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MPA Impacts Globally

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Introduction:

BOPP's core principles guiding the development of Bermuda's MSP include, among others, using the best-available science to inform proposed activities and developments in marine spaces, and managing the environment to conserve biodiversity and maintain ecosystem function.

These principles are supported by the goals and objectives of the MSP, and also provide transparency in the decision-making process by clearly demonstrating how the development and implementation of a zoned, managed, and well-enforced network of MPAs can protect Bermuda's marine environments, preserve its cultural heritage, and build resilience in the island's blue economies.

The following annotated bibliography is intended as a resource for decision-makers and ocean users, as well as members of the general public, who are interested in learning more about how MPAs have been developed and implemented in countries around the world.

The resources herein represent decades of accumulated knowledge about the lessons learned from the application of MPAs—partially protected, fully protected, and a mixture of both — for fisheries management, biodiversity conservation, species protection, and to protect cultural resources.

Significant endeavours have been undertaken to identify and incorporate literature that is either specific to Bermuda, or locations similar to Bermuda (e.g., island, subtropical, seagrass and coral reef environments) so that: 1) where parallels can be drawn between experiences, and/or 2) data can be used to clarify the decision-making process involved in the creation of Bermuda's MSP.

That said, this bibliography represents only part of the best-available science utilized in the development of Bermuda's MSP, as multiple other data sets—including feedback from the public Ocean Use Survey—have been incorporated.

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Introduction:

For the purposes of this document, BOPP would like to draw particular attention to the ecological benefits that appear most frequently in the peer-reviewed literature, and which are most likely to manifest in Bermuda under a well-managed and well-enforced network of MPAs:

- Increased biomass of fish species, particularly among target fish species, within MPA1 boundaries, especially within designated no take zones.

- Protection of ecologically valuable nursery habitats (e.g., mangrove stands and seagrass beds), for commercially and recreationally fished species, as well as legally protected species. Priority protection of these areas supports the export of adult fishes to offshore populations, which directly benefits local fisheries, and is critical in an ecosystems based management approach that protects vital ecosystem services.

- Preservation of the migration corridors and spawning areas for highly mobile and highly migratory pelagic fish species3. This ensures habitat connectivity throughout the lifespan of individual organisms, as well as genetic connectivity for species whose populations may require additional protection for replenishment or to prevent future losses.2

- Maintenance of marine habitat biodiversity and ecological function, with priority given to plans that protect both underwater cultural heritage and 20% of each marine habitat type, as well as help restore degraded marine habitats.

- Resilience of Bermuda's marine habitats to global climate change, protecting valuable marine economic resources for future generations.

References:

1. Turnbull, et al (2021), Cooney, et al (2019), McClure, et al (2020), Rojo, et al (2021)
2. Kopp, D., Bouchon-Navaro, Y., Louis, M., Mouillot, D. & Bouchon, C. (2010) Juvenile Fish Assemblages in Caribbean Seagrass Beds: Does Nearby Habitat Matter?. Journal of Coastal Research, 26(6),1133-1141.
3 Boerder, et al (2019); Gilman et al (2019)

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A four year closure of Mexico's EEZ increased the abundance of Striped Marlin.

The Galapagos Marine Reserve, which protects tuna spawning and breeding grounds, has had a positive impact on the industrial tuna purse-seine fishery.

The BIOT MPA offers protection to a variety of species with a range of ecologies.

On average, fish biomass in no-take MPAs is significantly higher than in unprotected areas

MPAs created near the Channel Islands, California, led to an increase in the total catch of spiny lobster, despite a reduction in the total fishing area.

50% (7,500,000)

of all yearly dives take place within MPAs such as Wakatobi, Indonesia.

Key Findings:

MPAs can benefit fisheries and tourism, preserve culture, history, and heritage, and are used for education and research.

People have a willingness to pay for environmental restoration, even if the habitat in question is remote and has little or no commercial value.

