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The Shark Reef Marine Reserve: a marine tourism project in Fiji involving local communities

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The Shark Reef Marine Reserve in Fiji is an ecotourism project designed to protect a small reef patch and its fauna while preserving the livelihood of local communities. It involves the local communities by using a participatory business planning approach to Marine Protected Area management, generating income through diver user fees, distributed to the local villages that have exchanged their traditional fishing rights in the marine reserve for this new source of income. The Shark Reef Marine Reserve is a self-sustaining and profitable project, and is an example of a privately initiated, bottom-up approach, which includes all relevant stakeholders in an area where marine rights are finely subdivided into small units.

Keywords: diver user fees; South Pacific; management; Marine Protected Area; conservation; ecotourism

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Introduction

Artisanal inshore reef fisheries provide a vital source of food and income for many coastal communities, and living standards in such communities are directly or indirectly linked to small-scale fisheries (Jiménez-Badillo, 2008; Kronen, 2004; Souter & Lindén, 2000). At the same time, artisanal fisheries have the potential to transform reefs in ways that compromise their ecological and economic values (Bascompte, Melián, & Sala, 2005; Carr, Anderson, & Hixon, 2002; Dulvy, Freckleton, & Polunin, 2004; Hawkins & Roberts, 2004). Many coral reef fisheries are poorly managed and have negative effects on the structure of the reef fish community (Cinner & McClanahan, 2006; Mangi & Roberts, 2007; Zeller, Booth, Craig, & Pauly, 2006). Degraded coral reef ecosystems, in turn, have socio-economic impacts on communities with strong reliance on coral reefs (Ochiewo, 2004; Turner et al., 2007).

Marine Protected Areas (MPAs) that permanently or partially close off fishing grounds have been widely adopted as a leading fishery management tool for marine conservation. However, many marine reserves are ineffective or remain "paper parks", and critical gaps in the biological knowledge such as, for example, connectivity and the anticipated fish recruitment impede the use of no-take zones and preclude implementing them with confidence that they will sustain surrounding fisheries (Christie & White, 2007; Grafton, Kompas, & Schneider, 2005; Lester & Halpern, 2008; Mora et al., 2006; Palumbi, 2004; Sale et al., 2005). While the "where" and "why" questions about marine park establishment are relatively easily addressed, it is often the "how" that is the most difficult question to accomplish successfully (Aswani, 2005; Kelleher & Kenchington, 1992; Souter & Lindén, 2000;

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Wescott, 2006). For example, in poor, developing countries, no-take MPAs have been proposed as a versatile marine fishery management tool, but are often difficult to establish or ineffective due to their incompatibility with traditional customary marine tenure systems or the lack of funds to manage them (Cinner & Aswani, 2007; Faasen & Watts, 2007; Foale & Manele, 2004; Reid-Grant & Bhat, 2009). Traditional marine parks that conserve resources through strict regulation of access may not work because of the dependence of local communities on these fishing resources for their economic and physical wellbeing (Cinner, 2007; Jiménez-Badillo, 2008).

A holistic approach to these issues focuses on the local people most affected by the implementation of the marine reserve, recognises the needs, perceptions and attitudes of local stakeholders towards the environment and conservation measures before implementing new management policies, while taking traditional systems of resource management into consideration (Aswani, 2005; Hoffmann, 2002). A hybrid management system, merging customary and modern management, can be an effective way to improve reef ecosystem health and provide significant conservation benefits for reef fish stocks, while at the same time meeting utilitarian community goals and taking into account customary practices or traditional knowledge (Adams, 1998; Aswani, 2005; Caillaud et al., 2004; Cinner, 2007; Cinner & Aswani, 2007; Jiménez-Badillo, 2008; McClanahan, Marnane, Cinner, & Kiene, 2006; Rodríguez-Martínez, 2008).

