

EFFECTIVENESS OF LOCAL GOVERNANCE OF ARTISANAL FISHERIES MANAGEMENT, NGAZIDJA ISLAND, COMOROS

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Abstract

Top-down, exogenous approaches to fisheries management have been ineffective in more traditional and small-scale fisheries. Yet, there remains little understanding of the effectiveness of alternative approaches. This case-study of artisanal fisheries in the Comoros examines how effective local fishing associations are at managing common fisheries resources, and provides some understanding of the underlying characteristics of effectiveness. Qualitative methods were used to collect data on local knowledge and beliefs, management structures, and resource conflicts in four major fishing villages on the island of Ngazidja.

Fishing in the Comoros is entirely artisanal, and management is informally shared among state fisheries departments, national and island fishing syndicates, and village fishing associations. Village fishing associations function much like cooperatives and collectively design, monitor, and enforce local regulations. Decisions are based on local knowledge and experience, and management strategies are adaptive and based on low-cost, practical solutions. Compliance with local regulations is high, primarily due to participatory decision-making, community-monitoring, and strong feelings of solidarity among fishers. Thus, while the overall development and management of fisheries is shared between the three levels of authority, the actual implementation of management strategies is largely undertaken at the local level. This study demonstrates how collective governance of common pool resources can be achieved within communities, and how feelings of empowerment and shared responsibility among resource users can lead to effective management practices.

Introduction

Tropical small-scale fisheries represent the main livelihood and protein source for a substantial portion of the global population. Growing pressures on marine resources, however, have left many fishing communities faced with declining catches and increased environmental degradation. It is now widely agreed that the current crisis is primarily a result of overfishing and poor management (Berkes et al. 2001; Bostford et al. 1997; Defeo et al. 2007). Effective governance institutions are thus critically important for ensuring sustainable livelihoods, food security, and marine conservation in these communities.

This study took place on the island of Ngazidja in the Union of the Comoros. The Comoros is situated at the northern end of the Mozambique Channel in between Madagascar and Mozambique (Figure 1). The country comprises the three volcanic islands of Ngazidja, Ndzouani, and Mwali, each of which is surrounded by patch and fringing reefs supporting a rich marine biodiversity. The Comoros is classified as a small island developing state and one of the poorest nations in the world (UNDP 2009). Coastal communities in the Comoros rely heavily on marine resources for both economic and subsistence livelihoods. However, the country is

currently facing considerable demographic pressure and with 88% of the population living on the coast (Union of the Comoros 2005; UNDP 2007), there will likely be a serious increase in environmental degradation and poverty unless effective management strategies are employed.

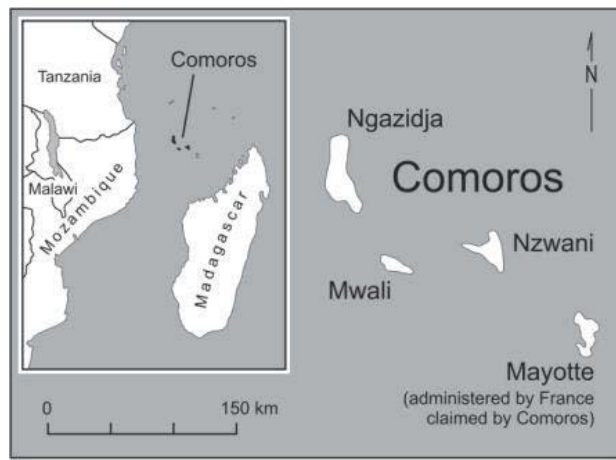


Figure 1 Union of the Comoros

This paper focuses on local fisheries institutions to determine how effective fishing communities are at managing common fisheries resources, and provides some understanding of the underlying characteristics of effectiveness. In particular, it will be shown how collective governance of common-pool resources can be achieved within communities, and how feelings of empowerment and shared responsibility among resource users can lead to effective management practices. While this study does not advocate a “cure all” for all small-scale fisheries, it does offer practical experiences and recommendations from which other artisanal fisheries may learn. The paper begins with a brief overview of some of the key concepts on governance institutions found in the common-property literature and introduces the fisheries sector in the Comoros. The results are then presented and discussed in reference to some of the key theoretical concepts. Recommendations are provided based on practical, low-cost solutions to a few of the core governance challenges facing fisheries on Ngazidja.

Theoretical context: Robust and sustainable governance institutions

Management tools affiliated with artisanal fisheries are numerous and diverse depending on the local culture, belief systems, and outside influences. Some examples are: territorial user rights (TURF's), temporary closures, gear restrictions, size limits, religious taboos, species bans, and community catch quotas (Cinner and Aswani 2007). These customary forms of management are not entirely different from modern techniques as they both use “limits on effort, time, space, species, size, and gear” (McClanahan and Castilla 2007, p. 305). The difference is in how they are adopted and implemented. Moreover, in customary management systems, emphasis is placed on *how* fishing is done, rather than *how much* is being caught (Achenson et al. 1998). The success of these management tools depends considerably on the institution implementing them, for without an effective and sustainable governance institution, management practices are futile. As noted by Charles (2001), “no amount of attention to management tools is likely to make them effective within a dysfunctional institutional environment” (p. 317). An examination of the

attributes necessary to make an institution effective is thus imperative to the overall analysis of fisheries governance.

