

# Science and Public Input: Biscayne National Park's Proposed Marine Reserve

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**Abstract.** Biscayne National Park (Florida, USA), an overfished marine protected area, proposed a 10,522 acre no-take marine reserve in its draft General Management Plan in September 2011, in order to provide snorkelers and divers the opportunity to experience healthy, natural coral reefs. With no standard planning guides for the Department of the Interior regarding marine reserves, the park identified the factors that would lead to enhanced visitor experience (diversity, abundance, and large size of fishes; coral diversity and health; reefs with structure; and presence of shipwrecks), and ensure effective management and ease of enforcement (visual markers and a single reserve instead of multiple reserves). In 2009, the planning team presented to the public a summary of data from universities, other federal agencies, and park scientists, and asked the public to propose the size, shape, and location of the reserve(s). The public-proposed designs were then presented to a panel of scientific reviewers for ranking on which designs were most likely to achieve the desired objective. The park planning team then created a final set of alternative designs to propose in the draft plan that was presented to the public in 2011. The three public meetings were well-attended and comments ranged from supporting a larger marine reserve to questioning the science and intent of the marine reserve.

**Key words:** Biscayne National Park, Marine reserve, Science and management, Public involvement, Planning.

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## Introduction

Biscayne National Park ("park"), a unit of the National Park Service (NPS), is a predominantly (~95%) marine park with over 5000 patch reefs that was established in 1968 in order to "preserve and protect for the education, inspiration, recreation, and enjoyment of present and future generations a rare combination of great natural beauty" (16 USC Sec. 410gg). The legislation also authorized the management of fishing within the park. The agency protects park resources and provides services such as ranger-led tours, environmental education, and conducts science and monitoring on park resources.

Despite the park and agency's missions, the coral reef ecosystems have been in decline in Biscayne National Park, due in large part to anthropogenic pressures including fishing pressure and vessel groundings as well as a number of factors outside the control of marine park managers such as climate change, nutrient loading, and disease. The park is in the process of updating its 1983 General Management Plan, in order to guide park staff in the protection of park resources while allowing appropriate and varied public usage and enjoyment. In September 2011, the National Park Service released a Draft Environmental Impact Statement on the proposed General Management Plan (GMP) for the park that included a controversial, 10,522 acre no-take marine reserve zone. The proposed zone would comprise 7% of park

waters and 30% of potential reef habitat, leaving 93% of park waters and 70% of potential reef habitat open to fishing. The purpose of this zone is to provide swimmers, snorkelers, divers, and those who ride a glass bottom boat the opportunity to experience a healthy, natural coral reef, with larger and more numerous tropical reef fish and an ecologically intact reef system (NPS 2011). Visitors to parks in the American West expect to see large healthy trees such as sequoias and redwoods, and large healthy diverse populations of big mammals such as bison and elk. Similarly, visitors to a subtropical marine park in the national park system expect to see healthy coral reefs teeming with diverse and large fish (Lewis 2011). In 2006, 4.2 million people participated in wildlife watching within the State of Florida, compared to 2.7 million people who went fishing (USFWS 2006).

Urban areas adjacent to the park have a population of ~2.5 million people locally and ~6 million people regionally; over half a million people visit the park each year for a nearly 2.5 fold increase since park establishment (NPS Public Use Statistics Office 2011). The recreational vessel fleet in South Florida has grown 444% between 1964 and 1998 (Ault et al. 2001), and there are significantly increasing trends for both the number of people participating in fishing along the east coast of Florida and the number of fishing trips anglers take (NMFS 2001). Both recreational and commercial fishing occur within the

park, and technological advances such as fish finders, depth indicators, global positioning systems, communications systems, improved vessel designs, increased engine horsepower, SCUBA, and spearguns, have facilitated both commercial and recreational fishers to reach, locate, and harvest fish. In the Florida Keys, 77% of the 35 reef stocks are overfished (Ault et al. 2001). Within the park, 64% of species were observed less frequently 2006-2007 than they were in 1977-1981, with mean species richness (including fishery-targeted species) also declining in a range from 9% to 27% (Kellison et al. 2011). It is widely accepted among marine scientists that reef health declines with declining fish populations (Mumby et al. 2007, Mumby & Harborne 2010). Live coral cover of all species monitored within the park has declined from 8-28% in 1977-1981 to 5-8% (Dupont et al. 2008, NPS 2012).