The introduction of management measures, such as areas closed for fishing, preferably needs to be coupled with projects to develop alternative income streams (Jiménez-Badillo, 2008; Souter & Lindén, 2000). In other words, instead of the traditional approach of protecting reefs to return them to a more productive state and then deciding how best to use the conservation gains to benefit people in a sustainable way, an alternative approach is to create incentives during the planning and implementation phases to protect the resources that provide livelihoods (Bell, Ratner, Stobutzki, & Oliver, 2006; Sale et al., 2005; Weiant & Aswani, 2006). Coupling marine tourism, a component of the wider ecotourism sector that is growing rapidly both in terms of its volume and value (Garrod & Wilson, 2004), with marine park management offers an income stream that additionally may have a positive influence on conservation awareness and support (Diedrich, 2007; Johannes, 2002; Notarbartolo di Sciara, Hanafy, Fouda, Afifi, & Costa, 2009). For example, recreational scuba diving has become a substantial component of the international tourism market and potentially offers considerable economic benefits to local communities with a managed coral reef area through the implementation of a diving user fee system (Asafu-Adjaye & Tapsuwan, 2008; Davenport & Davenport, 2006; Depondt & Green, 2006; White, Vogt, & Arin, 2000). Besides the attraction of diving to see healthy coral reefs, charismatic marine animals also attract divers and have led to the growth in the popularity of marine wildlife watching as a marine tourism activity (Cater, 2008; Garrod & Wilson, 2004). For example, diving with sharks is estimated to contribute millions of dollars to local and regional economies (Davis & Tisdell, 1998; Topelko & Dearden, 2005). At the same time, marine megafauna attracts increasing attention in ocean conservation planning and threatened predators, such as sharks, are often used politically to promote reserve designation (Hooker & Gerber, 2004).

Compensating traditional owners for not fishing in designated areas which are then used for tourism is both an important and a contentious issue involving MPA design and management and marine tourism. In many places, this approach has been applied, but failed due to issues such as equity, compensation, corruption and/or competition among dive operators. Additionally, the actual economic benefit for the people who give up fishing on the reefs is hardly ever reported. Case studies that report actual numbers are beneficial to

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both academics and practitioners who are involved in marine park management as well as those who are planning to protect marine resources in order to sustainably exploit them for tourism. This paper reports on the planning, implementation and economic revenue of the Shark Reef Marine Reserve (SRMR), a privately initiated reef and wildlife conservation and tourism project in Fiji. It does not quantitatively examine the ecological or social impact on the reef and communities involved, but does investigate the risks, limitations and opportunities of the chosen approach.

The author, a member of Swiss Federal Institute of Technology Zurich (ETH Zurich), has worked in the study area since 2003, spending up to four months per year on site as part of The Bull Shark Tagging Programme (http://www.leucas.net). This research project, funded by the Save Our Seas Foundation, the Shark Foundation Switzerland and other organisations in Fiji and internationally, aims to better understand bull shark and other shark species behaviour and ecology. He has worked closely with Beqa Adventure Divers (http://www.fijisharkdive.com) (the dive operator) and local people/fishermen. He has attended many community meetings, providing technical advice whenever requested. The income and visitor figures used were provided by the accountant for Beqa Adventure Divers.

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Fiji's customary fishing rights areas

Under traditional localised control over marine resources, access to inshore marine resources is generally controlled by social units, such as clans and villages (Cinner, 2005). As in many other formerly colonised nations, the inshore waters of Fiji are subject to a dual system of ownership under both customary and statutory laws (Aswani, 2005). This has important implications for economic development, as such development on native land can only occur following negotiations with customary landowners leading to permission for development (Lane, 2008). Fiji possesses a well-established system of traditional fishing ground management known as *qoliqoli* (officially referred to as customary fishing rights areas), which enjoys legal recognition and is protected by customary marine tenure agreement (Cooke, Polunin, & Moce, 2000; Muehlig-Hofmann, 2007; Ruddle, 1995). The *qoliqoli* is fished by the inhabitants of specific villages. Outsiders who want to fish in the *qoliqoli* can directly approach the village that owns the fishing rights to obtain a letter of consent, which is eventually endorsed by the government. This customary tenure of reef areas offers an obvious context within which fishery and tourism resources might be managed cooperatively. Furthermore, it offers a potentially fast and efficient route for private conservation initiatives because fishing rights can be obtained directly from the concerned village without following an often lengthy political process involving governments and/or NGOs. The system is well known in Fiji, but also applies in other places too.

