

Economic Valuation of Ecosystem Services in Bahamian Marine Protected Areas



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Prepared by the Natural Capital Project



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Executive Summary

Marine Protected Areas for People and the Environment

The marine and coastal environment of The Bahamas provides habitat for a diversity of animals and plants and numerous benefits for the Bahamian people. Yet coral reefs, mangroves, sand flats, beaches and other ecosystems across the archipelago suffer from a growing intensity of activities in the coastal zone, putting at risk the fisheries, tourism, storm protection, and other benefits from nature that underlie the country's economy and ensure human wellbeing.

The Bahamas has the opportunity to protect and manage coastal and marine ecosystems and the wealth of economic benefits they provide to Bahamians and beyond.

Bahamas Protected is a three-year initiative to effectively manage and expand the Bahamian marine protected areas (MPA) network to safeguard the economic value of marine ecosystems. It aims to support The Bahamas Government in its commitment to the Caribbean Challenge Initiative in which 11 countries pledged to protect 20% of marine and coastal habitat by 2020 with sustainable financing for effective management. Bahamas Protected is a joint effort between The Nature Conservancy (TNC), Bahamas National Trust (BNT), Bahamas Reef Environment Educational Foundation (BREEF), and other stakeholders, with major funding from Oceans 5. As a component of Bahamas Protected, the Natural Capital Project was contracted to quantify the economic value of ecosystems within the Bahamian MPAs and the influence of alternative management scenarios on future benefits.

Valuing nature's bounty to promote marine protection

Traditional approaches to MPA management focus on ecological considerations, such as a sufficient diversity and proximity of habitats. While such factors are essential for sustaining species, they may miss the societal importance of MPAs. Increasingly, conservation practitioners, governments, and other stakeholders are considering the benefits that nature provides to people, or 'ecosystem services.' Diverse, functioning ecosystems provide myriad benefits that can be sustained through protected area management. Nearshore habitats bolster the stocks of fisheries, beaches and reefs draw tourists, and coastal forests and seagrasses buffer storm waves, mitigate climate, and promote water quality.

Based on the Natural Capital Project's previous work in The Bahamas and throughout the Caribbean, we quantified the economic value of four key ecosystem services within the existing MPA network (Fig ES-1). We take two distinct, but complementary approaches. For the current MPA network, we estimate gross value of ecosystem services provided at each site as compared to no service provision. For New Providence and Andros, we include risk of human activities to ecosystems and services. Coupled with costs, this information could be leveraged to estimate the net value of Bahamian MPAs.

Nursery habitats to support lobster fisheries



- \$23.5 million in export value annually
- 6 million lbs. catch annually

Vibrant tourism



- \$67.6 million in expenditures annually
- 383,000 visitor-days annually

Communities protected from coastal hazards



- Reduced exposure to 39,000 people and \$806 million in annual income

Carbon storage for climate mitigation



- \$5 billion in avoided carbon emissions
- 400 million tons CO₂ in mangroves & seagrass

Figure ES-1. Economic value of four ecosystem services provided by The Bahamas MPA network.

Additional services that would likely increase the overall value of the network (Hargreaves-Allen 2016) include:

- Fisheries support worth \$268/km²/year from coral reef, mangrove, seagrass, and tidal creek
- Freshwater supply worth \$15.5/km²/year from tidal creek
- Water and water quality services worth \$508/km²/year coral reef, mangrove, seagrass, and tidal creek
- Cultural and aesthetic services worth \$324/km²/year from coral reef, seagrass, beach, tidal creek, and open water

Spatial variation in the value of ecosystem services provided by the MPA network

TNC, BNT, Dr. Venetia Hargreaves-Allen, and others have assembled considerable information about the economic value of ecosystems, species, and MPAs in The Bahamas. The Natural Capital Project built on this knowledge by estimating spatial variation in the economic value of ecosystem services within the existing MPA network. It is important to note that we do not analyze the marginal benefit of MPA implementation itself.

