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Review

Integrating customary management into marine conservation

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ABSTRACT

In many parts of the world, there is increasing interest among scientists, managers, and communities in merging long-enduring customary practices such as taboos that limit resource use with contemporary resource management initiatives. Here, we synthesize the literature on the customary management of coral reefs emerging from diverse disciplines including anthropology, common property economics, and ecology. First, we review various customary management strategies and draw parallels with Western fisheries management. Secondly, we examine customary resource management and conservation. We argue that, while resource conservation often appears to be an unintended by-product of other social processes, customary management can, in fact, conserve marine resources. In the third section, we examine the resilience of customary management institutions to socioeconomic transformations. We suggest that in conditions of high population and commercialization of marine resources, property rights may become strengthened but arrangements that rely on self-restraint become weakened. Finally, we examine the commensurability of customary management and conservation. We emphasize that practical and conceptual differences exist between customary management and contemporary conservation which have often led to failed attempts to hybridize these systems. However, when these differences are understood and acknowledged there exists a potential to develop adaptive management systems that are: (1) highly flexible; (2) able to conserve resources, and; (3) able to meet community goals. In each section, we provide research priorities. We conclude by developing six key features of successful hybrid management systems.

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1. Introduction

Early observers in the Pacific recorded the widespread presence of customary practices and taboos that limited access to marine resources (Somerville, 1897; Malinowski, 1922, 1935). These customary practices result in closed seasons and areas, limited entry, and gear restrictions that appear analogous to what Western fisheries managers attempt to achieve (Johannes, 1978; Colding and Folke, 2000a). Resource managers, conservation groups, anthropologists, and marine biologists have advocated using these “customary management” systems as a basis for modern marine resource conservation because of the perceived failure of Western command-and-control fishery management prescriptions (e.g. Rosenberg et al., 2006) and, more recently, the lack of success in implementing marine protected areas (MPAs) in many developing countries, (Johannes, 1978, 1981; Johannes, 2002a,b; Pollnac, 1984; Chapman, 1985, 1987; Neitschmann, 1985; Ruddle, 1988a,b; Cordell, 1989; Asafu-Adjaye, 2000; Aswani, 2005). Some authors suggest that conservation strategies that consider indigenous ecological knowledge, management practices, and customary sea tenure institutions have a higher rate of local acceptance and, consequently, greater conservation value (Ruddle, 1998; Johannes, 2002a; McClanahan et al., 2006; Aswani et al., in press).

A substantial body of research has described customary systems and highlighted aspects of their potential role in modern marine resource management (e.g., Adams, 1998; Johannes, 1998; Ruddle, 1994a, 1996; Ruddle, 1998; Cooke et al., 2000; Acheson and Gardener, 2004). However, there are still significant practical and theoretical barriers to incorporating customary management into contemporary marine resource conservation. Researchers from anthropology, conservation biology, economics, geography, political science, sociology and other disciplines have used empirical and theoretical research to question whether: (1) customary systems can actually conserve resources; (2) whether they will be resilient in the face of social, economic, and cultural changes, and; (3) whether there is sufficient congruence between Western and customary practices to effectively amalgamate the two systems into governance institutions capable of dealing with the scale and intensity of modern threats to marine resources. However, few attempts have been made to synthesize this research and develop comprehensive research and

applied agendas for integrating customary management of marine resources into a conservation context (although see Colding and Folke, 2000a for a global review of marine and terrestrial taboos).

Our objectives for this paper are to: (1) synthesize the multi-disciplinary research on customary marine resource management; (2) outline ways in which customary management can be effectively integrated into a contemporary conservation context, and; (3) provide strategic direction for future research in the field. In the first section, we review the different types of customary marine resource management and their parallels with Western fisheries management. In the second section, we examine customary resource management and conservation. In the third section, we examine the resilience of customary management institutions to socioeconomic transformations. Finally, we examine the commensurability of customary and modern fisheries management systems. In each section, we provide research priorities. We conclude by developing six key features of successful hybrid management systems.

2. Customary management

We define customary management as local practices that are designed to regulate the use, access, and transfer of resources. Customary management practices, which have been crafted through generations of human interaction with the environment, are informed by indigenous ecological knowledge and are culturally embedded in customary land and sea tenure institutions. Customary management is a dynamic system that continually evolves through adaptive processes, including the introduction, loss, invention, and syncretization of knowledge (Berkes and Folke, 1998).

Descriptions of customary management of marine resources are widespread throughout the resource management literature (e.g. Johannes, 1981; Polunin, 1984; Chapman, 1985; Ruddle and Johannes, 1985a,b; Wright, 1985; Zann, 1985; McCay and Acheson, 1987; Ruddle et al., 1992; Hunt, 1997; Hickey, 2006) as well as the anthropological literature (e.g. Hviding, 1989a, 1996; Hooper, 1985; Neitschmann, 1985; Zann, 1985; Carrier, 1987; Anderson, 1994; Peterson and Rigsby, 1998). These descriptions generally suggest that customary management practices employ techniques similar to those of modern fisheries managers (Johannes, 1981; Berkes et al., 2000), which include limiting

Table 1 – Summary of customary management measures

Types of customary management	Description	Analog in modern fisheries management techniques	Differences to modern fisheries management	Examples
Spatial	Areas closed to fishing. These can be temporary (i.e. closed for several months to provide supplies of fish for a feast) or permanent (where spirits reside)	Marine protected areas, temporary fisheries closures	Often temporary and almost always harvested. Maybe reactive to events (e.g. death in village, declining catch)	Polunin (1984) and McClanahan et al. (1997)
Temporal	Restricting fishing/harvesting activities during specific days, week, months, etc. Often short in duration (e.g. Sabbath), species-specific (e.g. trochus), and around a specified event (e.g. spawning aggregation)	Closed seasons	Dates may be highly flexible and reactive to events (e.g. price fluctuations for commercial species, spawning aggregations) rather than set dates.	Johannes (1978) and Thornburn (2001)
Gear	Prohibiting/restricting certain harvesting technologies or techniques	Gear prohibitions	Maybe inherited rights to use certain gears. Often exclude non-owners	Johannes (1991) and Cinner et al. (2005)
Effort	Limiting who can harvest certain species, use certain gears, fish certain areas, etc.	Permitting	Often based on initiation rights, lineage, class, or gender	Mantjoro (1996) and Veitayaki (2002)
Species	Prohibiting the consumption of certain species. Often lineage-related dietary restrictions.	Species-specific bans	Often the species may be caught or killed, but not eaten.	Carrier (1987) and Hickey (2006)
Catch	Restricting the quantity of a harvest. Often social norms that stress the avoidance of waste. Very rare.	Total allowable catch, quotas	Quotas not set <i>a priori</i>	Johannes (1981) and Tuelieres (1992)

at least one of the following six factors: (1) spatial areas; (2) time; (3) gear or harvesting technology; (4) effort (through the number of participants); (5) types of species that can be harvested, and; (6) the number of fishes harvested (e.g. through quotas) (Table 1). In many instances, a particular strategy will limit more than one of these factors. For example, temporary closures restrict both space and time. While size restrictions play an important role in Western fisheries management, they are not a widely documented restriction throughout the rest of the world (Colding and Folke, 2000a).