In natural resource management, institutions are devised to deal with the two underlying problems inherent to all common-property resources: controlling access to the resource (i.e., the excludability problem) and establishing rules which regulate users' ability to potentially extract more than their 'fair share' (i.e., the subtractability problem) (Berkes and Folke 1998). Institutions are characterized as the formal (e.g., laws, statutes, regulations) and informal (e.g., social and cultural norms) rules used to govern user behaviour (North 1990; Ostrom 2005). Fisheries institutions exist to protect fishers, promote and develop fisheries, and reduce livelihood vulnerability. Institutions also have the power to create or destroy user incentives to abide by regulations.

Much of the literature on common-property resource management focuses on the successes and challenges of management regimes that have been imposed on artisanal fishing communities (e.g., gear restrictions, MPA's, no-take zones, co-management), but few documented case-studies focus on working within existing social structures and with existing fisher knowledge to develop effective management strategies. Thus, emphasis needs to be placed on enhancing (rather than restructuring) local institutional strength and capacity to manage resources effectively.

Institutional sustainability and resilience

The effectiveness of an institution is directly linked to its sustainability. If an institution is not sustainable, its failure will eventually lead to the downfall of the fishery system. Charles (2001) and Ostrom (1992) developed indicators for assessing institutional sustainability in resource systems. In following Charles' suggestions, these indicators can be used as a framework (Table 1) to provide a starting point from which to assess whether a system is sustainable, and if not, the areas which are in need of improvement.

Table 1 Institutional sustainability indicators

	Sustainability indicator	Description
Charles (2001)	Management Effectiveness	Existing management structures control exploitation levels and regulate resource users
	Use of Traditional Methods	Traditional resource and environmental management methods are utilized
	Incorporating local input	Management activities incorporate local socio-cultural factors (e.g., tradition, community decision-making, LEK)
	Capacity-building	Capacity-building occurs within relevant organizations
	Institutional viability	Management organizations have long-term financial viability and political will exists to support local structures
Ostrom (1992)	Simple, key rules	Resource access and use are regulated by a small number of agreed upon rules
	Dual Enforcement	Rule enforcement is shared by all users and backed by officials

Adaptability	Institution must be able to adapt to changes by restructuring and/or changing rules
Ownership	Users have legal claims as owners over the resource
Nested institutions	Institutions are nested within larger organizations
Change is moderate	Changes external to the institution are moderate

A key factor in assessing and ensuring sustainability is resilience. The concept of resilience has been receiving growing attention in the field of natural resource management over the past decade and is now being applied to a variety of social and ecological systems, including institutions. Resilience can be defined as the ability of a system to withstand disturbances by adapting and reorganizing so that it maintains essentially the same functions (Folke et al. 2004; Holling 2001). A system becomes vulnerable to change when there is a lack (or loss) of resilience resulting in the inability to adapt and find opportunities to reorganize and renew. In a resilient system, change can lead to growth and innovation, whereas in a vulnerable system, small changes are often devastating.

With institutional resilience and sustainability as a central focus, governance approaches shift from being centered on maintaining a desirable fixed state to enhancing resilience to maintain optimal system functions through change and uncertainty (Anderies et al 2006; Walker et al. 2004). Diversity, in particular, is vital to enhancing resilience and includes, for example, using multiple management tools and approaches, various knowledge sources, cross-scale decision-making structures, mixed fishing practices, and occupational pluralism (Allison & Ellis, 2001; Charles, 2001; Folke et al., 1998). By increasing diversity, pressure and dependency on the fishery and governance institution is reduced, thereby enhancing resilience and sustainability.

Institutional effectiveness

Although a local institution may appear to be sustainable and resilient, this does not necessarily guarantee its effectiveness; i.e., simply because it is able to persist over the long-term does not mean that it will result in a successful and sustainable fishery system. By the same token, effective management tools, institutions, and governance processes do not guarantee the sustainable productivity of the marine ecosystem (see for example, Basutro and Coleman 2010; McClanahan et al. 2008). Nevertheless, governance institutions are the founding elements for sustainable fisheries management and thus the attributes which make an institution effective must also be examined.

Ostrom's (2005) work on robust institutions, and in particular, her eight design principles (Table 2), provide a practical and theoretical context from which to assess the effectiveness of an institution's ability to manage resources. While each of the eight principles are neither exclusive nor essential for an institution to be effective, they can be used as a guide for understanding why some institutions are more likely to be successful than others. Moreover, the principles are founded on a review of successful local governing institutions, all of which contain most of the eight attributes.

Table 2 Ostrom’s (2005) design principles for robust institutions (p. 259)

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| <ol style="list-style-type: none"> 1. Clearly defined boundaries 2. Proportional equivalence between benefits and costs 3. Collective-choice arrangements 4. Monitoring 5. Graduated Sanctions 6. Conflict resolution mechanisms 7. Minimal recognition of rights to organize 8. Nested enterprises |
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In this paper, fisheries institutions in the Comoros will be analyzed according to Ostrom’s (2005) eight ‘design principles’ and Charles’ (2001) and Ostrom’s (1992) indicators of institutional sustainability.

Background

The fisheries sector in the Comoros is entirely artisanal and catches are used for household subsistence or sold at local markets. Until 1985 fishing in the Comoros was purely traditional; i.e., comprised of dugout canoes and handcrafted traditional gear. Since then, the sector has modernized through international aid from development projects. This led to the provision of small (5 -7m) fiberglass boats with outboard motors (15–40HP) and modern gear (e.g., metal hooks, plastic bait and fishing lines) (Union of the Comoros 2005). See Table 3 below for the most common gear and target species per fisher group.

