Chapter 4

ENVIRONMENTAL CONSEQUENCES

Visitor Use at Buck Island

Buck Island Reef National Monument
Draft General Management Plan/
Environmental Impact Statement

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CHAPTER 4
ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

The National Environmental Policy Act mandates that environmental impact statements disclose the environmental impacts of proposed federal actions. In this case the proposed federal action is implementation of the general management plan for Buck Island Reef National Monument. This chapter analyzes the impacts that could result from implementing the management alternatives, as described in Chapter 2, on natural resources, cultural resources, visitor opportunities, and park operations. This general management plan establishes management objectives and implementation actions needed to manage Buck Island Reef National Monument for the next 20 years. Therefore, the analysis period of this environmental impact statement is 20 years.

The alternatives provide broad management direction for the park. Because of the general, conceptual nature of the alternatives, their potential consequences can only be analyzed in general terms. Therefore, this environmental impact statement should be considered a programmatic analysis. Prior to undertaking specific actions as a result of this general management plan, appropriate detailed environmental and cultural compliance documentation would be prepared consistent with provisions of the National Environmental Policy Act, the National Historic Preservation Act, and other legal and policy requirements. The public will have opportunity to review and comment during the implementation phase as well.

Included in Chapter 4 is a summary of the laws and policies relevant to addressing environmental consequences, definitions of impact thresholds (for example, negligible, minor, moderate, and major), methods used to analyze impacts, and the analysis methods used for determining cumulative effects. A summary of the environmental consequences of each alternative is provided in Table 9 in Chapter 2. The impact topics presented in this chapter and the organization of the topics correspond to the discussion contained in Chapter 3, Affected Environment.

SUMMARY OF LAWS AND POLICIES

Four overarching environmental protection laws and policies guide the actions of the NPS in the management of the parks and their resources: the NPS Organic Act of 1916, the National Environmental Policy Act and its implementing regulations, the National Historic Preservation Act and its implementing regulations, and the Omnibus Management Act. For a complete discussion of these and other guiding regulations, refer to Chapter 1 as well as Appendix B. These guiding regulations are described in brief below.

The *Organic Act of 1916* (16 United States Code [USC] 1) commits the NPS to making informed decisions that perpetuate the conservation and protection of park resources unimpaired for the benefit and enjoyment of future generations.

The *National Environmental Policy Act of 1969* is implemented through Council on Environmental Quality regulations (40 Code of Federal Regulations [CFR] 1500-1508). NPS procedures for compliance with these regulations are detailed in Director's Order 12: *Conservation Planning, Environmental Impact Analysis, and Decision-making Handbook* (NPS 2001).

The *1966 National Historic Preservation Act* is implemented through the Advisory Council on Historic Preservation's regulations (36 CFR 800). These regulations require that, as a federal agency, the NPS must assume responsibility for cultural resources within the parks, and must take into account the effects of NPS undertakings on these historic properties (e.g., cultural resources eligible for or listed on the National Register of Historic Places). NPS procedures for compliance with these regulations are outlined in Director's Orders 28 and 28A, *Cultural Resource Management* and *NPS Management Policies 2006*.

The *Omnibus Management Act* (16 USC 5901, *et seq*.) underscores the National Environmental Policy Act in that both are fundamental to park management decisions. Both acts provide direction for connecting resource management decisions to the analysis of impacts and communicating the impacts of these decisions to the public, using appropriate technical and scientific information. Both acts also recognize that such data may not be readily available, and they provide options for resource impact analysis should this be the case. Section 4.5 of Director's Order 12 adds to this guidance by stating, "when it is not possible to modify alternatives to eliminate an activity with unknown or uncertain potential impacts, and such information is essential to making a well-reasoned decision, NPS will follow the provisions of the CEQ regulation (40 CFR 1502.22)". If the incomplete information relevant to reasonably foreseeable significant adverse effects is essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant, the agency is directed to include the information in the environmental impact statement. If the relevant information cannot be obtained because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, the agency is directed to include the following within the environmental impact statement:

- A statement that such information is incomplete or unavailable;
- A statement of the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment;
- A summary of existing credible scientific evidence relevant to evaluating the reasonably foreseeable significant adverse impacts on the human environment; and
- The agency's evaluation of such impacts based on theoretical approaches or research methods generally accepted in the scientific community.

The term "reasonably foreseeable" includes impacts that have catastrophic consequences, even if their probability of occurrence is low, provided that analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason. Collectively, these guiding regulations provide a framework and process for evaluating the impacts of the alternatives proposed in this general management plan / environmental impact statement.

IMPACT ASSESSMENT METHODS

This impact analysis and conclusions are based largely on the review of existing scientific literature and studies; information provided by experts in the NPS, other agencies, universities, and the public; and professional judgment. The method of analyzing impacts is further explained below. It is important to remember that impacts have been assessed assuming mitigating measures would be implemented to minimize or avoid impacts.

A brief description of relevant components of existing conditions is presented for each impact topic in Chapter 3. This information is the basis for determining the effects of implementing each alternative. The impact analysis involved the following steps:

- Define the issues of concern, based on scoping input as described in Chapter 1.
- Identify the geographic area that could be affected. This varies by impact topic, and may include a specific location, within park boundaries, or the region. The region typically is defined as the area surrounding the park, St. Croix and waters surrounding St. Croix. In certain instances the region is defined as the U.S. Virgin Islands, and is so noted.
- Define the resources within the area that could be affected.
- Identify the effects caused by the management alternative, compare these to the No Action Alternative, Alternative A, and determine the relative change in resource conditions. For the No Action Alternative, the analysis assumes continuation of the current management direction, that is, the NPS continues to manage Buck Island and the waters surrounding the island within the park to the extent possible given current conditions and constraints.

- Director's Order 12, Conservation Planning, Environmental Impact Analysis, and Decision Making, presents an approach to identifying the duration (occurs over the short or long term), type (adverse or beneficial), and intensity or magnitude (e.g., the degree, level, or strength of an impact as negligible, minor, moderate, or major) and that approach has been used in this document. Impact topic-specific thresholds for each level of intensity are provided in each impact topic methods section. Threshold values were developed based on federal and state standards and consultation with NPS and other agency resource experts. Because definitions of intensity vary by impact topic, intensity definitions are provided separately for each impact topic analyzed. Where duration is not noted in the impact analysis, it is considered long term.
- Define whether the effect would be beneficial or adverse.
- Determine cumulative effects by evaluating the effect in conjunction with the past, on-going, or reasonably foreseeable future actions for Buck Island Reef National Monument and the region. Additional detail regarding the method for determining cumulative effects is provided in sections that follow.
- Determine whether impairment would occur to resources and values considered necessary and appropriate to fulfill the purposes of Buck Island Reef National Monument. Details regarding the method for analyzing impairment and a discussion of impairment will be provided in the record of decision.

Impacts of the alternatives are analyzed in this order: Alternative A – No Action Alternative, Alternative B, Alternative C, and Alternative D. Each impact topic includes a description of the impacts of the alternative, a discussion of cumulative effects, and a conclusion. At the end of the chapter is a brief discussion for each alternative of sustainability and long-term management to include: unavoidable adverse impacts, irreversible and irretrievable commitments of resources, and effects on short-term uses and long-term productivity. The major assumptions used in the analysis of effects are described in the paragraphs that follow.

For each of the impact topics, access to Buck Island and the underwater trail is directly related to the number of vessels that can be accommodated by a particular alternative through the number of moorings and/or anchoring capacity. Anchoring in the park is dependent upon the availability of deep sand (per the proclamation) and avoidance of sensitive resources. Placement of moorings is also dictated by resource conditions and avoidance of sensitive resources including seagrasses and corals. Impacts are assessed based on these conditions.

The number of vessels that can be accommodated through moorings was estimated based on the area of deep sand, safe swing radius of a vessel, and avoidance of sensitive resources such as seagrasses and corals. The number of vessels that could potentially be accommodated in the existing anchoring area (Alternative A) or an Anchoring Zone (Alternatives C and D) was based upon historical use and avoidance of sensitive resources. Although acreages are specified for these areas under each alternative, it is unlikely that the entire proposed acreages could be utilized at a single point in time due to shifting sands, the presence and recovery of seagrass, or other resource-related protective measures. Acreages and number of vessels proposed under each alternative are presented in Chapter 2. It is assumed that as the number of vessels increase, the number of visitors also increases relative to the number of vessels.

Estimates of maximum number of vessels under each alternative are approximations and are provided for relative comparison of impacts. These estimates will be refined during the implementation phase based on further planning efforts such as the vessel management plan and related environmental compliance documents, site specific data, resource analysis, and user capacity analysis.

CUMULATIVE IMPACT ANALYSIS

The Council on Environmental Quality (1978) regulations for implementing the National Environmental Policy Act require assessment of cumulative impacts in the decision-making process for federal actions (40 CFR 1508.7). Cumulative impacts are defined as "incremental impacts of the action when added to other past, on-going, and reasonably foreseeable future actions, regardless of what agency (federal or nonfederal) or person "undertakes such other action." Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. The time horizon for the cumulative impacts analysis depends on the impact topic under consideration, but for most topics was plus or minus twenty years, unless otherwise noted.

Cumulative impacts were determined by combining the impacts of each management alternative with known past, on-going, and reasonably foreseeable future actions. Other management actions that have the potential to have a cumulative effect in conjunction with measures that would be implemented in this general management plan were identified in Chapter 1 under the "Relationship of Other Planning Efforts to This General Management Plan" section. Cumulative impacts are considered for all management alternatives, including the no action alternative – Alternative A.

In addition to specific agency actions and programs, other activities would continue within the park or in the region that would cumulatively impact resources. These would include a variety of past, on-going, and future actions and events that would have effects on resources within park boundaries. These would include the effects of anchoring, mooring, releases of fuels and other pollutants from vessels and those associated with hulls; visitor use of sunscreens and insect repellents; recreational activity and inadvertent bumping, breaking, and touching of corals; accidental groundings; facility use and maintenance of the pier, toilets, and picnic areas; trail use; introduction and control of non-native species, terrestrial and marine; and enforcement of the no-take provision of the Proclamation. Prior overfishing of the park and region has also contributed to the deteriorated fishery in the park. Continued management of the park as a "no take" marine reserve into the future also contributes beneficial effect to the cumulative picture.

Other changes over time are attributable to hurricanes and other storms, African dust, temperature increases, diseases, and other effects related to climate change. Global climate change is expected to affect the park in several ways, and not all the effects are well understood. The inter-relationship of all of these factors is also thought to be important, and is also poorly understood at the present time. The South Florida/Caribbean Network coral reef monitoring program (NPS 2007) and other researchers will address these issues in the future, based on scientific studies.

An overview of climate change and related effects is provided in Appendix D. Some of the ways that climate change is expected to affect the park are summarized below and by impact topic.

Scientists are certain that human activities are changing the composition of the atmosphere, and that increasing the concentration of greenhouse gases will change the planet's climate (USEPA 2008; IPCC 2007). However, they are not sure by how much it will change, at what rate it will change, or what the specific effects will be. Observed effects have included sea level rise, changes in storm events, temperature increases, ocean acidification and others. Sea level rise is expected to result in inland movement of mangroves, alteration and loss of coastal habitats, and alterations in estuarine salinity patterns, consequently affecting important habitat for endangered species (such as sea turtles, terns, rare plants, fish, corals, etc). Changes in frequency of extreme weather events, such as major hurricanes, droughts, extreme ocean temperature events are expected to accelerate the impacts of sea level rise, strongly impact coral reefs, and further stress inland communities. Changes in temperature and rainfall are expected to impact hydrology, fire patterns, species migratory patterns, species ranges, reproductive timing and success, other recurring biological phenomena, and exotic species.

Over the past 200 years the oceans have absorbed nearly half the carbon dioxide produced by human activities. One effect has been to produce carbonic acid, thus increasing acidity and lowering the pH of surface seawater by 0.1 pH unit. Projections based on different emission scenarios give additional reductions in average global surface ocean pH of between 0.14 and 0.35 units by the year 2100 (IPCC 2007). This seawater acidity is probably higher than has been experienced for hundreds of millennia, and there is convincing evidence that such acidification will impair the process of calcification by which animals, such as corals and mollusks, make their shells from calcium carbonate. Acidification would likely also have affects on the beaches at Buck Island.

A cumulative impact discussion is provided for each impact topic by alternative in the sections that follow.

SOIL / SAND

Regulations and Policies

The regulations and policies that guide NPS actions with respect to soil are presented in the "Servicewide Mandates and Policies" Section of Chapter 1 and in Appendix B.

Methods

Soil and sand issues identified during public meetings and planning workshops included: (1) the highly erodible and fragile nature of the soil at Buck Island; and (2) the potential effects of visitor use on terrestrial trails and beaches. To address these issues, an assessment of the effects of projected park management actions on soil and sand was made using qualitative estimates of the expected levels of visitor use in the terrestrial portion of the park and expected levels of land-disturbing activities inside the park (installation and/or maintenance of picnic tables, grills, restroom, for instance), the practice of bow and stern anchoring, and the effects were compared to Alternative A. In addition, information on soil and sand was evaluated based on the professional judgment of NPS staff. Primary sources of information used in this analysis included U.S. Department of Agriculture soil surveys, NPS policy documents, and unpublished observations and insights from knowledgeable park staff. Buck Island is the area analyzed for possible effects on soil and sand.

The major assumption used in the analysis of effects on soil and sand was: (1) increased visitor use and access to Buck Island could potentially translate to greater terrestrial trail usage and a greater potential for erosion and trail compaction; (2) construction activities (e.g., installation of additional picnic tables or trail expansion) would be minimal under all alternatives given the fragile soil conditions and sensitive habitat present on Buck Island; and (3) under all alternatives, best management practices for construction would be implemented on any construction project proposed by the park and that potentially adverse effects of construction on soil would be minimized by implementation of site-specific mitigation measures identified in environmental assessments tiered to this general management plan/environmental impact statement.

Foot traffic on trails from visitors and park staff can compact soil or crush vegetation to the point where plants may no longer be able to grow. Due to shallow, friable soil conditions, once plant cover is removed the soil is more susceptible to erosion. Construction-related efforts frequently result in soil disturbance while the activity is conducted. Clearing vegetation and maintenance activities around facilities such as restrooms, trails, and picnic areas would be a soil disturbance. Other types of activities considered in the analysis include restoration, development of trails, picnic areas, improvement of trail access and signage areas, and bow and stern anchoring where applicable.

The discussions presented later in this chapter about impacts to soil and refer to the terms compaction, erosion, and disturbance as described above. Lengthy descriptions are not provided to avoid repetition. The effects of potential increases in visitation have been factored into the analysis.

Effects of individual projects on soil would be effectively assessed and mitigation measures employed. The geographic area analyzed is Buck Island.

Impact Threshold Definitions

The thresholds to determine the intensity of impacts on water resources are defined as follows:

Negligible: Soil and sand would not be affected, or the effects on soil and sand would be below or at levels of detection. There would be no discernable effect on the rate of soil or sand erosion and/or the ability of the soil or sand to support native species.

Minor: The effects on soil and sand would be detectable, but effects on soil productivity would be localized. There would be detectable effects on the rate of soil and sand erosion and/or the ability of the soil or sand to support native species.

Moderate: The effect on soil productivity would be readily apparent and would result in a change to the soil character over a relatively wide area. The rate of soil or sand erosion and/or the ability of the soil or sand to support native species would be appreciably changed.

Major: The effects on soil productivity would be readily apparent and would substantially change the character of the soil over a large area in the monument. The actions would have substantial, highly noticeable influence on the rate of soil or sand erosion and/or the ability of the soil or sand to support native species.

Duration: Long-term: Takes more than one year to recover.
Short-term: Recovers within one year.

Impacts of Alternative A

The soil of Buck Island is shallow, highly friable, and sensitive to disturbance. The combination of shallow, friable soil, dry conditions, and steep topography results in the potential for high erosion rates and decreased ability of the soil to support native vegetation. Under current management practices, the existing trail is used for hiking, with an estimated eight to ten hikers traversing the terrestrial trail per day. Due to the rigorous environment, there is a low potential for visitors to walk off-trail, creating unauthorized trails. However, park staff indicate that localized adverse effects to soil are observed even with a limited amount of trail usage, and trail stabilization measures are being taken.

Limited installation or replacement of existing facilities would occur under Alternative A and would not likely affect soil erosion rates. In addition, current methods of non-native, invasive vegetation removal have not adversely affected erosion rates on Buck Island (NPS 2004a; Hillis-Starr 2004). Removal of guinea grass and other non-native, invasive vegetation would also provide localized benefits by reducing the threats posed to soil by high intensity wildfires. Use of existing facilities would cause soil and sand disturbances and possible erosion in areas of concentrated visitor use, such as the picnic area and grills. Continued bow and stern anchoring would disturb sand along the shoreline, causing erosion to occur. The overall effect of Alternative A on soil and sand would be long- and short-term, minor, and adverse.

Cumulative Effects

Under all alternatives, including Alternative A, the cumulative effects on soil would largely be controlled by park management actions, since effects on soil are primarily related to the number of visitors that access Buck Island. The cumulative adverse effects of operation and maintenance activities on soil under Alternative A would be negligible, since this alternative would involve small amounts of land disturbance, use of stabilization measures along the park trail, and little to no new facility construction now and into the future. Past, on-going, and future management of non-native, invasive species including vegetation, goats, rats, and mice would constitute long-term and beneficial effects.

Continuation of bow and stern anchoring would continue to cause sand disturbance and possible erosion along West Beach where this type of anchoring occurs. The amount of erosion has not been quantified and would be difficult to determine due to the effects of other coastal processes such as storm surges and tidal activity. Climate change is anticipated to cause sea level rise and acidification that could adversely affect sand, erosion rates, and availability of habitat.

Regional implementation of outreach and educational programs such as the Virgin Islands Department of Planning and Natural Resources' Non-Point Source Program, Environmental Protection Handbook (Wright 2002), and Environmental Education and Outreach program have the potential to benefit park resources, including soil, by promoting awareness of the importance of resource preservation, benefits of non-native plant control and native restoration program, and methods for minimizing erosion. However, due to staffing and funding limitations, coordination and planning efforts between the NPS and other government agencies and organizations would remain at current levels, which could hinder the potential of such beneficial effects.

When the beneficial and adverse effects of other past, on-going, and future plans, projects, and activities affecting soil and sand are combined with actions under Alternative A, the resulting cumulative effects would be long- and short-term, minor, and adverse.

Conclusions

Long- and short-term, minor, adverse effects on soil would occur under Alternative A due to the sensitive nature of the soil and sand on Buck Island and effects related to trail usage and bow and stern anchoring. When other past, on-going, and future actions are taken into consideration, the cumulative effects on soil would also be long- and short-term, minor, and adverse.

Impacts of Alternative B, the Preferred Alternative

The Island Discovery Zone would be created under Alternative B, which includes trails as an appropriate use; however, construction of new trails would be limited under Alternative B, and constrained by sensitive conditions such as island topography, dry, shallow erodible soil, and hazardous vegetation. An environmental assessment would be required for any proposed trail and site specific mitigation measures would be identified and implemented. Under Alternative B, a similar amount of trail usage would be anticipated as compared to Alternative A, although phasing out anchoring at West Beach under Alternative B could potentially reduce the number of visitors resulting in slightly less trail usage.

Phasing out of bow and stern anchoring along West Beach would also reduce disturbance and erosion of sand with related beneficial effects. In addition, an increase in the number of park staff are proposed under Alternative B compared to Alternative A, which could limit visitors going off-trail due to greater law enforcement presence and resource-related education. Trail stabilization measures would also be implemented to address soil compaction and erosion as necessary. Therefore, related adverse effects would be less than Alternative A. The effects of management actions under Alternative B would be long- and short-term, negligible, and adverse.

Cumulative Effects

As described under Alternative A, cumulative effects for soil and sand are derived primarily from park management actions. Therefore, cumulative effects for Alternative B would also be long- and short-term, minor, and adverse. Although additional staff would be proposed under Alternative B, allowing for additional partnerships, enforcement, and opportunities for providing information to visitors regarding soil and sand conditions, and these efforts would have positive results, a similar level of cumulative effects is likely. Cumulative effects on soil and sand would not be measurably different from those described in Alternative A: long- and short-term, minor, and adverse.

Conclusions

Long- and short-term, negligible, adverse effects on soil and sand would occur under Alternative B due to implementation of management actions to address effects related to trail usage and elimination of bow and stern anchoring. When other past, on-going and future actions are taken into consideration, the cumulative effects on soil and sand would also be long- and short-term, minor, and adverse.

Impacts of Alternative C

Similar types of effects as those described under Alternative A are applicable to Alternative C. Shoreline bow and stern anchoring would be appropriate under Alternative C, with similar effects to Alternative A, such as sand disturbance and erosion along the shoreline. Since the limited bow and stern Anchoring Zone would be considerably smaller, and it is likely that Alternative C would accommodate fewer visitors with direct beach access via a reduced Anchoring Zone compared to Alternative A (Table 5). However, the additional mooring capacity provided by Alternative C would equate to a similar number of overall park visitors and numbers of visitors to Buck Island Alternative A.

The Island Discovery Zone would be created under Alternative C, and includes trails as an appropriate use; construction of new trails is limited by sensitive conditions such as island topography, dry, shallow erodible soil, and hazardous vegetation. New trail construction would cause erosion and compaction of soils in the vicinity of a new trail. An environmental assessment would be required for any proposed trail, and stabilizing boards would need to be utilized as a mitigation measure to protect the soil and minimize effects of erosion and soil compaction along existing and any proposed trails. Minimal facility construction or installation would be appropriate under Alternative C (installation of additional or replacement of existing picnic tables or grills for instance). The greater number of staff proposed under Alternative C compared to Alternative A would somewhat limit the potential for visitors to stray off-trail, creating unauthorized trails due to greater law enforcement presence and resource-related education. Since adverse effects would increase associated with new trail construction and use when compared to Alternative A, the level of intensity would be relative to the amount of trail use and construction. Therefore, the effects of implementation of Alternative C would be long- and short-term, minor to moderate, and adverse.

Cumulative Effects

As described under Alternative A, cumulative effects for soil and sand are derived primarily from park management actions. Hence, cumulative effects for Alternative C would also be long- and short-term, minor to moderate and adverse. Additional staff would be proposed under Alternative C, allowing for additional partnerships with local and other government agencies, universities, and organizations; however, it is likely that partnering efforts resulting in changes to soil and sand conditions would not be measurably increased above the levels described in Alternative A. When the beneficial and adverse effects of other past, on-going, and future plans, projects, and activities affecting soil and sand are combined with actions under Alternative C, the resulting cumulative effects would be long- and short-term, minor to moderate, and adverse.

Conclusions

Alternative C could result in greater trail construction and usage compared to Alternative A. Stabilizing boards would need to be used as a mitigation measure to protect soils and minimize effects of soil compaction and erosion. The overall effects of implementation of Alternative C would be long- and short-term, minor to moderate, and adverse. When other past, on-going and future actions are taken into consideration, the cumulative effects for Alternative C would also be long- and short-term, minor to moderate, and adverse.

Impacts of Alternative D

The elimination of bow and stern anchoring under Alternative D would eliminate associated effects of sand disturbance and erosion. It is projected that Alternative D would likely accommodate a greater number of vessels and visitors within the park when compared to Alternative A and other alternatives. This would increase the likelihood of trail use and increase the potential for soil compaction, erosion, and disturbance.

The Island Discovery Zone would be created under Alternative D, and includes trails as an appropriate use; construction of new trails is possible, and would be limited by sensitive conditions such as island topography, dry, shallow erodible soil, and hazardous vegetation. New trail construction would cause erosion and compaction of soils in the vicinity of a new trail. An environmental assessment would be required for any proposed trail, and stabilizing boards would need to be utilized as a mitigation measure to protect the soil and minimize effects of erosion and soil compaction along existing and any proposed trails. Minimal facility construction or installation would be appropriate under Alternative D (installation of additional or replacement of existing picnic tables or grills for instance). The greater number of staff proposed under Alternative D compared to Alternative A would somewhat limit the potential for visitors to stray off-trail, creating unauthorized trails due to greater law enforcement presence and resource-related education. However, due to the shallow, highly erodible nature of soils in the park, the increase in park staff would not be able to offset the adverse effects of new trails combined with increased visitation in the park. Since adverse effects would increase associated with new trail construction and use when compared to Alternative A, the level of intensity would be relative to the amount of trail use and construction. Therefore, the effects of implementation of Alternative D would be long- and short-term, minor to moderate, and adverse.

Cumulative Effects

As described under Alternative A, cumulative effects for soil are derived primarily from park management actions. Therefore, cumulative effects for Alternative D would also be long- and short-term, minor to moderate, and adverse.

Conclusions

Alternative D could result in increased trail construction and usage when compared with Alternative A. Stabilizing boards would be used as a mitigation measure to protect the soil and minimize effects of soil compaction and erosion. The overall effects would be long- and short-term, minor to moderate, and adverse. When other past, on-going, and future actions are taken into consideration, the cumulative effects for Alternative D would also be long- and short-term, minor to moderate, and adverse.

WATER RESOURCES

Regulations and Policies

The regulations and policies that guide NPS actions with respect to water resources are presented in the "Servicewide Mandates and Policies" Section of Chapter 1 and in Appendix B.

Methods

Water resource issues identified during public meetings and planning workshops included: (1) water quality issues related to vessels and visitor use; this includes spilled or leaking vessel fuel and oil, bacterial contamination from swimmers or sewage illegally discharged from vessel holding tanks, unauthorized bilge water pump-out, disposal of trash at sea by vessel owners, leaching or sloughing of vessel bottom paint, and sunscreen, insect repellent, or other products used by visitors. These types of pollutants are hereafter referred to pollutant discharges or releases throughout this document; (2)

effects related to potential vessel groundings and any associated spills within park waters; and (3) regional water quality issues that could potentially affect the park. To address these issues, an assessment of the effects of projected park management actions on water resources was made using qualitative estimates of the expected location, number, and size of vessels in park waters and the anticipated increase in staffing levels and partnering. Because water pollutants can lead to degradation of water quality over time, the effects were then compared to Alternative A. Increased water temperature resulting from changes consistent with climate change reported world-wide are addressed under the "Marine and Coastal Resources" section and, therefore, are not repeated in this impact analysis.

The primary sources of information used in this analysis included published water quality data, scientific journal articles, NPS policy documents, and unpublished observations and insights from knowledgeable park staff. Since there is no potable water supply on Buck Island and since there would be no effect on the salt pond on Buck Island under any alternative, surface water and groundwater resources were not included in this analysis. The area of possible effect for the impacts analysis corresponds to the marine waters of the park, nearshore areas and regional waters (the east coast of St. Croix) since marine currents could transport pollutants from these areas into the park.

The major assumptions used in the analysis were that: (1) potential effects on water resources from vessels would increase proportionally to the number of vessels that can be accommodated (via either anchoring or mooring under each alternative); (2) additional staff proposed under the action alternatives would benefit water resources through increased enforcement, research and monitoring, education, and interpretation; and (3) adverse regional effects (cumulative effects) could potentially be offset by partnering with territorial and other government agencies, universities, and organizations.

Under all alternatives, best management practices would be implemented on any proposed park project and potential adverse effects on water resources would be minimized by implementation of site-specific environmental assessments tiered to this general management plan/environmental impact statement. Effects of individual projects on water resources would be effectively assessed, and mitigation measures employed. The discussions presented later in this chapter about impacts to water resources refer to the pollutants and uses as described above. Lengthy descriptions are not provided to avoid repetition. The impacts of potential visitation increases have been factored into the analysis.

Impact Threshold Definitions

The thresholds to determine the intensity of impacts on water resources are defined as follows:

Negligible: Chemical, physical, or biological changes to water quality would not be detectable and would be below or within historical or desired water quality conditions.

Minor: Chemical, physical, or biological changes would be measurable but would be below water quality standards and would be within historical or desired water quality conditions.

Moderate: Chemical, physical, or biological changes to water quality would be measurable and readily apparent, but within all water quality standards. Water quality would be altered compared to historical baseline or desired water quality conditions. Mitigation would be necessary to offset adverse effects, and would likely be successful.

Major: Chemical, physical, or biological changes to water quality would be readily measurable, and some water quality standards would be periodically approached, equaled, or exceeded. Water quality would be frequently altered from the historical baseline or desired water quality conditions. Extensive mitigation measures would be necessary and their success would not be assured.

Duration: Long-term: Takes more than one year to recover.
Short-term: Recovers within one year.

Impacts of Alternative A

Under Alternative A, water quality in the park would be affected by pollutant discharges or releases as defined under the methods section. Water quality could also potentially be affected by erosion resulting from trail usage, although these impacts on overall water quality are negligible. In addition, there would also be the threat of oil tanker or other vessel groundings on reefs within the park, which could result in the release of oil or other harmful substances into park waters. However, a release associated with a grounding would constitute an isolated event and would not be typical of average conditions. The overall effect of Alternative A on water resources would be long- and short-term, minor, and adverse.

Cumulative Effects

Under all alternatives, including Alternative A, the cumulative effects on water resources would largely be controlled by park management actions. Regional impacts, such as runoff and sedimentation from development in Teague Bay, less than 1-mile south of Buck Island on the east coast of St. Croix, vessel discharge from tankers that may lighten their load north or east of the park and/or the container port on the south shore of St. Croix, sewage spills in Christiansted, and disposal of trash at sea outside the park boundary, could also contribute cumulative adverse effects.

On-going and future coral and other resource research and monitoring programs conducted by the NPS and its partners within park waters may have an indirect, beneficial, cumulative effect on water resources through collection and interpretation of water quality data. Regional implementation of outreach and educational programs such as the Virgin Islands Department of Planning and Natural Resources' Non-Point Source Program, the Environmental Protection Handbook (Wright 2002), and Environmental Education and Outreach program have the potential to benefit park resources, including water resources, by promoting awareness of the importance of resource preservation and methods for minimizing adverse impacts to water quality. However, due to staffing and funding constraints, Alternative A would likely not increase coordination and planning between the NPS and government agencies and other organizations, which could hinder the potential benefit of such actions.

When the beneficial and adverse effects of other past, on-going, and future plans, projects, and activities affecting water resources are combined with actions under Alternative A, the resulting cumulative effects would be long- and short-term, minor, and adverse.

Conclusions

Long- and short-term, minor, adverse effects on water resources would occur under Alternative A, primarily due to the potential for pollutant discharges or releases primarily from illegal waste disposal from vessels, which cannot be consistently monitored and prevented due to staffing limitations. The lack of restrictions on vessel size and access to potentially hazardous navigational areas within the park also increase the likelihood of a grounding and/or spills within park waters. Cumulative effects on water resources would also be long- and short-term, minor, and adverse due to the added potential for adverse impacts related to regional sources of pollution and the limited amount of regional partnering that is possible with existing staffing levels.

Impacts of Alternative B, the Preferred Alternative

Under Alternative B, water quality in the park would be affected by many of the same influences as those described under Alternative A, and the number of vessels that can be accommodated under each alternative would be slightly less (approximately 72 versus 87, respectively). However, increased staff proposed for this alternative would help limit unauthorized pollutant discharges or releases as described under Alternative A through increased education and enforcement. Creation of a Marine Hazard Zone under all action alternatives (elimination of vessels in this zone) would significantly

decrease the potential for vessel grounding on reefs within the park, reducing the potential for an oil spill in shallow waters within the park boundary. Vessels 151 feet and over would be required to have a permit to operate in park waters. This would also reduce the potential for spills/discharges into park waters and allow the NPS to monitor large vessel use in the park. The overall effects of Alternative B on water resources would be long- and short-term, minor, and beneficial.

Cumulative Effects

Under all alternatives, including Alternative B, the cumulative effects on water resources would largely be controlled by park management actions, but regional impacts described under Alternative A could also contribute adversely to cumulative effects. Likewise, the same beneficial cumulative effects described under Alternative A (on-going and future research and monitoring programs) would also be applicable to Alternative B. However, the increased staffing proposed under Alternative B would allow for more partnering and coordination between the NPS, government agencies, and other organizations on research, monitoring, and outreach programs, which would have long-term, beneficial effects on water resources. When these effects are combined with the adverse and beneficial effects of actions resulting from implementation of Alternative B, the resulting cumulative effects would be long- and short-term, minor, and beneficial.

Conclusions

Long- and short-term, minor, beneficial effects on water resources would occur under Alternative B due to increased staff presence in the park, creation of management zones and vessel size limitations in the park. Cumulative effects on water resources would be long- and short-term, minor, and beneficial due to the added potential for NPS interaction and partnering with other agencies in an effort to increase the knowledge base and stewardship of water resources, as well as implementation of other plans.

Impacts of Alternative C

Effects would be similar to Alternative B since Alternative C also proposes additional staffing, management zones and vessel size restrictions. However, Alternative C would accommodate approximately five more vessels compared to Alternative A. Shoreline bow and stern anchoring would also be permissible under Alternative C, which would allow for more vessels to be concentrated near West Beach and simultaneously allow for a greater potential of localized water quality impacts in this area related to discharge from outboard engines, oil and gasoline, swimmers and use of sunscreen and other products. In addition, shoreline bow and stern anchoring also allows for more direct access to the island, which could potentially translate to greater terrestrial trail usage, increased erosion, and limited increased sedimentation in park waters. The overall result would likely be long- and short-term, negligible, adverse effects on water resources since effects would be localized, mitigation measures would be successful and because it is unlikely that changes to water quality would be detectable in the majority of park waters.

Cumulative Effects

The beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting water resources are the same as those described for Alternative B. When these beneficial and adverse effects are combined with management actions proposed under Alternative C (which allows for anchoring and an increase in the number of vessels), the resulting cumulative effect would be long- and short-term, negligible, and beneficial.

Conclusions

Long- and short-term, negligible, adverse effects on water resources would occur under Alternative C due to the combined effects of increased staff presence, creation of the Marine Hazard Zone, shoreline bow and stern anchoring, and the increased number of vessels that may anchor or moor in

the park. Cumulative effects on water resources would be long- and short-term, negligible, and beneficial due to the added potential for NPS interaction and partnering with other agencies in an effort to increase the knowledge base and stewardship of water resources.

Impacts of Alternative D

Similar effects as those described under Alternative C are applicable to Alternative D. However, it is projected that Alternative D would likely accommodate a greater number of vessels and visitors within the park compared to Alternative A, with an associated increase in adverse effects to water quality associated with increased number of swimmers and vessels in the park. Increased vessel usage increases the potential for accidental spills, pollutant discharges and releases and adverse effects to water quality, particularly in areas where vessels are concentrated (off West Beach). A greater number of additional staff are also proposed under Alternative D when compared to Alternative A and other alternatives. Increased staff and elimination of shoreline bow and stern anchoring would help offset adverse effects to water resources resulting from increased visitation. Overall, the effects of Alternative D on water resources would be long and short-term, minor and adverse.

Cumulative Effects

The beneficial and adverse effects of other past, on-going, and future plans, projects, and activities affecting water resources are the same as those described for Alternative B. However, when these effects are combined with management actions under Alternative D (which allows for an increase in the number of vessels), the resulting cumulative effect would be long- and short-term, negligible, and adverse.

Conclusions

Long- and short-term, minor, adverse effects on water resources would occur under Alternative D due to the combined effects of increased staff presence, creation of the Marine Hazard Zone, and shoreline bow and stern anchoring. However increased number of vessels in the park will increase the likelihood of pollutant discharges or releases, and vessel accidents resulting in oil spills and fuel discharges into park waters. Cumulative effects on water resources would be long- and short-term, negligible, and adverse due to the added potential for NPS implementation of other plans, and interaction and partnering with other agencies in an effort to increase the knowledge base and stewardship of water resources.

VEGETATION

Regulations and Policies

The regulations and policies that guide NPS actions with respect to vegetation are presented in the "Servicewide Mandates and Policies" Section of Chapter 1 and in Appendix B.

Methods

Vegetation issues identified during public meetings and planning workshops were more general and included resource protection and habitat preservation. To address these issues, an assessment of the effects of projected park management actions on vegetation was made using qualitative estimates of the expected levels of visitor use in the terrestrial portion of the park and expected levels of land-disturbing activities inside the park (maintenance of picnic tables or grills, and trail work for instance), and the effects were compared to Alternative A. The primary sources of information used in this analysis include NPS plant species inventories, NPS policy documents, NPS research, and unpublished observations and insights from knowledgeable park staff. The area analyzed for possible effects on vegetation encompasses Buck Island.

The major assumptions used in the analysis of effects on vegetation were that: (1) increased visitor use and access to Buck Island could potentially translate to greater impacts to terrestrial vegetation

communities through increased picnic area and trail usage; (2) construction activities (e.g., installation of additional picnic tables or trail expansion) would be minimal under all alternatives given the fragile soil conditions and sensitive habitat present on Buck Island; and (3) under all alternatives, best management practices for construction would be implemented on any construction project proposed by the park, and potentially adverse effects of construction on vegetation would be minimized by implementation of site-specific mitigation measures identified in environmental assessments tiered to this general management plan/environmental impact statement. Effects of individual projects on vegetation would be effectively assessed, and mitigation measures employed.

Visitor use can impact vegetation through different means, including trampling of vegetation when hiking off designated trails, or moving picnic tables. Introduction or spread of invasive species can also result from visitors unwittingly bringing seeds to Buck Island on their clothing, shoes or other materials. Constructing new trails would cause the loss of vegetation and possibly introduce non-native species. The impacts of potential visitation increases have been included in the analysis. The geographic area assessed is Buck Island.

Impact Threshold Definitions

The thresholds to determine the intensity of impacts on vegetation are defined as follows:

Negligible: Individual native plants may occasionally be affected, but measurable or perceptible changes in plant community size, integrity, or continuity would not occur.

Minor: Effects on native plants would be measurable or perceptible. The natural function and character of the plant community would not be affected and, if left alone, would recover.

Moderate: A change would occur in the natural function and character of the plant community in terms of basic properties (e.g., growth, abundance, reproduction, distribution, structure, or diversity) but not to the extent that the basic properties of the plant community change.

Major: Effects on native plant communities would be readily apparent and would substantially and permanently change the natural function and character of the plant types.

Duration: Long-term: Takes more than one year to recover.
Short-term: Recovers within one year.

Impacts of Alternative A

Under current management practices, existing trails are used for hiking, with an estimated eight to ten hikers traversing the terrestrial trail per day. No new trails would be developed. Due to the rigorous environment, there is a low potential for visitors to walk off-trail, creating unauthorized trails. However, any off-trail use by hikers could affect scrub and dry deciduous forest habitats. Damage to vegetation could result in the trampling or uprooting of native vegetation on the island, and introduction and spread of non-native seed brought to Buck Island accidentally via hiker clothes, shoes or other materials. Beach and coastal thicket vegetation that occurs near the shoreline would likely continue to be affected as a result of off-trail usage by beachgoers, particularly in the high use area at West Beach. Visitors moving picnic tables farther into vegetated areas would likely continue to adversely affect vegetation in this area by trampling and other disturbances. Should visitation increase in the future, additional enforcement would be required to minimize the effects of unauthorized trail use and visitor expansion of the picnic area. Overall, this alternative would have short-term, minor, adverse effects on native plant species.