These declines in fish population, fish species diversity and live coral cover can be presumed to adversely affect the experience of visitors who snorkel, dive, or ride a glass-bottom boat. While the park is in a separate partnership planning effort with the State of Florida to manage park fishery resources in a sustainable way, the mission of the NPS goes beyond sustainable fisheries. Park managers concluded that a no-take marine reserve, for the purpose of visitor experience and not fishery management, would successfully achieve the zone's objective of having visitors experience a healthy, natural reef, with larger and more numerous tropical reef fish and an ecologically intact reef system. Other management alternatives (seasonal closures, catch-and-release, size and bag limits, etc.) each have their limitations. For example, any type of fishing still results in derelict fishing gear and fish mortality (Bartholomew and Bohnsack 2005). Marine reserves have been shown to increase fish populations (Nowlis 2000) and size (Bohnsack 2011). Coral reef areas that are unfished would provide an opportunity for fish to obtain larger sizes and consequently have greater reproductive success; unfished areas would also benefit from intact ecological communities and a reduction of fishing gear impacts to organisms and benthic habitats.

### **Material and Methods**

There are no federal guidelines for criteria to establish a marine reserve for visitor experience. The NPS used the planning process established via the National Environmental Policy Act (1969, as amended) to use both public input and science to plan the reserve. A reasoned and documented scientific approach that incorporated public input was planned to determine the locations, sizes, and shapes for this proposed zone, as presented in the different alternatives of the GMP.

The proposed marine reserve and monitoring objectives were planned over a series of two meetings held in 2008. The planning team included NPS scientists, visitor service and law enforcement managers, and managers from Dry Tortugas National Park which also has a marine reserve, albeit for different purposes.

The planning team put forward a list of potential criteria for the public to consider during a series of three zone-specific scoping workshops held July 21-23, 2009. At these meetings, the public was given park maps that indicated coral areas and landmarks and asked: "Based on the science, would you establish a Marine Reserve Zone and if so, where would you put it?" To facilitate decision-making, a series of slides with GIS layers showing data pertinent to the criteria were shown; participants were largely separated from their companions and grouped into ten tables each representing various stakeholder groups; and each table had two facilitators who guided the groups into what was hoped to be consensus maps with each group's proposed zoning configuration. Criteria recommended by the planning team for the marine reserve design were presented at the public workshop, as described below in no particular order.

#### *Criteria for marine reserve design*

(1) Public input (see Results). Stakeholder input is critical for marine reserve design success.

(2) Reefs at risk (decision of whether to aim to protect healthy or low risk vs. threatened reefs or reef components) - The planning committee recommended protecting healthy corals as it would be more difficult to attain the desired zone objective by protecting the less healthy, higher-risk corals. Data layers shared with the public included percent cover of live coral (S. Miller et. al, unpublished data; D. Lirman unpublished data) that indicated a generally low (almost all <10%) live coral cover, with highest coral cover along a few mid-channel patch reefs in the southern half of park.

(3) Reef structures with vertical relief and high rugosity. For criteria (1) and (2), the public was shown data layers of benthic cover in the reef areas of the park. This data layer showed continuous or patchy seagrass, sand, hardbottom, margin reef, patchy reef, and mid-channel patch reefs.

(4) Reef fish diversity and abundance. The public was shown data layers for fish species richness (Ault et al. unpublished data) that showed the highest richness in the northern and southern ends of the park on the reef slope and in the southern half of park mid-shelf patch reefs, with no clear trends north-to-south.

(5) Targeted fish species densities. The public was shown data layers (Ault et al. unpublished data) indicating very low densities for many targeted

species, especially red grouper, black grouper, and mutton snapper. Densities for other targeted species were higher on mid-shelf patch reefs and reef slope with no clear north-to-south trends. Because the park's fish have been so heavily extracted, it was suggested that basing a reserve on current abundance might not be effective, and that a better way might be to protect fish habitat.

(6) Impacts on fishing community. Almost all areas of the park are fished recreationally (even non-reef areas – for example, in shallow sandy flats and seagrass beds, bonefishing is popular). Most commercial fishing is for lobsters and crabs and shrimp. The public was shown overflight data (Ault et al. 2008) that indicated that based on density, park usage by boats is highest along islands, intracoastal waterway, in/near marina channels, and along the reef slope. Highest densities were for recreational boats. There seemed to be an even distribution of boats, with no clear trend seasonally or geographically. This seems to suggest equal pressure everywhere, and closing any specific area would not be likely to impact all or even most boaters, with the possible exception that if the reserve is successful and spillover effects happen, visitors who fish may choose to congregate just outside the boundary of the marine reserve to experience an improved fishing experience. Slightly more boats seemed to be south of Pacific Reef Channel than north of the channel along the reef tract – with the implication that setting a marine reserve south of Pacific Reef Channel would protect the hardest hit areas for fishing but also impact the greatest number of anglers.