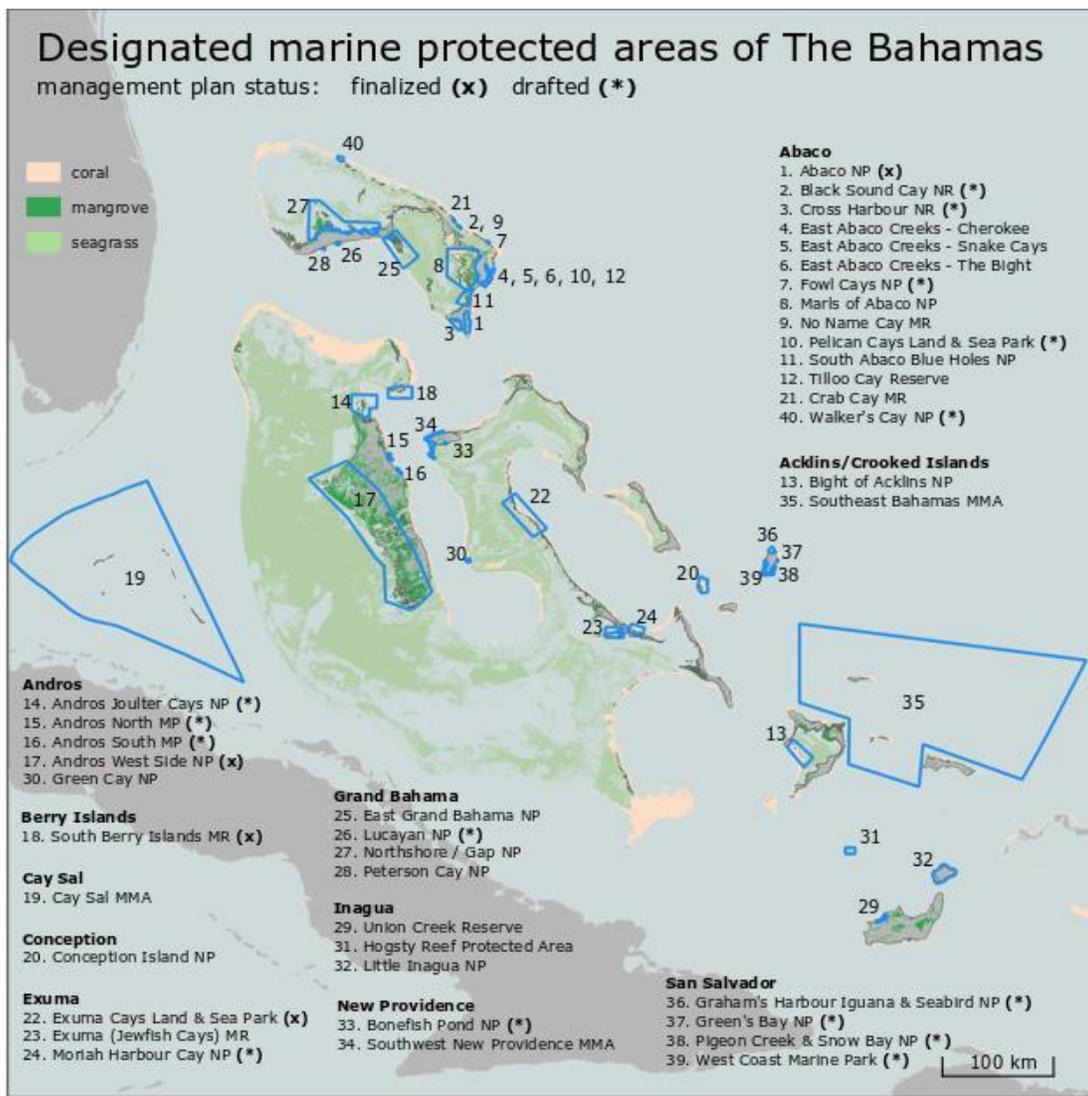


Figure ES-2. Designated marine protected areas of The Bahamas. NP=National Park, MP=Marine Park, MR=Marine Reserve, MMA=Marine Managed Area.

The value of ecosystem services within individual MPAs vary greatly across the network as a function of ecological, social, and economic factors. These differences can be used to inform management.



