Supplementary Online Materials

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Case Study Methodology

The following case studies are included to illustrate the impacts of COVID-19 on marine protected and conserved areas (MPCAs) and provide contextual information and examples to support the main article. These case studies are focused primarily on: (1) the impact of the pandemic on MPCAs, (2) the responses that MPCAs have adopted to cope with the challenges caused by COVID-19, and (3) the likely future, including any innovative approaches, for MPCAs to continue to function and avoid returning to business as usual. Some case studies portray a single MPCA and others a network of MPCAs. Each case study was drafted based on responses to a series of questions (see Box S1).

Case studies were identified based on personal contacts from the authors and chosen to represent diverse geographic ranges, types of MPCA governance, sizes of MPCAs, and national contexts. Case study narratives were either developed and written directly by the case study authors based on their perceptions and experience, or written by the coordinating authors based on an interview followed by detailed review by the individual case study authors. It is important to note that as case studies were primarily contributed by non-government organisation staff working in each MPCA, they likely represent only a subset of the diverse views and opinions that MPCA stakeholders have about the impact, responses and likely future of MCPAs post-COVID-19.

Box S1. Case study prompt questions. These questions were provided to case study authors to help guide the content to be included as each case study was developed.

- Overview of the MPCA
    - Summarize governance of area, history (date of establishment), location, key features protected, management/decision-making etc.

- COVID impacts on the MPCA
    - How have stakeholders and communities been affected by COVID where the MPCA/MPCAs are located?
    - Have any of these changes had impacts on the MPCA?
    - Have there been any changes to the MPCA and it's management?
        - Have there been any changes in how decisions are made?
        - Changes in monitoring and enforcement capacity?
        - An increase or decrease in people trying to access marine resources?
        - Changes in available budget and capacity for management?
    - Have any of these changes impacted the effectiveness of the MPCA?
    - What kinds of actions have been taken to reflect any of the new challenges emerging with COVID since the pandemic started?
        - By the community?
        - By NGOs?
        - By the government?
        - By other stakeholders?

- What has worked well
    - What aspects of the MPCA, MPCA governance system, or management have continued to be effective? Why?

        - For MPCA management? Why?
        - For community well-being? For different groups within the community? Why?
    - Of the *new* actions taken since the pandemic (from above question), which seem to be the most effective?
        - For MPCA management? Why?
        - For community well-being? For different groups within the community? Why?
    - Does the MPCA use an innovative approach which has helped it weather the COVID pandemic.
        - Note, this doesn't need to be MPCAs that have changed how they function in response to COVID. We are also interested in examples of MPAs that pre-COVID adopted an innovative approach that has enabled resilience through the pandemic.

- Likely future
    - What do you think are the most important lessons we should take from this pandemic?
        - Are there important things about MPCA governance and management that should change based on experience during the pandemic that can help us be resilient to future pandemics?
        - Are there practices that we should invest more in, or try in other places?
        - Are there practices that we should stop?
        - What do key stakeholders think about the above questions?
            - Community members and fishers?
            - Local and national government staff?

Case Study 1: Papahānaumokuākea Marine National Monument, Hawaii, United States

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About the MPA

Papahānaumokuākea Marine National Monument is the largest contiguous fully protected conservation area in U.S. waters, and one of the largest marine conservation areas in the world. It encompasses 1,508,870 km^2 of the Pacific Ocean and stretches for 2,173 km across the Northwest Hawaiian Islands. The Monument protects islands and atolls, seamounts, banks and shoals and supports an incredible diversity of coral, fish, birds, marine mammals and other flora and fauna, many of which are unique to the Hawaiian Island chain. Many of the islands and shallow water environments are important habitats for rare species such as the threatened Green Turtle (*Chelonia mydas*) and the endangered Hawaiian Monk Seal (*Neomonachus schauinslandi*), as well as the 14 million seabirds representing 22 species that breed and nest there. Papahānaumokuākea is of great importance to Native Hawaiians, with significant cultural sites found on the islands of Nihoa and Mokumanamana, both of which are on the National and State Register for Historic Places. Mokumanamana has one of the highest densities of sacred sites in the Hawaiian Archipelago and has spiritual significance in Hawaiian cosmology. Papahānaumokuākea is also inscribed as a mixed UNESCO World Heritage site.

The Monument is remote, and the only permanent residents are a few staff at Midway Atoll National Wildlife Refuge. Others must obtain a permit to visit, and most visitors do so for research or cultural purposes. The Monument is co-managed by the National Oceanic and Atmospheric Administration (NOAA)'s Office of National Marine Sanctuaries, NOAA Fisheries, US Fish and Wildlife Service (FWS), the State of Hawaii, and the Office of Hawaiian Affairs.

Due to Papahānaumokuākea's isolation, past management efforts, and current regulations controlling access, impacts from local human uses have been relatively few, and thus its reefs and other resources are considered to be in nearly pristine condition across most of the region (NOAA Office of National Marine Sanctuaries, 2020). Marine habitat condition in particular locations has, however, been impacted by derelict fishing gear, large storms, aggressive nuisance algae and coral bleaching, though most locations have not been significantly affected and are in good to fair condition. Monument-wide, inland and coastal water quality parameters have indicated relatively good conditions. In contrast, oceanic and atmospheric conditions have been affected by accelerated sea level rise, increased frequency of storms and increased regional sea surface temperature.

COVID-19 impacts on the MPA and community

The primary impact to the Monument during the pandemic has been the suspension of most field operations. Several planned expeditions were cancelled, including two that were culturally focused and organised by the Office of Hawaiian Affairs. All NOAA research cruises were cancelled, and cruises by the FWS were reduced. A planned seabird restoration project (to eradicate mice preying on seabirds) at Midway was postponed through 2021 because of safety protocols at Midway due to its remote location and lack of medical facilities.

Enforcement operations through the US Coast Guard and the NOAA Office of Law Enforcement (OLE) continue. Vessels visiting the Monument are required to use VMS (vessel monitoring system) and are tracked by NOAA OLE.

Monitoring capacity has been greatly reduced and long-term datasets have been disrupted for many sites. In 2020, there were no field camps to conduct surveys for monk seals, sea turtles, seabirds or corals on most islands. Seabird monitoring at Midway Island by the FWS has been scaled back, and nearshore monitoring at Nihoa and Mokumanamana for culturally important littoral zone species was cancelled. A private nonprofit organisation that supports the State of Hawaii staffed a field camp of four volunteers that went to Kure Atoll in early March to conduct restoration and monitoring activities, including eradicating invasive species, banding and counting seabirds and cleaning up marine debris. Due to reduced operations in the Monument, they were not able to be picked up as planned in late August, and had to stay an additional two months on the island.

The pandemic required the closing of the Monument visitors centre in Hilo (on the Big Island), which usually hosts 60,000 visitors a year including local school groups. The facility also serves as a community centre. Public events, such as those to celebrate the 20th anniversary of the Monument's initial establishment as the Coral Reef Ecosystem Reserve, and its 10th anniversary as a UNESCO World Heritage site, had to be made virtual, reducing their impact. The broader community impact to Hawaii was the suspension of all tourism for approximately six months, which only re-opened on October 15, 2020. Despite this, there were COVID-19 spikes this summer and beach parks and other activities had to be closed. There were also concerns about hospital capacity.To-date there have not been budget impacts to the Monument, which is funded through federal appropriations through NOAA, FWS and state revenue. This could possibly change next year due to loss of state tourism revenue.

Monument response to COVID-19

The Monument managers have responded to COVID-19 by moving most operations to a virtual format, such as meetings of the Monument Management Board of the co-management agencies. This has allowed most activities to stay on track (such as the recent release of the State of the Monument report; NOAA Office of National Marine Sanctuaries, 2020), but communication is more challenging. Meetings of the stakeholder Reserve Advisory Council are also virtual. While field operations have been greatly reduced, the Monument added new public health guidelines to all permits, ensuring that centres for Disease Control recommendations are followed.

New directions

Because few people visit Papahānaumokuākea, a management goal has always been to bring the place to the people and visitors of the main Hawaiian islands and elsewhere through a visitor centre, web presence and social media. That approach was made even more necessary, although challenging, by the pandemic. Staff stepped up efforts to communicate with the public about the Monument through email, by updating the website, and increasing a focus on social media. However, it has been difficult to get attention for the Monument with the public focused on the pandemic and an election year.

Because the islands of Papahānaumokuākea are relatively undisturbed, managers have always taken measures to ensure biosecurity. This focus may be a lesson for other MPAs as the pandemic has increased awareness of the connections between human and ecosystem health. No vessels are allowed to enter the Monument without a hull and rat inspection and thorough internal and external inspections. No individual can visit the islands without following detailed safety procedures, including new clothes that must be deep frozen to destroy any biological agents. Certain foods are

not allowed because of their seeds and cardboard is not allowed because it can contain biological materials (e.g. insect eggs).

Monument managers are increasingly using new digital imagery to map resources, tools that are especially important when field operations are suspended. This year, a partnership between NOAA, NASA and FWS used satellite imagery to map nuisance algae at Pearl and Hermes Atolls. The Monument has also used a wave glider to document the presence/absence of whale species, with the glider able to undertake a 8,047 km (5,000 mi) journey to the Northwest Hawaiian Islands and back to map whale sounds and vessel traffic.

On a broader scale, COVID-19 impacts have sparked dialogue about the future of tourism in Hawaii. With outside tourism suspended for six months, local people have appreciated having greater access to lands and waters and allowing these places to recover from tourism impacts. While this issue does not affect the Monument, it does affect other MPAs in the main Hawaiian islands.

Case Study 2: Galápagos Marine Reserve, Galápagos, Ecuador

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Overview of Galápagos

The Galápagos Islands belong to the Republic of Ecuador and are located 1,000 km west of Ecuador's continental coastline in the Pacific Ocean. Galápagos is an archipelago of volcanic islands with unique ocean dynamics – including deep near-shore waters, strong currents and nutrient-rich upwellings. These conditions support rich habitats for over 2,900 fish species, aquatic invertebrates and marine mammals, of which 20 per cent are endemic. Similarly, over 100 terrestrial-vertebrate species inhabit the islands, where 80 per cent of the birds and 97 per cent of the reptiles and land mammals are endemic. The islands also harbor over 600 plant species of which 30 per cent are endemic. These extraordinary flora and fauna, geological features and many unique species have made Galápagos into a major global centre for scientific research and nature tourism. In recognition of its natural value Galápagos was declared a World Heritage Site by UNESCO in 1978. Despite facing many problems, especially with invasive species, it is one of the best-preserved archipelagos in the world, and a leader in management of fragile ecosystems.

Galápagos includes two protected areas: (1) the Galápagos National Park (established in 1959 and covering 97 per cent of the land area of the archipelago), and (2) the Galápagos Marine Reserve (GMR). The GMR has evolved in size and governance since 1986 when it was initially created by Presidential Decree as a marine resources reserve. In 1998 the GMR was legally gazetted and included in the Ecuadorian Protected Area System. This GMR gazettement expanded coverage for marine protection 40 nautical miles from the previous 15 nautical miles included in the marine resources reserve. The GMR covers 138,000 km^2, and is a multi-use marine protected area under collaborative governance and under the management of the Galápagos National Park Directorate (GNPD; Dirección del Parque Nacional Galápagos, 2014). The Galápagos UNESCO World Natural Heritage sites area was expanded in 2001 to include the GMR.

The economy of the Galápagos largely depends on its marine and terrestrial ecosystem services and particularly on its biodiversity. Tourism is the most important economic activity in Galápagos (Utreras et al., 2014) – with 271,238 visitors to the islands in 2019. Other important jobs include in the public sector, agriculture and fishing (Utreras et al., 2014). In the last 30 years, growth in tourism has affected all economic sectors in Galápagos, including construction, commerce, fisheries, transportation, agriculture and public administration. The growth in tourism, and the livelihood opportunities it presents, has also driven an increase in population on the islands. In response to the increased socioeconomic and political challenges the Ecuadorian government has developed different instruments and regulations aimed at regulating the conservation and sustainable use of the islands. The Galápagos Government Council regulates productive activities in urban and rural areas by applying the Galápagos Special Law. Since 1998 the tourism entrance fees[1] for the two protected areas of Galápagos have been shared with local institutions. The entrance fees are currently divided between three municipalities (25 per cent), rural governments (5 per cent), and the Galápagos Government Council (GGC) (20 per cent), GNPD (45 per cent), and the Galápagos Biosecurity Agency (GBA) (5 per cent).

COVID-19 impacts and responses

In March 2020 the Ecuadorian government declared a health emergency (officially declared as a "state of exemption") because of the COVID-19 pandemic. In order to prevent the spread of the virus, there have been government-imposed restrictions, quarantines or other restrictions. As in the rest of the world, this decision paralysed most of the industries and economic production in Ecuador. The pandemic obliged the GGC to prioritise funding towards urgent health actions to combat COVID-19. As the pandemic progressed, with international support, a planning exercise was conducted to identify urgent measures to reactivate the Galápagos as a whole, putting emphasis on four main streams: well-being, productivity, connectivity of initiatives and institutional cooperation (Consejo de Gobierno del Regimen Especial de Galápagos, 2020). There were no urgent streams directed to tackle conservation and protection of the unique biodiversity of the Galápagos in the plan.

Local economy, fisheries, and food security

Immediately following the health emergency declaration, the Galápagos Emergency Committee met and took the decision to evacuate tourists and forbid the entrance of any kind of travelers, including local residents that have been on mainland Ecuador. These restrictions on travel to prevent the spread of COVID-19 have caused the collapse of the local economy, since the approximately 30,000 people who live in Galápagos depend directly or indirectly on tourism. Tourism revenues from entrance fee visitors and tourism operating licenses were approximately US$ 17 million in 2019, therefore, the loss of this level of income in Galápagos in 2020 will have dramatic and long-lasting effects for the local community. Measures have been taken by the local and national governments to support the tourism sector, with the reduction of the payment of tourism licenses and the implementation of COVID-19 biosafety protocols for the different tourism activities. Additional effort was made to increase capacity of local hospitals and medical centres, so Galápagos could be a safer place to travel.

With the sudden reduction in income, food security became an issue for local communities living in Galápagos. Responses to ensure food security spanned different institutional levels. For example, the GGCl formed inter-institutional working groups to coordinate activities to support food security of the community. Additionally, non-governmental organisations (NGOs) coordinated the donations of food and distribution to vulnerable groups within the community. To cope with income loss, the local community activated one of the oldest mechanisms of commerce and subsistence – barter – which was widely used. Those with access to fish, agricultural products or other food items began to exchange within the community to secure food that was needed.

Artisanal fishers played an important role by providing fish for the local community – which was often provided free to those with low income or that had lost their jobs. After a pause in fishing activities at the start of the pandemic, normal lobster fishing and demersal fishing continued to be carried out in the GMR. However, deeper water commercial species such as marlins, swordfish and even Yellowfin Tuna (*Thunnus albacares*) began to be targeted in the GMR using illegal modified long lines. Therefore, the COVID-19 situation created an opportunity for the local fishers to use illegal fishing gears, which they justified as crucial to increase fisheries capture to support local food security and help reactivate the local economy.