Cumulative Effects

Management plans to treat and remove non-native plants and animals on the island would have long-term, moderate to major, beneficial effects on native vegetation. The non-native vegetation management plan, which controls exotic vegetation, would result in recovery of native plant

communities, particularly in areas of scrub and dry deciduous forest where infestation is greatest. Implementation of the non-native vegetation plan would restore nearly 33 percent of the island's native vegetation. Removal of non-native animals, mongoose, rats, and mice would also indirectly contribute to the recovery of native vegetation. By suppressing native bird and lizard populations, non-native mammals have adversely affected the dispersal of native plants.

The short-term localized minor adverse effects of visitor impacts on terrestrial vegetation that would occur under Alternative A would not reduce the overall major, long-term, beneficial effects of non-native plant and animal management measures that would restore native plant communities in large areas of the island. When the beneficial and adverse effects of other past, on-going and future plans, projects, and activities affecting vegetation are combined with actions under Alternative A, the resulting cumulative effects would be considered major, long-term, and beneficial.

Conclusions

The effects to vegetation communities through continuing current management practices would be localized, short-term, minor, and adverse as a result of limited off-trail use or trampling that occurs along high use beach areas. Cumulative effects of Alternative A and other projects and plans would have overall long-term major beneficial effects.

Impacts of Alternative B, the Preferred Alternative

Similar effects as those described under Alternative A are applicable to Alternative B. The Island Discovery Zone would be created under Alternative B, which includes trails as an appropriate use; however, construction of new trails is limited by sensitive conditions such as island topography and shallow, dry, erodible soil. Potential development of limited new trails would result in a loss of habitat and loss of native plants in the localized area where the trail would be constructed. This would have long-term, minor to moderate, adverse effects as trail development would be expected to be the largest type of facility development that would occur on the island; however, this activity would not result in a loss of populations or changes to community types. Potential limited increased trail development would also result in the introduction of visitors into new areas, which would increase the area that could be affected by off-trail use by visitors and potential introduction of non-native species brought to Buck Island accidentally via hiker clothes, shoes or other materials. Increased trails and use increases the potential for adverse effects to native plant restoration as well. Due to the dry forest and scrub habitat conditions of the island, this activity would be localized and would have minor, short-term, adverse effects.

An environmental assessment would be required for any proposed trail, and mitigation measures would also be employed to reduce the spread of non-native plants into newly disturbed areas and to reduce or minimize erosion into adjacent native habitat. Under Alternative B, a similar amount of trail usage would be anticipated as compared to Alternative A, although phasing out anchoring at West Beach under Alternative B could potentially reduce the number of visitors, resulting in slightly less hiking on Buck Island. In addition, an increase in the number of park staff is proposed under Alternative B compared to Alternative A, which could limit the use of unauthorized trails and vegetation trampling in the picnic area due to greater law enforcement presence and resource-related education. Management actions would be taken as needed to reduce visitor impacts on native vegetation. The overall effect on native vegetation as a result of implementation of Alternative B would be long-term, negligible to minor, and adverse.

Cumulative Effects

Cumulative effects of other past, on-going, and future projects, plans, and activities would be the same as described for Alternative A. When the beneficial and adverse effects of other on-going and future plans, projects and activities affecting vegetation are combined with actions under Alternative B, the resulting cumulative effects would be long-and short-term, major, and beneficial.

Conclusions

Limited development of trails and potential for spread of non-native plants would have long-term, minor to moderate, adverse effects. However, these adverse effects would be offset by greater law enforcement presence, resource-related education, and a fewer trail hikers when compared to Alternative A, resulting in an overall long-term, negligible to minor, adverse effect on native vegetation. Cumulative effects of other projects and plans in combination with impacts of Alternative B would result in overall long-and short-term, major, benefits on native vegetation.

Impacts of Alternative C

The Island Discovery Zone would be created under Alternative C, which includes trails as an appropriate use; construction of new trails is limited by sensitive conditions such as island topography and shallow, dry, erodible soil. Development of new trails would result in a loss of habitat and loss of native plants in the localized area where the trail would be constructed. This would have long-term, minor to moderate, adverse effects as trail development would be expected to be the largest type of facility development that would occur on the island; however, this activity would not result in a loss of populations or changes to community types. Potential increased trail development would also result in the introduction of visitors into new areas, which would increase the area that could be affected by unauthorized or off-trail use by visitors and potential introduction of non-native species brought to Buck Island accidentally via hiker clothes, shoes or other materials. Increased trails and use increases the potential for adverse effects to native plant restoration as well.

An environmental assessment would be required for any proposed trail, and mitigation measures would also be employed to reduce the spread of non-native plants into newly disturbed areas and to reduce or minimize erosion into adjacent native habitat. Under Alternative C, an increased amount of trail usage would be anticipated as compared to Alternative A, associated with the increased number of visitors, resulting in slightly more hiking on Buck Island. In addition, an increase in the number of park staff is proposed under Alternative C compared to Alternative A, which could limit the use of unauthorized trails and vegetation trampling in the picnic area due to greater law enforcement presence and resource-related education. Management actions would be taken as needed to reduce visitor impacts on native vegetation. The overall effect on native vegetation as a result of implementation of Alternative C would be long-term, minor, and adverse.

Cumulative Effects

Cumulative effects of other past, on-going, and future projects and plans would be the same as described for Alternative A. When the beneficial and adverse effects of other on-going and future plans, projects and activities affecting vegetation are combined with actions under Alternative C, the resulting cumulative effects would be long-and short-term, moderate, and beneficial.

Conclusions

Development of trails and potential for spread of non-native plants, combined with an increased level of visitation, when compared to Alternative A, would have a long-term, minor, adverse effect on vegetation. When the beneficial and adverse effects of other on-going and future plans, projects and activities affecting vegetation are combined with actions under Alternative C, the resulting cumulative effects would be long-and short-term, moderate, and beneficial.

Impacts of Alternative D

The effects of potential development of new trails that would result in a loss of habitat and loss of native plants in localized areas where trails would be constructed would be similar to those described in Alternative D. The capacity for greater numbers of visitors to the island is greater under Alternative D, with approximately 25 more vessels than under Alternative A. The effects on vegetation from a greater number of visitors would be offset somewhat by the addition of enforcement and educational

outreach compared to Alternative A; however, increased trampling of vegetation at West Beach is likely. The overall effect on vegetation would be long-term, moderate, and adverse.

Cumulative Effects

Cumulative effects of other past, on-going, and future projects, plans, and activities would be the same as described for Alternative A (long-term, major, beneficial When the beneficial and adverse effects of other on-going and future plans, projects and activities affecting vegetation are combined with actions under Alternative D, the resulting cumulative effects would be long-and short-term, moderate, and beneficial.

Conclusions

Development of trails and potential for spread of non-native plants combined with a greater capacity for visitor use and increase in enforcement and educational outreach, when compared to Alternative A, would have a long-term, moderate, adverse effect on vegetation. When the beneficial and adverse effects of other on-going and future plans, projects and activities affecting vegetation are combined with actions under Alternative D, the resulting cumulative effects would be long-and short-term, moderate, and beneficial.

WILDLIFE

Regulations and Policies

The regulations and policies that guide NPS actions with respect to wildlife are presented in the "Servicewide Mandates and Policies" Section of Chapter 1 and in Appendix B.

Methods

Wildlife issues raised during public meetings and planning workshops were general in terms of protection of park resources and habitat preservation. To address these issues, an assessment of the effects of projected park management actions on terrestrial wildlife was made using qualitative estimates of the expected levels of visitor use in the terrestrial portion of the park and expected levels of land-disturbing activities inside the park (installation and/or maintenance of picnic tables or grills, and trail use for instance), and the effects were compared to Alternative A. In addition, information on wildlife was evaluated based on the professional judgment of NPS staff. The primary sources of information used in this analysis include NPS faunal species inventories, research, NPS policy documents, and unpublished observations and insights from knowledgeable park staff. The area analyzed for possible effects on wildlife incorporates Buck Island and the surrounding waters.

The major assumption used in the analysis of effects on wildlife were that: (1) increased visitor use and access to Buck Island could potentially translate to greater impacts to terrestrial wildlife through increased picnic area and trail usage; (2) construction activities (e.g., installation of additional picnic tables or trail expansion) would be minimal under all alternatives given the fragile soil conditions and sensitive habitat present on Buck Island; and (3) under all alternatives, best management practices for construction would be implemented on any construction project proposed by the park and potentially adverse effects of construction on wildlife would be minimized by implementation of site-specific mitigation specified in environmental assessments tiered to this general management plan/environmental impact statement. Effects of individual projects on wildlife would be effectively assessed, and mitigation measures employed.

Impact Threshold Definitions

The thresholds to determine the intensity of impacts on wildlife are defined as follows:

Negligible: Native wildlife species, their habitats, and the natural processes sustaining them would not be affected or the effects would be at or below the level of detection. Effects would not be of any

measurable or perceptible consequence to wildlife populations. Habitats would retain adequate ecological integrity to support a full complement of native fish and wildlife species.

Minor: An action would result in detectable effects to species and/or their habitats, but changes would not be expected to result in substantial population fluctuations, their habitats, or the natural processes (e.g., competition, dispersal). Occasional responses to disturbance by some individuals could be expected but without interference to feeding, reproduction, or other factors affecting population levels.

Moderate: An action would result in detectable effects on native wildlife, their habitats, or the natural processes sustaining them. Key processes such as dispersal, competition, and/or predation may experience disruptions that would alter population size and/or distribution, but would return to natural conditions after initial disturbance. Sufficient habitat would remain functional to maintain viable native fish and wildlife populations.

Major: An action would result in detectable effects on native wildlife, their habitats, or the natural processes sustaining them. Key processes such as dispersal, competition, and/or predation would be altered permanently. Adverse responses to disturbance by some individuals would be expected, with negative impacts on feeding, reproduction, or other factors, resulting in a long-term decrease in population numbers and genetic variability. Habitats may not remain functional for maintaining viable fish and wildlife populations.

Duration: Short-term: The effect would occur only during or shortly after a specified action or treatment. Within a year or less, conditions would be similar to those that predominated previously.

Long-term: Species would continue to be affected beyond one year's time, and/or conditions would not be similar to those that predominated previously.

Impacts of Alternative A

Birds use Buck Island for foraging and nesting as described in Chapter 3, Affected Environment. Continuation of recreational use of the island and the marine environment would cause many shorebirds, upland birds, waterbirds, and waterfowl to avoid areas with visitor activity due to human presence and associated noises, sights, vessels, recreational devices, or scents. Because of the rugged terrain on the interior of the island, the number of visitors to the interior is limited, and the impact of flushing and stress would not be as pronounced as it would be near the beach.

Disturbance by beach goers, people picnicking near the salt pond, and hikers can reduce the amount of time birds spend foraging and can result in flushing birds from nesting areas. Studies show that the number and proximity of people and their activities reduce the amount of time that species of sandpipers spent foraging (Ingle et al. 2003). The disturbances could result in physiological effects related to the altered behavior. Flushing that would lead to reduced foraging success of birds may result in reduced reproductive success. Visitors walking along the shoreline impact foraging plovers, sandpipers, and oystercatchers, as birds are flushed each time visitors pass; this typically occurs along the south shore coral cobble area. The presence of moorings on the eastern end of the monument at the underwater trail and SCUBA moorings may result in reduced foraging time by birds that feed on fish due to avoidance of the area or as a result of a change in the distribution of prey species. Brown pelican, osprey, and magnificent frigate bird foraging, nesting, and roosting occurs along the north shore above the lagoon, adjacent to but separated from the underwater trail area. Anchoring at the southwestern end of the island would have no overall long-term effect on fish species abundance and distribution that waterbirds feed upon. Overall, effects of disturbance from visitor use activities in the marine environment and on the island would have short- and long-term, minor, adverse effects to shorebird, waterbird, and waterfowl foraging, as the effects would be measurable but would not affect population levels in the monument.

Impacts on reptiles on the island, such as the St. Croix anole and the dwarf gecko, would occur from visitor access to forested and xeric habitats, respectively, on the island's hiking trail and any intrusion into forested habitats off-trail or from the beach. The presence of visitors would cause disturbance and result in temporary displacement of lizards but would not be expected to affect breeding and foraging behaviors. Because of the ruggedness of the area, the number of visitors to the interior of the island is limited, and the impact of disturbance on reptiles would be short-term, negligible, and adverse as individuals would be affected without resulting in population level changes.

Ghost crabs and hermit crabs spend a portion of their time on land. Adverse effects to these species would occur as a result of continued use of park beaches for recreation. Research on ghost crabs shows that higher densities of crabs occur in areas with fewer people (Cooper et al. 2005). The ghost crab is considered to be an indicator species of human interaction – the more holes, the less the impact by humans, unless food is introduced. Recent research shows that burrows of ghost crabs are more abundant in areas with less recreational activity, but the exact reasons why are unknown at this time (Barrows 2001). However, other research shows that pedestrians do not have harmful effects on ghost crabs and that densities were higher in areas with people, possibly due to the presence of food scraps (Leatherman (1981) as cited in Ingle et al. 2003). Bow and stern anchoring may disturb ghost crab burrows by accidentally disturbing them, thereby displacing some crabs. Continuing use of the beaches on the island would result in long-term, negligible, adverse effects along the beach, because few individual crabs may be displaced or trampled, but overall abundances of crabs would not be affected.

Other terrestrial invertebrates, which include insects and other species without a backbone, may be displaced or disturbed by human activity on the island; however, there is suitable habitat adjacent to visitor use areas that would provide habitat and forage and there would be no impacts at the population level. Therefore, Alternative A would have long-term, negligible, adverse effects on terrestrial invertebrates.

The overall effect on wildlife under Alternative A would be short- and long-term, negligible to minor, and adverse.

Cumulative Effects

Other on-going management actions to remove non-native vegetation, maintenance of trails, and limited island infrastructure would result in short-term, negligible to minor, adverse effects to wildlife from noise and presence of humans that may cause individuals to be displaced or avoid areas for short periods.

Restoration programs on the island would have long-term, moderate to major benefits to wildlife. Large areas of Buck Island, approximately 75 acres or 33 percent of the island (NPS 2006b; 2010) would be treated under the non-native plant removal project. This level of native habitat restoration would have moderate benefits to wildlife species that use the forested and shrub land habitats.

Eradication of non-native mongoose and tree rats on the island has also had a moderate to major beneficial effect on wildlife species on the island. Prior to eradication, these non-native species adversely affected ground-nesting shorebirds, native trees, and shrubs. As a result, native wildlife species are recovering. The non-native house mice population is also increasing as a result of the mongoose and rat eradication. As such, NPS plans to implement an eradication and/or control program to reduce or eliminate the effects of house mice on native wildlife species. Eradication of these non-native species on the island improved conditions thereby making it possible to re-introduce the endangered St. Croix ground lizard to Buck Island. Removal of non-native species and restoration of native species provides long-term, moderate beneficial effects.

Long-term effects from climate change including sea level rise, acidification, temperature increases, coral reef effects, and increased storm activity would have adverse effects on wildlife foraging, nesting,

and reproduction that cannot be quantified due to lack of available data and a thorough understanding of the interrelationships of all the effects.

Overall restoration programs and successful management of the monument's resources has led to long-term, moderate benefits. The short-and long-term negligible to minor adverse effects of Alternative A would not reduce these benefits. The overall cumulative effects on wildlife as a result of implementation of Alternative A in combination with other past, on-going, and future plans, projects, and activities would be long-term, moderate, and beneficial.

Conclusions

The impacts on wildlife would be short- and long-term, negligible to minor, and adverse as a result of terrestrial disturbances and visitor use of the island. Wildlife species would be disturbed due to visitor use of the island which may cause flushing from nests and foraging areas. Shorebirds, waterfowl, and waterbirds may be additionally affected as a result of potential collisions and changes in prey distribution as a result of boating activities, including mooring and anchoring. Cumulative effects of Alternative A in combination with other projects, plans, and actions would be long-term, moderate, and beneficial.

Impacts of Alternative B, the Preferred Alternative

Continued use of the monument for recreational purposes would have the same effects as described for Alternative A for wildlife. Potential development on the island, such as limited new trails, would result in a loss of habitat and displacement of individuals. Trail development could result in introduction of visitors into new previously undisturbed environments, which would result in the disturbance of wildlife in localized areas. Increased visitor use of the island's interior could also result in the spread of non-native plants into newly developed areas, thereby degrading habitat. Limited use of the island for hiking reduces the potential for this occurrence. Trail development and the potential for increased use of the island would have long-term negligible to minor adverse effects on birds, reptiles, and terrestrial invertebrates, assuming that trail development would be limited and that suitable adjacent habitat for foraging and nesting would be available.

Benefits to bird species from phasing out the existing anchoring area under this alternative would be offset by the use of vessels at new mooring sites. Development of additional mooring sites along the western portion of the island and for resource management purposes would cause short-term changes in distribution of fish species, but would not affect the overall availability of prey species for piscivorous birds (those that feed on fish). Waterbirds would avoid the area during mooring installation and while vessels are present, resulting in short-term, minor, adverse effects.

Under this alternative, a Marine Hazard Zone would be created that would prohibit recreational vessel use in this zone and limit the type and variety of visitor activity north and southeast of the island outside the underwater trail area. This zone would eliminate vessel-related effects to wildlife in this zone and reduce disturbance of waterbirds and waterfowl by visitors. In addition, protection of this area would increase fish abundance and distributions due to a lack of boating and recreational disturbance. Management of marine resources in this zone and the Resource Protection Zone would increase food availability for piscivorous bird species, which could lead to increased reproduction and success of populations. Development of these zones, along with increased ranger presence associated with increased staffing levels, would have long-term moderate benefits.

Enhanced research and monitoring of resources in the Resource Protection and Marine Hazard Zones within the monument would allow staff to detect impacts of monument use on wildlife, their habitats, and prey species or food sources more readily. Increased educational activities would enhance visitor knowledge and associated opportunities for stewardship and protection of wildlife. Management actions would be taken as needed to reduce visitor impacts on wildlife and wildlife habitats. Overall, Alternative B would have long-term, minor beneficial impacts to wildlife.

Cumulative Effects

The long-term moderate cumulative benefits of resource protection actions, restoration projects, and non-native species management programs would be the same as discussed in Alternative A. Short-and long-term negligible to minor adverse effects of Alternative B from potential installation of trails and moorings would not reduce these benefits. In addition, Alternative B, through management of marine resources in designated management zones and enhanced research and monitoring and outreach programs, would have overall moderate benefits to wildlife species that rely on marine resources for forage. The overall cumulative effects on wildlife and wildlife habitat as a result of implementation of Alternative B in combination with other past, on-going, and future plans and projects would be long-term, moderate to major, and beneficial.

Conclusions

Overall, Alternative B would have a long-term, minor benefit to wildlife, primarily due to creation of the Marine Hazard Zone, which would eliminate vessel-related effects to wildlife in this zone and reduce disturbance of waterbirds and waterfowl by visitors and increase fish abundance. Cumulative effects of management actions under Alternative B in combination with other past, on-going, and future projects, plans, and actions, would be long-term, moderate to major, and beneficial.

Impacts of Alternative C

The effects of visitor use of the monument and potential development of new trails in the Island Discovery Zone on the island would have the similar types of adverse effects on birds, reptiles, and terrestrial invertebrates as described for Alternative B. Designation of a Marine Hazard Zone and a Resource Protection Zone and enhanced research and monitoring of resources in these zones under Alternative C would also have similar types of beneficial effects as described under Alternative B. The increased number of vessels and therefore visitors to Buck Island proposed under Alternative C may increase the level of wildlife disturbance, particularly in high use areas such as West Beach during peak periods of visitation. Results would be similar to Alternative A, however, since the increase is slight (five additional vessels) and would be offset by creation of zones, and other measures mentioned above.

Under Alternative C, a two-acre Anchoring Zone and additional mooring sites off the western portion of the island would result in short-term displacement of fish that waterbirds forage upon. The placement of five additional anchoring locations in deep sand would result in negligible effects on fish as a result of loss of habitat, with negligible effects on wildlife. Therefore, there would be minor short-term adverse effects on prey species for foraging waterbirds during installation of moorings and during vessel use and activity in the Anchoring Zone. Overall, Alternative C would have long-term, negligible beneficial effects on wildlife.

Cumulative Effects

The long-term moderate cumulative benefits of resource protection actions, restoration projects, and non-native species management programs would be the same as discussed in Alternative A. Short-and long-term negligible to minor adverse effects of Alternative C from installation of trails and installation of moorings would not reduce these benefits. In addition, Alternative C, through management of marine resources in designated management zones and enhanced research and monitoring and outreach efforts, would have overall moderate benefits to wildlife species that rely on marine resources for forage. The overall cumulative effects on wildlife and wildlife habitat as a result of implementation of Alternative C in combination with other past, on-going, and future plans, projects, and activities, would be long-term, moderate to major, and beneficial.

Conclusions

Alternative C would have similar impacts on wildlife as Alternative B, but slightly less beneficial due to the creation of the Anchoring Zone and increased number of vessels and visitors resulting in an overall long-term, negligible beneficial effect. Cumulative effects of Alternative C in combination with other past, on-going, and future projects, plans, and actions would be long-term, moderate to major, and beneficial.

Impacts of Alternative D

The same types of effects described for Alternative C are applicable to Alternative D. The increased capacity created by the increased acreage for anchoring and installation of moorings would result in an increased potential disturbance associated with human presence, particularly at highly visited areas such as West Beach. The designation of a Marine Hazard Zone and a Resource Protection Zone and enhanced research and monitoring of resources in these zones under Alternative D would also have the same beneficial effects as described under Alternative C. Although there would be an increase in park staff, the increase in the number of vessels and likelihood of disturbance associated with more visitors would be greater than Alternative A. Because there would be an increase in adverse effects associated with human presence, the overall result would be long-term, negligible adverse effects to wildlife.

Cumulative Effects

The same cumulative effects described for Alternative C are applicable to Alternative D. Overall cumulative effects on wildlife and wildlife habitat as a result of implementation of Alternative D, although there would be an increase in the number of vessels and therefore visitors, when taken in combination with other past, on-going, and future plans, projects, and actions, would be long-term, moderate to major, and beneficial.

Conclusions

Alternative D would have similar impacts on wildlife as Alternative C, but slightly less beneficial due to the creation of a larger Anchoring Zone under Alternative D resulting in overall long-term, negligible adverse effects. Cumulative effects of Alternative D in combination with other past, on-going, and future projects, plans, and actions would be long-term, moderate to major, and beneficial when compared to Alternative A.

MARINE AND COASTAL RESOURCES

Regulations and Policies

The regulations and policies that guide the NPS actions with respect to marine and coastal resources are presented in Appendix B.

Methods

The impact assessment is organized according to the resource subcategories indentified in Chapter 3, including communities of shallow coral reef (including patch reefs and haystack formations), seagrass and algal plains, sand bottom, deep reef and wall reef, deep water abyssal bottom, and deep water oceanic/pelagic. Impacts to corals are addressed under “shallow coral reef communities,” and impacts to elkhorn and staghorn coral, specifically, are addressed in the “Species of Concern” section of this chapter. The impact assessment is based on issues regarding marine and coastal resources identified during public meetings and planning workshops, and includes:

- Potential effects of anchoring and accidental vessel groundings on marine and coastal resources. These types of effects would include, for example, disturbance of seagrass rhizomes

by vessel anchors, crushing of benthic invertebrates such as Calianassa by vessel anchors, or breakage of corals caused by accidental groundings on reefs.

- Potential effects of installation of moorings on marine and coastal resources. These types of effects would include physical disturbance of sand bottom or seagrass habitat and organisms during placement of sand anchors or other devices used to anchor moorings.
- Potential effects of recreation on marine and coastal resources. These would include, for example, effects of touching, bumping, or breakage of corals by snorkelers (particularly at the underwater trail) and/or SCUBA divers at the SCUBA moorings, effects of snorkeling, SCUBA diving, and vessel movement on behavior of marine animals. Effects of pollutant discharges or releases from vessels and visitors in the anchoring and mooring areas are addressed under the "Water Resources" section. Effects on marine organism are addressed in this section. (Note: pollutant discharges or releases include spilled or leaking vessel fuel and oil, bacterial contamination from swimmers or sewage illegally discharged from vessel holding tanks, unauthorized bilge water pump-out, disposal of trash at sea by vessel owners, leaching or sloughing of vessel bottom paint, and sunscreen, insect repellent, or other products used by visitors. These types of pollutants are hereafter referred to pollutant discharges or releases).

Climate change is expected to impact coral reef communities by increasing the frequency of extreme water temperature events (that result in coral bleaching, as summarized in Chapter 3), ocean acidification, sea level rise, and major storms. The 2005 temperate increases, coral bleaching and disease outbreaks resulted in 41 to 79 per cent live stony coral cover at monitored reefs in the Virgin Island parks. Changing climate conditions in which coral reefs have lived in the Caribbean for millennia are rapidly changing. Global climate change models predict that for the year 2070, the air temperature in the Caribbean will rise between 2 ° and 4 °Celsius, with the greatest changes occurring in the northern Caribbean and around continental borders (IAC et al. 2009). Because current levels of sea surface temperature are already close to the upper temperature threshold for the survival of corals, it is projected that for the year 2020, coral bleaching will become an annual event in the Caribbean (IAC et al. 2009). Other impacts include damages caused by hurricanes and storms, which are becoming more frequent, rising sea levels, reduction of potential calcification (increased acidity of water), and diseases.

These and other changes due to climate change are addressed under cumulative effects. However, the detailed nature and interrelationships of these cumulative effects are not understood at the present time. The various potential interrelationships of these factors will be assessed during future research and monitoring programs conducted by the NPS, National Oceanic and Atmospheric Administration, other agencies, the University of the Virgin Islands, and other organizations, colleges and universities. A summary of the cumulative effects of climate change is presented in the introduction of Chapter 4 as well as Appendix D.

Effects associated with anchoring, mooring, and recreation were addressed for each alternative by making qualitative estimates of: (1) differences in the numbers of vessels that would anchor or moor in different areas of the park; (2)relative size and location of anchoring and mooring areas; (3)relative effects of anchoring versus mooring on the bottom; and (3)relative numbers of visitors who would be expected to boat, swim, snorkel, or SCUBA dive under each alternative in different areas of the park, as determined by zones and prescriptions. This information was summarized for each action alternative (Alternatives B, C, and D) and the potential effects on marine and coastal resources were then assessed and compared with Alternative A. Cumulative effects are discussed at the end of this section and address all community subtopics (shallow water coral reef; sand bottom; seagrasses and algal plain; deep reefs and wall reefs; deep water abyssal bottom, and deep water oceanic/pelagic).

The major assumptions used in this analysis were that: (1) potential direct effects on marine and coastal resources would increase according to the number of vessels and visitors that use a given area

of the park; (2) effects on marine resources resulting from park use would be concentrated primarily in the relatively select areas used for moorings or anchoring; (3) installation and use of moorings would have a beneficial effect on marine resources as compared with anchoring because moorings are attached to the bottom by a small device such as a sand screw, which has a very small footprint. Anchors result in repeated disturbance of the bottom every time they are used, affect a larger area of the bottom than moorings, and can drag if not placed properly; (4) despite implementation of NPS management programs of research and monitoring, enforcement, and education and outreach programs, some activities in the park would continue to result in adverse effects on marine and coastal resources. These would include illegal taking of fish and shellfish, accidental or emergency vessel groundings and anchoring, pollutant discharges and releases, and accidental breaking of corals related to swimming, walking in shallow water, snorkeling, and SCUBA diving; and (5) expansion of park management programs would serve to offset the various potentially adverse effects of anchoring, mooring and recreational activities in the park. For example, additional staff proposed under the action alternatives would have a beneficial effect on marine and coastal resources through increased research and monitoring, enforcement, education and outreach, and partnering efforts.

The analysis is based on available published and unpublished scientific papers, agency research reports, planning documents, agency databases and mapping efforts, and consultation with NPS specialists. The area analyzed for possible effects on marine and coastal resources include the marine waters and bottom habitats within the park. The area of possible effect used in the cumulative analysis corresponds to the marine waters and benthic habitats of the park, surrounding waters, and nearshore areas (for example, the eastern end of St. Croix), and for issues such as climate change and temperature effects, the area of affect encompasses the park, while acknowledging that increases in water temperature and other related climate changes are happening on a world-wide scale.

Under all action alternatives, best management practices would be implemented on any proposed park project, and potential adverse effects on marine and coastal resources would be addressed under site-specific mitigation measures identified in environmental assessments tiered to this general management plan/environmental impact assessment. Effects of individual projects on marine and coastal resources would therefore be effectively assessed and mitigation measures employed.

Impact Threshold Definitions

Impact threshold definitions for marine and coastal resources (communities such as shallow coral reef, seagrass and algal plains, sand bottom, deep reef and wall reef, deep water abyssal bottom, and deep water oceanic/pelagic) are as follows:

Negligible: Coral reefs and other marine communities would not be affected or the effects would be at or below the level of detection, and the changes would be so slight that they would not be of any measurable or perceptible consequence to diversity, abundance, or health. Coral reefs and other marine communities would retain adequate ecological integrity to support a full complement of dependent or associated plants and animals.

Minor: Effects on coral reefs and other marine communities would be detectable, although the effects would be localized. Disturbance to individuals may occur, but perceptible changes to the overall abundance and diversity of coral reefs and other marine communities would not be expected. Habitats would retain adequate ecological integrity to support a full complement of dependent or associated plants and animals.

Moderate: Effects on coral reefs and other marine communities would be readily detectable resulting in a small but perceptible reduction in abundance and a decline in species diversity. Actions would result in creation of conditions that would inhibit feeding and decrease substrate availability. Coral reefs and other marine communities would return to natural conditions after initial disturbance and

sufficient habitat would remain functional to support plant and animal populations that are dependent on them.

Major: Effects on coral reefs and other marine communities would be readily detectable resulting in a large and substantial reduction in abundance and a decline in species diversity and abundance. The effects would alter the function of the habitat needed to support coral reefs and other marine communities.

Duration: Short-term: Recovers within one year.
Long-term: Takes more than one year to recover.

Impacts of Alternative A

Shallow Water Coral Reef Community

Alternative A features the continued regulation of anchoring in deep sand within the existing designated anchoring area at West Beach. Since no reefs occur in this part of the park, anchoring would have no adverse effects on the shallow water coral community. Up to eight new moorings for administrative use would be installed under Alternative A, and would be installed in areas that do not impact the shallow water coral community.

Occasional accidental groundings of vessels on shallow coral reefs would continue to occur under Alternative A. The probability of groundings on reefs would be the greatest on shallow reefs in areas north, northwest, and southeast of the island. In these areas, reefs often reach the water's surface posing a navigational safety hazard, as well as a threat of significant ecological damage to these valuable reef habitats should a vessel contact the reef. Marine wildlife such as sea turtles, sting rays, and dolphins can also be inadvertently struck by vessel propellers or hulls. These types of activities would have adverse effects on the shallow water coral community, but are expected to be relatively infrequent. Accidental spills of oil and gasoline from vessels, pollutant discharges and releases (as previously defined) in mooring and anchoring areas would also continue, with resulting adverse effects on water quality and exposure of marine organisms to contaminants.

Under Alternative A, continued snorkeling and SCUBA diving on the coral reefs at the underwater trail and SCUBA moorings, respectively, would continue to have adverse effects resulting from inadvertent touching, bumping, and accidental breaking of coral. Visitors would continue to swim and snorkel in the vicinity of West Beach and would have access to shallow patch reefs located in the vicinity as well as the shallow lagoon. This would result in continued touching, bumping and accidental breaking of corals in patch reefs in these areas.

Effects of anchoring and recreation would occur in a limited area of the park. Existing levels of research and monitoring, enforcement, education, outreach, and partnering efforts would continue. Staff limitations and funding constraints would likely continue into the future, resulting in constraints on the level of staff activity and presence near the shallow reef community. If monitoring results indicated that anchoring and recreation were having adverse effects on the health of the shallow coral reef community, management practices would adapt to reduce, avoid or minimize these effects where possible with existing staff resources and funding. These changes would be made in accordance with the Proclamation and all applicable laws, NPS regulations and management policies.

In summary, under Alternative A, continued authorized and unauthorized vessel anchoring, continued use of moorings, incidental vessel groundings, pollutant discharges and releases, and direct physical contact between snorkelers and SCUBA divers with corals, would result in long-term, moderate adverse effects on the shallow coral reef community in certain areas of the park. Research and monitoring, enforcement, education, outreach, and partnering efforts would likely continue to be constrained by staffing limitations and funding.

Sand Bottom Community

Under Alternative A, anchoring off West Beach would continue to be limited by the NPS to deep sand areas. These areas are dominated by benthic invertebrates and fish associated with the sand bottom community type. Fish, free swimming, can escape the effects of anchors placed in these areas, however there are several species of fishes that make shallow burrows in the sand that will be damaged by anchors. Benthic invertebrates such as *Calianassa* worms that live in deep sand areas can be crushed by anchors placed in the sand, or by anchors that drag across the sand bottom. Shoreline bow and stern anchoring in areas dominated by the sand bottom community would continue at West Beach under Alternative A. Similar effects from anchor drags and bow and stern anchoring on benthic invertebrates would occur in these areas. Installation of a maximum of eight new administrative-use moorings would have minor adverse effects on sand bottom communities through physical disturbance limited in extent by the area affected by the placement of the mooring equipment, and the short term period during installation.

Pollutant discharges and releases would continue to occur in the anchoring and mooring areas, with resulting adverse effects on water quality and marine resources (see also, "Water Resources" section). At West Beach, this would have an adverse effect on the sand bottom community by directly exposing organisms to contaminants in the water column. These types of effects would be expected to be in areas with higher vessel use, with negligible to minor adverse effects.

Snorkeling and SCUBA diving activities would have no effect on sand bottom communities since these types of recreational activities do not result in disturbance of this type of habitat. People walking and swimming in shallow water in the vicinity of West Beach would disturb the sand bottom community in this area. Impact to the high energy, shallow shoreline sand community would be minimal as the dynamics of the area limit permanent plant and animal community establishment. The wash zone in this area consists mainly of invertebrates, ghost crabs and small crustaceans. Shoreline activities (walking, swimming) have minimal disturbance as sandy areas are constantly being changed by tidal cycles and wave action. These types of activities would therefore have an overall minor, adverse effect on the sand bottom communities in the park.

Effects of anchoring and recreation would occur in a limited area of the park. Effects would be minimized by continuation of the existing research and monitoring, enforcement, education, outreach, and partnering efforts. If research and monitoring results indicate that anchoring and recreation were having adverse effects on the health of the sand bottom community, management practices would adapt to reduce, avoid, or minimize these effects. These changes would be made in accordance with the Proclamation and all applicable NPS regulations and management policies.

In summary, under Alternative A, continued authorized and unauthorized vessel anchoring, visitor use such as walking and swimming, and pollutant discharges and releases (as previously defined) within the designated anchoring area, would result in long-term, moderate, adverse effects on the sand bottom community. Research and monitoring, enforcement, education, outreach, and partnering efforts would likely continue to be constrained by staffing limitations and funding.

Seagrass and Algal Plain Community

Anchoring adversely affects seagrasses by destroying their underground system of stems (rhizomes), which in turn causes sediments to destabilize and erode. Some seagrasses, such as turtle grass, have a relatively slow rate of growth, and recovery of damaged stems can take several years. Other species such as manatee grass have a relatively rapid rate of growth. For example, rapid regrowth of this species in the Buck Island channel was observed between 1971 and 1999 (Kendall et al. 2004a). However, over time, continued use of anchors in seagrass beds destroys existing beds and also prevents damaged beds from reestablishing themselves.

Under Alternative A, seagrasses would continue to be protected from effects of anchoring by requiring anchoring in deep sand within the designated area. The ability of park staff to monitor seagrass in the vicinity of the anchoring area, and periodically update permit holders as to where anchoring is appropriate to avoid seagrass impacts would continue to be limited by availability of park staff. The abundance and distribution of seagrasses within the designated area would continue to be affected by natural factors, including waves and currents and movements of sand during periodic storms. Unauthorized and emergency anchoring, both inside and outside the designated anchoring area, would also have a minor adverse effect on seagrasses. Because of staffing limitations, enforcement of anchoring within the designated area is not conducted on a consistent basis. Therefore, adverse effects on seagrasses would likely continue to occur both inside and outside of the designated anchoring area. These types of effects would occur in a limited area of the park, and would affect a small percentage of the total area of seagrasses that are present. NPS would avoid seagrasses when locating a maximum of eight new administrative-use moorings, thereby avoiding impacts where possible. If determined to be necessary for management purposes, minor adverse effects on seagrasses or algal plain communities through physical disturbance would be limited to the period of installation and the footprint of the mooring equipment.

Accidental spills, pollutant discharges or releases (as previously defined) would continue to occur in the designated anchoring area, which would directly expose seagrasses to contaminants in the water column in these areas. These types of effects would occur in a limited area of the park. Research and monitoring, enforcement, education, outreach, and partnering efforts would likely continue to be constrained by staffing limitations and funding. Seagrass cover is very sparse in the mooring area at the underwater trail, so these types of effects would not be expected to occur in this area of the park.

Swimming and snorkeling within the designated anchoring area and the mooring area at the east end of the island would continue at present levels under Alternative A. These types of recreational activities would result in some direct physical disturbance of seagrasses in the designated anchoring area. Because these types of effects would occur in a limited area of the park, they would affect a small percentage of the total area of seagrasses that are present. It is unlikely that snorkeling would have any effect on seagrasses within the mooring area on the east end of the island since seagrass cover is sparse, and these types of activities typically do not adversely affect seagrasses. SCUBA diving does not typically occur in areas where seagrasses are present and is not expected to cause adverse effects.

The algal plain community does not occur in the areas in which anchoring would be allowed. Effects on this community type would be limited to occasional unauthorized, accidental or emergency anchoring in shallow water areas of the back reef.

Existing NPS monitoring, education, outreach, and partnering efforts regarding seagrasses would be maintained under Alternative A. Since these efforts would not be expanded under Alternative A, the potential for adverse effects of anchoring on seagrass beds would likely continue at existing rates, and would not be expected to be reduced compared to existing conditions.

In summary, under Alternative A, continued authorized and unauthorized vessel anchoring, spills, vessel related pollutant discharges and releases within the designated anchoring area, and visitor use activities would result in long-term, moderate, adverse effects on the seagrass community in a limited area of the park.

Deep Reef and Wall Reef Community

Continuation of large vessel access along the northern boundary of the park presents a continued threat from potential oil spills, groundings of large vessels, and illegal dumping of bilge water. These events could potentially affect the deep water and wall reef community, since pollutants could be transferred to these areas through the food chain or by physical circulation patterns. Illegal fishing would likely also continue to occur in deep reef areas. Limitations of available staff and enforcement

under Alternative A would result in continued limitations of enforcement of the regulations and NPS polices. Overall, Alternative A would result in long- and short-term, minor, adverse effects to the deep reef and wall reef community.

Deep Water Abyssal Bottom Community

Deep abyssal depths of 1000 feet occur within ½ to 1 mile of Buck Island making the park one of the only parks with this type of bottom community present. Research of this area of the park is underway, as NPS and the National Oceanographic and Atmospheric Administration have conducted video and multibeam sonar surveys of this area of the park. It is unlikely that human activity in the park would greatly affect this community, however data is not available to quantify existing types of use, number of vessels, or class of vessels in this area of the park. Based on existing information, there would be long- and short-term, negligible adverse, effects on the deep water abyssal bottom community under Alternative A.