People preferentially visit MPAs over other adjacent areas to experience nature and wildlife, and MPAs are associated with positive cultural ecosystem services like mental and physical health, sense of place, and identity formation.

MPA expansion in Hawaii has positive impacts on overall ecosytem, while no negative impacts on the fishing industry were observed.

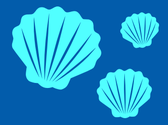
Fisheries found no decline in catch or any additional travel time following the closure of the Northeast Canyons and Seamounts Marine National Monument in New England, USA.

Local income has improved, new blue economy sectors and jobs were created, and scientific research and tourist visits in off-peak seasons increased after creating MPAs in France, Spain, Sweden and Italy.

MPAs can directly and indirectly influence the quality and quantity of tourism, as found in Nha Trang Bay, Vietnam.

The adjacent Roman Seabream fishery benefitted from establishment of the Goukamma Marine Protected Area.

Periodic Closure areas such as those established in the Indo-Pacific have above average biomass and fish size.



In Fiji, species closures led to large increases in clam numbers inside closed areas and in nearby fishing areas.

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General information:

- Marine reserves have rapid and lasting effects.
- Periodic Closure areas have above average biomass and fish size.
- No-take MPAs have Positive effects on the biomass numerical density, species richness, and size of organisms within reserve boundaries.
- MPAs are defensible instruments for pelagic conservation.
- No-take marine reserves are the most effective type of MPA.

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2002

Finding:
Marine reserves have rapid and lasting effects.

Evidence:
Biological responses (Higher average values of density, biomass, average organism size, and diversity) inside marine reserves appear to develop quickly and last through time.

Source:
Ecology Letters, vol. 5, no. 3, May 2002

2009

Finding:
Positive effects on the biomass, numerical density, species richness, and size of organisms within reserve boundaries.

Evidence:
Global synthesis of research into no-take marine reserves showing an average positive impact on the ecosystem.

Source:
Marine Ecology Progress Series, vol. 384, May 2009

2018

Finding:
No-take marine reserves are the most effective type of MPA

Evidence:
Fish biomass in no-take MPAs is 670% higher than in unprotected areas and 343% higher than in partially protected MPAs. No-take MPAs help restore the entire ecosystem through a chain of positive effects resulting from animal recovery. Effective MPAs also create benefits outside of their boundaries and provide ecotourism, job, and fisheries benefits.

Source:
ICES Journal of Marine Science, edited by Pendleton Linwood, vol. 75, no. 3, May 2018

2000 — 2020

2006

Finding:
Above average biomass and fish size inside Periodic Closure areas.

Evidence:
Biomass and the average size of fishes commonly caught in Indo-Pacific subsistence fisheries were greater inside areas subject to periodic closures compared to sites with year round open access. Also, both long-lived and short-lived species benefited from periodic closures.

Source:
Ecology and Society, vol. 11, no. 1, May 2006

2009

Finding:
MPAs are defensible instruments for pelagic conservation.

Evidence:
Recent advances across conservation, oceanography and fisheries science provide the evidence, tools, and information to address critics on the ecological, logistical, and economic feasibility of place-based management.

Source:
Trends in Ecology & Evolution, vol.24, no. 7, July 2009

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Key learnings for Tourism:

- Small community-based protected areas (Locally Managed Marine Areas) can yield significant increase in biological productivity.
- In the context of diving, the total value of a reserve becomes greater than pre-reserve value within five years of protection & may increase further as biomass & diversity increases.
- MPAs can directly and indirectly influence the quality and quantity of tourism by increasing visitor numbers, length of stays, business opportunities, and revenue, creating eco-tourism sectors, and extending peak tourist seasons.

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Key learnings for Tourism:

- MPA designation and implementation can improve local income, create previously non-existent blue economy sectors and jobs, and increase scientific research and tourist visits in off-peak seasons.
- Tourism benefits households directly involved in the tourism sector and those indirectly linked with the sector through production and income linkages. Tourism operators hire local people and buy local goods, and households spend wages or businesses spend profits earned through the tourism sector.
- Marine Protected Areas are preferred destinations providing more cultural ecosystem services than other adjacent coastal areas.

