Conservation Management Plan, 2017

Fiji

Contents

1. Summary and Aim

The Shark Conservation Project (SCP), based in Pacific Harbour, Viti Levu, Fiji, was established in January 2014. Since its start, the SCP has been working together with conservationists and scientists such as Dr. Juerg Brunnschweiler (Private researcher, Zurich), Dr. Mark Bond (Florida International University), Dr. Christine Ward-Paige (Dalhousie University), Dr. Ryan Kempster (University of Western Australia), Ian Campbell (WWF South Pacific), as well as students and professors from the University of the South Pacific in Suva, to carry out scientific research and to address shark conservation issues in Fiji.

The SCP is also collaborating with the Mangroves For Fiji initiative to plant mangrove seedlings and moderate the loss of mangrove forests along the south coast of Viti Levu. In addition, the SCP has a strong education and awareness programme with local communities and schools, about sharks and their importance in maintaining the balance of the ocean's ecosystems. The aim of the SCP is to generate scientific data to inform local managers and stakeholders about the status of shark populations in the south coast of Viti Levu, mitigate shark habitat loss, and to increase shark awareness among the local communities and the general public.

2. General Information

Fiji is an island country about 2000 km northeast of New Zealand and consists of over 300 islands, of which 110 are permanently inhabited. Because of its topography, the sea is and has always been an essential source of food and income. In modern days, it has been a growing attraction for tourism, which has, in turn, lead to an increasingly larger portion of the Fijian economy. Even though initiatives have been made to preserve the Fijian marine wildlife, such as a network of Locally Managed Marine Protected Areas (FLMMA), or the establishment or National Marine Park such as the famous Shark Reef Marine Reserve (SRMR) outside Beqa Lagoon, overfishing and coastal habitat loss are current conservation issues in the country.

Mangrove forests are a natural barrier for protecting the coastline against erosion, sea-level changes, storm surges, and tsunamis. This key ecosystem also helps to support the adjacent coral reef systems by providing nutrients, filtering running water from land, and being a nursery ground for numerous marine species of sharks, fish, and crustaceans. Therefore, the protection and sustainable use of these vulnerable ecosystems will improve the livelihoods of local communities, protect biodiversity, and secure a long-term ecotourism in the country.

3. Study Area

The SCP is based in Pacific Harbour on the south coast of Viti Levu, Fiji. Its area of influence extends from Navola village on the coral coast, to the Rewa River (Fig. 1). The main research area is the Pacific Harbour region; from Serua Island to the west, to Navua River to the east, including Beqa Lagoon and its marine protected areas including the famous Shark Reef Marine Reserve (Fig. 2).

Figure 1. Map of the area of influence and of the Fiji Shark Conservation Project

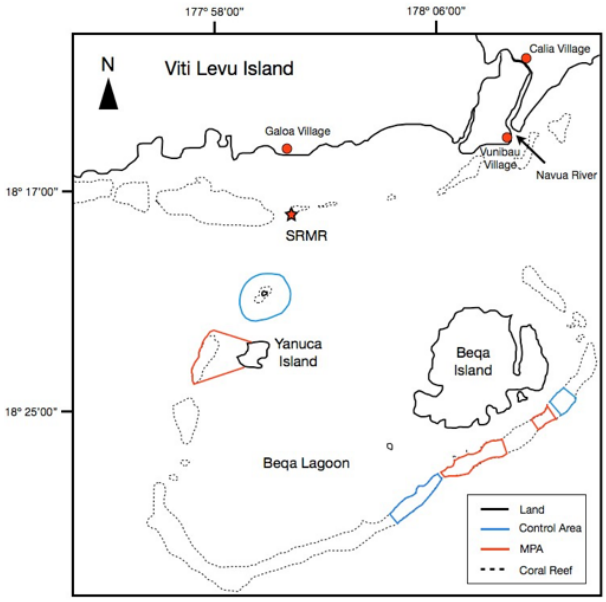

Figure 2. Map of the south coast of Viti Levu, where the main SCP activities and research take place.

4.Threats

Sharks have been roaming the oceans for the past 400 million years, surviving multiple major extinctions, but in less than a century, we have pushed those creatures to a critical point. "Sharks are more vulnerable today than ever before", said Boris Worm, a professor of biology at Canada's Dalhousie University. An estimated 73 million sharks are killed each year that works out to more than 10 000 sharks per hour. The most significant threats are overfishing, habitat loss and pollution. It is well documented the role of sharks as key species in the ecosystems they inhabit. As apex predators, sharks maintain the balance between the trophic levels of the food chain.