Deep Water Oceanic/Pelagic Community

Vessel access along the northern boundary of the park within the deep water oceanic pelagic community would continue to occur under Alternative A. Smaller vessels coming from St Croix or other islands would also continue to have access to this part of the park. Under Alternative A, this community would therefore be subject to a continued threat from illegal fishing of pelagic species, pollutant discharges or releases, or other pollutants from large vessel groundings in shallow water areas with transport of pollutants to deep water communities, and illegal dumping of wastes such as bilge water in deep water areas. Continuation of existing management practices under Alternative A would result in continued limitations of enforcement of the regulations and NPS polices due to limitations in available staff and enforcement efforts in the deep water oceanic/pelagic community due to the distance of travel necessary to enforce park policies. Overall, Alternative A would result in long- and short-term, minor adverse effects on the deep water oceanic/pelagic community.

Cumulative Effects

A variety of past, on-going, and future plans, projects, and actions would have effects on coral reefs and other marine communities within park boundaries. These would include the following:

- Past, on-going, and future permitted and unauthorized anchoring of vessels in areas of deep sand off West Beach in shallow water areas have an adverse affect on sand bottom and seagrass communities in this area. Vessels in the anchoring area would also continue to experience pollutant discharges and releases with associated adverse effects on the seagrass and sand bottom communities. Unauthorized anchoring outside of the designated area would continue to affect corals, seagrasses and sand bottom communities;
- Use of the existing underwater trail moorings and SCUBA moorings would result in continued effects on corals through bumping, breaking and touching of corals in this area, as well as adverse effects on fish and sea turtle behavior. Moored vessels would also continue to result in pollutant discharges and releases with associated adverse effects on the shallow coral community;
- Operation of vessels in the area along the north, northwest and southeast sides of Buck Island where reefs are at or very near the surface would continue to result in occasional accidental vessel groundings on shallow reefs, with adverse effects on corals;
- Maintenance and operation (and initial installation) of the dock, toilets, and picnic facilities at West Beach and Diedrich's Point, and use of the upland trails and observation tower cause limited amounts of erosion to occur on Buck Island. However, based on monitoring by park staff, these actions have had negligible effects on marine and coastal resources. Under Alternative A, no new facilities would be constructed on Buck Island in the future and

therefore there would be no related effects to coral reefs and other marine communities in the park;

- Under the non-native plant removal project, approximately 75 acres or 33 percent of the upland portion of the Buck Island (NPS 2006b; 2010) would be managed to control non-native invasive plants using mechanical removal and chemical herbicides. Control of non-native plant species on Buck Island has had no adverse effects on marine and coastal resources (NPS 2006b), and this would continue to be the case into the future. Removal of other invasive species would also continue to occur as staff and funding allows.
- Natural resources monitoring, research, and documentation would continue to occur as described in Chapters 1 and 3, as well as coordination with agencies, park partners, researchers, and others as staff and funding allows;
- Past fishing practices have had an adverse effect on the mosaic of marine and coastal resources. Implementation of regulations to protect the marine resource has resulted in the beginning or indications of improvement of marine and coastal resources (NOAA 2008). Illegal poaching presently occurs and is likely to be reduced due to enforcement of the Proclamation; and
- Partnering and education and outreach programs would continue to occur on a limited basis dependent on staffing and funding constraints.

Past, on-going, and future actions in the region surrounding the park (St. Croix and surrounding waters) would continue to occur under Alternative A. These include:

- Point- and non-point source pollution from development on St. Croix (siltation, sedimentation, nutrient enrichment, pesticides, and metals);
- Pollutant discharges and releases as defined in the methods section;
- Marine debris originating outside the park and carried into the park;
- Hurricanes and other storms that cause major changes in the structure and function of marine and coastal resources;
- Various forms of diseases such as white and black band disease, as described in Chapter 3;
- African dust (including its relation to disease effects); and
- Temperature increases, sea level rise, acidification, frequency and severity of storms and other changes related to climate change affect coral and other marine organisms in the park. These changes represent challenging major, adverse, cumulative effects that have been created by factors outside the park and occur on a world-wide scale. These and other effects related to climate change are described in the "Cumulative Impact Assessment" section and Appendix D.

Cumulative effects on coral reefs and other marine communities are therefore related to a wide variety of both natural and man-made factors that are interrelated in various complex ways, many of which are still being investigated and debated. The potential interrelationship between all these factors is not completely understood at the present time. The primary goal of research and monitoring by the NPS and other federal agencies and organizations is to develop improved understanding of these relationships, and to use this information to adapt management actions in the park in the most effective manner.

Cumulative effects would be offset to the extent possible via implementation of various NPS enforcement, research and monitoring, and education and outreach efforts. For example, regional implementation of education and outreach programs such as those outlined in Chapter 1 have the potential to benefit coral reefs and other marine communities in the park by promoting awareness of the importance of resource preservation and best management practices. NPS would continue to conduct research and resource research and monitoring under Alternative A. However, due to staffing and funding limitations, there would be no expected increase in the levels of these efforts under

Alternative A. Other plans as identified in Chapter 1 would also be prepared, including a vessel management plan that would specify terms and conditions for vessel use in the park. These plans would be created based on management approaches that maximize protection of resources in the park. Despite all the actions taken by NPS, however, they are likely to be overshadowed by the combined effects of the above factors that are outside NPS control, such as the damaging effects related to climate changes.

In summary, the NPS would therefore continue to conduct research and monitor coral reefs and other marine communities under Alternative A. Current trends of temperature increases, sea level rise, acidification, increased severity of storms and other changes related to climate change affect coral and other marine organisms in the park and would have projected long-term, major, adverse effects that would overshadow management actions taken by the park. Based on scientific studies conducted to date, it is unknown whether recovery of coral populations would be able to outpace the cumulative effects of future damage from hurricanes, bleaching events, temperature increases, sea level rise, acidification, and disease outbreaks. When the beneficial and adverse effects of other past, on-going, and future plans, projects, and activities affecting coral reefs and other marine communities are combined with actions under Alternative A, the resulting cumulative effects would be long-term, major, and adverse.

Conclusions

Under Alternative A, shallow water coral and seagrass and sand bottom communities would continue to be affected by visitor use activities such as boating, swimming, walking in shallow water areas, snorkeling, and SCUBA diving in designated anchoring and mooring areas as well as other areas within the park where recreation occurs. These effects would be associated primarily with touching and bumping of corals and inadvertent coral damage, physical disturbance of sand and seagrass communities by anchors, occasional accidental groundings on reefs, and pollutant discharges and releases from vessels. Contaminants and marine debris originating outside the park also have an adverse effect on coral reefs and other marine communities inside the park. Overall, implementation of management actions under Alternative A would result in long-term, moderate, and adverse effects on shallow water coral and seagrass and sand bottom communities.

Alternative A would have long-term, minor, adverse effects on the deep reef and wall reef community and deep water oceanic/pelagic community and a long-term, negligible, adverse effect on the deep water abyssal bottom community since these communities are so remote.

The NPS would continue to conduct research and monitor coral reefs and other marine communities under Alternative A. Current trends of climate change would have projected long-term, major, adverse effects that would overshadow management actions taken by the park. Based on scientific studies conducted to date, it is unknown whether the recovery of coral populations will be able to outpace the cumulative effects of future damage from hurricanes, bleaching events, and disease outbreaks. When the beneficial and adverse effects of other past, on-going, and future plans, projects, and activities affecting marine and coastal communities are combined with actions under Alternative A, the resulting cumulative effects would be long-term, major, and adverse.

Impacts of Alternative B, the Preferred Alternative

Shallow Water Coral Reef Community

Eventual phase-out of anchoring under Alternative B (with the exception of five designated anchoring locations in deep sand for vessels 91 to 150 feet by permit only) would have no effect on the shallow water coral reef community since anchoring in reefs has never been allowed in the park. Accidental vessel groundings could still occur under Alternative B. Establishment of the Marine Hazard Zone would eliminate use of vessels (except for administrative and research and monitoring purposes) in shallow reefs to the northwest, north and southeast of Buck Island, thereby reducing the potential for

adverse effects of emergency anchoring and/or groundings on the shallow water coral reef community in these areas. This would have a beneficial effect on the shallow water coral reef community. Adverse effects would be minimized through an increase in enforcement staff and patrol activities at the park, establishment of the Marine Hazard Zone, and through an increase in education, outreach, and partnering programs. The effects of an accidental grounding would be long-term, major, and adverse at the point where a grounding occurred; however, the likelihood of such an event would be minimized by the Marine Hazard Zone restrictions on vessel use and increased enforcement and education as to the hazards inherent in this zone.

A maximum of 10 new moorings would be installed southwest of the existing pier under Alternative B. These moorings would be placed in areas of deep sand and low density seagrass cover. Mooring installation would have no effects on the shallow water coral community in this area, since coral reefs are not present. A maximum of 45 new moorings would be installed off West Beach to offset the phased elimination of anchoring under Alternative B. Mooring installation would have no effects on the shallow water coral community in this area, since coral reefs are not present. No new moorings for recreational use would be installed at the east end of the park in the vicinity of the underwater trail under Alternative B. Mooring installation would have no effects on the shallow coral community in this area as a result. Administrative moorings would be installed in areas avoiding shallow water coral reef communities, and would have no adverse effect on these communities.

Under Alternative B, visitors would disembark at West Beach from the 45 moorings via marked beach access channels and/or at the pier. This would allow continued use of the West Beach and pier areas by visitors, similar to Alternative A. Swimming and snorkeling in the vicinity of the sand bottom, seagrass and the nearby shallow water coral communities would continue in the West Beach area. These types of activities are estimated to have minor adverse effects on the shallow water coral reef community in the vicinity of the West Beach similar to those associated with Alternative A, since access to these same areas would be provided from moored vessels under Alternative B.

Visitors using the 10 new moorings southwest of the pier would have increased access to adjacent shallow reefs in the vicinity of the mooring area as compared with Alternative A. This would result in minor adverse effects on reefs in these areas due to the potential for incidental touching and breaking of corals. Continued snorkeling at the underwater trail and SCUBA diving at the SCUBA moorings off the east end of the island would have similar effects as Alternative A on reefs in this area.

Inclusion of a major portion of the southern bank barrier reef in the Marine Hazard Zone would result in more limited uses of this area for recreation. This would result in a beneficial effect on the bank barrier reef by reducing the potential for touching and breaking of coral and by reducing the potential for groundings and damage from propellers. This would have beneficial effects on the shallow water coral reef community in these areas of the park.

Vessel use would continue to result in effects on water quality in the park as described in the "Water Resources" section. Under Alternative B, water quality in the park would be affected by many of the same influences as those described under Alternative A, and the number of vessels that would be accommodated under alternatives A and B would also have similar effects(87 vessels and 72 vessels, respectively). Increased staff proposed for Alternative B would help curb unauthorized pollutant discharges and releases from vessels through increased education and enforcement efforts. These pollutants would have adverse effects on shallow water coral reef communities by exposing marine organisms to contaminants during movement of vessels into and out and staying in the mooring and anchoring areas. Creation of a Marine Hazard Zone under all action alternatives (elimination of vessels in this zone) would significantly decrease the potential for vessel grounding on reefs within the park, reducing the potential for an oil spill within the park boundary. A restriction of vessel size to less than 150 feet in all park waters would also reduce the potential for spills / pollutant discharges and releases in park waters from freighters, tankers, cruise ships, or other large vessels. The effects of

Alternative B on shallow water coral reef communities would be long- and short-term, moderate to major, and beneficial.

Sand Bottom Community

Eventual phase-out of anchoring in the park (with the exception of 5 designated anchoring locations for vessels 91 to 150 feet by permit only, in deep sand) would have a beneficial effect on the sand bottom community off West Beach compared to Alternative A where bow and stern anchoring and anchoring in other deep sand is allowed. The phased elimination of anchoring off West Beach would eventually eliminate anchor drags and other adverse effects associated with off-shore and bow and stern anchoring. Replacing the anchoring area with 45 new moorings at West Beach would cause a short-term, negligible, adverse effect of the sand bottom community during installation. Installation of a maximum of 10 new moorings southwest of the pier would have minor adverse effects on sand bottom communities in this area through physical disturbance limited to the period of installation. Continuation of present mooring practices at the east end of the island would have no adverse effects on the sand bottom community since no new moorings would be installed.

Vessel use would result in minor adverse effects on water quality as described in the "Water Resources" section. Pollutant discharges and releases from vessels could have adverse effects on the sand bottom community in the anchoring and mooring areas similar to Alternative A. However, under Alternative B, these effects would be minimized more effectively as compared with Alternative A, by expansion of the existing park research and monitoring, enforcement, education, outreach, and partnering programs.

In summary, the sand bottom community would benefit from the transition from anchoring to the use of moorings. Installation and use of 45 new moorings at West Beach and 10 new moorings southwest of the pier, continued use of the existing moorings at the underwater trail, and expansion of existing park research and monitoring, enforcement, education, outreach, and partnering programs would have a long-term, moderate to major beneficial effect on the sand bottom community.

Seagrass and Algal Plain Communities

Eventual phase-out of anchoring in the park (with the exception of 5 designated anchorage locations for vessels 91 to 150 feet by permit only) would have a beneficial effect on seagrasses by allowing seagrasses to grow, recover, and expand existing coverage, including the existing anchoring area. Anchors result in repeated disturbance of the substrate and if not placed in deep sand, have the potential for having major adverse effects on seagrasses. Installation of new moorings southwest of the pier would have minor adverse effects on seagrasses in this area through physical disturbance limited to the period of installation.

The abundance and distribution of seagrasses would continue to be affected by periodic storms, waves and currents, and movement of sand, especially during storms. Some emergency anchoring may occur within seagrass beds. Effects on seagrasses and algal plains in these areas would be of lower intensity than Alternative A because management zones, research and monitoring, enforcement, education, outreach, and partnering programs would be expanded under Alternative B.

Pollutant discharges and releases from vessels and recreational use would result in minor adverse effects on water quality in the park as described in the “Water Resources” section. The effects of these pollutants on the seagrass community would be similar to Alternative A. However, under Alternative B, these effects would be minimized more effectively as compared with Alternative A, by expansion of the existing park research and monitoring, enforcement, education, outreach, and partnering programs.

No algal plain community exists in the areas in which anchoring would be allowed or where new moorings would be installed. Alternative B would have no adverse effect on the algal plain community

as a result, and would benefit from increased staffing levels for research and monitoring, enforcement, education, outreach, and partnering programs.

In summary, eventual phase-out of the majority of anchoring throughout the park under Alternative B would have long-term, moderate to major beneficial effects on seagrass and algal plain communities. Expansion of park research and monitoring, enforcement, education, outreach, and partnering programs would be expanded under Alternative B, which would minimize potentially adverse effects associated with vessel use, pollutant discharge and inappropriate anchoring.

Deep Reef and Wall Reef Community

Continuation of ship access along the northern boundary of the park presents a continued threat from potential oil spills during groundings of large vessels and illegal dumping of bilge water, and other pollutant discharges and releases. However, the vessel size limitations (vessels over 151 feet by permit) in the Resource Protection Zone under the action alternatives would allow the NPS to monitor the amount of large vessel traffic, and therefore the potential for these adverse effects to occur in the park, as well as the potential scale of impacts. Spill and grounding events could potentially affect the deep water and wall reef community from other locations, however, since pollutants could be transferred to these areas through the food chain or by physical circulation patterns.

Illegal fishing may continue to occur in deep reef areas. However, enhanced research and monitoring of resources and enforcement activities in the Resource Protection Zone under Alternative B would provide increased awareness as well as enhanced protective measures within park boundaries as compared to Alternative A. Overall, the effects of proposed management actions under Alternative B would be long-term, minor and beneficial.

Deep Water Abyssal Bottom Community

The impacts to the deep water abyssal bottom community would be similar to Alternative A because it is unlikely that human activity would greatly affect this resource. Under Alternative B, however, this community would be included in the Resource Protection Zone, and would be managed to protect all resources, including increased enforcement efforts. Management actions proposed under Alternative B would result in long-term, negligible, beneficial effects.

Deep Water Oceanic/Pelagic Community

Under Alternative B, this community would be included in the Resource Protection Zone, and would be managed to protect these resources. The effects of illegal fishing of pelagic species, pollutant discharges or releases from vessels, releases of oil or other pollutants from large ship groundings in shallow water areas would be similar to Alternative A. However, enhanced research and monitoring of resources and enforcement activities in the Resource Protection Zone within the park would provide knowledge as well as enhanced protective measures within park boundaries. Overall, Alternative B would have long-term, minor, beneficial effects to the deep water oceanic / pelagic community.

Cumulative Impacts

The NPS would conduct research and monitor marine and coastal communities under Alternative B, providing additional protective measures. Implementation of proposed plans, and increased staffing levels would provide increased research and monitoring, enforcement and outreach efforts. However, similar to Alternative A, the current trends of climate change would have projected long-term, major, adverse effects that would overshadow management actions taken by the park. Based on scientific studies conducted to date, it is unknown whether the recovery of coral populations and other communities will be able to outpace the cumulative effects of future damage related to climate changes such as hurricanes, bleaching events, and disease outbreaks. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting marine and coastal

communities are combined with actions under Alternative B, the resulting cumulative effects would be long-term, major, and adverse.

Conclusions

Under Alternative B, eventual phase-out of the majority of anchoring in the park would result in a major beneficial effect on marine and coastal communities. Installation of moorings would allow continued visitor access to the island and beach areas, while protecting seagrasses and sand bottom communities from recreational activities. Some adverse effects associated with visitor use on shallow water coral, seagrass and sand bottom communities would occur. The overall effect of Alternative B on the shallow water coral community, sand bottom community, and seagrass community and algal plain would be long-and short-term, moderate to major, and beneficial.

The effects of Alternative B on the deep reefs and wall reefs community would be long-term, minor, and beneficial and the deep water abyssal bottom community would be long-term, negligible and beneficial. The effects of Alternative B on deep water oceanic/pelagic community would be long-term, minor, and beneficial.

Although the effects of management actions proposed under Alternative B differ from Alternative A, the major adverse effects of climate change overshadow the management actions proposed by the park. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting marine and coastal communities are combined with actions under Alternative B, the resulting cumulative effects would be long-term, major, and adverse.

Impacts of Alternative C

Shallow Water Coral Community

The effects related to anchoring on the shallow water coral community would be similar to Alternative A since anchoring would not be allowed in areas inhabited by shallow coral reefs under Alternative C. Bow and stern anchoring at West Beach would not directly affect coral reefs, which are located at some distance to the north of this area. Some emergency anchoring on shallow reefs elsewhere in the park may occur, however.

Establishment of the Marine Hazard Zone would eliminate use of vessels in shallow reefs to the northwest, north and southeast of Buck Island, thereby reducing the potential for adverse effects of emergency anchoring and/or groundings on the shallow water coral reef community in these areas. Inclusion of a major portion of the southern bank barrier reef in the Marine Hazard Zone would result in more limited uses of this area for recreation. This would result in a beneficial effect on the bank barrier reef by reducing the potential for touching and breaking of coral and by reducing the potential for groundings and damage from propellers. This would have beneficial effects on the shallow water coral reef community in these areas of the park. Adverse effects would be minimized through an increase in enforcement staff and patrol activities at the park, establishment of the Marine Hazard Zone, and through an increase in education, outreach, and partnering programs compared to Alternative A. The effects of an accidental grounding would be long-term, major and adverse at the point where a grounding occurred; however, the likelihood of such an event would be minimized by the Marine Hazard Zone restrictions on vessel use and increased enforcement and education as to the hazards inherent in this zone.

Under Alternative C, visitors would disembark at West Beach from the 45 moorings via marked beach access channels and/or at the pier, or designated Anchoring Zone. This would allow continued use of the West Beach areas by visitors, similar to Alternative A. Swimming and snorkeling in the vicinity of the sand bottom, seagrass and the nearby shallow water coral communities would continue in the West Beach area. These types of activities are estimated to have adverse effects on the shallow water coral reef community to the north of West Beach similar to those associated with Alternative A, since

access to these same areas would be provided by a similar number of vessels and therefore visitors to nearby shallow water coral communities (92 vessels under Alternative C, compared to 87 vessels under Alternative A).

Visitors using the 10 new moorings southwest of the pier would have improved access to adjacent shallow reefs in the vicinity of the mooring area as compared with Alternative A. This is not expected to increase snorkeling activity on the shallow reefs east of the pier.

Vessel use would continue to result in effects on water quality in the park as described in the "Water Resources" section. Under Alternative C, water quality in the park would be affected by many of the same influences as those described under Alternative A, and the number of vessels that would be accommodated under alternatives A and C would also have similar effects(87 vessels and 92 vessels, respectively). Increased staff proposed for Alternative C would help curb unauthorized vessel pollutant discharges and releases through increased education and enforcement efforts. These pollutants would have adverse effects on shallow water coral reef communities by exposing marine organisms to contaminants during movement of vessels into and out, and staying in mooring and anchoring areas.

In summary, the overall effects of management actions under Alternative C on the shallow water coral reef community would be long-and short-term, negligible, and beneficial, due to the establishment of the Marine Hazard Zone and other management zones and additional resource protective measures enforced by an increased workforce.

Sand Bottom Communities

Under Alternative C, use of moorings and limitation of anchoring to a two-acre Anchoring Zone located immediately adjacent to West Beach, primarily for bow and stern anchoring, would minimize the effects of disturbance on the sand bottom community as compared with Alternative A, which features an approximately 22-acre anchoring area. Effects of moorings on the sand bottom community would be beneficial compared to anchoring that would be phased out in the anchoring area provided under Alternative A. Anchors result in repeated disturbance of the substrate and if not placed in deep sand, have the potential for having major adverse effects on sand bottom communities. Installation of new moorings southwest of the pier would have minor adverse effects on sand bottom communities in this area through physical disturbance limited to the period of installation. Sand bottom communities would continue to be affected by periodic storms, waves and currents, and movement of sand, especially during storms.

Pollutant discharges and releases from recreational vessel use would result in minor adverse effects on water quality in the park as described in the “Water Resources” section. The effects of these pollutants on the sand bottom community would be similar to Alternative A based on the number of vessels. However, under Alternative C, these effects would be of lower intensity because management zones, research and monitoring, enforcement, education, outreach, and partnering programs would be expanded under Alternative C.

In summary, the expansion of park research and monitoring, enforcement, education, outreach, and partnering programs under Alternative C would minimize potentially adverse effects associated with vessel use, pollutant discharge and inappropriate anchoring. Overall, Alternative C is estimated to have long-term, minor, adverse effects on the sand bottom community.

Seagrass and Algal Plain Communities

Shoreline bow and stern anchoring would be appropriate within the Anchoring Zone at West Beach. Since no seagrasses or algal plains occur in the Anchoring Zone, bow and stern anchoring would have no adverse effects on these communities under Alternative C. Installation of new moorings off West Beach and southwest of the pier would have minor adverse effects on seagrasses in this area through

physical disturbance limited to the period of installation. The phasing out of anchoring off West Beach would have beneficial effects on the seagrasses in this area, by allowing them to grow, recover and expand existing coverage.

The abundance and distribution of seagrasses would continue to be affected by periodic storms, waves and currents, and movement of sand, especially during storms. Some emergency or unauthorized anchoring may occur within seagrass beds. Effects on seagrasses and algal plains in these areas would be of lower intensity than Alternative A because management zones, research and monitoring, enforcement, education, outreach, and partnering programs would be expanded under Alternative C.

Effects of changes in water quality on seagrass and algal plain communities resulting from recreational activities would be similar to Alternative A, except Alternative C would accommodate more vessels, with a slightly higher potential for adverse effects of vessel discharges and releases. Expanded research and monitoring, enforcement, education and outreach programs would result in minimization of these effects, however. Overall, Alternative C is estimated to have long-term, moderate to major, beneficial effects on seagrass communities.

No algal plain community exists in the areas in which anchoring would be allowed or where new moorings would be installed. Alternative C would have no adverse effect on the algal plain community as a result, and would benefit from increased staffing levels for research and monitoring, enforcement, education, outreach, and partnering programs.

In summary, eventual phase-out of the majority of anchoring in the park under Alternative C and expanding park research and monitoring, enforcement, education, outreach and partnering efforts with increased staffing levels would result in long-term, moderate to major beneficial effects on seagrass and algal plain communities.

Deep Reef and Wall Reef Community

The effects of Alternative C on the deep reef and wall reef community would be the same as Alternative B. Management actions proposed under Alternative C would result in long-term, minor, beneficial effects.

Deep Water Abyssal Bottom Community

The effects of Alternative C on the deep water abyssal bottom community would be the same as Alternative B. Overall, management actions proposed under Alternative C would result in long-term, negligible, beneficial effects to the deep water oceanic / pelagic community.

Deep Water Oceanic/Pelagic Community

The effects of Alternative C on the deep water oceanic/pelagic community would be the same as Alternative B. Overall, management actions proposed under Alternative C would result in long-term, minor, beneficial effects to the deep water oceanic / pelagic community.

Cumulative Effects

The cumulative effects of Alternative C on marine and coastal resources would be the same as those described for Alternative B. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting marine and coastal communities are combined with actions under Alternative C, the resulting cumulative effects would be long-term, major, and adverse.

Conclusions

Under Alternative C, use of moorings and limitation of anchoring to a two-acre Anchoring Zone located at West Beach and large vessel anchoring in deep sand would minimize the effects on marine and coastal resources as compared with Alternative A. NPS management zones and expanded park

research and monitoring, enforcement, education, outreach and partnering efforts with increased staffing levels would result in long-term, beneficial effects to marine and coastal resources. When compared to Alternative A, the overall effect of management actions under Alternative C to shallow water coral reef communities would be long- and short-term, negligible and beneficial; for sand bottom communities the effects would be long-term, minor and adverse; for seagrass communities and algal plains, the effects would be moderate to major, and beneficial; for deep reefs and wall reefs, and deep water oceanic/pelagic communities there would be long-term, minor beneficial effects; and for deep water abyssal bottom communities the effects would be long-term, negligible and beneficial.

The cumulative effects of Alternative C on marine and coastal resources would be the same as Alternative B, long-term, major, and adverse.

Impacts of Alternative D

Shallow Water Coral Community

Effects of anchoring under Alternative D on the shallow water coral community would be similar to Alternative A, since no anchoring in areas occupied by coral reefs would be authorized in any management zone. Moorings would not be installed in areas inhabited by shallow water coral reefs and, therefore, would have no adverse effects on the shallow water coral community. Effects of water quality of shallow coral reefs resulting from vessel use would increase relative to the increased number of vessels (25) and visitors, from approximately 87 vessels under Alternative A compared to 112 under Alternative D.

The potential adverse effects of recreation on the shallow water coral community would be of greater intensity then Alternative A relative to a greater number of visitors accommodated under Alternative D by a 16-acre Anchoring Zone, 45 moorings at West Beach as well as 10 new moorings southwest of the pier. Alternative D would therefore result in a greater potential for increased touching, bumping and accidental breaking of coral from visitor use as compared with Alternative A. These activities would have minor adverse effects on the shallow water coral community, as increased staffing would provide additional research and monitoring, enforcement and education efforts that would help offset adverse effects.

The effects of changes in water quality under Alternative D on the shallow water coral community would be greater in intensity compared to Alternative A due to the increased number of vessels mooring and anchoring in the park. Enforcement, research and monitoring, education and outreach programs would be expanded under Alternative D, which would help to offset adverse effects of recreational activities on shallow water coral reefs, yet some adverse effects are likely to occur. Overall, Alternative D is therefore estimated to result in long-term, minor, adverse **effects** on the shallow water coral community compared to Alternative A.

Sand Bottom Community

Under Alternative D, effects of anchoring in a 16-acre Anchoring Zone on the sand bottom communities would be roughly similar to Alternative A, which features a 22-acre anchoring area. Elimination of bow and stern anchoring at the West Beach would have a beneficial effect on the sand bottom community in this area. Installation of 45 moorings off West Beach, and 10 other moorings southwest of the pier would have a moderate adverse effect on the sand bottom community during installation, but mooring use would provide a beneficial effect by minimizing future disturbances of the substrate compared to anchor related disturbances. Expanded recreational opportunities provided by a 16-acre anchoring zone and additional moorings would increase the potential for adverse effects of recreational activities and disturbance of the sand bottom community. Enforcement, research and monitoring, education and outreach programs would be expanded under Alternative D, which would help to offset adverse effects of recreational activities on sand bottom communities. Effects of water quality on the sand bottom community resulting from vessel use would

be of greater intensity compared to Alternative A due to the increased number of vessels that may anchor and/or moor. Overall, because of the nature of the offsetting impacts of moorings and additional research and monitoring, enforcement and outreach management actions taken under Alternative D, the effects to the sand bottom community are estimated to be long-term, minor, and adverse.

Seagrass and Algal Plain Communities

Under Alternative D, effects of anchoring in a 16-acre area on the seagrass community would be similar to Alternative A, which features a 22-acre anchoring area. Elimination of bow and stern anchoring at West Beach would have no effect on the seagrass community since seagrasses are not present in this area. Installation of moorings would have a moderate adverse effect on the seagrass community during the installation period, but mooring use would provide an offsetting beneficial effect by minimizing future disturbances of the substrate. Expanded recreational opportunities provided by a 16-acre anchoring zone (and additional moorings) would increase the potential for adverse effects of physical disturbance of the seagrass community. Enforcement, research and monitoring, education and outreach programs would be expanded under Alternative D, and would help to somewhat offset adverse effects of recreational activities on the seagrass community.

The abundance and distribution of seagrasses would continue to be affected by periodic storms, waves and currents, and movement of sand, especially during storms. Some emergency or unauthorized anchoring may occur within seagrass beds. Effects on seagrasses and algal plains in these areas would be of lower intensity than Alternative A because management zones, research and monitoring, enforcement, education, outreach, and partnering programs would be expanded under Alternative D.

Effects of changes in water quality on seagrass and algal plain communities resulting from recreational activities would be of greater intensity compared to Alternative A, because Alternative D would accommodate more vessels, with a slightly higher potential for adverse effects of vessel pollutant discharges and releases and use of products by visitors. Expanded research and monitoring, enforcement, education and outreach programs would help reduce the intensity of effect. Overall, management actions proposed under Alternative D would result in long-term, moderate, adverse effects on seagrass and algal plain communities.

Deep Reef and Wall Reef Community

The effects of Alternative D on the deep reef and wall reef community would be similar to Alternative B. Although there would be in increase in the number of vessels mooring and anchoring in the park, the visitation to the deep reef and wall reef community is not expected to have the same relative increase. Management actions proposed under Alternative D would result in long-term, minor, beneficial effects.

Deep Water Abyssal Bottom Community

The effects of Alternative D on the deep water abyssal bottom community would be similar to Alternative B. Although there would be in increase in the number of vessels mooring and anchoring in the park, the visitation to the deep water abyssal bottom community is not expected to have the same relative increase. Overall, management actions proposed under Alternative D would result in long-term, negligible, beneficial **effects** to the deep water abyssal bottom community.

Deep Water Oceanic/Pelagic Community

The effects of Alternative D on the deep water oceanic/pelagic community would be similar to Alternative B. Although there would be in increase in the number of vessels mooring and anchoring in the park, the visitation to the deep water oceanic/pelagic community is not expected to have the same

relative increase. Overall, management actions proposed under Alternative D would result in long-term, minor, beneficial **effects** to the deep water oceanic / pelagic community.

Cumulative Effects

The cumulative effects of Alternative D on marine and coastal resources would be the same as those described for Alternative B. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting marine and coastal communities are combined with actions under Alternative D, the resulting cumulative effects would be long-term, major, and adverse.

Conclusions

The effects of management actions proposed under Alternative D on the shallow water coral reef community and sand bottom community would be long-term, minor and adverse. This is primarily due to the increase in numbers of vessels and therefore visitors in the park. Some of the adverse effects would be offset by increased levels of staffing providing increased research and monitoring, enforcement, education, outreach and partnering efforts as compared to Alternative A. Establishing management zones and these same beneficial effects of increased staffing would influence the overall effects to deep reefs and wall reefs, and deep water oceanic/pelagic communities, resulting in long-term, minor beneficial effects. Effects to the deep water abyssal bottom community would be long-term, negligible, and beneficial. Since anchoring would continue to occur and the number of vessels and associated visitors would increase under Alternative D, the effects to the seagrass community and algal plain would be long-term, moderate, and adverse.

Cumulative effects of Alternative D on coral reefs and other marine communities would be the same as Alternative B, long-term, major, and adverse.

FISH/AQUATIC LIFE

This section assesses the potential effects of the alternatives on finfish and other forms of aquatic life. Other forms of aquatic life are defined as spiny lobsters (*Panulirus argus*), queen conch (*Strombus gigas*) and long-spined sea urchins (*Diadema antillarum*) as summarized in the Chapter 3. Spiny lobsters are included in the impact assessment because they are an important sport and commercial fisheries species in the area surrounding the park. As a marine reserve in which no extractive uses of any type are allowed, the park serves to help replenish this resource. The queen conch has been included for the same reason. Long-spined sea urchins are included as a resource in the general management plan because historically sea urchins are a major factor in controlling algae growth on coral reefs without which algae will inhibit coral recruitment, can smother corals, and disrupt reef recovery. Long spined urchin populations are still low at the present time due to Caribbean-wide urchin die-off in the 1980's. They are included because of their ecological importance to reef recovery. A discussion of effects of the alternatives on Essential Fish Habitat is included in a separate subsection.

Regulations and Policies

The regulations and policies that guide the NPS actions with respect to fish and aquatic life are presented in Appendix B.

Methods

The same methods presented in the "Marine and Coastal Resources" subsection are applicable to fish / aquatic life. All extractive uses of fish and aquatic life are prohibited throughout the park, and this requirement would be continued under all alternatives, with long-term beneficial effects as fish and other aquatic life populations continue to recover, as described in Chapter 3. Continued recovery of fish/ aquatic populations in the park is part of the existing condition under all management actions. As described in Chapter 1, this analysis does not address the impacts of establishing the marine reserve.

This evaluation addresses the change that would occur related to management actions proposed under each action alternative (B, C and D) compared to the No Action Alternative (A), or continuation of current management practices. The geographic area assessed includes the waters within the park boundary; the region is defined as waters surrounding St. Croix unless otherwise noted. Past, on-going and future projects and actions addressed under cumulative effects are the same as those presented under the "Marine and Coastal Resources" section.

Impact Threshold Definitions

The thresholds to determine the intensity of impacts on fish/aquatic life are defined as follows:

Negligible: The waters and substrates that define the habitat for fish and aquatic life would not be affected or the effects would be at or below the level of detection, and the changes would be so slight that they would not be of any measurable or perceptible consequence to the fish and aquatic life.

Minor: Effects to waters and substrates that define the habitat for fish and aquatic life would be detectable. Individuals of fish and aquatic life populations that depend on the habitat may be affected, but it would not be expected to result in substantial population fluctuations.

Moderate: Effects to waters and substrate that define the habitat for fish and aquatic life would be readily detectable, resulting in disruptions or disturbance of small portions of habitat that would alter population size or distribution of fish and aquatic life that depend upon it. The system, however, would return to natural conditions after initial disturbance, and sufficient habitat would remain functional to maintain viable fish and aquatic life populations.

Major: Effects to waters and substrates that define the habitat for fish and aquatic life would be detectable. The effects would result in the loss of the habitat for fish and aquatic life over a large area, thereby altering the function of the habitat and its ability to maintain viable fish and aquatic life populations.

Duration: Short-term: recovers within one year.
Long-term: takes more than one year to recover.

Impacts of Alternative A

Fish

Continuation of the current management practices under Alternative A provides for the continued protection of fish and aquatic life under the Proclamation which prohibits extractive use in the park. Continuation of NPS management actions to enforce the "no take" requirement provides protection to fish populations in the park resulting in long-term beneficial effects. Due to constraints on staffing and funding availability to enforce the no take rule, some illegal poaching/fishing would occur, and would be expected to have minor adverse effects on fish.

Continuation of the existing limited anchoring program under Alternative A would have minor, beneficial effects on fish populations in the park because anchoring would be limited to deep sand habitat and sparse seagrass in a 22 acre area off West Beach (fish populations are characterized by low abundance and diversity in deep sand areas). Likewise, the installation of a maximum of 8 new administrative moorings in deep sand would have short-term, negligible adverse effects on fish. Use of these moorings for research and monitoring purposes would assist park resource specialists in their efforts, resulting in increased knowledge and beneficial effects regarding the management of fish. Continued management efforts limiting anchoring to a 22 acre area of deep sand and seagrass area would result in long-term, minor and beneficial effects to fish. Some adverse effects would occur related to anchor drag and disturbance of sand bottom communities in the anchoring area.

Under Alternative A, fish behavior could be disturbed in the anchoring area and in the vicinity of the moorings at the underwater trail by vessel activity, swimmers, snorkelers, and by SCUBA divers at the

two SCUBA moorings. No quantitative studies of potential adverse effects on fish behavior have been conducted in the park. However, qualitative changes in fish behavior have been documented by the NPS at West Beach that may be associated with inappropriate fish feeding (prohibited in the park). These types of activities would be expected to have negligible adverse effects on fish by altering natural predator/prey conditions.

Continuation of existing vessel use and practices in the park would result in occasional groundings resulting in reef damage from propeller and keel strikes. These types of accidents would result in minor adverse effects on fish habitat and behavior depending on the severity of the occurrence. Changes in water quality as a result of discharges from vessel operations primarily within the anchoring and mooring areas would result in relative minor adverse effects on fish populations.

Habitats for fish would continue to be protected through the use of the anchoring, mooring and law enforcement programs. NPS would continue to monitor and survey fish in and outside the park in cooperation with other agencies and organizations. The park would provide limited education and outreach programs with available staffing and funding. Research and monitoring and educational efforts would help identify and minimize effects of human actions on valuable reef and seagrass habitats that are important to fish for spawning, breeding, and feeding. Under Alternative A, these programs would not be expanded. Enforcing the prohibition of extractive use would continue to be a challenge due to availability of staff, and some amount of illegal fishing would continue to occur. Overall, continuation of existing management practices under Alternative A would have long-term, minor, beneficial effects on fish.

Other Marine Animals (Lobster, Conch, Long-Spined Sea Urchin)

Under Alternative A, anchoring would continue to be allowed in the designated area at West Beach. Spiny lobster live primarily on the reefs or other rocky areas, but during their life cycle, juveniles migrate from mangrove nursery areas off St. Croix through sand bottom areas and seagrass beds across Buck Island Channel to shallow reefs in the park. Some lobsters could therefore be expected to periodically occur within sand bottom areas and seagrass beds within the designated anchoring area. The presence of vessels, swimmers, and snorkelers as well as anchoring activity within designated areas could disturb the migration of some lobsters. However, the overall adverse effects of Alternative A on lobster habitat and migration patterns would be expected to be negligible, since the designated anchoring area is a small portion of the total spiny lobster habitat available. The illegal poaching of lobsters would likely continue to occur based on current constraints to enforcing the no take provision without an expanded enforcement staff. This could result in significant illegal harvesting that could affect future populations of spiny lobster in and outside the park since the species is dependent on a mosaic of habitats over its life cycle.