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2003

Finding:
Small community-based protected areas can yield significant increase in biological productivity, and associated biodiversity also seems to increase in undisturbed (protected) areas.

Evidence:
Socioeconomic benefits from Locally Managed Marine Areas in the Pacific region have also been observed; one area reported a significant increase household income and catch rates with some noting the mutual benefits of the tourism industry being closely involved in these community-based conservation efforts.

Source:
Aalbersberg, W.G.L. 2003. The role of locally managed marine areas (LMMAs) in the development of eco-tourism in Fiji. Institute of Applied Science, Faculty of Islands and Oceans, University of the South Pacific, Suva, Fiji.

2018

Finding:
MPAs can directly and indirectly influence the quality and quantity of tourism by increasing visitor numbers, length of stays, business opportunities, and revenue, creating eco-tourism sectors, and extending peak tourist seasons.

Additional Benefits:
Recreation and tourism improvements caused by MPA implementation will spill over into other sectors and the wider community, such as hotels, restaurants, real estate, and community infrastructure, providing a boost to all parts of local economies.

Source:
Haines, Rupert, et al. "Study on the Economic Benefits of MPAs Final Report." Publications Office of the European Union, 2018.

2021

Finding:
Tourism benefits households directly involved in the tourism sector and those indirectly linked with the sector through production and income linkages. Tourism operators hire local people and buy local goods, and households spend wages or businesses spend profits earned through the tourism sector.

Additional Benefits:
Recreation and tourism improvements caused by MPA implementation will spill over into other sectors and the wider community, such as hotels, restaurants, real estate, and community infrastructure, providing a boost to all parts of local economies.

Source:
World Bank. 2021. Banking on Protected Areas: Promoting Sustainable Protected Area Tourism to Benefit Local Economies.

2000 — 2022

2013

Finding:
In the context of diving, the total value of a reserve becomes greater than pre-reserve value within five years of protection & may increase over time as biomass & diversity increases.

Evidence:
In the wider Caribbean and Pacific coast of Central America, 50% of all dives (7.5 million dives annually) take place within marine protected areas. There is a clear preference for diving in MPAs because of the expectation of encountering more abundant marine life within their boundaries.

Source:
A General Business Model for Marine Reserves. 2013

2018

Finding:
MPA designation and implementation improved local income, created previously non-existent blue economy sectors and jobs, and increased scientific research and tourist visits in off-peak seasons.

Evidence:
Several MPAs around the world (inc. France, Spain, Sweden, Italy & more) have successfully been implemented, positively impacting marine environments, tourism industries, fisheries, and livelihoods.

Source:
European Commission, 2018

2021

Finding:
Marine Protected Areas are preferred destinations providing more cultural ecosystem services than other adjacent coastal areas.

Additional Benefits:
This study of MPAs worldwide found that people preferentially visit MPAs over other adjacent areas to experience nature and wildlife, and that MPAs are associated with positive cultural ecosystem services like mental and physical health, sense of place, and identity formation.

Source:
One Earth, vol. 4, no. 8, Aug. 2021

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Key learnings for Fisheries:

- Species closures led to large increases in clam numbers inside closed areas and in nearby fishing areas; catch per unit of effort increased in the area adjacent to a closed area; certain species that had disappeared locally returned to the area; and habitat health improved within the closed areas.
- Reserves can benefit fisheries, even those targeting species that are expensive to harvest.
- Goukamma Marine Protected area has benefitted the adjacent Roman fishery.
- Catch and catch-per-unit-effort are higher amongst Hawaii longline fleet since the expansions of two of the world's biggest MPAs began.