The Andros West Side National Park, Marls of Abaco National Park, and Cay Sal Marine Managed Area contain a higher proportion of their region’s mangroves and seagrass than other protected areas in those regions and thus exemplify priority areas for management to ensure the economic benefits of fisheries into the future. The economic value of nursery habitat for spiny lobster within MPAs depends on the extent of nursery habitat, and proximity to adult, shallow shelf habitat, as well as other factors such as larval recruitment.



The higher tourism expenditures attributable to Southwest New Providence Marine Managed Area and Exuma Cays Land & Sea Park illustrate the importance of infrastructure and access for supporting tourism and highlight how investing in protection and management of coral reef and fish communities can foster a world-renowned location for tourism.



Half the population of San Salvador and 1/3 the population of the Berry Islands are at lower risk from coastal hazards due to ecosystems within MPAs. More than 30,000 people on New Providence live in areas partially protected by corals in SWMMA and coastal forests in Bonfish National Park. The economic value of coral reefs, seagrass beds, mangroves, and coppice within MPAs for reducing the storm risk of coastal communities depends on exposure (e.g., shallow, wide shelves are associated with storm surge) and proximity to coastal populations.



Habitats in Andros West Side National Park and Marls of Abaco store the most carbon in the network, valued at more than \$3.5 billion and \$500 million in avoided carbon emissions, respectively. The economic value of carbon sequestration within MPAs varies spatially, due to size (i.e. area of carbon-storing habitat), relative abundance of seagrass vs mangroves (mangroves store more carbon per unit area), and abiotic factors (e.g., precipitation, temperature).

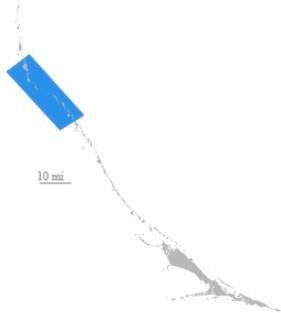
Table ES-1. Value of four ecosystem services provided by existing marine protected areas in The Bahamas.

Ecosystem Service	Values provided by ecosystems within the existing MPA network	Factors that influence spatial variation in ecosystem service value (not comprehensive)
Tourism	383,000 visitor-days and \$67.6 million in expenditures annually	Island differences in visitation, expenditure, habitat extent, access, infrastructure
Coastal protection	Reduced exposure to 39,000 people and \$806 million in income annually	Habitat type and quality, coastal elevation, shoreline type, surge potential, wave characteristics, sea-level rise, proximity of habitats in MPA to coastal population
Nursery habitat for spiny lobster	6 million lbs. and \$23.5 million in revenue from the lobster fishery is attributable to nursery habitat annually	Habitat type and extent, larval recruitment to nursery habitat, proximity of nursery habitat to shallow shelf habitat for adults
Carbon storage for climate mitigation	400 million tons of CO ₂ stored and \$5 billion in avoided damages from emissions globally	Relative abundance of mangroves and seagrass, carbon stored in soil and aboveground biomass (based on climate).

Island-scale valuation of ecosystem services to inform future management

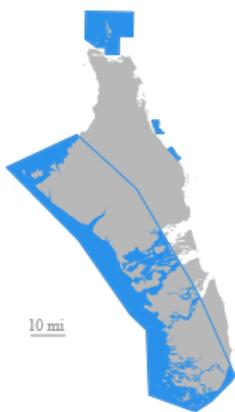
The economic value of ecosystem services provided by habitats within the current network differs among MPA sites, as does management status. Some MPAs have finalized management plans and others have plans in the development stage. In the island-scale analyses below, we explore in greater depth the value of ecosystem services provided by habitats and implications for management. For New Providence and Andros, we include current risk of human activities to habitats and services. Results for these cases provide insight into potential gains if MPAs were to fully protect habitats.