Through a cascade effect, a decline in sharks can result in an increase of primary producers (algae), which in turn can have negative effects on the coral reef ecosystems.

This lack of balance has been shown to have negative effects on the reefs, and ultimately in the livelihood of local communities. Mangrove forests provide an important nursery ground for commercially valuable species as well as species important for the tourism industry such as sharks. Despite their value in ecosystem services, mangroves in Fiji are being deforested for timber, as firewood and building materials, or to make way for urban development, aquacultures and agricultures.

5. Our Projects

5.1 Baited Remote Underwater Video (BRUV)

Due to the difficulties of studying elasmobranch abundance in the wild, several techniques have been invented in order to address different ecological questions. One of these successful techniques is the Baited Remote Underwater Video (BRUV). This non-invasive research method is being used all around the world for the same purposes.

Objectives

The BRUV project is part of Dr Mark Bond's research. The main objective is to estimate the relative abundance and species diversity of elasmobranchs and commercially valuable fish species in the studied area. In addition, we would like to test several other hypotheses concerning the relation between the abundance of predatory fish and the sizes, the topography,

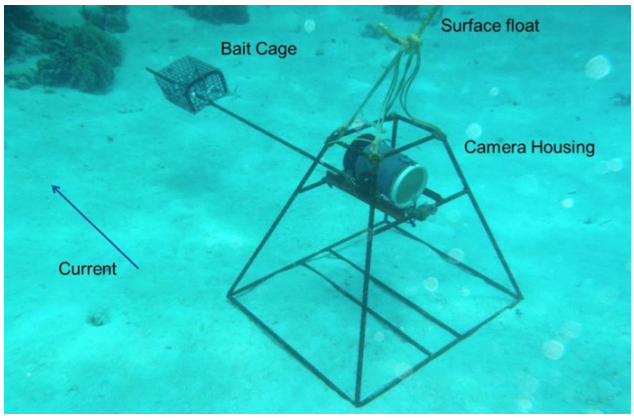

Figure 3. Baited Remote Underwater Video design and drop position facing the direction of the current.

and the type of bottom of the protected areas. We would also like to see if the MPAs created by NGOs and local villages have been successful.

Methodology

Our BRUV consists of a video camera inside an underwater housing that is mounted on an aluminium frame. We use 1 kg of sardine as standardised bait for every single BRUV drop. Bait will be placed in a wire cage mounted on a pole in the camera's field of view. BRUV sampling is conducted in three different MPAs in Beqa Lagoon and their respective Control Areas (Fig. 2), and locations are chosen for each site by using a random number generator to avoid location bias. BRUVs are placed in random locations at daylight hours and upon arrival the vessel captain finds the closest suitable location for deployment (usually an area between 4 and 25 m with a flat bottom to maximise line of sight). BRUVs are deployed using scuba gear to guide it away from live coral and to orient the BRUV facing down current. The BRUV is left in the water for over 90 minutes and other activities (e.g. survey dives) are simultaneously conducted at least 1 km away from the BRUV drop site.

At both the start and end of each deployment, environmental variables are measured, including water current speed (with a general oceanic, mechanical flowmeter), bottom depth, underwater visibility and water temperature. BRUVs are ideally dropped four times a week. Two different pairs of volunteers are viewing the video and every elasmobranch or commercially valuable fish species (Appendix I) present in the frame are counted and recorded.

5.2 Survey Dives

Roaming survey dives is a very common technique to estimate abundance of organisms in different ecosystems such as coral reefs. Recently, studies have shown the potential use of survey dives to collect data and when compared to other techniques such as BRUVs or fishing surveys, it showed similar results of the abundance of elasmobranchs.

Objectives

The main objective of the survey dive project is to estimate the abundance of elasmobranchs, turtles and commercially valuable fish species (Appendix I) in different areas around Beqa Lagoon (Fig. 2). This survey method complements the data collected through our BRUV Project. The elasmobranchs sightings recorded during the dives are also shared on two online databases helping Dr Ryan Kempster from the University of Western Australia, and Dr Christine Ward-Paige of Dalhousie University, in their worldwide research.

Methodology

Two survey dives will be conducted after every BRUV drop for an ideal total of eight survey dives per week. The divers record all species of interest sighted, estimate their length, and, when possible, identify their sex. Variables such as current, temperature, and visibility are also recorded. Prior to the survey dives the volunteers have to learn how to identify 11 species of shark, five species of rays, two species of turtle (Appendix II). In addition, volunteers are trained to identify all fish species from Appendix I and how to estimate their length. The survey will start after reaching 5 m and will continue for 30 minutes, between 5 and 20 m. After each dive, the data will be entered and closely reviewed by Projects Abroad scientists to avoid biases and overestimation of numbers.