Based on previous survey results, the anchoring area is not a primary habitat for conch. Seagrasses are a primary habitat for conch, and they are known to occur in adjacent turtle or manatee seagrass areas north and south of the anchoring area, and other locations near the anchoring area. It is unknown if this is due to the visitor presence, illegal harvesting practices, the status of the seagrass coverage in the area, or natural preferences. Anchoring could affect conch habitat by destroying seagrass rhizomes and causing erosion of the substrate. Also, the designated anchoring area represents a small portion of the total conch habitat in the park. Continued anchoring in the designated area would therefore have negligible adverse effects on conch. Illegal poaching of conch would likely continue to occur based on current constraints to enforcing the no take provision without an expanded enforcement staff. This could result in significant illegal harvesting that could affect future populations of conch.

Long-spined sea urchins are present in the park, but are at low population levels compared to historic conditions as a result of abrupt decline in the 1980s brought about by disease and other unidentified factors. This species lives primarily on reefs and feeds mainly on attached algae in these areas. This species may occur only occasionally in the anchoring area, and leaves the reefs at night to feed on

seagrasses. However, it is not likely to occur in any abundance within the designated anchoring areas, therefore continued anchoring and visitor use in the existing designated areas would have negligible adverse effects on the long-spined sea urchin.

Installation of new administrative moorings would not adversely affect conch, lobster or long-spined sea urchins. These moorings would provide a means for consistent monitoring and meet park research needs that would benefit fish and aquatic life.

Recreational use of the park in areas inhabited by lobster, conch and long-spined sea urchins would continue in the present manner under Alternative A. Potential effects of recreational use would include direct disturbance of animals as a result of contact with swimmers, vessels, snorkelers and SCUBA divers, and effects of pollutant discharges and releases from vessels within the mooring and anchoring areas or in the vicinity of accidental groundings. Direct contact with swimmers and other water recreational activities could have adverse behavioral effects on lobsters and conchs. However, these effects would be limited to the anchoring area and the mooring area at the underwater trail. Because these are relatively small areas in relation to the total habitat for these species available in the park, direct effects of contact with visitors is expected to have negligible adverse effects on lobster, conch and long-spined urchins.

Changes in water quality in the park would continue as a result of pollutant discharges and releases from vessel operations inside and outside the park. These changes in water quality are estimated to result in negligible adverse effects on lobster, conch and long-spined sea urchin because of the limited extent of the areas that are used for anchoring and mooring, and that these areas are not the prime or preferred habitat for these species.

The effects identified above would be offset by continuation of the existing research and monitoring, enforcement, education, outreach, and partnering programs. Under Alternative A, these programs would not be expanded, however. Enforcing the prohibition of extractive use would therefore continue to be a challenge due to availability of staff, and some amount of illegal taking of lobster and conch would continue. Overall, continuation of existing management practices under Alternative A would have long-term, minor, beneficial effects on lobster, conch and long-spined sea urchins.

Cumulative Effects

Overfishing of fish and shellfish in the St. Croix region and in the area now occupied by the park has occurred in the past, and is therefore included for consideration in this cumulative impact assessment. Since all extractive uses are now prohibited in the park, overfishing within park boundaries by commercial, sport and recreational fishermen does not occur and will not occur in the future. Fisheries in the area surrounding the park will continue to be depleted unless the present trends change. However, establishment of the park as a "no-take" marine reserve will have a beneficial long-term effect on fisheries in the area surrounding the park by helping to replenish these resources. This will amount to a beneficial cumulative effect, assuming the park ecosystems function sufficiently to serve in this role. Although the park cannot reverse the existing trends alone, by functioning as a "no take" marine reserve, it provides a unique opportunity to improve the health of marine and coastal ecosystem in the area. Research and monitoring programs implemented by the NPS and others will reveal the nature of these types of effects on fish and other aquatic life in the park and its effectiveness in replenishment of fish populations in the surrounding area. NPS would continue to conduct research regarding fish and aquatic life under Alternative A with the funds and staff available.

The current trends of temperature increases, acidification, sea level rise and frequency and intensity of storms and other associated climate changes, diseases, and other factors (discussed previously in the methods section for cumulative effects section and Appendix D) would have projected long-term, major, adverse effects that would overshadow management actions taken by the park. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting

fish and aquatic life are combined with continued management actions under Alternative A, the resulting cumulative effects would be long-term, major, and adverse.

Conclusions

Continuation of the existing anchoring program would have a negligible adverse effect on fish and aquatic life in the park because anchoring would be limited to deep sand in a relatively small area off West Beach. Since no new moorings would be installed under Alternative A, mooring installation would have no adverse effects on fish and aquatic life. Recreational activities in the mooring and anchoring areas, including disturbance of fish and aquatic life behavior, and changes in water quality as a result of discharges and releases from vessel operations within the anchoring and mooring areas would result in minor adverse effects on fish and aquatic life. Overall, Alternative A would have long-term, minor, adverse effects on fish and aquatic life. These effects would be offset by enforcement, research and monitoring, education and outreach programs that would be continued, but not expanded, under Alternative A.

The NPS would continue to conduct research and fish and aquatic life under Alternative A. Current trends of climate change, and other factors discussed previously would have projected long-term, major, adverse effects that would overshadow management actions taken by the park. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting fish and aquatic life are combined with actions under Alternative A, the resulting cumulative effects on fish and aquatic life would be long-term, major, and adverse.

Impacts of Alternative B, the Preferred Alternative

Fish

Eventual phase-out of anchoring in the park under Alternative B (with the exception of 5 anchoring sites to be located in deep sand)would have moderate beneficial effects on fish habitat in the designated anchoring area by preventing damage to the sand bottom community and avoiding effects of physical disturbance of seagrasses by anchors. Some accidental groundings would be possible to occur outside the designated deep sand anchoring locations under Alternative B, with minor adverse effects on fish. Elimination of bow and stern anchoring would have negligible beneficial effects on fish habitat at West Beach since this area is characterized by a naturally low fish density and diversity.

Addition of a maximum of 10 moorings to be located southeast of the pier, 45 moorings off West Beach and 8 administrative moorings could affect fish habitat by temporary disturbance of the bottom during mooring installation. However, density and diversity of fish populations are much lower in the sand bottom areas of the park as compared with seagrass beds or coral reefs, and the total area affected by mooring tackle would be small. Therefore, installation of new moorings would have short-term, negligible adverse effects on fish habitat and populations in these areas of the park.

Under Alternative B, fish behavior could be disturbed in the vicinity of the moorings at the underwater trail by vessel activity, swimmers, snorkelers, and by SCUBA divers at the two SCUBA moorings. No quantitative studies of potential adverse effects on fish behavior have been conducted in the park. However, qualitative changes in fish behavior have been documented by the NPS at West Beach that may be associated with inappropriate fish feeding (prohibited in the park). These types of activities would be expected to have negligible adverse effects on fish by altering natural predator/prey conditions.

Elimination of vessels in the Marine Hazard Zone would help minimize the likelihood of groundings and propeller damage on shallow reefs in these areas, thereby avoiding adverse effects to fish and aquatic species, especially in the reefs in the lagoon, areas to the north, northwest and southeast of the island. This change would have a moderate beneficial effect on fish habitat and populations. Inclusion of a large portion of the bank barrier reef in the Resource Protection Zone would help minimize

effects of snorkelers and vessels on coral reef habitat that are used by fish. This change would result in moderate beneficial effects on fish populations.

Changes in water quality in the park as a result of discharges from vessel operations inside and outside the park are estimated to result in minor, adverse effects on fish populations.

In summary, elimination of anchoring in the park under Alternative B would have moderate beneficial effects on fish habitat in the designated anchoring area by preventing damage to the sand bottom and seagrass communities. Some accidental vessel groundings would be possible outside the designated anchoring areas under Alternative B, with minor adverse effects on fish. Elimination of bow and stern anchoring would have negligible beneficial effects on fish habitat at the West Beach since this area is characterized by a naturally low fish density and diversity. Installation of moorings near the pier and at West Beach would have short-term, negligible adverse effects on fish habitat and populations in these areas of the park since little habitat would be disturbed during mooring installation. Elimination of vessels in the Marine Hazard Zone would have a moderate beneficial effect on fish habitat and populations by greatly reducing the likelihood of accidental groundings and vessel use in this zone. Inclusion of a large portion of the bank barrier reef in the Resource Protection Zone would have moderate beneficial effects on fish populations by minimizing effects of vessels.

All of the adverse effects described above would be offset to a greater level than under Alternative A by expansion of the existing research and monitoring, enforcement, education, outreach, and partnering programs provided by an increase in staffing levels and efforts. Enhanced research and monitoring of resources and enforcement activities in the newly created zones within the park would provide knowledge as well as enhanced protective measures within park boundaries, resulting in major, beneficial effects to fish and aquatic life. The increased efforts would provide opportunities for increased knowledge to adapt management actions in the "no take" marine reserve for species protection. Expanding partnering efforts would provide opportunities for increasing stewardship of park resources, particularly given the interrelationships of habitats and species during their life cycles spent both inside and outside the park.

Overall, management actions proposed under Alternative B would have long-term, moderate to major, beneficial effects on fish habitat and populations in the park as compared to Alternative A.

Other Marine Animals (Lobster, Conch, Long-Spined Sea Urchin)

Eventual phase-out of anchoring in the park under Alternative B (with the exception of 5 anchoring sites to be located in deep sand)would have moderate beneficial effects on other marine animals and habitat in the designated anchoring area by preventing damage to the sand bottom community and avoiding effects of physical disturbance of seagrasses by anchors. Elimination of bow and stern anchoring would not adversely affect conch, lobster, or long-spined sea urchins since this area is characterized by a sand bottom that does not provide preferred habitat for lobster, conch, or long-spined sea urchins. Although difficult to assess given the existing condition of the long-spined sea urchins, phasing out anchoring would be expected to have beneficial effects by protecting habitat by eliminating anchor drags and creating less disturbance of bottom conditions. Creating the Marine Hazard Zone would also reduce the likelihood of potential groundings that would protect these reef dwelling animals. Some accidental groundings would be possible to occur outside the designated anchoring sites under Alternative B, with minor adverse effects on habitat for other marine life.

Addition of a maximum of 10 moorings to the southeast of the pier and 45 moorings at West Beach as well as administrative moorings could temporarily affect lobster and conch habitat by disturbing the bottom during mooring installation. However, density and diversity of lobster and conch populations are much lower in the sand bottom areas of the park as compared seagrass beds or coral reefs located elsewhere in the park. NPS would avoid these sensitive areas when locating mooring sites. Therefore, installation of new moorings would have negligible adverse effects on lobster and conch habitat and

populations in these areas of the park. Addition of these moorings would have no adverse effects on long-spined urchin populations, since they are primarily reef dwelling animals, and are uncommon in the mooring areas.

Under Alternative B, elimination of vessels in the Marine Hazard Zone would reduce the likelihood of groundings and propeller damage on shallow reefs in these areas, especially in the reefs in the lagoon on the north shore of the island, and on the reefs southeast of the island. This change would also help reduce illegal take or poaching of lobster and conch in these same areas. This would have a moderate to major beneficial effect on lobster, conch and long-spined sea urchin and habitat in these areas.

Inclusion of a large portion of the bank barrier reef in the Resource Protection Zone would help reduce the effects of snorkelers on lobster, conch and long-spined sea urchins. This would have a minor, beneficial effect on these animals.

Changes in water quality in the park as a result of discharges from vessel operations inside and outside the park are estimated to result in negligible, adverse effects on lobster, conch and long-spined sea urchin habitat and populations.

Recreational use of the park in areas inhabited by lobster, conch and long-spined sea urchins would continue in the present manner under Alternative B. Potential effects of recreational use would include direct disturbance of animals as a result of contact with swimmers, vessels, snorkelers and SCUBA divers, and effects of pollutant discharges and releases from vessels within the mooring and the 5 anchoring sites or in the vicinity of accidental groundings. Direct contact with swimmers and other water recreational activities could have adverse behavioral effects on lobsters and conchs. However, these effects would be limited to the anchoring area and the SCUBA moorings and underwater trail moorings. Because these are relatively small areas in relation to the total habitat for these species available in the park, direct effects of contact with visitors is expected to have negligible adverse effects on lobster, conch and long-spined urchins.

Changes in water quality in the park would continue as a result of pollutant discharges from vessel operations inside and outside the park. These changes in water quality are estimated to result in negligible adverse effects on lobster, conch and long-spined sea urchin because of the limited extent of the areas that are used for anchoring and mooring, and the fact that these animals not common in these areas.

All of the adverse effects described above would be offset by expansion of the existing research and monitoring, enforcement, education, outreach, and partnering programs provided by an increase in staffing levels and efforts under Alternative B compared to Alternative A. Enhanced research and monitoring of resources and enforcement activities in the newly created zones within the park would provide knowledge as well as enhanced protective measures within park boundaries, resulting in major, beneficial effects to marine life. Increased efforts would provide opportunities for increased knowledge to adapt management actions in the "no take" marine reserve for species protection. Expanding partnering efforts with other agencies, organizations and researchers would provide opportunities for increasing stewardship of park resources, particularly given the interrelationships of habitats and species during their life cycles spent both inside and outside the park. Overall, Alternative B would have long-term, moderate to major, beneficial effects on lobsters, conch, long-spined sea urchins, through the phasing out the majority of anchoring, and installation of moorings, establishment of management zones, and increased staffing and research and monitoring, enforcement, education and partnering efforts.

Cumulative Impacts

The NPS would expand the level of research and monitoring of fish and aquatic life under Alternative B due to the increase in park staff and level of effort. Implementation of other plans and activities would provide beneficial effects to park marine resources. Current trends of temperature increases

and other climate changes, hurricanes, disease, and other factors discussed previously in the marine and coastal resources section would have projected long-term, major, adverse effects on coral reefs and associated species in the park. The overall cumulative effect associated with climate change, and in particular water temperature increases on the marine ecosystem is not well understood due to the complexities of the system. The effects of temperature increases and other results of climate changes would overshadow management actions taken by the park under Alternative B. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting aquatic life are combined with actions under Alternative B, the resulting cumulative effects on fish and aquatic life would be long-term, major, and adverse.

Conclusions

Overall, Alternative B would have long-term, moderate to major, beneficial effects on fish and aquatic life (such as lobsters, conch, long-spined sea urchins) through the phasing out the majority of anchoring, and installation of moorings, establishment of management zones, and increased staffing, research and monitoring and research, enforcement, education and partnering efforts.

The NPS would continue to conduct research and monitor fish and aquatic life under Alternative B. Current trends of climate change, hurricanes, disease, and other factors would have projected long-term, major, adverse effects that would overshadow management actions taken by the park under Alternative B. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting aquatic life are combined with actions under Alternative B, the resulting cumulative effects on fish and aquatic life would be long-term, major, and adverse.

Impacts of Alternative C

Fish

Phasing out of the existing 22-acre designated anchoring area under Alternative C (with the exception of 5 anchoring sites to be located in deep sand) and replacement with moorings would have a beneficial effect on fish in this area by elimination of continued physical disturbance of sand bottom and sparse seagrass habitat. Use of the two-acre Anchoring Zone at West Beach would have negligible adverse effects on fish habitat and populations, since this area is characterized by deep sand, and naturally low diversity and densities of fish. Some accidental groundings would be possible to occur outside the designated anchoring areas under Alternative C, with minor adverse effects on fish.

Under Alternative C, fish behavior could be disturbed in the Anchoring Zone and in the vicinity of the moorings as well as at the underwater trail by vessel activity, swimmers, snorkelers and SCUBA divers at the SCUBA moorings. No quantitative studies of potential adverse effects on fish behavior have been conducted in the park. However, qualitative changes in fish behavior have been documented by the NPS at West Beach that may be associated with inappropriate fish feeding (prohibited in the park). These types of activities would be expected to have negligible adverse effects on fish by altering natural predator/prey conditions.

Installation of a maximum of 10 moorings to be located southeast of the pier, 45 moorings off West Beach and 8 administrative moorings could affect fish habitat by temporary disturbance of the bottom during mooring installation. However, density and diversity of fish populations are much lower in the sand bottom areas of the park as compared with seagrass beds or coral reefs, and the total area affected by mooring tackle would be small. Therefore, installation of new moorings would have short-term, negligible adverse effects on fish habitat and populations in these areas of the park. Use of moorings versus anchors would provide long-term, beneficial effects to fish and aquatic life.

Elimination of vessels in the Marine Hazard Zone would help minimize the likelihood of groundings and propeller damage on shallow reefs in these areas, thereby avoiding adverse effects to fish and aquatic species, especially in the reefs in the lagoon, areas to the north, northwest and southeast of the

island. This change would have a moderate beneficial effect on fish habitat and populations. Inclusion of a large portion of the bank barrier reef in the Resource Protection Zone would help minimize effects of snorkelers and vessels on coral reef habitat that are used by fish. This change would result in moderate beneficial effects on fish populations.

Visitor use of moorings and the Anchoring Zone would have a negligible beneficial effect on fish populations in the mooring areas as anchoring is phased out compared to Alternative A because the number of vessels and therefore visitors is similar (92 vessels in Alternative C compared to 87 under Alternative A). The increase of five vessels would have negligible adverse effects on water quality and fish resulting from vessel discharges.

Beneficial effects of the new Marine Hazard Zone and the Resource Protection Zone on fish would be similar to Alternative B, and provide increased protection of reef habitat for fish, decrease the likelihood of vessel groundings, and protect sensitive fish habitats, resulting in long-term, moderate to major beneficial effects.

All of the adverse effects described above would be offset to a greater level than under Alternative A by expansion of the existing research and monitoring, enforcement, education, outreach, and partnering programs provided by an increase in staffing levels and efforts. Enhanced research and monitoring of resources and enforcement activities in the newly created zones within the park would provide knowledge as well as enhanced protective measures within park boundaries, resulting in major, beneficial effects to fish and aquatic life. Increased efforts would provide opportunities for increased knowledge to adapt management actions in the "no take" marine reserve for species protection. Expanding partnering efforts would provide opportunities for increasing stewardship of park resources, particularly given the interrelationships of habitats and species during their life cycles spent both inside and outside the park.

Overall, management actions proposed under Alternative C would have long-term, minor to moderate, beneficial effects on fish habitat and populations in the park as compared to Alternative A.

Other Marine Animals (Lobster, Conch, Long-Spined Sea Urchin)

Phasing out anchoring in the park under Alternative C to all but 2 acres of a bow and stern Anchoring Zone, (with the exception of 5 anchoring sites to be located in deep sand) would have moderate beneficial effects on other marine animals and habitats by preventing damage to the sand bottom community and avoiding effects of physical disturbance of seagrasses by anchors. The 2-acre bow and stern Anchoring Zone would not adversely affect conch, lobster, or long-spined sea urchins since this area is characterized by a sand bottom that does not provide preferred habitat for lobster, conch, or long-spined sea urchins. Although difficult to assess given the existing condition of the long-spined sea urchins, phasing out anchoring would be expected to have beneficial effects by protecting habitat by eliminating anchor drags and creating less disturbance of bottom conditions.

Addition of a maximum of 10 moorings to the southeast of the pier and 45 moorings at West Beach as well as 8 administrative moorings could temporarily affect lobster and conch habitat by disturbing the bottom during mooring installation. However, density and diversity of lobster and conch populations are much lower in the sand bottom areas of the park as compared seagrass beds or coral reefs located elsewhere in the park. NPS would avoid these sensitive areas when locating mooring sites. Therefore, installation of new moorings would have negligible adverse effects on lobster and conch habitat and populations in these areas of the park. Addition of these moorings would have no adverse effects on long-spined urchin populations, since they are primarily reef dwelling animals.

Under Alternative C, elimination of vessels in the Marine Hazard Zone would reduce the likelihood of groundings and propeller damage on shallow reefs in these areas, especially in the reefs in the lagoon on the north shore of the island, and on the reefs southeast of the island. Creating the Marine Hazard Zone would protect these reef dwelling animals. Some accidental groundings would be possible to

occur outside the designated anchoring sites and Anchoring Zone under Alternative C, with minor adverse effects on habitat for other marine life. The Marine Hazard Zone would also help reduce illegal takings of lobster and conch in this zone. This would have a moderate to major beneficial effect on lobster and conch habitat.

Inclusion of a large portion of the bank barrier reef in the Resource Protection Zone would help reduce the effects of snorkelers on lobster, conch and long-spined sea urchins. This would have a minor, beneficial effect on these animals.

Changes in water quality in the park as a result of discharges from vessel operations inside and outside the park are estimated to result in negligible, adverse effects on lobster, conch and long-spined sea urchin habitat and populations, since the number of vessels would be similar to Alternative A.

Recreational use of the park in areas inhabited by lobster, conch and long-spined sea urchins would continue in the present manner under Alternative C. Potential effects of recreational use would include direct disturbance of animals as a result of contact with swimmers, vessels, snorkelers and SCUBA divers, and effects of pollutant discharges from vessels within the mooring and anchoring sites or in the vicinity of accidental groundings. Direct contact with swimmers and other water recreational activities could have adverse behavioral effects on lobsters and conchs. However, these effects would be limited to the anchoring area and the mooring area at the underwater trail. Because these are relatively small areas in relation to the total habitat for these species available in the park, direct effects of contact with visitors is expected to have negligible adverse effects on lobster, conch and long-spined urchins.

All of the adverse effects described above would be offset by expansion of the existing research and monitoring, enforcement, education, outreach, and partnering programs provided by an increase in staffing levels and efforts under Alternative C compared to Alternative A. Enhanced research and monitoring of resources and enforcement activities in the newly created zones within the park would provide knowledge as well as enhanced protective measures within park boundaries, resulting in major, beneficial effects to marine life. The increased efforts would provide opportunities for increased knowledge to adapt management actions in the "no take" marine reserve for species protection. Expanding partnering efforts with other agencies, organizations and researchers would provide opportunities for increasing stewardship of park resources, particularly given the interrelationships of habitats and species during their life cycles spent both inside and outside the park. Overall, Alternative C would have long-term, minor to moderate, beneficial effects on lobsters, conch, long-spined sea urchins, through the reduction in anchoring, and installation of moorings, establishment of management zones, and increased staffing and research and monitoring, enforcement, education and partnering efforts.

Cumulative Effects

The NPS would continue to conduct research and monitor fish and aquatic life under Alternative C. Current trends of climate change, hurricanes, disease, and other factors discussed in the "Marine and Coastal Resources" section would have projected long-term, major, adverse effects that would overshadow management actions taken by the park. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting fish and aquatic life are combined with actions under Alternative C, the resulting cumulative effects on fish and aquatic life would be long-term, major, and adverse.

Conclusions

Overall, Alternative C would have long-term, minor to moderate, beneficial effects on fish, lobsters, conch, long-spined sea urchins, through the reduction in anchoring, and installation of moorings, establishment of management zones, and increased staffing and research and monitoring, enforcement, education and partnering efforts.

The NPS would continue to conduct research and monitor fish and aquatic life under Alternative C. Current trends of climate change would have projected long-term, major, adverse effects that would overshadow management actions taken by the park. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting fish and aquatic life are combined with actions under Alternative C, the resulting cumulative effects on fish and aquatic life would be long-term, major, and adverse.

Impacts of Alternative D

Fish

Creating a 16 acre Anchoring Zone in addition to installation of moorings would provide opportunities for approximately 112 vessels to access Buck Island. Continuation of anchoring off West Beach would be similar to Alternative A with the exception of no bow and stern anchoring. This would disturb less bottom habitat, however, impacts to fish would be considered similar to Alternative A. This is because the former bow and stern anchoring area under Alternative A is characterized by deep sand, and naturally low diversity and densities of fish. Continued limitation of anchoring off West Beach would result in long-term, minor beneficial effects to fish under Alternative D.

Under Alternative C, fish behavior could be disturbed in the Anchoring Zone and in the vicinity of the moorings as well as at the underwater trail by vessel activity, swimmers, snorkelers and SCUBA divers at the SCUBA moorings. No quantitative studies of potential adverse effects on fish behavior have been conducted in the park. However, qualitative changes in fish behavior have been documented by the NPS at West Beach that may be associated with inappropriate fish feeding (prohibited in the park). These types of activities would be expected to have negligible adverse effects on fish by altering natural predator/prey conditions.

Installation of a maximum of 10 moorings to be located southeast of the pier, 45 moorings off West Beach and 8 administrative moorings could affect fish habitat by temporary disturbance of the bottom during mooring installation. However, density and diversity of fish populations are much lower in the sand bottom areas of the park as compared with seagrass beds or coral reefs, and the total area affected by mooring tackle would be small. Therefore, installation of new moorings would have short-term, negligible adverse effects on fish habitat and populations in these areas of the park. Use of moorings versus anchors would provide long-term, beneficial effects to fish and aquatic life. Installation and use of 8 administrative moorings for research and monitoring purposes would assist park resource specialists in their efforts, resulting in increased knowledge and beneficial effects regarding the management of fish.

Elimination of vessels in the Marine Hazard Zone would help minimize the likelihood of groundings and propeller damage on shallow reefs in these areas, thereby avoiding adverse effects to fish and aquatic species, especially in the reefs in the lagoon, areas to the north, northwest and southeast of the island. This change would have a moderate beneficial effect on fish habitat and populations. Inclusion of a large portion of the bank barrier reef in the Resource Protection Zone would help minimize effects of snorkelers and vessels on coral reef habitat that are used by fish. This change would result in moderate beneficial effects on fish populations.

Visitor use of moorings and the Anchoring Zone would have a negligible adverse effect on fish in the area of this zone compared to Alternative A because the number of vessels and therefore visitors is greater (112 vessels in Alternative D compared to 87 under Alternative A). The increase of 25 vessels would have minor adverse effects on water quality resulting from vessel discharges, and the potential to also have adverse effects on fish and aquatic life.

Beneficial effects of the new Marine Hazard Zone and the Resource Protection Zone on fish would be of greater intensity compared to Alternative A without the zones, by providing increased protection of

reef habitat for fish, decreasing the likelihood of vessel groundings, and protecting sensitive fish habitats, resulting in long-term, moderate to major beneficial effects.

All of the adverse effects described above would be offset to a greater level than under Alternative A by expansion of the existing research and monitoring, enforcement, education, outreach, and partnering programs provided by an increase in staffing levels and efforts. Enhanced research and monitoring of resources and enforcement activities in the newly created zones within the park would provide knowledge as well as enhanced protective measures within park boundaries, resulting in major, beneficial effects to fish and aquatic life. Increased efforts would provide opportunities for increased knowledge to adapt management actions in the "no take" marine reserve for species protection. Expanding partnering efforts would provide opportunities for increasing stewardship of park resources, particularly given the interrelationships of habitats and species during their life cycles spent both inside and outside the park.

Overall, management actions proposed under Alternative D would have long-term, minor to moderate beneficial effects on fish habitat and populations in the park as compared to Alternative A.

Aquatic Life (Lobster, Conch, Long-Spined Sea Urchin)

Effects of management actions proposed under Alternative D to aquatic life are similar to Alternative C. Although the number of vessels and relative number of visitors would increase, the overall intensity of effects would be similar due to increased staff levels and management efforts. Therefore, Alternative D would have long-term, minor to moderate, beneficial effects on fish, lobsters, conch, and long-spined sea urchins, through the reduction of anchoring, and installation of moorings, establishment of management zones, and increased staffing, research and monitoring and research, enforcement, education and partnering efforts.

Cumulative Effects

The NPS would continue to conduct research and monitor fish and aquatic life under Alternative D. Current trends of climate change, hurricanes, disease, and other factors discussed previously in the "Marine and Coastal Resources" section would have projected long-term, major, adverse effects that would overshadow management actions taken by the park. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting fish and aquatic life are combined with actions under Alternative D, the resulting cumulative effects on fish and aquatic life would be long-term, major, and adverse.

Conclusions

Effects of management actions proposed under Alternative D to aquatic life are similar to Alternative C. Although the number of vessels and relative number of visitors would increase, the overall intensity of effects would be similar due to increased staff levels and management efforts. Therefore, Alternative D would have long-term, minor to moderate, beneficial effects on fish, lobsters, conch, and long-spined sea urchins, through the reduction of anchoring, and installation of moorings, establishment of management zones, and increased staffing, research and monitoring, enforcement, education and partnering efforts.

The current trends of climate change, hurricanes, disease, and other factors would have projected long-term, major, adverse effects that would overshadow management actions taken by the park under Alternative D. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting fish and aquatic life are combined with actions under Alternative D, the resulting cumulative effects on fish and aquatic life would be long-term, major, and adverse.

ESSENTIAL FISH HABITAT

Guiding Regulations and Policies

The Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267) requires all federal agencies to consult with National Marine Fisheries Service on all actions or proposed actions permitted, funded, or undertaken by the agency that may adversely affect Essential Fish Habitat (EFH). Essential fish habitat is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." "Waters" include aquatic areas and their associated physical, chemical and biological properties. "Substrate" includes sediment underlying the waters. "Necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem. Spawning, breeding, feeding, or growth to maturity covers all habitat types utilized by a species throughout its life cycle. The National Marine Fisheries Service would provide recommendations on conserving essential fish habitat to federal, territory or state agencies for activities that would adversely affect essential fish habitat. The NPS will consult with the National Marine Fisheries Service before any future implementation action is undertaken that may affect essential fish habitat.

Methods

Buck Island Reef National Monument provides essential fish habitat for reef fish, spiny lobster, queen conch, corals, and coral reefs (CFMC 2004). Because the life stages of these species (including pelagic stages) collectively occur in all habitats of the U.S. Caribbean, essential fish habitat at Buck Island Reef National Monument includes coral reefs, hard and soft bottoms, sand/shell bottoms, benthic algae, seagrass, and pelagic waters that may be affected by management alternatives.

The intent of the 1996 Magnuson-Stevens Fishery Conservation and Management Act is to conserve and enhance essential fish habitat and focus conservation efforts on areas that are important to the life cycles of federally managed fish and shellfish. For this document, complying with the Act includes the protection of coral reefs, seagrasses, and hard-bottom habitats that provide refuge, foraging, and breeding areas for fish and shellfish.

Issues were evaluated using information obtained through best professional judgment of park staff. In addition, relevant scientific literature and data was used to assess impacts. In particular, the *Environmental Impact Statement for the Generic Essential Fish Habitat Amendment to Caribbean Fisheries Management Plan* (2004) was used to evaluate impacts to essential fish habitat.

Issues related to essential fish habitat were identified during public and internal scoping. They include: 1) habitat modification/habitat degradation; 2) motorized vessel activity, anchoring, and mooring installation may alter and/or degrade habitat; 3) visitor use of the underwater environment may damage or disturb essential fish habitats; and 4) management zones that restrict access or use could provide enhanced protection of essential fish habitats.

For a detailed analysis of effects of management alternatives and cumulative effects analysis for seagrasses, corals, and fisheries, see the "Marine and Coastal Resources" and "Fish / Aquatic Life" sections of Chapter 4.

Impact Threshold Definitions

As defined by the Magnuson-Stevens Fishery Conservation and Management Act, adverse effects on essential fish habitat are those that reduce the quality or quantity of this habitat by (1) altering the physical, chemical, or biological condition of the waters or substrates; or (2) resulting in the injury or loss of benthic organisms or prey species and their habitat. Adverse impacts are "more than minimal and not temporary in nature" based on an evaluation of the intensity, extent, and frequency of the impact and the type and function of habitat being impacted (50 CFR 600.815[a] [2]). Minimal impacts "are those that may result in relatively small changes in the affected environment and insignificant

changes in ecological functions." Temporary impacts "are those that are limited in duration and that allow the particular environment to recover without measurable impact" (67 FR 2354). Determination of substantial adverse effects "should be based on project-specific considerations, such as the ecological importance or sensitivity of an area, the type and extent of essential fish habitat affected, and the type of activity. Substantial adverse effects are "effects that may pose a relatively serious threat to essential fish habitat and typically could not be alleviated through minor modifications to a proposed action" (67 FR 2367). The thresholds to determine the intensity of impacts on essential fish habitat are defined as follows.

Negligible: The waters and substrates that define the essential fish habitat would not be affected or the effects would be at or below the level of detection, and the changes would be so slight that they would not be of any measurable or perceptible consequence to the essential fish habitat. Fisheries or invertebrate species that depend on these habitats would not be affected. There would be no adverse effect as defined by the Magnuson-Stevens Fishery Conservation and Management Act.

Minor: Effects to waters and substrates that define the essential fish habitat would be detectable, although the effects would be localized, and would be small and essential habitat would not be lost. The function of the habitat for fisheries or invertebrate species would not be affected. Although some individuals' behaviors may be affected, populations of the fish and invertebrate species that use these habitats would not be affected. The adverse effects would be considered minimal as defined by the Magnuson-Stevens Fishery Conservation and Management Act.

Moderate: Effects to waters and substrate of the essential fish habitat would be readily detectable resulting in changes of small portions of habitat and effects would alter some of its function for fisheries or invertebrates that depend on this habitat. This would result in a decline or increase in populations of these fish or invertebrate species in the local area. The adverse effects would be considered minimal as defined by the Magnuson-Stevens Fishery Conservation and Management Act.

Major: Effects to waters and substrates that define essential fish habitats would be widespread. The effects result in the loss or increase of essential fish habitat over a large area and would result in a loss or enhancement of function of the habitat to support fisheries and invertebrate populations resulting in substantial changes in fisheries or invertebrate populations that rely on that habitat. The adverse effects would be considered substantial as defined by the Magnuson-Stevens Fishery Conservation and Management Act.

Duration: Long-term: Species would continue to be affected beyond one year's time, and/or conditions would not be similar to those that predominated previously.

Short-term: The effect would occur only during or shortly after a specified action or treatment. Within a year, conditions would be similar to those that predominated previously.

Impacts of Alternative A

Anchoring would continue in the deep sand areas inside authorized, designated anchoring areas established by the NPS. These areas are permitted for use and are designated by park staff to avoid areas where seagrass and corals occur. Continuation of permitted anchoring would have short-term negligible adverse effects on essential fish habitat that would occur over the life of the plan. Bow and stern anchoring on West Beach would also continue under this alternative and would disturb sand bottom communities in this area. This area of Buck Island is very dynamic in nature and is affected by wind and wave action. As such, marine fish and invertebrates that inhabit, forage or reproduce in this area are also adapted to these highly changing conditions. Because of this dynamic nature it would be expected that bow and stern anchoring that occurs in this area would have short-term, negligible, adverse effects and the area would recover rapidly after vessels are removed.

The potential for illegal and emergency anchoring or groundings in the monument would continue to occur in areas of shallow reefs and seagrasses and hard bottom habitats. These activities could have long-term minor adverse effects in localized areas as larger patches of seagrass and coral reefs take long periods of time to recover from this type of damage or disturbance. In some cases, recovery is not possible. These infrequent and dispersed unauthorized or emergency activities would not be expected to affect the overall abundance and use of the habitat by designated fish and invertebrate species.

Recreational use of the marine environment for snorkeling and SCUBA diving could disturb both the essential fish habitat and the fisheries that rely on those habitats. Scarring of seagrass beds, damage to hard bottom substrates, and loss or damage to coral reefs as a result of recreational vessel use would be long-term and up to moderate in intensity depending on the size of the area affected and the type of coral damaged. In addition, snorkelers and divers can inadvertently damage corals by touching and/or breaking coral and disturbing other habitats. These effects have not been quantified but are mitigated to some degree by boat operator experience and education of visitors of the sensitivity of these habitats to disturbance. These communities take a long time to recover from loss and damage, and in some cases, recovery is not possible. Because of the infrequency of such occurrences, essential fish habitats would continue to function without loss of abundance of designated fish and invertebrate species that depend on the habitat. The impacts would be long-term, minor, and adverse.

NPS enforcement efforts would be expected to continue at existing levels and therefore would not be able to address all illegal fishing or poaching activities within park boundaries. This would result in long- and short-term, moderate, adverse effects as these illegal activities would result in damage to essential fish habitats from techniques such as fish traps, gill nets, grappling, and others. Because of the destructive nature of these activities and the size of the areas affected, there could be localized declines in designated fish and invertebrate species populations.

Cumulative Effects

Essential fish habitat has been and continues to be affected by human induced environmental degradation that results from both fishing and non-fishing related activities such as coastal development and pollution from agricultural and urban land uses. There is no information currently available to define quantitatively the effect of these actions and effects depend also on the sensitivity of the environment. Due to the distance from development activities on St. Croix, and existing current patterns, adverse impacts on essential fish habitat would continue to be expected to be negligible. In fact, the park is used as a background station for comparison of water quality conditions. The following paragraphs describe the conditions which could substantially change the effects from human induced environmental degradation related to development activities on St. Croix.

A number of non-fishing impacts to essential fish habitat include a variety of physical, water quality, and biological effects. The majority of these impacts are directly related to anthropogenic activities that vary across St. Croix, such as dredge and fill operations, urbanization and land development, and industrial and municipal waste. Nutrient loading from agricultural areas and sewage entering the water can severely degrade essential fish habitats. Excess nutrients fuel phytoplankton blooms in the water column, which can contribute to low oxygen events in the water column and bottom sediments, causing fish kills and mortality of fish and non-mobile invertebrates in various habitats. Reduced light availability in the water column from plankton blooms and excessive epiphytic growth impacts the ability of seagrasses to survive and grow. Excess nutrient loading can result in toxic blooms such as red tide.

Activities associated with urbanization (e.g., building construction, utility installation, road and bridge building, storm water discharge) can significantly affect essential fish habitat through habitat loss or modification. Construction activities and removal of vegetation that expose soils to erosion, alter essential fish habitat by increasing sedimentation which prohibits the settlement of corals and other larvae, and inhibits coral ability to feed. Increasing turbidity in the habitat and diminishing light

penetration cause mortality of seagrass and corals and inhibit the ability of visual predators to feed. Development activities also alter the amount of water entering the habitats thereby changing salinity, raising water temperature, and transporting pollutants causing the loss of essential fish habitat. The level of effect of development activity on St. Croix to the surrounding waters has not been fully quantified.

Fishing related impacts to essential fish habitat result from previous use of bottom-disturbing fishing gear such as traps, grappling and gills nets. Commercial or recreational vessel operators also disturb the bottom as a result of accidental groundings, and anchoring. These activities disturb bottom substrates and uproot seagrass. Habitat such as corals and hard bottom can be physically destroyed and water clarity reduced as a result of these activities. The disturbance of soft bottom habitat can alter productivity of benthic microalgae and reduce structural complexity of the bottom (CFMC 2004).

Establishment of comprehensive management plans by National Oceanic Atmospheric Administration National Marine Fisheries Service, conservation efforts by local, territory, and federal agencies, and increased collaboration between agencies have resulted in major long-term beneficial effects on essential fish habitats in the U.S. Virgin Islands that outweigh many of the adverse effects of those activities discussed above. National Oceanic Atmospheric Administration National Marine Fisheries Service management plan for the protection of essential fish habitats and the economically important species that rely on them have ceased or set conservation limits on harvesting over a wide area of the Caribbean. This plan which implements monitoring, sets regulations on harvestable species and types of equipment used, and is adaptive to allow for stricter enforcements and limitations as needed in the future, and has resulted in increases in the size, abundance, and distribution of economically important fish and invertebrate species. This comprehensive management has led and would continue to provide long-term major benefits to essential fish habitats and the species associated with them. Regional actions by territorial and local actions to restore and protect essential fish habitat such as the mangrove restoration project in Salt River Bay and the establishment of the St. Croix East End Marine Park on St. Croix would provide long-term major benefits as well. Protection of essential fish habitats in the St. Croix East End Marine Park in particular has provided protection of important habitats that are used by species which migrate between this location and Buck Island Reef National Monument. Although harvesting of economically important species is permitted within St. Croix East End Marine Park, the limitations set on types of equipment used and size of the catch and the overall preservation of habitat provide great benefits. Protection of these areas and limitations on harvesting of species in the Buck Island Channel would continue to allow for the connectivity between critical sites of the various life stages of important species into the future (CFMC 2004).