Table 3 Most common gear and target species per fisher group

Fisher Group	Boat Specifications	Gear	Target species
Male and elder fishers	Single-outrigger canoes, 3-5m, hand paddled	Handlines, spear guns, spears, traps	Reef fish, coastal pelagics, crustaceans
Male fishers	Motorized boats, 5-7m, 15-40HP	Handlines	Oceanic pelagics
Female fishers	By foot at low tide	Mosquito nets, sheets, spears, traps	Juvenile reef fish, molluscs

The current national government’s outlook for the fishing sector is one of growth, expansion, and modernization. The government’s 2009 targets were to increase fisheries production by more than 50%, to create 5,000 new jobs, and to increase contribution to GDP by more than 13% (Union of the Comoros 2005). These goals have yet to be achieved, but the government contends that development can occur through the expansion of the Exclusive Economic Zone (EEZ) and the exploitation of unexploited resources (e.g., shrimp, lobster, cephalopods) – all in light of the high global demand for seafood in an era of overexploited fisheries. The growth and development of the industry is appealing for many, however, it also raises concerns regarding the uncontrolled expansion of fishing, and a need to understand better the current situation before such measures are taken.

Methods

Fieldwork was conducted between July 2009 and December 2009. The primary data-collection methods used were semi-structured interviews, focus group discussions, GIS mapping, and participant observation.

Study Design

A variety of fisheries stakeholders were consulted regarding the proposed goals, objectives, and design of the research. These consultations helped inform study site selection, questionnaire design, and general methodology. A pilot study was then conducted to assess questionnaires. Translators fluent in both French and ShiNgazidja were employed to assist with interviews.

Semi-structured, key-informant interviews were the main data collection method. A mix of open- and closed- ended questions was used to provide quantitative and qualitative information. Two main questionnaires were employed: one regarding local fisheries knowledge and practices asked to expert current and elder fishers, and one regarding management structures and strategies asked to local village association leaders. Additional questionnaires were created for authorities in the National Fisheries Department, National Fishing Syndicate, and private sector. Focus group discussions were tailored to specific villages and held last to allow for certain issues to be explored in greater depth, to cross-check information, and to gather additional information. Participant observation (including eight fishing trips) and GIS mapping of traditional fishing grounds took place at various intervals throughout the field season.

Study Area

Four large fishing communities on Ngazidja were chosen as the primary study sites: Chindini, Bangoua, Hantsambou, and Hantsindzi (Figure 2). Selection was based on geographical distribution, the importance of fishing within the community, recommendations made during the initial interviews, and community interest in participation.

There are approximately 44 landing sites on Ngazidja, though many of these are quite small (e.g., 1 -10 fishers/village), particularly on the central east coast. Each of the study sites is the main fishing village within its region and fishing is the main livelihood (economic and subsistence) activity within the community.

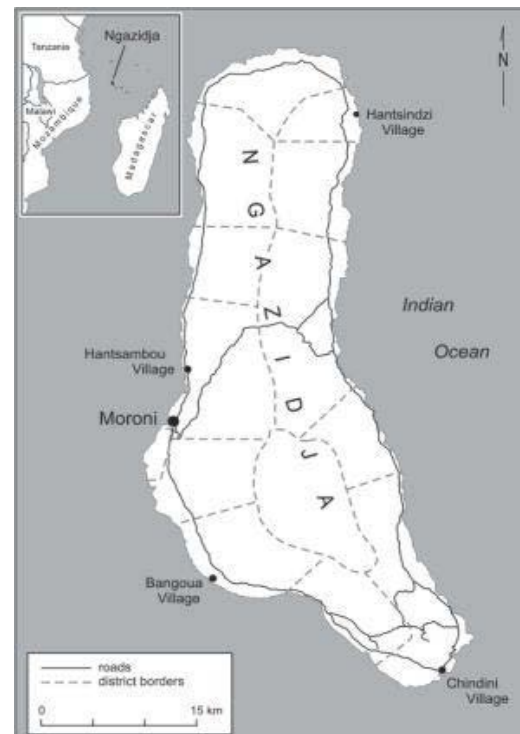


Figure 2 Main study sites on Ngazidja

Table 4 Estimated fisher and boat numbers in study sites

	Hantsindzi	Hantsambou	Bangoua	Chindini
# of male fishers	150	260	600	1700
# of traditional canoes	55	160	90	70
# of powerboats	13	50	60	100
% of traditional fishers	50%	35%	15%	20%
% of modern fishers	50%	65%	85%	80%
% of fishers in village	80%	85-90%	90%	90%

Participant selection

Participant selection was based on the sampling of experts as the study sought to document information on specific issues which would be known primarily by those with extensive knowledge and experience. Snowball sampling was used to identify expert fishers. Expertise was defined by the fishers themselves and referred to a fisher with extensive knowledge, skill, and experience. Purposive sampling was used to select management authorities based on their position.

Interviews

A total of 75 expert fisher interviews, 17 management authority interviews, and 11 focus group discussions were completed. Expert fishers interviewed had a minimum of 7 yrs experience (n=3) and an average of 21.3 years experience; elders had a minimum of 27 years experience (n = 1) and an average of 55.4 years experience. Management authorities had been in their position for a minimum of 1 year and a maximum of 10 years, however, they had all been involved in the fishing sector for a minimum of 10 years. Interview times ranged from 30 minutes to 1.5 hours.