2.1. Spatial restrictions

There are numerous documentations of customary closed areas throughout the Pacific. In contrast to modern marine reserves, which permanently close off fishing grounds to extractive use, almost all customary closures are temporary. In Papua New Guinea (PNG), the Solomon Islands, Vanuatu, and Fiji, there are examples of temporary reef closures before religious ceremonies (Polunin, 1984), to replenish supplies of fish and invertebrate species (Hviding, 1989a; Aswani and Weiant, 2004; Hickey, 2006), following the death

of a landowner or village chief (Wright, 1985; Hickey 2006; Macintyre and Foale, 2007), and after a marriage or birth (Ravuvu, 1983). Customary closures are often implemented for short periods (several weeks to 12 months—although in some cases they can last for years), and a concentrated effort of a family, clan, or the wider community may be applied to harvest the closed area after it is opened again (Wright, 1985; Foale and Macintyre, 2000; Cinner et al., 2005b). Customary closures include “fallow” rotation of fishing areas (Neitschmann, 1985; Colding and Folke, 2000a; Cinner et al., 2006) and the closure of certain areas to allow over-fished species (such as rabbitfish [*Siganidae* spp.], beche-de-mer [Holothurians], blood cockles [*Anadara granosa*], and mud clams [*Polymesoda* spp.]) to recover (Hviding, 1989a; Ruddle, 1995; Aswani and Weiant, 2004). It should be noted that quite often the explicit purpose of customary closures is to “tame” the fish, making them easier to capture, rather than to increase their abundance (Cinner et al., 2006; Macintyre and Foale, 2007), which is often conceptually linked to supernatural factors over which humans have no control (Hviding, 1996; Foale, 2006). In other instances, the sacredness of an area or the belief of the presence of spirits at a particular site can influence who may access an area,

the fishing methods employed, and the species collected (Veitayaki, 1994; McClanahan et al., 1997; Kinch, 2002; Macintyre and Foale, 2007; Aswani and Vaccaro, in press).

2.2. Temporal restrictions

Temporal restrictions occur when a group bans access to resources during certain time periods, which can be sporadic, daily, weekly, seasonal, or even permanent. Temporal restrictions on marine resources seem to have three general purposes: (1) to reduce harvesting pressure (Hickey, 2006); (2) to protect spawning aggregations (Johannes, 1978), and; (3) to prevent the disturbance of more highly favoured fish species (Zann, 1985; Hviding, 1996). These can include bans on fishing during the Sabbath (Cooke et al., 2000), temporary bans on harvesting species such as trochus (*Trochus niloticus*) and beche-de-mer (Ruttan, 1998; Thornburn, 2001; Kinch, 2002), and bans on fishing during specified months of the year (Dahl, 1989).

2.3. Gear restrictions

Gear restrictions occur when social groups ban specific harvesting technology or techniques, such as gill nets, spear guns, and night diving methods (Johannes, 1981; Hviding, 1989a; Ruddle, 1998). For instance, Johannes (1981) documents restrictions on the techniques used to poison reef fish with *derris* root in Palau. Other Pacific communities have banned particular gear because it is perceived to be too effective (Zann, 1985; Hviding, 1996; Johannes, 2002a), destructive to the coral habitat, or conducive to extensive juvenile fish mortality (Johannes, 1981). For example, in Maluku, Indonesia, certain community leaders used customary management to ban cyanide fishing associated with the live reef food fish trade (Thornburn, 2001). In some cases, certain groups have customary rights to particular fishing techniques and do not allow others to use their methods (Carrier and Carrier, 1983). Today, coastal groups in the Roviana Lagoon, Solomon Islands, are not only excluding non-owners from using restricted technologies such as spear fishing at night but they are also increasingly demanding that inclusive stakeholders stop using these fishing methods (Aswani and Hamilton, 2004). Restricting harvesting technology to inefficient gear may also serve the dual purposes of providing access equity to resources and maintaining employment (Colding and Folke, 2000a).

2.4. Effort restrictions

There are three general types of effort restrictions identified in the literature: (1) limitations of who can utilize certain species; (2) who can use certain gear, and; (3) who can use certain areas. In some instances, these restrictions serve to limit participation in the fishery much as modern licensing does. Effort restrictions are often based on initiation rights or lineage, class, and gender divisions. For example, individuals may not be allowed to participate in a particular fishery until they have undergone an initiation ceremony or unless overseen by a master fisherman (Veitayaki, 1994; Cinner et al., 2006). In other cases, access to fishing areas may be accessible only to certain social classes such as royalty or social elite. For example, Veitayaki (2002) reports that in Fiji certain swimming spots were

kept for paramount chiefs and that these were only opened to fishing when requested by the chiefs. Lineage-based ownership of rights to specific harvest techniques have also been reported (Johannes, 1981; Carrier, 1987). Rotational user access based on a lottery system has been observed in Chile and Indonesia (Mantjoro, 1996; Gelcich et al., 2006).

Sexual divisions of access to species and gear are also common throughout Melanesia. In parts of the Western Solomon Islands, women were barred from fishing in certain passages in pre-Christian times. Even today, when no such customary restrictions are institutionalized, only women with direct kin relations to the original owners of the spot come to fish in these areas (Aswani and Vaccaro, in press). In Fiji, women were not allowed to participate in fishing activities while men were on organized fishing expeditions (which could last up to three months) (Ruddle, 1995). Alternatively, in some areas certain harvesting techniques, such as the capture of mangrove crabs (*Scylla serrata*), could only be used by women, although in recent times men have begun participating in such activities (Tuelieres, 1992).

2.5. Species restrictions

Taboos that limit the utilization of a particular species for individuals or groups of a certain age, gender, or social class are commonly called segment taboos or specific food taboos. A wide range of age, sex, totem, and community-wide practices limit or prohibit consumption of certain marine species (Zann, 1985; Hviding, 1996; Colding and Folke, 1997, 2000a). There are generally five types of species restrictions discussed in the literature: (1) dietary restrictions in the form of taboos on the consumption of certain species (Carrier, 1987; Hickey, 2006); (2) restrictions on the consumption and/or harvest of sacred/totem species (Zann, 1985; Hviding, 1996); (3) reservation of certain species for royalty or a social elite (Ruddle, 1995); (4) restrictions during particularly sensitive life stages of target species (Colding and Folke, 2000a), and; (5) restrictions on certain types of species except during times of bad weather (Johannes, 1981).

