Economic Valuation of Bahamian Marine Protected Areas

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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 values 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 Government of The Bahamas in meeting its commitment to the Caribbean Challenge Initiative (CCI) 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 multiple national 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 Bahamian MPAs and the influence of alternative management scenarios on future values.

Valuing nature's bounty to promote marine protection

Traditional approaches to MPA management have historically focused on ecological considerations, such as a sufficient area and diversity of habitats and proximity. While such ecological considerations are essential for the sustainability of critical species, they may miss the importance of MPAs and ecosystems for humans. Increasingly, conservation practitioners, government agencies, and other stakeholders are considering the benefits that nature provides to people, or 'ecosystem services.'

Diverse and functioning ecosystems provide myriad economic benefits that can be sustained through protected area management. Nearshore habitats bolster the stocks of commercial and recreational 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 for the existing MPA network of four ecosystem services that reflect important shared values of Bahamians (Fig ES-1).

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/km^2/year from coral reef, mangrove, seagrass, and tidal creek
- Freshwater supply worth $15.5/km^2/year from tidal creek
- Water and water quality services worth $508/km^2/year coral reef, mangrove, seagrass, and tidal creek
- Cultural and aesthetic services worth $324/km^2/year from coral reef, seagrass, beach, tidal creek, and open water

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

Past work by The Nature Conservancy, the Bahamas National Trust, 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.