Results

Cross-scale governance structures

Fisheries governance in the Comoros is informally shared among state fisheries departments, national and island fishing syndicates, and village fishing associations (Figure 3). Although the overall development and management of fisheries is shared among the three levels of authority, the actual implementation of management strategies is largely undertaken at the local level. The national government maintains no formal regulations on fishing and due to limited staff, resources, expertise, and funding, they have little capacity for effective management. As a result, local fishing associations have taken-on a pivotal role in managing fisheries in their own communities. They function much like cooperatives and collectively design, monitor, and enforce local regulations. Decisions are based on local knowledge and experience, and management strategies are adaptive and based on low-cost practical solutions. Nevertheless, the multi-level fisheries governance structure provides a strong foundation upon which to build effective management strategies.

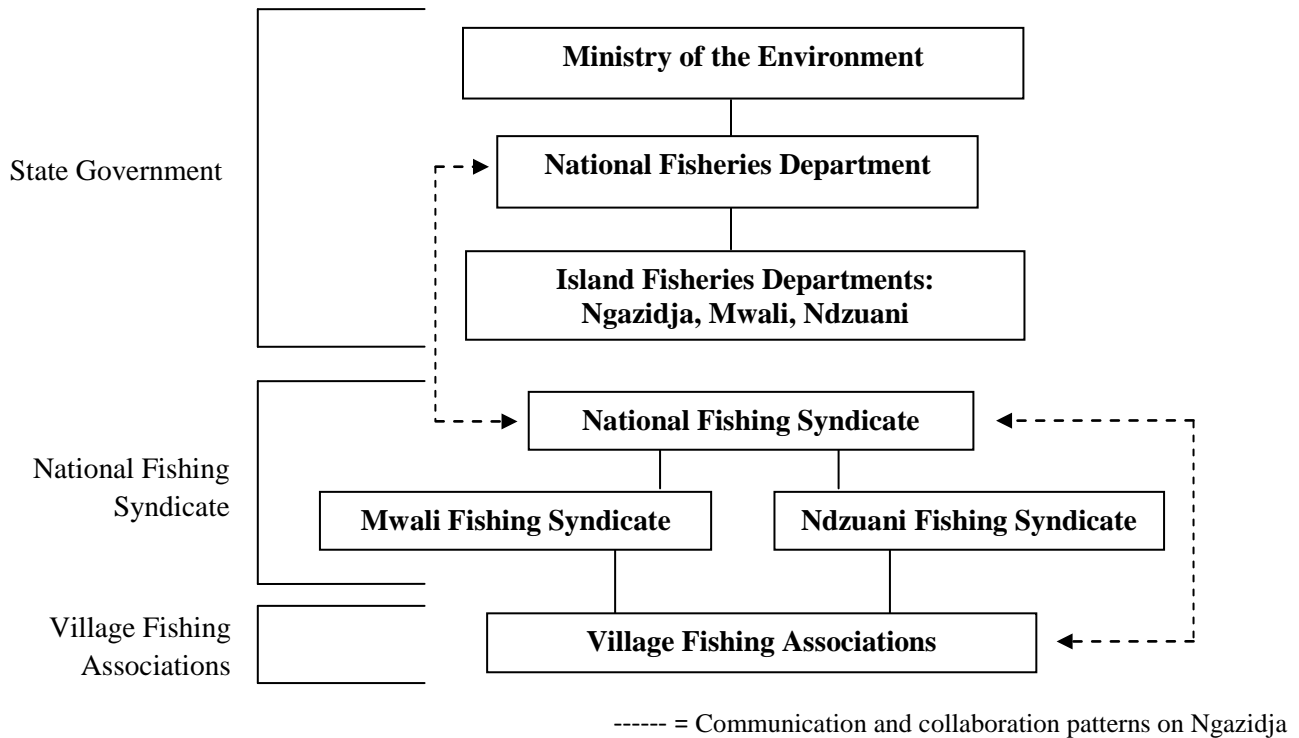


Figure 3 Fisheries governance structures of the Comoros

Village fishing associations work closely with the National Fishing Syndicate. The Syndicate acts as a mediator between local associations and State departments by intervening on behalf of the associations. If an association has problems or project ideas, they will first consult with the National Fishing Syndicate who will then convey the message to the National Fisheries Department, and vice-versa.

Village fishing associations

The creation of village fishing associations stems from an island custom of creating associations for those of like interests and occupations (e.g., cultivators, traditional dancers, weddings). It is a means for villagers to pool finances for projects, to elaborate on new ideas, and to share knowledge and skills. The associations also provide a certain safety net as revenues from the association can be redistributed among members or the wider village to help alleviate the acute effects of poverty (Union of the Comoros 2005). Even the national government has acknowledged that the “associations take initiatives that fill in the gaps left by the State in order to meet the needs of those communities” (Union of the Comoros 2007, p. 24). These associations are equally capable of adapting to the growing and changing needs of the population. For example, an increasingly large percentage of the funds collected during ‘big wedding’ ceremonies are redistributed to help with community development projects; e.g., installation of water pumps and construction of youth centres. Thus, in light of the current limited capacity and resources of the national government, the answer to creating effective fisheries management structures may lie in strengthening the capacity of existing local organizations so that they may play a larger role in managing their own resources.

Each fishing village on Ngazidja has a local fishing association. Initially, the associations were quite informal and acted more as a means of creating feelings of unity among fishers and providing financial assistance. Many of these associations, however, have since grown into impressively organized and self-reliant institutions. They are almost solely responsible for managing fisheries in their communities, including financing the majority of their fisheries development projects. Associations are designed to enable the development of the sector, to better manage and regulate local fisheries, and to empower users through participation. The formation of user groups is allowed under Comorian legislation, however, it does not permit user groups to devise and legally implement management regulations. Nevertheless, local fishing regulations are often respected and enforced by the gendarmerie.