5.3 Shark Tagging Project

In order to reach efficient conservation measures, global and precise understanding of shark species, habitat use, ecology, feeding habits, as well as behaviour is necessary. In addition, sharks should be protected at all stages of life, which require knowledge of life cycles, and accurate localisation of nursery grounds. The SCP addresses the lack of data on the subject by deploying fishing gear in the coastal waters of the Pacific Harbour region, as well as contributing to students researching sharks at the University of the South Pacific.

Objectives

In collaboration with the University of the South Pacific and the private researcher Juerg Brunnschweiler, Projects Abroad aims to find potential shark nurseries in Fiji and assess their quality, as well as collecting information on species diversity, abundance, life cycle, and habitat use of sharks in the region.

Methodology
The study is conducted under a permit provided by the Fijian Ministry of Fisheries and Forests. All methods and protocols are approved by the Department of Fisheries. Collection and tagging of sharks are performed according to regulations and permits provided by the Serua Provincial Council to Beqa Adventure Divers.

The surveys are performed twice a week along the south coast of Viti Levu during which sharks are collected using standardised longline gear with baited circle hooks and 4-inch gillnets. Caught sharks are sexed, measured (pre caudal, fork and total length), sampled for future genetic analyses, and the healing stage of the umbilical scar is recorded. In addition, the sharks will be tagged with a Personal Integrated Transponder (PIT) tags allowing the research team to identify the individual if recaptured.

In 2017, a network of trustful fishermen along the Shark Corridor should be developed where bycatches are being voluntarily declared. This network could potentially provide completely new information on the abundance of sharks being caught in coastal traditional fisheries and fill an important gap in shark conservation and management.
In addition, the SCP will try to initiate a new project aiming at exploring the epi- and mesopelagic species diversity in the Shark Corridor.

5.4 Mangrove Reforestation Project
Mangrove forests are the coastal tropical rainforest where ocean, river and land meet. It's one of the most productive ecosystems on earth and acts as nursery and habitat for numerous species of fish, crustaceans, mammals and birds. It's also an important carbon sink that counteracts climate change. Many of the commercial fish species use the mangrove as a nursery ground for their juveniles.

Objectives
The SCP mitigates the loss of mangrove habitats by planting mangrove trees in the region. By collecting seeds, raising them, and planting mangrove trees, the SCP offsets some of its own carbon emissions and helps local business to become carbon neutral. The research team calculates the 'tree-equivalent' of their emissions and progressively plant trees for the business in exchange for their financial contribution. The first client is a local resort (Uprising Beach Resort), which will eventually become the first carbon neutral resort in Fiji. The SCP team progressively developed a mangrove ecosystem curriculum that is implemented in schools and taught by the volunteers to raise awareness about the importance of mangrove forests and the services they provide.

Methodology
Volunteers are collecting mangrove propagules (seeds) from the local area and bring them back to the research facility where they are planted in the project nursery. Even though the SCP team believes that it is already the largest mangrove nursery in the South Pacific, it continues to extend and modernise each year with custom made steel propagule tables used to maximise capacity allowing a double layer of seedlings. In the nursery, a mangrove seed is raised in a pot for 4 to 12 weeks until it shows at least four leaves, indicating a healthy root system. When this stage is reached for a minimum of 2 000 plants, they are removed from their pots, bagged, transported to a suitable site, and planted. The pots are refilled for the next seedlings.

5.5 Shark Identification Project
Sharks and rays display natural markings like spots, stripes, colouration, and pigmentation, or abnormal features such as deformities, cuts, or permanent scars that make them unique and visually recognisable or by using a computer programme.

Objectives
The objective of this project is to create a census and a presence/absence database of the different identified individuals at the Shark Reef Marine Reserve (Fig. 2). This database allows us to study abundant trends throughout the year, as well as habits, site fidelity, and behaviour of each individual. Social groups are also investigated.

Methodology
Volunteers attend a shark identification workshop during which they learn how to spot these specific markings and distinguish the known individuals. Volunteers self-train with flashcards and databases on how to recognise our most famous bull sharks by name. During each shark dive they conduct at SRMR, they are asked to count or estimate the number of sharks of each species, identify individuals they can recognise, and pay attention to individual behaviour.
A recently initiated project aims at realising a census of reef sharks on SRMR using automated recognition software. These reef sharks exhibit unique dorsal fin patterns, which, as a fingerprint in humans, can be used to tell individuals apart. Short-term volunteers are asked to share their best and close-up pictures of reef sharks, while long-term ones can be trained to use the computer programme and assist the research team.