(7) Impacts on snorkelers, divers, and other non-consumptive user groups - The park's concession tours take snorkelers and divers throughout the park's reef tract, with special trips to shipwrecks such as the Mandalay and reefs near Caesar Creek.

(8) Enforcement issues. The park's Law Enforcement staff indicated that it is easier for the public to understand zone boundaries with visual markers and line-of-sight considerations, and with "zero" lat/long lines that are clearly marked on maps and GPS; recommended large visual markers that are consistent with those used by other areas in Florida to demarcate no-take zones to increase visitor understanding, and stated that several small no-take areas would be much more difficult to enforce than one larger area. The public was shown maps with existing and proposed aids to navigation such as channel markers, buoys and other highly visible markers, in case they could be used as easily understood delineating features for a potential Marine Reserve Zone.

(9) Potential for connectivity with other protected areas (existing or future) - The adjacent Florida Keys

National Marine Sanctuary, managed jointly by a State/federal partnership, borders the park to the east and south and could potentially designate deep-water reserves adjacent to the park's proposed reserve in order to increase the size and population of deep-water species that could spend part of their life cycles on the park's shallower reefs and therefore increase visitor enjoyment.

(10) Qualitative and/or quantitative comparisons of locations on park map – The U.S. Coral Reef Task Force has recommended that 20% of each marine protected area should be a no-take reserve. Biscayne National Park was formally recognized as a charter member of the National System of Marine Protected Areas on April 22, 2009.

(11) Accessibility - The planning team considered depths within the proposed reserve in order to allow not only divers, but also snorkelers (and novices) the opportunity to experience an unfished reef.

(12) Presence of cultural sites - Visitors enjoy snorkeling shipwrecks, which can be found throughout the ocean areas of the park including the reef areas, but no matter where the marine reserve(s) was proposed, these submerged archeological sites would benefit from less fishing debris. Visitors to sites on the park's proposed Maritime Heritage Trail would benefit from having these sites included within the marine reserve because they would see bigger fish at the shipwreck, thus adding a natural component to their snorkeling experience. However, these sites are throughout the reef tract. The six proposed areas for the trail are sufficiently scattered so that no matter where the proposed marine reserve was located, there would be some trail sites that were inside the proposed reserve, and some outside. One of the more popular shipwrecks for snorkeling is the Mandalay wreck. The public was shown the locations of the shipwrecks proposed as Maritime Heritage Trail sites.

(13) Political boundaries – Within the original boundaries of Biscayne National Monument, the federal government has authority to regulate fishing after consulting with the State of Florida. In 1980, when the National Park was established and its boundaries expanded via land transfer from the State of Florida, the State retained authority within the expansion area to regulate fishing. The public was shown maps delineating the original monument area.

(14) Size. The proposed marine reserve should be large enough to accommodate many dive sites, potentially with enough mooring buoys that would protect reefs from anchor damage. The marine reserve should also provide an uncrowded snorkel or dive experience. If mooring buoys are utilized, the park should have the ability to move mooring buoys to other equally suitable locations should reef

monitoring indicate that sites are being impacted to an unacceptable level.

(15) Boater access. Establishment of a marine reserve on both sides of a channel (ex. Caesar Creek) would result in fishers being forced to travel long distances in order to reach fishable waters.

#### *Rejected criteria*

Criteria not recommended for marine reserve design by the planning team included locations of historic fish spawning aggregations, as there was no documentation available to the planning team regarding historic fish spawning aggregations within the park. Presence of federally endangered *Acropora* corals was also not recommended as criteria, as they could be found in most reefs in the park as they are reef-building species. Presence of vessel grounding restoration sites was also not recommended, as these sites can be closed to the public on a case-by-case basis and this would likely continue whether or not the vessel grounding site was within or outside of a marine reserve. Groundings occur in almost all areas within the park, so vessel groundings would likely neither increase nor decrease by establishment of a marine reserve.

Submerged archeological sites with portable artifacts are easily looted, and therefore the NPS carefully guards site location information and does not encourage visitation to these types of sites since they typically cannot be protected at all times. These sites are typically small within the park, and scattered throughout the park; therefore inclusion or exclusion of these sites was rejected as criteria for the proposed marine reserve. Public education and outreach about the marine reserve zone were recognized as important components of implementation, as well as critical to the success of the zone once implemented, but not as planning criteria as they are applicable to any configuration.

