

An Ecological Correction to Marine Reserve Boundaries in the US Virgin Islands

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Abstract. Marine protected areas (MPAs) are important tools for management of marine ecosystems. While desired, ecological and biological criteria are not always feasible to consider when establishing protected areas. In 2001, the Virgin Islands Coral Reef National Monument (VICR) in St. John, US Virgin Islands was established by Executive Order. VICR boundaries were based on administrative determination of Territorial Sea boundaries and land ownership at the time of the Territorial Submerged Lands Act of 1974. VICR prohibits almost all fishing and other extractive uses. Surveys of habitat and fishes inside and outside of VICR were conducted in 2002-07. Based on these surveys, areas outside VICR had significantly more hard corals; greater habitat complexity; and greater richness, abundance and biomass of reef fishes than areas within VICR, further supporting results from 2002-2004 (Monaco et al., 2007). The administrative (political) process used to establish VICR did not allow a robust ecological characterization of the area to determine the boundaries of the MPA. Efforts are underway to increase amounts of complex reef habitat within VICR by swapping a part of VICR that has little coral reef habitat for a Territorially-owned area within VICR that contains a coral reef with higher coral cover.

Key words: Marine Protected Area, Coral Reef, Fishes, Overfishing

Introduction

Virgin Islands Coral Reef National Monument (VICR) is an MPA established by US President Clinton on January 17, 2001 under the Antiquities Act of 1906 (34 Stat. 225, 16 U.S.C. 431). These submerged lands consist of about 51 km² of marine habitat in five areas off the island of St. John, US Virgin Islands and are managed by the Secretary of the Department of the Interior through the National Park Service. VICR is comprised of many tropical marine habitats, including fringing mangroves, seagrass beds, nearshore coral reefs, a mid-shelf reef structure and deep water algal plains. Marine resources around St. John have declined dramatically over the past few decades (Rogers and Beets 2001, Beets and Rogers 2002). VICR was intended to enhance resources in the Virgin Islands and specifically in the Virgin Islands National Park (VINP), which was established by Congress in 1956 and expanded to include submerged lands in

1962. This new Monument roughly doubles the area in and around St. John now under the jurisdiction of the National Park Service (NPS). Provisions within the Presidential Proclamation prohibit all extractive uses with the exception of fishing for a coastal pelagic species, blue runner (*Caranx crysos*) south of St. John and bait fishing in a small area within the Coral Bay component of VICR (Fig. 1). In addition, boat anchoring is prohibited in VICR, except for emergency or authorized administrative purposes. The NPS, the National Oceanic and Atmospheric Administration (NOAA), and the US Geological Survey (USGS) initiated a joint project in 2002 to develop a baseline characterization of species and their associated habitats within and outside VICR to assess changes within the ecosystem. The project objectives have evolved to monitor the efficacy of the marine reserve and adjacent areas.