5.6 Environmental Impact Control & Sustainability

The major part of the plastic production is lead by single-use items, such as bags, cups, food wrappings and bottles. This ingenious material is designed to last forever and is non-degradable. Right now there is an estimated 100 million tonnes of garbage in the world's oceans, and conservationist's estimates that there will be more plastic than fish in the ocean by 2050. Furthermore, according to a new UN DESA report, the human population is predicted to increase from the current 7.3 billion to 9.3 billion by 2050 and 11.2 billion by 2100. As populations continue to grow, the need for the sustainable use of resources is required. This encompasses but is not limited to fresh water use, food types, origins and mileage required to transport to point of sale, and an increase in the reliance on renewable energy.

Objectives

In conjunction with the carbon neutral project, we also conduct waste and environmental degradation mitigation initiatives. The SCP aspires at influencing a long-term change of behaviour from volunteers, tourists, local communities, and commerce; as well as reducing waste in the Pacific Harbour region.

Methodology

These initiatives start as simple as encouraging volunteers and locals to use alternatives to bottles or bags and consider the low environmental impact and locally produced goods. The SCP volunteers and staff perform talks and seminars in local villages to raise awareness concerning the waste issue and influence them to take responsibility for their own environment and the future generations. In addition, a network of partners such as resorts, restaurants, and local residents, store their plastic bottles for the team to collect. This excess of 50,000 plastic bottles is repurposed into pots in the mangrove nursery. Finally, food wrappers from the research facility kitchens are kept and given to a local women's group where they repurpose them as purses, handbags, belts, etc.

In line with sustainability values, volunteers are encouraged to limit showers on the project to four minutes in an attempt to conserve water and switch off lights and fans when apartments are left vacant to reduce energy consumption and subsequent carbon emissions. In addition to this, cardboard generated by the project is burned and ash used to re-fertilise used soil from the mangrove nursery and used milk cartons are filled with concrete and resulting bricks used as platforms for propagule tables to rest on. Future goals are to implement a Projects Abroad micro-farm that will sustain the project as much as possible and thus reduce food mileage and subsequent carbon emissions. The micro-farm will focus on growing fruits and vegetables frequently used in the kitchen, keeping chickens to obtain eggs and potentially pigs to process the organic waste generated by the project into manure that can be utilised in the mangrove nursery.

5.7 Community Outreach

Part of the holistic approach towards the SCP is through the outreach and awareness programme that volunteers conduct within the locality. Partners involved include Vunibau Village, Rampur Primary School, Pacific Harbour Multi Cultural School, Dranikula Village, Galoa and Culanuku Village, and activities include education, beach cleans, swim lessons and cultural days. Over the years, the programme has been very productive resulting in a very close relationship to date. SCP aims to gain additional partners over the coming years.

Objectives

The outreach and awareness programme plays a very important role in this project. Volunteers showcase their talents and skills through knowledge of study through the survey dive, BRUV, mangrove reforestation, tagging, shark ID and the beach clean-ups they conduct on a fortnightly basis. Through such work activities, volunteers not only gain experience but a good amount of cultural enrichment with the local people both in schools and villages.

Methodology

Community education is conducted twice a month and volunteer involvement requires a lot of initiative, preparation time and interaction of volunteers with the target audience. Most land based activities allow volunteers to work towards the topic that can realistically be approached within the locality. One example is the topic of rubbish/trash disposal; something Fiji is lacking education on. Volunteers tackle this within a timeframe allocated to prepare; through the use of research on the internet or personal interviews with the local people. By incorporating the topic of environment and marine habitat volunteers present the effects of trash within these areas. Reduce, Re-use, Recycle (3R) is a common topic discussed in the Fiji school curriculum and through this, the SCP incorporates well. Other topics include mangroves, sharks, rays and turtles, climate change and various other marine conservation issues.

Beach cleans are an action put in place once a month to help in the reduction of waste materials around the local environment destined for the ocean. Volunteers are required to collect waste materials and record data in order to quantify total volumes of different materials.

The swim club programme was introduced in 2016 inviting children from around Pacific Harbour to learn and strengthen their swimming skills. Fiji consists of 332 islands which are surrounded by the sea, just one of the many reasons why SCP volunteers ensure that knowing how to swim is an essential part of local children's daily lives.