Dietary restrictions can be somewhat limited in scope in that a particular species may only be restricted to women (particularly when menstruating), certain age groups, one particular family or clan, or during a particular time period such as during warfare. Reasons for species-specific taboos can include perceptions that the species is toxic, is a religious or totemic symbol, or is a reincarnated human, and in some cases avoidance is due to appearance or behavior (Colding and Folke, 2000a,b). Species taboos can be inherited from patrilineal, matrilineal, or cognatic descent. In some communities, the introduction of Western religions such as the Seventh Day Adventist Church (in which members do not eat shell fish or fish without scales) have also played a large role in limiting the consumption of certain marine species (Hviding, 1996). The consumption of sacred species may be reserved only for a particular class of people, thus limiting its total harvest. Some communities also limit the harvest of particular species (including giant clams, sea cucumbers, and other vulnerable inshore invertebrates) during times of good weather so that there will be easily accessible food during bad weather (Johannes, 1981; Zann, 1985).

2.6. Catch restrictions

Social taboos that regulate how much of a resource can be harvested (i.e. quotas) are rare forms of customary management. However, social norms have stressed avoidance of waste and harvesting only what is needed. For example, in New Caledonia, the Torres Strait Islands of Australia, and Palau, wastage of fish was condemned, and fishers were encouraged to catch only what could be consumed (Johannes, 1981; Neitschmann, 1985; Tuelieres, 1992). Excessive harvesting (i.e., taking more than what is required by kin networks) was considered greedy and socially unacceptable behavior in many Oceanic societies. Similarly, in the Vonavona Lagoon, Solomon Islands, elderly informants report that during the early colonial days chiefs and elders encouraged fishermen to control their catch of sailfin snapper (*Symphoricthys spilur*), especially when they were forming spawning aggregations (Aswani and Vaccaro, in press).

2.7. Compliance and enforcement

Sanctions for violations of customary management can include payment of cash, compensation in the form of livestock, social alienation or exclusion, violence, and gossiping or other forms of social pressure (Johannes, 1978; Ruddle, 1994b, 1988b). Enforcement of specific taboos within a tenure regime is generally the responsibility of the landowner (Asafu-Adjaye, 2000) or traditional authorities that may have been assigned as caretakers by the original reef owners. Some customary fishing regulations are spiritual in nature and are often followed out of fear of spiritual retribution (Colding and Folke, 2000a; Foale and Macintyre, 2000). For instance, reef owners in the Western Solomon Islands may place a taboo (*tokoro*) on a particular place or resource, which can affect the interloper's health or life if broken.

Although they are not enforced by governments, compliance with customary management can be high because of close kinship bonds in customary societies, beliefs in supernatural enforcement of sanctions, and religious beliefs (Colding and Folke, 2000a). Compliance in areas under customary management, which may be promoted by regularly reminders of the taboos during rituals, ceremonies, and other traditional activities, has been shown to be higher than in community-based reserves and national parks (Berkes et al., 2000; McClanahan et al., 2006).

3. Customary management and resource conservation

Interest in integrating customary management techniques into modern resource management originates from the notion that these local practices can provide a cost-effective means of regulating complex multi-species fisheries in places where good biological and economic data are lacking and enforcement of government regulations is often weak (Christy, 1982; Dahl, 1989; Acheson and Wilson, 1996). Authors have argued that customary management practices can conserve and manage marine resources while also reducing expenditures on regulation and enforcement for underfunded and understaffed fisheries departments (e.g. Johan-

nes, 1978, 1981; Hviding, 1989a,b; Akimichi, 1984; Chapman, 1985; Dahl, 1989; Foster and Poggie, 1993; Hyndman, 1993; Begossi, 1995; Acheson and Wilson, 1996; Ruddle, 1998; Berkes, 1999). These notions have been reinforced by research on common-pool resources that suggests that common-property institutions such as customary management often possess governance design principles (including the demarcation of boundaries, the capacity to monitor activity, and the existence of conflict-resolution mechanisms) that can lessen free riding, resource over-exploitation, and self-enforcement problems (Ostrom, 1990; Stevenson, 1991; Bromley, 1992; Dietz et al., 2003). However, researchers from disciplines as diverse as anthropology and marine ecology have debated the conservation value of customary management and have even questioned whether customary management practices can conserve resources at all (e.g. Polunin, 1984; Alvard, 1995a; Foale and Manele, 2004).

3.1. Does customary management create incentives for resource conservation?

Researchers have used data from a wide range of traditional societies to examine whether customary management practices create incentives for individuals and groups to conserve resources (Hviding, 1989a, 1996; Ruddle and Akimichi, 1984; Carrier, 1987; McCay and Acheson, 1987; Bird and Bliege Bird, 1997). Two general arguments have been made as to why customary management institutions may provide effective incentives for marine resource conservation: (1) landowners must bear the entire cost of over-exploitation, hence conservation is in their self-interest; and (2) the complexities that arise from customary marine tenure arrangements can serve to limit development (and subsequent exploitation) of coastal resources.

First, studies on sea tenure studies have suggested that because fishermen are able to exclude others they have a vested interest in not over-fishing (Hviding, 1989a, 1996; Ruddle and Akimichi, 1984; McCay and Acheson, 1987; Hunt, 1997). The cost of over-fishing (i.e., reduced future harvests) in these situations accrues directly and entirely to the resource owners (Johannes, 1981). Despite the popularity of this argument, its merits are somewhat overstated because it is well established that private property ownership does not necessarily guarantee resource conservation (McGoodwin, 1990; Ostrom, 1990). For example, in Melanesia the need to build repute among community members may provide incentives for over-exploitation of marine resources, even though ownership rights provide the ability to exclude outsiders from accessing resources (Bird and Bliege Bird, 1997). Carrier (1987) argues that the highly decentralized customary marine tenure regime on Ponam Island in PNG does not encourage incentives for long-term accumulation of resources because the high social value associated with granting others the privilege of harvesting marine resources constrains resource owners from exercising discretion. Despite the apparent individual-level incentives to conserve resources created by tenure institutions, the varying scales and complexities of customary institutions can create commons dilemmas in ways that appear paradoxical to an open-access scenario (Hardin, 1968; Cinner et al., 2005a). For example, traditional tenure and trade institutions at

Andra Island in PNG seem to create individual-level incentives to conserve resources but retaining a dominant market position in the lucrative lime production trade created community-level incentives to over harvest coral (Cinner et al., 2005a).

Second, customary resource rights in the Pacific are also perceived by some economists as inefficient and a limiting factor to economic development. In particular, complicated land ownership arrangements create a lack of resource security for investors, which can result in under-utilization (Chand and Duncan, 1997). Compensation to customary land or water rights owners can also add to the costs of a development project (Wright, 1985). Local fishers in small-scale fisheries may be reluctant to purchase necessary gear to pursue migratory species such as mackerel because tenure arrangements significantly restrict their fishing range, making the fishery unviable (Johannes, 1981).