#### *Public scoping comments*

The public scoping period attracted 85 workshop participants and resulted in ten "table maps" from the workshops as well as 36 individually submitted maps. The individually-submitted maps varied from recommending the entire park be a marine reserve to recommending no marine reserve, with multiple variations of marine reserve configurations proposed.

Separately from the public input, the planning team designed an "NPS-proposed" marine reserve zone, using the criteria described above.

#### *Scientific review panel*

On November 19, 2009, the planning team met with additional marine scientists (both government and university) with the objective of receiving scientific

commentary and ranking of public- and NPS-proposed marine reserve(s) sizes, shapes, and locations for use in developing alternatives for the GMP. The ranking was based on which zone configurations were expected to best meet the ecological goals of the zone (healthier reef with bigger fish and greater species diversity). The scientists ranked the proposed zones and also offered two new configurations of marine reserves for NPS consideration, one of which included seagrass areas and bordered a mangrove shoreline to serve as both buffer zones for the coral reef marine reserve and to protect the entire life cycle of targeted reef fish as they moved from juvenile fish in the mangroves out to the reefs.

Following the science review panel, the park planning team met to discuss the merits of the different configurations with regard to the criteria. The planning team delineated two different proposed marine reserve areas, each assigned to a different GMP alternative. Since the locations selected were located within the area of the National Monument prior to the 1980 expansion, the park has the legal authority to establish marine reserves in each of these areas without consent from the State of Florida.

#### *Monitoring*

Although not listed as criteria or described in detail to the public, monitoring within and outside of the proposed marine reserve zone, and before and after establishment, was recognized as necessary to determine effectiveness of the zone implementation especially with regard to user capacity indices. The planning team identified reef health indices that would have implications on visitor experience, including some already being monitored by the NPS, that include but are not limited to live coral cover; coral biodiversity and size; macroalgae biodiversity and abundance; diversity, abundance, and size of targeted, non-targeted, and cryptic reef fish species; presence and trends of endangered coral species (e.g. *Acropora* spp.) ; octocorals; seagrass communities; vessel groundings; diadema distribution and abundance; coral disease and bleaching; fishing-related debris; and underwater clarity and visibility. The planning team recommended that mooring buoy sites have their own set of monitoring criteria including user capacity thresholds to determine if the impacts exceed thresholds and the mooring buoys should be moved away to allow for restoration of the dive/snorkel site.

Because the marine reserve is being proposed for visitor experience, in addition to monitoring ecological criteria, the NPS, in conjunction with East Carolina University has embarked on a potentially long-term social science study to inform the

development of a visitor-focused social science project. The project will use a series of surveys to assess visitor attitudes, perceptions and beliefs concerning marine resources including marine reserves, and provide a geospatial assessment of geographic locations of park visitor uses. One key component of this study is the use of visitor perceptions to assess biophysical resource condition.

### Results

In August 2011, the NPS released the GMP with a draft environmental impact statement for a public comment period through October 31, 2011. Over three hundred people attended a series of three public meetings held in Miami, Florida City, and Key Largo. Over 18,000 comments were received verbally, in writing and on the agency's commenting website. Most of the comments supported the marine reserve zone. Several comments were received from individuals and non-government organizations in opposition to the zone, citing unacceptable adverse impacts to visitors who fish and/or claiming faulty scientific basis for the proposed marine reserve. Some of the comments indicated confusion about the objective of the proposed marine reserve, suggesting some stakeholders believed it was proposed for fishery management.

In addition to public comments, the NPS also initiated consultation with federal and State agencies and tribal governments. Most of these consultations resulted in concurrence or no objection. As of April 2012, the NPS is in continued consultation with the State of Florida and with the National Marine Fisheries Service. A Record of Decision, which would end the planning process and signal the start of implementation, is anticipated by the end of 2012.

### Discussion

A reasoned and documented scientific approach was needed to determine the proposed locations, sizes, and shapes for a marine reserve zone with great potential for controversy. As the NPS is still in the planning process, only time will tell if the approach described here will result in the establishment of a marine reserve in Biscayne National Park. The approach used by the NPS for the proposed visitor-focused marine reserve in this park may not be appropriate for every marine reserve planning effort, but the approach and criteria could serve as an example for planning efforts for marine reserves in other reef areas.

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