The long-term major benefits provided by regional level management plans that would adapt as needed to enhance protection of essential fish habitats and continuing and future efforts to preserve essential fish habitats in large areas of the Caribbean find that the challenge of the recovery of past and present fishing and non-fishing related effects continue. The combined effects of these other actions, projects, and plans would be long-term, moderate, and beneficial. The combined effects of past, on-going, and future actions along with the long-term adverse effects of Alternative A would result in overall long-term, moderate benefits on essential fish habitats within the region. Cumulative effects related to climate change include temperature increase, acidification, sea level rise and increase in frequency and intensity of storms (as described in the marine and coastal resources section and Appendix D). The trends of climate change and the potential effects on coral reef that are designated as essential fish habitat would have projected long-term, major, adverse effects that would overshadow management actions taken by the park. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting the abundance and distribution of essential fish habitat are combined with management actions under Alternative A, the resulting cumulative effects would be long-term, major, and adverse.

Conclusion

Continuing current management actions under Alternative A would result in long- and short-term, minor, adverse effects to essential fish habitat from vessel access and recreational use of the monument and long- and short-term, moderate, adverse level of effect due to illegal anchoring and fishing activities that take place in part due to limitations on enforcement abilities. Overall, the diversity and abundance of designated fish and invertebrate species that rely on the essential fish habitats within the monument would not be adversely affected by management actions.

The cumulative effects of comprehensive management planning, preservation of large areas, and restrictions of harvesting, would outweigh the adverse effects of commercial, recreational, and land use actions occurring with the region. The cumulative effect of these actions combined with effects of Alternative A would be long-term, moderate, and beneficial. Current trends of climate change and the effects on coral reefs as essential fish habitat would have projected long-term, major, adverse effects that would overshadow management actions taken by the park. The resulting overall cumulative effects on coral reef habitats would be long-term, major, and adverse.

Impacts of Alternative B, the Preferred Alternative

Under this alternative, anchoring, including bow and stern anchoring, at West Beach would be phased out, with the exception of 5 anchoring sites located in deep sand. This would have long-term, negligible to minor, beneficial effects on the essential fish habitat off West Beach particularly sand bottom community and seagrass community as seagrass may be able to establish in the anchor area.

Installation of moorings off West Beach in place of the anchoring area would result in negligible short-term, adverse effects on essential fish habitat as the placement of moorings would be conducted in a manner that avoids sensitive habitats such as seagrasses. Short-term effects would include generation of noise and temporary increase in turbidity during installation of mooring equipment. Adult and juvenile fish are highly mobile and would be expected to vacate the area to avoid these impacts and return to the area once turbidity and sounds returned to background levels. Given the size of the area where mooring equipment would be installed, effects to non-mobile species inhabiting the sand bottom would be short-term, negligible and adverse. These activities would not be expected to affect the overall abundance and use of the habitat by designated fish and invertebrate species. Installation of moorings compared to anchoring would provide long-term beneficial effects to seagrass and sand bottom communities as moorings, once installed, do not disturb seagrass and sand bottom communities.

Visitor activities such as snorkeling and SCUBA diving would continue to occur with the potential for damage from touching and inadvertent breaking particularly to hard-bottom and coral reef habitats. However, enhanced visitor education as to the sensitivity of the environments and the enhanced research, monitoring and enforcement of regulations would reduce the level of long-term adverse effect to negligible to minor.

Under this alternative, along with other management zones, the Marine Hazard Zone would be created that would prohibit vessel use and limit the type and variety of visitor activity north and southeast of the island. This zone would eliminate vessel related adverse effects of grounding or accidental anchoring to essential fish habitats such as shallow coral reefs and hard-bottom habitats in the area. In addition, the limitation of vessel size within the Resource Protection Zone would also act to reduce potential impacts of groundings on these sensitive habitats. Development of these zones would have long-term, moderate beneficial effects to essential fish habitat.

Illegal activities such as fishing and anchoring activities would be reduced to a large degree and over a large area as a result of the establishment of management zones that would have a low tolerance for resource degradation and enhanced levels of enforcement of regulations. Although there is a low potential for these illegal actions to still occur, overall, this increased level of enforcement and

protection would represent a long-term, moderate benefit to essential fish habitat and would be expected to result in an increase in designated fish and invertebrate species abundance.

Management actions under Alternative B that include restricting vessel activity in the monument and the size of vessels permitted by zone and the elimination of anchoring and installation of moorings would have long-term minor to moderate beneficial effects. Visitor use of the marine environment would have long-term negligible to minor adverse effects on essential fish habitat. Development of management zones that would enhance protection of essential fish habitat and increased and consistent enforcement of regulations would have overall long-term moderate benefits. Overall, management actions under Alternative B would have long-term, moderate beneficial effects to essential fish habitat and the designated species they support.

Cumulative Effects

Cumulative effects of other projects and plans would be the same as described for Alternative A.

Similar to Alternative A, when combining the effects of comprehensive management, restoration and protection projects, commercial, agricultural, and recreational use that occur in the region with the long-term moderate beneficial effects of Alternative B on essential fish habitat, the overall cumulative effects would be long-term, moderate, and beneficial. However, as described in Alternative A, the effects of global climate change on essential fish habitat would far outweigh these other cumulative effects, resulting in long-term, major, adverse effects to essential fish habitat and the designated species they support.

Conclusion

Alternative B would have long-term moderate beneficial effects on essential fish habitat from elimination of anchoring areas and replacement with moorings, establishment of management zones that restrict or eliminate vessel use, and enhanced protection and preservation of the marine environment. Mooring installation would have short-term negligible adverse effects to essential fish habitat during installation. Overall, the diversity and abundance of designated fish and invertebrate species that rely on essential fish habitat within the monument would increase as a result of management actions.

Similar to Alternative A, when combining the effects of comprehensive management, restoration and protection projects, commercial, agricultural, and recreational use that occur in the region with the long-term moderate beneficial effects of Alternative B on essential fish habitat, the overall cumulative effects would be long-term, moderate, and beneficial. As described in Alternative A, the effects of global climate change on essential fish habitat would far outweigh these other cumulative effects, resulting in long-term, major, adverse effects to essential fish habitat and the designated species they support.

Impacts of Alternative C

Under this alternative bow and stern anchoring would occur in a 2-acre Anchoring Zone in areas of deep sand at West Beach. This activity would disturb sand bottom communities in this area of the monument. As the nature of this environment is dynamic and marine fish and invertebrate species that use this environment have adapted to the highly changeable conditions, the affected area would be expected to return to existing conditions shortly following vessel removal. As in Alternative A, permitted anchoring and bow and stern anchoring under this alternative would have short-term negligible adverse effects on essential fish habitat.

Installation of moorings off West Beach in place of the anchoring area would result in negligible short-term, adverse effects on essential fish habitat as the placement of moorings would be conducted in a manner that avoids sensitive habitats such as seagrasses. Short-term effects would include generation of noise and temporary increase in turbidity during installation of mooring equipment. Adult and

juvenile fish are highly mobile and would be expected to vacate the area to avoid these impacts and return to the area once turbidity and sounds returned to background levels. Given the size of the area where mooring equipment would be installed, effects to non-mobile species inhabiting the sand bottom would be short-term, negligible and adverse. These activities would not be expected to affect the overall abundance and use of the habitat by designated fish and invertebrate species. Installation of moorings compared to anchoring would provide long-term beneficial effects to seagrass and sand bottom communities as moorings, once installed, do not disturb seagrass and sand bottom communities.

Visitor activities such as snorkeling and SCUBA diving would continue to occur with the potential for damage from touching and inadvertent breaking particularly to hard-bottom and coral reef habitats. As in Alternative B, enhanced visitor education as to the sensitivity of the environments and the enhanced monitoring and enforcement of regulations would reduce the level of long-term adverse effect to negligible to minor.

The establishment of a Marine Hazard Zone that would prohibit vessel use, establishment of a Resource Protection Zone, and increased research, monitoring, education and partnering programs, and enforcement of regulations would have the same overall effects on essential fish habitat as described in Alternative B. Management actions under Alternative C including restricting vessel activity in the monument and the size of vessels permitted in management zones would have long-term moderate beneficial effects. Visitor use of the marine environment, anchoring by permit, bow and stern anchoring, and mooring installation would have short- and long-term negligible to minor adverse effects on essential fish habitat. Development of management zones that would enhance protection of essential fish habitats and increased enforcement of regulations would have overall long-term moderate benefits. Overall, Alternative C would have long-term moderate benefits to essential fish habitat and the designated species they support.

Cumulative Effects

Cumulative effects of other projects and plans would be the same as described for Alternative A.

Similar to Alternative A, when combining the effects of comprehensive management, restoration and protection projects, commercial, agricultural, and recreational use that occur in the region with the long-term moderate beneficial effects of Alternative C on essential fish habitat, the overall cumulative effects would be long-term, moderate, and beneficial. As described in Alternative A, the effects of global climate change on essential fish habitat would far outweigh these other cumulative effects, resulting in long-term, major, adverse effects to essential fish habitat and the designated species they support.

Conclusion

Alternative C would have long-term, moderate, beneficial effects on essential fish habitat from establishment of management zones that restrict or eliminate vessel use and enhance protection and preservation of the marine environment. A reduced Anchoring Zone limited to bow and stern anchoring by permit, and mooring establishment would have short-term negligible adverse effects to essential fish habitat. Overall, the diversity and abundance of designated fish and invertebrate species that rely on the essential fish habitat within the monument would increase as a result of management actions. Overall, Alternative C would have long-term moderate benefits to essential fish habitat and the designated species they support.

Similar to Alternative A, when combining the effects of comprehensive management, restoration and protection projects, commercial, agricultural, and recreational use that occur in the region with the long-term moderate beneficial effects of Alternative C on essential fish habitat, the overall cumulative effects would be long-term, moderate, and beneficial. However, as described in Alternative A, the effects of global climate change on essential fish habitat would far outweigh these other cumulative

effects, resulting in long-term, major, adverse effects to essential fish habitat and the designated species they support.

Impacts of Alternative D

Under this alternative anchoring by permit would occur in a 16-acre Anchoring Zone in areas of deep sand that would be slightly smaller than the anchoring area under Alternative A. Locations for anchoring would be designated by park staff to avoid areas where seagrass has established. As in Alternative A, permitted anchoring under this alternative would have short-term negligible adverse effects on essential fish habitat. Installation of moorings in lieu of anchoring would provide beneficial effects to seagrass and sand bottom communities.

Elimination of bow and stern anchoring in the West Beach area under this alternative would have long-term negligible beneficial effects on sand bottom communities and fish and invertebrate species that inhabit this dynamic shoreline area.

Visitor activities such as snorkeling and SCUBA diving would continue to occur with the potential for damage from touching and inadvertent breaking particularly to hard-bottom and coral reef habitats. As in Alternative B, enhanced visitor education as to the sensitivity of the environments and the enhanced research, monitoring and enforcement of regulations would reduce the level of long-term adverse effect to negligible to minor.

The establishment of a Marine Hazard Zone that would prohibit vessel use, establishment of a Resource Protection Zone, and increased education of visitors and enforcement of regulations would have the same overall effects on essential fish habitats as described in Alternative B (long-term, moderate, beneficial). Overall, Alternative D would be expected to result in an increase in designated fish and invertebrate species abundances from protection and preservation of essential fish habitat.

Management actions under Alternative D include restricting vessel size and access by management zone would have long-term moderate beneficial effects. Visitor use of the marine environment, anchoring by permit, and establishment of moorings would have short- and long-term negligible to minor adverse effects on essential fish habitat. Development of management zones that would enhance protection of essential fish habitat and increase enforcement of regulations would have overall long-term moderate benefits. Overall, Alternative D would have long-term, moderate beneficial effects to essential fish habitat and the designated species they support.

Cumulative Effects

Cumulative effects of other projects and plans would be the same as described for Alternative A.

Similar to Alternative A, when combining the effects of comprehensive management, restoration and protection projects, commercial, agricultural, and recreational use that occur in the region with the long-term moderate beneficial effects of Alternative D on essential fish habitat, the overall cumulative effects would be long-term, moderate, and beneficial. As described in Alternative A, the effects of global climate change on essential fish habitat would far outweigh these other cumulative effects, resulting in long-term, major, adverse effects to essential fish habitat and the designated species they support.

Conclusion

Alternative D would have long-term moderate beneficial effects on essential fish habitat from establishment of management zones that restrict or eliminate vessel use and enhance protection and preservation of the marine environment. Anchoring by permit and mooring installation would have short-term negligible adverse effects to essential fish habitat. Elimination of bow and stern anchoring at West Beach would have short-term negligible beneficial effects of sand bottom community. Overall,

the diversity and abundance of designated fish and invertebrate species that rely on the essential fish habitat within the monument would increase as a result of management actions.

The cumulative effects of comprehensive management planning, preservation of large areas, restrictions of harvesting, would outweigh the adverse effects of commercial, recreational, and agricultural actions occurring within the region. The cumulative effect of these actions combined with overall moderate benefits of Alternative D would be long-term, moderate, and beneficial. Current trends of climate change and the effects on essential fish habitat would have projected long-term, major, adverse effects that would overshadow management actions taken by the park. The resulting overall cumulative effects on essential fish habitat would be long-term, major, and adverse.

SPECIES OF CONCERN

Regulations and Policies

The regulations and policies that guide NPS actions with respect to species of concern are presented in the "Servicewide Mandates and Policies" Section of Chapter 1 and in Appendix B. In accordance with 50 CFR 402(a), federal agencies are required to review all actions to determine whether an action may affect listed species or critical habitat. If such a determination is made, formal consultation is required, unless the federal agency determines, with the written concurrence of the U.S. Fish and Wildlife Service or the National Marine Fisheries Service, that the proposed action is not likely to adversely affect any listed species or critical habitat. It is NPS policy to survey for, protect, and strive to recover all native species that are listed under the Endangered Species Act.

Methods

Impacts on special status species were evaluated and determined qualitatively based on the existing literature, professional judgment of NPS staff, South Florida Caribbean Network Inventory and Monitoring Program for Vascular Plant and Vertebrates and Vital Signs, U.S. Fish and Wildlife Service, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Virgin Islands Department of Planning and Natural Resources Division of Fish and Wildlife, and consultants. The primary sources of information used in this analysis include existing literature for each species, park management documents, NPS research and documents, and unpublished observations and insights from knowledgeable park staff and experts. Based on this analysis, anticipated impacts to the federal listed and territory listed species that have the potential to occur within the park are discussed in this chapter. The geographic area analyzed is the area within the park unless otherwise noted.

Federally listed threatened and endangered species addressed include corals (first marine invertebrates listed under the Endangered Species Act), plants (cactus, orchids), and wildlife (marine mammals, birds, and reptiles). Impacts associated with visitor use and facility development (particularly trails) and use are also described under wildlife, marine and coastal resources, and shallow water coral reef community impact topics and would also apply to the species of concern. Therefore, the reader is encouraged to read previous descriptions of activities leading to habitat alteration and disturbances.

Impacts were evaluated by comparing projected changes resulting from the action alternatives to existing conditions and continuation of existing management actions under Alternative A, the No Action Alternative. These evaluations were based on documented occurrences of the species within the park and the distribution of their preferred habitats within the park. Impacts of potential visitation increases related to increased use of vessels in the park have been factored into the analyses.

Cumulative effects are as described in the introduction to this chapter. The cumulative effects of climate change are generally described in the introduction to this chapter and summarized in Appendix D.

The NPS considers how to protect and perpetuate federally and territory listed species during park management planning, and consults with lead federal and territory agencies as appropriate. NPS will, to the greatest extent possible, inventory, monitor, and manage territory-listed species in a manner similar to the treatment of federally listed species.

Impact Threshold Definitions

The thresholds to determine the intensity of impacts on territory listed species of concern are defined in the paragraphs that follow. The U.S. Fish and Wildlife Service Section 7 impact terms are used for federally listed species and are defined following the negligible, minor, moderate, and major terms.

Negligible: No territory-listed species would be affected, or the action would affect an individual of a listed species or its critical habitat, but the change would not be of any measurable or perceptible and would be within the range of natural variability.

Minor: The action would result in detectable impacts to an individual (or individuals) of a territory-listed species or its critical habitat, but they would be within the range of natural variability both spatially and temporally. No interference with feeding, reproduction or other activities affecting population viability would result from impacts. Sufficient functional habitat would remain to support viable populations.

Moderate: An action would result in detectable impacts on individuals or population of a territory listed species, critical habitat, or the natural processes sustaining them. Key ecosystem processes may experience disruptions that may result in population or habitat condition fluctuations that would be outside the range of natural variation (but would return to natural conditions).

Major: Individuals or population of a territory-listed species, critical habitat, or the natural processes sustaining them would be measurably affected. Key ecosystem processes might be permanently altered resulting at the population level and permanently modifying critical habitat.

Duration: Not applicable due to definitions in accordance with U.S. Fish and Wildlife Service terminology.

The Endangered Species Act defines the terms used to assess impacts on listed species as follows. These were applied only to species listed, proposed for listing, or candidate species at the federal level.

No effect/no adverse modification: The alternative and its interrelated and interdependent actions would not directly or indirectly affect listed species or adversely modify designated critical habitat. A "no effect" determination does not include effects that are unlikely to occur.

May affect/not likely to adversely affect or adversely modify critical habitat: Effects on species or designated critical habitat would be discountable (that is, would be extremely unlikely to occur and could not be meaningfully measured, detected, or evaluated) or completely beneficial. Beneficial effects do not take into consideration any balancing of effect, in other words, there cannot be balancing so that the benefits of the action would outweigh the adverse effects.

May affect/likely to adversely affect species or adversely modify critical habitat: An adverse effect on a listed species or designated critical habitat may occur as a direct or indirect result of the action, and the effect is either not discountable or not completely beneficial.

Is likely to jeopardize a listed species/adversely modify designated critical habitat: The action directly or indirectly could jeopardize the continued existence of a species or adversely modify habitat designated as critical to a species.

Impacts of Alternative A

Federally Listed Species

Elkhorn and Staghorn Coral. Elkhorn and staghorn coral are federally listed threatened species that occur in reef systems within the park as described in Chapter 3. Under Alternative A and all action alternatives, the park is used for a variety of appropriate or allowed recreational uses. Vessels traverse the park, anchor and moor at designated areas, and visitors snorkel, swim, SCUBA dive and walk in areas where these species occur.

Under Alternative A (as under all alternatives) anchoring would be in deep sand, therefore, there would be no adverse effects on the shallow water coral reef community, including elkhorn and staghorn coral associated with anchoring in designated areas. Some unauthorized anchoring could occur as a result of accidental groundings or emergency anchoring that could affect elkhorn and staghorn coral.

Vessels moving throughout the park have the potential to damage the shallow water coral community from groundings or propeller damage, especially within the shallow lagoon and areas surrounding Buck Island where patch reefs reach the water's surface. This would result in adverse effects on elkhorn and staghorn corals from direct hits by anchors, propeller scrapes, or anchor drags in the area where it would occur. Hazardous navigating conditions occur in the shallow coral reefs where the reefs reach the surface of the water. Inexperienced vessel operators such as new operators to the area, or those that rent vessels that may not be aware of navigation hazards, may cause major adverse effects to reefs if they were to ground or be required to anchor for emergency reasons.

Continuation of existing management practices under Alternative A would feature continued use of moorings near the underwater trail and the two SCUBA moorings located to the north of Buck Island. Under Alternative A, 8 new administrative moorings would be installed in areas of deep sand, and therefore, would not affect corals. The use of administrative moorings would aid consistency and efficiency in research and park management efforts. The existing underwater trail and SCUBA moorings provide access for visitors to view the underwater qualities of the "marine garden"; these underwater features of the park are significant. With any human interaction with the natural environment, there is an associated impact. Visitors at the underwater trail and SCUBA diving at the SCUBA moorings may cause damage from touching or inadvertently breaking coral. NPS provides training to concessioners and information to visitors regarding the sensitivity of these resources and would continue to do so under Alternative A as a deterrent to damaging corals. NPS would also continue to monitor conditions in the park within the constraints of funding and staff resources.

Under Alternative A, visitors anchored in the West Beach area would continue to swim and snorkel in this area. Some shallow water coral communities, including elkhorn and staghorn coral habitat are located near the anchoring area and are frequented by snorkelers. This continued activity would have adverse effects on elkhorn and staghorn coral through physical disturbance (touching, standing, handling, or breaking corals). Snorkeling and diving on reefs would have adverse effects on elkhorn and staghorn corals resulting from accidental touching and breaking of coral and disturbance of behavior of marine wildlife such as sea turtles and fish.

Studies have indicated correlations between sunscreen products and adverse effects to corals (Danovaro et al. 2008). The potential effects of visitors using these and other products within park waters have not been quantified. Other water quality concerns for corals are related to pollutant discharges and releases from vessel use (as defined in the introduction to this chapter). These are addressed under the "Water Resources" and "Marine and Coastal Resources" sections of this document. Although data are not available to quantify the potential effects from vessel related pollutants associated with normal use and operations are estimated to have negligible adverse effects on elkhorn and staghorn coral.

In summary, under Alternative A, continued authorized and unauthorized vessel anchoring, continued use of moorings, incidental vessel groundings, spills and pollutants from vessels and vessel hulls moving within the park, and direct physical contact between snorkelers and SCUBA divers at the SCUBA moorings with corals in the vicinity of the moorings and anchoring areas would result in adverse, effects on elkhorn and staghorn coral in limited areas of the park. This would equate to a "may affect, likely to adversely affect" determination under the Endangered Species Act Section 7 finding.

These effects would be offset by continuation of the existing monitoring and research, enforcement, education, outreach, and partnering programs. NPS and other agencies involved recognize the need for stewardship of these species and their habitat, and continued access to be able to view these species in the park advances visitor understanding of the importance of resource protection. NPS has coordinated with the National Marine Fisheries Service during the listing of these species, and continues to coordinate coral research and monitoring within park boundaries.

Sea turtles (Green sea turtle, Hawksbill sea turtle, Leatherback sea turtle, and Loggerhead sea turtle). Year round, but intensified during peak sea turtle nesting season, monument staff make every effort to prevent adverse impacts on sea turtles, their nests, and hatchlings by visitors, dogs (which are prohibited, but occur), predation, illegal poaching, and vessel activities in the park. NPS sea turtle research and monitoring efforts would continue to occur, as would partnering, education and outreach efforts.

Visitor access to nesting areas on Buck Island would continue to be restricted during nesting season. Nests laid within or adjacent to high visitor use areas such as picnic areas would continue to be safely relocated. Efforts would be taken to permanently fix picnic tables so that visitors would not inadvertently move them on top of sea turtle nests. Sea turtles would likely continue to avoid areas where visitors frequently occur, such as the underwater trail and anchoring area. Due to the extent of other available habitat, visitor presence would have minor, adverse effects.

The adverse impacts on seagrass beds, benthic algae, and marine invertebrate species from vessel activity and anchoring would be negligible to minor due to restrictions on anchoring locations to deep sand. Shoreline anchoring can pose a threat to sea turtle nests, especially hawksbill nests that are shallow, if laid near the high water line. Sea turtle foraging habitats in other areas such as seagrasses and reefs may be altered due to visitor presence (vessel use, vessel noise, snorkeling, walking in shallow areas or SCUBA diving at the SCUBA moorings), as such this would have minor adverse effects.

The potential for collision with vessels and disturbance from motor vessel activity as sea turtles rest on the surface or surface to breathe is also limited to minor adverse effect due to education regarding sea turtles safety to motor boat operators, and restrictions on vessel speeds when approaching Buck Island. Overall, the actions taken by park staff and other partners, agencies and individuals to protect threatened and endangered sea turtles would continue to have long term benefits, as evidenced by increasing numbers of nesting sea turtles in the park and results of research and monitoring programs.

Continuing the existing management direction would result in conditions that are beneficial to preserving habitat and minimizing impacts on sea turtles. Alternative A may affect but would not be likely to adversely affect threatened and endangered sea turtles.

St. Croix Ground Lizard. Habitat for the federally listed endangered St. Croix ground lizard is typically dry, rocky coastal areas with sandy soils and shrub scrub or forested vegetation communities. NPS has coordinated with the U.S. Fish and Wildlife Service during the successful re-introduction and continued research and monitoring of the St. Croix ground lizard on Buck Island. NPS has conducted a successful mongoose and rat eradication program on Buck Island, continues to monitor, and is also conducting a similar program to monitor and potentially control the European house mouse (*Mus*

musculus). Eradication of these pest species made re-introduction of the St. Croix ground lizard to Buck Island possible. NPS would continue these efforts under Alternative A.

Over time as the ground lizard population on Buck Island is expected to increase and disperse, there may be locations near high visitor use areas such as the picnic areas, restroom, or trails where individual lizards could be adversely affected. However, populations of the lizards currently occur on St. Croix on hotel grounds where they are adjacent to areas subject to high levels of human presence and activity. Although individuals may be disturbed or displaced near picnic areas, the restroom, or trails, there is adequate undisturbed habitat in adjacent areas.

Continuing the current management direction would result in conditions that are beneficial to preserving habitat and minimizing impacts to the St. Croix ground lizard. Alternative A "may affect but would not be likely to adversely affect" the endangered St. Croix ground lizard.

Territory Listed Species

Brown Pelican. The brown pelican is territory-listed endangered species. The nesting area of the brown pelican is not easily accessible to park visitors. Some individual birds may alter their foraging habits during peak visitor use periods; however habitat and prey species are available in areas where visitors are not present. Therefore, there would be short-term, negligible adverse effects.

Least Tern. The least tern is a territory-listed threatened species. The least tern has been known to historically nest on Buck Island. Beachgoers on Buck Island and vessels anchoring on West Beach could adversely affect least terns. The occasional unauthorized presence of dogs on Buck Island, would also have adverse effects on least terns, causing stress, flushing, or nest abandonment. Disturbance by recreational visitors can cause terns to flush from foraging areas, increase stress on individuals or cause nest abandonment that would lead to loss of eggs. Recreational vessel use in the vicinity of Buck Island would not be expected to alter small fish abundance and distributions that terns prey upon. When least terns are present during nesting season, park staff restrict access to the nesting area and provides educational information to visitors of the sensitivity of least terns to disturbance during the nesting period. However, terns have failed to nest successfully on Buck Island in recent years for as yet unknown reasons. This has also occurred on St. Croix.

Should least terns return to nest, there is potential for continued disruption since staff resources for research and monitoring, enforcement of regulations and education are limited under current conditions. Because least terns nest in groups, disturbance would have larger effects than to species that nest individually and adverse effects could translate to the population level. Therefore it is estimated that long-term, minor, adverse effects on the least tern could occur under Alternative A due to visitor use and access.

Territory Listed Plant Species

The territory lists the following plants as endangered: lignum vitae, stinging bush, butterfly orchid, woolly nipple cactus, and Spanish lady. Sensitive plant species on Buck Island could potentially be disturbed by visitor use and access by trampling, uprooting, or in the case of the butterfly orchid and the wooly nipple cactus, individuals could be removed by collectors. Because of the rigorous environment on the island, the limited use of the existing hiking trail and the low potential for creation of unauthorized trails or going off-trail, these types of effects on these species would be unlikely. Continuation of existing management direction would result in conditions that are beneficial to preserving habitat and minimizing impacts to territory listed plant species. Under Alternative A, the effects would be long-term, minor, and beneficial.

Cumulative Effects

Elkhorn and Staghorn Coral. Cumulative impacts are described for Alternative A under the "Marine and Coastal Resources" section and readers are encouraged to refer back to this section for additional

details on the types of impacts resulting from past, on-going, and future projects and activities. NPS would continue to conduct research and monitor elkhorn and staghorn coral under Alternative A as well as continue coordination with the National Marine Fisheries Service.

Changing climate conditions in which coral reefs have lived in the Caribbean for millennia are rapidly changing. Global climate change models predict that for the year 2070, the air temperature in the Caribbean will rise between 2 ° and 4 ºCelsius, with the greatest changes occurring in the northern Caribbean and around continental borders (IAC et al. 2009). Because current levels of sea surface temperature are already close to the upper temperature threshold for the survival of corals, it is projected that for the year 2020, coral bleaching will become an annual event in the Caribbean (IAC et al. 2009). Other impacts include damages caused by hurricanes and storms, which are becoming more frequent, rising sea levels, reduction of potential calcification (increased acidity of water), and diseases. The degree to which these changes will impact elkhorn, staghorn and other corals has yet to be determined.

Current trends of temperature increases, other effects of climate change, hurricanes, disease, and other factors discussed above and under the marine and coastal resources and essential fish habitat sections would have projected long-term, major, adverse effects that would overshadow beneficial management actions taken by the park under Alternative A. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting elkhorn and staghorn coral are combined with actions under Alternative A, the resulting cumulative effects on elkhorn and staghorn coral would be "may affect/ likely to adversely affect."

Sea Turtles (Green sea turtle, Hawksbill sea turtle, Leatherback sea turtle, and Loggerhead sea turtle). Protection of sea turtles from harvesting, poaching, and predation over the past four decades in the U.S. Virgin Islands, has provided major benefits to the populations in the Virgin Islands. In addition, establishment of ocean parks, sanctuaries, refuges, and reserves by federal and territory agencies provide (past, present and future) increased habitat protection for sea turtle nesting and foraging as beaches, seagrass, and coral reefs are preserved. Programs such as those taken on Buck Island Reef National Monument to eradicate and control non-native predators such as mongoose and rats have also provided enhanced protection of nests. Management actions taken by the park continue to contribute to the recovery effort. For example, the average number of Hawksbill sea turtle nests in the park has increased from an average of 12 to an average of 60 per season (Zandy Hillis-Starr, personal communication, 2010).

Although negative trends in recovery are reported for many areas (Nicaragua, Costa Rica, Panama and the Yucatan Peninsula of the Wider Caribbean, the trends for Buck Island Reef National Monument are positive, with recovery after many years of protective actions (IAC et al. 2009). Whereas populations are increasing in the park, similar signs of overall recovery throughout their range despite over a decade of protection are not reported (Mac et al. 1998; IAC et al 2009). Threats include direct take and trade of products, incidental catch and entanglement in discarded fishing gear, coastal development, habitat deterioration, and climate change. Nesting beaches are threatened by development, light pollution, erosion, marine debris, anchoring, and vegetation removal. Nests of sea turtles are impacted by non-native predators, dogs, vehicle traffic, and illegal poaching. These activities have cumulative, widespread, long-term major adverse impacts on sea turtle populations throughout their range. The current trends of climate change as related to effects on habitat and forage for sea turtles (i.e. seagrass, corals, benthic algae, and marine invertebrates) are not completely understood. Increased temperature conditions affect one of the most important sea turtle habitats, coral reefs, by coral bleaching (see also "Marine and Coastal Resources section and elkhorn and staghorn discussion).

Overall programs within the park, other protected areas, and enforcement of regulations to stop harvesting of sea turtles and sea turtle eggs implemented in the U. S. Virgin Islands have resulted in a

rebounding of sea turtle populations with long-term major beneficial effects. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting sea turtles are combined with management actions under Alternative A, the resulting cumulative effects would be "may affect/not likely to adversely affect" sea turtles.

St. Croix Ground Lizard. The recovery program in the Virgin Islands to re-introduce and conserve the St. Croix ground lizard in combination with efforts to reduce or eradicate non-native predators would have long-term major beneficial impacts. Education and volunteer programs supported by private businesses, the territory of the Virgin Islands, and the NPS would continue to promote preservation of the species. Management actions under Alternative A would continue to contribute to the conservation of the species. Overall the cumulative effects on the St. Croix ground lizard would be, "may affect/not likely to adversely affect."Territory Listed Species

Brown Pelican. Establishment of ocean parks, sanctuaries, refuges, and reserves by federal and territory agencies would provide increased nesting habitat and protection of marine habitat that would result in increased fisheries for forage. These activities would have major, long-term benefits. Programs on Buck Island and in other nature preserves and sanctuaries to control or eradicate non-native plants would improve nesting habitat in the region. Efforts to protect mangrove forests and associated estuarine nursery areas on St. Croix and in preserves and refuges within the Virgin Islands would have long-term beneficial effects on the brown pelican populations in the Virgin Islands.

Over harvesting of fish species and degradation of important fisheries habitats has major adverse affects on pelican populations, which readily fluctuate as a result of fish abundance. Development within the region affecting mangrove and fringe mangrove habitats would have long-term, adverse impacts on pelicans due to a loss of nesting habitat and increased potential for pollution of adjacent marine habitats (Nature Conservancy 1998). Human disturbance of nests, poaching activities, and mortalities resulting from fishing with hooks and monofilament lines would have minor adverse effects on the species (USFWS 1995). Regionally, populations appear to be stable, but they are not increasing.

The current trends of climate change and the potential effects on fisheries would have projected long-term, major, adverse effects on the brown pelican that would overshadow management actions taken by the park. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting the brown pelican are combined with management actions under Alternative A, the resulting cumulative effects would be long-term, major, and adverse.

Least Tern. Park staff successfully eradicated and now maintains control of 2 non- native predators, mongoose and tree rats, on Buck Island, which had severely affected the least tern nesting success on the island. These programs and other programs to eradicate or reduce these non-native pests in the region would have long-term moderate benefits.

The establishment of marine protected areas, sanctuaries, and ocean parks by federal and territory agencies, such as the St. Croix East End Marine Park established in 2003, protect and preserve important beach habitat for nesting and enhances small fish prey that least terns feed upon. Increased collaboration with the U.S. Fish and Wildlife Service, U.S. Virgin Islands Coastal Zone Management Program, St. Croix East End Marine Park, and Virgin Island Department of Planning and Natural Resources, Division of Fish and Wildlife to monitor populations and future management actions would further enhance protection of the species based on research and monitoring results as part of collaborative conservation initiatives. These programs to protect and preserve important habitat and forage have long-term major benefits on the least tern population and survival.

Degradation of habitat along beaches due to development and increased recreational use in the area has caused increasing disturbance of nesting birds and avoidance of habitat. Over fishing that continues to occur in the region has resulted in declines of small fish prey. These actions continue to

have long-term major adverse effects on least terns and outweigh the benefits of other programs to preserve and protect least tern habitat. In addition, the current trends of climate change and the potential effects on fisheries would have projected long-term, major, adverse effects that would overshadow management actions taken by the park under Alternative A.

When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting the least tern are combined with management actions under Alternative A, the resulting cumulative effects would be long-term, major, and adverse.

Territory Listed Plant Species

Non-native invasive plant eradication and control program on the island would restore a large portion of the native habitat as exotic plants island-wide are treated. The stinging bush, the wooly nipple cactus, and Spanish lady that inhabit the dry deciduous forest and/or the scrublands on Buck Island would benefit to a moderate level over the long-term due to the high level of habitat restoration. The butterfly orchid would benefit to a lesser degree. Control of non-native plants and restoration efforts undertaken by park staff would continue to have long-term major beneficial impacts on lignum vitae on Buck Island and in the region as this species is protected from extinction.

Development within the region, loss of habitat, infestation by non-native plants and insects, and illegal collecting of plant species continue to degrade populations of these sensitive species in the Virgin Islands resulting in long-term major adverse effects. Overall encroachment and degradation of habitat over large areas of the Virgin Islands outweighs to a moderate degree the restoration and preservation programs on Buck Island, resulting in long-term moderate adverse impacts on sensitive plant species. Management actions under Alternative A contribute little to these overall effects. The overall cumulative effects on sensitive plant species as a result of implementation of Alternative A in combination with other past, on-going and future plans and projects would be long-term, moderate, and adverse.

Conclusions

Continuation of management practices under Alternative A may affect threatened and endangered species within the park and the likelihood of adversely affecting each species varies according to impacts associated with vessel and visitor use and protective management actions taken. Impacts to federally listed species and associated intensity of effect are summarized as follows:

- Elkhorn and staghorn coral: may affect/likely to adversely affect
- Sea turtles: may affect/not likely to adversely affect
- St. Croix ground lizard: may affect/not likely to adversely affect

Territory listed species also have a range of effects dependent on the level of impact associated with vessel and visitor use. Least terns could be disturbed and abandon nests due to recreational activities, resulting in long-term, minor, adverse effects. There would be short term, negligible adverse effects to brown pelicans. Continued protection of territory listed plants would result in long-term, minor, beneficial effects.

The current trends of temperature increases, other effects of climate change, hurricanes, disease, and other factors would have projected long-term, major, adverse effects that in some cases would overshadow management actions taken by the park under Alternative A. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting species of concern are combined with actions under Alternative A, the resulting cumulative effects would vary by species and are summarized below.

- Federal listed elkhorn and staghorn coral: may affect/likely to adversely affect.
- Federal listed sea turtles: may affect/not likely to adversely affect

- Federal listed St. Croix ground lizard: may affect/ not likely to adversely affect
- Territory listed brown pelican: long-term, major and adverse
- Territory listed least tern: long-term, major and adverse
- Territory listed plant species: long-term, moderate, and adverse.

Impacts of Alternative B, the Preferred Alternative

Elkhorn and Staghorn Coral. Eventual phase-out of anchoring under Alternative B (with the exception of 5 designated anchoring locations in deep sand for vessels 91 to 150 feet by permit only) and replacement of anchoring with moorings would reduce the number of vessels (from 87 under Alternative A to 72 under Alternative B), and therefore reduce the number of visitors that would access the park. Phasing out anchoring would not directly affect elkhorn and staghorn coral because anchoring was only authorized in deep sand, however, the reduced number of visitors would proportionally reduce the number of visitors that may be snorkeling, or swimming in areas where elkhorn and staghorn coral occur.

Accidental vessel groundings could still occur under Alternative B, however, establishment of the Marine Hazard Zone would eliminate use of vessels in shallow reefs to the northwest, north and southeast of Buck Island, thereby reducing the potential for adverse effects of emergency anchoring and/or groundings on the shallow water coral reef community where elkhorn and staghorn coral occur. This would have a beneficial effect on elkhorn and staghorn coral. Adverse effects would be minimized through an increase in enforcement staff and patrol activities at the park, establishment of the Marine Hazard Zone, and through an increase in education, outreach, and partnering programs. The effects of an accidental grounding would be long-term, major and adverse at the point where a grounding occurred; however, the likelihood of such an event would be minimized by the Marine Hazard Zone restrictions on vessel use and increased enforcement and education as to the navigation hazards inherent in this zone.

Up to 10 new moorings would be installed southwest of the existing pier under Alternative B. These moorings would be placed in areas of deep sand and low density seagrass cover. A maximum of 45 new moorings would be installed off West Beach to offset the phased elimination of anchoring under Alternative B. Mooring installation would have no effects on the shallow water coral community, since coral reefs are not present in these areas. Administrative moorings would be installed in areas avoiding coral, and would have no adverse effect on elkhorn or staghorn species.

