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Ostrom's Governance Principles and Sustainable Financing of Fish Reserves

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Abstract
Previous studies on community-based natural resource management have repeatedly underlined the significance of the design principles for sustainable commons governance developed by Elinor Ostrom. In this paper, we apply the principles heuristically to the case of the Sikunga Channel Fish Protection Area (FPA), a recently established fish reserve in the Upper Zambezi in Namibia. Based on qualitative fieldwork including semi-structured household interviews, expert interviews, focus group discussions and participant observation, we assess the utility of Ostrom's design principles as guidance for promoting sustainable fisheries co-management structures. Our results indicate that the lack of a sustainable financing mechanism is both a major source of resentments at Sikunga and the main obstacle for sound resource management, endangering the long-term effectiveness and social acceptance of the fish reserve.

Keywords Community-based natural resource management · Co-management · Fish reserve · Commons governance · Conservation financing · Namibia

Introduction

Inland water systems are among the most productive socio-ecological systems. Human dependence on their ecosystem services is significant (Welcomme *et al.* 2010; Welcomme 2011). Yet inland water systems, including inland fisheries, are severely affected by overuse and degradation (Allan *et al.* 2005; Vörösmarty *et al.* 2010; Gardner *et al.* 2015). Conventional fisheries management has been criticised for its lack of inclusiveness and narrowly defined objectives (Pauly *et al.* 2002; Nielsen *et al.* 2004). Instead, fisheries co-management is assumed to better account for both social and environmental sustainability concerns (Viswanathan *et al.* 2003). A recent meta-analysis by d'Armengol *et al.* (2018) confirms this for small-scale fisheries. Co-management refers to the sharing of both power and responsibility among different actors (Berkes 2009). In fisheries, it also includes the negotiation and acceptance of rules in collectively used resource systems. Therefore, research on the possible conditions under which the rules become well-functioning is highly relevant for fisheries co-management.

Elinor Ostrom's work on rules and conditions for sustainable common pool resource (CPR) management (Ostrom 1990; Ostrom *et al.* 1999) has resulted in diverse applications of the design principles she proposes in the field of fisheries (Pomeroy and Williams 1994; Levine and Richmond 2015; Partelow 2015; d'Armengol *et al.* 2018). Ostrom's work has significantly changed our understanding of how local resource users can manage their commons and which institutional settings fare better with managing common property than others. Contextual factors (e.g., rule of law and access to markets) and user group features (e.g., social cohesion and dependence on resources) influence whether CPRs are over-exploited or sustainably managed (Adams *et al.* 2003). Therefore, and inspired by Ostrom, guidebooks on sustainable fisheries and co-management consider wider context and common property governance aspects, in addition to the more technical tools and management measures (Pomeroy and Rivera-Guieb 2006; Cochrane and Garcia 2009). However, this has not led to a larger scale change in policies and conservation practice in inland fisheries (Andrew *et al.* 2007; Cooke *et al.* 2016).

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Ostrom's principles are well established as a diagnostic framework in social-ecological research, but do not seem to prominently guide implementation efforts on the ground.

One reason may be that scholars who applied Ostrom's work to fisheries management around the globe (e.g., Yandle 2003; Levine and Richmond 2015; Trimble and Berkes 2015) seem to disagree about the relative importance of some of her design principles. Also, the number of variables that (should, or) have been examined in 'Ostrom-inspired' analyses of social-ecological systems is very large (Agrawal 2001; Basurto *et al.* 2013; d'Armengol *et al.* 2018). This illustrates the complexities involved and raises doubts as to whether the much shorter list of generic CPR principles can convincingly inform the design of fisheries co-management. Thirdly, the CPR principles seem to have been drowned in an even larger list of 'do's and don'ts,' as in the FAO Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries (FAO 2015). These guidelines are an internationally agreed policy instrument, and thus not only the reflection of realities on the ground but the result of negotiations, combining some of Ostrom's principles (adjudication, participation, tenure rights, coordination, use rules) with broader issues such as access to schools, gender equality, fair treatment of migrants, and similar. Fourthly, the paradigm of 'fisheries co-management' – and with it of CPR concepts and terminology – seems to have lost attraction in international policy discourse. In the 227-page FAO's State of World Fisheries and Aquaculture Report 2018, 'co-management' or 'co-managed' is mentioned four times only, whereas 'small-scale fisheries' has 95 mentions (FAO 2018). The latter term is less explicit regarding the need for resource users themselves to reach and maintain functioning and fair agreements in a CPR setting. In light of these observations, the relevance of Ostrom's CPR principles for guiding fisheries co-management in practice seems limited. The actual implementation of the principles simply does not correlate with their scientific appeal and explanatory power.

Against this backdrop, we ask: Can Ostrom's CPR principles support the process of setting up a co-management arrangement? They describe conditions under which CPR regimes are particularly feasible while neglecting the temporal dimension and practical socioeconomic dynamics involved in establishing a co-management regime. In other words: Even though these design principles are embedded in Ostrom's larger *diagnostic* framework for the analysis of social-ecological systems, can they also serve as action-oriented *guidance* for future interventions (cf. Cox *et al.* 2010; Trimble and Berkes 2015)?