Changes in wildlife

The reduction in tourism within the GMR has led to some interesting and unexpected changes in marine life behavior. For example, Killer Whales (*Orcinus orca*) with a calf have been observed swimming close to shore between anchored boats at Academy Bay on Santa Cruz Island. In July 2020 a rapid monitoring assessment was conducted by park rangers and scientists at a number of major

marine and terrestrial tourist visitor sites to collect data on how the absence of tourists had affected wildlife (Keith, pers. comm.). These surveys combined with recent wildlife survey census data suggest that the populations of penguins were at their highest since 2006, and flightless cormorant populations have reached a record number since historical data was first collected in 1977. Such increased penguin and cormorant numbers are the product of many years of work controlling introduced species (e.g. rats which ate eggs of these ground nesting birds) and the presence of the natural event La Niña (which cools waters and generates increased fish prey for both birds). However, it is believed that the absence of disturbances in the nesting areas from no tourist visits has helped to boost chick survival during 2020 and also contributed to recent population growth. The GNPD has taken advantage of the absence of visitors to implement additional monitoring to establish better baselines on wildlife populations in the absence of tourism to better understand impacts of tourism on wildlife.

Impact on management

A substantial part of the projected tourism income for 2020 was planned to be used for management and conservation activities of the archipelago. Thus, the drastically reduced tourism income received in 2020 has limited many planned field conservation activities such as surveillance, control of invasive species, repatriation and monitoring of wildlife. As the first impacts of the pandemic were felt in Galápagos (March 2020), the operations of the GNPD and the GBA changed to assist with activities to avoid the spread and expansion of COVID-19 on the five inhabited islands of the archipelago. The GBA has been fundamental in the pandemic for not only preventing new invasive species arriving and dispersing in Galápagos, but to supporting human and logistic infrastructure around the control, information management and key field work to avoid dispersal of COVID-19. Their efforts and inter-institutional coordination made it possible for the GBA to elevate its biolab from level 2 to level 3, becoming capable of processing over 500 polymerase chain reaction (PCR) COVID-19 tests per day. This laboratory has been key in supporting COVID-19 management measures, and will be fundamental for future tourism reactivation and its direct contribution to funding conservation and environmental activities.

All uses of the GMR (tourism, fishing, science, public transport) were cancelled completely for the first two months of the pandemic. This freeze of activities was needed to avoid social contact while protocols were developed and put in place by the Emergency Committee. By August, park rangers and scientists were allowed to resume field work throughout the archipelago, although logistics to travel to and from distant islands were still limited. It has already been confirmed that much of the scientific information expected to be collected during the months of the pandemic has suffered from lack of continuity, affecting the analysis of data and results. New scientific projects, however, from the Charles Darwin Foundation and University San Francisco have also been started in this period. These embrace the “One Health” concept, connecting healthy ecosystems and wildlife populations with human health – for both urban and rural areas.

The GMR and the coasts of the Galápagos have been impacted by the continuous arrival of floating debris, mainly plastics and carrying potential marine invasive species (Carlton et al., 2019). During the pandemic, many of these debris had Chinese labels, with possibly some coming from the Chinese industrial fishing fleet outside the Ecuador-Galápagos exclusive economic zone. Because of the pandemic, the cleaning of coastal rubbish by rangers, scientists and naturalist guides was drastically reduced.

Likely future

Protected areas within Galápagos – including the GMR – have solid governance and management processes – many of which have been recognised regionally for their best practices. Despite the impact of a global pandemic, the management authorities responded effectively to maintain

management activities where possible, and shift focus to assist with human health and food security needs. A great challenge for management authorities that is still ongoing is to identify alternative funding to continue with projects and programmes due to the lack of income from tourism. The pandemic has emphasized the importance of embracing the “One Health” concept when shaping future conservation activities.

The pandemic has highlighted the extraordinary dependence on tourism to sustain the human population and most of their economic activities within Galápagos. This raises the need for greater diversification of livelihoods in Galápagos away from reliance on tourism in the future. This current disruption could be used as an opportunity for the development of businesses based on a circular economy. As tourism returns post-pandemic a conscious effort should be made to improve tourism sustainability and increase equitable benefits sharing from tourism within the Galápagos community.

Unfortunately, conservation and management of the protected areas of Galápagos (both the GMR and the National Park) did not get much attention during COVID-19. Instead decision-makers were focused on ways to resume economic activities to bring income into Galápagos. Conservation of the Galápagos was rarely mentioned in the political discourse during COVID-19. This could be interpreted in two ways: (1) that the GNPD and GBA were perceived to be solid institutions that were capable of being resilient; or (2) despite the importance of conservation and ecosystem services for the local population, during COVID-19 immediate human well-being (e.g. food security, income) became priorities over the need to maintain the long-term nature and ecosystem service value of the Galápagos. The development of the Regional Galápagos 2020-2030 Plan was put on hold due to COVID-19. It is hoped when work on this plan resumes it will capture a broader and more holistic vision for the Galápagos, bringing a balanced combination of social, economic and environmental strategies based on lessons learned during the pandemic, and lead towards a better and more resilient Galápagos and GMR.

Case Study 3: Northern Belize Coastal Complex, Belize

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Overview

The Belize Barrier Reef extends 220 km from Sapodilla Cayes in the south to the Belize-Mexico border in the north, and forms the heart of the Mesoamerican Barrier Reef, the second longest reef in the world – shared by Mexico, Belize, Guatemala and Honduras. In 1996, seven of Belize's MPAs, collectively known as the Belize Barrier Reef Reserve System (BBRRS) was declared a "UNESCO World Heritage Site" due to its high level of biological diversity, ecological processes, natural beauty and important and significant natural habitats for threatened species (UNESCO, 1996). The Northern Belize Coastal Complex (NBCC) is a river-to-reef seascape that includes the Corozal Bay Wildlife Sanctuary (CBWS), the largest estuary in the Mesoamerican Reef, the Bacalar Chico Marine Reserve, Hol Chan Marine Reserve and Caye Caulker Marine Reserve. Managed through a series of co-management agreements between the Belize Government (Fisheries or Forest Department) and non-governmental organisations (NGOs), the NBCC encompasses 894.3 km^2 of inter-connected littoral forest, mangrove, seagrass and coral reef habitat supporting at least 24 species of international concern, including the critically endangered Goliath and Nassau Groupers (*Epinephelus itajara, Epinephelus striatus*), Hawksbill Turtle (*Eretmochelys imbricata*), Acropora corals, and the endangered Antillean Manatee (*Trichechus manatus*). The NBCC provides important nursery grounds for traditional conch, lobster and finfish fisheries, supporting over 1,345 Belizean fishers who depend on these resources for their livelihoods (Chapman et al., 2019).

Many coastal communities in Belize are directly dependent upon healthy reefs as their primary source of income. Sarteneja village, a key stakeholder community of the NBCC, is the largest fishing community in Belize, where over 80 per cent of households are directly dependent upon fishing as their primary source of income (Kyne et al., 2020). Belize's fisheries are under increasing pressure. Improved fisheries management, as well as alternative incomes and fisheries diversification are recognised needs (Chapman et al., 2019).

COVID-19 Impacts

In Belize, COVID-19 impacts have been felt far and wide. Fishers, tourism-workers and daily or informal workers have lost or have seen a drastic reduction in their livelihood opportunities and income across Belize. The closure of international borders, leading to the collapse of the tourism industry, has created many uncertainties for the future of the industry and the domestic seafood market (Rodriguez et al., 2020). The international market for lobster has become seriously depressed, with low prices being offered by seafood processors at the opening of lobster and conch seasons. With unemployment and loss of income, there has already been reduced compliance and increased pressure put on protected areas within the NBCC and the BBRRS seascape. The Sarteneja Association for Conservation and Development (SACD), who has held co-management responsibility for the CBWS since 2012, has observed a 21 per cent increase in infractions of illegal fishing activities (per comms. SACD, 2020) as tour guides turn to subsistence fishing for their livelihoods. It is predicted that these activities will increase with the long, slow anticipated recovery of the tourism sector.

Impacts have been felt in Sarteneja, where Blue Ventures (BV) has operated volunteer expeditions over the past 10 years. These expeditions brought much needed income and job opportunities into

the community, but have now been suspended due to travel restrictions caused by the COVID-19 pandemic. Another casualty of the suspension is that the otherwise robust 10-year coral reef monitoring programme that BV implemented through its expedition programme at BCMR will have a gap for 2020 and beyond. Data collection is particularly important this year, given the recent arrival of the Stony Coral Tissue Loss Disease in the NBCC, as well as the unprecedented halt in tourism, diving and lionfish removal activities. In addition, BV's nationally coordinated invasive species monitoring programme, which included the promotion of a lionfish fishery to both the local and tourism market as a strategy for control of the invasive species within multi-use Belizean MPAs, has been suspended, due to COVID-19 restrictions and the collapse of tourism in Belize.

What has worked well

The far reaching impacts of the COVID-19 pandemic have reinforced the assumption that protected areas cannot be managed in isolation. SACD has been the primary advocate of system level collaboration and management in northern Belize since 2015. With stakeholders across the NBCC, a participatory conservation planning and management approach has been championed by SACD, culminating in the establishment of the NBCC Management Action Plan (2015-2020), which will be imminently reviewed and updated to further collaborative, participatory conservation management and stakeholder engagement as well as address COVID-19 related threats and recovery strategies. BV's expeditions programme has made substantial contributions in building capacity and supporting the delivery of long-term monitoring objectives for BCMR's commercial and ecologically important species and habitats. In order to fulfil its commitments to support national monitoring programmes and build local capacity, BV has partnered with Belizean MPAs, including SACD, to train and deliver dive operations and coral reef and invasive species monitoring using established national and regional survey protocols. Through collaborations like these, and at a time when funding and capacity gaps have widened due to the pandemic, BV aims to bolster on-site capacity for protected area management in the NBCC and wider network, as well as create opportunities for capacity building in diving and conservation science.

There has been significant effort in Sarteneja to provide income diversification opportunities in tourism for reef fishers. With the pressures of the pandemic, SACD has embarked on an ambitious project to support tour guides that were left unemployed by involving them in a citizen science programme that aims to build their capacity, while also supporting protected areas management and making them more marketable if and when the tourism sector is able to recover.

Likely future

The NBCC has the potential to provide an innovative working model of cost-effective collaborative management at the seascape level. This will be achieved through increased communication, collaboration and coordination for enhanced surveillance and enforcement, monitoring and research, and meaningful stakeholder participation in management across the NBCC seascape. This builds on the shared experiences of individual protected areas and contributes to increased conservation outcomes, improved climate change resilience and natural resource user benefit. It also seeks to strengthen resilience of the protected areas to impacts such as COVID-19, through diversification of financial sustainability mechanisms, as part of COVID-19 recovery strategies.

Bold strategies and interventions are needed to help Belizean MPAs weather the long-term impacts of the COVID-19 pandemic. By redeploying BV's capacity to support community based fisheries management within the NBCC and wider MPA network, BV aims to better equip coastal communities with the tools needed to make informed and equitable management decisions, promote resilience to environmental change and ensure the long-term sustainability of Belizean fisheries.

Case Study 4: Florida Keys National Marine Sanctuary, Florida, United States

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Introduction

The Florida Keys National Marine Sanctuary is administered by the National Oceanic and Atmospheric Administration (NOAA), a federal agency, and jointly managed with the State of Florida to protect 3,800 square nautical miles of waters surrounding the Florida Keys, from south of Miami westward to the Dry Tortugas. The sanctuary protects unique and nationally significant marine resources including North America's only coral barrier reef, extensive seagrass beds, mangrove-fringed islands, and more than 6,000 species of marine life. Visitors to the sanctuary enjoy many recreational activities, including diving, swimming, snorkeling and fishing. The sanctuary has established rules and regulations[2] for specific zones to reduce user conflict and protect the sanctuary's natural and cultural resources.

Resources in Florida Keys National Marine Sanctuary are under threat, and the 2011 Condition Report shows that these resources are not adequately protected (NOAA Office of National Marine Sanctuaries, 2011). The report concluded that the natural and cultural resources were in fair to fair/poor condition and generally either stable or in decline. Since that report:

- Florida Bay experienced seagrass and sponge die-offs from elevated salinity, harmful algal blooms and storm effects.
- Corals weakened by a cold snap in 2010 and two summers of warm water temperatures in 2014 and 2015 succumbed to the devastatingly rapid outbreak of Stony Coral Tissue Loss Disease.[3]
- Hurricane Irma fractured coral reefs, ripped up seagrass, smothered sponges and altered the seascape.
- Habitats continue to suffer vessel impacts as boating use increases.

COVID-19 Impacts on the MPA community and the MPA

The most significant impact to the Sanctuary and surrounding community has been the decline in tourism since the start of the pandemic. From mid-March 2020 until the end of May, the only roads leading to the Florida Keys were closed to anyone except residents or people working in the southern Keys. This was a country decision to limit visitors to reduce the spread of the virus and due to the limited health infrastructure. In addition, all cruise ship visits have stopped since March 2020. In 2019, Key West had visits from 417 cruise ships, with 12,000 passengers visiting on the busiest day and 1 million people visiting Key West by ship during the year.

In general, seafood demand has declined due to restaurant closures and reductions in business. The lobster fishery, one of the largest in the Keys, has seen a decline due to declining demand for its product due to reduced restaurant business. Tariffs due to trade with China have impacted the lobster fishery (and COVID-19 impacts in China have also reduced demand for lobster there).

Because the Sanctuary is federally funded, funding has been stable. However, some non-profit partners, many of whom rely on fundraising, public interaction and educational programming, have or may experience reductions in their capacity due to reduced budgets and staff. All Sanctuary staff are under mandatory telework orders. While most management activities are continuing virtually, field operations have been very limited. The Visitors centre is closed. By contrast, other activities such as public meetings on the draft management plan, meetings of the citizen Sanctuary Advisory Council, other partnership meetings and education activities continue virtually.

Most enforcement in the sanctuary is conducted by partners who have continued operations during the pandemic (including the State of Florida, NOAA's Office of Law Enforcement, US Coast Guard, and the Monroe County Sheriff's office). Managers did see more violations of the Area To Be Avoided (ATBA) designated through the International Maritime organisation, including by megayachts who are increasingly using the area. Early in the pandemic there was some public perception that enforcement wasn't occurring, but cases continued to be pursued, so the public is more aware that enforcement continues.

Staff do not yet have the information to determine the impacts of COVID-19 on biodiversity in the sanctuary. Reduced use of the area, including the absence of cruise ships since March 2020, may have reduced stress on marine ecosystems (e.g. noise, air pollution, sediment pollution from bottom disturbance). Because dive operations have been suspended, the sanctuary has not been able to maintain many of its mooring buoys with its dive team, and is getting further behind in maintaining this important tool for reducing benthic impacts due to anchoring of recreational boats. The pandemic has resulted in reductions in MPA monitoring. NOAA's Coral Reef Conservation Programme would have been doing coral reef monitoring, which has been significantly curtailed. Sanctuary staff have not been able to dive at all either, so can't lead or contribute to research and monitoring efforts. Some partner monitoring efforts are occurring in a reduced capacity.

Unlike public lands, which were closed at times due to the pandemic, Sanctuary waters have been open throughout. While data on visitor use is not available, anecdotal evidence suggests that the sanctuary was an important recreational resource to the community during a period when many other pastimes were not available. Many fishing charters remained open.