The concept and its implementation

The SRMR project started to develop in 2002 and aimed at declaring parts of Shark Reef, a small reef patch located on the fringing reef off the coast of Viti Levu, Fiji (see Figures 1 and 2), as a no-take zone that would be used as a self-sustaining shark observation diving site. The reef had been known for its shark abundance and convenient accessibility, so a private expatriate with no formal connections to academia, NGOs and/or government agencies developed the idea that a single local dive operator would focus on the MPA's ability to provide a unique long-term wildlife diving experience to its target users and ensure that local stakeholders became the beneficiaries of tourism development. In other words, the basic concept of the SRMR project was to "buy" the fishing rights from

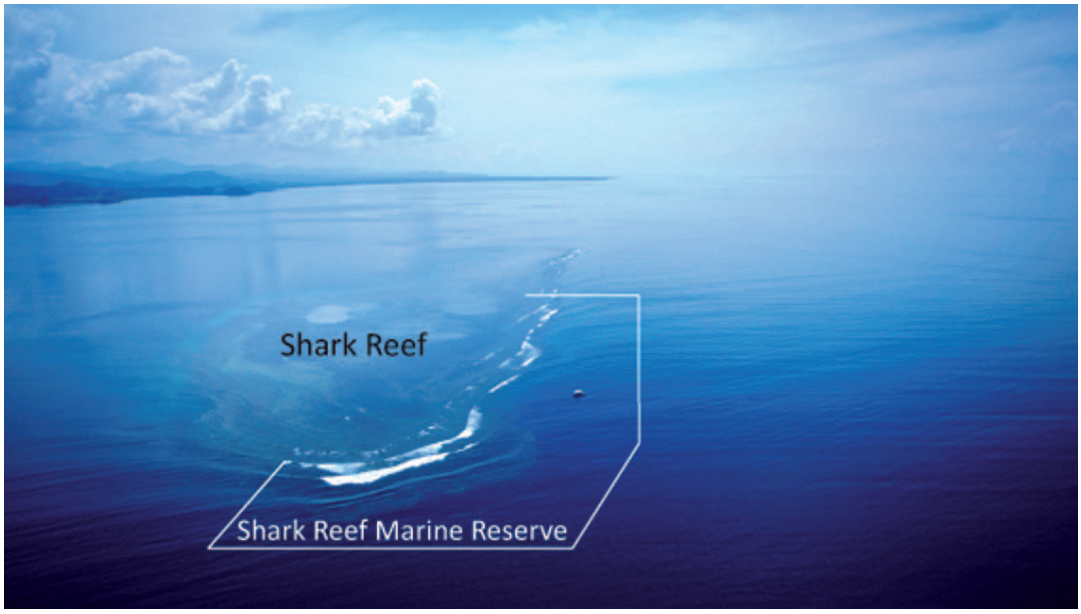

Figure 1. Shark Reef on the southern coast of Viti Levu, Fiji. The borders of the no-take zone (Shark Reef Marine Reserve) are marked in white. Photo: Klaus Jost.