We approach this issue by applying a version of Ostrom's principles that has been adapted to the context of fisheries by Pomeroy and Williams (1994) to the early-stage co-management efforts at the Upper Zambezi in Namibia, known as Sikunga Channel Fish Protection Area (FPA). This fish reserve has recently been established by local stakeholders such as fishermen, Traditional Authorities (TA), and tourist operators in liaison with government actors in a complex situation of competing fish resource uses, low enforcement of fisheries regulations, and looming overexploitation. We specifically explore how Ostrom's principles – used as a heuristic – serve to inform and consolidate the structure and management of the recently established Sikunga FPA. We test each principle against the realities observed in the Sikunga FPA in order to identify gaps that exist between the principles and actual implementations. Insights from this case have the potential to refine our current understanding of how these principles can support sustainable inland fisheries within and beyond the Namibian context.

We first present Ostrom's principles, their application in the field of fisheries co-management, and the analytical framework of this study, followed by an overview of our methodology. We next describe the context of fisheries at the Upper Zambezi and introduce the case study. We then apply the design principles one by one to the case of Sikunga. Following a discussion of our findings with an emphasis on the issue of sustainable financing, we conclude with a summary of our main findings and recommendations for further research.

Ostrom's Governance Principles in Fisheries Co-Management

Ostrom (1990) originally suggested eight design principles for robust commons governance that have been adopted by many commons scholars to analyse common property institutions such as co-management regimes. Based on the synthesis of 91 studies that evaluated Ostrom's principles in the context of communities managing common pool resources, Cox *et al.* (2010) conclude that they are well supported empirically. The incompleteness of the set of principles is the most significant empirical critique found in the literature under analysis, mainly regarding social variables, relevant properties of the resource system, and external factors (ibid.). Baggio *et al.* (2016) also emphasise that the importance of each design principle for the success of CPR management regimes depends on the respective characteristics of natural and hard human-made infrastructure (i.e., technology). Several scholars of the commons have refined the principles further and proposed adjusted versions of them (e.g., Cinner *et al.* 2009). Consequently, different variants of Ostrom's design principles exist in the scientific literature.

Ostrom's design principles are also applied to fisheries co-management (e.g., Serafini *et al.* 2017). The concept of fisheries co-management is increasingly recognised among governments, development agencies and academics as a promising way to provide for more equitable, efficient and sustainable systems of fisheries management than centralised government intervention (Nielsen *et al.* 2004). Co-management

regimes figure between pure state property and communal property regimes, with an institutional design that includes the sharing of costs and benefits (Trimble and Berkes 2015). Co-management covers different kinds of organisational arrangements and degrees of integration of centralised and local management systems (Pomeroy and Williams 1994; Sen and Nielsen 1996; Pomeroy and Berkes 1997; Yandle 2003).

Initially, fisheries co-management was mostly understood as a power-sharing arrangement between the government and local fishing community (e.g., Pinkerton 1989; Pomeroy and Berkes 1997). Over time, the concept has become more complex, accounting for the multiplicity of stakeholders and relationships involved (Trimble and Berkes 2015). It is often viewed as a more democratic governance system as resource users are given a voice in determining rights over the fishery and are endowed with certain decision-making authority (Viswanathan *et al.* 2003; CAPRi 2010). However, co-management should not be considered a panacea for all existing problems with fisheries, but rather as a set of management strategies appropriate for specific areas and circumstances (Pomeroy and Williams 1994). Moreover, the concept has been defined and adapted differently in various contexts and remains rather vague (Nielsen *et al.* 2004).

While there is an abundance of literature discussing Ostrom's work and the number of studies in the field of fisheries co-management has also been increasing (in line with efforts to establish co-management regimes), there are few cases in which Ostrom's principles have been explicitly applied to assess and guide existing or planned co-management institutions. Some of the more recent examples include Cinner *et al.* (2009), who assess the degree to which the co-management frameworks for inshore marine resources in Kenya and Madagascar entail the design principles to identify potential institutional gaps. Both Yandle (2003) and Levine and Richmond (2015) use the principles to assess the likelihood of success: the former was applied to the development of a co-management approach in New Zealand and the role of commercial stakeholder organisations, whereas the latter evaluates the outcomes of emerging co-management regimes in American Samoa and Hawaii, and explicitly confirms the utility of the design principles as a framework to predict the likely success of fisheries co-management programmes.

Likewise, Napier *et al.* (2005) quantitatively evaluate the relative influence of 16 conditions (including Ostrom's principles) for the success of co-management in South African subsistence fisheries. The approach that bears the most resemblance to our study is Trimble and Berkes's (2015) exploration of whether Ostrom's principles can serve as a guide for policies and initiatives towards adaptive co-management that identified barriers and opportunities for two co-management cases in Brazil and Uruguay. Whereas these studies generally underline the validity of the design principles, they point to, amongst other things, the influence of additional contextual factors (Levine and Richmond 2015), scale issues, and the lack of consideration of social learning in the set of principles (Trimble and Berkes 2015). In general, many of these studies lack an approach through which the design principles could serve more proactively as an orientation for co-management programmes already at an early stage. In addition, little has been discussed about financing co-management and common property regimes as a fundamental institutional condition.