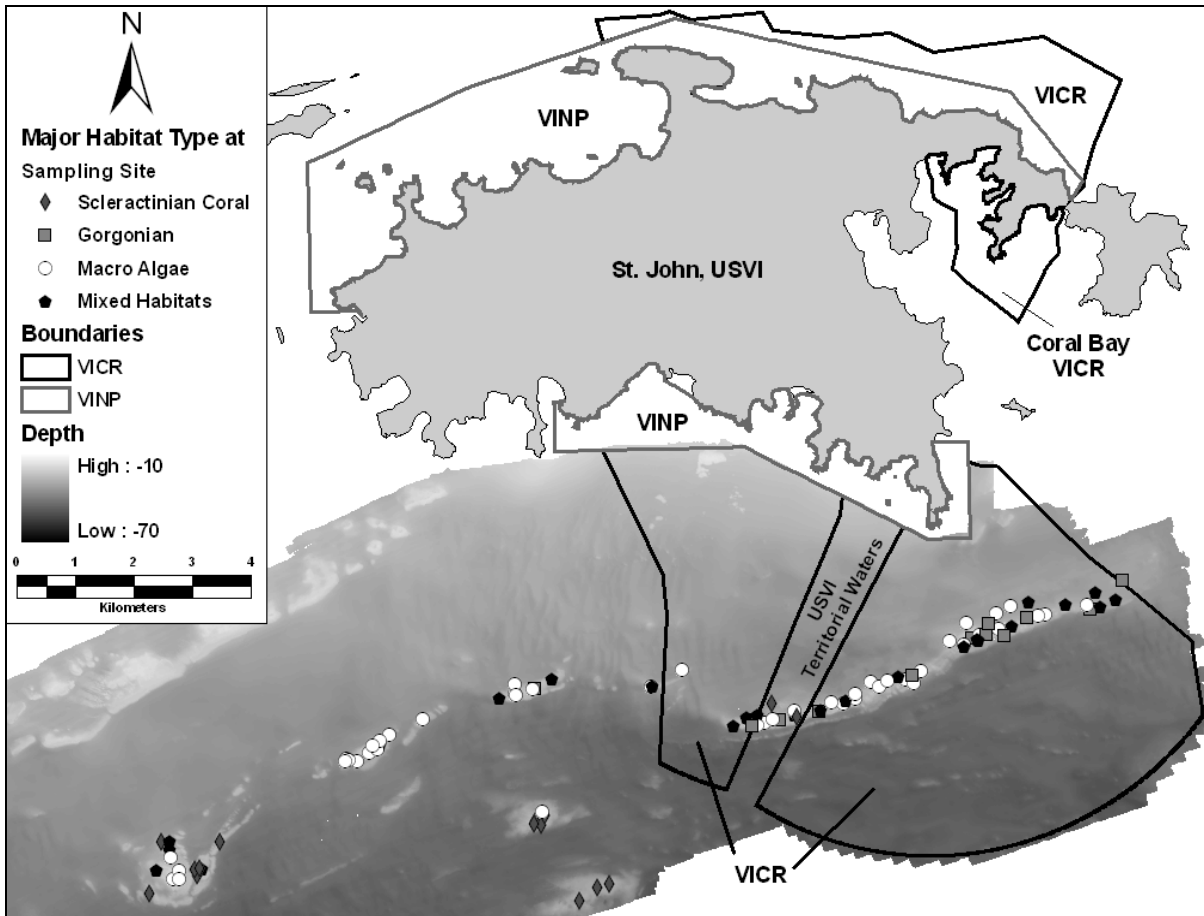


Figure 1. Boundaries of Virgin Islands National Park (VINP) and Virgin Islands Coral Reef National Monument (VICR). Symbols represent survey locations and major habitat types defined at each location.

Material and Methods

The mid-shelf reef is unique for St. John, owing to its relatively deep (17-35m) coral reef ecosystem and relatively high percent live coral cover and topographic complexity. Not all of the mid-shelf reef area is contained within VICR because the MPA was delineated based on legal parameters of the Submerged Lands Act that define federal waters. As a result, VICR is bisected by a wedge of submerged land that extends out from shore from privately owned lands that are not included in the VINP. Additionally, the mid-shelf reef extends to the west of St. John and south of St. Thomas.

Sampling sites were randomly selected inside and outside of VICR within the coral reef habitat of the mid-shelf reef. Modeled bathymetry derived from NOAA depth soundings was used as a surrogate to identify areas of potential coral reef habitat. Additional bathymetry data for water depths ranging from 20-100m for the area south of St. John (Fig. 1) were provided from multibeam surveys (2004-05) off the NOAA ship R/V *Nancy Foster*. Visual reef fish

surveys were conducted annually in July from 2002 to 2007 and associated fine-scale habitat data were also obtained during the surveys. Fish abundance and size at each location were obtained on SCUBA via visual belt transect surveys (25x4m). A second diver assessed habitat quality (coral cover) and complexity (rugosity) within a 15-m diameter circular sampling area nested within the belt area. Both of these parameters are based on a visual estimation as defined by the rapid habitat assessment protocol with rugosity scaled from 1 to 3 (low to high).

Results

Habitat Comparisons

Although there was no significant difference in depth between management strata ($P > 0.05$), there were differences between the benthic habitats inside vs. outside VICR (Table 1). Rugosity and live coral cover were greater outside VICR compared to inside VICR ($P < 0.05$). The extent of hard bottom habitats outside VICR was greater than inside VICR. No sites within VICR were classified as having live scleractinian coral as a dominant biotic component (Fig. 1).

However, gorgonian cover was significantly higher inside VICR than outside (Table 1).