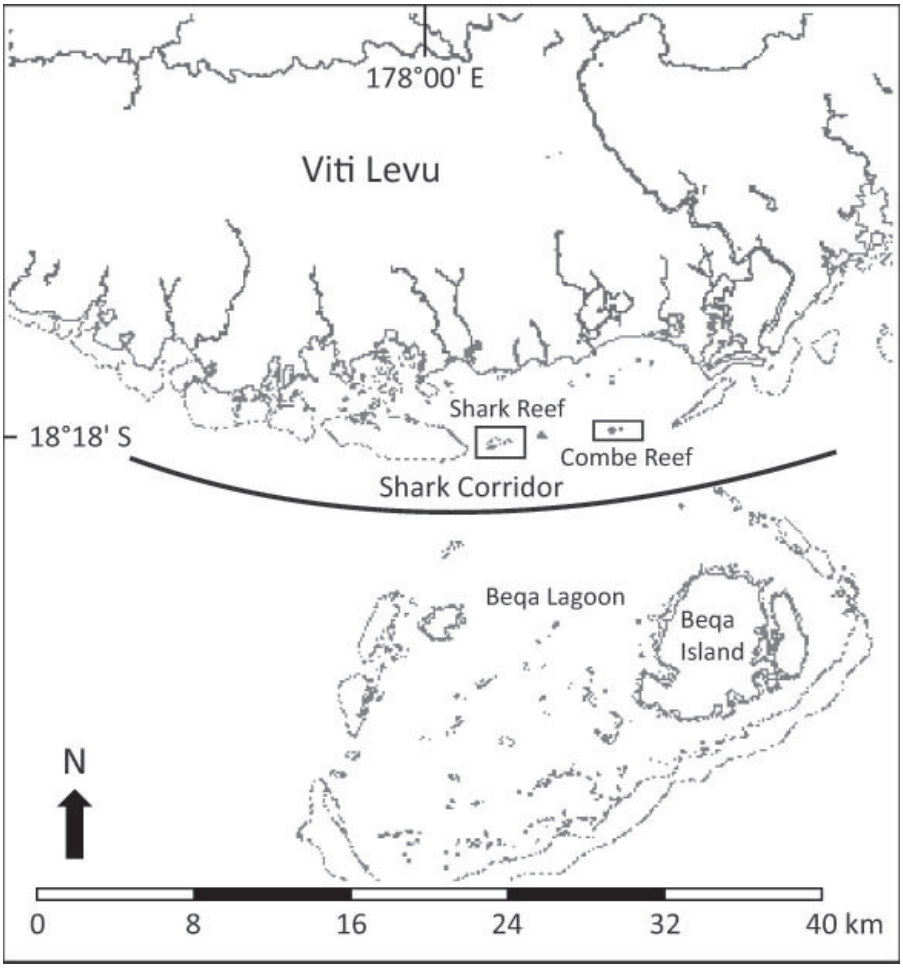

Figure 2. The southern coast of Viti Levu, Fiji, showing Shark Reef, Combe Reef and the Shark Corridor.

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the local villages that traditionally own those rights on Shark Reef and designate it as a partially closed area. An extended fishing moratorium on a reef is, in effect, an MPA, with the diving rules common to MPAs in force.

In 2003, a basic agreement was reached with the two villages that owned the traditional rights to the reef. In exchange for the villages' agreement not to fish on parts of the reef, the dive operator would be granted exclusive access rights to the site and collect a so-called daily marine park levy from each visitor. That levy would be directly paid to the villages. Although economically self-sustaining, community-controlled reserves are preferable to government-controlled or legislated reserves, official governmental recognition of marine reserves is desirable and marine resources can be more effectively managed if communities and governments combine their knowledge (Caillaud et al., 2004). Even though not ratified by legislation, the traditional methods and practices of managing artisanal fisheries, when supported by the Fijian government, have been successful in protecting the fishing stocks and reef health (Adams, 1998; Jennings & Polunin, 1996). Meetings with government representatives resulted in the endorsement of having the site eventually declared as a marine reserve by the Fijian government. Representatives of both villages then jointly asked for the formal establishment of a marine reserve at Shark Reef, and that request was granted on 9 April 2004, the official date for the establishment of the SRMR. It was agreed that the marine park levy would be equally split between these two villages.

The agreement between the dive operator and the villages includes additional incentives that are: (1) A sponsorship programme, whereby each year the dive operator agrees to train a member from each village up to the qualification of dive master, (2) the dive operator serving as an intermediary in all necessary contacts with the relevant authorities of Fiji, (3) the dive operator helping to procure and install the required moorings and markers, (4) the dive operator assisting the villages in monitoring the protected areas, and (5) the training of fish wardens, in cooperation with the Department of Fisheries, in order to efficiently monitor the protected area. Fish wardens are honorary officials appointed under the provision of the Fisheries Act (1978). Their task is to enforce the provisions of the Fisheries Act and ensure compliance with conditions attached to fishing licences in their communities' traditional fishing rights areas (Johannes, 2002).

After the successful implementation of the SRMR, representatives from other villages along the southern coast of Viti Levu approached the dive operator asking for expansion of the protected area and a share of the tourism revenue. The coast adjacent to Shark Reef comprises the traditional fishing grounds of three villages, including the two that got involved in the project in 2003, and the third one which became partner in 2006, thereby agreeing to ban all fishing activities on Combe Reef (see Figure 2). At the same time, the third village was also entitled to a share of the levy collected on Shark Reef to compensate for any losses in income. In addition, all the three villages banned shark fishing in their respective entire *qoliqoli*, resulting in the so-called Fiji Shark Corridor, which currently comprises approximately 30 miles of coastline (see Figure 2). Although sharks are taboo to eat for many native Fijians (see below), they are not so for the large Indo-Fijian community living along the southern coast of Viti Levu.