Innovation for post-COVID-19 MPA management

Prior to the pandemic, the Sanctuary launched two related efforts to address widespread coral loss due to coral disease and cumulative impacts of human activities: Restoration Blueprint, an updated management plan for the sanctuary, and Mission: Iconic Reefs, a partnership plan to restore seven reefs in the sanctuary. These restoration efforts recognised that past management approaches were not sufficient to address current and future challenges, and assembled partners to take a more proactive approach to re-establishing corals and providing additional protection to sensitive areas. Restoration efforts were in their early stages when the pandemic hit, so while restoration field partners are operating with skeleton crews, planning, education and organizing efforts continue.

At the same time, the Keys community has begun a dialogue about what the future of tourism should look like in the region. Some community members are calling for an end to cruise ship tourism. There is widespread and growing recognition that future tourism must occur at sustainable levels, and that healthy water quality and marine ecosystems are essential to the economic future of the region. The local Tourism Development Council is a strong advocate for sustainable tourism and resource protection. At the operational level, the pandemic has raised questions about how much office space is needed and the long term expansion of telework. It has also demonstrated the utility of virtual community meetings for a large-scale MPA to eliminate lengthy drives. However, it also

highlights that there is no substitute for a field presence for research, enforcement and buoy maintenance.

Case Study 5: Dutch Caribbean, Netherlands

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Overview of sites

The Dutch Caribbean comprises six islands: Aruba, Curaçao and Bonaire lie just to the north of Venezuela in the Lesser Antilles; Saba, Sint Eustatius and Sint Maarten lie some 900 km to the north in the Leeward Islands. Aruba, Curaçao and Sint Maarten are self-governing, separate constituent countries of the Netherlands, while the three smallest (Bonaire, Saba, and St. Eustatius – known collectively as the Caribbean Netherlands) are special municipalities ("public bodies") and are governed from the Netherlands. On each island, management of protected areas (both terrestrial and marine) is ceded to local non-governmental non-profit foundations (*stichting*) or protected area management organisations (PMOs), which manage the sites under co-management agreements with local stakeholders. The Dutch Caribbean Nature Alliance (DCNA), an umbrella non-profit organisation, plays a key role in coordinating protected area management, and the DCNA Board includes representatives of all PMOs.

All six islands have MPAs (see Table S1) variously protecting coral reefs, seagrass beds, mangroves, seabirds, turtles, cetaceans and other key marine biodiversity. The MPAs on Bonaire, St. Eustatius, and Saba entirely surround each island. Saba Bank lies 5 km off the coast of Saba and protects a seamount. On Aruba, the MPA comprises four separate marine areas (Arikok, Sero Colorado, Mangel Halto, Oranjestad Reef Islands) within the primarily terrestrial Parke Nacional Arikok. Pre-pandemic, most of the MPAs attracted thousands of yacht visitors and diving/snorkeling visitors a year, and island visitation included hundreds of thousands of cruise ship tourists. Revenues from tourism are the mainstay of the island economies and are an important source of employment in restaurants, hotels and other services.

Table S1. MPAs in the Dutch Caribbean

Island	MPA Name	PMO	Date estab	Size (ha)
Aruba	Parke Marino Aruba -	Foundation Parke Nacional Arikok	2019	6020
Curacao	Curacao Underwater park	CARMABI	1983	600
St Maarten	Man of War Shoals Marine Park	St Maarten Nature Foundation	2010	3,100
Bonaire	Bonaire National marine Park	STINAPA Bonaire	1979	2,700

Saba	Saba National Marine Park	Saba Conservation Foundation (SCF)	1987	1,300
	Saba Bank National Marine Park	Saba Bank Management Unit in the SCF	2010	268,000
St Eustatius	St Eustatius National Marine Park	St Eustatius National Parks Foundation (STENAPA)	1996	2,750

In 2006, following a financing study, seed capital for an endowment Trust Fund of US$ 28.33 million (Euro 24 million) was secured from the Dutch Ministry of the Interior through a 10-year subsidy agreement. For the first decade, all revenues from the interest of the fund and through active asset management by the Trust Fund Committee were reinvested, and the capital is now in excess of US$ 18 million. Disbursements started in 2016. The Trust Fund was designed so that, once fully capitalized, the annual revenues would cover the basic management costs of one terrestrial protected area and one MPA on each of the islands, but was not meant to take responsibility away from the local governments to contribute financially to conservation through income from user fees.

Since 2016, there has been some additional funding from the Dutch Post Code lottery, and, for the three Caribbean Netherlands islands, the national government of Netherlands allocates US$ 1.53 million (Euro 1.3 million) a year for regular nature conservation and management, including research, ongoing activities and a working budget. Initially, based on the 2006 study, a greater amount of revenue went to Bonaire given its more advanced status as an MPA, but in 2019 this discrepancy was resolved and now equal amounts go to each island, regardless of the status of their protected areas.

Common constraints pre-pandemic included unreliable government support, lack of structural funding and limited spatial, conservation and environmental planning. The main threats include development pressure, particularly in the coastal zone, invasive species and over harvesting of marine resources such as grouper, snapper, grunts and local lobster and conch. There are also entrenched local issues over land tenure in and around the protected areas. The small size, geology and hydrology of the islands mean that land-based activities directly and immediately impact the environment. This is evident after heavy rains, when terrigenous sediment plumes, exacerbated by coastal development and over grazing, can be seen in near shore marine environments. It also means that less visible organic and inorganic pollutants from poorly treated wastewater and discharges quickly enter the marine environment, affecting the ecology of near shore mangrove, seagrass and reef communities in those MPAs that lie close to shore.

Impacts of the pandemic

Most of the protected areas in the Dutch Caribbean were closed from March to June, following the onset of the pandemic, the cessation of international travel and, for the most part, the prohibition of travel between the islands. Tourism, which is a large source of income for the parks, plummeted. All the PMOs have seen both a significant drop in income due to the disappearance of user fees and this had a particularly significant impact on the marine parks (particularly Bonaire, Aruba, and Curaçao), where income depended largely on these, and where much of the management revolved around visitor management. All non-essential work was halted and there was little day-to-day management. Impacts on individual marine parks tended to vary according to the stage they had reached in their Action Plans; for example, Curaçao is still preparing its Management Plan. Perhaps

ironically, those marine parks with the previously more secure income streams and established management procedures, such as Saba and Bonaire, were impacted more significantly. The more recently established sites that were still struggling to develop effective and sustainable management practices, were less affected.

A Research and Monitoring Working Group, established by DCNA in late 2019, attempted to establish an ecological monitoring programme during the pandemic but this was not feasible given the difficult working conditions and unusual priorities. Information on the impact on biodiversity is thus only anecdotal and varies from island to island. Any direct impact from changes in human activity may be obscured by the fact that a major coral bleaching incident has been underway, although fishermen on Aruba petitioned to be allowed to resume spearfishing (it had been banned pre-pandemic) and this was made legal again. Bonaire National Marine Park had substantial influxes of *Sargassum* seaweed during lockdown.

Immediate response

The Trust Fund has an emergency component and each protected area received an additional US$ 150,000 to replace lost income from the user fees as a result of the pandemic. There was urgent lobbying by DCNA with its Dutch partners in The Hague for increased support, and DCNA's Royal Patron was engaged to exert influence. Information on the situation was disseminated as widely as possible. Private philanthropy and food banks are providing essential food for vulnerable families while restaurants have been donating food packages and setting up soup kitchens. The immediate response was "hunker down" mode, although Saba National Marine Park received a special permit allowing it to maintain its coral nursery. In early November 2020, the government of the Netherlands advised against travel to all countries except the Dutch Caribbean islands, providing these had "yellow" (i.e. less restricted) status in relation to COVID-19. This was to stimulate the island economies, but there are concerns that it will lead to increased exposure to COVID-19 from international visitors, and there is an expectation that entyre fees to the parks may be increased.

The marine parks were, to some degree, partially prepared for a major crisis, having developed some resilience through their experience of hurricanes. As a result of the impact of Hurricanes Irma and Maria in 2017, funding was made available from the Trust Fund to prepare a Disaster Response Manual. This did not cover pandemics but, using material from the manual, DCNA rapidly produced a Pandemic Response Letter for all PMOs[4] which provided the necessary guidance. This covered: arrangements for staff and individuals entering and exiting a protected area (a key issue for contact tracing which is particularly difficult in the case of MPAs which do not have fenced boundaries); requirements for PPE equipment and its use; dealing with emergencies given the need for social distancing; pandemic-specific training requirements; sanitation of facilities and equipment; social distancing arrangements in the workplace; staggering of work hours; installation of protective barriers; communications and signage; lockdown protocols; financial considerations; emergency planning; response training and budgeting. Each protected area was expected to prepare a location-specific plan.

The future

The Trust Fund disbursements and the role of DCNA in providing an active support network for PMOs have been key aspects in allowing the MPAs to weather the pandemic. COVID-19 has brought to light the need for rigorous emergency response plans for each protected area, in order to safeguard both staff and visitors, and this is in development and will be shortly signed off by the DCNA Board.

Although partial recovery of tourism is anticipated, full recovery to pre-COVID-19 figures is not expected and there are real concerns that some of the PMOs will have to scale back or cease

operation. It is thus clear that the long-term financial management of marine parks in the Dutch Caribbean will have to change, and the need to diversify income streams and secure diverse sources of structural funding for them is now critical.

In collaboration with WWF-Netherlands and a consultancy company, DCNA had started a financial gap analysis on behalf of the PMOs in 2019 that revealed that, due to changes in investment markets and revenue generation potential, an estimated US$ 47.3 million (Euro 40 million) would now be needed to achieve the original goal of the Trust Fund. The analysis showed that pre-pandemic there was already a financing gap of about US$ 4 million a year for maintaining the islands' protected areas and associated nature conservation actions and that this has risen to about US$ 6 million in the current COVID-19 scenario. Work on the gap analysis and the search for solutions is continuing at an accelerated pace. Most of the marine parks in the Dutch Caribbean do not qualify for financial support from US foundations, or from international agencies such as USAID, World Bank, and the Global Environment Facility, sources used by many MPAs in small islands and less developed states. A further key requirement in such crises and indeed long-term is that MPAs, and indeed all protected areas, should be considered "essential services" as are health and other key sectors. Marine parks have an essential role in a sustainable future.

Also important for building resilience in the future is DCNA's detailed data collection and analysis system, based on the IUCN "management effectiveness framework". Called the Management Success approach, this is a tool for analysing the conservation success, institutional progress and management effectiveness of each protected area. It was developed in response to establishment of the Trust Fund as the Dutch Government required adherence to stringent reporting requirements by both DCNA and the PMOs; few of the PMOs at that time would have been able to be held accountable for their conservation success. The first "Management Success" reports were produced in 2006, and were considered to be suitable both for guiding adaptive park management and also meeting technical reporting requirements (MacRae & De Meyer, 2020). The reports were halted in 2016, but restarted in November 2019, and will now play a key role in identifying more fully the impact of the pandemic and how long term sustainable recovery can be achieved.

Sharing experiences and information is recognised as vitally important for dealing with such events, and it is considered that this needs improvement both regionally across the Caribbean and between the Dutch Caribbean islands. There was some support through the Caribbean Environment Programme during the pandemic, and efforts are underway to create a more effective network of MPAs recognised under the SPAW Protocol of the Cartagena Convention, and to strengthen the CAMPAN network. The pandemic has demonstrated the role that zoom meetings can play in information and experience sharing which will aid this process.

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Case Study 6: Adriatic Sea Marine Protected Areas, Croatia and Italy

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Overview

The Adriatic, a marine ecoregion in its own right, is a narrow body of water (only 116 km wide) that extends north from the main part of the Mediterranean, and is surrounded by six countries: Albania, Bosnia and Herzegovina, Croatia, Montenegro and Slovenia on the east, and Italy on the west. It contains over 1,300 islands, mostly located off the Croatian coast, and is divided into three basins. Tidal movements in the Adriatic are slight, and its salinity is lower than the Mediterranean's: the Adriatic collects one third of the fresh water flowing into the Mediterranean, as a result of the large discharge from rivers such as the Po. The western coast is alluvial or terraced, while the eastern coast is highly indented with a dramatic karst landscape. The unique nature of the Adriatic gives rise to an abundance of marine endemic flora and fauna (such as fish), very high marine diversity (notably algae) and important populations of cetaceans and monk seals.

By 2019, only an estimated 1.27 per cent of MPAs in the Mediterranean Sea were effectively implementing their management plans, although many areas important for marine biodiversity are protected (Gomei et al., 2019*)*. In most countries in the northern Mediterranean, effective management is still limited to a few small sites, and is often inadequate. In several countries, particularly in the southern Mediterranean, management plans and enforcement are still lacking for most MPAs (Gomei et al., 2019*).*

The main threats are overfishing, degradation or destruction of coastal habitats as a result of development, pollution from shipping, cruise tourism, marine litter from coastal sources, invasive species and climate change (Prvan & Jakl, 2016). Coastal development has been particularly dramatic in Croatia (only 2 per cent of the coastline here was urbanized or developed in 1960, whereas over 15 per cent is now developed, with predictions that this will reach 25 per cent), and along the Italian Adriatic coast where it has developed even faster (Romano & Zullo, 2014). The Croatian economy is highly dependent on tourism which makes up about 15 per cent of GDP (Ivandić & Šutalo, 2018), and over 90 per cent of tourism activities occur on the coast. This case study focuses on Croatia and Italy but reflects the broader situation throughout the Adriatic, where the pandemic has had a major impact.

Croatia has 17 MPAs covering about 2 per cent of its waters, protected through several designations, and designed to safeguard a range of key habitats including Neptune Grass (*Posidonia oceanica*) seagrass meadows and coralligenous aggregations, as well as fish stocks and endemic, rare or endangered species. Out of the five main MPAs three are designated as national parks (Brijuni, Kornati and Mljet), in which economic activity is limited and extraction of natural resources is prohibited, and two as nature parks (Lastovo Islands and Telašćica) where extraction, including commercial fishing allowed but it is more regulated form than outside the MPA. Both designations are managed by public institutions set up by the ministry in charge of the environment. In addition to the formal MPAs 16 per cent of Croatia's waters are protected through European Natura 2000 sites. Tourism involving Croatian MPAs has been rising fast, and now provides the major source of income (Paić, 2016).

The Italian Adriatic coast has three full MPAs and many coastal protected areas, designated as Natura 2000 sites, which include small marine extensions. Many of these areas protect the rare Italian Adriatic rocky coast, with a few protecting wetlands and dune habitats. The Kentish Plover (*Charadrius alexandrinus*), a coastal wader listed as Endangered in the Mediterranean[5] and on Annex I of the EU Birds Directive, is the "flagship species" for the sandy beaches found along this coast which are threatened by beach tourism, marine litter and global climate change. This species migrates from Africa to Europe in the spring to nest on sandy beaches from March to July, on the same beaches and over the same period that attract the tourists. Since tourism is vital to the local economy, the municipalities clean the beaches of debris over this period to keep them attractive to visitors. The vastly increased quantities of litter that now accumulate on the beaches has meant that, since the end of the 1990s, large machines are used for cleaning, which damage the nests. In recent years, this species has reproduced successfully in just a few coastal protected areas, such as Veneto Lagoon Natura2000, Delta Po regional park, Borsacchio natural reserve, and Torre del Cerrano MPA. A major programme (DFMR & MedPAN, 2019), involving NGOs, volunteers and different stakeholders, is now underway to try to protect the Kentish Plover, supported by AdriaPAN (see below)**.**

Impacts of the pandemic and immediate responses

Both Croatia and Italy went into lockdown in mid-March, resulting in cessation of all tourism to the MPAs, with a limited tourism season starting when borders opened in June.