In order to test their empirical usefulness for this specific purpose, we draw on key conditions for successful fisheries co-management that were originally formulated by Pomeroy and Williams (1994) based on Ostrom (1990, 1992) and Pinkerton (1989). These conditions (Annex A) have been further substantiated empirically by Pomeroy and colleagues (Pomeroy *et al.* 1999) based on extensive evidence gained from research on fisheries co-management in Asia.

1) Clearly defined boundaries
2) Membership is clearly defined
3) Group cohesion
4) Existing organisation
5) Benefits exceed costs
6) Participation by those affected
7) Management rules enforced
8) Legal rights to organise
9) Cooperation and leadership at community level
10) Decentralisation and delegation of authority
11) Coordination between government and community

Pomeroy and Williams (1994).

Here, we apply these principles as a heuristic in order to assess the prospects for sustainable fisheries co-management at Sikunga Channel Fish Protection Area (FPA) in the Zambezi Region of Namibia.[1]

Methodology

The lead author conducted field research in Namibia between April and June 2016 in close collaboration with the Namibia Nature Foundation (NNF). The methods used for collecting data in the field were expert interviews, focus group discussions, semi-structured household interviews, and participant observation in the local communities.

In total 21 experts were interviewed including local community leaders and government and NGO representatives, both for explorative purposes and enhancing data

[1] At the time of data collection it was still early to judge the FPA's impact on local fish communities. Whilst acknowledging the importance of the ecological dimension, we here concentrate on the socioeconomic sustainability of the FPA regime.

triangulation. Two focus group discussions were held with the members of the Conservancy Committee. With the assistance of a translator, different participatory appraisal tools were used to engage participants in discussion about pressing issues at Sikunga and preliminary results of the household interviews.

The semi-structured household interviews in the different villages were planned in line with the information gathered during the expert interviews and the first focus group discussion. Seven villages were identified as the main administrative entities in Sikunga and used as basis for analysis. The number of household interviews conducted per village differed according to their accessibility and distance to the regional capital Katima Mulilo. Local community leaders facilitated the researcher's contacts with interview participants in these villages. In total, 51 individuals of 48 households in six out of the seven villages (one village was inaccessible due to flooding) could be interviewed, in most of the cases the head of household (Table 1). Thirty of the interview participants were male and 21 female. Their ages ranged between 22 and 86 years. Particular attention was paid to the locals' problem perception that had originally motivated the establishment of the FPA and the levels of awareness, compliance with, and enforcement of FPA rules. Most of the interviews required translation for Silozi/SiSubia.

Besides the interviews and focus groups, the lead author spent a large share of the fieldwork period on site to observe day-to-day life and become familiar with local routines. Pomeroy and Williams' (1994) 11 key conditions guided the building of categories used to extract relevant information through qualitative content analysis of the data collected.

The Context of Fisheries Co-Management at Sikunga

About 70% of the Namibian population directly rely on natural resources for their livelihoods, and more than 40% of Namibia's landmass is under some form of public, private, or community managed conservation status (MET 2015). Furthermore, the protected area (PA) system has been estimated to contribute more than 6% to the national GDP, much of it related to tourism (Chapeyama 2012). These numbers hint at the importance of environmental benefits to Namibian society, and the significant role played by conservation in this context. Namibia boasts a diversity of conservation governance types and management regimes, each with different financial constraints and opportunities (Turpie *et al.* 2010; NACSO 2015; Berghöfer *et al.* 2017). Expenditures on biodiversity conservation including PAs (from all sources) peaked near N$1.2 billion in 2014/2015 but are expected to stagnate (NNF 2014).

Table 1 Household interview sample: overview

Main villages in Sikunga	Registered households (Source: Village Development Committees)	Households interviewed	Individuals interviewed
Kalimbeza	190	14	14
Keena	150	5	7
Nasisangani	76	5	10
Sifuha	155	14	9
Kalundu	94	6	5
Oldisize[a]	–	–	–
Malindi	88	13	6
In total	**753**	**58**	**51**

[a] This village was inaccessible during the research stay due to flooding

The Zambezi Region (until 2013 known as Caprivi Region) in Northeast Namibia is one of 14 administrative regions, comprising six constituencies and bordered by Angola, Botswana, Zambia, and Zimbabwe. It is often characterised as one of the most resource-rich areas of Namibia (Purvis 2002a). Moreover, the Zambezi is one of Namibia's most significant perennial rivers. The river system consists of extensive floodplains, backwaters, and seasonal and permanent swamps that together form an extremely productive aquatic environment (Naesje *et al.* 2001; Tweddle 2010).

Resembling the diverse patterns of land-water interfaces, the livelihood strategies of the Zambezi floodplain communities are typically described as complex and flexible. Fishing is often one of multiple interlinked livelihood support activities. Other typical activities are livestock and crop production, horticulture, off-farm activities, and tourism (Purvis 2002b; Stephanus *et al.* 2002). In particular, tourism and recreational angling along the great African rivers constitute an important source of income for residents of rural areas, especially in the eastern Zambezi Region. Together with wildlife viewing, angling is regarded as one of the most important tourist attractions due to the large number of excellent local fish species (Naesje *et al.* 2001). This hints at an increased potential for conflict as subsistence, commercial, and recreational fishing compete for the same resources.