Economic benefit for the villages

In 2004 and 2005, the dive operator paid a total amount of US$3910 and US$5930, respectively, to the two villages as a compensation for not fishing in the SRMR (see Figure 3). For the years 2006 to 2008, the levy paid to the three villages was US$9210, US$19,150 and US$19,840, respectively. With the expansion of the protected area and the inclusion of

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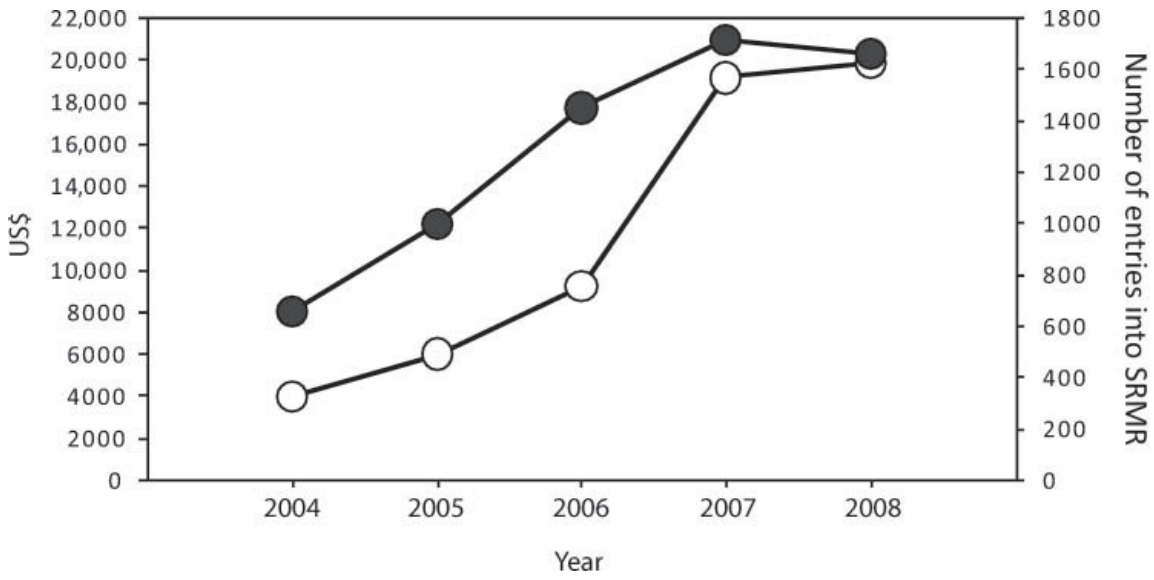

Figure 3. Marine park levy (in US$) paid to the villages (left axis; white dots) and number of entries into the Shark Reef Marine Reserve (right axis; black dots) for the years 2004 to 2008.

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other villages in the project, the marine park levy increased from 10 Fijian dollars (US$6) in 2004 to 20 Fijian dollars per visitor. These amounts are higher than many of the fees charged in other MPAs in both Fiji and other places (Barker & Roberts, 2008). In order to provide divers with a unique and safe self-contained underwater breathing apparatus (SCUBA) experience, the dive operator limits the number of divers it takes to the SRMR to fewer than 20 per day. Additionally, diving trips to the SRMR are offered only four times weekly. This intentionally limited capacity was about to be reached in 2007 and 2008. Therefore, unless the dive operator increases the number of divers it takes to the SRMR and/or frequency of diving trips, the total amount paid annually to the eligible villages will now stabilise at around US$20,000.

The SRMR is a capitalistic venture that strongly builds on the mutual agreement between the villages and the dive operator to restrict fishing in a relatively small area on Shark Reef and grant exclusive access to the no-take zone to a single dive operator that offers an exclusive tourism product. Other dive operations are welcomed to dive in the SRMR if spaces are available on the dive, but need to pay the marine park levy for their clients to the contractual operator, the sole conductor of all dives. The total levy paid to the villages between 2004 and 2008 was US$58,040 and will rise to well over US$100,000 over the next five years (see Figure 3). The numbers reported here are the villages' direct economic benefits only for giving up fishing in a small part of Shark Reef. They do not include additional potential benefits, such as increased fish production outside the no-take zone. A complete assessment of the economic benefit generated by this project must include the dive operator's revenue from taking divers to the SRMR, salaries of local employees of the dive operation and tourist expenditure that represents direct revenue to island residents and the local economy.