In Croatia for all MPAs, there was a significant decline in tourism income; for example Lastovo Island lost 30 per cent of its income, and Kornati lost over 60 per cent (through entry tickets, souvenirs, guided tours). Furthermore, government funds were reduced for Kornati, Telašćica and Lastovo Islands MPAs, and Brijuni received no government income as funds were redirected to different schemes put into place to support the various aspects of the fight against the pandemic. Despite this, these four MPAs were able to maintain most of the work of conservation and ranger services. Some of the planned activities such as ecological monitoring, educational activities, conferences and training workshops, as well as staff recruitment, were postponed or cancelled. There was some adaptation, in that activities that were previously outsourced (e.g. monitoring) were done in-house to cut costs, extra staff time being available as many activities were cancelled.

At the same time, there was reduced tourism pressure on the environment compared to previous years, which was positive. According to the MPA staff there was no obvious increase or decrease in reported or spotted illegal activities. Once the MPAs opened, visitor procedures were adapted to reflect the national COVID-19 guidance (smaller groups or no group visits, different distribution of visitors within the MPAs to lower density in some areas, pocket and virtual guides instead of tourist guides, etc.). Selling of tickets and souvenirs shifted to online channels, an approach that MPAs will look to keep in the future.

The fact that the four MPAs mentioned above are islands, some of them quite remote, provided a natural barrier to COVID-19 (there are still no confirmed cases on Lastovo) so local communities were not severely affected. In Telascica and Lastovo Islands, where commercial fishing is allowed, small-scale fishers had (and still have) difficulty marketing and selling their catches (exports were halted, demand moved to virtual domain), which has in some instances led to establishment of *ad hoc* virtual fish markets on social media channels like Facebook and WhatsApp. In both places management institutions and WWF had already started pilot initiatives for co-management of fisheries, and these continued during the pandemic; fishery management plans have been finalized and will be adopted as legal regulatory ordinances for the first time in Croatia. The adaptations needed to the pandemic showed that on occasions online meetings and especially email exchanges instead of physical meetings can lead to more objective discussion, based more effectively on facts,

than in-person meetings that sometimes tend to be too emotional (and it is easier to track what was said, when and by whom).

In Italy, the COVID-19 restrictions meant that throughout the spring, no one could visit the beaches, and municipalities could not undertake beach cleaning. The Kentish Plover started to nest on beaches that previously they had avoided. Voluntary organisations along the Italian Adriatic beaches worked to protect these nests that were outside the MPAs and thus at risk from the re-opening of the beaches. The Environment Minister and all the Italian conservation institutions were alerted of the urgency for such protection, given the pressure from economic activities that wanted to start as soon as the tourist season opened. The work involved a special monitoring of beaches and protecting the nests, undertaken by protected area managers, association coordinators, nature conservation surveillance corps, scientific departments of national institutions and volunteers. Nets have been protected with light boundaries with poles and ropes and with strong surveillance by volunteers, that showed the birds on the nests, with binoculars and telescopes to anyone asking information about the fences. Only at the end of nesting activities and after the flight of the newborns was everything removed. In mid-July, a group of experts held a video-meeting, hosted by AdriaPAN, with the support of MedPAN within the InterregMED "*MPA Networks*" project to discuss the next steps such as meetings to work on a revised protocol and for a better organisation.

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Case Study 7: Kanamai-Mtwapa Co-Management Area, Kenya

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Overview

Implementation of marine area-based conservation in Kenya before the 1990s occurred through a top-down approach, leading to controversy, mistrust, and sometimes conflict with local communities (Mahajan & Daw, 2016; Samoilys et al., 2017). However, since the late 1990s, Kenya has increasingly supported a more participatory and inclusive approach towards resource co-management, such as the adoption of Beach Management Units (BMUs) that were formalised under the national fisheries regulations in 2007 (Mahajan & Daw 2016; Samoliys et al., 2017). BMUs are local organisations at fish landing sites made up of local fishers and other stakeholders such as fish traders, boat owners, and beach operators, that can make decisions about resource use and management with spatial jurisdiction and registration rules[6] incumbent upon the Director of Fisheries (Cinner et al., 2012). BMUs are therefore mandated to undertake fisheries management activities within a specified area, called a co-management area. These activities include gear restrictions, designating no-take-areas and multiple-use areas.

In the global context, the co-management area is a locally managed marine area (LMMA), which can encompass fishing communities from more than one BMU. In this regard, Kanamai and Mtwapa BMUs situated in Kilifi county, on the north coast of Kenya, came together to jointly manage a shared fishing area referred to as Kanamai-Mtwapa co-management area. Nested within the co-management area is a no-take area (*tengefu* in Swahili- "to set aside") called Mradi Conservation Area, established in 2011 to conserve fisheries and marine resources within an area of 22 ha (Kawaka et al., 2017). The establishment of the no-take area was motivated by the success of the adjacent Kuruwitu co-management area, despite several challenges- particularly funding (Mahajan & Daw 2016). While the conservation area has not had significant external donor support like others, it is perceived to provide long-term benefit, such as fish spillover and habitat provisioning (Cinner et al., 2014; Mahajan & Daw 2016; Kawaka et al., 2017).

Pandemic impacts

One of the most notable impacts from the COVID-19 pandemic in the co-management area was the drastic increase of people accessing the reefs, including the no-take area located nearshore, for fishing. This resulted from government-imposed COVID-19 curfews as well as cessation of movement and closures of schools, which increased dependence on fishing for subsistence. The curfews meant fishers had fewer hours a day to catch and market fish. Since fishing could not take place at night, fishing activities that would otherwise take place in deeper areas became concentrated in the inshore waters, including in no-take areas. The cessation of movement stopped all tourism activities while school closures increased the number of young people venturing into fishing. With inadequate time to sell, and in some cases no time, such as for women fish traders who traditionally sold fish in the evening when curfew began, the need for fast access to resources to mitigate financial loss became apparent (Kithia et al., 2020).

As a result of the increase in concentrated fishing, poaching in the Mradi Conservation Area increased and could not be controlled, exacerbated by unstable leadership within the management committee and a lack of enforcement. Monitoring, already a challenge pre-COVID-19, also came to a halt. The influx of people into the conservation area and increased fishing activities likely resulted in

negative impacts on the environment, such as the trampling of corals in shallow waters. However, some positive occurrences were observed, such as an increase in sea turtle sightings on beaches, likely a result of decreased disturbance from a decline in tourists and human activities. Tourism, one of the main activities in the conservation area, has also come to a stop. Loss of income from fish sales due to inadequate time to sell fish and reduced markets such as hotels and restaurants from the decline in tourists has driven local community members to exploit the marine conserved areas to greater extent, as their livelihoods are heavily dependent on these two sectors.

At the onset of COVID-19, the Mradi Conservation Area was undergoing a transition in leadership. The Kanamai and Mtwapa BMUs in charge of the area had held an election, with the expectation that the new team would steer the co-management area and conservation area towards better management of its resources. However, management activities are now greatly reduced. The government, through the Kenya Fisheries Service, is working to strengthen co-management approaches, while supporting fishing communities through various livelihood projects, including those that are not associated with marine and fisheries resources. However, these opportunities are limited. More immediate responses have included support from various non-government organisations (NGOs), aiding fishing communities with food relief hand-outs and connecting with community members through phone calls and other forms of virtual communication (Kithia et al., 2020) despite reduced activities. However, these local and international NGOs still rely on local leadership to relay information on use and management trends within the co-management area.

Moving forward

The narrow focus on limited livelihood sources (e.g. fisheries, tourism) will always create a local fishing community that is vulnerable to numerous shocks, as revealed by the COVID-19 pandemic. Community conserved areas cannot rely on foreign tourists alone to raise income. Diversification in livelihood activities is key at the BMU and individual levels. Local communities should shift focus from heavy reliance on LMMAs and other marine protected areas and fisheries to other sustainable livelihoods, such as promoting planting of drought resistant crops, trees (for charcoal), bee keeping and other activities that cannot be affected in the same ways by these shocks. This would also help to reduce pressure on the marine resources. LMMAs offering ecotourism related services should rebrand and capitalise on local tourism during such events.

Another important aspect is empowerment to access diverse consumer markets – there needs to be a provision for these communities to access and sell to different markets if there are declines in sales in the tourism and restaurant sectors, including consideration for gender roles. This requires promoting social enterprises that use technology to supply foods through online platforms. Indeed, community enterprises that shifted business to an online market have been able to survive and retain customers, and hence have faster recovery when COVID-19 restrictions were lifted. It has also become apparent that there is poor access to post-harvest technology, which can further decimate the market/supply chain. The need to invest in reliable storage facilities, and specifically ones that can be managed by the communities (e.g solar powered equipment), as well as capacity building on value addition to diverse markets are tangible priorities. Finally, there is a need to build capacity within communities and their governance bodies (i.e. BMUs) so that there is less dependence on outside actors.

Case Study 8: Mafia Island Marine Park, Tanzania

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Overview

Mafia Island Marine Park (MIMP) was established in April 1995 under Mafia Island District jurisdiction, as part of a series of marine protected areas (MPAs) established via the country's Marine Parks and Reserves Act No. 29/1994 to protect marine resources from overuse, unplanned commercial development, and destructive practices (Board of Trustees, 2011). The park, covering 822 km^2 of Tanzania's coastal waters, includes the southern part of Mafia Island and the inhabited islands of Chole, Juani, Jibondo, and Bwejuu. Mafia Island lies roughly 120 km south of Dar Es Salaam and 20 km offshore from the eastern extent of the Rufiji Delta, one of Africa's largest delta systems. The park protects an array of tropical marine habitats including coral reefs (over 278 hard coral species), with many reefs considered to have high recovery potential from natural disturbances (such as temperature-induced bleaching). It also protects seagrass beds, mangroves and intertidal flats as well as harboring a block of threatened lowland coastal forest and one of the few remaining intact reef systems in Tanzanian waters (Mwaipopo, 2008; Board of Trustees, 2011). Two species of sea turtle use the Island's beaches as nesting grounds, endangered whale sharks are residents of MIMP waters, and the dugong is believed to still inhabit some locations in the Mafia channel.

MIMP was the first marine park gazetted under the Government's initiative of the early 1990s to conserve biodiversity and safeguard the livelihoods of people for future generations, becoming operative with the government and non-governmental organisation (NGO) support in the early 2000s. Unlike non-extractive/small use marine reserves (15), the marine park, one of three, was created as a multiple-use MPA to accommodate sustainable livelihoods and environmental and commercial interests, especially as over 23,000 people live within its boundaries, with 50 per cent heavily dependent on marine resource use (Mwaipopo, 2008; Board of Trustees, 2011). Fisheries is the driving sector for the economic development of the entire District (60 per cent of total district economy): Mafia Island is the hub and major source of fish along the coastal region and Dar es Salaam at large (Mafia District Council, 2017; 2019). The park is divided into three zones: core (fully protected), specified use (regulations on fishing activities, fishing only for residents), and general use (open to outside fishers).

A collaborative, co-management approach is applied to decision-making and management, involving community members and stakeholders in all stages of planning and implementation. An Advisory Committee, which consists of state and non-state stakeholders, community representatives, tourism operators, fish factories and others advises the Warden in charge on general management of the MPA. This Warden supervises the MPA, supported by five department heads (Research and Monitoring, Law enforcement, Tourism, Community conservation and Administration and Finance). At the community level, Village Liaison Committees have been established that link MIMP management to communities and village governments. MIMP also implements community-based programmes to assist the development of activities and technologies for generating supplementary income, such as ecotourism, alternative livelihood schemes, and environmental education.

Pandemic impacts

The most profound impacts of the pandemic seen thus far for the park are financial in nature and stem from the fact that (1) there is no diversified funding source for MIMP and (2) the marine park provides a high level of revenue to a "basket" fund for several sister MPAs, thus, operation and

management of MIMP has come to a virtual standstill. The marine park pre-COVID-19 depended solely on its usage fee, mostly from tourism revenue and partly from fishing permits for non resident fishers. It is estimated that revenue for MIMP has dropped 50 per cent due to the pandemic shutdown (MIMP Annual Progress Report, 2019/2020): according to the MPA's headquarter office, pre-COVID-19 revenue from MIMP alone per month averaged US$ 25,000; that same value is now generated by MIMP and four other MPAs combined. Efficiency of the small number of staff in place normally has been further constrained with the diminished cash flow; this includes disrupted engagement of community members. The MPA's capacity has been impaired in terms of both staff number and skill, as training of remaining staff is financially hampered. The loss of revenue has also had cascading effects: education/outreach programmes on sustainable resource use have stopped, monitoring is irregular and will likely occur at wider intervals and surveillance patrolling has been reduced; as a result compliance is highly compromised. There is reported fishing-related reef damage and heightened poaching in remote, but ecologically key areas of the MPA. The overall performance of the MPA has dropped.

These impacts are felt directly by the communities within the MPA's boundaries, particularly those directly accessing marine resources (indigenous communities, fishers) and those in business ventures, such as fish mongers, small-scale businesses such as local street food vendors and tourism (investors, dive centres, hotels, tour guides, etc.). Household economic disruption is significant from highly impaired supply and value chains, e.g. tourism contributes significantly to the household economy of the MPA communities. For example, many Mafia communities have skilled traditional fishers that provide high quality seafood products to hotels. Now, however, with a severe reduction in tourists, income from fishing has drastically declined. There are also employment challenges, as many tourist industries have laid off staff. Fisheries market export has also been devastated. Closure of seafood markets in EU countries and other regional markets such as Rwanda and Kenya have vast implications at the local level, e.g. the COVID-19 outbreak has enormously affected the Fish Export Processing Firms (FEPFs) in Tanzania. A small-scale fishing community member provides an individual perspective:

> "I have no business at all because my agent who buys from me and supplies to export industrial processors and tourist hotels has stopped because of COVID-19. I have nowhere to sell my catch. I deal with highly priced seafoods - lobsters, crabs and octopus. Prices for octopus [and lobster] have tremendously dropped… a few days ago, Tanpesca management [main buying firm] circulated a message requiring their agents and fish collectors to stop buying fish and other seafood products from all fish landing sites because of Coronavirus. Our fish buyers (the market) not only provide me with loans for my fishing but also family sponsorship when a family member gets sick or I need school fees. I get a cash advance which is eventually deducted from my fish sells."
> -Masoud Issa, a fisherman from Kilwa, April 2020

Currently, management implementation in the MPA is based on high priority issues, decided by top management or at the discretion of the Warden In-charge, as regular stakeholder meetings have been put on hold. Collaboration is in process for research on further impacts, though affected by travel restrictions: a proposal is currently in development for a COVID-19 impact assessment of MPAs for both Tanzania and Kenya.