In Namibia, the Ministry of Fisheries and Marine Resources (MFMR) has overall responsibility for inland fisheries management. However, in the absence of enforcement of a strong formal fisheries management system (Purvis *et al.* 2003), informal or traditional management structures have persisted in the Zambezi floodplain area. Yet, the traditional management system has come under increasing pressure in the context of demographic growth, commercialisation, weakening of traditional power, and the intrusion of fishermen from outside the region, in particular neighbouring Zambia (Haller 2002; Tvedten 2002; Abbott *et al.* 2003; Abbott *et al.* 2007; New Era: "Illegals, pollution threaten fish resources" 2013; Tjihenuna 2013).

Sikunga Conservancy, one of 82 registered nature conservancies in Namibia, is located in the Zambezi Region about

30 km east of the regional capital Katima Mulilo in Kabbe Constituency. Sikunga was selected as a case study as it is where one of two FPA pilot projects in Namibia has been established. Comprising an area of 287km^2 with approximately 2473 inhabitants in total, the Conservancy was formally gazetted in line with the Nature Conservation Amendment Act of 1996 and started to fully operate in 2010 (NACSO 2018; Tweddle and Hay 2011). The Conservancy Committee is the main management body and consists of 11 women and six men, including Area Representatives that are elected democratically in each of the villages and two representatives of the local Traditional Authorities (TA).

Sikunga Channel Fish Protection Area (FPA) was established within the boundaries of Sikunga Conservancy under Section 22 of the Inland Fisheries Resources Act (IFRA), which allows for the creation of fish reserves upon request by local communities. The initiative was mainly motivated by the recognition of declining fish stocks (related to, inter alia, the use of environmentally damaging fishing gears and in particular the change to monofilament nets) and the urgent need to protect them to ensure long-term sustainability of local fisheries (Denker 2014; Tweddle *et al.* 2015).[2] Another influential factor has arguably been the high influx of illegal fishermen from neighbouring countries, especially Zambia. The management agreement for the FPA (Annex B) was set up by the Conservancy Committee in collaboration with the TA in Bukalo, MFMR, the Zambezi Regional Council, and adjacent tourist lodges. The long-term objective of the fish reserve is to be fully self-sustaining by means of revenue from fee-paying local and tourist catch-and-release-anglers (Tweddle *et al.* unpubl. data). Although the FPA was only gazetted in late 2015, the rules have already been implemented (backed up by the TA) and collaboration with the MFMR has been in place since 2012 (Tweddle and Hay 2011). The local angling club and the tourist lodges supported the establishment of the FPA by making various donations in kind. The Conservancy Committee is now in charge of both the conservancy and fish reserve management.

The FPA encompasses the southern side channel of the Zambezi from the point where it leaves the river to where it exits back into the main river, extending another 50 m into the Zambezi to the eastern boundary of Kalizo Lodge (Annex B). Consequently, the channel itself is closed for netting while the backwaters in the surroundings are still open for local fishermen. Recreational angling is allowed on the channel on a catch-and-release basis. Monitoring and enforcement is done by a number of Fish Guards hired from the local communities.

[2] For a detailed discussion of the 'global overfishing narrative' and how it resonates with fisheries management at the Upper Zambezi see Abbott and Campbell (2009).

Results: Applying the Design Principles to Sikunga Channel FPA

Clearly Defined Boundaries

Sikunga Channel itself is closed for netting, but the backwaters are still open (Annex B). This means the FPA boundaries are not explicitly based on the ecosystem boundaries as recommended by Pomeroy and Williams (1994), but they are clearly laid down in the management agreement. Besides, the size of the fish reserve seems manageable in terms of monitoring. The local fishermen that are directly affected by the restrictions are mostly informed about the FPA boundaries. However, the levels of awareness about the demarcation of the FPA are highly dependent on people's attendance at local community meetings. Some of the local experts indicated that attendance tends to be low at the Conservancy meetings; sometimes not even 200 members attend the Annual General Meetings. In addition, not everyone living within the area of Sikunga is a registered Conservancy member, which means that non-members might be excluded from the information-sharing. The tourist operators and an external expert seriously doubted that the demarcation of the FPA is clear to everyone. Therefore the general level of information among the communities needs to be further assessed and, if necessary, remaining gaps should be addressed.

Clearly Defined Membership

The local resource user group of Sikunga Channel FPA is much smaller than estimated in a previous study by Purvis *et al.* (2003) (Table 2), but the membership is not explicitly defined. Instead, resource use is still largely based on traditional access rights. Fishermen residing in the villages adjacent to Sikunga Channel typically go fishing at and nearby the Channel, whereas fishermen from other villages at Sikunga traditionally have other fishing grounds. Besides owning and allocating the land, the village-level TA has a say in regulating resource access. For example, before the Conservancy and the FPA were established, people wanting to fish at fishing

Table 2 Local fisherfolk

Main villages in Sikunga	Estimated no. of active fishermen
Kalimbeza	14
Keena	5
Nasisangani	5
Sifuha	14
Kalundu	6
Oldisize	<10
Malindi	13
In total	**57**

grounds that belonged to another village had asked for permission of the respective village headman. Allegedly, some locals continue to do this. This indicates that the lack of formally defined membership does not necessarily constitute a problem since traditional access rights continue to be valid and largely function as a substitute.