However, these same complexities of customary management that restrict resource use and development can also make coordinating and implementing conservation strategies difficult, particularly over spatial scales larger than a single village. Highly decentralized decision-making units, such as the village-based customary tenure institutions in Melanesia, may have heterogeneous visions for whether resources should be conserved, sustainably used, or over-exploited. Furthermore, although the disincentives to development provided by customary marine tenure may lead to *de facto* conservation, when resource extraction projects do proceed in circumstances of insecure ownership agreements, the environmental consequences may be more severe. Fear of additional compensation claims or contract re-negotiation encourages investors to 'get in and get out quickly', resulting in the best resources being taken first, with minimal attention being paid to environmental impacts (Duncan and Duncan, 1997). Additionally, when access to a sacred area is prohibited, perceptions that resources within that area are unlimited can be perpetuated because their condition can not be verified. This can result in severe overharvesting of species that use taboo areas as part of their habitat (Brooke and Tschapka, 2002).

3.2. Is it truly conservation?

A number of researchers have questioned whether "taboos" are cultural systems designed to conserve resources or simply by-products of other processes that appear to conserve resources (Alvard, 1998; Ruttan, 1998; Ruttan and Borgerhoff Mulder, 1999; Johannes, 2002b; Foale and Manele, 2004; Pollnac and Johnson, 2005). One hypothesis speculates that island communities became acutely aware of their ability to deplete the environment during resource shortages and consequently developed conservation practices that regulated resource use (Johannes, 1981, 2002b; Ruddle and Johannes, 1985a). Johannes (2002b) notes:

If a culture never exceeded the sustainable limits of its natural resources then we should not expect it to have developed a conservation ethic. Moreover, those cultures that did possess such an ethic must have over harvested their natural resources earlier in their history. How else could they have learned that their natural resources had limits? This is not knowledge our species is born with.

Critics of the idea that indigenous peoples intentionally conserve resources because they have ideologies that encourage habitat and species conservation point out many cases in which the practices of indigenous people have led to widespread environmental degradation (Diamond, 1992; Edgerton, 1992). For example, empirical evidence suggests that hunters (Alvard, 1995b, 1998) and fishermen (Aswani, 1998; Sosis, 2002) generally prefer maximizing short-term returns over the expected harvesting returns of long-term resource conservation. Some researchers argue that customary management practices may simply be epiphenomena (i.e., unintended side-effects of practices that are not specifically designed to conserve resources) (Ruttan, 1998; Pollnac and Johnson, 2005). For example, Ruttan (1998) suggests that some customary management restrictions, such as temporary restrictions that are followed by an intensive harvesting event, may appear to conserve resources but may actually result in more efficient harvesting that can lead to long-term stock decline. Human ecologists suggest that conservation practices should evolve in populations only when the expected benefits of long-term resource conservation outweigh the costs of short-term harvest restraints (Alvard, 1995a, 1998; Ruttan and Borgerhoff Mulder, 1999; Smith and Wishnie, 2000).

Determining whether customary management represents conservation or epiphenomena will require the development of explanatory models based on thorough examinations of the daily behavior of inclusive actors (Smith, 1984; Winterhalder and Smith, 2000). To date, no studies have specifically examined whether the long-term benefits of customary practices such as temporary closures outweigh the costs associated with the short-term harvesting restrictions. However, a potential methodological weakness of this type of model is that the benefits of customary management may come from social factors such as prestige and improved trade relations—factors that may be difficult to measure and are not immediately evident.

3.3. Can customary management practices conserve resources?

The subject of customary practices and resource conservation has also been explored from a natural science perspective by examining whether these practices have effects on populations of target species and the wider ecosystem. Some studies have used archaeological evidence, such as sustained harvesting in high pre-European contact population densities on infertile coral islands or species decline following the breakdown of customary management practices, to suggest the efficacy of customary conservation (e.g., Neitschmann, 1985; Zann, 1985; Dalzell, 1998). Alternately, others suggest that sustained harvests may actually be a result of poor distribution channels and low demand rather than actual conservation practices (Pollnac and Johnson, 2005). Likewise, paleontological evidence of species extinctions following the arrival of humans on Pacific Islands has been used to argue that a conservation ethic did not exist among pre-colonial Pacific Islanders (Diamond, 1986, 1991; Jackson et al., 2001).

Some studies use marine science to examine whether customary management practices have tangible effects on spe-

Table 2 – Summary of studies examining impacts of customary management on target species and the wider ecosystem

Target	Improve harvest (total yield, size of individuals, etc.)	Increase target species in situ	Improve wider ecosystem	Country	Study
Fish	+	NI	0	Kenya	McClanahan et al. (1997)
Fish	+	+	0	PNG	Cinner et al. (2005)
Fish	NI	+	0	PNG, Indonesia	Cinner et al. (2006)
Fish	NI	+	+ Herbivory	Solomon Islands	Aswani et al. (in press)
Fish	NI	NI	+ Coral cover	Indonesia	Baird et al. (2005)
Fish	NI	NI	+ (?) Coral diversity	Cook Islands	Hoffmann (2002)
Trochus	–	NI	NI	Indonesia	Ruttan (1998)
Trochus	+ ^a	NI	NI	Indonesia	Ruddle (1994b)
Trochus	NI	+	NI	Solomon Islands	Foale and Day (1997)

+, positive impact; NI, not investigated; 0, not significant; –, declining yield; (?), improper replication or survey design – results are questionable.

a Harvest declined after customary management ceased.

cies diversity, species abundance, benthic cover, fish size, and fish biomass (e.g., McClanahan et al., 1997; Cinner et al., 2006; Baird et al., 2005; Aswani et al., in press). Within the biological literature, conclusions as to the effectiveness of customary fisheries management systems in meeting conservation goals are varied and the research conducted to date is limited. Furthermore, some studies have suffered from design flaws so that their results are inconclusive and their contribution to the debate should be treated cautiously. For example, Hoffmann (2002) claimed that customary reef closures in the Cook Islands were effective in improving fish abundance and benthic diversity. However, this study suffered from improper replication which may have artificially inflated the sample size, making the results unreliable (Underwood, 1997).