Exuma Cays Land and Sea Park is the oldest marine protected area in The Bahamas and the only one managed as a no-take area. The fisheries, tourism, and carbon storage and sequestration values indicate the importance of continued investment into the ECLSP for enforcement, boats, infrastructure and more to maintain these benefits now and into the future. Within the park, our analysis estimates



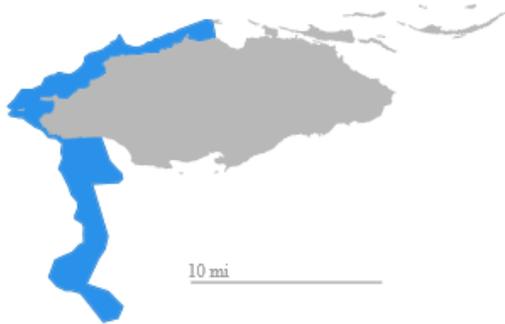
- Visitors spend \$6.6 million annually from 23,000 visitor-days.
 - Nursery habitat supports \$1 million in export value of spiny lobster annually and 240,000 lbs. in catch.
 - Coral, seagrass, and mangrove protect much of the Exuma Cays coastline and reduce the risk of coastal hazards for people along the southern extent of the Cays (low population precludes assigning a coastal protection value to ecosystems within ECLSP).
 - Seagrass and mangroves prevent over \$130 million in avoided damages due to emissions by storing more than 10.7 million tons of carbon.
- Previous studies indicate increased biomass and reproductive capacity for lobster, Nassau grouper, and queen conch within the park and that improved fisheries outside the park, along with increased high-end tourism and property values within the park, has generated over \$9 million in direct and measurable economic impact in a single year.

Andros' West Side National Park, Joulter Cays, North and South Marine Parks, and Barrier Reef provide a wealth of natural resources. The Sustainable Development Master Plan for Andros informs investments in infrastructure and education to support livelihoods, while safeguarding the ecosystems that underlie the island's economy and human wellbeing. The Master Plan would



- Increase tourism expenditures from \$113 million currently to \$170 million, an increase of more than 35% in Mangrove Cay and North Andros and 10% and 20% in South and Central Andros, respectively. In contrast, intensive development would concentrate tourism in the North and South districts, further exacerbating the unequal distribution of wealth.
 - Increase the value to the lobster fishery provided by nursery habitats in Andros MPAs by \$6.5 million, from \$14.5 to \$21 million annually.
 - Protect more than 60% of the populated coast of Andros (up from 50%, \$2.4 million, currently protected). Unregulated development and destructive fishing practices would more than triple the number of people at risk from flooding and erosion.
 - Increase carbon storage assets, worth \$6 billion in Andros West Side National Park, by 3% and safeguard against \$550 million in damages possible under more intensive development.
- Previous studies show that natural resources on Andros generate \$155.6 million in direct economic revenue (2015 dollars), including \$52,000 from fishing and roughly \$25,000 from crabbing and sponging (Hargreaves-Allen 2010).

Southwest New Providence Marine Managed Area borders the most populated island in The Bahamas. Habitats within SWMMA provide benefits to a multitude of users, yet the cumulative risk from human activities—development, dredging, oil leakage, tourism, invasive species, fishing, and marine transportation—threatens to reduce the services the area provides. Our risk-based analysis for SWMMA estimates that



- Visitors currently spend an estimated \$14 million annually, yet this could be increased by 14% if habitats faced lower risk of degradation.
- Risk from current activities reduces, by 50%, the contribution of nursery habitat for lobster, a loss of \$127,000 (from \$259,600 if habitats faced no risk of degradation from human activities).
- 6% of New Providence’s population (and 12% of its income) is at greater risk from storms as a result of current risk to habitats. Habitats around New Providence could

protect up to 30,000 people if they faced no risk.

- Habitats in SWMMA could store up to 2.45 million tons of carbon, but are compromised by risk from current activities, storing only 1/2 as much than if they faced no risk, at a global cost of \$16 million.
- Restoring ~6 km² of coral within the park could result in \$662,000 more in visitor-expenditure annually and would protect an additional 22,000 people and \$606 million in annual income.