Risks, limitations and opportunities

A number of MPAs that involve the local communities have been successfully developed in Fiji and other parts of Oceania (Aswani, 2005; Aswani & Hamilton, 2004; Aswani, Albert, Sabetian, & Furusawa, 2007; Caillaud et al., 2004; Christie & White, 2007; Russ & Alcala,

1999; Sano, 2008), where community-based resource management is more widespread than in any other tropical region in the world (Johannes, 2002). The SRMR is another example of a small no-take zone in the South Pacific that has been developed with the specific goal of contributing to the conservation of large predatory fish, and is, at the same time, a tourism project. Taking into account sociocultural, environmental, and economic aspects, the "three pillars" of sustainability (Townsend, 2008), it builds on the premises that (1) a system of traditional fishing rights actually exists and is enforced, (2) the traditional fishing rights owners are disposed to give up fishing in the SRMR in exchange for a marine park levy collected from divers visiting the MPA, and (3) a single dive operator offers an economically viable diving experience in the protected area. A user fee system allows the local stakeholders (villages, local community, dive operator) to benefit from visiting divers who enjoy the resources in the SRMR, and it should therefore be in the long-term interest of all involved stakeholders (villages, local community, dive operator, tourists) that the SRMR remains a protected area that is worth visiting.

The chosen approach implies a number of risks. For example, the strength of customary marine tenure is related to certain socio-economic processes such as growth in population and consumption, modernisation, and/or dependence on fishing (Aswani, 2002; Cinner, 2005; Cinner, Sutton, & Bond, 2007). Socio-economic transformations within communities have the potential to weaken conservation initiatives with a customary foundation (Aswani, 2005; Hoffmann, 2002). Tourism development might lead to economic stratification, which may result in the weakening of marine tenure or the customary closure on which diving tourism is based, ultimately leading to a breakdown of tourism. Additionally, a capitalistic venture might fail in Melanesia due to cultural constraints (Foale & Manele, 2004) and furthermore there is always a risk that the flow of tourists from distant markets might be interrupted for various reasons outside local control. In order to minimise the risk of eroding traditional principles of redistribution and prevent personal gain (Johannes, 2002), the marine park levy is not paid to individual village representatives directly, but into a dedicated village bank account. A village committee then decides how the tourism revenue is to be used by the community. The economic revenue is considered substantial given the fact that only a part of Shark Reef is a designated no-take zone, while other reefs owned by the respective villages along the southern coast of Viti Levu can still be fished for everything but sharks (see Figures 1 and 2).

The project was initiated and implemented without following specific protocols by a dedicated non-professional who had the idea of establishing a small and locally manageable marine reserve that would be funded through a unique and sustainable marine tourism product. The number of stakeholders in the project was intentionally minimised and long-term relationships with local communities envisaged by closely involving representatives from the local communities in the planning, implementation and maintenance processes. Such an "individual participatory approach" has been successfully adopted in other marine conservation projects (Caillaud et al., 2004; McClanahan et al., 2006; Sano, 2008). Developments that are required to generate sustainable outcomes, such as tourism projects, imply substantial changes to the ways in which local stakeholders perceive their role in exploiting natural resources. Not giving the local communities sufficient opportunities or incentives to make these changes could result in failure, whereas applying a bottom-up planning and a hybrid management approach centring on livelihoods can help to bring about the necessary changes in the attitudes and actions of local stakeholders (Aswani, 2005; Cinner & Aswani, 2007; Garrod, 2003; Johannes, 2002).

Protected areas should be correspondingly small in islands where marine area rights are finely subdivided into small units. The relatively small size of the no-take zone on

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Shark Reef means both constraints and opportunities for activities possible within the area. It offers the advantages that the no-take zone is easily controllable, and that individuals from the villages are not forced to switch occupation or find new fishing grounds, which could result in degrading neighbouring unprotected sites. Because the area of interest is not governed by a heterogeneous network of social units that operate at different scales, the legal capacity is flexible and fast in that it provides the dive operator, as a representative of the traditional authority (the village), the ability to exclude outsiders. Licensing a single dive operator to dive the site eliminates issues among competitive dive operators that, for example, may have opposing opinions on diving user fees and also minimises the risks of an open access system that may lead to reef deterioration through the impact of high levels of tourism usage (Davenport & Davenport, 2006; Depondt & Green, 2006; Hasler & Ott, 2008). Although other operators can send clients to Shark Reef, they are only accepted if space is available and their dives take place under the aegis of Beqa Adventure Divers. Nevertheless, as marine resources become more developed economically, the externalities associated with commercial development also increase, potentially contributing to the decline of coral reef health and increasing degradation of the reef environment (Diedrich, 2007; Hoffmann, 2002). For the SRMR this risk is regarded as minor because the number of divers is intentionally limited by the capacity of the dive operator to bring divers to Shark Reef and offer them an exclusive diving experience. Entries into the SRMR in 2008 were levelled off compared to 2007, indicating that the capacity was about to be reached (see Figure 3).