A few studies have applied more rigorous marine science to examine whether customary practices conserve resources. These studies largely suggest that customary practices do have some conservation benefits, but conservation effects are limited largely to target fish and invertebrate species (Table 2). For example, McClanahan et al. (1997) found that sacred sites in Kenya were able to increase fish catch in adjacent landing areas, but were ineffective at protecting species diversity or ecological functions. In PNG and Indonesia, customary closures were found by Cinner et al. (2005a) and Cinner et al. (2006) to have significantly higher biomass of target fish than areas outside of this management and were effective at conserving both long- and short-lived fish species. In a related study, McClanahan et al. (2006) compared the ecological effectiveness of customary management, MPAs co-managed by communities and non-government organizations (NGOs), and national marine parks in 11 sites throughout PNG and Indonesia using standard indicators and methodologies. They found that all three sites practicing customary reef closures had higher fish biomass inside the reserve than outside, whereas only one out of four co-managed sites and none of the four national parks showed a difference in biomass inside versus outside. However, none of the areas appeared to conserve other ecosystem indicators such as coral diversity, fish species richness, or fish abundance.

Customary management of trochus shells (*Trochus niloticus*) in Eastern Indonesia has been successful at regulating

harvests to sustainable levels (Evans et al., 1997 but see Ruttan, 1998). Where this customary management has eroded, trochus yields have declined from 3 to 4 t/yr to 0.8 t/yr (Ruddle, 1994b). Likewise, in the Solomon Islands, densities of trochus were highest in sites that imposed closed seasons of >9 months; however, trochus abundance in many sites was low relative to other areas of the Pacific (although habitats varied widely in this study) (Foale and Day, 1997).

A few studies have found that customary management practices can impact the wider ecosystem (Table 2). For example, in the Aceh province of Indonesia, coral cover protected by customary management was almost four times higher than that in nearby open-access areas subject to destructive fishing practices such as bombing and cyanide use (Baird et al., 2005). Aswani et al. (in press) found greater fish diversity, biomass of fish (particularly grazing species), and herbivory inside managed areas integrating modern marine protected areas with customary management than the adjacent areas that were open to local fishing.

Although these customary management systems have been able to produce outcomes consistent with some conservation goals, the spatial scale at which they often operate is very small (i.e., on the order of tens of hectares) (McClanahan et al., 2006). Whether these systems are large enough to sustain ecosystem processes and functions if conditions in the adjacent areas become highly degraded is a question of critical importance (Foale and Manele, 2004). The small scale of these systems raises unanswered questions about the functional ecological mechanisms driving the differences observed inside customary management systems compared to other areas and the types of ecosystem functions they can preserve. For example, are fish migrating from outside customary management areas or is growth and recruitment occurring from inside? Do customary management systems preserve broader ecosystem functions, such as predation and larval exchange? To answer these questions, more research is needed to: (1) investigate ecological conditions before and after harvests following temporary closures; (2) monitor fish catch during regular fishing activities and from harvesting events, and; (3) provide understanding of the spatial patterns of fishing effort to determine whether temporary closure areas become severely over-fished after they are opened.

4. How socioeconomic transformations affect customary management

Whether customary management can fulfil conservation objectives is just part of the broader debate about the potential role of customary management in the modern conservation context (Cinner et al., 2005a). If these systems are to provide a foundation for national and regional reef conservation in the Pacific (Hoffmann, 2002; Johannes, 2002a), it is also important to understand whether these systems will be resilient to the intense demographic, social, and economic changes forecasted for the region (UNEP, 2002). Some researchers have suggested that the flexibility of customary management systems have made them resilient to population growth and economic modernization (Baines, 1989; Hviding, 1998). Alternatively, others suggest that customary management systems may be effective common-pool resource-management institutions in situations of relatively low population density and subsistence economies but may die out in response to factors such as increased population pressure, commercialization of resources, and the breakdown of customary authority (Johannes, 1978; Watson, 1989; Ruddle, 1994b; Thomas, 2001; Hoffmann, 2002; Pollnac and Johnson, 2005; Sabetian and Foale, 2006). The conventional wisdom behind the latter argument is that customary management practices are weakened by population growth and Western influence, and particularly by the effects on indigenous cultures of Christianity, modernization, and economic development.

A range of specific socioeconomic factors can influence the ability of communities to employ customary institutions, including population growth, leadership, settlement patterns, price fluctuations, technological change, urbanization, changes in education systems, policies of donor agencies, new commercial valuations for species that had no previous value (e.g. beche-de-mer or trochus), monetization, and the adoption of contemporary government policies and legal systems (Baines, 1989; Watson, 1989; Ruddle, 1994b; Hviding, 1996, 1998; Cox and Elmqvist, 1997; Aswani, 1999, 2002; Cooke et al., 2000; Harkes and Novaczek, 2002; Pollnac and Johnson, 2005). For example, in Palau, chiefly authority declined after property ownership shifted from kinship groups to individuals (Ruddle, 1994b). Ruddle (1994b) provides an extensive review of the external socioeconomic forces that can alter customary management institutions.

It is critical to recognize that customary institutions are heterogeneous and that different strategies may be more resilient to specific socioeconomic conditions. In particular, some aspects of population growth and commercialization appear to strengthen the exclusivity of tenure institutions but weaken the implementation of customary closures. Changing socioeconomic conditions, such as a drop in market price for cash crops, can render customary management strategies ineffective and inappropriate (Watson, 1989; Evans et al., 1997). Customary closures in PNG appear to occur only in communities that have populations fewer than 600 people, that are more than 15 km from markets, and that are economically unstratified (Cinner et al., *in press*). Thus, customary closures may lack resilience to population and market pressures above relatively low thresholds (See also Sabetian

and Foale, 2006). In Eastern Indonesia, communities with closed seasons were also found only far from markets, but these had populations of 2000–3000 in one study (Harkes and Novaczek, 2002) and 14,000 in another (Evans et al., 1997), suggesting that inter-country variation in social organization may allow for higher thresholds for some socioeconomic factors.

Alternatively, numerous examples exist of tenure institutions that became established or more exclusive in response to the commercialization of marine resources (e.g., Ruddle, 1994b; Hviding, 1996; Thornburn, 2001; Sabetian and Foale, 2006; Macintyre and Foale, 2007). Marine tenure rules in the Marovo Lagoon, Solomon Islands, became more exclusive for both commercial and subsistence activities in response to increased prices of particular shells (Hviding, 1996). Likewise, the commercialization of trochus shells in Muluku, Indonesia during the 1950s and 1960s transformed a formerly open-access system to one with regulated village sea space (Ruddle, 1994b). Also in Muluku, Indonesia, certain aspects of modernization (e.g. transformation to a cash economy, individualistic behavior, and modern fishing technologies) served to weaken customary management. However, the introduction of cyanide fishing in the area threatened local property rights and actually served as a stimulus for a local affirmation and, later, a wider revival of customary management (Thornburn, 2001). In Okinawa, Japan, commercialization of subsistence fisheries led to the establishment of sea tenure where none previously existed (Ruddle, 1994b). The few comparative studies to date have found that the strengths of marine tenure institutions were strongly related to socioeconomic factors such as dependence upon marine resources, conflicts, distance to markets, settlement history, and immigration, but that population had only a moderate effect (Aswani, 1999, 2002; Cinner, 2005).