Table 1. Mean (\pm SD) benthic habitat characteristics inside and outside VICR along the mid-shelf reef south of St. John (2003-07). P is the probability of a significant difference between inside and outside VICR. Asterisk (*) indicates significant difference ($P < 0.05$).

Habitat characteristic	Outside VICR mean (+ SD)	Inside VICR mean (+ SD)	% Difference	P value
Abiotic				
Depth (ft)	87.76 (8.76)	87.03 (8.86)	-0.8	0.555
Rugosity	2.21 (0.66)	1.92 (0.81)	-15.1	0.007*
Hard bottom (%)	85.76 (9.654)	81.21 (23.89)	-5.6	0.07
Sand (%)	10.53 (7.97)	13.07 (16.59)	19.4	0.161
Rubble (%)	3.7 (4.09)	4.88 (11.49)	24.2	0.322
Biotic				
Live scleractinian coral cover (%)	18.41 (19.37)	4.46 (6.4)	-312.8	<0.001*
Gorgonian cover (%)	11.46 (7.87)	19.72 (14.8)	41.9	<0.001*
Macroalgal cover (%)	46.28 (18.83)	42.45 (21.84)	-9.0	0.18

Fish Assemblage Comparisons

Fish assemblage characteristics (species richness, numerical density, and biomass) differed significantly between management strata (Table 2), with all significantly greater outside VICR. Among the three habitat types represented both inside and outside VICR (gorgonian, macroalgae, and mixed coral), fish assemblage characteristics were not significantly different (Two-way ANOVA, $P > 0.05$) for all.

Table 2. Comparison of mean (\pm SD) fish assemblage characteristics inside and outside VICR along the mid-shelf reef south of St. John (2002-07). P is the probability of a significant difference between inside and outside VICR. Density and biomass $\ln(x+1)$ transformed for statistical analyses. Asterisk (*) indicates significant difference ($P < 0.05$).

Fish assemblage characteristic	Outside VICR mean (+ SD)	Inside VICR mean (+ SD)	% Difference	P value
Species richness	27.05 (5.87)	23.0 (0.44)	-0.18	<0.001*
Density (indiv/100m ²)	307.92 (23.52)	215.79 (13.71)	-0.43	0.003*
Biomass (kg/100m ²)	10.49 (8.78)	8.21 (6.7)	-0.28	0.01*

Comparisons Among Major Fish Families (2002-2007)

- Total parrotfish biomass was 42% higher outside than inside VICR ($Z=4.33$, $P < 0.001$). These species are important grazers on the reef
- Economically important groupers had 44% higher biomass outside VICR relative to inside ($Z=2.33$, $P=0.02$; Fig. 2)
- Fish biomass has increased inside VICR since 2005 primarily due to an increase in piscivores; however

piscivores have declined outside over this same time period (Fig. 3)

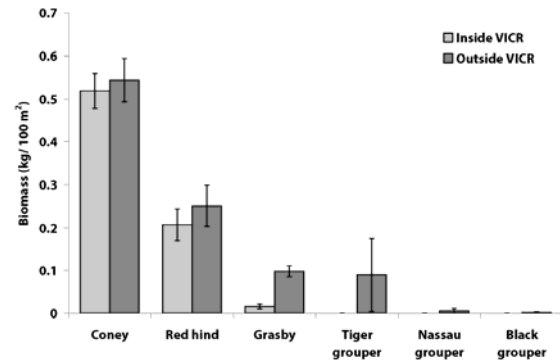


Figure 2. Mean biomass of an economically important fish family, groupers (Serranidae), inside and outside VICR (2002-07). Error bars represent standard error of the mean.