Group Cohesion

Most of the resource users reside permanently near the protected area, although some temporary fishing camps appear next to the water during high fishing season. There is a relatively high degree of homogeneity among the resource users in terms of fishing gear, ethnicity, and religion, whereas the frequency and intensity of fishing activity differ among them. Most of them use *mokoros* (dugout canoes) and monofilament gill nets; a few also use traditional gears, such as traps or spears. There are also Zambians (both legal and illegal immigrants, Conservancy members and non-members) that reside permanently in Sikunga Conservancy and are actively involved in fishing. Given the geographical and ethnic proximity of Zambia and Namibia in the region, they are not likely to significantly reduce group cohesion within Sikunga (cross-border marriages and family ties were frequently emphasised during the interviews). The household interviews revealed a common understanding of the problems associated with declining fish stocks and illegal fishing (both in terms of illegal fishing gears and illegal fishing by immigrants).

Existing Organisation

The *sub-khuta* (advisory council at village level) and the Conservancy Committee existed at Sikunga prior to the establishment of the FPA and have experience in managing local resources (see also Purvis *et al.* 2003). Both entities proved useful to channel information and facilitate initial discussions about protection measures and later the establishment of the FPA. The membership of the *sub-khuta* is rather limited given that it is traditionally based on family groups and excludes women. However, most of the members of the Conservancy Committee (both men and women) are elected democratically by the Conservancy members. Moreover, the Committee includes one elected representative from each of the seven villages. Currently, the Conservancy Committee fulfils the double function of managing both the nature conservancy and the fish reserve.

Benefits Exceeding Costs

Most of the local interviewees expressed positive feelings about the FPA: the protection of fish stocks was the benefit mentioned most often, followed by the exclusion of foreigners. However, the distribution of benefits is generally viewed much more critically. Not everyone believes that their own local communities will also benefit from the FPA or understands how they themselves might benefit. Several interviewees question the fair distribution of costs and benefits, especially residents of the villages directly affected, village headmen, but also members of the Conservancy Committee. Some of them claim the tourist lodge operators are the main beneficiaries of the FPA given the lack of a formal financing agreement with the recreational angling sector.

At the time of the fieldwork, the local stakeholders had not managed to agree on and impose the angling fee that had originally been envisaged in the management agreement and was supposed to fund the fisheries co-management regime over the long term. Therefore, the Fish Guards are still paid with Conservancy money generated by trophy hunting, which could otherwise be distributed among the Conservancy members as part of the annual cash benefit or invested in community projects. The consequence of this has been notable resentment among the locals, as many perceive that the costs are not shared among the stakeholders but disproportionately borne by the communities.

Participation by those Affected

Several of the village headmen interviewed were active or former fishermen so that some of the *sub-khuta* members are to a certain extent familiar with the situation of the resource users affected. Similarly, some of the Conservancy Committee members are or were previously involved in fishing or fish sale, such as the Vice-Chairperson and the Senior Fish Guard. However, active resource users are generally underrepresented in the decision-making group. In addition, the local community members involved in monitoring local fish catches[3] are not included in the decision-making group (contrary to Pomeroy and Williams' (1994) suggestion). This means that whether resource users feel adequately represented needs to be further clarified and, if necessary, the FPA management can be made more inclusive.

Nevertheless, it is noteworthy that the fishermen were consulted prior to the establishment of the FPA. Local participation in the decision-making process was explicitly encouraged, even though not everyone showed interest in participating. Several interviewees, including opponents of the FPA, confirmed that the establishment process of the FPA had been based on a majority decision. Moreover, the democratic and community-based decision-making at the Conservancy in general was repeatedly emphasised during the interviews.

[3] Two fish monitors from Sikunga employed by NNF have been recording the catches of a random sample of fishermen twice a week at different spots at the river banks and backwaters of Sikunga Conservancy since 2010. The collected data include information about fish species, length and weight per fish, and fishing gear, net length and mesh size used.

Enforcement of Management Rules

The situation at Sikunga still largely corresponds to what has been described by Tvedten (2002) and Purvis *et al.* (2003): There seems to be a notable enforcement vacuum in terms of fisheries legislation. The majority of local interviewees advocate more involvement of both the government and the TA to enhance enforcement in the area. Even although the existing FPA management rules can be considered straightforward (Annex B), monitoring and enforcement are conducted by a small group of officially appointed Fish Guards who have some equipment at their disposal and are currently paid by the Conservancy rather than by all affected resource users. Local community members or the tourist operators may contact the Guards if they observe illegal netting at the FPA, and local fishermen can apply to be Fish Guards and thus become involved in monitoring and enforcement.