Despite the negative financial impacts, the pandemic has not prevented the usual MPA-based community livelihood activities such as beekeeping, seaweed farming, crop farming for banana, cassava, and coconuts, handmade crafting, food vending and some fishing (though a worrying factor is high mobility by and concentrations of fishers and fish traders, "coronavirus hotspots", consisting of fish markets, fishing and transportation harbors, fishing camps and fish processing areas). Still,

most MPA workstreams have fallen below a 70 per cent efficacy rate, primarily due to the drop in overall revenue. Administration has remained functional, as the little funding currently secured is serving this purpose. As a result, there is still in effect formal, regular progress reporting, and management is taking advantage of its MPA Village Liaison Committees for communication, enforcement, and oversight of resource use practices.

Likely future

The pandemic has presented a silver lining in terms of understanding the approaches needed for future resilience. Particularly for MIMP, greater investment should be placed in enforcement and intelligence-based patrol response, using community-based informers, to reduce high patrol costs of the regular enforcement patrols. The pandemic has also signified the need for less dependence on revenue from tourism, given that it is a fragile and highly unpredictable sector in terms of its adaptiveness to global shocks. It has become increasingly apparent to develop internal capacity for fundraising and generation of sustainable financing; a first step is to implement sooner than later the proposed business plan for 2018-2027, which provides a roadmap for how to develop, operate and maintain the MPA so that it is financially sustainable while also fulfilling its objectives.

Case Study 9: Velondriake Locally Managed Marine Area, Madagascar

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Overview

In 2006, fishing communities in Southwest Madagascar came together to create the Velondriake Locally Managed Marine Area (LMMA), which was then designated as a Category V marine protected area in 2015. The LMMA is governed by the Velondriake Association (VA), which comprises three regional sub-committees representing northern, central and southern villages. Management responsibility for the MPA has been delegated to the non-governmental organisation (NGO) Blue Ventures (BV) and the Velondriake Association by the Government of Madagascar, with the VA carrying out all management activities and BV providing technical and financial support. The MPA legislation regulates non-community based users of the area and its resources (fishing, tourism developments, mining) whereas regulation of local users is through *dina* – a locally-developed set of laws that has been ratified in court to become a local by-law.

The LMMA has incorporated a growing number of marine management practices as it has evolved, and now includes five permanent coral reef reserves and two permanent mangrove reserves (areas closed to extractive activities), as well as numerous periodic fishery closures on reef flats (primarily for octopus) and in mangroves (for crabs and shrimp). These are contained within an envelope of approximately 600 km^2 in which gear-based restrictions apply and use is restricted to small-scale fishers and artisanal aquaculturists. A reef monitoring programme has been underway since 2004, previously undertaken by BV expedition volunteers based in Andavadoaka, to provide data to the Velondriake Association. The Tahiry Honko project is located in the south of the Velondriake LMMA , which is the first carbon sequestration project in Madagascar based on a mangrove ecosystem, and the largest mangrove conservation carbon project in the world. The community-based project generates carbon credits which will provide regular income to support local management of the LMMA over the next 20 years. The southwest of Madagascar is arid, isolated and infertile and lacks industry and infrastructure (roads, irrigation, education, healthcare, etc.). Therefore, local communities have extremely high dependence on marine resources, and small-scale fisheries generate 82 per cent of all household income and provide over 99 per cent of dietary protein (Barnes-Mauthe et al., 2013). However, the coastal economy has transformed from subsistence-based to trade-based in recent decades (Cripps & Gardner, 2016), following the rise of global markets for seafood products including octopus (primarily *Octopus cyanea*), sea cucumber (Holothuroidea), mangrove mud crabs (*Scylla serrata*) and shark fin (Elasmobranchii).

COVID-19 impacts

At the onset of the COVID-19 crisis, regional exporting companies for seafood limited their export due to the decline in global markets, so fewer collectors were buying seafood from fishers in Velondriake. Collectors withdrew their contracts loaning boats and fishing nets to local fishers so many fishers lost their ability to fish and to access the fishing grounds and were left with little support. Most catches were for local consumption so prices fell significantly for octopus, crab and finfish. As a result, there was a severe drop in household income, and some people could not afford to buy food. Seaweed and sea cucumber farming, activities initiated and supported by BV and regional aquaculture businesses as alternative livelihood projects, remained important sources of income.

> "We are not motivated to go fishing because even if we get abundant products, we earn very little in return. Some communities are more interested in seaweed production than fishing" – Fisher, southwest Madagascar

In general there was less fishing, although initially some people returned to coastal villages from cities in order to fish. Many fishers, especially young fishers, turned to other sources of income such as cultivating cassava. There were also changes in the types of fishing to focus on demand. In some areas, there was more illegal fishing and mangrove cutting due to a perception of reduced enforcement by government agencies. In response to this increase in infractions, the Velondriake Association increased the frequency of patrols and made a written request to the Fisheries Ministry to ask for more support from enforcement agencies.

BV suspended volunteer monitoring expeditions in southwest Madagascar due to travel restrictions caused by the COVID-19 pandemic. This has impacted the community in the Velondriake LMMA, as they are no longer receiving income from volunteers who spend money in their villages; in particular the Women's Association that had previously been making a good income from providing meals to volunteers.

BV carried out extensive COVID-19 awareness campaigns, supported the training of all Community Health Workers and health centre staff on COVID-19, and advocated for better access to PPE. BV also pioneered the development of new protocols that minimise health worker-client transmission.

What has worked well

National restrictions on movement were relatively permissive in the core operating area for Velondriake, which meant that Velondriake Association and BV activities were largely able to continue. Advice on COVID-19 precautions, regulations and risk assessment were sought and activities were adapted to be safe, which meant that community management activities for the LMMA were largely able to continue as before the crisis. Indeed, ambitious new conservation measures were implemented during the crisis, with communities deciding to expand the network of permanent no-take zones significantly, in line with recommendations from monitoring of the existing no-take zones. Community-led fisheries monitoring has continued throughout the pandemic with necessary precautions and PPE.

Following the closing of the BV expeditions volunteer programme due to the COVID-19 crisis, a new programme was launched to train community members to carry out marine ecological monitoring in the LMMA, so that they can continue monitoring of critical ecosystems and no-take zones in the area, in the absence of support from BV's volunteers. Thanks to training delivered during the pandemic, these community members now have the same advanced field skills as scientific researchers, enabling long-term monitoring to continue within Madagascar's first community-managed marine reserves. This team has also undertaken community outreach efforts, raising awareness of the importance of conservation areas, resulting in recent community agreements to expand the network of permanent reserves in Velondriake.

It has been possible to maintain aquaculture activities (sea cucumber and seaweed farming) because commercial buyers and exporters of these products have been able to continue operations. Stocking and sales have continued throughout the COVID-19 pandemic as planned. So far, the pandemic has had a limited impact on sales, so this has been a key source of income during the COVID-19 crisis, with sea cucumber farmers in Tampolove making important earnings during this period: during April-Sept 2020 the farm made US$ 23,107 (90 million ariary) of net income for 78 farmers.

Community-led savings and loans groups (SILC) have provided a critical buffer against financial difficulties during the COVID-19 crisis. These low-tech solutions, which BV and partners support across Madagascar, enable people to save money and access credit in remote areas where there are no banks. Community groups pool together their savings in order to address financial hardship and provide loans to those within their group. Throughout the pandemic, having access to the additional financial support offered by the SILC groups has provided a lifeline for families living in remote coastal areas. As of October 2020, BV is supporting 140 groups with almost 40 per cent of the population participating. Over two thirds are women.

> "Some groups have begun to come to the end of a cycle, so they have redistributed the money with interest! One particular group that redistributed in April had close to 70 per cent interest in nine months of savings and loans. This is extremely helpful during this COVID-19 crisis" – Solontena Raivosoa, Blue Ventures outreach field technician, southwest Madagascar

Since the Andavadoaka Cooking Groups are no longer cooking for volunteers and staff, they have begun the mask-making project. In total, they have produced 6,088 masks, for a total income of roughly US$ 2,747 (10.7 million ariary) and have made more money than they did when they were cooking. Prior to the pandemic, demand for Tahiry Honko carbon credits outstripped supply, as the project is small in area and there were few blue carbon projects on the market. Given that a large proportion of global demand for carbon credits pre-pandemic was from the aviation and tourism sectors, there was speculation that demand would decrease, however broader corporate demand for voluntary carbon offsets has in fact increased during the COVID-19 pandemic (Gross, 2020).

Likely future

As community-based management is bottom up and low cost, it is highly resilient in the face of massive disruption to systems. Where communities are involved in monitoring and managing their own resources, such as in Velondriake, it has been possible to maintain effective management in spite of global disruptions to travel, tourism and funding caused by the COVID-19 crisis.
We have seen that where communities had strong local governance structures in place, they were also better able to respond to the crisis and engage with partner organisations and governmental services for support, underlining the importance of focussing on improving community-based governance mechanisms.

The shift towards community-led marine ecological monitoring has clear benefits. Since starting the training, the community-based teams have been able to share the information in their own language with their own communities, which leads to a much faster process for data feedback, and more in-depth and impactful discussions about fisheries management. The relationship between the people who collect the data and the local marine conservation efforts is much more reciprocal, because the monitoring team is made up of people whose livelihoods depend on the ocean. And the teams are able to bring their own rich indigenous knowledge, including where species can be found and in which seasons they are most abundant. Most importantly, by training local people to collect their own ecological data, the monitoring process is more sustainable so that they can continue to monitor the state of their ocean autonomously, without needing to rely on foreign volunteers.

It is also clear that organisations that are able to respond with a holistic approach are well placed to be able to support communities to deal with crises such as the COVID-19 pandemic, by addressing a range of needs from marine monitoring to community health and livelihoods. The risk of communities relying on single supply chains for seafood products has been emphasised, alongside the benefits of having access to a diverse range of livelihoods to improve resilience.

Case Study 10: Seychelles Marine Protected Areas

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Overview

Seychelles comprises 115 granite and coral islands in an Exclusive Economic Zone (EEZ) of 1.3 million km^2. Its waters are internationally recognised for their important marine biodiversity, and the country has long been a leader in biodiversity conservation. It has a diverse network of marine protected areas (MPAs) with a range of sizes, conservation objectives and governance mechanisms including very small sites managed by non-governmental organisations (notably Cousin Island Special Nature Reserve), the government (e.g. St. Anne Marine National Park), and a government trust (Aldabra World Heritage Site. Nevertheless by 2012, less than 1 per cent of its marine waters were managed in MPAs. That year, the Government of Seychelles committed to protecting 30 per cent of its marine waters by 2020. This target was achieved in March 2020, with the final designation of a series of new Marine Protection Areas that encompass and vastly expand the pre-existing MPA network (Office of the President of the Republic of Seychelles, 2020).

The Marine Protection Areas comprise:

- *High Biodiversity Protection Areas*: five areas covering 15 per cent of Seychelles waters that are designated as Marine National Parks; these are designed to protect the top priority areas for marine and coastal biodiversity. Each site is large enough to ensure ecological resilience and to provide climate change adaptation; extractive activities will not be permitted.
- *Medium Biodiversity Protection and Sustainable Use Areas***:** eight areas, also covering 15 per cent of the EEZ, that are designated as Areas of Outstanding Natural Beauty; these areas cover regionally and nationally significant areas and include habitats and species that have some tolerance to disturbance and human use and are considered suitable for some level of extraction and sea-bed alteration.

The Seychelles has high-income country status but also most of the constraints of a Small Island Developing State in terms of its isolated location, limited human and economic resources, weak state performance, high national poverty rate and dependence on tourism, high income inequality and susceptibility to natural disasters. Fisheries and tourism are the main contributors to the national economy. About 15 per cent of the population depend on fishing or fishing-related activities for their livelihoods (Cockerell & Jones, 2020). Prior to the pandemic, the tourism sector had reached a record high of over 360,000 visitors in 2018; tourism employs about 26 per cent of the active workforce and accounts for approximately 55 per cent of GDP (Cockerell & Jones, 2020) but importantly 75% of foreign currency. Conservation budgets of NGOs, private programmes and the Seychelles National Parks Authority are derived largely from tourism inflows, ranging from access fees to Corporate Social Responsibility (CSR) Tax. Seychelles also relies heavily on donor-funded projects to implement environmental projects, including the Global Environment Facility (GEF), the Adaptation Fund and the EU.

COVID-19 impacts

With the pandemic, tourism ground to a standstill. Lockdown resulted in lack of staff to maintain normal conservation and other environmental functions. Other works such as repairs and maintenance may have stopped; for example, Nature Seychelles' programme to adapt to recent severe climate-induced coastal erosion on Cousin Island Special Reserve by moving and rebuilding

essential infrastructure was halted; the money raised for this had to be used to support staff and recurring budgets.

All protected areas in Seychelles lost funding for recurrent budget lines (other than staff, whose salary is currently covered by the government – see below). Some large tourism companies that bring tourists to Cousin Island Special Reserve did not pay their invoices for February and March, putting additional pressure on cash flow. Management effectiveness was expected to plummet dramatically depending on capacities to cope with extended periods of financial difficulties. Nature Seychelles has already been informed of the possibility of funding being rerouted from one of its flagship projects.

The local fishery, already heavily exploited, is now expanding as even marine tourism operators are going fishing to eke out a living. The government urged artisanal fishers to fish more to bolster local food security during the crisis, in order to reduce imports, and has increased taxes on imports of foodstuffs, which is leading to increased fishing and demand for fishing licenses. The local fishery was at overcapacity already. Illegal fishing by mostly Sri Lankan vessels in the EEZ has increased according to official reports. At the local level, with fewer or no conservation staff in place, poaching is anticipated to increase – even normally law-abiding fishers may be tempted to poach in protected areas.

National planning from 1990 onwards in Seychelles made the environment key to development, and no other national budgetary priorities are supposed to take precedence over environmental protection. However, with the onset of the pandemic, the 2020 national budget was reorganised to cover the vastly expanded social welfare net and job retention scheme, as well as other socio-economic programmes. At this crisis time, the recognition that the natural environment provides the basis for the nation's economic and social well-being has seemingly been forgotten. Environmental protection/conservation was not classed as an Essential Service that would continue during lock down; the environmental authority may not have understood the need to continue to safeguard strategic natural assets and the essential services they provide, so that resilience is maintained to help recovery.

On Cousin Island Special Reserve, the reproductive success of seabirds along the tourist paths compared to those nesting deeper in the forest is being monitored. Early results seem to show that in this period with no tourists, the reproductive success of White Terns (*Gygis alba*) and White-tailed Tropicbirds (*Phaethon lepturus*) is lower along the trails than in previous years. This is probably due to the increase in density of predators such as ghost crabs and skinks along the trails. Human traffic may, therefore, deter diurnal predators, an unexpected result.

Actions and what has worked

Even before the pandemic, one of the main challenges the government was facing was how to implement long-term strategies to increase resilience to climate change without weakening economic growth, given the strong incentives to develop the country's Blue Economy. Concerns about the impacts of climate change were growing because of sea level rise and increasing sea surface temperatures. Marine Spatial Planning, a requirement of the debt-for adaptation swap previously discussed, has been used as a tool to ensure that, in protecting new areas of ocean, biodiversity goals would be balanced with the requirement for a sustainable national economy.