Thus, customary mechanisms regulating self-restraint may operate under conditions of relatively low population, greater distances from markets, and relative economic equality. However, customary institutions may effectively exclude outsiders in situations involving higher populations, high dependence upon marine resources, and certain aspects of commercialization of marine resources, although these systems also appear to break down in close proximity to markets. When faced with social transformations such as population pressures or the market creation of value for a previously unused species, individuals and communities may react by using customary institutions to exclude outsiders rather than exercising self-restraint through strategies such as implementing closures (Foale, 1998). It should be noted that closed seasons for benthic invertebrates such as Trochus have been recorded, but these are thought to represent a harvest maximization rather than a conservation technique (Foale, 1998; Ruttan, 1998). Commercial pressures such as the live reef fish trade (which pays communities higher values for live reef fish used to supply luxury seafood restaurants in Asia) may serve to strengthen the exclusivity of tenure regimes while weakening other aspects of customary management. Under pressure from markets and the live reef fish trade, fisheries resources have been serially depleted in many locations under customary control (Hughes et al., 2006; Scales et al., 2006), particularly those nearest to markets

(Cinner and McClanahan, 2006). Thus, socioeconomic transformations, such as the establishment of new markets, may degrade the resource base and eventually erode customary institutions.

In addition to the socioeconomic factors outlined above, modern legal systems governing marine resources can also erode customary management. Modern legal frameworks governing marine resources are frequently based on the notion of freedom of the seas and often contradict and undermine customary institutions, which allow for exclusion of outsiders from fishing grounds (Hyndman 1993; Pulea, 1993; Ruddle, 1994b). In places such as Hawai'i and Tonga, government policies that allow residents to fish anywhere in coastal waters have replaced customary institutions governing access to marine resources (although government-imposed restrictions on fishing, such as marine protected areas, exist) (Adams, 1998; Bender et al., 2002). In some areas, such as PNG, Vanuatu, the Solomon Islands, and Fiji, customary institutions are recognized by national law (Pulea, 1993; Ruddle, 1994b; Hviding, 1998), providing what has been referred to as tenurial shells (Alcorn and Toledo, 1998). Yet, even where customary institutions are legally recognized by national law, conflicts exist between the fixed nature of codified legislation and the highly dynamic nature of customary institutions (Ruddle, 1994b; Hviding, 1998). For example, in Fiji, customary fishing grounds have been demarcated and codified into law, a process which has undermined the adaptive flexibility of customary management (Hviding, 1998).

5. The commensurability of customary management and conservation

Even where they are institutionally recognized by governments, customary management regimes cannot effectively guard against contemporary economic and social threats such as the rapid and often rapacious live reef fish and aquarium trades (Berkes et al., 2006; Hughes et al., 2006; Scales et al., 2006). There is a clear need to amalgamate local customary practices with aspects of modern conservation and management initiatives that operate on both national and regional scales. Yet, few countries have accomplished this successfully because there appear to be profound differences in the application, intent, and conceptual underpinnings of customary and modern practices (Berkes et al., 1998; Aswani, 2005). Understanding how customary systems differ from Western conservation is important because incongruence between communities' and outsiders' views about the roles and expectations of marine conservation could produce misunderstandings that, in turn, could lead to disenchantment with the conservation process overall (Cox and Elmquist, 1997).

Customary and Western conservation principles overlap in some aspects, although they are often practiced differently. For example, customary reef closures are generally temporary, as opposed to the permanently closed marine reserves advocated by Western science and conservation (Roberts et al., 2003; Russ and Alcala, 2004). These temporary closures are often adaptively implemented in response to perceived changes in social or ecological conditions (Cinner et al., 2006). Extremely poor compliance has been reported where inflexible permanent closures are implemented by conserva-

tion organizations in communities that traditionally employed temporary closures because the rationale behind permanent no-take closures does not fit with the community's utilitarian experience of harvesting a closure after several months or years (Cinner et al., 2003). Likewise, a species taboo may prohibit an individual from eating a particular species but may not prevent that individual from capturing, selling, or killing the species. Practical differences such as these can have implications for how these systems affect the ecosystem, but, perhaps more importantly, differences between Western conservation and customary practices are also deeply rooted in cultural concepts and norms, including the very concept of conservation.

In the Pacific, customary forms of resource management are not always consciously practiced as conservation techniques (Polunin, 1984; Hooper, 1985; Wright, 1985; Ruttan, 1998; Berkes et al., 2000; Macintyre and Foale, 2007). Often, they are embedded in ceremonies, religion, dietary restrictions, and other traditions. For example, in the New Ireland province of PNG taboos on extractive activities within a proscribed reef area are often established following the death of a village leader, landowner, or other person of social significance (Wright, 1985). When the taboo (which can last from several months to six years) is lifted, the area is harvested to provide food for a feast to mark the end of the mourning period. Thus, the explicit intent of the customary management is to provide fish for a ceremony, although rebuilding fish stocks within the closure area is clearly an implicit goal. Other examples exist of limiting access to spiritual places (Wright, 1985; McClanahan et al., 1997) and closures that facilitate ceremonial exchanges (Cinner et al., 2005b). In such scenarios, access to resources may be limited for the economic, social, and physical well-being of coastal residents rather than for the preservation of resources (Wright, 1985). Thus, although resources may be consciously improved by these practices, conservation in the Western sense may be simply a by-product of other economic, spiritual, or social needs (Ruttan, 1998).

Differences also exist between the conceptually linear nature of Western thought (and conservation) and the cyclical nature of Melanesian systems. For example, cultural obligations such as bride price ceremonies and feasts require the periodic accumulation of relatively large sums of resources to be redistributed. Customary reef closures are sometimes implemented for periods of several months to years to build up a stockpile of resources for occasions such as feasts (Wright, 1985; Foale 1998; Foale and Manele, 2004). Resources within the closure are then collectively harvested, and afterward the area is open to harvesting. This approach contrasts strongly with Western ideas of sustainable management that attempt to achieve a steady flow of benefits. For example, marine reserves seek to provide benefits to extractive users by maintaining resources inside the reserve and increasing fishing yield outside the core through a spillover of fish to adjacent areas (Russ et al., 2004). This steady flow of benefits fits the economic and cultural needs of Westerners—for example, a Western fishermen may have the need for a steady stream of income to repay monthly boat loans. The customary model is akin to saving money then spending it all, whereas the Western model is more akin to keeping money

in the bank and living off the interest (Foale and Manele, 2004).