The greatest risk to the project is considered to be a decline in large predatory fish at the site. Sharks are currently the main attraction of the SRMR. This group of fish is under severe threat globally (Ferretti, Myers, Serena, & Lotze, 2008; Myers, Baum, Shepherd, Powers, & Peterson, 2007; Robbins, Hisano, Connolly, & Choat, 2006). Marine reserves have been found to be effective for protecting at least some portion of reef shark populations (Garla, Chapman, Shivji, Wetherbee, & Amorim, 2006; Heupel et al., 2009). Because of the small reserve size, individual sharks naturally spend the majority of their time outside the SRMR where they are of attraction not for divers but for artisanal and industrial fisheries. A decrease in the number of sharks would most certainly lead to a decrease in the number of divers visiting the SRMR and consequently the amount of the marine park levy paid to the villages.

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Five years of SRMR – a look back and forward

Reviewing the project five years after its implementation, it is evident that several criteria of ecosystem-based management and design principles for common property regimes that effectively integrate customary management into reef conservation have been met (Bell et al., 2006; Christie & White, 2007; Cinner & Aswani, 2007; Pitcher, Kalikoski, Short, Varkey, & Pramod, 2009). For example, the SRMR project applies several main clauses and sub-clauses of the recently proposed ISO 14001 standard for environmental management systems to MPAs (Thompson, Dumont, & Gaymer, 2008). The planning phase included assessing the attributes of Shark Reef (good accessibility, large predatory fish), defining the area to be protected (SRMR), how it will be used (as a recreational shark diving site) and who has got the rights to withdraw resources (local villages, and a single licensed dive operator). A compensatory mechanism (marine park levy collected from divers) for giving up fishing in the SRMR by the traditional fishing rights holders was negotiated and has been paid to the eligible villages on a fortnightly basis ever since the start of the project. Focusing solely on members from the villages that traditionally own the fishing rights on the

reef in question is likely to encourage the local communities to participate in the planning and implementation process and integrate local knowledge in the project. The application of traditional ecological knowledge and customary ecological management practices to conservation issues has re-emerged in recent years (Caillaud et al., 2004; Drew, 2005). The SRMR project uses the local villager's site-specific knowledge generated through long-term association with the area and includes informal institutions, such as local taboos, that have been largely neglected in conservation design in biodiversity-rich, developing countries, where park protection has been the major approach for protecting biodiversity (Colding & Folke, 2001). In recent years, *tabu* areas have been increasingly used as a management tool, for example, through the Fiji Locally Managed Marine Area (FLMMA) network (Caillaud et al., 2004). Despite seasonal or temporary traditional area closures, in Oceania different marine animals, foremost sharks, have a special place in the region's traditional societies and adaptively implemented segment taboos restrict resource use (Allen, 2007; Bataille-Benguigui, 1997; Colding & Folke, 2001; Hickey, 2006). Shark Reef is home to a great variety and abundance of sharks (Brunnschweiler & Earle, 2006). The local Fijian communities involved in the SRMR project and the dive guides in particular revere sharks in honour of the god *Dakuwaqa*, who was believed to manifest himself as a great shark. They consider it a taboo to consume sharks and have a culturally rooted relationship to this particular dive spot and its fauna, which allows a mutually beneficial relationship to be created between a conservation-minded dive operator and local people (Drew, 2005). Additionally, the majority of the staff hired by the dive operator are native Fijians who are themselves members of the villages that "sold" their fishing rights in the SRMR. This ensures that the villages have access to first-hand information on the current status of the project and allows villagers to gain access to new knowledge and information on coastal resource management. Cooperation with local communities is most likely to be achieved where it can be demonstrated that it is in the interest of local people to establish and manage marine reserves and that living next door to a reserve can be an economic benefit. The participation of communities that have a small population size and a strong sense of ownership, both factors favouring a high level of participation in the decision-making processes (Rodríguez-Martínez, 2008), helps to achieve broad-based political support for the development of tourism and raises vital eco-awareness among local people (Garrod, 2003).