The government has guaranteed payment of salaries for all employees till the end of this year but that will consume almost the entire national budget and jeopardise former priorities, like marine protection. The MPAs that have established trust funds or had investments may be covered for a period of time, and others that are government-funded could be resilient – until the government's

attention moves elsewhere. Some MPAs that have donor-funded projects may keep activities going, but often such donors do not fund recurrent budgets. Cousin Island Nature Reserve has a business plan, and emergency funds are budgeted and there is a trust fund – which has allowed the reserve to keep going for the time being. The business plan did not anticipate a COVID crisis but it had a built-in mechanism to cope for short term down-turn in tourism (as has happened previously). Unfortunately, part of the coping mechanism involved international volunteers and students to lend a helping hand - the pandemic did not allow that to happen. Long term research by international academic partners, another section of the business plan, also ceased.

Likely future

The highest priority is to keep MPA institutions afloat, and to ensure that gains of the previous years are not lost with irreversible damage. The staff is the most important resource. There are some very tough decisions to be taken where staff may need to be laid off. Leaner institutions will be needed, which means cost-cutting measures that include shedding of staff and assets – but not to the point where long-term harm is done to MPA management. MPA organisations must have a business plan, one where the outcome is not profit but conservation. Some MPA objectives will have to be phased in more slowly (e.g. in the case of Cousin Island the work to address coastal erosion).

Diversification of MPA income streams has been recommended for decades, but this is not easy, particularly where tourism may be the only immediate option and where national economies are also not very diversified. In a tourism-dependent economy and one which is very small and already highly regulated and taxed, new prospects will need a lot of innovation and political support.

Before the pandemic, Seychelles had launched the world's first sovereign blue bond which raised US$ 15 million from international investors. Seychelles' Conservation and Climate Adaptation Trust (SeyCCAT) was established in 2015 to competitively distribute funds to support the management and expansion of Seychelles MPAs, sustainable fisheries and other conservation activities. It was capitalised with proceeds from a US$ 21.6 million debt conversion but also attracts capital from philanthropic organisations and seeks other innovative mechanisms to boost its assets. The Blue Bond is partially guaranteed by a US$ 5 million guarantee from the World Bank (International Bank for Reconstruction and Development) and further supported by a US$ 5 million concessional loan from the Global Environment Facility (GEF), which will partially cover interest payments for the bond. The three international investors in the bond were Calvert Impact Capital, Nuveen and U.S. Headquartered Prudential Financial Inc. SeyCCAT manages US$ 3 million of the blue bond proceeds; the Development Bank of Seychelles manages US$ 12 million.

SeyCCAT provides an important source of funding for small, time bound projects, but will not support recurrent budgets; unrestricted income for recurrent conservation budgets now needs to be found outside of tourism. A critical path would be for SeyCCAT to respond to the unprecedented crash in MPA revenues and attempt to support institutions (as initiatives such as BIOPAMA are doing for African-Caribbean-Pacific countries) Out-of-the-box thinking will be needed, such as a retrial of the far-sighted but unsuccessful conservation cryptocurrency offer launched by IUCN, the Porini Foundation and Nature Seychelles some years ago. There is potential for establishing carbon taxes on profitable economic activities e.g. carbon-taxing the fleets of distant-water fishing nations extracting tuna in Seychelles, with the tax revenue going to support marine conservation. Carbon offset projects and selling carbon credits (like those that Nature Seychelles buys internationally to make Cousin Island Special Reserve carbon neutral). A Blue Carbon evaluation project is currently funded by SeyCCAT.

A review of government functions and activities would be an important step in planning for a better future: the government will have to let go of some things as it will be required to focus on creating

the enabling environment to kick start the economy, getting everyone back to work, ensuring a safe and resilient environment and helping the most vulnerable for some years. This is a chance for the government to streamline its environmental activities, with reduced international travel and fewer committees and meetings, and to become more responsive and open to partners and citizens. There are entry points for more substantive private sector and NGO-led projects and community-driven activities, but there needs to be government policy or strategy to elucidate these entry points and to share the resources and space necessary in a transparent and equitable manner. There are real concerns that most agencies and NGOs may be more interested in boosting tourism revenues in the medium term, but this is now an opening to perhaps start looking seriously at over-tourism, first identified in early 2019 on Cousin Island Special Reserve, and to monitor and research the impacts of this sector.

Case Study 11: Tun Mustapha Park, Sabah, Malaysia

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Overview of Tun Mustapha Park

Tun Mustapha Park (TMP) is a marine protected area (MPA) in northern Sabah, Malaysia containing rich coral reef beds, mangrove and seagrass habitats and is home to threatened marine wildlife such as turtles, cetaceans and dugongs (Beliku & Saleh, 2013; Jumin et al., 2018; Ponnampalam et al., 2018). It is the largest multiple-use marine park in Malaysia with objectives of biodiversity conservation, sustainable resource use and sustainable development (Jumin et al., 2018). The outer boundary of TMP was gazetted in 2016, and since then zonation plans have been developed, agreed, included in the management plan and are being socialized – though zones have not yet formally been legally designated. The park covers three districts' water areas (Kudat, Kota Marudu and Pitas), with more than 187,000 people residing within these areas. These people are mostly dependent on fisheries for their livelihoods, posing significant challenges for native marine biodiversity (e.g. Beliku & Saleh, 2013).

TMP is managed using a multi-stakeholder collaborative management approach through a Steering Committee comprising Sabah Parks, Department of Fisheries Sabah, District Offices (Kudat, Kota Marudu, Pitas), Sabah Wildlife Department and other agencies, chaired by the State Permanent Secretary of the Ministry of Tourism, Culture and Environment Sabah. Through Park Enactment 1984, Sabah Parks is mandated to lead TMP's management and operations. Enforcement and patrolling activities are conducted mainly by Sabah Parks staff, Department of Fisheries Sabah, as well as enforcement agencies such as the Royal Malaysian Police (Marine Police), Malaysian Maritime Enforcement Agency (MMEA) and Malaysian Armed Forces. These agencies are jointly involved in preventing illegal fishing activities (e.g. blast and cyanide fishing) within the MPA, though the enforcement agencies also have a specific interest in transborder crime – the MPA includes the Malaysian marine waters that border the Philippines. Additionally, Sabah Park staff also conduct regular patrolling and monitoring activities within the MPA to inform adaptive management.

Communities are also involved in decision-making processes and enforcement activities within TMP through several action bodies and committees. The TMP Community Action Body, which is led by Sabah Parks, is a partnership between community groups, district agencies and enforcement agencies, working to promote active community participation in co-management of the park. The action body has a particular focus on improving fisheries sustainability within the park and working to eradicate blast and cyanide fishing. An annual meeting (which has previously always been in-person) is held where community representatives come together with all stakeholders involved in enforcement under the lead of Sabah Parks to have open dialogues around any ongoing MPA management challenges.

TMP has been identified as a priority protected area for Sabah Parks and Malaysia. Sabah Parks has set an ambitious aim of achieving the IUCN Green List status for TMP by 2025 – which would provide a platform for global recognition of the park and its management. TMP is the only protected area (for both marine and terrestrial areas) that has been selected by Sabah Parks for this rapid aim of achieving the Green List status. As part of broader support for this agenda, WWF-Malaysia works closely with Sabah Parks to support TMP. In 2017 WWF-Malaysia signed an MOU with Sabah Parks; WWF-Malaysia's capacity building support for Sabah Parks' staff in resource management and also

knowledge exchange activities between park stakeholders are aimed at helping achieve the Green List status by 2025.

COVID-19 impacts on TMP and responses

Malaysian governmental movement restrictions

In response to the COVID-19 pandemic the Malaysian federal government imposed a movement control order (MCO) in March 2020 (Jomitol et al., 2020). The MCO halted all entry into Malaysia (except for limited numbers of Malaysian citizens and residents with permission) and prevented Malaysian citizens from leaving the country. The MCO is still in place with an end date of December 31, 2020 – though it is expected that as this end date approaches the government will review conditions and extend into 2021. In addition to the MCO there have been a series of "lockdowns" either nationally or by state. The first partial lockdown was nation-wide and ran from March – May 2020 , with the country entering into the Recovery Movement Control Order (RMCO) phase between June 10 and August 31. COVID-19 outbreaks associated with the September 2020 Sabah state elections led to a second partial lockdown imposed initially in stages by district, then nation-wide, from October 2020. This second partial lockdown remains in place at time of writing (November 2020), and it is uncertain when this will be lifted. Following the Sabah state elections, Sabah became a "hotspot" for COVID-19 in Malaysia, and the situation is more severe for Sabah than the initial outbreaks of COVID-19 earlier in 2020 (e.g. Jomitol et al., 2020). All three districts within TMP have rapidly rising COVID-19 infection rates, and all possible working activities are being done virtually if possible.

The Sabah state election also caused some additional challenges for COVID-19 and TMP management. Village authorities (consisting of village leaders and development leaders) have been crucial in supporting community responses to COVID-19. These village authorities have deep local knowledge of individuals and groups in their communities who were struggling due to the impacts of the pandemic, and were assisting with channeling support to the communities in need. In advance of the September 26th state election all state-related political or elected positions were dissolved for the election period. Village authorities are elected as part of state elections, and so – as is standard procedure – were dissolved. Many urgent decisions around managing COVID-19 at the district or village levels were therefore delayed because of a lack of decision-makers. Urgent decisions therefore on issues such as distribution of food support to communities had to be made by district offices, which are staffed by civil servants whose positions remained in place throughout the election period. These district offices are more detached from the local level – where village authorities personally recognised the members of the community and understood where the support was most needed – making support harder to reach those who needed it.

Negative impacts on tourism

Tourism sectors worldwide collapsed due the impact of the pandemic, with negative impacts to Sabah Parks. To reduce the risk of the pandemic spreading, Sabah Parks announced on October 12, 2020 a prohibition on tourism activities within the parks managed by them, which included TMP. This has had large impacts on those who rely on tourism in TMP. Additionally, the MCO prohibits people crossing district boundaries without an exemption for work (which requires a formal letter), so domestic tourism cannot occur even outside the park. Prior to the pandemic, the tourism sector in TMP was still in the early stages of development so there was limited tourism within the park. Therefore, while those working in tourism have faced high impacts of the pandemic – with a loss of income – this is not the main pathway through which the pandemic has affected TMP and people resident within the park. The restrictions on tourism and the MCO, however, have had severe effects on Sabah Parks which is mostly funded by tourist entry fees from visitors to other well-established terrestrial protected areas or other MPAs. Sabah Parks have been able to maintain activities based

on its existing Trust Fund reserves and financial support from the Sabah State Government. This has meant that TMP operations by Sabah Parks have been sustained.

Potentially improved coordination of park enforcement

During the pandemic, patrolling and enforcement efforts have been maintained and in some parts of TMP, the enforcement efforts have been strengthened. Malaysian National Security Council through coordination by Eastern Sabah Security Command (ESSCOM), has mandated the enforcement agencies to intensify operation at the Malaysian-Philippines border, to further prevent illegal border crossings and other transborder crime, as these may also be associated with imported COVID-19 cases. Therefore, there was a shift in enforcement priorities in the region. Hence, other than regular patrolling and monitoring activities, the enforcement agencies have combined resources (e.g. workforce) and assets (e.g. boat patrols) to support the shift to strengthen protection at the border. Sabah Parks has also continued its normal enforcement and patrolling activities on the ground.

Aside from transborder crime, the main focus of park enforcement activities within TMP is preventing illegal fishing – especially preventing destructive fishing methods such as blast and cyanide fishing. Long-term data from blast fishing monitoring in the park suggests that blast fishing activities are associated with time of year and periods of higher rainfall, as this prevents fishers getting to usual fishing grounds. Preliminary data from the blast fishing monitoring array suggests that, even after controlling for weather and time of year, blast fishing recorded has declined during the pandemic especially in the area of the park, nearest the border. This is the area that has been subject to more effective and coordinated operations by the enforcement agencies as a result of the increased focus on transboundary crime. It is not yet clear whether the reduction of illegal fishing activities that has potentially occurred in the border area of TMP represents a reduction in overall illegal fishing, or whether these activities have been displaced to other locations where there is lower enforcement capacity. Moving forward, however, communicating how this coordinated approach has affected blast fishing will be important to show the value in maintaining it. Ideally if the enforcement agencies will continue to play an active role in the border area of the park it would make sense for Sabah Parks to coordinate its patrolling efforts and focus on the remaining areas of TMP.

Decline in fish demand impacts the community

The majority of residents in TMP rely on fisheries for their livelihoods. With limited tourism in the park, prior to the pandemic, the majority of fish are caught for local consumption or are sold via middlemen to major population centres in Sabah (e.g. Kota Kinabalu). The fish exported from TMP were sold for consumption by both local people and also tourists elsewhere in the state. With the decline in tourists in Sabah due to the control measures taken, the demand for fish has also declined. Many fish markets have also been closed temporarily, and those that are open face restricted opening times – making it harder for people to buy fish. There has also been increased unemployment in other businesses (e.g. retail and other industries that cater to tourism), with some unemployed people taking up fishing. This has led to an increased supply of fish. The result of this decline in fish demand and increased supply has been reductions in fish prices in the region (Jomitol et al. 2020). In the early part of the pandemic fish catch was being sold in the villages to middlemen for around 50-70 per cent lower prices than prior to the pandemic (Jomitol et al., 2020).

Crowdfunding to support community food security

In the initial phase of the pandemic in March 2020 following the implementation of the MCO there were significant food security issues for many communities living within TMP. Many communities and middlemen were unsure whether they were allowed to catch or trade fish. There were ongoing efforts by the government in disseminating information on the implementation of MCO through

social media and messaging platforms, however, it was not quite effective for certain rural areas with limited internet connection. Therefore, most fishers were worried about being stopped by enforcement agencies for being in breach of the MCO and so did not want to go out fishing. This lack of fishing activities led to some communities running out of food, alongside having no income from fish sales. To address this challenge, WWF-Malaysia helped communities set up crowdfunding platforms. This was done through supporting key community partners able to pass information onto existing community groups with which WWF-Malaysia was already working.

Given the MCO, all communication was done via WhatsApp groups, which provided a low-cost way of maintaining communications with key stakeholders in community groups and with the district offices and the village leaders. The key community partners were then able to coordinate via WhatsApp purchasing groceries and getting them to community groups who could allocate to members struggling with food security issues. It was then after intensified effort to reach out the rural communities, the government reassured that the MCO does not prohibit small-scale fishers going fishing, nor middlemen trading fish, and fishing activities resumed. Despite the second partial lockdown more recently being implemented, fishing has continued as there is now clarity that the lockdown and MCO does not prohibit fishing activities. Concurrently, the government through the District Disaster Management Committees facilitates food aid provision for the affected communities. The effort is also supported by Sabah Parks, by providing logistics for aid distribution in spite of not being part of the district committee. This shows the proactive initiative taken by the agency over concern about the well-being of the communities who are also largely TMP stakeholders.

