interpret and understand the world around them and to translate beliefs into behaviors. Survey results show that a greater proportion of Baraulu people than Dunde people are tolerant toward interloping by outsiders (i.e., non-Roviana residents). At first glance, this result defies expectations, given that neighboring communities such as Olive in nearby Saikile (which are institutionally and culturally similar to Baraulu) (see Aswani, 2002) are more territorial and adamant in their opposition to interloping by either outsiders or neighboring kin. If we consider certain historical and economic contingencies, however, Baraulu's apparent tolerance and Dunde's disdain for interloping (especially by non-Roviana people) is better understood. Baraulu and its adjoining land and sea territory lie at the intersection between the Kalikoqu and Saikile chieftain districts (Figure 3). Half of the village pledges its alliance to the chief of Saikile and the other half to the chief of Kalikoqu, though most inhabitants have rights to both districts (Table 1). Both chiefs vie for control of this area, yet their claims are only nominal, and formal jurisdiction over adjacent waters falls under the control of Baraulu elders (Aswani and Weiant, 2004). Although neighboring Kalikoqu and Saikile villages have rights over Baraulu waters, they have no interest in fishing here. Baraulu residents, on the contrary, do often forage in neighboring reefs because they too have dual rights of access. It is, therefore, in their best interest to tolerate movement across boundaries (which neither outsiders nor neighbors do anyway) to avoid having their neighbors close their grounds to them. This explains why Baraulu residents are more tolerant than the neighboring Kalikoqu and Saikile. Also, villages in Saikile (Olive, Ha'apai, and Nusa Hope) (Figure 2) rely upon a shell called *bangapodu* (*Nassarius camelus*) for receiving income and, as a result, have established stringent controls to keep interlopers out from their reefs. This shell and other marketable marine products are not as abundant in Baraulu waters, thus giving Baraulu people less incentives to protect their resources than their Saikile neighbors. However, this does not mean that Baraulu residents are not territorial, for they keep interloping by outsiders to a minimum and cautiously discourage neighbors from accessing their marine resources.

Dunde respondents, by contrast, are theoretically intolerant of outsiders, which suggest that they exercise their territorial rights to keep interlopers out. In effect, however, Dunde residents cannot bar outsiders (many of whom live in a nearby township and various settlements) from entering its waters because of lack of organization and cooperation. This situation is not too different when it comes to neighboring groups. Whereas Baraulu nominally allows neighbors to access its waters for food and income for tactical reasons, Dunde residents have no other choice but to acquiesce. Entitlement holders to Dunde waters live scattered throughout the region, including in nearby Rendova Island, and, as a result, neighboring communities have access rights to Dunde reefs (particularly those located in *Vuragare*) (Figure 3). Results also show that chiefly authority in Dunde is eroding – which, consequently, inhibits possibilities for organizing manpower for defensive and offensive purposes. These situations correspond with those of neighboring Nusa Roviana, whose members also disdain outsiders, allow neighbors in due to lack of territorial mechanisms, and are increasingly losing faith in their traditional chiefs (Aswani, 2002). In short, Dunde cannot translate governance into actual management because of the erosion of indigenous social and political institutions caused by conflict over natural resources between Dunde people, outsiders, and neighboring groups with overlapping rights. This institutional erosion is aggravated by the fact that Dunde is more culturally heterogeneous than Baraulu, a circumstance that has resulted from its missionization history, European colonial policies, the effect of WWII, and intermarriage with foreigners. The Dunde people's

opening to the outside world has predictably increased their fear of outsiders, while simultaneously neutralizing their capacity to manage their resources autonomously.

The spatial distribution of entitlement holders, then, establishes whether transaction costs can be reduced and collective action problems can be solved by traditional authorities or if outside intervention is required. Generally, close-knit communities of people who share linguistic, cultural, social, and consanguine affinities and live adjacent to their property (e.g., Baraulu) can reduce negotiation, monitoring, and enforcement costs more effectively than communities whose entitlement holders are geographically dispersed from their holdings (e.g., Dunde). As the latter integrate with other communities (non-Roviana), their entitlement ties to regional marine estates become increasingly diffuse. In sum, insofar as settlement patterns are concerned, it can be argued that if a majority of owners live adjacent to their marine property, the jurisdictional tendency is for territorial boundaries to be circumscribed, for local political powers over estates to be centralized in chiefs, and for sea entitlements to be regionally recognized and uncontested (called the *territorial-enclosed entitlement regime*). If most entitlement holders live away from their marine holdings, the jurisdictional propensity is for territorial boundaries to be porous, for jurisdictional controls over estates to be decentralized, and for sea tenure entitlements to be contested by different regional groups (called the *mosaic-entitlement regime*) (Figure 3) (Aswani, 1999, 2002).

Finally, we must ask whether the different management responses between the illustrated CST systems result in divergent environmental outcomes. The analysis shows that there is a significant difference between Baraulu and Dunde in yields and, particularly, in fishing effort. Dunde inhabitants receive a somewhat lower net return rate per fishing event and spend significantly longer fishing time per bout. Differences in return rates can be explained by the fact that the two communities may be exploiting different habitats with more intensity. Differences in time allocation per fishing event (using the same fishing methods), however, suggest that the Baraulu people are catching an equal or greater amount of fish than the Dunde people, and in less time. It is possible that fishing returns are low and effort high in the Dunde and the Munda area in general, owing to widespread cross-boundary interloping on each other's territories for subsistence and commercial fishing. Undoubtedly, a number of other factors can affect resource abundance besides harvest controls (e.g., fish recruitment), and rarely is there a one-to-one relationship between resource abundance and harvest yields. However, given the institutional differences between Baraulu and Dunde, it is not far-fetched to hypothesize that yield and effort differences between villages not only show differences in territorial size, population density, and environmental variance, but possibly show the efficacy of each community's resource use and access rules.