North Bimini Marine Reserve (NBMR) was approved in 2010 but never officially gazetted. Management actions that reduce the risk of degradation have the potential to benefit not only the seagrass, mangroves, coral, and species, but also the people of Bimini that rely on these ecosystems for their sustenance, livelihood, and safety. Within the reserve



- An estimated 19,500 tourists visit each year, spending \$3.3 million.
- Nursery habitat supports nearly \$300,000 in lobster export value and 76,505 lbs. of catch annually.
- Mangroves, seagrass, and even the little bit of coral within the reserve reduce the risk to coastal hazard for nearly half of the population of north Bimini (3,000 people), with reduced exposure to \$31.2 million in income annually.
- Mangroves and seagrasses store over 3.5 million tons of carbon, worth \$46.2 million in avoided damages.

Eleuthera does not currently have any MPAs, yet adjacent habitats provide important benefits, demonstrating the potential value of MPA designation. These metrics could be used to engage diverse stakeholders (e.g. residents, fishers, and tour guides) around MPA designation. Benefits include



- \$30 million in visitor-expenditures are generated in Northern Eleuthera, followed by \$17 million and \$11.5 million in Central and Southern Eleuthera, respectively.
- \$5.7 million annually in lobster export value (from 1.5 million lbs. in catch) is attributable to nursery habitat around Eleuthera.
- All 11,000 people living on the island benefit from the reduction in coastal hazards marine ecosystems provide, especially along the high hazard areas to the north, the eastern side of the island, and Southern Eleuthera.
- Mangroves and seagrass store more than 120 million tons of carbon, worth more than \$1.5 billion in avoided damages.

Implications of findings for MPA policy, planning, and management

According to our analysis, visitation within MPAs provides \$67.6 million annually in tourism expenditures, 2.6% of overall expenditures in 2015. Ecosystems within the existing MPA network are worth more than \$23.5 million annually in nursery habitat values for spiny lobster. The nursery habitat within the MPA network contributes to 50% of the overall value of the lobster fishery, which in turn provides more than 1,300 active lobster jobs (Sealey 2011). In addition, ecosystems in the network reduce the risk of coastal hazards, such as Hurricanes Mathew and Joaquin, to nearly 40,000 people living along coastlines throughout the country and \$806 million in annual income. Mangroves and seagrass within the MPA network store 400 million tons of carbon, worth \$5 billion in avoided emissions globally.

- Effective management is important for maintaining and growing the economic value of the ecosystem services within the existing network of MPAs, as the examples of SWMMA and Andros show. Only four out of the 40 existing MPAs have management plans finalized; 15 sites have draft plans. Without effective management and financing to protect coastal and marine ecosystems, The Bahamas puts at risk the economic value of its fisheries and tourism sectors and increases its vulnerability to hurricanes and climate change.
- The economic value and benefits of coastal and marine ecosystems for all Bahamians illustrates the importance of considering MPA management within the context of comprehensive planning processes. Vision 2040 and the Integrated Coastal Zone Management processes on a national scale, and sustainable development planning on a local scale, provide opportunities to incorporate MPA management.
- By maintaining the economic value of ecosystem services provided by functional habitats, well-managed MPAs can help The Bahamas achieve several of its international commitments, such as those under the Convention on Biological Diversity. Additionally, several Sustainable Development Goals are related to MPAs including, healthy oceans (Goal 14), poverty alleviation (Goal 1), hunger (Goal 2), health (Goal 3), climate action (Goal 13), and sustainable cities and communities (Goal 11).
- An analytical ecosystem services approach can be used to model and quantify the gross economic value of possible sites for future protection under the 20-by-20 challenge. Taken in conjunction with information about costs of implementation and threats to habitats that provide services, the economic value of ecosystem services can help to ensure that management strategies maximize net benefits to MPA-adjacent communities and all Bahamians.
- By fostering an iterative process between ecosystem service valuation and stakeholder engagement, Bahamas Protected has the opportunity to understand how management decisions made today will influence the sustainability and economic value of ecosystems into the future, to enhance information exchange, transparency, and positive participant interaction, and to ensure local support and management of new sites in the Bahamian MPA network.

Conclusion

The economic value of ecosystem services and the livelihoods they support indicate the importance of managing the MPA network now in order to help safeguard against the loss of economic and societal benefits to Bahamians, the Caribbean, and people world-wide in the future. Please see the complete report for the full analysis of spatial variation in ecosystem services provided by habitats within the MPA network and island-scale valuation of ecosystem services to inform management.