Social media to increase fish sales

The reduced demand for fish, present since the start of the pandemic (e.g. Jomitol et al., 2020) has been further exacerbated by a renewed temporary closing of fish markets with the second COVID-19 outbreak in Sabah in October 2020. For example, Kudat fish market – which is the primary fish market for sales from TMP – has been fully closed for several weeks from mid-October and remains closed at the time of writing (November 2020). This has led to individual fishers and middlemen looking for alternative ways to sell fish and other fisheries species. One innovative response has been a blossoming of using social media and messaging platforms such as Facebook and Whatsapp for selling fish, with several groups set up based in different districts around the TMP and adjacent cities to connect fish buyers with sellers. Most of these buyers are individuals, buying small numbers of fish, crabs and prawns for household consumption. Some sellers are middlemen, with large ranges of species and quantities available for home delivery. Other sellers are individual fishers, who may post to offer three or four individual fish they have caught for sale that they can bring to a buyer.

Therefore, in some cases using Facebook and Whatsapp has allowed some fishers to sell fish directly to consumers (and so secure greater income) without going through middlemen who take fish to physical markets for resale. Buyers are also proactively posting in some of these groups requesting specific quantities of different items, allowing fishers or middlemen to directly contact them. Some sellers are also able to directly state where the fish was caught, and some buyers have informally said they are interested and select fish they purchase based on the new transparency of knowing exactly where fish were caught. While these online groups existed prior to the pandemic, they had limited use previously, whereas now because of the pandemic they are becoming an important way for people in cities in Sabah to purchase seafood. There is hope that some of these electronic approaches connecting fishers directly to sellers may become more formalized in the future and can be maintained post-pandemic. Those with livelihoods based on agriculture have also been suffering from reduced demand in the pandemic. These social media and messaging platform groups have

also been used for some bartering between fishers and farmers on the Sabah mainland, with fishers swapping fresh fish for agricultural products such as rice.

Likely future

Overall, the TMP and management activities have generally been resilient to the effects of the pandemic, and in some cases may have achieved greater management effectiveness based on the pandemic driving greater alignment and coordination between key institutions involved in enforcement activities. However, despite this resilience of the park and its management system, there have been severe impacts – which are still ongoing – of the pandemic on local communities that are resident within the park. Moving forward there is a need to improve community resilience to disturbance, especially around income generation and food security. This resilience is important beyond considering future pandemics, as TMP is vulnerable to increased typhoon frequency and intensity. Even when typhoons pass to the north of TMP and through the Philippines, the increased rainfall and wind prevents many fisheries activities in TMP. Pre-pandemic, tourism was an important industry for diversifying livelihoods. Given the low presence of tourism pre-pandemic in TMP, it still makes sense to grow the tourism industry in the park – though with the caution of avoiding it becoming the dominant source of income for the park and communities. Other products have been produced by the community in recent years for sale, for example handmade soap, and honey from stingless bees. Finding the right markets for these products beyond visiting tourists will be key to help build resilience.

Moving forward, TMP and Sabah Parks are maintaining their commitment to achieve IUCN Green List status for TMP by 2025. Sabah Parks still view TMP as a model park to take through the green listing process to better learn the process and so allow other parks in Sabah to be considered for this in the future. During the pandemic work towards this goal has continued, with a recent gap analysis to identify aspects of the IUCN Green List criteria that TMP is currently not meeting. There are ongoing discussions to put a plan of action in place to address these and so be able to register TMP as a candidate for consideration for the Green List.

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Case Study 12: Nusa Penida Marine Protected Area, Bali, Indonesia

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Overview of the marine protected area and early consequences of the pandemic

Approximately 10 km off the southeast coast of Bali, Indonesia spans the Nusa Penida Marine Protected Area (MPA), which encircles the islands of Penida, Lembongan and Ceningan. The MPA was reserved in 2010 by the government of Klungkung District and enacted in 2014 by decree of the Ministry of Marine Affairs and Fisheries (Carter et al., 2014). The MPA, which is managed at the provincial level, covers 20,057 ha and is located in the Lesser Sunda Marine Ecoregion, notable within the Coral Triangle for its many endemic coral and fish species (Wilson et al., 2011). The MPA's zoning system was designed to incorporate traditional beliefs and practices of the islands' approximate 46,000 residents and includes a named "sacred" sub-zone and areas for seaweed farming, traditional fishing and marine tourism, among others (Carter et al., 2014; Klungkung District Statistics Centre, 2020). Goals of the MPA include protection of coral reef, mangrove and seagrass ecosystems to benefit local communities through marine tourism and enhanced fisheries (POKJA KKP Nusa Penida, 2012).

Beginning in early April 2020, government-imposed travel restrictions in response to the pandemic brought tourism to an abrupt halt in the Nusa Penida islands. Dependence on the industry had grown over 20 years, transforming the economy as would-be emigrants sought economic opportunities at home through hotels and other tourism-related services. Between 2014 and 2018, an average of 235,000 visitors flocked to the islands annually, including frequent counts of 2,000 or more per day (Klungkung District Statistics Centre, 2019; unpublished data, Nusa Penida MPA Management Unit and Coral Triangle Center). According to local estimates, visits had dropped to 20–30 per day by September 2020, following five months of virtually none. Nearly all communities have suffered economic and job losses as tourism has plummeted. A series of one-on-one interviews revealed a sobering reality: travel agents, SCUBA centres, hotels, restaurants, car and motorcycle rentals and passenger ferries have laid off most or all of their employees.

The pandemic has also interrupted operations of the MPA Management Unit, which has seen its operational budget from the provincial government cut by half, in addition to tourism revenue losses. Surveillance patrols were suspended from April through July. After resuming in August, no violations were observed during August, September and October, though an absence of activity was noted in locations typically crowded with snorkelers, divers and boats (pers. obs. W.S.).

Ecological responses to the drop in tourism have not yet been quantified within the Nusa Penida MPA. Anecdotally, however, dive operators have reported observing a change in the behaviour of locally sighted manta rays (typically *Mobula alfredi*; Germanov et al., 2019), with individuals appearing less afraid of divers. The sighting frequency of both manta rays and ocean sunfish (presumably *Mola alexandrini*; Nyegaard, 2018), though, does not appear to have changed. As charismatic megafauna, manta rays and ocean sunfish are two of the MPA's most popular tourist attractions.

Adaptations and future prospects

In response to job losses, many formerly employed in the tourism industry have shifted to seaweed farming. Previously, Nusa Penida was recognised as one of the primary seaweed-producing areas in Indonesia for over 30 years (Firdausy & Tisdell 1991). By 2010, seaweed farming was in decline and

had completely disappeared by 2015, due to the rise in tourism and seaweed disease[7] (Darmawan et al., 2019). While the profits tend to be lower and the work more physically demanding than tourism jobs, seaweed farming has become a critical source of income for many, thanks to the traditional knowledge and natural resources that have facilitated its revival.[8]

While face-to-face meetings and field access were limited, the MPA Management Unit focused on preparing key protocols, attending online professional development activities and organising field data. In collaboration with the provincial fisheries agency it finalised and tested technical guidelines for MPA surveillance. A competency training on open standards for conservation practitioners helped them refine their work plan to better target management objectives. To better understand use patterns within the MPA, they spent time reviewing, cleaning, organizing and interpreting data previously collected through marine resource use monitoring.

Some of the changes caused by the pandemic are likely to persist. For the MPA Management Unit, technology has become central in training and other operational aspects. Since field activities have resumed on a limited scale, surveillance and community outreach have been prioritised. The potential change likely to occur post COVID-19 in Nusa Penida MPA includes shifts in governance structure from state governance into quasi-governmental co-management. Elsewhere in Bali, a government stimulus programme funding coral restoration has been implemented to reduce unemployment while benefiting the marine environment.[9] While Nusa Penida is not directly involved, interest has grown in smaller-scale, local reef rehabilitation through collaborative projects among community groups, the MPA Management Unit, non-profit organisations and SCUBA centres. While the disruption to tourism has upended the economy and livelihoods in Nusa Penida, the flexibility of its people bodes well for the resilience of its communities and marine environment.

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Case Study 13: Raja Ampat Marine Protected Area Network, West Papua, Indonesia

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Overview of Raja Ampat Marine Protected Areas

Raja Ampat marine protected area (MPA) network is located in the Raja Ampat Archipelago, West Papua, eastern Indonesia. This region is recognised as the global epicentre of marine biodiversity, with over 75 per cent of the world's coral species and the most speciose reef fish communities on the planet (Allen & Erdmann 2009; Mangubhai et al., 2012; Andradi-Brown et al., 2021). Raja Ampat is also an important area for marine megafauna, including sea turtles (Donnelly et al., 2003), cetaceans and dugongs (Huffard et al., 2012). The Raja Ampat Archipelago is composed of four main islands and many smaller islands, and is sparsely populated[10] (approximately 94,000 people as of 2020). Tourism has been rapidly growing in Raja Ampat, with international visitors increasing from 932 in 2007 to 24,131 in 2019 – representing a 2,489 per cent growth (Purwanto et al., 2021). Domestic Raja Ampat tourist numbers have also rapidly increased, from 66 in 2007 to a peak of 5,848 in 2018, before dropping slightly to 3,056 in 2019 – representing a 8,761 per cent increase (Purwanto et al., 2021).

Raja Ampat's MPA network includes four MPAs spanning 1,880,098 ha (Purwanto et al., 2021). At the heart of this network is Taman Wisata Perairan (TWP; Aquatic Park) Raja Ampat, a multiple use MPA established under authority of Kementerian Kelautan dan Perikanan, Indonesia's Ministry of Marine Affairs and Fisheries (MMAF). Although a single MPA legally, TWP Raja Ampat comprises six discrete areas: (1) Ayau-Asia Islands, (2) Teluk Mayalibit, (3) Dampier Strait, (4) South East Misool Islands, (5) Kofiau-Boo Islands, and (6) Fam Islands. These areas cover 1,355,000 ha – and so represent the majority of marine protection in Raja Ampat (Purwanto et al., 2021). In addition to TWP Raja Ampat there are also two Suaka Alam Perairan (SAP; Water Reserve), SAP West Waigeo and SAP Raja Ampat Islands. There is also a new MPA under initiation – Kawasan Konservasi Perairan Daerah (KKPD; Provincial MPA) North Misool, though this is not yet formally established and functioning (Purwanto et al., 2021). MPAs in Raja Ampat are mixed-use zoned MPAs, with some no-take areas but the majority of them open to sustainable fishing by the local community. Communities living within Raja Ampat also have a rich history of customary marine resource governance, including periodic harvest closures for important fisheries species known as *sasi* controlled by local institutions (e.g. churches) or community leaders (McLeod et al., 2009). Many of these *sasi* areas have been formally recognised in the MPA zonation.

The currently functioning MPAs follow two different governance models. (1) TWP Raja Ampat is governed by a quasi-governmental co-management body called the Regional Public Service Body (Badan Layanan Umum Daerah-Unit Pelaksana Teknis Daerah; BLUD-UPTD). The West Papua provincial government marine and fisheries office, which ultimately has oversight of TWP Raja Ampat, has delegated day-to-day management decision-making power to BLUD-UPTD. (2) Both SAP West Waigeo and SAP Raja Ampat Islands are under direct national governance of MMAF.

Therefore, day-to-day decisions are made by locally based staff that have been nationally appointed by MMAF in Jakarta. These two different governance structures have significant effects on how the MPAs function and funding is received.

TWP Raja Ampat depends heavily on tourism entry fees, currently set at approx. US$ 34 (IDR 500,000) for domestic tourists and approx. $68 (IDR 1 million) for international tourists to have a one-year entry permit (Atmodjo et al., 2017; Purwanto et al., 2021). This income from tourism is split in three ways: 30 per cent of international tourist and 15 per cent domestic tourist revenue goes to general revenue for Raja Ampat Regency government; the remainder goes to BLUD-UPTD for the management of the Raja Ampat MPA network, from which approx US$ 100,000 (IDR 1.5 billion) is deducted annually for a community fund (Atmodjo et al., 2017). The community fund is allocated to local non-government organisations (NGOs) and village communities based on locally submitted proposals (Atmodjo et al., 2017). The Raja Ampat UPTD-BLUD received more than approx (US$ 1.5 million (IDR 22 billion) in 2019 from the entrance fees which was used directly for MPA management and management authority operating costs – including employing approximately 150 local community members for various management roles such as patrolling and enforcement.

This income represents the majority of the budget for MPA operations. In contrast, as nationally governed MPAs, SAP West Waigeo and SAP Raja Ampat Islands receive a direct budget from MMAF in Jakarta for management activities that is independent of local fluctuations in tourism levels. Despite the different governance structures, SAP West Waigeo has a collaborative agreement with the UPTD-BLUD to coordinate and share resources to support management activities between TWP Raja Ampat and SAP West Waigeo.

COVID-19 impacts on Raja Ampat and responses

Travel restrictions

Following the outbreak of COVID-19 the Government of Indonesia implemented a series of travel restrictions at the national, provincial, and regency/district levels. Sorong, the main gateway city to access Raja Ampat and located to the south, has been subject to flight restrictions. Prior to COVID-19, it was possible to fly into Sorong from many Indonesian cities. In response to the pandemic, flights into the city were limited to only Jakarta or Makassar to the west, and only several key regional Indonesian cities to the east (e.g. Manokwari, Jayapura). The number of flights were significantly reduced, with 4-5 airlines flying from Jakarta/Makassar to Sorong offering five or six daily flights pre-COVID-19. This has now reduced to two airlines with only two daily flights in total on most days. Prior to being allowed to board one of these flights all passengers are required to have a COVID-19 rapid test/swab test that shows absence of infection.

Travel throughout Raja Ampat has also been severely impacted by COVID-19. Prior to traveling from Waisai (the major city within Raja Ampat) to Sorong, all visitors must obtain a letter from the Sorong Regency Government allowing entry – and anyone without West Papua identification must complete a COVID-19 rapid test/swab test that shows absence of infection. Before COVID-19 there were two public fast boat connections per day between Sorong and Waisai, and also a larger ferry (capable of carrying larger goods and freight) twice a week. Since March, the frequency of the connection has reduced to three fast boats per week and only one ferry per week. This reduction is in part because of reduced demand for travel, but has increased isolation of communities living within Raja Ampat.

Tourism collapse

Many communities within Raja Ampat depend on tourism (Ahmadia et al., 2017), and thus have been significantly affected by the pandemic. This includes small businesses such as homestays and restaurants or *warungs* to boat drivers and local dive guides who work in larger land-based resorts

or on liveaboard dive boats. Travel operators from Sorong that coordinate shorter tourist visits to Raja Ampat have also been affected. The majority of the tourist resorts in Raja Ampat are located within the MPAs, and closed to guests since April 2020. Some of these resorts started to reopen in October 2020 for domestic tourists – though numbers visiting remain very low. Liveaboard vessels are a major part of the international dive tourist market in Raja Ampat – with 30 liveaboard dive vessels registered at the Port of Waisai for operation in Raja Ampat in 2019 and many more moving into the area that are registered at other ports (Purwanto et al., 2021). These liveaboard vessels also had to shut down operations in April, and have since tried to target the domestic market by offering substantial discounts. For example, a typical week-long liveaboard diving trip to northern Raja Ampat would cost approx. US$ 1,689 (IDR 24) pre-pandemic, and operators have been offering these trips for approx. US$ 1,345 (IDR 19 million) in September-October 2020. There has been little demand, however, as international tourists have not returned, and this price point is too high for Indonesia's domestic tourism market – with domestic tourists normally staying at shore-based homestays.