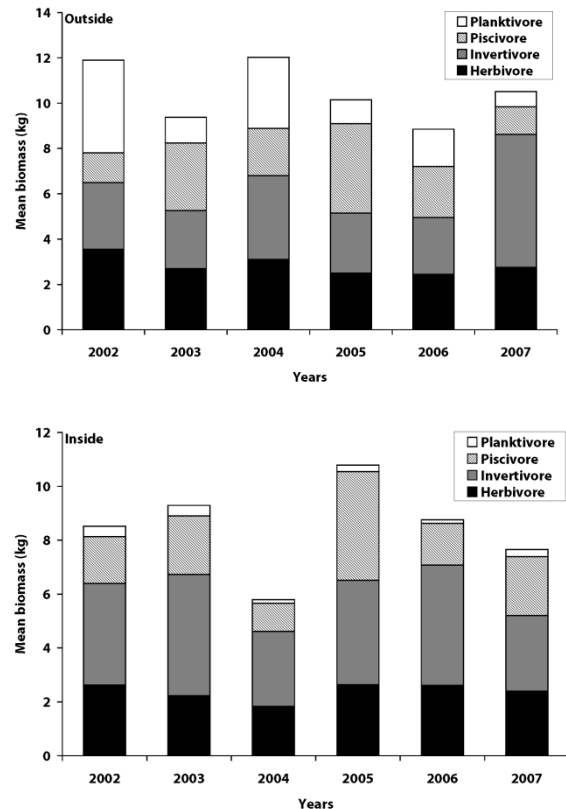


Figure 3. Biomass of trophic guilds outside (top) and inside (bottom) VICR.

Conclusions and Next Steps

The establishment of VICR was a politically driven process based on an exception in the Submerged Lands Act of 1974. As a result, much of the optimal coral reef and fish habitat on the mid-shelf reef is located both in the wedge and to the west of VICR.

Nevertheless, establishment of this MPA does provide for protection of the resources and may lead to resource enhancement over time, especially if an ecological correction can be applied.

While reef sites outside of VICR cannot be considered for inclusion an ecological correction can be made by exchanging the eastern, less biologically rich portion of VICR for the wedge of Territorial Sea that currently bisects VICR on the south side of St. John (Fig. 4a).

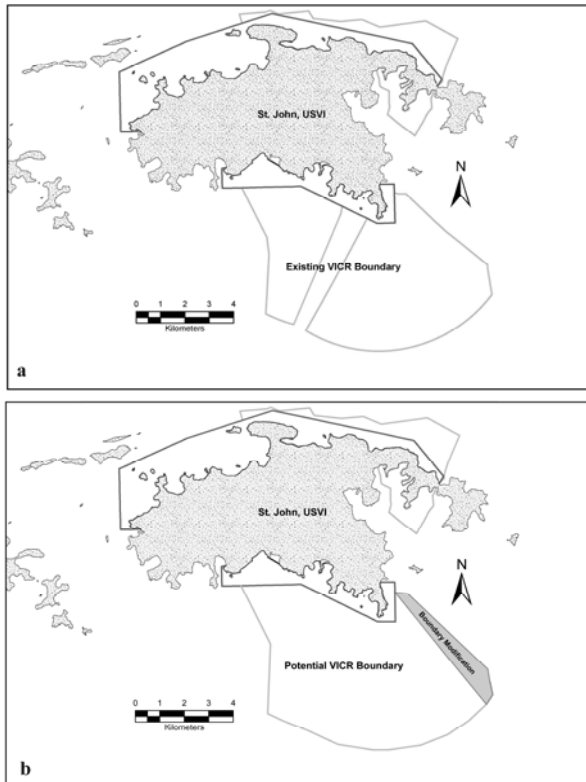


Figure 4. a) Existing VICR boundary and b) potential modification of VICR boundary along the south shore of St. John, USVI.

This process requires agreement from both Territorial and Federal governments in order to occur. The process was initiated before the election of a new VI Governor which delayed progress. The new Governor and the local Department of Planning and Natural Resources, along with many fishermen, have expressed support for the exchange. A recent meeting with the VI Delegate to Congress has resulted in a letter from the Governor to the Secretary of the Department of Interior requesting that negotiations begin for the exchange. As the wedge is already within the authorized boundaries of VICR, this should facilitate the boundary adjustment (Fig. 4b). The major issue will be an appraisal of the submerged lands to be exchanged, since no precedent exists for appraising deep water coral reefs and algal plain.

Inclusion of the mid-shelf reef currently located within the wedge will increase the amount of coral reef and fish habitat in the VICR and provide greater opportunity for resources in this MPA to recover from past harvest of resources and other stressors. This will also eliminate the concern of fishermen that they may be violating VICR regulations and will enhance enforcement of those regulations by NPS law enforcement rangers.

Acknowledgements

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