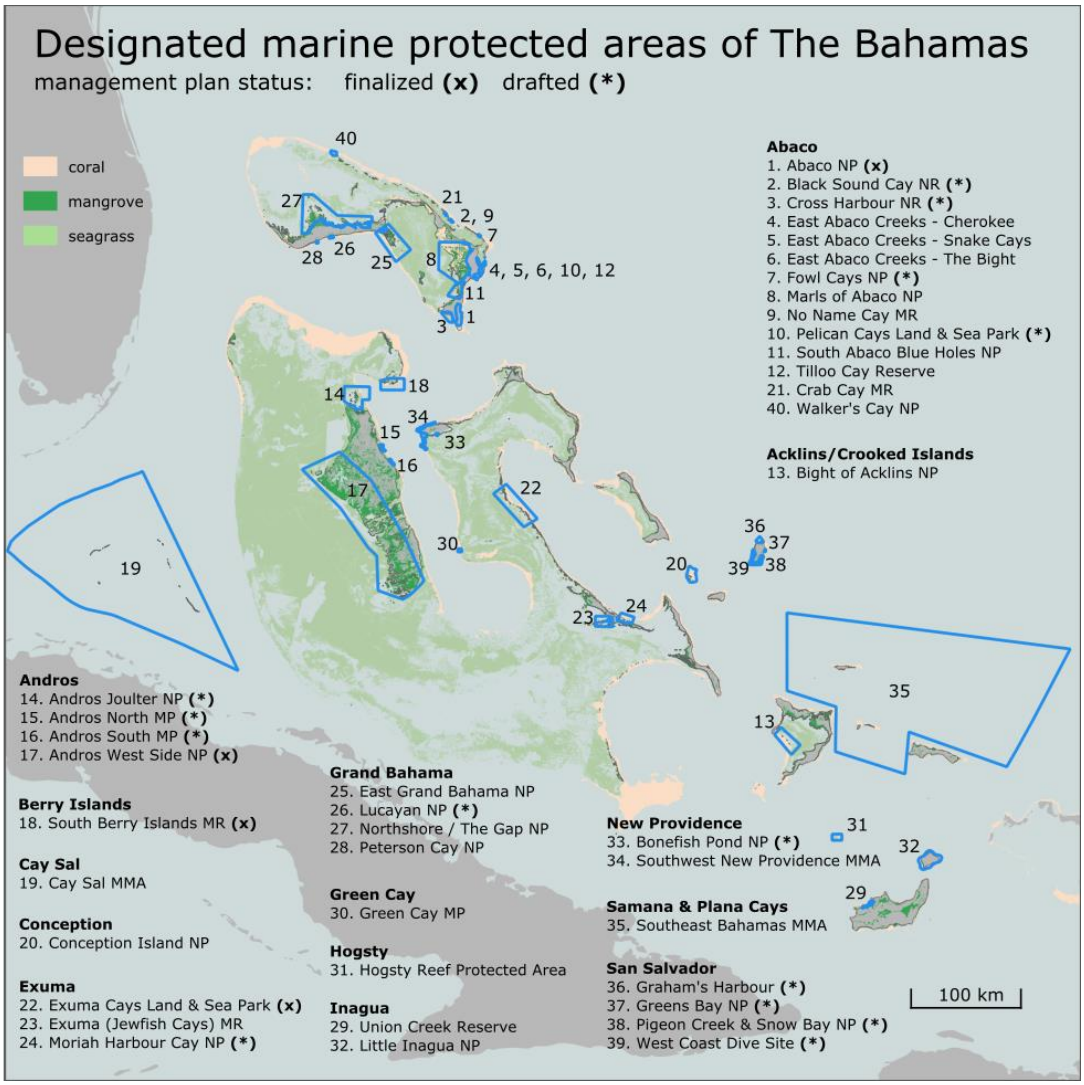


Figure ES-2. Designated marine protected areas of The Bahamas. NP=National Park, MP=Marine Park, MR=Marine Reserve, MMA=Marine Managed Area.

The values for 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 MPAs for their nursery habitat contribution to the spiny lobster fishery depends on MPA size, 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 due to ecosystems within MPAs. More than 30,000 people on the island of New Providence live in areas partially protected by corals in SWMMA and coastal forests in Bonefish 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 shelfs are associated with storm surge) and proximity to coastal populations.

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 particular MPAs varies spatially, due to size (and thus 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 the existing MPA network	Factors that influence spatial variation in MPA 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).

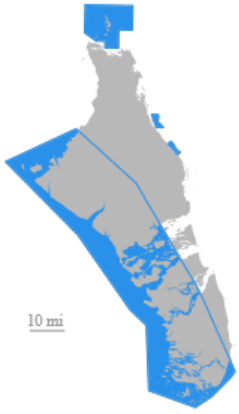
Island-scale valuation of ecosystem services to inform future management

The MPAs in the current network differ in their economic value of ecosystem services and management status. Some MPAs have finalized management plans and others have plans in the development stage. Still other islands are scoping the potential of MPAs to manage coastal and marine activities in the future. We explored the influence of current and future management of nearshore activities on economic values of ecosystem services for five different areas.

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 ECSLP).
- 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

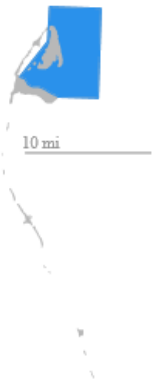


- Increase tourism expenditures from $113 million currently to $170 million, an increase of more than 35% in Mangrove Cay and North Andros and 10% and 20% in South and Central Andros, respectively. In contrast, intensive development would concentrate tourism in the North and South districts, further 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. SWMMA provides 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 km^2 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), valued at $31.2 million 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, MPAs are worth $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. Due to spatial variation in proximity of nursery and adult habitat, the nursery value of 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 provide $806 million annually in coastal protection benefits, reducing the risk of coastal hazards, such as Hurricanes Mathew and Joaquin, to nearly 40,000 people living along coastlines throughout the country. 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 existing network of MPAs, as the examples of SWMMA and Andros show. Only four out of the 40 existing MPAs have management plans finalized; 14 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 ecosystem services approach and models can be used to quantify the economic value of possible sites for future protection under the 20-by-20 challenge. Exploring the economic value of alternative protected area options can help to ensure that management strategies maximize benefits and minimize costs to local communities, as well as generate social support from adjacent residents to ensure that the protected areas meet community expectations.
- 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 taking action to protect and manage the MPA network now in order to ensure economic and societal benefits to Bahamians, the Caribbean, and people world-wide into the future. Please see the complete report for the full analysis of spatial variation in ecosystem services provided by the MPA network and island-scale valuation to inform management.