The collapse in tourism has had dramatic effects on local communities that previously depended on tourism income. Many local dive guides or dive centre staff have returned to their home villages across the region. They have mostly survived based on family and community networks providing access to locally-grown food such as cassava and sago, and also fishing for both household consumption and to make dry fish.

Community fisheries

The pandemic has altered local fishing practices as a response to travel and tourism declines. Access to fishing grounds has been made easier with weakened enforcement of regulations. Previously those who did not fish, such as homestay owners, have now become fishers primarily for personal consumption but also for selling dried fish at market (additional food is brought from Sorong or Wasai). Using private boats, they sell dried catch in Sorong, one of the main markets available for the region (though prices here have declined, i.e. price for 1 kg dry coral reef snapper/grouper pre-COVID-19 valued at US$ 2.82 (IDR 40,000) now is reduced to US$ 2.11 (IDR 30,000). Selling fresh fish from many parts of Raja Ampat (such as from Misool) is difficult because of a lack of storage and transport – a ferry for transport only comes once per week. Fishers in many parts of Raja Ampat therefore generally fish for family consumption, but will increase fishing effort prior to the arrival of the ferry to sell to a middle man aboard. Additionally, some fishers will sell fish to middle men in Sorong that have an ice boat able to come to collect fish in Misool.

Not surprisingly, this increased fishing and increased access to fishing grounds has resulted in lowered compliance with area-based regulations. Several community members have tried to fish in no-take zones (e.g. permanent core/tourism/food security zones that prohibit fishing), attempting, for example, to catch turtles, citing the pandemic as justification. Turtle poaching for consumption by local communities was reported in SAP Waigeo Barat; the MPA enforces strict regulations against turtle harvesting. This behaviour may also be a result of the reduction in patrols and enforcement.

Despite various forms of rule-breaking, community managed areas, and those that institute *sasi*, are still functioning fairly well. In Misool, for example, the usual open season for sea cucumber in April did not occur this year because there were no buyers from China present. The plan is to open access for this resource in November, as flights have resumed and so buyers will be able to return. Finally, there have been some benefits observed attributed to the COVID-19 outbreak: sightings of large-bodied schooling fish and dolphins closer to shore have been perceived by communities to be due to declines of boat and tourist activity.

Livelihood diversification

Many local people in Kofiau and Misool have survived the pandemic by using traditional practices and trades, particularly with farming (despite a decline in this sector in recent years pre-COVID-19). This is also true in Dampier Strait, where people such as homestay owners and dive guides are also farmers. Several people across Raja Ampat are both fishers and farmers – a trend which many show an upswing in the aftermath of COVID-19's outbreak if tourism does not recover quickly.

Management activities

One of the most tangible impacts of COVID-19 on Raja Ampat's MPAs was the severe reduction in staff of BLUD-UPTD, a direct result of the drop in tourism revenue. Previously at 145 staff members, 95 staff were lost from the Wasai office (where the majority of loss occurred) and the field offices. Reduced capacity includes the loss of the team that handled tourism permits as well as other administrative support. Patrol teams in the field have been reduced from six to 2-4 people in Misool, Ayau, and Dampier Strait (and likely in all BLUD-UPTD MPA areas). These teams are attempting to maintain the same number of patrols as pre-staff cuts. Monitoring and public awareness teams have also been reduced from four to 1-2 people.

MPA activities have mostly been able to continue in light of the pandemic because of additional funding resources. With the budget cycle for MPA management for BLUD-UPTD, past tourism income had secured a budget for MPA operations to continue until the end of April 2020. During March and April 2020 there was no revenue from tourism fees and local fishers/dive operators reported an escalation in illegal fishing – sparking concern of what would happen from the start of May when the budget ran out. In response, Conservation International (CI) coordinated an emergency grant in April 2020 from a private family foundation (a long-time donor to the region involved in funding MPA establishment), to provide Yayasan Misool Baseftin (YMB) and BLUD-UPTD with funds to maintain patrolling activities for TWP Raja Ampat and SAP Waigeo Barat through April 2021. This emergency funding prevented a gap in patrols, and as a result BLUD-UPTD has been able to prioritise surveillance and is trying to maintain usual levels of enforcement. The emergency funding was administered through the Blue Abadi Fund (a regional trust fund for MPA management) but was not directly using Trust Funds.

While sustainable financing continues to be sought, collaborative management, particularly over traditional use zones, has continued through the pandemic. BLUD-UPTD has given increased autonomy for communities to patrol areas near their villages (2-3 km away) so the government body can focus its patrols on more remote areas. This specific strategy has thus far been successful in Misool, and is planned to be replicated elsewhere.

Likely future

The pandemic has quickly brought to focus the need for diversified sources of funding for Raja Ampat MPAs; 80-90 per cent of current funds are dependent on entry fees from tourism, and more core funding is necessary from the provincial or national governments. There is also the realisation that BLUD-UPTD can operate effectively with reduced staff and should not return to pre-COVID-19 levels; MPA managers need better targets to ensure they retain quality vs. quantity staff.

Livelihoods for local communities also require diversification in the future. As mentioned above, several homestay and local guides have become fishers or farmers, thereby reducing dependence on tourism. In parallel, a new strategy to increase sustainability of tourism following the pandemic is in development. This aims to reduce high numbers of tourists to prevent environmental degradation, and track tourist numbers and manage the sector more strategically, i.e. a "one-gate" approach for tourism registration, carrying capacity allocations, and increases in entry fees from approx. US$70.38-140.75 (IDR 1-2 million), distributed across MPA authorities.

Case Study 14: Great Barrier Reef Marine Park, Queensland, Australia

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Overview of Great Barrier Reef Marine Park

The Great Barrier Reef Marine Park (344,400 km^2) covers the world's largest coral reef ecosystem stretching over 2,300 km along the Queensland coast. It includes over 3,000 reefs, more than 600 continental islands and inter-reefal, mangrove and coastal communities. The Great Barrier Reef Marine Park was established by the Australian Government in 1975 and is co-managed by the Great Barrier Reef Marine Park Authority together with the State of Queensland. On its coastal margin, it adjoins a State Marine Park in areas of State responsibility and the two areas are managed for multiple use in a coordinated management system. The marine protected area (MPA) has been zoned to regulate allowable uses including fishing, with one-third of the park zoned as no-take area.

Impact of COVID-19 on marine park management

Despite the fact that there have been very few COVID-19 cases in Queensland (total of 1,171 cases and six deaths in the State, approximately 100 cases and no deaths in the coastal areas adjoining the Great Barrier Reef), the impact on the communities and tourism industry in the region has been severe. From mid-March when international arrivals were suspended and the State went into a local lockdown, all tourism activity in the Great Barrier Reef stopped completely with not even a single tourism operation continuing – closing down US$ 4.34 billion/year (AUS $6 billion) industry.

Despite the Commonwealth Government instigating a programme to pay US$ 1,084/fortnight (AUS $1,500) for the wages of staff,[11] many operators laid off most of their staff as they would have still been obliged to pay superannuation and payroll tax and yet they had no income. Limited local travel within the State was permitted from mid-May when the lockdown ended with all internal travel within the State possible from July, but the continued absence of tourists from the main domestic markets of Sydney and Melbourne, tourism has only been able to recommence at a limited scale. This will likely be the case until international tourism recommences at some stage in the future.

During March and April, COVID-19 restrictions resulted anecdotally in unprecedented recreational use and fishing effort in the Great Barrier Reef World Heritage Area. Favourable weather during these restrictions coincided with other forms of recreational activity being prohibited. The Reef Joint Field Management Programme responded by applying high levels of effort and resourcing to surveillance while adhering to modified work practices due to COVID-19. The programme delivered 89 days of dedicated compliance patrols for April 2020 and detected 97 offences. The effort for this period was approximately 30 per cent higher than previous years and the level of detections is considered higher than anticipated. This higher recreational effort has now declined. A higher ongoing level of recreational activity is expected for some time, as those with a renewed interest in recreational fishing continue to participate.

While commercial fishing has been able to operate for most of this period, the cessation of flights has meant that international markets, especially for high value live export fisheries have been largely stopped. The lack of a domestic market for restaurants has also meant that the prices received for seafood has also declined.

There has been relatively little impact on the capacity of managers to do their job. Particularly in early phases of the pandemic, during the local lockdown, field work in the marine park was partly restricted in compliance with COVID-19 safe guidelines. In particular, the ability to travel to regional areas to consult with communities and stakeholders has been constrained. This has been especially the case with Indigenous communities where visitation has been restricted.

Response to COVID-19 and innovations in management

In response to the major impacts on the tourist industry, a waiver on payment of the Environmental Management Charge (EMC) collected by the tourism operators of US$ 5.60 (AUS$ 7) per visitor per full day or US$ 2.53 (AUS$ 3.50) for part day has been instituted from April 1, 2020 to June 30, 2021, with funds already collected in the first quarter being refunded to operators. The EMC normally contributes US$ 5.83-7.29 million/annum (AUS$ 8-10 million) towards management of the Marine Park. The government is providing additional revenue to the management agency to fully compensate for this lost income.

The government is also providing US$ 2.3 million (AUS$ 3.2 million) towards reef tourism operators through a Tourism Industry Activation and Reef Protection Initiative. This initiative will provide some business continuity within the Reef tourism industry through engaging marine tourism operators to undertake in-water conservation and monitoring activities that will ensure tourism sites are well maintained and ready to welcome guests as COVID-19 travel restrictions are eased.

In response to restrictions on travel within the region, managers have ramped up communication on a whole range of issues. For general reef users, communications via media such as the smartphone app *Eye on the Reef* have emphasised responsible reef use and the provision of zoning information and other guidance that would normally also be communicated in the field.

The Great Barrier Barrier Reef Marine Park Authority has also stepped up its online education activities. While it has conducted online programmes nationally and internationally in the past, the absence of on-site engagement with schools and universities has led it to substantially expand this work with many students across multiple countries being involved. This expanded use of outreach technologies is likely to be a continued feature of their programmes.

Tourism operators have responded (in addition to laying off most of their staff) by seeking efficiencies in their operations (for example by consolidating multiple office locations). Some have also sought to stay connected to their customers and potential customers by offering virtual streaming tours of dive locations, snorkelling tours and other reef experiences. One concern raised by operators, especially the large enterprises with significant investment in infrastructure, is whether an exclusively or dominantly domestic market can support the price point of reef tourism that was aligned with a largely international tourism market that was prepared to pay a premium for a Great Barrier Reef experience.

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Case Study 15: Vatu-i-Ra Conservation Park, Fiji

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Overview of Vatu-i-Ra Conservation Park

The Vatu-i-Ra Conservation Park was set up as a traditional *tabu* area (periodically harvested closure) in 2012 by the 28 villages of Nakorotubu District in Ra Province. The Conservation Park was extended in 2015 and covers 110.5 km^2 of coral reefs and deep ocean, as well as Vatu-i-Ra Island (0.023 km^2 land cover), making it the largest no-take *tabu* in Fiji (Sykes et al., 2018; Mangubhai et al., 2020). The island is listed as a "Site of National Significance" in Fiji's National Biodiversity Strategy Action Plan, and is one of the 28 internationally "Important Bird and Biodiversity Areas" (IBA) recognised by BirdLife International. The island belongs to the Nagilogilo clan, who reside in the two villages of Nasau and Navuniivi.

The Wildlife Conservation Society (WCS) has been instrumental in facilitating the discussions between local communities and tourism operators and has largely borne the initial transaction costs through external grants. The objectives of the Vatu-i-Ra Conservation Park, included in the management plan for the Park, are to: protect the unique biodiversity of the island and the surrounding reefs; protect the unique cultural history of the area; and protect critical breeding grounds for fish so that the "spillover" from this Conservation Park supports community fisheries in the adjacent customary fishing ground. The management plan sits under the Integrated Coastal Management Plan for Ra Province.

All visitors to the Vatu-i-Ra Conservation Park are able to make a voluntary contribution (currently US$ 7.13/person/year; FJ$ 7.13) to a trust that has been set up to support the day-to-day management of the Park, and an education fund. A trust deed has been registered and a Board of Trustees oversees the management of all funds collected through the tourism sector, and through donations. A management committee of 5−7 key representatives provides advice and oversees the management of the Park and the education fund. The funds generated are allocated as follows: (1) 40 per cent are used to provide educational support for students from a single clan, Naqiloqilo with rights to the Vatu-i-Ra Island; (2) 30 per cent to educational support for the remaining communities in the district; and (3) 30 per cent for the day-to-day management of the Park.

Impact of COVID-19 on park management

Fiji had its first COVID-19 case in the population on March 19th, and peaked at 18 cases on April 20th. In response to the global pandemic the Fiji Government closed its international border and imposed mandatory two week lockdowns on any town that got an active case, with the military and navy on patrol to ensure there was no movement in and out of the lockdown areas. A national curfew was put in place, and there were fines and potential jail sentences for breaches, or the spreading of misinformation. Almost a month after our first case, Category 4 Cyclone Harold passed through Fiji in April, causing significant damage to the southern part of the country. To date, Fiji has had 34 cases, and two deaths, with all cases (since April) occurring in quarantine and not in the active population.

The closure of Fiji's international borders has meant no tourists and therefore no tourism fees have been collected for the Park in 2020. Since July, some hotels have opened to part-capacity, and reduced prices to encourage local tourism. Given the high costs of traveling to the Park, and low number of local dive tourists, there have been almost no visitors to the Park. There is anecdotal evidence to suggest there is increased poaching in the Park, especially given its distance from shore,

and the lack of tourism boats frequenting the area. Although there is increased poaching and there is some increase in fishing, the price of fish has decreased significantly and therefore is not as profitable as it was below the cyclone (Mangubhai et al., *forthcoming*). With the exception of two, all meetings of the management committee were stopped, to minimise risk to rural communities and avoid spending available funds. All education grants proposed for 2020 were cancelled.

Response to COVID-19 and innovations in management

Despite the lack of funds from tourism, the local communities and management committee have committed to maintaining the Vatu-i-Ra Conservation Park, and the traditional closure (*tabu*) that is in place. In response, the management committee held onto the funds collected in 2019, and opted to postpone spending until 2021, to cover the shortfalls of 2020. The Board of Trustees is putting a proposal together to seek "emergency" funding through IUCN Oceania Regional Office, to support Park management in 2021. Since July, WCS has been working with members of the management committee to: (a) develop a standard operating procedure for monitoring and surveillance of the Park; (b) donate a brand new boat to the Committee for monitoring and surveillance; (c) organise for boat driving certification for 10 community members who will serve as "fish wardens" for the Park; and (d) coordinate training and appointment of for at least 10 fish wardens by the Ministry of Fisheries. The appointment of fish wardens under the Fisheries Act enables communities to work in partnership with the Ministry of Fisheries to monitor compliance with national and local rules within customary fishing grounds. Lastly, WCS were able to successfully fundraise and undertake coral reef monitoring of the Park, to continue to assess the recovery of coral reefs damaged by the devastating Cyclone Winston in 2016.

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