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Key learnings for Fisheries:

- Interactions of tuna purse seine fisheries with the Galápagos Marine Reserve might enhance fish stock availability to local fisheries and help to stabilize local catches.
- In California, there was a greater build-up of lobsters within MPAs relative to unprotected areas, and greater increases in fishing effort and total lobster catch.
- No decline in catch and no additional travel time for fisheries following the closure of the Northeast Canyons and Seamounts Marine National Monument.

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2002

Finding:
Species closures led to large increases in clam numbers inside closed areas and in nearby fishing areas; catch per unit of effort increased in the area adjacent to a closed area; certain species that had disappeared locally returned to the area; and habitat health improved within the closed areas

Evidence:
Project of the University of the South Pacific and the Biodiversity Conservation Network with the village of Ucunivanua in the Verata district of Fiji.

Source:
Community-based closed areas in Fiji. The fishery effects of marine reserves and fishery closures, WWF, 2022

2010

Finding:
Through a synthetic analysis across these conservation and bioeconomic studies, this study constructs guidelines for MPA network design that reduce or eliminates tradeoff. It presents size, spacing, location, and configuration guidelines for designing networks that simultaneously can enhance biological conservation and reduce fishery costs or even increase fishery yields and profits.

Source:
Proceedings of the National Academy of Sciences, vol. 107, no. 43, Oct. 2010

2017

Finding:
Interactions of tuna purse seine fisheries with the Galápagos Marine Reserve might enhance fish stock availability to local fisheries and help to stabilize local catches despite overall decreasing biomass trends for these highly commercial tuna stocks.

Source:
Marine Ecology Progress Series. Vol. 585, 2017

2022

Finding:
No decline in catch and no additional travel time for fisheries following the closure of the Northeast Canyons and Seamounts Marine National Monument.

Evidence:
The economic arguments made against the 2016 commercial fishing prohibition and in favor of the 2020 re-opening do not appear to be supported by data on landings and vessel movements.

Source:
Scientific Reports, vol. 12, no. 1, Dec. 2022

2000 — 2022

2008

Finding:
Reserves can benefit fisheries, even those targeting species that are expensive to harvest.

Evidence:
Reserve area and harvest intensity can be traded off with little impact on profits, allowing for management flexibility while still providing higher profit than attainable under conventional management.

Source:
Ecology Letters, vol. 11, no. 4, Apr. 2008

2013

Finding:
The establishment of the Goukamma Marine Protected area benefitted the adjacent Roman fishery.

Evidence:
Roman-directed catch-per-unit-effort (CPUE) in the vicinity of the new MPA immediately increased, contradicting trends across this species' distribution. The increase continued after 5 years, the time lag expected for larval export, effectively doubling the pre-MPA CPUE after 10 years.

Source:
Ecology Letters, vol. 11, no. 4, Apr. 2008

2020

Finding:
Catch and catch-per-unit-effort are higher amongst Hawaii longline fleet since the expansions of two of the world's biggest MPAs began

Evidence:
The MPA expansions had little, if any, negative impacts on the fishing industry, corroborating ecological models that have predicted minimal impacts from closing large parts of the Pacific Ocean to fishing.

Source:
Nature Communications, vol. 11, no. 1, Dec. 2020

2021

Finding:
Greater build-up of lobsters within MPAs relative to unprotected areas, and greater increases in fishing effort and total lobster catch, but not CPUE, in fishing zones containing MPAs vs. those without MPAs

Evidence:
A 35% reduction in fishing area resulting from MPA designation was compensated for by a 225% increase in total catch after 6-years, thus indicating at a local scale that the trade-off of fishing ground for no-fishing zones benefitted the fishery.

Source:
Scientific Reports, vol. 11, no. 1, 2021

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Key learnings for Migratory Species:

- Temporary closures of Mexico's EEZ to long-lining from 1977–1980 and 1984–1985 had a rapid effect on local abundance of striped marlin.
- Western Indian Ocean MPA had an important impact on the fishing mortality and succeeded in stabilizing the spawning population.
- The Galápagos Marine Reserve (GMR) has had a positive impact on the industrial tuna purse-seine fishery.
- The Phoenix Islands Protected Area (PIPA) is a stable spawning area for skipjack, bigeye, and yellowfin tunas.