Each fishing association has a management committee which is elected by local fishers. They are selected according to their knowledge, skills, and social status. A president, for example, is often an older, experienced fisher who has earned the respect of others and has strong leadership skills. A secretary, on the other hand, may have little knowledge of fishing but is often formally educated, and therefore, able to perform secretarial duties that could be difficult for others with lower literacy levels.

Membership and collective-financing

Membership within fishing associations is mandatory for all fishers using motorized boats and optional for fishers using traditional canoes. Most associations require an entrance fee to become a member (e.g., ~60€powerboat) and daily or monthly contributions thereafter (e.g., 1 fish/day for every ~15 caught). Powerboat fishers generally rent their boats, so fees and contributions are the responsibility of boat owners, not fishers. Traditional canoe fishers are not obliged to pay fees as they tend to catch smaller quantities and fish closer to shore. A substantial portion of the fees are used for the search and rescue of lost powerboat fishers, and the remaining fees contribute to fisheries management and development within respective communities. For example, in some of the study sites, membership fees have contributed to the construction of a boat ramp, building sheds to store outboard motors and other equipment, and providing credit to fishers who wish to buy a motor or boat.

Customary fisheries management regulations

Fishing associations employ a variety of customary fishing regulations including gear, spatial, and species restrictions (Table 5). Catch and temporal restrictions also exist though are based on social taboos, not actual regulations employed by the fishing association. Interestingly, with exception to the rules regarding fishing gear and practices, fishing in the Comoros is entirely open-access and there is no desire among fishers to implement regulations on user access-rights, i.e., by placing restrictions on who may enter the fishery, how much they can harvest, and when they can harvest. Instead, fishers believe very strongly in allowing all fishers to fish wherever and whenever they like - primarily in light of maintaining solidarity and reciprocity among Comorian fishers. Although fishers claim that since 'the time of their ancestors', the sea has belonged to everyone, interviews with the National Fishing Syndicate revealed that prior to 1978, fishing villages enforced fishing boundaries much more strictly. At that time, it was viewed as an insult if a fisher from a neighbouring village fished in front of another village. Now, according to the President of the National Fishing Syndicate, while this is still looked down upon, "fishers have realized that management is best done by stopping destructive techniques, rather than having limiting boundaries". Moreover, with the arrival of powerboats, fishing zones

and target species have changed significantly, making the enforcement of near-shore fishing boundaries less applicable. Thus, although traditional fishing grounds and clearly-defined boundaries exist in all villages, and fishers monitor and enforce regulations in these areas, they believe equally strongly in the values of reciprocity, including the freedom to fish where one pleases. To restrict the access of others would mean that they would also be restricted from fishing within the grounds near other villages.

Regulations are informal and site-specific although most associations submit their rules regarding fishing gear bans to the justice institute so that they may punish offenders through the legal system when necessary - though as mentioned above, this is not formally recognized under Comorian law. Rules are often created on an ad hoc basis as new issues arise. They are also adaptive and often modified to changing needs and environments. Regulations are first proposed by a management committee member or a fisher, and then discussed and voted on by all fishers. It is a highly-participatory process that engages both resource users and managers, and helps to ensure higher compliance rates.

Table 5 Customary fishing regulations in study sites on Ngazidja

Fishing Regulations	Description
Gear Restrictions	Gillnets, dynamite, and the use of ichthyotoxic plants (<i>Tephrosia vogelii</i>) are prohibited in all study sites. The use of lanterns while fishing at night is prohibited in Chindini and Hantsindzi.
Spatial Restrictions	Within community fishing grounds, locally determined gear and species restrictions also apply to outside users.
Species Restrictions	Skipjack tuna (<i>Katsuwonus pelamis</i>) and Indian mackerel (<i>Rastrelliger kanagurta</i>) are banned for use as bait in Chindini and Hantsindzi.
Catch Restrictions (social taboos)	There are no formal catch restrictions; however, social and cultural norms look unfavourably upon greed and wastage. Harvesting more than can be consumed or sold daily is uncommon.
Temporal restrictions (social taboos)	There are no temporal restrictions in terms of times of day, seasons, etc., though it is generally looked down upon if people fish on Fridays, the day of the Muslim <i>jumu'ah</i> prayer.

Most fishing gear bans were adopted as fishers began to notice the negative environmental consequences of using certain gears. The prohibition of dynamite, gillnets, and ichthyotoxic plants is fairly self-explanatory, however, the reasoning behind fishing with a lantern at night and using certain species as bait stems primarily from social taboos against greed and wastage. For instance, many fishers believe that using lanterns at night makes it far too easy to capture fish. They fear that fish will become so drawn to the lights at night that they will no longer feed during daylight hours, making them impossible to catch. The same reasoning is used for the prohibition of using tuna or mackerel as bait. Fishers in Chindini and Hantsindzi believe that fish will become habituated to fish meat so that they no longer take to plastic bait, making it difficult for other fishers. Others also believe that using fish as bait is wasteful. While the reasoning behind some of these prohibitions may be false, the logic stems from a drive to regulate harvests and ensure a certain amount of equity among fishers. All of those interviewed believed that fish stocks and marine habitats had improved since the gear prohibitions.

Compliance rates to fishing regulations are very high, with intra-village infringements being extremely rare. Many fishers passionately expressed their willingness to enforce local fishing

gear bans as they believe so adamantly in their importance. A management committee member from Chindini stated, “there is a second government here in the Comoros: the village. If the government does not want to enforce regulations, we will do it ourselves”. Another management committee member from Hantsambou stated, “whoever is found using prohibited fishing methods will be beaten-up and their materials will be destroyed. Even if the police tell us not to do this, we will still do it as we want people to respect the rules”.