According to the Fish Guards, the main obstacles hampering effective enforcement are the lack of a well-defined procedure to be followed when someone is caught netting illegally at the FPA and the unclear division of responsibilities among the locals, the police, and the Ministry of Fisheries and Marine Resources (MFMR). Moreover, the punishment for illegal fishing is claimed to be insufficient. The tourist operators and angling club representatives were quite critical about the enforcement at Sikunga's FPA, especially about the appointment of community members as Fish Guards. Some of them questioned the Fish Guards' commitment to stringent enforcement, given strong family ties or friendships among the locals. Others pointed to the lack of equipment, training, and enforcement authority, which make the Fish Guards' job even more difficult. They also advocated more assistance by the government to enhance enforcement.

Legal Rights to Organise

Sikunga Channel FPA was established under Section 22 of the Inland Fisheries Resources Act (IFRA) that allows for the set-up of fish reserves upon request by local communities. The management agreement for the FPA has been set up by the Conservancy Committee in collaboration with the TA in Bukalo, the Ministry of Fisheries and Marine Resources (MFMR), the Zambezi Regional Council in Katima Mulilo, and adjacent tourist lodges. Enabling legislation was provided for the FPA through a Gazette Notice by MFMR in late 2015. The rules have been implemented supported by the TA and collaboration with the MFMR had been in place since 2012.

Cooperation and Leadership at Community Level

The Conservancy Committee took the responsibility of leadership of the FPA. At first, the local TA was very cooperative and largely supported the establishment process. Now, however, many TA members are more critical of the FPA, mainly because of the financing issue and conflict with the tourist operators. Several of the fishermen interviewed confirmed that there had been declining fish catches; this was also noted by other community members as one of the major problems for local fisheries. Therefore, it can be assumed that the local resource users are generally aware of the problem and the need for fisheries protection and, consequently have an incentive to participate in (or at least support) the FPA initiative (Pomeroy and Williams 1994). However, our interviews revealed that not all fishermen had been interested in or in favour of establishing the FPA. Moreover, the incentive to support the initiative is likely to be eroded if no financing agreement is reached between the Conservancy Committee and tourist operators.

Decentralisation and Delegation of Authority

Certain powers and management functions in the FPA have been devolved to the community level within the framework of the Conservancy structure. However, there are differing views on the devolution of power. A high-raking representative of the MFMR in the Zambezi Region emphasised the general willingness to support fish protection initiatives and the empowerment of local communities on the part of the Ministry. In contrast, one of his colleagues was highly critical about the devolution of authority to the community level, especially in relation to responsible financial management.

Furthermore, representatives from both MFMR and the Ministry of Environment and Tourism (MET) addressed the fact that Namibian Community-Based Natural Resource Management (CBNRM) legislation explicitly mentions only wildlife, but not fisheries. Even though conservancies may register for a fish reserve within their territory under IFRA, this seems to cause some confusion regarding the division of ministerial responsibilities, thereby hampering progress with effective local-level fish protection. Nonetheless, one of the ministerial representatives indicated that an amendment of the Nature Conservation Amendment Act to also include fisheries is already under discussion at a higher level but will likely take more time before it is approved.

Coordination between Government and Community

There is no external representative body yet in place that is in charge of coordination between the government and the local communities. A Regional or Area Fisheries Council or Agency (Purvis *et al.* 2003) had not been established at the time of our fieldwork, although local non-governmental organisations (NGOs), especially Integrated Rural Development and Nature Conservation (IRDNC), play an important coordinating and guiding role though by assisting the Conservancy with management issues. In addition, the Namibia Nature

Foundation (NNF) has been playing an important mediating role between the Conservancy Management and both the tourist lodges and angling club to facilitate a financing agreement for the FPA. This perhaps indicates that the absence of an external coordinating body does not currently constitute a major problem.

Discussion

Based on these results, we argue that most of Pomeroy and Williams' (1994) 11 key principles apply, at least in part, to the case of Sikunga (Table 3). Even though the FPA boundaries are not based on the ecosystem, they are clearly defined (1). However, there is a certain risk that those who do not attend (or are not allowed to attend) the Conservancy meetings are not as well informed about them. Membership is not formally defined (2), but since traditional resource access rights and regulatory mechanisms are still largely accepted this issue seems of minor importance. There is a common understanding of the problem regarding fisheries among the local communities. Moreover, group cohesion is high among local resource users (3), yet likely to be disturbed by foreigners fishing illegally at the FPA in the absence of effective monitoring and enforcement. There were pre-existing organisational entities with resource management experience that facilitated the establishment of the FPA (4).

Principle 5 is clearly not fulfilled, as local communities are deeply concerned about the distribution of costs and benefits. Although they generally feel positive about the fish reserve as such, they are critical about distribution, claiming that the communities bear a disproportionate share of the costs whereas the tourist operators and anglers benefit. Based on our interview findings, it is difficult to judge whether affected resource users feel adequately represented in management (6). The FPA management rules are straightforward and local fishermen can participate in monitoring and enforcement activities through employment as Fish Guards (although employing all of them would not be financially feasible) (7). Nevertheless, the interview findings indicate significant room for improvement in terms of training and equipment for the Fish Guards, enforcement procedures, and government assistance.

Principles 8 and 10 are partly met in Sikunga. Enabling legislation has been passed by the government, despite differing views on the degree to which management authority should be delegated to the community level. The establishment of FPAs might be facilitated in the near future if the Nature Conservation Amendment Act is revised to explicitly cover fisheries. In light of declining fish stocks, there is an incentive for local resource users to support the FPA and comply with the rules (9). However, it is likely to diminish as a result of the conflict over equitable distribution. In the absence of an external coordinating body (11), local NGOs have been playing a pivotal role in supporting local conservation efforts and mediating between the communities and the government.