Under Alternative B, visitors would disembark at West Beach from the 45 moorings via marked beach access channels and/or at the pier. This would allow continued use of the West Beach and pier areas by visitors in the Recreation Zone along the shoreline and reef areas in designated areas only, similar to Alternative A. Swimming and snorkeling in the vicinity of the sand bottom, seagrass and the nearby shallow water coral communities would continue in the West Beach area. These types of activities are estimated to have similar types of adverse effects on elkhorn and staghorn coral in the vicinity of the West Beach, but at reduced levels of intensity compared to Alternative A, since there would be fewer visitors. This would result in minor, beneficial effects.

Continued snorkeling at the underwater trail and SCUBA diving at the SCUBA moorings off the east end of the island would have similar effects as Alternative A on elkhorn and staghorn in this area. Increased staff and enforcement under Alternative B, however, would allow additional training of concessioners, education, partnering and enforcement to increase awareness of these sensitive resources and help prevent resource damage.

The elkhorn coral barrier reef is excluded from the Recreation Zone to further protect the threatened species. Inclusion of a major portion of the southern bank barrier reef in the Marine Hazard Zone would result in more limited uses of this area for recreation. This would result in a beneficial effect on

the bank barrier reef by reducing the potential for touching and breaking of coral and by reducing the potential for groundings and damage from propellers. This would have beneficial effects on the elkhorn and staghorn coral.

Vessel use would continue to result in effects on water quality in the park as described in the "Water Resources" section and Alternative A. Under Alternative B, water quality in the park would be affected by many of the same influences as those described under Alternative A, and the number of vessels that would be accommodated under alternatives A and B would also have similar effects(87 vessels and 72 vessels, respectively). Increased staff proposed for Alternative B would help reduce pollutant discharges and releases from vessels through increased education and enforcement efforts. These pollutants would have adverse effects on coral communities by exposing marine organisms to contaminants during movement of vessels into and out, and staying in the mooring and anchoring areas. Creation of a Marine Hazard Zone under all action alternatives (elimination of vessels in this zone) would significantly decrease the potential for vessel grounding on reefs within the park, reducing the potential for an oil spill within the park boundary. A restriction of vessel size in park waters would also reduce the potential for spills/discharges in park waters from freighters, cruise ships, or other large vessels.

The effects of management actions proposed under Alternative B would have less intense effects on eklhorn and staghorn coral than Alternative A, and result in the Section 7 determination of may affect, not likely to adversely affect. NPS would increase efforts regarding monitoring and research, enforcement, education, outreach and partnering under Alternative B compared to Alternative A. NPS would continue to coordinate with the National Marine Fisheries Service regarding the protection of elkhorn and staghorn coral as research and monitoring of the these species continues within park boundaries and adaptive measures are developed. As was described for Alternative A, the NPS recognizes the need for stewardship of these species and their habitat, and continued access to be able to view these species in the park advances visitor understanding of the importance of resource protection.

Sea Turtles (Green sea turtle, Hawksbill sea turtle, Leatherback sea turtle and Loggerhead sea turtle). Protection of sea turtle nesting areas and efforts to reduce impacts on sea turtles from recreational use of the park would have the same effects as described for Alternative A. Under Alternative B, anchoring within the monument would be phased out (with the exception of five designated anchoring locations for vessels 91 to 150 feet in deep sand) and moorings would be established for recreation and management use. The overall number of vessels accessing the park would be reduced under Alternative B compared to Alternative A, which could also reduce the potential for collisions with sea turtles and the number of visitors interacting or disturbing sea turtles, their nests, and hatchlings.

The installation of moorings may cause short-term avoidance of the area by sea turtles during the installation timeframe, but would not have overall long-term adverse effects. Phasing out of anchoring and transition to a mooring system could improve foraging habitat, as seagrasses may re-establish and recover in the area off West Beach. Eliminating bow and stern anchoring would also reduce disturbance to sea turtle nests, especially hawksbill nests that are shallow, if laid near the high water line. Impacts associated with the presence of vessels, vessel noise, swimming, snorkeling, and walking in shallow areas, and SCUBA diving at SCUBA moorings would be similar to Alternative A.

The designation of the Resource Protection and Marine Hazard Zones would have beneficial effects on sea turtles. These zones would provide additional protection of habitat for foraging and cover. Elimination of vessels in the Marine Hazard Zone precludes possible vessel damage to coral reefs where sea turtles seek cover, rest, mate, and also reduces the potential for collisions between vessels and sea turtles as they surface to breathe. Increased staffing, research, monitoring, enforcement, education and outreach would also provide long-term beneficial effects. Management actions,

management zones, and vessel size and use limitations proposed under Alternative B would result in conditions that are beneficial to preserving habitat and minimizing impacts to sea turtles. NPS would continue to coordinate with the National Marine Fisheries Service, U.S. Fish and Wildlife Service, and Territorial Department of Natural Resources Division of Fish and Wildlife on future actions. Alternative B would result in a may affect, not likely to adversely affect finding.

St. Croix Ground Lizard. The types of effects of Alternative B on the St. Croix ground lizard would be the same as those described for Alternative A. While a minimal amount of new trail or kiosk construction is possible under Alternative B, construction would be conducted in a manner to avoid critical habitat. Environmental compliance documentation would be conducted prior to any trail work and measures would be taken to avoid the St. Croix ground lizard, and the NPS would coordinate with the U.S. Fish and Wildlife Service regarding future actions. Therefore, the overall effect of Alternative B would be the same as Alternative A. Alternative B may affect but would not be likely to adversely affect the endangered St. Croix ground lizard.

Territory Listed Species

Brown Pelican. The effects of Alternative B on the brown pelican would be similar to Alternative A. Installation of moorings off West Beach and up to 5 anchoring locations in deep sand for larger vessels would not affect the pelican's prey distribution or abundance. The designation of a Marine Hazard Zone that includes the area north of Buck Island would prohibit vessel use in that area, provide additional area for undisturbed foraging and reduce the potential for vessel activities to disturb nesting. Overall Alternative B would have a long-term, minor, beneficial effect on the territory listed, endangered brown pelican.

Least Tern. Under Alternative B, anchoring at West Beach would be phased out as new moorings are installed. The exception would be installation of five designated anchoring locations for vessels 91 to 150 feet in length. These anchoring sites would be located well off shore in deep water, and would not directly affect least terns. Reduction in anchoring along the West Beach shoreline would reduce the potential for stressing individuals, disruption of nesting behaviors, or flushing and abandonment of nests near West Beach. Park staff would continue to restrict access to nesting areas and provide educational information to visitors of the sensitivity of the species to disturbance during the nesting period. Recreational vessel use under this alternative would not be expected to alter small fish abundance and distributions that are prey for the terns.

Limited new trail or kiosk development that may occur under Alternative B would be conducted to avoid sensitive habitats and sensitive nesting periods of terns resulting in no effect on least terns. Under Alternative B, there would be increased staff resources to enhance research and monitoring, education, and enforcement of regulations for protecting least terns. As such, there would be increased protection of least terns and nesting areas. This would eliminate or reduce the potential for disturbance by recreational use compared to Alternative A and would result in long-term, negligible, adverse effects on the territory listed threatened least tern.

Territory Listed Plant Species

The park would continue their efforts to control non-native, invasive plant species with the same beneficial effects as described under Alternative A. Limited development of new trails and kiosks on Buck Island would be conducted in a manner to avoid locations where sensitive plants occur. Limited trail development could increase visitor use of the interior of the island and increase the potential for spread of non-native plant species into sensitive terrestrial habitats. Steep topography, dangerous plant species, and hot temperatures would limit visitor use of the island's interior, however. Increased educational opportunities under this alternative would improve visitor understanding and appreciation of the monument's sensitive species, which would help prevent or reduce unauthorized

off-trail use. As such, there would be long-term, minor, beneficial **effects** on territory listed plant species.

Cumulative Effects

Effects on special status species from other past, on-going, and future plans and projects would be the same as described for Alternative A. Management actions proposed under Alternative B would likely contribute a relatively small component to these cumulative impacts. The current trends of climate change, hurricanes, disease, and other factors would have projected long-term, major adverse effects on some species of concern that would overshadow management actions taken by the park under Alternative B. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting species of special concern are combined with actions under Alternative B, the resulting cumulative effects would vary by species and are summarized below.

- Federal listed elkhorn and staghorn coral: may affect/likely to adversely affect.
- Federal listed sea turtles: may affect/not likely to adversely affect
- Federal listed St. Croix ground lizard: may affect/not likely to adversely affect
- Territory listed brown Pelican: long-term, major and adverse
- Territory listed least tern: long-term, major and adverse
- Territory listed plant species: long-term, moderate, and adverse.

Conclusions

Overall the enhancement of research and monitoring of special status species and their habitats and enforcement of regulations in the newly designated management zones within the monument and increased educational information that promotes the protection and preservation of these species would have overall long-term, moderate, beneficial **effects**. Management actions proposed under Alternative B would result in a "may affect/not likely to adversely affect" Section 7 finding for federal listed species (elkhorn and staghorn coral, sea turtles, and the St. Croix ground lizard). Least terns could be disturbed and abandon nests due to recreational activities; however increased research and monitoring and enforcement of regulations would reduce this potential resulting in a long-term negligible adverse effect. Under Alternative B there would be long-term, minor, beneficial effects on the brown pelican and territory listed plants.

Effects on special status species from other past, on-going, and future plans and projects would be the same as described for Alternative A. Management actions proposed under Alternative B would likely contribute a relatively small component to these cumulative impacts for some species, and would be overshadowed by effects of climate change, hurricanes, disease, and other factors

Impacts of Alternative C

Elkhorn and Staghorn Coral. The types of effects of management actions under Alternative C on elkhorn and staghorn coral are similar to those described under Alternative B due to the beneficial effects associated with the Marine Hazard Zone, Resource Protection Zone and increased park staff, research, monitoring, enforcement, and education and partnering. Alternative C would continue to provide an Anchoring Zone for bow and stern anchoring, and since this area is deep sand, this designated anchoring location would not affect elkhorn and staghorn coral.

The elkhorn coral barrier reef is excluded from the Recreation Zone to further protect the threatened species. Establishment of the Marine Hazard Zone would eliminate use of vessels in shallow reefs to the northwest, north and southeast of Buck Island, thereby reducing the potential for adverse effects of emergency anchoring and/or groundings on the shallow water coral reef community including elkhorn and staghorn coral. Inclusion of a major portion of the southern bank barrier reef in the Marine Hazard Zone would result in more limited uses of this area for recreation. This would result in

a beneficial effect on the bank barrier reef by reducing the potential for touching and breaking of coral and by reducing the potential for groundings and damage from propellers. This would have beneficial effects on elkhorn and staghorn coral in these areas of the park. Adverse effects would be minimized through an increase in enforcement staff and patrol activities at the park, establishment of the Marine Hazard Zone, and through an increase in education, outreach, and partnering programs compared to Alternative A. The effects of an accidental grounding would be long-term, major and adverse at the point where a grounding occurred; however, the likelihood of such an event would be minimized by the Marine Hazard Zone restrictions on vessel use and increased enforcement and education as to the hazards inherent in this zone.

Under Alternative C, visitors would disembark at West Beach from the 45 moorings via marked beach access channels and/or at the pier, or the designated Anchoring Zone. This would allow continued use of the West Beach areas by visitors, similar to Alternative A. Swimming and snorkeling in the vicinity of the sand bottom, seagrass and the nearby shallow water coral communities would continue in the West Beach area. These types of activities are estimated to have adverse effects on elkhorn and staghorn coral located in proximity to the north of West Beach similar to those associated with Alternative A, since access to these same areas would be provided by a similar number of vessels and therefore visitors to nearby shallow water coral communities where elkhorn and staghorn coral are present (92 vessels under Alternative C, compared to 87 vessels under Alternative A).

Continued snorkeling at the underwater trail and SCUBA diving at the SCUBA moorings on the east end of the island would have similar effects as Alternative A on reefs in this area.

Vessel use would continue to result in effects on water quality in the park as described in the "Water Resources" section. Under Alternative C, water quality in the park would be affected by many of the same influences as those described under Alternative A, and the number of vessels that would be accommodated under alternatives A and C would also have similar effects(87 vessels and 92 vessels, respectively). Increased staff proposed for Alternative C would help reduce pollutant discharges and releases from vessels through increased education and enforcement efforts. These pollutants would have adverse effects on shallow water coral reef communities by exposing marine organisms to contaminants during movement of vessels into and out and staying in mooring and anchoring areas.

In summary, the overall effects of management actions under Alternative C may affect but are not likely to adversely affect federally listed threatened elkhorn and staghorn coral. NPS establishment of the Marine Hazard Zone and other management zones and additional resource protective measures enforced by an increased workforce provide for protection of elkhorn and staghorn coral. NPS would continue to coordinate with the National Marine Fisheries Service regarding the protection of these species as coral research and monitoring continues within park boundaries and adaptive measures are developed. NPS recognizes the need for stewardship of these corals and their habitat, and continued access to be able to view these species in the park advances visitor understanding of the importance of resource protection.

Sea Turtles (Green sea turtle, Hawksbill sea turtle, Leatherback sea turtle and Loggerhead sea turtle). The impacts of management actions of Alternative C on threatened and endangered sea turtles would be the same as Alternative B, including establishment of management zones, limitation on vessel size by management zone, increased staffing, enforcement, research and monitoring. The increased number of vessels and therefore visitors that would be possible under Alternative C compared to Alternative A may cause in increase in the potential for boat strikes, and disturbance of nesting, resting and mating sea turtles. However, this would be offset somewhat by the establishment of management zones, enforcement of speed limits, vessel size limitations, and increased staffing, education and outreach. The Anchoring Zone at West Beach would be somewhat reduced compared to Alternative A, which would also decrease potential disturbances. Management actions under Alternative C would also result in conditions that are beneficial to preserving habitat and minimizing

impacts to sea turtles. Alternative C would result in a "may affect, not likely to adversely affect" Section 7 finding.

St. Croix Ground Lizard. The effects of management actions described under Alternative C on the federally endangered St. Croix ground lizard would be the same as those described for Alternative B. Protective measures would be taken during the planning and construction of any facilities such as limited trail work or installation of information kiosks. Alternative C may affect, but would not be likely to adversely affect the endangered St. Croix ground lizard.

Territory Listed Species

Least Tern. The impacts of recreational use and development actions under Alternative C would be similar those described under Alternative A. Under Alternative C, an approximately two-acre area along West Beach would be established for bow and stern anchoring in deep sand habitat. Park staff would continue to restrict access to nesting areas and provide educational information to visitors regarding the sensitivity of the species to disturbance during nesting periods when least terns are present. There would also be increased resources to enhance research and monitoring, education, and enforcement of regulations for protecting least terns. Under Alternative C, if impacts from anchoring are found to be occurring at unacceptable levels, permits would be changed to enhance protection of the least tern. With increased research and monitoring and implementation of adaptive management actions to protect least terns and their nests, the overall effect would be long-term, minor, and adverse.

Brown Pelican. The effects of Alternative C on the brown pelican would be similar to Alternative B. Installation of moorings off West Beach and a limited number (five) of off shore anchoring locations for larger vessels would not affect the pelican's prey distribution or abundance. Designation of a Marine Hazard Zone that includes the area north of Buck Island would prohibit vessel use in that area, provide additional area for undisturbed foraging, and reduce the potential for vessel activities to disturb nesting. Overall, Alternative C would have a long-term, minor, beneficial effect on the territory listed, endangered brown pelican.

Territory Listed Plant Species

The park would continue their efforts to control non-native, invasive plant species with the same beneficial effects as described under Alternative A. Development of minimal new trails and installation of kiosks on Buck Island would be conducted in a manner to avoid locations where sensitive plants occur. However, new trail development could increase visitor use of the interior of the island and increase the potential for spread of non-native plant species into sensitive terrestrial habitats, and increase the amount of litter. Steep topography, dangerous plant species, and hot temperatures would limit visitor use of the island's interior, however. Increased educational opportunities under this alternative would improve visitor understanding and appreciation of the monument's sensitive species, which would help prevent or reduce unauthorized off-trail use. Overall, there would be long-term, minor, beneficial effects on territory listed plant species.

Cumulative Effects

Effects on special status species from other past, on-going, and future plans and projects would be the same as described for Alternative A. Management actions proposed under Alternative C would likely contribute a relatively small component to these cumulative impacts. The current trends of climate change, hurricanes, disease, and other factors would have projected long-term, major adverse effects on some species of concern that would overshadow management actions taken by the park under Alternative C. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting special status species are combined with actions under Alternative C, the resulting cumulative effects would vary by species and are summarized as follows.

- Federal listed elkhorn and staghorn coral: may affect/likely to adversely affect.
- Federal listed sea turtles: may affect/not likely to adversely affect
- Federal listed St. Croix ground lizard: may affect/not likely to adversely affect
- Territory listed brown pelican: long-term, major and adverse
- Territory listed least tern: long-term, major and adverse
- Territory listed plant species: long-term, moderate, and adverse.

Conclusions

Overall the enhancement of research and monitoring of special status species and their habitats and enforcement of regulations in the newly designated management zones within the monument and increased educational information that promotes the protection and preservation of these species would have overall long-term, moderate, beneficial effects. Management actions proposed under Alternative C would result in a "may affect/not likely to adversely affect" Section 7 finding for federally listed species (elkhorn and staghorn coral, sea turtles, and the St. Croix ground lizard). Least terns could be disturbed and abandon nests due to recreational activities on West Beach and the associated bow and stern anchoring area; however increased monitoring and enforcement of regulations would reduce this potential resulting in a long-term minor adverse effect. Under Alternative C there would be long-term, minor, beneficial effects on the brown pelican and territory listed plants.

Effects on special status species from other past, on-going, and future plans and projects would be the same as described for Alternative A. Management actions proposed under Alternative C would likely contribute a relatively small component to these cumulative impacts for some species of concern.

Impacts of Alternative D

Elkhorn and Staghorn Coral. The types of effects of management actions under Alternative D on elkhorn and staghorn coral are similar to those described under Alternative C as far as the beneficial effects associated with the Marine Hazard Zone, Resource Protection Zone and increased park staff, research, monitoring, enforcement, education and partnering efforts are concerned. Alternative D would provide a 16 acre Anchoring Zone, and since this area is deep sand it would not affect elkhorn and staghorn coral. In addition to the Anchoring Zone, Alternative D would provide an additional 55 moorings off West Beach and west of the pier, combined. The approximate number of total vessels would increase from 87 under Alternative A to approximately 112 vessels under Alternative D. This increased number of vessels and therefore visitors would likely create an increase in adverse impacts to elkhorn and staghorn coral associated with increased recreational activity such as snorkeling, swimming, and SCUBA diving at the SCUBA moorings in the park and the increased likelihood of coral touching, breakage or inadvertent damage.

The elkhorn coral barrier reef is excluded from the Recreation Zone to further protect the threatened species. Establishment of the Marine Hazard Zone would eliminate use of vessels in shallow reefs to the northwest, north and southeast of Buck Island, thereby reducing the potential for adverse effects of emergency anchoring and/or groundings on the shallow water coral reef community including elkhorn and staghorn coral. Inclusion of a major portion of the southern bank barrier reef in the Marine Hazard Zone would result in more limited uses of this area for recreation. This would result in a beneficial effect on the bank barrier reef by reducing the potential for touching and breaking of coral and by reducing the potential for groundings and damage from propellers. This would have beneficial effects on elkhorn and staghorn coral in these areas of the park. Adverse effects would be minimized through an increase in enforcement staff and patrol activities at the park, establishment of the Marine Hazard Zone, and through an increase in education, outreach, and partnering programs compared to Alternative A.

The effects of an accidental grounding would be long-term, major and adverse at the point where a grounding occurred. The likelihood of such an event would be minimized by establishing the Marine Hazard Zone prohibiting vessel use and providing increased enforcement and education as to the hazards inherent in this zone. However, due to the increase in overall capacity for more vessels to access Buck Island via moorings and sites to anchor compared to Alternative A, there may be an increased chance for an accidental grounding to occur.

Under Alternative D, visitors would disembark at West Beach from the 45 moorings via marked beach access channels and/or at the pier, or the designated Anchoring Zone. This would allow continued use of the West Beach areas by visitors, similar to Alternative A. Swimming and snorkeling in the vicinity of the sand bottom, seagrass and the nearby shallow water coral communities would continue in the West Beach area. These types of activities are estimated to have adverse effects on elkhorn and staghorn coral located in proximity to the north of West Beach similar to those associated with Alternative A, since access to these same areas would be provided by an increased number of vessels and therefore visitors to nearby shallow water coral communities where elkhorn and staghorn coral are present (112 vessels under Alternative D, compared to 87 vessels under Alternative A).

Continued snorkeling at the underwater trail and SCUBA diving at the SCUBA moorings on the east end of the island would have similar effects as Alternative A on reefs in this area.

Vessel use would result in effects on water quality in the park as described in the "Water Resources" section. Under Alternative D, water quality in the park would be affected by many of the same influences as those described under Alternative A, and the number of vessels that would be accommodated under Alternative D could have increased adverse effects. Increased staff proposed for Alternative D would help reduce pollutant discharges and releases from vessels through increased education and enforcement efforts. However, the increase in staffing may not be able to address the potential magnitude of the increase in vessels. These pollutants would have adverse effects on shallow water coral reef communities, including elkhorn and staghorn coral by exposing marine organisms to contaminants during movement of vessels into and out and staying in the mooring and Anchoring Zone. In addition, an increase in the number of visitors would increase the use of sunscreens and other products that may adversely affect corals.

In summary, the overall effects of management actions under Alternative D may affect but are not likely to adversely affect federally listed threatened elkhorn and staghorn coral. NPS establishment of the Marine Hazard Zone and other management zones and additional resource protective measures enforced by an increased workforce provide for protection of elkhorn and staghorn coral. NPS would continue to coordinate with the National Marine Fisheries Service regarding the protection of these species as coral research and monitoring continues within park boundaries and adaptive measures would be developed to address any increase in adverse effects to elkhorn and staghorn coral, including the potential adverse effects from an increase in vessel and visitor use, particularly during periods of peak visitation. These measures are included in the user capacity analysis of Chapter 2. NPS recognizes the need for stewardship of these corals and their habitat, and continued access to be able to view these species in the park advances visitor understanding of the importance of resource protection.

Sea Turtles (Green sea turtle, Hawksbill sea turtle, Leatherback sea turtle and Loggerhead sea turtle). Protection of sea turtle nesting areas and efforts to reduce impacts on sea turtles from recreational use of Buck Island would have the similar effects as Alternative A, with the exception of the number of vessels and therefore visitors accessing Buck Island would increase from 87 under Alternative A to 112 under Alternative D. Under Alternative D, a 16 acre Anchoring Zone would be established along with five designated anchoring locations for vessels 91 to 150 feet in deep sand (by permit only). Moorings would also be established for recreation and NPS administrative use. The

overall increase in number of vessels accessing the park could increase the potential for collisions with sea turtles and the number of visitors interacting or disturbing sea turtles.

The installation of moorings may cause short-term avoidance of the area by sea turtles during the installation timeframe, but the presence of moorings would not have overall long-term adverse effects. Impacts associated with the increased presence of vessels, vessel noise, swimming, snorkeling, and walking in shallow areas near West Beach would likely cause sea turtles to avoid areas where people frequent, in particular West Beach and the underwater trail. Visitor use of the underwater trail and nearby SCUBA diving moorings would have effects similar to Alternative A. Sea turtles would avoid these areas during peak visitation periods.

The designation of the Resource Protection and Marine Hazard Zones would have beneficial **effects** on sea turtles. These zones would provide additional protection of habitat for foraging and cover. Elimination of vessels in the Marine Hazard Zone eliminates possible vessel damage to coral reefs where sea turtles forage, seek cover, rest, mate, and also reduces the potential for collisions between vessels and sea turtles as they surface to breathe. However, the potential for vessels colliding with sea turtles in other zones in the park may increase relative to the increase in number of vessels entering and leaving the mooring areas and Anchoring Zone as well as traversing the park.

Increased access and numbers of vessels and visitors to Buck Island may also result in increased disturbance to nesting sea turtles, their nests, and hatchlings. Park managers would consider adaptive measures should impact to sea turtles become apparent (these measures are addressed in the user capacity analysis in Chapter 2). NPS would continue to monitor sea turtles in the park and take measure should the need be indicated. NPS will continue to coordinate with the National Marine Fisheries Service, U.S. Fish and Wildlife Service, and the Territorial Department of Natural Resources Division of Fish and Wildlife regarding future actions and protective measures taken. Increased staffing, research, monitoring, enforcement, education and outreach would provide long-term beneficial effects. Management actions proposed under Alternative D would result in conditions that are beneficial to preserving habitat and minimizing impacts to sea turtles. Alternative D would result in a may affect, not likely to adversely affect finding.

St. Croix Ground Lizard. The effects of management actions described under Alternative D on the federally endangered St. Croix ground lizard would be the same as those described for Alternative B. Increased number of vessels and therefore visitors would likely increase use of the picnic area and encroachment compared to Alternative A, which could affect the St. Croix ground lizard habitat in this area. Protective measures would be taken during the planning and construction of any facilities such as limited trail work or installation of information kiosks. Increased research and monitoring efforts may be necessary to determine effects and adapt management strategies accordingly. Alternative D may affect, but would not be likely to adversely affect the endangered St. Croix ground lizard.

Territory Listed Species

Least Tern. The effects of recreational use and development actions under Alternative D actions would be the same as those described under Alternative B. Under Alternative D, a 16-acre Anchoring Zone located off West Beach would be established for anchoring in deep sand habitat; however, shoreline bow and stern anchoring would be eliminated compared to Alternative A. Park staff would continue to restrict access to least tern nesting areas when the birds are present and provide educational information to visitors regarding the sensitivity of the species to disturbance during the nesting period. There would also be increased resources to enhance research and monitoring, education, and enforcement of regulations for protecting least terns. If Anchoring Zone impacts were found to occur at unacceptable levels, anchoring permits would be changed to enhance protection of the least tern. Other measures to restrict access may be necessary to protect the least tern and NPS managers would adapt measures to reflect changing conditions. Although the number of vessels and

therefore visitors accessing Buck Island would be greater under this alternative, the enhanced research, monitoring, adaptive management actions, and the prohibition on shoreline anchoring would result in overall long-term, minor, adverse effects.

Brown Pelican. The effects of Alternative D on the brown pelican would be the same as Alternative B. Installation of moorings off West Beach and a limited number of anchoring locations for larger vessels would not affect the pelican's prey distribution or abundance. The designation of a Marine Hazard Zone that includes the area north of Buck Island would prohibit vessel use in that area, provide additional area for undisturbed foraging, and reduce the potential for vessel activities to disturb nesting. Overall, Alternative D would have a long-term, minor, beneficial effect on the territory listed, endangered brown pelican.

Territory Listed Plant Species

The park would continue their efforts to control non-native, invasive plant species with the same beneficial effects as described under Alternative A. Development of minimal new trails and kiosks on Buck Island would be conducted in a manner to avoid locations where sensitive plants occur. However, new trail development could increase visitor use of the interior of the island and increase the potential for spread of non-native plant species into sensitive terrestrial habitats. Steep topography, dangerous plant species, and hot temperatures would limit visitor use of the island's interior, however. Increased educational opportunities under this alternative would improve visitor understanding and appreciation of the monument's sensitive species, which would help prevent or reduce unauthorized off-trail use. As such, there would be long-term, minor, beneficial **effects** on territory listed plant species.

Cumulative Effects

Effects on special status species from other past, on-going, and future plans and projects would be the same as described for Alternative A. Management actions proposed under Alternative D would likely contribute a relatively small component to these cumulative impacts.

The current trends of climate change, hurricanes, disease, and other factors would have projected long-term, major adverse effects on some species of concern that would overshadow management actions taken by the park under Alternative D. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting special status species are combined with actions under Alternative D, the resulting cumulative effects would vary by species as summarized below.

- Federal listed elkhorn and staghorn coral: may affect/likely to adversely affect.
- Federal listed sea turtles: may affect/not likely to adversely affect
- Federal listed St. Croix ground lizard: may affect/not likely to adversely affect
- Territory listed brown pelican: long-term, major and adverse
- Territory listed least tern: long-term, major and adverse
- Territory listed plant species: long-term, moderate, and adverse.

Conclusions

Although the number of vessels and therefore visitors accessing Buck Island would be greater under this alternative, the enhancement of research and monitoring of special status species and their habitats and enforcement of regulations in the newly designated management zones within the monument and increased educational information that promotes the protection and preservation of these species would have overall long-term, beneficial effects. Due to the increase in number of vessels and relative number of visitors, NPS may be required to take adaptive measures to protect special status species, particularly during peak visitation periods. Management actions proposed under

Alternative D would result in a "may affect/not likely to adversely affect" Section 7 finding for federally listed species (elkhorn and staghorn coral, sea turtles, and the St. Croix ground lizard). Territory listed least terns, when present, could be disturbed and abandon nests due to recreational activities on West Beach resulting in long-term minor adverse effects. Alternative D would have a long-term, minor, beneficial effect on the territory listed, endangered brown pelican and long-term, minor, beneficial effects on territory listed plant species.

Effects on special status species from other past, on-going, and future plans and projects would be the same as described for Alternative A. Management actions proposed under Alternative D would likely contribute a relatively small component to these cumulative impacts for some species.

CULTURAL RESOURCES

Regulations and Policies

The regulations and policies that guide NPS actions with respect to cultural resources are presented in the "Servicewide Mandates and Policies" section of Chapter 1 and in Appendix B.

Methods

Regulations for implementing the National Environmental Policy Act and the National Historic Preservation Act require the analysis of the effects of proposed actions on important cultural resources. Each of the acts has a different set of definitions for assessing effects on cultural resources. To comply with the requirements of both acts, this general management plan and environmental impact statement uses both definition sets to evaluate effects on the cultural resources of Buck Island Reef National Monument.

In accordance with regulations from the Advisory Council on Historic Preservation (Advisory Council) for implementing Section 106 of the National Historic Preservation Act, the effects on archeological resources were identified and evaluated by:

- Determining the area of potential effects;
- Identifying cultural resources present in the area of potential effects that are either listed in or potentially eligible to be listed in the National Register of Historic Places;
- Applying the criteria of adverse effect to all of the listed or potentially eligible cultural resources that could be affected; and
- Considering ways to avoid, minimize, or mitigate adverse effects.

Section 106 determinations of effect characterize the severity or intensity of impacts on National Register-listed or -eligible cultural resources.

- A determination of no historic properties affected means that either there are no historic properties present or there are historic properties present but the undertaking will have no effect on them (36 CFR 800.4(d)(1)).
- A determination of no adverse effect means there an effect, but the effect would not meet the criteria of an adverse effect; that is, it will not diminish the characteristics of the cultural resource that qualify it for inclusion in the National Register (36 CFR 800.5(b)).
- An adverse effect occurs whenever an impact alters, directly or indirectly, any characteristic of a cultural resource that qualifies it for inclusion in the National Register. For example, this could include diminishing the integrity (or the extent to which a resource retains its historic appearance) of its location, design, setting, materials, workmanship, feeling, or association. Adverse effects also include reasonably foreseeable effects caused by the alternatives that would occur later in time, be farther removed in distance, or be cumulative (36 CFR 800.5(a)(1)). All adverse effects on National Register-eligible cultural resources in Buck Island

Reef National Monument would be long-term and would have a high level of concern because cultural resources are nonrenewable.

The following discussion correlates the differing requirements of the National Historic Preservation Act and National Environmental Policy Act in a way that impacts (effects) on cultural resources are presented in a thorough, thoughtful, and meaningful manner and compliance with both laws is achieved. For these reasons, the impact criteria for cultural resources are presented in a different format from the other impact topics. The Council on Environmental Quality (1978) regulations for implementing the National Environmental Policy Act and Director's Order 12 (NPS 2001) call for a discussion of the appropriateness of mitigation with an analysis of how effective the mitigation would be in reducing the intensity of a potential impact (for example, reducing the intensity of an impact from major to moderate or minor). However, any reduction in intensity of impact from mitigation is an estimate of the effectiveness of mitigation only under the National Environmental Policy Act. The level of effect as defined by Section 106 is not similarly reduced, because cultural resources are nonrenewable, and adverse effects that consume, diminish, or destroy the original historic materials or form would result in a loss in the integrity of the resource that can never be recovered. Therefore, even if actions determined to have an adverse effect under Section 106 may be mitigated, the effect remains adverse.

A Section 106 summary follows the cultural resource impact analysis for the preferred alternative. The Section 106 summary is intended to meet the requirements of Section 106 and is an assessment of the effect of the undertaking (implementation of the alternative) on cultural resources, based on the criteria of effect and adverse effect in the Advisory Council's regulations.

Issues related to cultural resources were identified during public and internal scoping. They include:

- Inappropriate visitor uses, including looting and vandalism, could harm cultural resources, especially submerged shipwrecks.
- Cultural resources could inadvertently be damaged by facility development, such as trails or installation of signs and other maintenance work.

The impact analyses presented are for the purposes of the National Environmental Policy Act. They are intended to assist the NPS with coordinating its compliance with this act and with Section 106 of the National Historic Preservation Act, as amended. However, the NPS does not intend to use this General Management Plan/Environmental Impact Statement to meet Section 106 compliance for individual actions discussed in this document in accordance with 36 CFR 800.8(c). NPS will comply with Section 106 in accordance with 36 CFR 800 as it continues implementation planning and refines its management options with alternatives analyses and specific proposals for individual projects. NPS will consult with the Territory state historic preservation officer and other consulting parties to determine areas of potential effects; to identify cultural resources and evaluate their National Register of Historic Places eligibility; to determine effects on historic properties; and to develop measures to avoid, minimize, or mitigate adverse effects on historic properties.

Impact Threshold Definitions

The thresholds to determine the intensity of impacts on cultural resources are defined as follows:

Negligible: The action would not have the potential to cause effects on archeological resources that would alter any of the characteristics qualifying the resource for inclusion in or eligibility for the National Register. For purposes of §106, the determination would be *no historic properties affected.*

Minor Adverse: The action would affect one or more archeological sites with low data potential and no significant ties to a living community's cultural identity. Site disturbance would be confined to a small area with little, if any, loss of information potential. For purposes of §106, the determination of effect would be *no adverse effect.*

Minor Beneficial: The action would result in preservation of a site in its natural state. For purposes of §106, the determination of effect would be *no adverse effect*.

Moderate Adverse: The action would affect one or more archeological sites with modest data potential and possible ties to a living community's cultural identity. Site disturbance would be noticeable. For purposes of §106, the determination of effect would be *adverse effect*.

Moderate Beneficial: The action would noticeably enhance the protection or preservation of one or more archeological sites. For purposes of §106, the determination of effect would be *no adverse effect*.

Major Adverse: The action would affect one or more archeological sites with medium or higher data potential, and having ties to a living community's cultural identity. The action would result in loss of site or district integrity. Site disturbance or resource degradation would be highly visible. For purposes of §106, the determination of effect would be *adverse effect*.

Major Beneficial: The action would substantially enhance the ability to protect and interpret important archeological resources and would foster conditions under which archeological resources and modern society can exist in productive harmony and fulfill the social, economic, and other requirements of present and future generations. For purposes of §106, the determination of effect would *be no adverse effect.*

Duration: Archeological resources are nonrenewable, so all adverse effects would be long-term.

Impacts of Alternative A

Archeological Resources

Under Alternative A, two primary factors, human actions and natural processes, would contribute to parkwide long-term, moderate, adverse effects on archeological sites from loss of artifacts, damage to structural remains, and diminished site integrity. Effects would be long-term because archeological resources are nonrenewable, and once damaged or lost, cannot be restored. Minor, long-term benefits would result from visitor education and park management actions.

Five terrestrial archeological sites have been documented on Buck Island (see Chapter 3, Table 16). Almost all of the sites are relatively close to the existing trail system and/or to areas typically used by visitors, and thus are vulnerable to unauthorized artifact collecting and inappropriate uses. One of the most threatened of the sites is BUIS-2, which has been disturbed by erosion and is vulnerable to loss of additional artifacts and features. Anchoring or other shoreline or beach-related activities could disturb or erode submerged areas or exposed beach surfaces in the vicinity of archeological sites.

Unauthorized collecting often removes diagnostic artifacts that hold clues to the age, cultural affiliation, and function of the site. Collecting also can skew the assortment of cultural items, leaving behind a puzzling array of items that may reflect a singular function or historical connection. Climbing or standing on ruins could damage exposed foundations or other structural elements and contribute to future damage from erosion and plant growth.

The steep terrain and thick vegetation make access to areas away from trails difficult, so terrestrial site damage from human activities generally would be modest. However, any damage would diminish site integrity and potential for future research, and result in adverse effects on Buck Island's cultural sites.

Ten shipwreck sites are thought to lie within the park, and other shipwrecks are known to be somewhere in the general vicinity (Table15). Shipwrecks are especially fascinating to visitors, but these complex resources could easily suffer damage if divers attempt to enter and explore the wreck, or try to locate and remove artifacts. Vessels with a deep draft, strong wakes, or unauthorized use of anchors also can disturb submerged resources. The slave ships *Mary* and *General Abercrombie* are especially vital to the park's interpretive story. These and the other shipwrecks are vulnerable to inappropriate uses.

NPS management policies and programs provide an umbrella of protection for cultural sites by establishing proactive procedures for their identification, evaluation, management, and interpretation. Parks develop resource management plans and various special studies to provide the best possible care for non-renewable resources. These policies and procedures would continue to benefit Buck Island's cultural sites.

One of the best deterrents to vandalism and looting is visitor education. On-going park management, interpretation, and visitor education would continue to have some long-term parkwide benefits to archeological sites on Buck Island. However, interpretative and educational materials are only found outside the park at Christiansted, and are not readily available to Buck Island visitors. Concessions operators may not have received training about ways to protect and preserve sites. Park staff have experienced a greatly expanded workload in the recent past, reducing the available time that can be spent on visitor education and resource protection.

While benefits would accrue from park management actions to protect and stabilize sites threatened by natural processes or inappropriate visitor use, management of Buck Island's archeological resources is complicated by the fact that little is known about some of the island's sites, and because no systematic survey of submerged cultural resources has been conducted. Unknown, undocumented sites cannot be protected, and such sites could suffer adverse effects from unwitting visitor or management actions. Resource protection and management activities would be expected to continue at existing levels.

Also, sites lack National Register evaluations. Without an evaluation of National Register significance and integrity of recorded or known sites, it is difficult to develop appropriate, proactive management actions. Consequently, unevaluated sites might not be adequately protected, or, on the other hand, protective measures could be unnecessarily proposed for sites lacking integrity and significance. Lack of information would have an adverse effect on archeological resources.

Natural processes also have damaged sites, and appear to be one of the most destructive of the various threats facing Buck Island's cultural resources. Bioturbation would continue to occur from digging or other activities of rodents and insects that loosen structural features and disrupt soil stratigraphy. Control of rodents in recent years reduces such effects. Mixing of older and newer deposits would make definition of different site occupants, functions, or periods of use difficult, if not impossible. Vegetation growing into foundations or through and over structural ruins would continue to contribute to localized site degradation by expanding cracks and displacing structural elements.

Rough seas, wave action, strong currents and salt water also would continue to damage submerged resources, and wind and water would contribute to terrestrial site damage, particularly those sites near the beach. Rapid erosion is known to have adversely affected Buck Island prehistoric site (BUIS-2) by causing loss of artifacts and site integrity. These natural processes would adversely affect sites in localized areas.