User monitoring and enforcement of regulations

Monitoring and enforcement of regulations is conducted by the fishers and the association’s management committee. It is the most effective, low-cost, and practical option available. It empowers fishers with being responsible over their own resources and ensures greater compliance. Also, as fishers participated in the creation of these regulations, they are enforcing rules that they themselves believe are important.

Penalties for those who break the rules are very specific and may include one or a combination of: fines, temporal fishing bans, physical assault, destruction of fishing gear, and imprisonment. If the rule violations are repeated, the severity of the penalty increases. Physical assault and the destruction of fishing gear is most often use for infringements of fishing gear bans, and the remainder are more common for infringements of safety and/or administrative regulations.

Fisheries Conflicts

Fisheries conflicts on Ngazidja seem to be primarily of short duration and medium- to high-intensity. Using the scale presented in Table 6, most fisheries conflicts in the Comoros can be categorized as level 3 and 4. There have been no conflicts over access-rights or actual resources. Instead, fisheries conflicts are primarily related to management practices and gear prohibitions. Conflicts which go beyond the scope of fisheries (e.g., intra-village conflicts related to historical tensions) tend to last much longer, be less intense, and flare-up from time to time. All of those interviewed believed that their conflict management strategies are effective. They attempt to solve problems within their village - through the fishers association and/or village chief, and only if things get out of hand do they call the gendarmerie or seek intervention from the State.

Table 6 Conflict intensity scale

Intensity	Level		Description
None	1	Non-violent, latent conflict	A positional difference over definable values
	2	Non-violent, manifest conflict	Verbal pressure, threat of violence, economic sanctions
Moderate	3	Crisis, partly violent	Tense situation in which at least one party uses sporadic violent force
High	4	Serious crisis, repeated and / or organized use of violence	Severe conflict where violent force is organized and used repeatedly
	5	War	Systematically organized violent force using extensive measures

Based on the Heidelberg Institute for International Conflict Research *Conflict Barometer* (2008)

Inter-village conflicts occur primarily over gear restrictions and tend to be more violent than conflicts between fishers of the same village. These conflicts are infrequent, occurring every couple years per village. They are often of high-intensity but short duration, lasting from 1-2

days to one week. A typical conflict involves a group of fishers from one village catching a fisher from another village using prohibited fishing gear within the boundaries of the former fishers' village. Awareness of village-specific fishing gear prohibitions is widespread, so the enforcing fisher(s) tend to resort quickly to violence (i.e., physically assaulting the fisher, sinking his boat, and destroying his gear). If the conflict does not subside here, then more fishers from the village may get involved, and/or the gendarmerie. In a few extreme situations, military intervention was required to restore order.

Intra-village conflicts are uncommon. Solidarity, particularly within a village, is so strong among fishers that conflict tends to be rare. Moreover, as association management practices and structures develop, fishers tend to be more involved in decision-making and management activities, thus increasing compliance and reducing incidents of conflict. Past disputes within villages were most often related to disobeying safety or association regulations; e.g., fishing alone rather than in pairs. However, some more prominent conflicts led to the creation of a second fishing association in two of the study sites. While these disputes became escalated, they eventually resulted in redefining regulations pertaining to management structures and clarifying the rights of fishers and management committees. The conflicts also seemed to bring about productive working relations between the two associations as they now follow the same regulations and often work together on fisheries development projects.

Mild tension between fishers and the state government exists as many fishers do not feel they are supported or respected by the state. During part of the fieldwork for this research (November 2009), fishers and fish vendors went on strike nationwide. The strike lasted over 2 weeks and sought to bring public and government attention to the lack of governmental support of the fishing sector: one of its main industries and most important food sources. The National Fishing Syndicate and village fishing associations joined forces to request that the government offer subsidized fuel prices for fishers and more capacity development, equipment, and financial support for the sector. The result was a 25KmF/L (~0.05€) reduction in fuel prices and a general agreement to provide increasing support. It remains to be seen specifically how and when this support will take effect. Nevertheless, fishers succeeded in drawing attention to their undervalued importance in Comorian society and their ability to incite change.

Discussion

Results suggest that local governance institutions on Ngazidja fulfill most of the criteria touted as 'critical' for effective and sustainable governance of common-property resources (Table 7). Moreover, the success of local governance systems seems to be achieved not only through the characteristics of robust institutions, but also through the shared values of reciprocity, trust, invested interests, and solidarity which provide the ultimate incentive not to overexploit or disobey the rules. The results demonstrate that local fishing associations have the ability to regulate resource users and control exploitation levels. However, it is yet to be determined whether management strategies are effective not only at managing people, but also at conserving marine ecosystems. Moreover, while the structure and foundation for effective and sustainable multi-layered governance is in place, additional research and capacity building are needed in several key areas to strengthen each institution's ability to manage fisheries.