This concept that Melanesians do not maintain capital is further compounded by cultural wealth distribution mechanisms. In Melanesia, it is difficult for individuals to stockpile wealth because of cultural norms that require individuals to gain repute through perceived generosity. Attempts at accumulating or maintaining personal wealth are often perceived as greedy by kin and community members and are met with social stigma. Therefore, the accumulation of wealth to meet obligations such as bride price requires periodic cooperation between loosely connected social units (Foale and Manele, 2004). Carrier and Carrier (1989) note that cooperation has to be induced rather than commanded. Thus, securing adequate resources for cyclical obligations involves the accumulation and expenditure of social as well as natural capital. In summary, customary conservation practices and engagement in cooperative behavior are often done to meet the cyclical needs of communities, which results in both practices and expectations that are in strong contrast to the linear systems of many Western conservation approaches (but see Folke et al., 2005). Research is needed that directly compares the priorities of conservationists and local communities in areas where customary management and modern conservation efforts overlap. This will help conservation practitioners design hybrid strategies that reflect local values and practices and better meet shared goals.

6. Conclusion: the integration of customary management into the modern conservation context

Customary management practices are typically dynamic and adaptively evolving to reflect changes in social, political, economic, and cultural conditions. Perhaps the most recent configuration for customary management in many locations has been an amalgamation with the goals, techniques, and institutions of modern fisheries management. The failure of conventional inshore resource management and conservation programs in much of the Indo-Pacific region, and the vulnerability of customary management institutions to socioeconomic transformations in the region, are increasingly demonstrating that the best hope for resource conservation in the region may lie in an amalgamation of customary management systems and contemporary conservation initiatives. In the marine environment, these “hybrid” institutions of customary and modern management may involve using customary governance structures such as village councils to: (1) allocate catch quotas in individually transferable quota (ITQ) systems (Adams, 1998); (2) use traditional ecological knowledge to locate and temporarily restrict fishing in spawning aggregation sites of commercially valuable species (Graham and Idechong, 1998; Drew, 2005); (3) map vulnerable benthic habitats for integration into conservation plans (Aswani and Lauer, 2006a,b); (4) adaptively experiment with gear restrictions (Adams, 1998; Cooke et al., 2000; McClanahan and Cinner, in press); (5) implement temporary closures to manage stocks such as trochus that had no previous commercial value (Ruttan, 1998; Thornburn, 2001; Hickey and Johannes, 2002); and (6) establish community owned and managed MPAs

(Cooke et al., 2000; Johannes, 2002a; Hickey and Johannes, 2002; Aswani et al., in press).

Hybrid community-based gear restrictions and MPAs based on customary governance structures have been developed in places such as Palau, the Cook Islands, the Solomon Islands, Fiji, Samoa, and Vanuatu (Johannes, 2002a; Hickey and Johannes, 2002). For example, communities throughout Vanuatu have established MPAs, gear restrictions, and species restrictions founded on customary rights to marine resources (Hickey and Johannes, 2002). This system of hybrid management, first promoted by the national fisheries department, expanded rapidly between 1993 and 2001 (Hickey and Johannes, 2002). Likewise, a hybrid marine conservation and development program that integrated indigenous ecological knowledge and existing sea tenure governance with modern fisheries management tools such as MPAs was developed in the Roviana and Vonavona Lagoons, Western Solomon Islands, in 1999 by Shankar Aswani in partnership with local communities. By 2006, a system of 23 no-take marine reserves and “spatio-temporal” refugia had been instituted in Roviana and Vonavona - a system that is currently expanding across the Western Solomons (e.g. Rendova, Vella Lavella, North New Georgia) (Aswani and Furusawa, in press; Aswani et al., in press). The hybrid nature of the program, the participatory process, and the locally perceived social and biological success of the ongoing community-based MPA program were key in mustering local support. A variety of participatory research strategies were used, including: (1) conducting an ethnographic study of regional customary sea tenure (Aswani, 1999, 2002); (2) using a geographical information system (GIS) to map local knowledge of benthic habitats, resident taxa, and spatio-temporal events of biological significance (Aswani and Lauer, 2006a); (3) coupling of indigenous ecological knowledge with marine science to study aspects of life history characteristics of vulnerable species (Aswani and Hamilton, 2004), and; (4) incorporation of fishing time-series data (1994–2004) into the GIS to examine spatial and temporal patterns of human fishing effort and yields (Aswani and Lauer, 2006b). This process led to closures being located near villages - a key characteristic for compliance with small community-enforced areas (Crawford et al., 2004; McClanahan et al., 2006).

In some instances, these hybrid institutions have produced direct benefits to harvesters, secondary producers, and tourists. For example, a customary ban on gill netting in Macuata coastal communities in Vanua Levu, Fiji, had the far-reaching and unintended effects of fishers organizing into groups (providing economies of scale), refrigerated storage capacity in the private sector being established, marketing and distribution networks for higher-quality fish being developed, and the subsistence fishery being improved (Adams, 1998). In the Cook Islands, diving, snorkelling, and touring in recently re-established customary closure (Ra’ui) areas has become a tourist draw (Tiraa, 2006). The perceived success of hybrid MPAs and gear restrictions in Samoa and Vanuatu inspired a number of neighboring communities to adopt similar restrictions. (Hickey and Johannes, 2002; Johannes, 2002a).

Hybrid management regimes (e.g., MPAs) have institutional adaptiveness, which is seldom found in programs designed by science-driven programs implemented by national

agencies, which tend to be more inflexible in managerial and statutory terms (Aswani et al., in press). Often, these hybrid institutions take advantage of both customary and modern governance systems (such as village councils and village by-laws, respectively) to implement and manage marine resources. However, modern governance frameworks which are based on freedom of the seas can hamper the implementation of hybrid institutions by legally restricting the ability to develop bylaws that limit marine resource use and exclude outsiders (Ruddle, 1994b). In some countries, development of hybrid institutions will require changes in governance structures; away from top-down centralized systems to multi-scale institutional arrangements that allow for flexible local decision-making.

We suggest that scientists and policy makers encourage and strengthen institutional hybrids, even if fundamental differences exist between customary and modern management systems. Hybrid institutions offer considerable potential for sustainable resource management by harnessing traditional ecological knowledge, respect for traditions, scientific knowledge, and local acceptance. Hybridizing customary management with Western systems of management (e.g. MPAs) during the design, implementation, and monitoring phases of a conservation program can help to implement resource management and conservation in a culturally sensitive fashion to increase compliance and subsequent conservation effects.

However, hybrid institutions may retroactively configure customary practices in attempting to meet modern goals by including conservation and equity factors that were generally absent in the original systems (Zerner, 1994). If improperly planned and implemented, such efforts may do more harm than good by eroding confidence not only in modern science and conservation organizations but also in traditional authority (Gelcich et al., 2006). In both the Cook Islands and Chile, attempts to develop customary management into co-management arrangements have undermined and weakened traditional authorities and reduced the adaptive capacity of customary management institutions (Gelcich et al., 2006; Tiraa, 2006). In an attempt to maximize the area of protection at a section of the Masoala Marine Park in Madagascar, national-level conservation practitioners zoned a no-take area adjacent to a sacred area where no fishing was allowed (J.E.C., field notes, 2005). However, community members noted that the presence of the marker buoys violated taboos that maintained the spiritual purity of the area. Hence, the community felt that the park was providing negative spiritual energy that resulted in bad weather, poor crop yields, and low fish catch. The community was subsequently reluctant to engage in conservation efforts with park officials. Thus, inadequate understanding of local power structures and the spiritual role of, and rules associated with, customary institutions can lead to feelings of ill will between community members and scientists/conservationists.