One key element that emerges from this analysis is that the establishment of a sustainable financing mechanism is crucial for the long-term prospects of the FPA. This is directly related to the distribution of costs and benefits (5 and 9) and indirectly to lack of funding required for effective enforcement (3 and 7). In the absence of such a mechanism these principles will not be adequately fulfilled in the long run which, in turn, will have serious negative consequences for the operation of the co-management regime. This is in line with earlier recommendations made by Pomeroy *et al.* (2001) regarding sufficient, timely, and sustained funding, and reflections by Gutiérrez *et al.* (2011) on the significance of incentives for successful fisheries co-management. While Ostrom's design principles do not address the importance of financing, we highlight four key aspects of this issue here.

Table 3 Key conditions for successful co-management applied to Sikunga FPA

1) Clearly defined boundaries	Partly fulfilled, further research recommended
2) Clearly defined membership	Not fulfilled, but not problematic
3) Group cohesion	Fulfilled, but at risk
4) Existing organisation	Partly fulfilled
5) Benefits exceed costs	Not fulfilled and highly problematic
6) Participation by those affected	Partly fulfilled, further research recommended
7) Enforcement management rules	Partly fulfilled, but room for improvement
8) Legal rights to organise	Fulfilled
9) Cooperation and leadership at community level	Fulfilled, but at risk
10) Decentralisation and delegation of authority	Partly fulfilled
11) Coordination between government and community	Not fulfilled, but not problematic

Effective Management Requires Adequate Financing

The costs of a management regime have to be covered as no property rights regime and no collective culture can fully dispense with monitoring and enforcement tasks. Ostrom's principles can be interpreted as conditions that are conducive to keeping conservation costs low because of local acceptance of use restrictions and the absence of resource conflict. However, costs cannot be reduced to zero because actual work and equipment have to be paid for (Hoggarth *et al.* 1999).

Equally, financing, enforcement, and the success of conservation measures are mutually dependent: The tourist operators

are only willing to contribute more financially if they see that the FPA is effectively enforced. Similarly, recreational anglers are only willing to pay a user fee if they are actually able to catch fish. At the same time, enforcement can only be improved significantly (i.e., more Fish Guards with better training and more sophisticated equipment and procedures) with more financial resources made available. If sustainable financing is not ensured, any conservation achievements are likely to be lost without continuing effective conservation management. Funding volatility seriously impacts conservation outcomes (Chen *et al.* 2014; Berghöfer *et al.* 2017).

Costs and Benefits Need to Be Distributed Fairly

Ostrom's principles emphasise that benefits should outweigh costs so as to ensure long-term acceptance or appropriate incentives for a sustainable resource use regime. This has to be ensured for each stakeholder group involved (Castro and Nielsen 2001): if tourist operators benefit at the expense of local resource users the regime will obviously not work. Moreover, the benefits of sustainable fish supply accrue in the future whereas the opportunity costs of fishing restrictions or increased fishing effort are incurred today. People with limited livelihood opportunities, as in the case of many fishermen at Sikunga, cannot afford long time horizons when it comes to equity (e.g., Halwass *et al.* 2013).[4]

The status quo at Sikunga is highly problematic because the Conservancy is bearing an important share of the financial costs of the FPA. This is not what had originally been laid down in the management plan in agreement with all parties involved. Moreover, as a consequence the Conservancy has less money available to distribute among its members or to invest in community projects. This is likely to further aggravate local resentment towards the tourist operators and increase the potential for conflict. Importantly, with more financial resources available more Fish Guards could be employed from the local communities, providing a stable alternative income opportunity for more local fishermen as compensation for the negative affects of the FPA restrictions. This is likely to enhance the sense of ownership and the acceptance of resource access restrictions and to reduce the probability of non-compliance among local fishermen (Hoggarth *et al.* 1999; Campbell *et al.* 2013).

Transparency about the Financing Is Crucial for Legitimacy Reasons

Apart from the need for a fair distribution of costs and benefits, financial transparency seems of equally critical importance to stakeholders' perceptions of fair distribution. Doubts about conservation-related funding flows or benefits can severely undermine the legitimacy of the management regime and favourable local pro-conservation attitudes (Cinner *et al.* 2014). This seems intuitively not very surprising, but it requires close attention to financial procedures and appropriate communication (Kaplan and McCay 2004). Unless local resource users have good reasons to trust established procedures and accounting, there are always opportunities for doubts to flourish. Even though the FPA protects a public good, different benefits go to different people, including the cash benefits from conservation expenditures. This is conducive to mistrust, and a transparent financial mechanisms is key to earn the trust necessary for sustaining the FPA in the long term.

It is evident that misinformation strongly influences local attitude towards other stakeholders; therefore it is very important that the Conservancy Management communicates more openly about contributions by different stakeholders (including employment generated through tourism and donations by the tourist operators). It should, however, be taken into account that many Conservancy members may not possess the skills to understand unfamiliar financial management procedures (Bollig and Menestrey Schwieger 2014). Overall, enhanced communication between management and stakeholders is likely to contribute to a climate of cooperation and mutual trust (Mikalsen and Jentoft 2001).