Table 7 Key characteristics of effective and sustainable local governance institutions on Ngazidja

Key characteristics of local institutions on Ngazidja	Sustainability Indicators									Effectiveness Indicators								
	Management Effectiveness	Use of traditional methods	Incorporates local input	Capacity-building	Institutional viability	Simple, key rules	Dual enforcement	Adaptability	Ownership	Change is moderate	Clearly defined boundaries	Costs & benefits	Collective-choice	Monitoring of rules	Graduated Sanctions	Conflict resolution	Right to organize	Nested Enterprises
High compliance rates to local regulations	√	√	√			√	√	√	√*			√	√	√	√		√	
Direct involvement of fishers in management, decision-making, monitoring, and enforcement	√	√	√	√		√	√	√	√		√		√	√		√		
Funding for local projects is largely obtained through fisher contributions			√	√	√			√	√									
Association leaders are respected and electoral procedures abide by local customs	√	√	√	√				√	√			√					√	
Resource conflicts are relatively infrequent and quickly resolved via culturally appropriate mechanisms							√							√	√			
Cross-scale linkages exist between the three levels of governance	√		√	√	√		√					√			√	√	√	
National Fishing Syndicate acts on behalf of fisher needs and interests																		√
Use of traditional knowledge and methods		√	√							√		√						
Government and enforcement authorities respect fishers' right to organize and create local regulations	√		√		√				√		√	√					√	
Comorian society remains significantly isolated from outside influences										√								

*Users do not have actual legal ownership over the resource, however, they feel and act as if they do, leading to behaviours which promote sustainable use.

Table 7 presents some of the key characteristics of local governance institutions which fulfill the sustainability and effectiveness indicators mentioned earlier. Note that the sustainability and effectiveness indicators which overlap have been combined to avoid redundancy. A brief discussion of some of the main strengths and weaknesses of local governance institutions is provided below.

Key strengths of local governance institutions

Local fishing associations are characterized by qualities which empower and engage resource users and local managers, resulting in high compliance rates, social capital, and ultimately, effective governance processes.

i. Strong feelings of solidarity, trust, and reciprocity

Although these values (or user characteristics) do not fit within the framework of the sustainability or effectiveness indicators, they are prominent among fisher communities and greatly influence behaviour. Ultimately, it is these underlying values, or feelings, which provide users with the incentive to comply with regulations.

ii. Highly-participatory

Fishers are directly involved in decision-making and monitoring. This results in users feeling they have a direct stake within their fishery, greatly enhancing their sense of responsibility and invested-interests.

iii. Nested enterprises

Nested enterprises is a key characteristic of both effective and sustainable institutions. Although local fishing associations demonstrate their ability to function independently, being 'nested' within larger-scale organizations provides local institutions with assistance resolving problems or conflicts when necessary. Larger organizations also have access to resources (e.g., external funding for projects, diverse management tools) that local associations may not have access to on their own. Likewise, local institutions can provide current information on marine resources that larger organizations do not have the time or resources to collect. This polycentric structure thus provides opportunity for use of a blend of knowledge sources and approaches which can enhance the overall adaptability and resilience of the fishery system.

Primary weaknesses of local governance institutions

1. Limited access to scientific fisheries information

Fishers in the Comoros demonstrate extensive local and traditional knowledge of marine resources and have always managed fisheries from this framework. However, with increasing local and external pressures on marine ecosystems, fishers and local managers need a wider range of management tools at their disposal in order to continue to adapt effectively to changing environments. The combination of local knowledge with more modern skills and approaches will likely enhance their ability to monitor resources effectively and adapt their management methods accordingly.

2. External threats

With such a high population density, particularly along the coast, controlling fisher behaviour and harvests may not be enough to achieve sustainable use and conservation of marine resources. Coasts and reefs around the Comoros are under serious threat from household waste and pollution, destructive reef gleaning practices, and coastal development. Moreover, although the fishing associations in this case-study are well-organized and enforce regulations which control fishing practices, not all communities are the same. The weak capacity of the state government also translates into an inconsistent regional and national approach to coastal management and a complete lack of knowledge about the current or historical status of marine ecosystems. Nevertheless, there is hope that the current National Fishing Syndicate will be better able to fill these gaps and act as a bridge between local and national governance agencies.

3. Institutional viability

Although membership fees and contributions facilitate fishery development projects and management within communities, and the state does not interfere in local governance, institutional viability may still be considered weak for two reasons. First, neither local nor state institutions have long-term financial security. Local associations have limited funds which could be quickly exhausted by unforeseen circumstances. The state government has also been in a financial crisis for years, resulting in civil servants being unpaid for 8 - 12 months at a time and leaving little money for research or development projects. Second, interviews with fishers suggest a lack of state support (i.e., moral, political, financial) for local governance institutions. This tends to impede the ability for local associations to move forward with fisheries management and development as they lack access to the tools and information necessary to do so. Nevertheless, it is important to note that the long history of weak, centralized governmental support is the reason that local organizations have evolved into effective and independent governing institutions. Also, as relations between local associations and the National Fishing Syndicate strengthen, there is greater possibility to significantly enhance the financial and adaptive capacity of local associations to govern fisheries effectively.

Conclusion

In conclusion, the results presented in this paper demonstrate that fisheries governance structures on Ngazidja provide a sound platform from which to build effective management strategies. The next steps will be to augment effectiveness by enhancing the capacity of local associations to monitor marine resources to ensure fishing regulations are appropriate and practices are sustainable. The ultimate goal is to transform effective institutional structures and processes into effective practices. A few key recommendations are provided and focus on low-cost, practical solutions that would be easy to implement and maintain in the context of unstable political and financial situations. Solutions concentrate on working with the limited resources and current capacity of each of the organizations. Imposing new structures or projects which require increased funding and/or expertise are not a sustainable solution at this time.

1. Increase cooperation and information sharing among the three levels of governance to enhance the capacity of each organization to manage fisheries. Village fishing associations should be better informed of the diversity of management options available to them so that they may improve and adapt management practices when necessary.

Likewise, government officials need increased training in alternative fisheries management approaches; e.g., ecosystem-based management and adaptive management, as they are somewhat constrained by their training in conventional Western ideologies of fisheries management.