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Key learnings for Migratory Species:

- MPAs can protect migratory species, particularly those with predictable behaviors that are protected within MPAs.
- The BIOT MPA likely offers protection to a variety of pelagic and reef species with a range of spatial ecologies.
- Cost of licenses had not caused the observed decline in license sales but a shift in consumer demand toward lighter tuna species resulted in a decrease in Japanese imports for bigeye tuna.

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2010

2010

Finding:
Temporary closures of Mexico's EEZ to long-lining from 1977–1980 and 1984–1985 had a rapid effect on local abundance of striped marlin.

Evidence:
Regional striped marlin abundance likely increased by 12–22% following the 4-year closure and 6–12% following the 2-year closure. Increases near Baja California may have been larger.

Source:
Progress in Oceanography, vol. 86, no. 1-2, July 2010

2013

Finding:
Western Indian Ocean MPA had an important impact on the fishing mortality and succeeded in stabilizing the spawning population.

Evidence:
The simulations also showed that the effect of an MPA depends on the evolution of fisheries, and it is therefore important to explore different fishery scenarios to assess the future benefits of an MPA.

Source:
Aquatic Living Resources, vol. 26, no. 2, Apr. 2013

2017

Finding:
The evolution of decreased movement can augment the efficacy of marine reserves, especially for species, such as skipjack tuna, with relatively short generation times.

Evidence:
Even when movement rates did not evolve substantially over 50 years, marine reserves were an effective tool for the conservation of fish populations when mean movement rates were low or Marine Reserves were large.

Source:
Evolutionary Applications, vol. 10. No. 5, June 2017

2018

Finding:
The Galápagos Marine Reserve (GMR) has had a positive impact on the industrial tuna purse-seine fishery.

Evidence:
The GMR includes key habitat for juvenile yellowfin tuna, protecting this critical life stage area from industrial fishing.

Source:
Marine Policy, vol. 87, Jan. 2018

2018

Finding:
Palmyra Atoll National Wildlife Refuge is an important refuge and long-term habitat for green turtles.

Evidence:
The GMR includes key habitat for juvenile yellowfin tuna, protecting this critical life stage area from industrial fishing.

Source:
Endangered Species Research, vol. 37, Oct. 2018

2019

Finding:
The Phoenix Islands Protected Area (PIPA) is a stable spawning area for skipjack, bigeye, and yellowfin tunas.

Evidence:
Spawning occurs consistently within the protected area (during both El Niño and non-El Niño conditions) demonstrating that PIPA is protecting viable tuna spawning habitat.

Source:
Scientific Reports, vol. 9, no. 1, Dec. 2019

2019

Finding:
MPAs can protect migratory species, particularly those with predictable behaviors that are protected within MPAs (e.g., protecting aggregation sites and migratory corridors and for philopatric species). To rebuild fished stocks, MPAs must be paired with effective fisheries management.

Source:
Marine Policy, vol. 105, July 2019

2019

Finding:
The BIOT MPA likely offers protection to a variety of pelagic and reef species with a range of spatial ecologies.

Source:
Frontiers in Marine Science, vol. 6, May 2019

Finding:
Pelagic MPAs could be designed to achieve five ecological objectives without causing cross-taxa conflicts as well as exacerbating fisheries-induced evolution (FIE).

Source:
Ecosphere, vol. 10, no. 12. Dec. 2019

2022

Finding:
The cost of licenses had not caused the observed decline in license sales but a shift in consumer demand toward lighter tuna species resulted in a decrease in Japanese imports for bigeye tuna.

Source:
Frontiers in Marine Science, vol. 9, Feb. 2022

2022