There have also been considerable efforts to investigate the integration of customary and contemporary management in terrestrial ecosystems (e.g., Stevens, 1997; Horowitz, 1998; Mgumia and Oba, 2003; Moller et al., 2004; Bodin et al., 2006). Lessons from these terrestrial systems indicate that it is critical for hybrid systems to: (1) formally recognize cus-

tomary practices through a legal mechanism; (2) reinforce local authorities; (3) provide a sense of ownership of the resource (which may include the ability to exclude outsiders); (4) provide direct economic benefits; (5) tailor strategies to the specific socioeconomic, cultural, and historical context of an area; and (6) incorporate local understandings of human-environment interactions (Horowitz, 1998; Colding and Folke, 2000b; Armitage, 2003; Colding et al., 2003; Bhagwat and Rutte, 2006). Based on these lessons from terrestrial systems, and our experience studying customary management and designing hybrid management systems, we suggest that the following six key principles should be considered in attempts to develop hybrid management systems (Fig. 1):

- Customary management strategies are heterogeneous, and specific strategies are more appropriate under certain socioeconomic conditions (Cinner, 2007). Factors such as market conditions and population may erode certain types of customary systems but strengthen property rights, influencing whether spatial (i.e. MPA) or rights-based (i.e. ITQ) hybrid strategies are most viable. The presence of complex tenure institutions can also restrict the ability of individuals to switch between occupations, fishing grounds, and gear types, potentially limiting the available options for hybrid conservation strategies. Consequently, a fundamental understanding of the tenure and socioeconomic situation at each location is necessary to develop unique hybrid strategies.

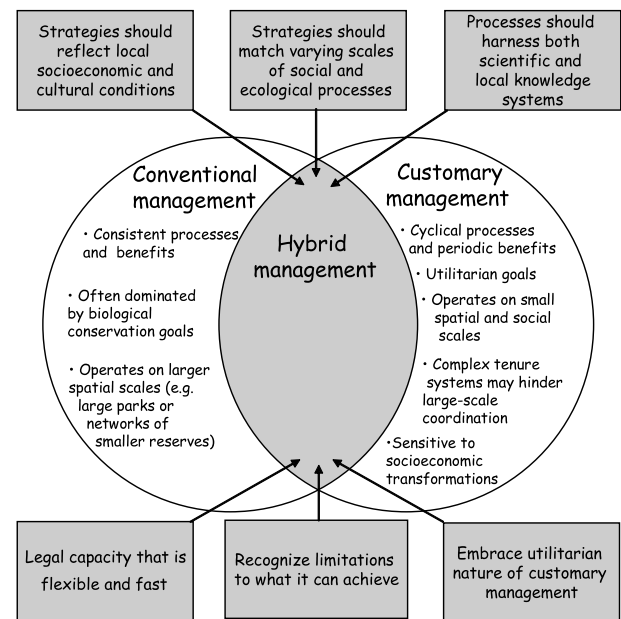


Fig. 1 – Properties of successful hybrid management institutions. Customary and contemporary management systems may have contrasting goals, social and ecological benefits inferred and spatial scales. The six principles (denoted as grey boxes) may help overcome these differences as managers, scientists, and communities hybridize the two systems.

- Hybrid institutions must match the varying spatial scales at which resources are owned, used, and governed under customary management systems with the scale of ecologically relevant processes (i.e. in spatial units large enough to protect ecological functions such as herbivory, predation, and recruitment) (Wilson, 2006). Part of the challenge of matching these scales involves gaining a better understanding of the gaps in marine science with regard to using customary management methods as resource management tools. Such an effort would include identifying the types of ecological processes that customary management techniques protect, determining the minimum “reserve” size necessary, establishing the appropriate minimum distance between reserves, and appreciating the trophic effects of limited fishing activities that customary institutions often allow (Sale et al., 2005). Of equal importance is the need to understand the spatial scales at which relevant social processes operate. Complicated use rights and ownership systems mean that a specific area of conservation interest may be governed by a heterogeneous network of social units that operate at different scales (e.g. individual, sub-clan, clan, village, etc.) and that may have historical patterns of non-cooperation with one another. Existing customary institutions may create incentives for either conservation or over-exploitation in unexpected and unfamiliar ways and present commons dilemmas at varying spatial scales—i.e., people within a clan or community may be willing to cooperate with each other, but communities may attempt to “free ride” on the efforts of their neighbors. Where national governments are weak, NGOs can play a critical role in fostering cross-scale coordination with local institutions (e.g. government permitting activities such as the live reef food fish trade, aquarium, or other commercial enterprises, which must be coordinated with and not allowed to undermine local regulations).
- Hybrid management should understand and harness both scientific and local knowledge systems and mechanisms for detecting and reacting to changes in social-ecological systems. The participatory process during the establishment of hybrid strategies is critical for capturing local knowledge and for explaining scientific knowledge.
- The adaptive nature of hybrid management systems requires a legal capacity to adaptively enact and enforce decentralized management (either through recognized marine tenure institutions or village bylaws). This legal capacity should: (1) provide the ability to exclude outsiders; and (2) must not erode the traditional authority structure upon which customary management practices may depend.
- Hybrid management strategies should embrace the utilitarian nature and goals of customary management institutions. Although preserving biodiversity and maintaining resilience are often primary goals of modern conservation, these must not be prioritized over utilitarian community goals, such as allowing occasional harvests for feasts. Maintaining important customary characteristics such as utilitarian goals will mean that hybrid management is a compromise between modern and customary practices. Finding strategies that can meet conservation and com-

munity goals will require understanding of not only the ecosystem benefits they confer but also the social benefits and costs they entail.

- There are limits to what hybrid management can achieve, and it may not be appropriate everywhere. As with customary counterparts, hybrid management will be limited in the scope and scale of the threats it can address and in its resilience to some socioeconomic processes. Additionally, hybrid management may not be able to address some social goals of contemporary conservation (e.g., equity). Understanding the complex social processes, such as the historical, socioeconomic, governance, political, and environmental conditions within which the social-ecological systems are embedded is critical to translating customary governance into hybrid management. At the same time, it must be recognized that unravelling these processes can take social scientists years to accomplish and that the effort may not fit with conventional project timeframes for donors and conservation groups.

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