In the future, all of these destructive processes are likely to be influenced by climate change as well. Shipwrecks in shallow waters are damaged by high frequency waves of long duration; on the other hand, increased sea levels could be beneficial to these wrecks by covering them more deeply. Shipwreck resources tend to reach a sort of equilibrium when moisture, pH and temperature levels remain fairly consistent. If a wreck is exposed to the air during frequent storm events, deterioration of its wood and metal components could be accelerated. As with the growth of coral, the various flora and microorganisms present on wrecks could be affected by changes in pH, temperature, amount of sunlight and storm intensity and frequency. The overall effect of such changes is, at present, unclear.

Rising sea levels and frequent storm surges can contribute to the physical damage to or loss of coastal historical and archeological resources from wave action that erodes away beach deposits and exposes sites. In other areas, however, beach deposits could accrue, helping to bury and protect coastal sites.

On the island's steep slopes, previously disturbed soils in archeological and historical sites are especially vulnerable to erosion. Storm events and changing precipitation patterns can contribute to creation of new gullies (guts) or extreme runoff episodes and erosion of existing drainages. Changes in seasonality and temperatures could contribute to unanticipated changes in the types of vegetation and location of vegetation communities on the island, affecting archeological sites and ruins of historic structures both positively and negatively. Because effects from climate change are complex and may be synergistic (both positively and negatively), such effects may not be quantifiable within the lifetime of this general management plan. It is anticipated, however, that with continuing attention to resource preservation such as retrieval of archeological information where sites are threatened, adverse effects of climate change would be negligible to minor over the next decade.

In summary, under Alternative A, human activities, natural processes, and lack of data would result in long-term, moderate adverse effects on the island's archeological resources (site BUIS-2 and the shipwreck sites are especially threatened). It is anticipated that climate change would play a negligible to minor role in adverse effects on cultural resources over the lifetime of this plan, while park management, interpretation, and visitor education efforts would have long-term, minor benefits. Beneficial effects would be minor because of lack of staffing and funding to complete surveys and evaluations.

Cumulative Effects

The area considered for cumulative effects on archeological resources under Alternative A is the entire park. The time period for cumulative effects extends from 1948 (when the Municipal Government of St. Croix designated Buck Island as a park or protected area) to the present, during which time the wind, tides, hurricanes, natural processes, and human activities have added to, modified, or destroyed cultural resources.

Goat grazing and periodic burning had made a virtual desert of the island by the late 1940s. When grazing was discontinued in the 1950s, vegetation gradually returned. Cessation of grazing ended some physical impacts to terrestrial sites from trampling and displacement of structural elements. However, without grazing, vegetation has gained ground within the ruins. Vegetation tends to hide cultural features and artifacts, reducing their vulnerability to unauthorized collecting or disturbance. On the other hand, vegetation growth damages ruins, so there are both positive and negative effects from cessation of grazing.

Existing programs for removal of the island's exotic plants are being implemented with consideration for archeological resources. Removal of exotic plants from archeological ruins would have long-term moderate localized benefits.

Non-native tree rat and mongoose populations also occupied the island. These animals tend to burrow and can undermine and damage archeological ruins and sites. Park management programs recently eradicated both species, greatly benefiting archeological resources.

Acquisition of Buck Island by the NPS helped to ensure the protection and preservation of the property's cultural sites. Also, NPS management activities and interpretive programs have shaped the ways visitors use the island, gradually reducing impacts on sites from collecting and inappropriate uses. These management actions would result in long-term, parkwide moderate benefits to sites. Unfortunately, management of the island's rich and varied natural and cultural resources has sometimes been constrained by limited availability of funding and park staff, and many of these constraints are expected to continue into the foreseeable future. Lack of knowledge about cultural sites also contributes to adverse effects on sites.

Other plans and projects help the park protect its cultural resources. Implementation of the Exotic Plant Management Plan would continue to help reduce the potential for damage to sites from non-native vegetation. Buck Island lacks a comprehensive cultural resources survey, so some unknown

(and consequently unprotected) terrestrial and underwater sites might continue to be subject to damage from human activities and natural forces.

As described above, climate change also could contribute to cumulative effects on cultural sites. The gradual changes in various factors such as sea level, water temperature and acidity and episodic storm events would combine with ongoing physical processes. In some cases, effects could be beneficial, such as covering shipwrecks more deeply or burying beach archeological sites. Or, storm surges and changes in the water temperature and pH level could accelerate the process of deterioration of sites and wrecks. Cultural resources are non-renewable, so over time these various actions and processes described above cumulatively diminish the park's cultural resource base, and reduce the number and variety of cultural sites available for visitor appreciation, ethnographic heritage, and scientific study.

When effects of other plans, projects, and activities affecting cultural resources are combined with these effects of actions under Alternative A, cumulative long-term, minor to moderate, adverse effects would occur, primarily from continuing deterioration of sites and shipwrecks. That is, past site damage and future threats to nonrenewable cultural sites from natural processes, climate change and occasional human actions appear to outweigh the on-going benefits of park management actions.

Conclusions

These effects would accrue from human activities (inappropriate actions such as climbing on ruins, unauthorized artifact collecting, entering and damaging shipwreck structures and artifacts, and damage from vessels, wakes, and unauthorized anchor drops)and natural processes (wind, water, high tides, storm surges, erosion, bioturbation from insects and vermin, and vegetation growing into structural ruins). Over the lifetime of this plan, climate change would likely play a negligible to minor or adverse role in preservation of the park's cultural resources. Adverse effects are offset slightly from current NPS management, interpretation and education, preservation, and protection efforts.

Cumulative effects would be long-term, minor to moderate, and adverse; primarily from continuing human activities and deterioration of sites and shipwrecks as well as from effects of climate change. That is, past site damage and future threats to nonrenewable cultural sites from natural processes and occasional human actions outweigh the on-going benefits of park management actions.

Impacts of Alternative B

Archeological Resources

Overall, the impacts of Alternative B on archeological resources would be similar to those described for Alternative A, except that effects would be long-term, minor, and adverse. When compared with Alternative A, adverse effects on archeological resources would be minor rather than moderate because better protection of resources located underwater and on the shore would be achieved by phasing out the existing anchoring areas with vessel moorings. Cultural sites also would benefit from increased resource protection through use of management zones, by increased research and monitoring, opportunities for education and outreach, and by future implementation of cultural resource research studies.

In all three action alternatives, terrestrial cultural resources would be included in the Island Discovery Zone, and submerged resources would be in either the Resource Protection Zone or the Marine Hazard Zone. The five cultural sites within the Island Discovery Zone would need a moderate to high degree of management to help ensure resource protection, and any future development would be designed to avoid sites other than those suitable for interpretation. Sites in the Resource Protection Zone would benefit from focused resource preservation, protection and scientific research. Sites in this zone would continue to be threatened by inappropriate human actions, but visitor use of this zone would be expected to be less than in the more heavily visited West Beach and south and southeast portions of the island. Although use of the visitor facilities, the beach, and the trails would continue as

in Alternative A, the potential for disturbance of cultural resources in the general vicinity of West Beach would be reduced by the eventual phasing out of anchoring that presently tends to disturb areas near shore and nearby beach. The five designated anchoring locations for vessels 91 to 150 feet in length by permit only would be installed only after survey for resources to avoid impacts.

To avoid physical damage to archeological resources, areas proposed for mooring facilities or beach access channels, such as those proposed for the West Beach area, or limited new trails or sign installation would require archeological investigations prior to implementation of Alternative B. With appropriate investigations, monitoring, and protective measures as described in "Best Management Practices," development of these facilities would have a negligible effect on archeological resources.

As discussed under Alternative A, human actions such as unauthorized collecting and inappropriate site use at terrestrial sites would have long-term adverse effects, as would effects on shipwreck sites from visitor exploration, souvenir removal, wakes, vessel encounters, and poorly placed anchors. Adverse effects from human activities would be reduced from those described for Alternative A, primarily because of the additional outreach and education and increased opportunities for concessionaire and/or ranger led tours and hikes under Alternative B. These interpretive and educational opportunities would, over the long-term, help visitors to understand and appreciate the importance of the island's cultural resources, resulting in better protection and increased stewardship, both at Buck Island and outside the park.

Impacts on cultural sites from natural processes (wind, water, storm surges, erosion, bioturbation, and vegetation growth—as described in Alternative A) would continue to have adverse effects. That is, climate change could result in heightened sea levels, wave action, storm surges, loss of coastal terrain and damage to beaches (or accretion), as well as enhance changes in types, locations, and numbers of micro-organisms and plants on wrecks and other cultural sites,

All of these impacts would be partially offset by NPS management of and proactive programs for these Buck Island resources, including development of dynamic resource management schemes and revision of the collections management plan as appropriate. Stewardship that actively involves the public in protection of cultural resources would be important in slowing the adverse effects of natural processes and inappropriate uses. Working closely with resource partners to identify, evaluate and measure potential impacts of climate change would enable the park to better analyze and protect its cultural sites and shipwrecks. The 2004 archeological overview and assessment recommends further archeological investigations of Buck Island's archeological resources, especially the submerged sites. Future work would help document these resources, and would develop measures for their evaluation and protection to reduce adverse effects on archeological sites.

In summary, under Alternative B, human activities, natural processes, climate change and lack of data would have long-term, minor adverse effects on the island's archeological resources. With mitigation, installation of moorings, beach access channels, and limited new trails/signs would have negligible effects. Adverse effects on archeological resources would be partially offset by moderately beneficial park management actions, zoning and adaptive management in response to resource research and monitoring, involvement of the public in stewardship activities, and interpretation and visitor education efforts. Most effects would be localized, but benefits of interpretation and visitor education and involvement could extend far beyond the park boundaries as visitors develop a sense of stewardship for cultural resources. The park would work with resource partners to identify effects of climate change as well as potential adaptive management strategies to protect resources.

Cumulative Effects

Under Alternative B, most of the cumulative effects on archeological resources would be the same as described for Alternative A. These cumulative effects are associated with past goat grazing activities,

burnings, cessation of grazing, proliferation of exotic plant and animal species, eradication or planned control of exotic species, visitor uses, and NPS management of those uses and of the affected cultural resources. Other plans that would contribute to cumulative effects include the on-going implementation of the *Exotic Plant Management Plan* (NPS 2006b; 2010). This plan helps to define the species to be treated, appropriate treatment methods, timing, and mitigation measures as well as consideration of exotic plants that exist on archeological sites.

Effects of Alternative B on cultural resources would be as described in the analysis above, long-term, minor adverse effects from human activities (inappropriate uses such as climbing on ruins, unauthorized artifact collecting, entering and damaging shipwreck structures and artifacts; damage from vessels, wakes, anchor drops); lack of knowledge about site locations, integrity and significance; and natural processes (wind, water, high tides, storm surges, erosion, bioturbation from insects and vermin, and vegetation growing into structural ruins). The as yet undefined effects on cultural resources from climate change (e.g. higher ocean levels and changes in pH, water temperature, storm events, vegetation, and microorganisms) would coalesce with these other previous and on-going effects to produce long-term, negligible to minor adverse cumulative effects on cultural sites. Long-term moderate benefits would accrue from NPS management, interpretive, preservation, and protection efforts.

When effects of other plans, projects, and activities affecting cultural resources are combined with these effects of actions under Alternative B, cumulative long-term, minor, adverse effects would occur. Past and on-going adverse effects of human activities, lack of knowledge, climate change and natural processes would continue to outweigh the benefits from zoning and increased opportunities for visitor understanding and stewardship under Alternative B.

Conclusions

Under Alternative B, human actions and natural processes would contribute to long-term, minor adverse effects on archeological resources. These adverse effects would result from inappropriate visitor uses such as climbing on ruins, unauthorized artifact collecting, entering and damaging shipwreck structures and artifacts, and damaging underwater resources by vessels, wakes, and unauthorized anchor drops.

Until studies are done to identify and evaluate underwater sites and other sites that are presently unknown or poorly documented, the lack of knowledge about the park's archeological resources would have minor adverse effects on their management and preservation.

With archeological investigations, site evaluation, and development of mitigating measures prior to development of park facilities such as beach access channels and mooring facilities, development effects on archeological resources would be negligible. Natural processes such as wind, water, high tides, storm surges, erosion, bioturbation from insects and vermin, and vegetation growing into structural ruins would continue to have long-term, minor adverse effects on archeological sites. Climate change causing higher ocean levels, warmer water temperatures and increases in ocean pH, storm surges, new weather patterns, and changes in microorganisms and vegetation communities would have long-term, negligible to minor adverse effects on cultural sites.

When compared to Alternative A, adverse effects would be minor primarily because of increased attention to resource protection. NPS management, cooperative efforts with resource partners, and increased interpretation and education, preservation, and protection efforts would raise visitor resource awareness and stewardship, resulting in moderate benefits and future enhanced resource protection.

Under Alternative B, cumulative long-term, minor, adverse effects would result because past losses from human actions and natural processes would continue to outweigh the moderate benefits of

actions under Alternative B (primarily use of management zones and increased opportunities for visitor understanding and stewardship.).

Impacts of Alternative C

Archeological Resources

Overall, effects of actions in Alternative C on archeological resources would be the same as described for Alternative B, long-term, minor, and adverse. Human actions and natural processes contribute to most adverse effects on archeological resources. Human actions include unauthorized collecting and inappropriate site use such as climbing on ruins or vandalism, attempts to enter shipwreck sites or to remove souvenirs, vessel wakes that are too close to wrecks, vessel/wreck encounters, and poorly placed anchors.

Under all the action alternatives, additional educational and interpretive opportunities would be offered visitors, and these enhanced programs would help to educate and inform them about the importance and sensitivity of cultural sites. Under Alternative C, effects resulting from human actions would have adverse effects on archeological sites, but there would be benefits of enhanced outreach and education for visitors and increased opportunities for concessionaire and/or ranger led tours and hikes under Alternative C. These enhanced opportunities would help develop better resource protection and increased stewardship.

Impacts on cultural sites from natural processes and climate changes (wind, water (including temperature and pH increases), storm surges, erosion, bioturbation, and vegetation growth—as described in Alternative A) would continue to have adverse effects on sites. A lack of knowledge about exact site location, condition, integrity, and significance also contributes to adverse effects (unknown sites cannot be protected, and it is difficult to prioritize funding and protective actions when the importance of a site is undetermined). Future protective management actions under Alternative C, and archeological investigations as recommended by the 2004 archeological overview and assessment would help document submerged resources and provide information on terrestrial sites. These proactive management actions and investigations would help reduce impacts of natural processes on archeological resources.

Management zoning would have the same benefits as described for Alternative B. The Anchoring Zone proposed in Alternative C could pose a threat to area archeological resources. However, when compared with the present anchoring area, the area proposed under Alternative C is relatively small in size (2 acres as compared with the present 22-acre area). Prior to implementation of this zone, and development of the mooring areas, beach access channels, and limited new trails/sign installation, archeological investigations (both underwater and on land) would be conducted to identify resources and evaluate their condition and potential eligibility for the National Register of Historic Places. Before implementation of these actions, compliance investigations would be completed and would further evaluate potential impacts to cultural sites. This documentation would include mitigating measures especially designed for the proposed action.

In summary, under Alternative C, human activities, climate change, natural processes, and lack of data would have an adverse effect on the island's archeological resources, causing occasional loss of artifacts, deterioration of structural remains, and diminished site integrity. However, proactive park management, future studies and investigations, and increased opportunities for visitors to learn about and appreciate the island's cultural sites (developing stewardship) would benefit sites and help to reduce adverse effects. Working with resource partners to identify potential effects and adaptive management strategies would also help reduce effects so the overall long-term adverse effects to archeological resources would be minor and generally localized in nature.

Cumulative Effects

The cumulative effects under Alternative C would be the same as described for Alternative B; that is, the effects of past events such as grazing, burning and the cessation of both; management of the island as a territorial park and later as a national park with forty years of visitor use; removal of non-native animal species; implementation of the Exotic Plant Management Plan; and climate change. Effects of Alternative C on cultural resources would be as described in the analysis above, long-term, minor adverse effects from human activities (inappropriate uses such as climbing on ruins, unauthorized artifact collecting, entering and damaging shipwreck structures and artifacts; damage from vessels, wakes, unauthorized anchor drops); lack of knowledge about site locations, integrity and significance; climate change bringing higher sea levels, warmer water, increased pH, changes in vegetation and microorganisms; and natural processes (wind, water, high tides, storm surges, erosion, bioturbation from insects and vermin, and vegetation growing into structural ruins).

When effects of other plans, projects, and activities affecting cultural resources are combined with these effects of actions under Alternative C, cumulative long-term minor adverse effects would result. Past and on-going negative effects of human activities, lack of knowledge, and natural processes would continue to outweigh the benefits from management enforcement efforts, management zones and increased opportunities for visitor understanding and stewardship under Alternative C.

Conclusions

Under Alternative C, long-term, minor, adverse effects on archeological sites would result from human actions such as shoreline anchoring at West Beach, inappropriate use of sites and unauthorized collecting, climate change and all its associated factors, and natural processes (wind, water, high tides, storm surges, erosion, bioturbation from insects and vermin, and vegetation growing into structural ruins). These adverse effects would be partially offset by the moderate benefits of management efforts, management zones, mitigation measures for development, proactive management and enhanced opportunities for visitors to learn about the park and its sites. The park would work with resource partners to identify and counter resource threats posed by climate change.

When effects of other plans, projects, and activities affecting cultural resources are combined with these effects of actions under Alternative C, cumulative long-term, minor, adverse effects would result. That is, the benefits of actions under Alternative C, primarily use of management zones and increased opportunities for visitor understanding and stewardship, would be outweighed by past and on-going negative effects of human activities, lack of knowledge, and natural processes.

Impacts of Alternative D

Archeological Resources

Overall, actions proposed in Alternative D would result in long-term, minor, adverse effects on archeological resources from the effects of human actions, climate change and natural processes, as described for Alternatives B and C. However, creation of the 16-acre Anchoring Zone could potentially have a moderate adverse localized effect on underwater archeological resources. As described for Alternative C, appropriate archeological investigations and an environmental assessment would be completed before implementation of Alternative D to help ensure that significant resources are not damaged or lost due to project implementation. The park would work with its resource partners to identify, evaluate, and deal with potential adverse effects of climate change.

Cumulative Effects

Under Alternative D, cumulative effects on archeological resources would be the same as described for Alternatives B and C. That is, when effects of other plans, projects, and activities affecting cultural resources are combined with the effects of actions under Alternative D (short-term adverse effects of

construction, long-term adverse effects on cultural sites from anchoring, looting and inappropriate site use; natural processes; and beneficial effects of NPS management and improved visitor stewardship), the resulting cumulative effects would be long-term, minor, and adverse (e.g. past and on-going damage to resources would continue to outweigh beneficial effects.

Conclusions

The 16-acre Anchoring Zone would slightly increase the potential for inadvertent damage to submerged resources, resulting in occasional localized moderate adverse effects. Minor long-term adverse effects on archeological sites would result from human actions (inappropriate use of sites and unauthorized collecting) and natural processes (wind, water, high tides, storm surges, erosion, bioturbation from insects and vermin, and vegetation growing into structural ruins). Installation of moorings would be preceded by investigations and development of an environmental assessment prior to project initiation; this would help ensure resource protection. Management zones, increased research and monitoring, enforcement, and enhanced opportunities for visitors to learn about the park and its sites would have moderate long-term benefits and would result in improved protection of archeological resources.

The overall effects of climate change on the park's cultural resources are poorly understood at present. However, close coordination among all the resource partners would be necessary to identify, evaluate, and mitigate potential adverse effects of climate change on cultural sites.

When effects of other plans, projects, and activities affecting cultural resources are combined with these effects of actions under Alternative D cumulative long-term minor adverse effects would result. That is, the benefits of actions under Alternative D, primarily establishment of management zones, mitigation measures for development, increased opportunities for visitor understanding, and stewardship, and concerns related to climate change would continue to be outweighed by past and on-going negative effects of human activities, lack of knowledge, and natural processes.

SECTION 106 SUMMARY

This general management plan and environmental impact statement provide detailed descriptions of four alternatives (including a no action alternative), analyze the potential impacts associated with possible implementation of each alternative, and describe the rationale for choosing the preferred alternative. Also contained in the document are mitigation measures that would help avoid adverse effects on cultural resources.

Impacts to resources and values under the Preferred Alternative (Alternative B) were analyzed using the methods described earlier in this document. See the “Methods” subsection in the “Cultural Resources” section of Chapter 4 for further explanation.

There are no standing historic structures, identified cultural landscapes, or ethnographic sites of concern on the island. Thus there would be no historic structures, cultural landscapes, or ethnographic resources affected by this project (*No historical properties affected)*. Collections are housed elsewhere and would not be affected by actions proposed in this environmental document. Thus discussion of these impact topics has been dismissed for this document (see the “Impact Topics Considered but Dismissed from Further Evaluation” section of Chapter 1).

Archeological Resources. There are known archeological resources present on Buck Island. These archeological resources document both prehistoric and historic use of the island. For example, Chicoid-style pottery at the prehistoric Buck Island site (BUIS-2) suggests use of the island as early as AD 530 at the beginning of the Ostionoid period. Other sites reflect the use of the island from about 1754 when African slaves of European colonists at St. Croix came to Buck Island to harvest lignum

vitae trees, gather shellfish, lobsters, and crabs, and tend introduced sheep and goats foraging on the island.

Occasionally, Europeans lived or worked on the higher ridges of the island, including those at the Danish Signal Station. Structural ruins from these early occupations include the Signal Station Site (BUIS – 1), which contains wall and foundation remains. The Foundation Site (BUIS-4) also consists of a stone masonry foundation and chimney, and the Goby Site (BUIS-5) is comprised of a cistern or well ruins. Ceramic sherds dating from the end of 1700s through the 1800s are found at both BUIS -4 and BUIS -5.

Several artifact scatters also may be eligible for the National Register of Historic Places; these sites include historic materials such as ceramics and glass (in the vicinity of BUIS - 1), as well as prehistoric pottery and piles of conch shell and coral at the Buck Island Site (BUIS -2). At BUIS-6, the Historic Midden site includes Afro-Cruzan ceramic vessel sherds and sherds similar to those found at BUIS – 4).

While no systematic survey of maritime cultural resources has been conducted to date, at least 10 wrecks on the island's coral reefs between 1523 and 1917 have been identified from historic narratives (Towle, et al. 1976 and Tyson 1983) (Table 14). Most of the wrecks were small cargo ships, and two were British slave ships.

BUIS – 3 (the Buck Island Reef Wreck) is a submerged site identified northwest of the island. Two other shipwrecks (Shipwreck 1 and a circa 1800 sailing ship wreck) have been identified north of Buck Island.

Until formal evaluations of these archeological resources have been made, these resources will be considered eligible for the National Register of Historic Places.

Threats to Resources. Threats to these archeological resources include beach erosion, tides and storm events, invasion by plants, bioturbation from plants and animals, vandalism and inappropriate visitor uses (exploration of submerged remnants, climbing on ruins, etc.). The frequency and intensity of storms and erosion are increasing along with other related climate changes including sea level rise and ocean acidification which could affect archeological resources in the future.

In the past, natural processes have damaged some sites, and appear to be the most destructive of the various threats facing Buck Island's cultural resources. Rapid erosion is known to have adversely affected Buck Island prehistoric site (BUIS-2) by causing loss of artifacts and site integrity. Rough seas, wave action, strong currents and salt water also could continue to damage submerged resources, and wind and water would contribute to localized terrestrial site damage, particularly those sites near the beach.

Bioturbation would continue to occur from digging or other activities of rodents and insects that loosen structural features and disrupt soil stratigraphy. Vegetation growing into foundations or through and over structural ruins also would continue to contribute to localized site degradation by expanding cracks and displacing structural elements. However, on-going exotic plant management would be beneficial by removing some of these plants.

Almost all of the sites are relatively close to the existing trail system and/or to areas typically used by visitors, and thus could be vulnerable to unauthorized artifact collecting and inappropriate uses such as climbing or standing on ruins. However, the steep terrain and thick vegetation make access to areas away from trails difficult, so site damage from human activities generally would be modest.

Eight shipwreck sites are thought to lie within the park, and other shipwrecks are known to be somewhere in the general vicinity (Table 15). Shipwrecks are especially fascinating to visitors, but these complex resources could easily suffer damage if divers attempt to enter and explore the wreck, or try to locate and remove artifacts. Vessels with a deep draft, strong wakes, or unauthorized anchors

also can disturb submerged resources. The slave ships *Mary* and *General Abercrombie* are especially vital to the park's interpretive story. These and the other shipwrecks are vulnerable to inappropriate uses.

Management of Buck Island's archeological resources is complicated by the fact that little is known about some of the island's sites, and because no systematic survey or evaluation of submerged cultural resources has been conducted

Preferred Alternative. Under Alternative B, the preferred alternative, resources located underwater and on the shore would be better protected than at present, because most of the existing anchoring areas would be replaced with vessel moorings. For example, the potential for disturbance of resources in the vicinity of West Beach would be reduced by elimination of bow and stern anchoring that presently tends to disturb areas of the shore and nearby beach.

Cultural sites also would benefit from increased resource protection through establishment of management zones, by increased opportunities for education and outreach, and by future implementation of cultural resource research studies. Continued development and implementation of resource management plans and various special studies would continue to benefit Buck Island's cultural sites.

One of the best deterrents to vandalism and looting is visitor education. Increased staffing and resource management, interpretation, and visitor education services would have long-term benefits to archeological sites on Buck Island. Benefits also would accrue from park management actions to protect and stabilize sites threatened by natural processes or visitor use.

Under Alternative B, the preferred alternative, terrestrial cultural resources would be included in the Island Discovery Zone, and submerged resources would be in either the Resource Protection Zone or the Marine Hazard Zone. The five cultural sites within the Island Discovery Zone would have a moderate to high degree of management to help ensure resource protection, and any future development would be designed to avoid sites other than those suitable for interpretation. Sites in the Resource Protection Zone would benefit from focused resource preservation, protection and scientific research. Sites in the Marine Hazard Zone would benefit from the exclusion of vessels, and resource protection in this zone.

To avoid physical damage to archeological resources, areas proposed for mooring facilities or beach access channels, such as those proposed for the West Beach area, would require archeological investigations and further evaluation prior to implementation of the preferred alternative. With appropriate investigations, monitoring, and protective measures as described in "Best Management Practices," development of these facilities would not have an adverse effect on archeological resources (*No Adverse Effect)*.

Human actions such as unauthorized collecting and inappropriate site use at terrestrial sites would likely continue to affect some terrestrial archeological sites, as would effects on shipwreck sites from visitor exploration, souvenir removal, wakes, vessel encounters, and unauthorized anchoring. However, management zones as proposed in Alternative B would help reduce inappropriate activities. In addition, effects on cultural sites would be reduced by additional outreach and education and increased opportunities for concessionaire and/or ranger led tours and hikes proposed under Alternative B. These interpretive and educational opportunities would, over the long-term, help visitors to understand and appreciate the importance of the island's cultural resources, resulting in better protection and increased stewardship, as visitor education would help protect sites.

Future implementation of recommendations for further archeological investigations and evaluation contained in the 2004 archeological overview and assessment would help identify sites and site significance so that measures for their protection could be developed.

Natural processes (wind, water, storm surges, erosion, bioturbation, and rampant vegetation growth) would continue to affect cultural sites, but the majority of these effects would be offset by NPS management of and proactive programs for these Buck Island resources.

Because little is known about effects of climate change on cultural sites in the Caribbean, gaining knowledge about potential effects through close coordination and cooperation with resource partners is important. For example, research is needed to address the effects of temperature rise and acidification on vegetation and microorganisms present on shipwrecks, or to the submerged wood and metal and effects of increased temperature and pH; as well as changes in rainfall patterns and storm events and erosion patterns and the effects on beach sites. Identification and analysis of some of the parameters of climate change would be important in order to develop and implement adaptive management strategies for future resource preservation.

Mitigation measures contained in Table 8 would also help protect sites from unauthorized collecting or inappropriate sites uses; help educate work crews, staff and contractors about cultural resources in general and the need to protect any cultural resources encountered and protect sites prior to and during ground disturbing activities.

As provided for in the implementing regulations for Section 106 (36 CFR 800) of the National Historic Preservation Act, the NPS has complied with the requirements for using the *National Environmental Policy Act* process to achieve Section 106 compliance. The Virgin Islands State Historic Preservation Officer (SHPO), and the Advisory Council on Historic Preservation (ACHP) have been formally notified about the General Management Plan/Environmental Impact Statement, and a variety of public involvement activities have been undertaken, as summarized in Chapter 5. Correspondence related to these notifications is included in the appendices. This General Management Plan/Environmental Impact Statement has been forwarded to the above groups for their review and comment.

After applying the implementing regulations of the Advisory Council on Historic Preservation (36 CFR 800, revised regulations effective January 2001), addressing the criteria of effect and adverse effect, the NPS finds that the implementation of the preferred alternative, Alternative B, would result in a finding of *no adverse effect* to historic properties.

SOUNDSCAPE

Regulations and Policies

The regulations and policies that guide NPS actions with respect to soundscape are presented in the "Servicewide Mandates and Policies" Section of Chapter 1 and in Appendix B.

Methods

Issues related to the park soundscape identified during public meetings and planning workshops included: (1) sound should be minimized that is generated from vessel engines and generators, "rafting parties," (2 to 3 vessels tied together on one anchor for a party), music from radios and stereos, and other sounds resulting from social activities; and (2) the potential effects of these sounds on the natural soundscape, visitor experience, and wildlife. To address these issues, an assessment of the effects of projected park management actions on the soundscape was made using qualitative estimates of the expected levels of visitor use in the park and the number of vessels that can be accommodated under each alternative. Primary sources of information used in this analysis included unpublished observations and insights from knowledgeable park staff. The area analyzed for possible effects on soundscape includes the entire park; however, effects on soundscape are generally localized to high use areas near West Beach (beach and water) and the underwater trail mooring area. It should also be noted that the affect of sound on wildlife is not included in this impact analysis, but rather is

addressed under the "Wildlife" and "Species of Concern" sections. The area of effect considered for the cumulative impact analysis corresponds to the park boundary because the soundscape is predominately affected by activity within the park.

The major assumptions used in the analysis of effects on soundscape were that: (1) effects on soundscape under all alternatives are variable depending on the season of the year, day of the week, and holidays/non-holidays; (2) increased visitor use and access to Buck Island could potentially translate to an increase in the generation of human-related sounds; and (3) alternatives permitting shoreline bow and stern anchoring could concentrate effects along the West Beach shoreline; and (4)effects on soundscape due to visitor use would outweigh effects related to park operations or programs (installation/replacement and maintenance of facilities, research and monitoring programs, etc.); therefore the analysis focuses primarily on sounds introduced via visitor use and recreational activities.

Impact Threshold Definitions

Impact thresholds to determine the intensity of impacts on soundscape are defined as follows:

Negligible: Human-caused or project specific sounds do not compete with ambient sounds. Where noise is audible, it is for short duration, with significantly lengthy periods of time that are noise free.

Minor: Human-caused or project sounds are detectable above ambient sounds; however, there are frequent periods of time that are noise free. Where noise is audible, impacts occur for short durations (less than an hour) during the day.

Moderate: Human-caused or project sounds compete with ambient sounds. Noise generated is perceptible for extended periods throughout the day. There are however short periods of time that are noise free.

Major: Human-caused sounds dominate the soundscape and replace natural sounds. Natural sounds in the project area are commonly impacted by noise from management or recreational activities for most of the day without periods of time that are noise free.

Duration: Long-term: Persistent
Short-term: Intermittent or subsides in months

Impacts of Alternative A

The natural soundscape of the park consists predominantly of the sounds of birds, (terrestrial and seabirds) and the ocean or sea. Natural soundscape is affected by sounds generated by vessel engines and generators, and from the sounds of visitors (music, "rafting parties," picnicking, etc.) which are typically concentrated in the vicinity of West Beach. Visitors at the underwater trail moorings may also be heard onboard vessels as well as in the water. Depending on the perspective and the desired activity of a park visitor, these sounds may be perceived as noise. The natural soundscape is more prevalent in the interior or other areas of Buck Island accessible by trail, and in park open water that are farther away from West Beach and the underwater trail moorings.

Under Alternative A, effects on soundscape are greatest during periods of peak visitation, which have traditionally coincided with weekends, particularly Sundays, with lesser visitation occurring throughout the week. Park visitor counts also reflect greater visitation seasonally, with the greatest visitation typically occurring in the months from February through April (with other spikes). Due to staffing limitations and funding constraints, ranger or other staff presence is not always maintained within the park on a regular basis which limits the ability of park staff to minimize noises adversely affecting visitor experience or wildlife. The overall effect on soundscape under Alternative A is variable, and defined as long- and short-term, negligible to moderate, and adverse.

Cumulative Effects

Under all of the alternatives, including Alternative A, the cumulative effects on soundscape would largely be controlled by park management actions and to a lesser extent by outside influences, since effects on soundscape are largely related to the number of visitors to Buck Island. There are few, if any, influences outside of the park that would create sound or noise that would be audible within the park boundaries. Exceptions to this would be vessels traveling directly outside park boundaries or aircraft traveling in airspace within the park. Neither of these factors was identified as an issue during scoping, however. Future planning efforts within the park would include a vessel management plan that would also address noise issues. Recommendations from these planning efforts would be instituted as needed. When the beneficial and adverse effects of other past, on-going, and future plans, projects, and activities affecting soundscape are combined with actions under Alternative A, the resulting cumulative effects would be considered long- and short-term, negligible to minor, and adverse.

Conclusions

Effects on soundscape are variable depending on the day of week, holiday/non-holiday, season of the year, and location within the park. Due to staffing limitations and funding constraints, a ranger or other staff presence is not always maintained within the park on a regular basis which limits the ability of the park staff to minimize noise-related impacts. The overall effect on soundscape under Alternative A is long- and short-term, negligible to moderate, and adverse. The cumulative effects on soundscape would be long- and short-term, negligible to minor, and adverse due to benefits associated with implementation of future planning efforts.

Impacts of Alternative B, the Preferred Alternative

The effects of Alternative B would be similar to Alternative A; however, an increased level of ranger and other staff proposed for this alternative would likely reduce adverse effects on soundscape during periods of high use. Elimination of shoreline bow and stern anchoring would reduce the amount of sound that is associated with vessels concentrated along the shoreline in a small area, including engine sounds and vessel passengers. In addition, sounds generated by vessels would not be present in the Marine Hazard Zone, since vessels are restricted from this zone due to safety- and resource-related concerns. Vessel size limitations by management zone in the park, as compared to Alternative A, which does not limit vessel size in park waters, would also change the type and location of vessel related sounds. Restricting vessel size to 150 feet, with larger vessels anchoring further away from the shoreline would reduce some sounds (primarily vessel engines and generators) in the vicinity of West Beach. The overall effect on soundscape would be long- and short-term, negligible to minor, and beneficial.

Cumulative Effects

The same past, on-going, and future plans, projects, and activities affecting soundscape described under Alternative A are applicable to Alternative B. When combined with management actions proposed under Alternative B, the cumulative effect would be long- and short-term, minor, and beneficial.

Conclusions

An increased level of staffing proposed for this alternative in addition to vessel size and access limitations associated with management zones would likely reduce adverse effects on soundscape during periods of high usage. Therefore, there would be a long- and short-term, negligible to minor, beneficial effect. The cumulative effects on soundscape would be long- and short-term, minor, and beneficial due to benefits associated with implementation of future planning efforts.

Impacts of Alternative C

The effects of Alternative C would be similar to Alternative A since a similar number of vessels would have access to the park via a combination of mooring and shoreline bow and stern anchoring. However, sounds generated by vessels would not be present in the Marine Hazard Zone, since vessels are restricted from this zone due to safety- and resource-related concerns. Vessel size limitations by management zone in the park, as compared to Alternative A, which does not limit vessel size in park waters, would also change the type and location of vessel related sounds. Restricting vessel size to 150 feet, with larger vessels anchoring further away from the shoreline would reduce some sounds (primarily vessel engines and generators) in the vicinity of West Beach. In addition, more staff are proposed under Alternative C when compared to Alternative A; this would likely reduce adverse effects on soundscape during periods of high use. The overall effect of Alternative C on soundscape would be long- and short-term, minor, and adverse.

Cumulative Effects

The same past, on-going, and future plans, projects, and activities affecting soundscape described under Alternative A are applicable to Alternative C. When combined with management actions proposed under Alternative C, the cumulative effect would be long- and short-term, negligible, and adverse.

Conclusions

The effects of Alternative C would be similar to Alternative A since a similar number of vessels would have access to the park via a combination of mooring and shoreline bow and stern anchoring. However, since more staff are proposed under Alternative C when compared to Alternative A, and vessel size and access limitations are proposed under Alternative C, the overall effects would be long- and short-term, minor, and adverse. The cumulative effects on soundscape would be long- and short-term, negligible, and adverse, due to benefits associated with implementation of future planning efforts.

Impacts of Alternative D

Although it is projected that Alternative D would accommodate an increased number of vessels compared to Alternative A (112 compared to 87, respectively), and therefore increase the number of visitors, a greater number of additional staff (9 full time equivalents) and increased presence in the park are also proposed under Alternative D when compared to Alternative A. Increased outreach, enforcement, research and monitoring of conditions would benefit soundscape and help deter some unwanted noise that would likely be associated with an increased number of visitors, particularly on and near West Beach. Elimination of shoreline bow and stern anchoring, proposed limitations to vessel size, implementation of management zones, and access limitations would help decrease some adverse effects to the soundscape for the same reasons described under other action alternatives. However, during peak visitation, these adverse effects would have a greater magnitude of adverse effect. Effects to soundscape would also vary depending on location within the park, with most adverse effects occurring in the vicinity of West Beach where visitation is concentrated. The resulting effects would, therefore, be long- and short-term, minor to moderate, and adverse.

Cumulative Effects

The same past, on-going, and future plans, projects, and activities affecting soundscape described under Alternative A are applicable to Alternative D. When combined with management actions proposed under Alternative D, the cumulative effect would be considered long- and short-term, negligible, and adverse.

Conclusions

Although it is projected that Alternative D would accommodate a greater number of vessels and visitors within the park, additional staff are also proposed under Alternative D which would result in a long- and short-term, minor to moderate, adverse effect on soundscape. The cumulative effects on soundscape would be long- and short-term, negligible, and adverse due to benefits associated with future planning efforts.

SCENIC RESOURCES

Regulations and Policies

The regulations and policies that guide NPS actions with respect to scenic resources are presented in the "Servicewide Mandates and Policies" Section of Chapter 1 and in Appendix B.

Methods

Issues related to scenic resources identified during public meetings and planning workshops included: (1) the potential effects of moorings on the park viewshed; and (2) the potential effects of development in St. Croix on the park viewshed. To address these issues, a qualitative assessment of the effects of projected park management actions on scenic resources was conducted. The primary sources of information used in this analysis included unpublished observations and insights from knowledgeable park staff. The geographic area analyzed for possible effects on scenic resources includes all vantage points visible from the park, including the north eastern portion of St. Croix.