CST as rights-based fishery management: theory into action

Seen from the surface, the Roviana peoples have similar hereditary property rights and systems of CST governance and management. However, to incorporate CST in any form of co-management (i.e., sharing the responsibility of fisheries management between the government and/or NGOs and local communities, whereby stock management is vested directly on the community and the government provides the unit of coercion necessary for compliance), it is necessary to distinguish between CST systems in terms of people's capacity to institute regulatory mechanisms. We have used the analysis of CST to establish a network of marine protected areas in the Roviana and Vonavona Lagoons. The biological rationale for designing the MPA network was to (1) protect vulnerable species and habitats (i.e., biodiversity and ecosystem function), (2) protect susceptible life history stages (i.e. spawning and nursery grounds), and (3) to enhance fisheries productivity in the region. Yet, the biological design could not be applied unless the social and tenurial landscape was first mapped and understood (see also Christy et al., 2003; Mascia, 2003). In this case, building upon CST was not only advantageous but the only possible way to implement marine protected areas (MPAs) in this region effectively. That is, it was futile to implement a management regime in an area, no matter how rich in marine biodiversity, if exclusion of non-members and harvest restriction rules could

not be enforced locally. Note that the absence of any binding and enforceable legislative or regulatory tools in the Solomon Islands necessitates the use of sea tenure as a framework for establishing any form of inshore fisheries regulations. Therefore, mapping forms of sea tenure (i.e., secure versus insecure tenure) was crucial for determining which sites were more appropriate for accommodating MPAs (see Aswani and Hamilton, 2004b for further discussion).

Conclusion

Does CST in Roviana – and we can extend the same question for Oceania at large tentatively – work in terms of environmental sustainability, social equity, and institutional endurance? While the Roviana research does not answer this question entirely, it alerts us to the complexities of local rights-based fishery management systems and to the fact that their managerial outcomes are context dependent. The case study shows that divergent historical paths have shaped CST systems into diverse, wide-ranging, and dynamic institutions. It also shows that, even at small geographical scales, historical settlement patterns of inclusive stakeholders, among other socioeconomic variables, can influence the capacity of actors to implement cooperation and enforcement mechanisms. These results, when paired with prior research in the Roviana region (Aswani, 2002; Aswani and Hamilton, 2004a) show a gradient of territorial strategies across an east-west axis that are clearly conditioned by diverging cultural and historical contingencies.

The first lesson for fishery policy makers is to pay heed to existing rights-based fishery management systems before assuming that contemporary processes have erased all forms of local control. Certainly, there are many cases in which government intervention, commercialization, modernization, and globalization have removed any trace of local control over fisheries irreversibly. Yet, many coastal communities across the northern and southern hemisphere still retain endogenous forms of governance and management. By integrating local tenure systems (not replacing them) with government initiatives such as ITQs or CDQs, policy makers can design and implement hybrid rights-based fishery management regimes that are more successful and just. That is, policies that genuinely allow communities to reap fishery benefits and maintain a measure of self-governance and management responsibilities, while balancing fishing rights across neighboring communities.

Second, managers need to conceptualize the various conditions that encourage social actors to develop cooperation and enforcement mechanisms. Doing so can teach us much about a community's governance structure and the capacity to translate governance into action for self-managing marine resources in a modern fisheries context. In the Solomons case, it was the geographical distribution of stakeholders in relation to their estates, among other factors, that determined whether or not management could be implemented successfully. Mapping the social seascape is relevant not only for Oceania but also for coastal communities, such as those in Nova Scotia, Alaska, and Maine, that have some form of informal or formal territorial rights-based fishery management system of their own (e.g., Berkes, 1985; Acheson, 2003; Wagner and Davis, 2004). In sum, knowing something about a community's operational principles of governance and management (and the social, economic, political, and historical conditions that allow their deployment) can help us to predict whether a community is more or less likely to accept a management prescription (e.g., ITQs) and whether it can integrate an introduced "rights-based" fishery prescription with its existing template for assigning use and access to resources. Naturally, there are cases in which such combination may not be necessary or even desirable at all.

In conclusion, CST shares some basic attributes with modern rights-based fishery management. Both are responses to problems related to the allocation and geographical distribution of, and the competition for, common-pool resources in coastal marine environments (Bromley, 1992). These fundamental similarities open fertile ground for their hybridization. Some critics might be hard pressed to the see the actual value of understanding CST for modern rights-based management in industrial fisheries. If anything, they should understand that the social and cultural backdrop against which a management prescription is to be

implemented (particularly when dealing with coastal fishing communities) is not just a secondary research and policy priority. It is a determinant factor and a necessity for assuring that the same stakeholders who are going to have to accept or reject a management plan are suitably researched and that their opinions, territorial claims, conflicts, and conflict resolution mechanisms are well understood. The case study presented in this paper shows that quite often local permutations not only are instigated by outside influences but also are outgrowths of local socio-cultural and historically embedded practices. Thus, not only do we need to conduct Social Impact Assessments (SIAs) following the implementation of ITQs and/or other command-and-control measures, but we also need to study the community's characteristics *prior* to the application of fisheries management. Social scientists have spent decades advocating the use of social science research in designing fisheries policies. Social science, it should be noted, encompasses not only "policy" (as "social science" is commonly understood by fishery scientists) but also, among other subfields, human ecology, or the study of human–environmental interactions at various spatial and temporal scales. Given the long history of failed fishery management, it is now of vital importance to design innovative fishery management prescriptions that integrate natural and social science research more comprehensively.

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