The Source of Funding Needs to Be Adequate

Napier *et al.* (2005), recognising the general importance of funding for successful co-management, advocate the funding of co-management by local or national governmental authorities since local stakeholders generally have a limited ability to contribute financially. In cases of persistent poverty in local communities, and resources not suited for commercialisation, it may be difficult for co-management to become self-sustaining. In contrast, Pomeroy *et al.* (2001) warn against too great a dependence on external sources, which may affect the sustainability of the co-management arrangements, rather than investment of community financial resources.

A financing mechanism that is based on resources generated through angling tourism addresses both concerns; it neither requires the financial assets of local fishermen nor increases the financial dependence on authorities (Granek *et al.* 2008; Cowx *et al.* 2010). At the same time it helps to reconcile the usually conflicting interests of conservation and tourism. However, it should be considered that such a mechanism is only viable in areas with sufficient capacity to attract and host tourists who are willing to pay. The benefits of a user fee-based financing mechanism have also been addressed in literature on funding of marine protected areas (e.g., Reid-Grant and Bhat 2009; Thur 2010).

[4] The sharp contrast between the local communities and the (overwhelmingly white) recreational anglers and tourists illustrates the important role of ethnicity and socioeconomic status in this context. A more detailed discussion of this issue, which needs to be considered against the historical background of apartheid in Namibia, is beyond the scope of this paper.

Conclusion and Outlook

In view of subsistence, commercial, and recreational fishing competing for the same resource in the Upper Zambezi, it does not seem surprising that freshwater fisheries in the region face a high risk of overexploitation. At the heart of the problem are the geographical conditions of the region, especially the Zambezi River constituting the border between Namibia and neighbouring Zambia, which – in addition to the river's magnitude – makes sustainable fisheries management particularly challenging.[5] The situation is further complicated by overlapping governance structures, including different government-related entities, the jurisdictions and various levels of the TA, and an apparent enforcement vacuum regarding fisheries.

Sikunga Channel FPA was selected as our case study since it is an exemplary attempt to translate an open access regime of a CPR into a hybrid of state and communal property to the benefit of local communities. Given that Sikunga's FPA still constitutes one of only two officially gazetted FPAs in Namibia, this case can clearly be considered a role model for co-management initiatives in Namibia and beyond. Accordingly, lessons learnt at Sikunga should be taken as a valuable baseline for future endeavours.

The FPA was established in a participatory and consultative process involving local stakeholders and government representatives. More than five years after its launch, however, the fish reserve still seems to lag behind its own ambition of becoming self-sustaining and has not lived up to the expectations of many local resource users. Although the local population seems to perceive the benefits of the FPA in terms of conservation and exclusion of foreigners, distributional concerns are causing irritation and discontent. Many locals feel that, in contrast to the tourist operators and recreational anglers, they do not benefit directly and bear a disproportionate share of the costs. Furthermore, there seems to be notable room for improvement regarding monitoring and enforcement. Both issues can be related to the fact that the user fee-based financing mechanism that had originally been agreed on in the FPA management agreement has not been adequately implemented.

The central issue of sustainable financing that is decisive for the future of Sikunga's FPA is not explicitly addressed by Ostrom's principles for robust CPR governance, and seems relatively underrepresented in the fisheries co-management literature in general. Evidently, Ostrom's work is not a tailor-made or one-size-fits-all approach for fish reserves, but directed at many different settings and collective resource uses. However, the results of our research show that the aspect of sustainable financing demands more attention as a complement to Ostrom's principles when designing and implementing fisheries co-management regimes.

We conclude from our findings that there is widespread agreement on the need for fish conservation measures, such as FPAs, in the Upper Zambezi. Given its relatively recent implementation at the time of the fieldwork, it is still early to meaningfully judge the impact of Sikunga's FPA. The findings presented here that focus on the social acceptance and financial sustainability at Sikunga need to be complemented by an assessment of local fish communities (e.g., Silvano *et al.* 2009) to evaluate its ecological sustainability and enhance its effectiveness.[6] Moreover, further investigation on the local level of awareness of the FPA boundaries and whether resource users feel adequately represented in the decision-making – aspects that turned out to be relatively weak in this case and may require action – is to be recommended. In particular, the issues of representativeness and local participation requires closer attention as their current lack is a significant source of conflict in co-management regimes (e.g., Castro and Nielsen 2001; De Pourcq *et al.* 2015). Lastly, we recommend a number of areas for improvement, primarily the need for a transparent, fair, and stable financing mechanism. If addressed more thoroughly and proactively, this emphasis on financing will certainly help researchers and practitioners to identify ways to maximise benefits for local communities and make this and future fish conservation initiatives more sustainable.

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Data Availability The data that support the findings of this study are available from the corresponding author on reasonable request.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

[5] For more detailed information on the trans-boundary nature of floodplain fisheries in the region see Abbott *et al.* (2007).

[6] For a critical discussion of empirical studies investigating the effect of marine reserves see Willis *et al.* (2003).

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