Cultural enrichment allows SCP volunteers to learn and participate freely amongst the local people. Cultural days happen once a month during which volunteers participate in a variety of activities, from making coconut cups, known as a 'bilo', weaving baskets, learning Fijian dances, language classes, cooking food in an earth oven, known as 'lovo', and drinking the local traditional drink, known as 'kava'. Such activities are either conducted at the project base or in local villages along with many other Fijian's which gives volunteers the opportunity to sample the local culture.

6. Partners, collaborators, and contributors

Conservation

Recorded Wildlife at …

Appendix I.
Teleostei (33)

Scientific name	Vernacular
1. Family Carangidae – Jacks & Trevallys (6)	
Caranx ignobilis	Giant trevally
Caranx plagioteania	Barcheek trevally
Carangoides ferdau	Blue trevally
Caranx melampygus	Bluefin trevally
Caranx sexfasciatus	Bigeye trevally
Elagatis bipinnulatus	Rainbow runner
2. Family Lethrinidae – Emperors (4)	
Lethrinus olivaceus	Longface emperor
Lethrinus miniatus	Sweetlip emperor
Lethrinus laticaudis	Grass emperor
Monotaxis grandoculis	Humpnose bigeye bream
4. Family Serranidae – Groupers (10)	
Plectropomus leopardus	Leopard coral grouper
Cephalopholis miniata	Coral grouper
Plectropomus laevis	Blacksaddle coral grouper
Epinephelus malabaricus	Malabar grouper
Epinephelus maculatus	Highfin grouper
Cephalopholis argus	Peacock grouper
Epinephelus cyanopodus	Speckled grouper

Variola louti	Yellow-edged lyretail grouper
Variola albimarginata	White-edged lyretail grouper
Epinephelus polyphekadion	Camouflage grouper

5. Family Lutjanidae – Snappers (6)

Lutjanus bohar	Red snapper
Lutjanus gibbus	Humpback snapper
Macolor niger	Black snapper
Macolor macularis	Midnight snapper
Lutjanus monostigma	Onespot snapper
Aprion virescens	Green jobfish snapper

6. Family Sphyraenidae – Barracudas (4)

Sphyraena barracuda	Great barracuda
Sphyraena qenie	Blackfin barracuda
Sphyraena jello	Pickhandle barracuda
Sphyraena forsteri	Bigeye barracuda

7. Family Scombridae – Mackerels & Tunas (3)

Scomberomorus commerson	Narrow-barred spanish mackerel
Gymnosarda unicolor	Dogtooth tuna
Grammatorcynus bilineatus	Double-lined mackerel

Recorded Wildlife at Fiji Shark Conservation Project

Appendix II
Elasmobranchs & turtles (21)

Scientific name	Vernacular
1. Family Carcharhinidae – Requiem sharks (7)	
Carcharhinus melanopterus	Blacktip reef shark
Triaenodon obesus	Whitetip reef shark
Carcharhinus leucas	Bull shark
Carcharhinus albimarginatus	Silvertip shark
Negaprion acutidens	Sicklefin lemon shark
Carcharhinus amblyrhynchos	Grey reef shark
Galeocerdo cuvier	Tiger shark
2. Family Sphyrnidae – Hammerhead sharks (2)	
Sphyrna mokarran	Great hammerhead shark
Sphyrna lewini	Scalloped hammerhead shark
3. Family Ginglymostomatidae – Nurse sharks (1)	
Nebrius ferrugineus	Tawny nurse shark
4. Family Stegostomatidae – Zebra shark (1)	
Stegostoma fasciatum	Zebra shark
5. Family Dasyatidae – Whiptail stingrays (4)	
Taeniura lessoni	Oceania fantail ray
Neotrygon trigonoides	Coral sea maskray

Taeniurops meyeni	Blotched stingray (Giant reef ray)
Pateobatis fai	Pink whipray (Tahitian whipray)
Urogymnus asperrimus	Porcupine ray

6. Family Myliobatidae – Eagle & manta rays (2)

Aetobatus ocellatus	Spotted eagle ray
Mobula alfredi	Reef manta ray

7. Family Rhinobatidae – Guitarfish (1)

Rhynchobatus australiae	Bottlenose wedgefish (White-spotted guitarfish)

8. Family Cheloniidae – Sea turtle (2)

Eretmochelys imbricata	Hawksbill sea turtle
Chelonia mydas	Green sea turtle