2. Train expert fishers and local association authorities to gather baseline data on fishing effort and marine resources in their communities.
3. Conduct pilot projects in select villages to test key management tools; e.g., temporal or area closures, minimum allowable hook sizes, etc.
4. Fisheries departments, syndicates, and local associations may want to explore the costs and benefits of formalizing their current multi-layered structure into co-management. Perhaps by more thoroughly defining the structure and role of each organization, and their relationship to one another, management and task completion can become more efficient.
5. Conduct a 'futures scenarios' workshop where groups of fisheries stakeholders work together to agree on desired fisheries outcomes and how to best achieve them (see: Andrew 2007; Pauly et al. 2003).

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References

- Acheson, J., Wilson, J., and Steneck, R. 1998. Managing chaotic fisheries. *In* Berkes, F. and Folke, C. (eds), *Linking social and ecological systems: management practices and social mechanisms for building resilience* (pp. 390 – 413). Cambridge, UK: Cambridge University Press.
- Allison, E.H. and Ellis, F. 2001. The livelihoods approach and management of small-scale fisheries. *Marine Policy* 25: 377 - 388.
- Andrew, N.L., Béné, C., Hall, S.J., Allison, E.H., Heck, S., and Blake, D.R. 2007. Diagnosis and management of small-scale fisheries in developing countries. *Fish and Fisheries* 8: 227 - 240.
- Anderies, J.M., Walker, B.H., and Kinzig, A.P. 2006. Fifteen weddings and a funeral: case studies and resilience-based management. *Ecology and Society* 11: 21.
- Basutro, X. and Coleman, E. 2010. Institutional and ecological interplay for successful self-governance of community-based fisheries. *Ecological Economics* 69: 1094 - 1103.
- Berkes, F. and Folke, C. 1998. Linking social and ecological systems for resilience and sustainability. *In* Berkes, F. and Folke, C. (eds), *Linking social and ecological systems:*

- management practices and social mechanisms for building resilience* (pp. 1 – 25). Cambridge, UK: Cambridge University Press.
- Berkes, F., Mahon, R., McConney, P., Pollnac, R., and Pomeroy, R. 2001. *Managing small-scale fisheries: Alternative directions and methods*. Ottawa, Canada: IDRC.
- Bostford, L.W., Castilla, J.C., and Peterson, C.H. 1997. The management of fisheries and marine ecosystems. *Science* 277: 509-515.
- Charles, A.T. 2001. *Sustainable fishery systems*. Oxford, UK: Blackwell Science.
- Cinner, J.E. and Aswani, S. 2007. Integrating customary management into marine conservation. *Biological Conservation* 140: 201 - 216.
- Defeo, O., McClanahan, T.R., and Castilla, J.C. 2007. A brief history on fisheries management with emphasis on societal participatory roles. *In* McClanahan, T.R. and Castilla, J.C. (eds), *Fisheries management: progress toward sustainability* (pp. 305 – 326). Oxford, UK: Blackwell.
- Folke, C., Berkes, F., and Colding, J. 2001. Ecological practices and social mechanisms for building resilience and sustainability. *In* Berkes, F. and Folke, C. (eds), *Linking social and ecological systems: management practices and social mechanisms for building resilience* (pp. 414 - 436). Cambridge, UK: Cambridge University Press.
- Folke, C., S. Carpenter, B. Walker, M. Scheffer, T. Elmqvist, L. Gunderson, and C.S. Holling. 2004. Regime shifts, resilience, and biodiversity in ecosystem management. *Annual Review of Ecology and Systematics* 35: 557-581.
- Heidelberg Institute for International Conflict Resolution. 2008. *Conflict Barometer 2008*. Heidelberg, Germany: Author.
- Holling, C.S. 2001. Understanding the complexity of economic, ecological, and social systems. *Ecosystems* 4: 390-405.
- McClanahan, T. R. and Castilla, J.C. 2007. Healing fisheries. *In* McClanahan, T.R. and Castilla, J.C. (eds), *Fisheries management: progress toward sustainability* (pp. 305 – 326). Oxford, UK: Blackwell.
- McClanahan, T.R. et al. 2008. Conservation action in a changing climate. *Conservation Letters* 1: 53 - 59.
- North, D.C. 1990. *Institutions, institutional change and economic performance*. Cambridge, UK: Cambridge University Press.
- Ostrom, E. 1992. The rudiments of a theory, the origins, survival, and performance of common-property institutions. *In* Bromely, D. W. et al. (eds), 2000. *Making the commons work: theory, practice and policy* (pp. 293 - 318). San Francisco: ISC press.
- Ostrom, E. 2005. *Understanding institutional diversity*. Princeton, New Jersey: Princeton University Press.
- Pauly, D., Alder, J., Bennett, E., Christensen, V., Tyedmers, P., and Watson, R. 2003. The future for fisheries. *Science* 302: 1359–1361.
- UNDP. 2007. *Report of the Union of the Comoros*. Strengthening state capacity in Africa, African governance forum, Ouagadougou, Burkina Faso, 24-26 October 2007. Moroni, Comoros: Author.
- UNDP. 2009. *Human development report 2009*. Available at: <http://hdr.undp.org>
- Union of the Comoros. 2005. *Document de stratégie de croissance et de réduction de la pauvreté*. Moroni, Comoros: Ministère du Plan, de l'Aménagement du Territoire, de l'Énergie et de l'Urbanisme.

Walker, B., Holling, C.S., Carpenter, S.R., and Kinzig, A. 2004. Resilience, adaptability and transformability in social–ecological systems. *Ecology and Society* 9: 5.