Traditional and scientific knowledge can complement each other, and in the process expand the knowledge base on the status of marine resources that is necessary for ensuring their sustainable management. The establishment of marine reserves results in significant increases in average levels of faunal density, biomass and diversity within short time periods, independent of reserve size (Halpern & Warner, 2002; Palumbi, 2004; Russ & Alcala, 2003). Despite the fact that no-take or even no-entry reserves generally show greater ecological benefits relative to only partially protected sites, such as the SRMR (see Figure 1), that likely cannot protect viable populations of large marine predators and functioning ecosystems, they can nevertheless play a supportive role (Garla et al., 2006; Heupel et al., 2009; Lester & Halpern, 2008; Robbins et al., 2006; Schafer, 1999). The fishing ban on parts of Shark Reef was imposed as part of the management of a marine resource, namely large predatory fish (Grafton et al., 2005) that has a great potential to attract divers (Topelko & Dearden, 2005). A first non-definitive fish species count was conducted in the no-take zone in 2004, yielding a total of 267 species of fishes including eight species of sharks (Brunnschweiler & Earle, 2006). A subsequent fish count was conducted in 2008 by the same authors using similar methodologies. The fish species list of the SRMR currently includes approximately 400 species, indicating that this relatively small reef in the South Pacific has a high degree of biodiversity (http://www.explorers-log.com/observations.cfm).

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Despite being a diving site, the SRMR has been serving as an observing and tagging site for sharks and other fishes (Brunnschweiler, 2009; Brunnschweiler & Earle, 2006; Brunnschweiler & Sazima, 2008), and a detailed database comprising presence–absence data for various fishes and oceanographic parameters is maintained. In the future, these data will allow the assessment of the effectiveness of the protected area with regard to species abundance and diversity. Furthermore, a knowledge base is being developed about the effects of tourism activity upon the health and wellbeing of the target species, in this case large predatory fish. The lack of such knowledge has been one of the major pitfalls in the assessment of marine tourism (Garrod & Wilson, 2004).

According to The International Ecotourism Society, ecotourism is responsible travel to natural areas that conserves the environment and improves the wellbeing of local people. In this sense, the SRMR is an ecotourism project providing sustainable tourism that rests on the "three pillars" of sustainability and as such "meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987; Diedrich, 2007; Townsend, 2008). The value of marine reserves is undisputed for enhancing marine tourism and for raising consciousness of the need for, and the benefits of, marine conservation. The SRMR is no exception to this (http://www.theworldchallenge.co.uk/2006-finalists-project06.php). The main purposes of protected management areas include preservation of species and genetic diversity, protection of specific natural and cultural features, tourism and recreation, education, sustainable use of resources from natural ecosystems, maintenance of cultural and traditional attributes and scientific research. Based on the primary management objectives of the project, the SRMR is an International Union for Conservation of Nature's (IUCN) category II MPA, functioning mainly for the protection of ecosystem and recreation and designated to (1) protect the ecological integrity of an ecosystem for present and future generations, (2) exclude exploitation or occupation inimical to the purposes of designation of the area, and (3) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible (IUCN, 1994). But the work is not finished. Quoting Jameson, Tupper, and Ridley (2002), "In this day and age, with all the stresses imposed on coral reefs and other marine environments, an area is not magically or instantaneously 'protected' via an MPA designation process – protection must be fought for – and it may never be attained". Actions are more important than concepts and definitions. The SRMR project will only be successful if future divers enjoy a unique and exclusive diving experience in the marine reserve and compensate the traditional fishing rights holders for having this privilege. This way, it will hopefully serve as a pilot project for future privately or community-initiated, locally implemented and managed marine reserves.

Future research

Shark tagging and monitoring continues at Shark Reef as part of the Bull Shark Tagging Programme. Questionnaire work will shortly be undertaken to learn more about divers' reactions to the SRMR and to probe their interest in sharks.

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Notes on contributor

Dr. Juerg Brunnschweiler is a zoologist and his research interests encompass the behaviour, ecology and conservation of free-ranging marine fish. In particular, he focuses on large- and small-scale movement patterns and habitat use of large predatory sharks and the interaction between echeneids and their hosts. He is also interested in Marine Protected Area design and how local communities can be successfully involved in sustainable conservation projects in developing countries.

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