The major assumptions used in the analysis of effects on scenic resources were that: (1) an increase in the number of moorings within park waters could potentially affect scenic resources in the park; (2) visual effects of mooring buoys would be more long-term than effects associated with an anchoring area/zone due to the presence of the mooring buoy; (3) scenic resources would be predominately affected by development on St. Croix, which is outside of the park's control; and (4) the scenic value of the park's "marine garden," including the underwater trail, has been diminished due to several factors (including bleaching events) contributing to the decline of coral populations in the park. The cumulative effects of climate change on the scenic value of the underwater resources including the "marine garden" are summarized in this section.

Impact Threshold Definitions

The thresholds to determine the intensity of impacts on scenic resources are defined as follows:

Negligible: Effects of the action would be barely perceptible and would not affect the scenic quality or the visitor experience.

Minor: Effects of the action would alter features or alter the landscape but would not diminish the scenic quality or the overall visitor experience.

Moderate: Effects of the action would alter features or landscape such that the scenic quality would be slightly degraded and the quality of the visitor experience would be diminished.

Major: Effects of the action would alter features or the landscape in an obvious way. There would be substantial consequences for the quality of the visitor experience.

Duration: Long-term: Changes would be recognized for more than one year;
Short-term: Changes would be recognized for less than one year.

Impact of Alternative A

As visitors travel to the park from St. Croix, the view of Buck Island and the surrounding park waters is relatively unaffected. There is little infrastructure at Buck Island (no roads, utilities, etc.) with minimal facilities consisting of boundary and regulatory buoys, a pier, picnic shelter, toilets, and

moorings at the underwater trail. Vessels anchored at West Beach are also visible upon approach to Buck Island and may be viewed as a minor intrusion on the scenic landscape by some visitors, while others might perceive this as a common, attractive element of a marine seascape. This same dual perception would also be applicable to the moorings located at the underwater trail, the two designated SCUBA moorings, and the proposed new moorings for administrative use. In addition, the practice of shoreline bow and stern anchoring partially obstructs the shoreline and beach view with anchors, lines, and motors. Scenic qualities of underwater resources would not be expected to be change due to management actions taken under alternative A. The overall effect on the scenic resources under Alternative A is long- and short-term, negligible, and adverse.

Cumulative Effects

Under all of the alternatives, including Alternative A, the cumulative effects on scenic resources would be largely controlled by outside influences and to a lesser extent by park management actions. The viewshed facing south toward St. Croix from Buck Island has been altered by private development and consists more of the built environment including houses, small hotels, roads, street lights and commercial development. As St. Croix continues to develop it is likely that these effects would continue to affect the scenic quality. These effects are not a result of park management actions, however, and are outside of the park's control. It should also be noted that only a portion of the vantage points visible from the park would be affected by development on St. Croix and that the majority of the park's scenic resources consists of unobscured seascape.

Beneficial effects on scenic resources could potentially be derived from territory planning efforts that incorporate preservation of scenic vistas and limitations on coastal development. The Division of Coastal Zone Management is reportedly revisiting the concept of a Territorial Park System and is developing a "Management Framework for the Marine Protected Areas of the United States Virgin Islands." St. Croix East End Marine Park, a marine protected area that abuts Buck Island Reef National Monument, was established in 2003 and is managed under this program as described in Chapter 1. NPS was involved in many planning workshops during the establishment of St. Croix East End Marine Park, and continues its cooperation for the protection of resources, in the marine park. It is also anticipated that the park's vessel management plan would incorporate viewsheds as a topic of concern. Past, on-going and future planning efforts provide additional beneficial effects. Overall, the resulting cumulative effects on the viewshed and seascape would be long- and short-term, minor, and adverse.

The spectacular elkhorn coral barrier reef that wraps around the eastern two-thirds of Buck Island, referred to as "one of the finest marine gardens in the Caribbean Sea" in the park's proclamation, was the primary reason for the establishment of the park. The underwater trail provides a means to view these corals as well as other associated marine resources. The scenic value of the "marine garden" and underwater trail has been affected by a variety of factors that have collectively led to reductions in the abundance of coral throughout the Caribbean, including the park. These factors are associated with world-wide trends and conditions, such as elevated water temperatures and other climate changes, hurricanes, disease, and are outside of the park's control and are not related to park management actions. These factors are discussed in detail in the "Marine and Coastal Resources" and "Species of Concern" sections of Chapters 3 and 4. On-going global climate changes have resulted in long- and short-term, major, adverse effects on the scenic value of the "marine garden" and other underwater resources. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting scenic resources are combined with actions under Alternative A, the resulting cumulative effects to the underwater trail/marine garden would be long and short-term, major and adverse.

Conclusions

Long- and short-term, negligible, adverse effects on the viewshed and seascape would occur under Alternative A due to the presence of moorings in the vicinity of the underwater trail (and the addition of administrative moorings) and the sight of vessels anchored on West Beach. Cumulative effects on the viewshed and seascape would be long- and short-term, minor, and adverse and would be largely due to the effects of development on St. Croix. The decline of coral populations in the park has resulted cumulative long- and short-term, major, adverse effects on the scenic value of the "marine garden" and other marine resources.

Impacts of Alternative B, the Preferred Alternative

Under Alternative B, the existing twelve moorings in the park would be retained and the existing anchoring area at West Beach would be phased out over a ten year period of time and replaced by a mooring field that would contain up to 45 new moorings off West Beach, up to 10 new moorings southwest of the pier, and up to eight new mooring for administrative use only. The exception to this is the addition of five designated anchoring locations in deep sand for vessels 91 to 150 feet in length. These anchoring locations would be established in deep water south of West Beach, and this would be a negligible change to scenic resources. Installation of additional moorings would constitute a more long-term effect on scenic resources than an anchoring area, since a mooring buoy would be a fixture on the seascape, compared to an unobscured seascape when no vessels are anchored under Alternative A. However, it is unlikely that the overall scenic quality and visitor experience would be diminished and the resulting effects would primarily impact the vantage point off West Beach. In addition, some visitors may perceive these sights as common elements of a marine seascape. Establishment of management zones, increased staffing, enforcement, research and monitoring would help prevent resource damage and maintain or improve scenic resources, providing beneficial effects. The overall result of Alternative B on scenic resources would be long-term, minor, and adverse. Effects on the scenic value of the "marine garden" and underwater trail would be the same as described for Alternative A; long- and short-term, major, adverse effects, would be applicable to Alternative B.

Cumulative Effects

Cumulative effects of Alternative B would be the same as those described for Alternative A. Even though the park management actions proposed in Alternative B would result in a minor adverse effect on scenic resources, additional staffing proposed under Alternative B may allow for more partnering between the NPS, government agencies, and other organizations that could potentially increase the level of coordinated efforts to address the scenic viewshed of the park and potential adverse effects of development actions. This may be addressed via zoning restrictions on building heights, low-light options, and design sensitivities. Past, on-going, and future planning efforts and activities described under Alternative A would also be applicable to Alternative B. Cumulative effects on the scenic value of the "marine garden" would also be the same as described for Alternative A, long- and short-term, major and adverse.

Conclusions

Long-term, minor, adverse effects on the viewshed and seascape would occur under Alternative B due to a proposed increase in the number of moorings. Cumulative effects would be long- and short-term, minor, and adverse and would be largely due to the effects of development activities on St. Croix. The cumulative effects of coral bleaching, disease, hurricanes and climate change would result in a cumulative long- and short-term, major, adverse effect on the scenic value of the "marine garden" and other underwater resources due to on-going global climate changes.

Impacts of Alternative C

Under Alternative C, the installation of additional moorings would constitute a more long-term effect on scenic resources than the anchoring area under Alternative A, since a mooring buoy would be a fixture on the seascape, compared to an unobscured seascape when no vessels are anchored under Alternative A. However, it is unlikely that the overall scenic quality and visitor experience would be diminished and the resulting effects would primarily impact the vantage point off West Beach. In addition, some visitors may perceive these sights as common elements of a marine seascape. A two-acre Anchoring Zone would also be incorporated into Alternative C and shoreline bow and stern anchoring would also be appropriate. This would result in partial obstruction of the shoreline and beach views with anchors, lines, and motors, similar to Alternative A. Establishment of management zones, increased staffing, enforcement, research and monitoring would help prevent resource damage and maintain or improve scenic resources, providing beneficial effects. The overall effect of Alternative C on the scenic resources would be long- and short-term, minor, and adverse since the effects of management actions under Alternative C would not diminish the scenic quality or the overall visitor experience.

Cumulative Impacts

Cumulative effects would be the same as those described for Alternative B, long- and short-term, minor, and adverse and would be largely due to the effects of development on St. Croix. The cumulative effects of coral bleaching, disease, hurricanes and climate change would result in a cumulative long- and short-term, major, adverse effect on the scenic value of the "marine garden" and other underwater resources.

Conclusions

Long- and short-term, minor, adverse effects on the viewshed and seascape would occur under Alternative C due to a proposed increase in the number of moorings when compared to Alternative A, which would constitute a more long-term effect. The allowance for shoreline bow and stern anchoring, which partially obscures views of the shoreline and beach, would cause effects the same as Alternative A. Cumulative effects would also be long- and short-term, minor, and adverse and would be largely due to the effects of development on St. Croix. The cumulative effects of coral bleaching, disease, hurricanes and climate change would result in a cumulative long- and short-term, major, adverse effect on the scenic value of the "marine garden" and other underwater resources.

Impacts of Alternative D

Under Alternative D, the installation of additional moorings would constitute a more long-term effect on scenic resources than the anchoring area under Alternative A, since mooring buoys would be a fixture on the seascape, compared to an unobscured seascape when no vessels are anchored under Alternative A. However, it is unlikely that the overall scenic quality and visitor experience would be diminished and the resulting effects would primarily impact the vantage point off West Beach. In addition, some visitors may perceive these sights as common elements of a marine seascape. A 16-acre Anchoring Zone would also be incorporated into Alternative D. Therefore, under Alternative D the number of vessels that could be moored or anchored off West Beach which would affect the seascape from primarily West Beach and surrounding waters. Establishment of management zones, increased staffing, enforcement, research and monitoring would help prevent resource damage and maintain or improve scenic resources, providing beneficial effects. The overall effect of Alternative D on scenic resources would be long- and short-term, minor, and adverse since the effects of management actions under Alternative D would not diminish the scenic quality or the overall visitor experience.

Cumulative Impacts

Cumulative effects would be the same as those described for Alternative B, long- and short-term, minor, and adverse and would be largely due to the effects of development on St. Croix. The cumulative effects of coral bleaching, disease, hurricanes and climate change would result in a cumulative long- and short-term, major, adverse effect on the scenic value of the "marine garden" and other underwater resources due to on-going effects from climate change.

Conclusions

Long- and short-term, minor, adverse effects on the viewshed and seascape would occur under Alternative D due to a proposed increase in the number of vessels in the park associated with opportunities for both moorings and anchoring in the park when compared to Alternative A. Cumulative effects would be long- and short-term, minor, and adverse and would be largely due to the effects of development on St. Croix. The cumulative effects of coral bleaching, disease, hurricanes and climate change would result in a cumulative long- and short-term, major, adverse effect on the scenic value of the "marine garden" and other underwater resources.

VISITOR USE AND EXPERIENCE

Regulations and Policies

The regulations and policies that guide NPS actions with respect to visitor use and experience are presented in the "Servicewide Mandates and Policies" Section of Chapter 1 and in Appendix B.

Methods

Visitor use and experience issues identified during public meetings and planning workshops included: (1) the importance of the park as the primary boating destination in St. Croix; (2) concern that elimination of shoreline bow and stern anchoring would eliminate a valued visitor experience; and (3) a desire for greater opportunities for visitor education and interpretive programs. To address these issues, an assessment of the effects of projected park management actions on visitor use and experience was made using qualitative estimates, and the effects were compared to Alternative A. In addition, information on visitor use and experience was evaluated based on the professional judgment of NPS staff. The geographic area analyzed for possible effects on visitor use and experience includes the entire park.

The major assumptions used in the analysis of effects on visitor use and experience are described in the paragraphs that follow.

> Access to Buck Island and the underwater trail is directly related to the number of vessels that can be accommodated by a particular alternative through the number of moorings and/or anchoring capacity. Anchoring in the park is dependent upon the availability of deep sand (per the proclamation) and avoidance of sensitive resources. Placement of moorings is also dictated by resource conditions and avoidance of sensitive resources including seagrasses and corals.
>
> The number of vessels that can be accommodated through moorings was estimated based on the area of deep sand, safe swing radius of a vessel, and avoidance of sensitive resources such as seagrasses and corals. The number of vessels that could potentially be accommodated in the existing anchoring area (Alternative A) or an Anchoring Zone (Alternatives C and D) was based upon historical use and avoidance of sensitive resources. Although acreages are specified for these areas under each alternative, it is unlikely that the entire proposed acreages could be utilized at a single point in time due to shifting sands, the presence and recovery of seagrass, or other resource-related protective measures. Acreages and number of vessels proposed under each alternative are presented in Chapter 2. It is assumed that as the number of vessels increase, the number of visitors also increases relative to the number of vessels.

Estimates of maximum number of vessels under each alternative are approximations and are provided for relative comparison of impacts. These estimates will be refined during the implementation phase based on further planning efforts such as the vessel management plan and related environmental compliance documents, site specific data, resource analysis, and user capacity analysis.

Regional economic growth, levels of tourism in the Virgin Islands, and population levels at St. Croix influences the level of visitation to the park (in other words, visitation numbers may fluctuate given economic conditions), however carrying capacity at the park is determined by resource conditions and other factors as described above.

All alternatives would accommodate universal access through handicapped accessible concession vessels and a handicapped accessible concrete pier.

Under Alternative A, the existing management direction for visitor experience would be extended into the future, and few or no new programs for visitors would be planned and implemented;

Under all alternatives, educational materials, outreach efforts, and interpretive activities would continue to be provided by the NPS from Park Headquarters located at Christiansted National Historic Site, Visitor Contact Station in Fort Christiansvaern, and the Scale House Eastern National Bookstore, by park staff, and by concessioners.

Concessioners will continue to operate in the park at or near existing levels.

Visitor use and experience is assessed in terms of visitor use and access, recreational opportunity, and access to orientation information and interpretation. The effects of shoreline bow and stern anchoring on visitor use and experience are addressed under "Recreational Opportunity" for each of the alternatives.

Impact Threshold Definitions

Impact threshold definitions for visitor use and experience are as follows:

Negligible: Visitors would likely be unaware of any effects associated with implementation of the alternative. There would be no noticeable change in visitor use and experience or in any defined indicator of visitor satisfaction or behavior.

Minor: Changes in visitor use and/or experience would be slight but detectable, but would not appreciably diminish or enhance the desired visitor experience. Visitor satisfaction would remain stable.

Moderate: Few characteristics of the desired visitor experience would change and/or the number of participants engaging in an activity would be altered. Visitors would be aware of the effects associated with implementation of the alternative and would likely express an opinion about the changes. Visitor satisfaction would begin to either decline or increase as a direct result of the effect.

Major: Multiple characteristics of the desired visitor experience would change and/or the number of participants engaging in an activity would be greatly reduced or increased. The visitor would be aware of the effects associated with implementation of the alternative and would likely express a strong opinion about the change. Visitor satisfaction would markedly decline or increase.

Duration: Long-term: Changes would be recognized for more than one year.
Short-term: Changes would be recognized for less than one year.

Impacts of Alternative A

Visitor Use and Access - Under Alternative A, visitor use is traditionally highest on weekends, especially Sundays, and between the months of February and April with other spikes during the year. Visitor use is typically concentrated in the vicinity of West Beach and the underwater trail. These visitor trends

would be unlikely to change. Under Alternative A, visitor use and access would remain essentially unchanged.

Under Alternative A, there is no vessel size or access restriction in place in the park outside of the lagoon. Beach access may be limited during nesting season for sensitive species including least terns and sea turtles. There are no limits set on park visitation, and the user capacity of Buck Island and the underwater trail is established by avoidance of sensitive resources including corals and seagrasses, configuration of the underwater trail, the number of visitors that can be transported via each concessioner, the number of available existing moorings, and by the number of anchoring applications that have been issued to date. There are twelve authorized concessioners, ten moorings located near the underwater trail, and an anchoring area of approximately 22 acres located near West Beach that includes shoreline bow and stern anchoring. It should be noted, however, that the entire anchoring area cannot be utilized at all times due to shifting sands, the presence of seagrass beds, or other resource-related restrictions. As seagrass recovery occurs in this area, the amount of available anchoring space would become increasingly limited. Anchoring is appropriate by permit and only in deep sand. A pier located on the south side of Buck Island is also available for dropping off passengers. Based on the assumptions outlined in Table 5 of Chapter 2, it is estimated that a maximum of approximately 87 vessels could be accommodated under Alternative A through available, existing moorings and authorized anchoring sites.

Continuation of current management actions under Alternative A would result in a range of effects on visitor use and access, from long- term, major, beneficial effects for visitors who value accessing Buck Island via both anchoring at West Beach and existing moorings near the underwater trail, to long-term, moderate, adverse effects for visitors who prefer a substantially anchorless park and/or a change to the current visitation trends. The differences between beneficial and adverse would depend on the expectations and preferences of the visitor.

Recreational Opportunity - Under Alternative A, anchoring is appropriate near West Beach (by permit), and shoreline bow and stern anchoring is also a common practice. Shoreline bow and stern anchoring is a common practice, particularly on weekends and holidays. The park would continue to restrict beach access at certain times of the year to protect nesting species. A size restriction is placed on vessels entering the lagoon (up to 42 feet in length), and this would be the only vessel size limitation within park waters. Swimming and snorkeling are permitted in all waters of the park. A hiking trail, a pier, toilets, picnic tables, and NPS grills, information kiosks and picnic shelter at Diedrich's picnic area would continue to be provided under Alternative A. Some visitors would prefer some additional improvements in existing facilities and the lack of these would result in minor adverse impacts on these visitors. Continuation of current management actions under Alternative A would have a long-term, minor, beneficial effect on recreational opportunity.

Access to Orientation Information and Interpretation - Access to park information, interpretation programs, and educational materials is available outside the monument (at locations noted in the preceding "Methods" section) through authorized park concessioners, two information kiosks (one at West Beach and another at Diedrich's picnic shelter), or incidental contact with NPS personnel. Public and internal scoping identified the desire for increased interpretation training for concessions operators, greater emphasis on educating visitors on resources and resource protection, and educational partnering with schools and other local stakeholders. The current level of staffing limits expansion of the park's educational and interpretive programs, however. Continuation of current levels of education, interpretation, and partnering offered by the park would have long-term, minor to moderate, adverse effects.

Cumulative Effects

Visitor Use and Access - The majority of NPS future studies and implementation plans outlined in Chapter 1 would benefit visitor experience within the park. Future implementation of a vessel

management plan would aid in assessing visitor use, access, and capacity issues and further refine indicators, standards, and monitoring strategies that would be used to protect park resources while providing for quality experiences. Effects related to potential future growth on St. Croix and tourism are described under "Recreational Opportunity". When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting visitor use and access are combined with actions under Alternative A, the resulting cumulative effects would be long-term, minor, and beneficial for the majority of park visitors.

Recreational Opportunity - Under all the alternatives, there is a potential for increased future growth, development, and tourism in St. Croix yet this is dependent on economic conditions. Increased growth would likely result in an increased demand for recreational activities, especially water-based recreation and tourism, and a subsequent potential increase in visitor use at the park. Assuming this pattern continues, increased visitor use could, in turn, result in fewer recreational opportunities for park visitors since a greater number of visitors would be competing for a relatively fixed number of facilities and recreational opportunities. Development of territorial parks, such as St. Croix East End Marine Park and the proposed Marine Research and Education Center at Salt River Bay National Historical Park and Ecological Preserve, and other as yet unknown commercial attractions could potentially buffer these increased demands.

Increased demand for access to Buck Island would also mean more vessel operators would want to anchor off West Beach. This would adversely affect visitor opportunities and experiences as the potential for crowding at the anchoring area and West Beach would increase. Increased vessel use would create additional enforcement challenges to protect resources. There would therefore be an increased probability of resource damage or other adverse effects from the increased vessel use, including vessel damage from unauthorized anchoring and increased potential for disturbing park resources. This would adversely affect visitor experiences as the overall quality of their experience and opportunities to enjoy recreational activities such as swimming and beach use would be adversely affected. When the beneficial and adverse effects of other past, on-going, and future plans, projects, and activities affecting recreational opportunities are combined with actions under Alternative A, the resulting cumulative effects would be long-term, minor, and beneficial.

Access to Orientation Information and Interpretation - The potential for future increased visitor use would also translate to greater demand for expanded educational and interpretive programs. However, the current level of park staffing and funding limits the capability to expand the park's educational and interpretive programs. On-going and proposed education and outreach programs within the territory and through other NPS units on St. Croix would have beneficial effects. Such initiatives include the U.S. Virgin Islands Department of Planning and Natural Resources' Environmental Education and Outreach Program and the proposed Marine Research and Education Center at Salt River Bay National Historical Park and Ecological Preserve. When the beneficial and adverse effects of other past, on-going, and future plans, projects and activities affecting access to park information and interpretation activities are combined with actions under Alternative A, the resulting cumulative effects would be long-term, minor, and adverse.

Conclusions

Continuing existing management direction under Alternative A would result in a range of effects on visitor use and access, from long-term, major, beneficial effects for visitors who value accessing the park via both anchoring at West Beach and existing moorings at the underwater trail to long-term, moderate, adverse effects for visitors who prefer a substantially anchorless park and/or a change to the current visitation trends. Alternative A would have long-term, minor, beneficial effects on recreational opportunities in the park. Continuation of existing management direction and levels of park education and interpretation activities would have long-term, minor to moderate, adverse effects.

Cumulative effects on visitor use and access and recreational opportunities would be long-term, minor, and beneficial for the majority of park visitors. Cumulative effects regarding access to information and interpretive activities would be long-term, minor, and adverse

Impacts of Alternative B, the Preferred Alternative

Visitor Use and Access - Under Alternative B the existing 22-acre anchoring area off West Beach would be phased out over a ten-year period of time as moorings are installed. The exception to this is addition of five designated anchoring locations for vessels 91 to 150 feet in length, by permit only. Up to 45 new moorings off of West Beach and up to 10 new moorings southwest of the pier would be installed, which could potentially reduce the number of vessels able to access Buck Island at a given time. Installation of moorings and phasing out the majority of anchoring in the park will reduce adverse effects resulting in less stress to ecological communities and healthier marine resources and therefore better visitor experiences. In addition, installation of moorings provides for long term access compared to Alternative A, as seagrasses recover in the anchoring area, the amount of available deep sand would likely decrease over time, and vessel operators would compete for available space to anchor. This would cause potential conflicts and visitor frustration. Phasing the mooring installation over a ten year timeframe will allow vessel operators time to adjust to the change and avoid inconveniencing visitors during the installation process. Shoreline bow and stern anchoring is eliminated under Alternative B, which would dissatisfy some visitors, and alter their experiences at Buck Island compared to traditional uses under Alternative A; this would be considered a long-term, major adverse effect to these visitors. Conversely, visitors who would prefer a more natural setting and an anchorless park would be satisfied with Alternative B; this would be considered a long-term, major beneficial effect to these visitors.

In addition, under all the action alternatives, vessel size would be limited to up to 42 feet in the lagoon and 150 feet in all park waters with the exception of the Marine Hazard Zone, where vessel use is not appropriate. Management zones would provide increased protective measures for vessel operators to avoid hazardous conditions, and be able to maneuver safely and effectively while enjoying the park. Access to park waters for vessels 151 feet and over would be authorized by permit only.

Alternative B would provide access to Buck Island for approximately 72 vessels compared to 87 vessels under Alternative A which would likely result in a reduction in visitation. This would constitute a long-term, major, adverse effect for visitors who value accessing the park by vessel to anchor and moor as well as long- and short-term, moderate, beneficial effects for visitors who prefer a substantially anchorless park and/or a change to the current visitation trends. The differences between adverse and beneficial would depend on visitor preferences and expectations related to the change in opportunities and access via anchoring versus mooring. Effects of management zones and access are addressed in terms of recreational opportunity below.

Recreational Opportunity - Under all the action alternatives, including Alternative B, all the current land-based facilities and recreational opportunities (hiking trail, picnic areas, NPS grills, toilets, and the pier) would continue to be provided and maintained in the Island Discovery Zone and Recreation Zone. Limited trail development would be possible, which would provide improved / increased visitor opportunities to explore Buck Island. Visitors would also have opportunities for guided hikes and talks.

Existing moorings at the underwater trail and SCUBA moorings would be maintained under Alternative B. Anchoring within the park would be phased out over a ten year period (with the exception of the five designated anchor locations) eliminating the recreational /social experience associated with shoreline bow and stern anchoring. This would dissatisfy some visitors, and would be a long-term, major adverse effect to these visitors.

Other forms of recreation would be altered by management zones to address visitor safety and protection of threatened elkhorn and staghorn coral, other threatened and endangered species, and sensitive resources. Boating, swimming, snorkeling, SCUBA diving, and several other forms of recreation (see Table 2) would be appropriate in the near shore Recreation Zone that encompasses 112 acres under Alternative B. These recreational opportunities are similar to Alternative A. The majority of the park would be included in the Resource Protection Zone. Beach access channels would be provided in this zone to protect swimmers and snorkelers and to avoid boater and swimmer conflicts near West Beach. The Marine Hazard Zone, where navigation is hazardous due to shallow reef complexes, would be created under all the action alternatives to protect threatened elkhorn and staghorn coral and other shallow reef species and prevent accidental vessel groundings, and protecting vessel operators. Vessel use and all other forms of aquatic recreation, with the exception of swimming, would not be appropriate in this zone. In addition, under all the action alternatives, vessel size would be limited to up to 42 feet in the lagoon and 150 feet in all park waters with the exception of the Marine Hazard Zone, where vessel use is not appropriate. Vessels greater than 151 feet would be authorized in the park under permit. This would allow the NPS the ability to track large vessel use in the park.

Phased elimination of the majority of anchoring, and limitations to vessel size by management zone, and the area available for other forms of aquatic recreation opportunities would affect visitors according to personal preference. The effects of Alternative B range from long- and short-term, major, beneficial effects on visitors who prefer a substantially anchorless park and limitations on recreational opportunities to provide greater resource protection and a natural setting, to long- and short-term, major, adverse effects on visitors who prefer to anchor and enjoy similar recreational opportunities and access as provided under Alternative A.

Access to Orientation Information and Interpretation - Under Alternative B, the methods of providing information and interpretation activities described under Alternative A would continue to be used, and the levels of education, outreach and partnering activities would increase. There would also be increased opportunities for guided interpretive tours within the Island Discovery Zone and Recreation Zone. Increased staff levels would increase NPS presence in the park and provide more opportunities for interacting with visitors. Additional opportunities for education and outreach activities involving school groups, universities and other organizations outside of the park would also be explored such as interpretive activities at Christiansted National Historic Site or utilization of the proposed education center at Salt River Bay National Historical Park and Ecological Preserve. Enhanced educational, outreach, and partnering opportunities would provide visitors an understanding of the park purpose and resources and increase awareness of the sensitivity of park resources. The overall effect on visitor access to information and interpretive activities would be long- and short-term, major, and beneficial.

Cumulative Effects

The same past, on-going, and future plans, projects, and activities affecting visitor use and experience described under Alternative A would be applicable to Alternative B. The cumulative effect of past, on-going, and future plans, projects, and activities when combined with management actions under Alternative B (phasing out the majority of anchoring and replacing the anchoring area with a mooring area, creating management zones and setting vessel size limits in the management zones) result in cumulative effects that might be concurrently viewed as beneficial and adverse, depending on personal preference and expectations.

Visitor Use and Access - The cumulative effect on visitor use and access would range from long-term, major, adverse effects for visitors who value accessing the park via anchoring to long- and short-term, moderate, beneficial effects for visitors who prefer a substantially anchorless park and/or a change to the current visitation trends.

Recreational Opportunity - The cumulative effects on recreation opportunities would range from long- and short-term, major, beneficial effects on visitors who prefer a substantially anchorless park and limitations on recreational opportunities to provide greater resource protection, to long- and short-term, major, adverse effects on visitors who prefer to anchor and enjoy recreational opportunities such as those provided under Alternative A.

Access to Orientation Information and Interpretation - The cumulative effect on visitor access to information and interpretive activities would be long- and short-term, major, and beneficial, substantially due to the contribution of management actions proposed under Alternative B.

Conclusions

Altering the type of visitor access and use via management zones and potentially reducing the number of vessels that would access Buck Island under Alternative B would constitute a long-term, major, adverse effect for visitors who value accessing the park via anchoring, convenience, and a more social experience. Concurrently, for visitors who prefer a substantially anchorless park and/or a change to the current visitation trends and who appreciate a more natural park setting, the effects of Alternative B would be long- and short-term, moderate, and beneficial.

The cumulative effects of Alternative B on recreational opportunity would range according to personal preference as well, from long- and short-term, major, beneficial effects on visitors who prefer a substantially anchorless park and limitations on recreational opportunities to provide greater resource protection, to long- and short-term, major, adverse effects on visitors who prefer to anchor and enjoy similar recreational opportunities and access as provided under Alternative A.

The overall effect of Alternative B on visitor access to information and interpretive activities would be long- and short-term, moderate, and beneficial. The cumulative effect of Alternative B on visitor access to information and interpretive activities would be long- and short-term, major and beneficial.

Impacts of Alternative C

Visitor Use and Access - Under all the action alternatives, including Alternative C, all the current land-based facilities and recreational opportunities (hiking trail, picnic areas, NPS grills, toilets, and the pier) would continue to be provided and maintained in new management zones, Island Discovery Zone and Recreation Zone. Limited expansion of trails would be possible, which would provide increased visitor opportunities to explore Buck Island. Trail conditions could degrade with increased trail use, however with soil stabilization measures and maintenance activities, the visitor experience would not be adversely affected. Visitors would also have opportunities for guided hikes and talks.

Under Alternative C, the existing 22 anchoring area would be eliminated and replaced with a 2-acre Anchoring Zone for shoreline bow and stern anchoring at West Beach. In addition, designated anchoring locations would be provided for vessels 91 to 150 feet. Anchoring would be appropriate by permit only in deep sand. Shoreline bow and stern anchoring would be appropriate under Alternative C, and anchors would be required to be buried in the sand to avoid visitor trip and fall hazards. This would provide similar benefits as Alternative A for visitors who prefer bow and stern anchoring and the ability to access the beach directly from a vessel. In addition, a maximum of 45 new moorings would be installed off West Beach, and 10 new moorings would be installed southwest of the pier. It is anticipated that a similar number of vessels (5 fewer) would be accommodated under Alternative C when compared to Alternative A (92 and 87, respectively), which is a negligible effect.

In addition, under all the action alternatives, vessel size would be limited to up to 42 feet in the lagoon and 150 feet in all park waters with the exception of the Marine Hazard Zone, where vessel use is not appropriate. Management zones would provide increased protective measures for vessel operators to avoid hazardous conditions, and be able to maneuver safely and effectively while enjoying the park. Access to vessels 151 feet and over would be authorized by permit only.

The effects from these management actions might be concurrently viewed as beneficial and adverse, depending on personal preference and expectations. Under Alternative C, for visitors who value accessing the park via anchoring and mooring there would be long-term, minor to moderate, and beneficial effects; the effects to visitors who prefer a substantially anchorless park and a change in visitation use trends would be long- and short-term, moderate, and adverse.

Recreational Opportunity - Under all the alternatives, including Alternative C, all current land-based facilities and recreational opportunities (hiking trail, picnic areas, NPS grills, toilets, and the pier) would continue to be provided and maintained. Moorings (up to 10) would be maintained at the underwater trail, along with 2 SCUBA moorings, the same as Alternative A. As with all alternatives, anchoring in deep sand would be designated at 5 sites for larger vessels by permit. Shoreline bow and stern anchoring is also appropriate, resulting in effects similar to those described under Alternative A. Additional moorings would also provide access for visitors and would replace the anchoring area over a ten year timeframe. Phasing the transition to moorings avoids inconveniencing visitors during installation.

In addition, other forms of recreation would change with the implementation of management zones to address visitor safety and protection of threatened and endangered species and other sensitive resources. Boating, swimming, snorkeling, SCUBA diving, and several other forms of recreation (see Table 2) would be appropriate in the Recreation Zone, which encompasses 112 acres under Alternative C. The majority of the park would be included in the Resource Protection Zone. Beach access channels would be provided in this zone to protect swimmers and snorkelers and to avoid boater and swimmer conflicts. The Marine Hazard Zone, where navigation is hazardous due to shallow reef complexes, would be created under all the action alternatives. Vessel use and all other forms of aquatic recreation, with the exception of swimming, would not be appropriate in this zone. The effects of the management zones would be long-term, moderate and beneficial.

The overall effect on recreational opportunity would be long- and short-term, moderate, and beneficial for the majority of visitors since there are opportunities for anchoring for large vessels, shoreline bow and stern anchoring is appropriate, additional moorings would be provided, underwater trail and SCUBA moorings would remain, and all land based recreational opportunities would be the same as Alternative A. Management zones provide additional benefits for resource protection and visitor safety, which satisfies a large range of visitor preferences.

Access to Orientation Information and Interpretation - The same effects as those described under Alternative B are applicable to Alternative C. With increased staff, the overall effect on access to information and interpretive activities would increase outside the park as well as in the Island Discovery Zone and Recreation Zone, resulting in long- and short-term, major, and beneficial effects.

Cumulative Effects

The same past, on-going, and future plans, projects, and activities affecting visitor use and experience described under Alternative A would be applicable to Alternative C. The cumulative effect of past, on-going, and future plans, projects, and activities when combined with management actions under Alternative C result in cumulative effects that might be concurrently viewed as beneficial and adverse, depending on personal preference and expectations.

Visitor Use and Access - The cumulative effect on visitor use and access under Alternative C, for visitors who value accessing the park via moorings and anchoring there would be long-term, minor to moderate, and beneficial effects; the effects to visitors who prefer a substantially anchorless park and a change in visitation use trends would be long- and short-term, moderate, and adverse.

Recreational Opportunity - The cumulative effects on recreational opportunity would be long- and short-term, moderate, and beneficial for the majority of visitors since there are opportunities which satisfy a large range of visitor preferences.

Access to Orientation Information and Interpretation - The cumulative effect on visitor access to information and interpretive activities would be long- and short-term, major, and beneficial, substantially due to the contribution of management actions proposed under Alternative C.

Conclusions

The effects of Alternative C on visitor use and access would range from long-term, minor to moderate and beneficial for visitors who value a more social experience and accessing the park via both anchoring and mooring to long- and short-term, moderate, and adverse for visitors who prefer a substantially anchorless park, a change in visitation use trends, and a more natural park setting.

The overall effect on recreational opportunity would be long- and short-term, moderate, and beneficial for the majority of visitors since there are opportunities which satisfy a large range of visitor preferences. With increased staff, the overall effect on access to information and interpretive activities would be increased, resulting in long- and short-term, major, and beneficial effects.

The cumulative effect of Alternative C on visitor use and access would be a long- and short-term, minor, benefit for the majority of park visitors compared to Alternative A. The cumulative effect on recreational opportunities would be long- and short-term, moderate, and beneficial for the majority of visitors since a large range of visitor preferences are satisfied, similar to Alternative A. The cumulative effect regarding visitor access to information and interpretive activities would be long- and short-term, major, and beneficial.

Impacts of Alternative D

Visitor Use and Access - Under all the action alternatives, including Alternative D, all the current land-based facilities and recreational opportunities (hiking trail, picnic areas, grills, toilets, and the pier) would continue to be provided and maintained in new management zones, Island Discovery Zone and Recreation Zone. However, the number of these facilities would not increase, with the exception of limited expansion of trails, which would provide increased visitor opportunities to explore Buck Island. Trail conditions could degrade with increased trail use, however with soil stabilization measures and maintenance activities, the visitor experience would not be adversely affected. Visitors would also have opportunities for guided hikes and talks. With the increase in vessels and visitors to Buck Island, the demand for existing picnic tables, NPS grills, toilets, the trail and pier would likely increase. This may adversely affect visitor experiences as visitors may have to compete for available space, or may encounter other visitors on a more frequent basis. Crowding on West Beach would also likely occur especially on peak visitation days, primarily on weekends and holidays when locals traditionally visit Buck Island. These effects would be considered long-and short-term, moderate and adverse.

Under Alternative D, the existing anchoring area would be phased out and replaced with a 16-acre Anchoring Zone off of West Beach. Anchoring would be appropriate by permit only in deep sand. Shoreline bow and stern anchoring would be eliminated under Alternative D and this would dissatisfy some visitors. Up to 45 new moorings would be installed beyond the Anchoring Zone off West Beach, and up to 10 new moorings would be installed southwest of the pier. Compared to Alternative A, Alternative D would provide more opportunities to access Buck Island via moorings and anchoring (87 vessels compared to 112 vessels, respectively).

The effects of management actions proposed under Alternative D would range from long-term, minor, and adverse for visitors who value accessing the park via both anchoring and mooring and appreciate a more social experience, to long- and short-term, major, and adverse for visitors who prefer a substantially anchorless park, fewer vessels and therefore fewer visitors.

Recreational Opportunity - Under all the alternatives, including Alternative D, all current land-based facilities and recreational opportunities (hiking trail, picnic areas, NPS grills, toilets, and the pier)

would continue to be provided and maintained. Moorings (up to 10) would be maintained at the underwater trail, along with 2 SCUBA moorings, the same as Alternative A. Due to the increased number of vessels and visitors to the park, the demand on these moorings would be expected to increase, resulting in some visitors not being able to find an available mooring. This would lead to dissatisfied visitors, or perhaps vessels moving to anchoring sites or moorings off West Beach while they wait available space at the underwater trail. Vessels that idle while waiting for a mooring at the underwater trail also increase the potential for navigation and maneuvering issues for other vessels, as well as the potential for groundings.

As with all alternatives, anchoring would be designated at 5 deep sand sites for larger vessels by permit. Shoreline bow and stern anchoring is eliminated under Alternative D, which would dissatisfy some visitors, and alter their experiences at Buck Island compared to traditional uses under Alternative A. Additional moorings would provide access for visitors and would replace the anchoring area over a ten year timeframe. Phasing the transition to moorings avoids inconveniencing visitors during installation.

Some forms of recreation would change with the implementation of management zones to address visitor safety and protection of threatened and endangered species and other sensitive resources. Boating, swimming, snorkeling, SCUBA diving at the SCUBA moorings, and several other forms of recreation (see Table 2) would be appropriate in the Recreation Zone, which encompasses 112 acres under Alternative C. The majority of the park would be included in the Resource Protection Zone, which would also allow a similar level of recreational opportunities. Beach access channels would be provided in this zone to protect swimmers and snorkelers and to avoid boater and swimmer conflicts. The Marine Hazard Zone, where navigation is hazardous due to shallow reef complexes, would be created under all the action alternatives. Vessel use and all other forms of aquatic recreation, with the exception of swimming, would not be appropriate in this zone. The effects of the management zones would be long-term, moderate and beneficial.

The overall effect on recreational opportunities would be long- and short-term, minor, and beneficial for the majority of visitors since there are opportunities for anchoring for large vessels, moorings would be provided, underwater trail and SCUBA moorings would remain, and all land based recreational opportunities would be the same as Alternative A, with guided walks and limited opportunities for more trails. The elimination of shoreline bow and stern anchoring would dissatisfy some visitors, however. Management zones would provide additional benefits for resource protection and visitor safety, which satisfies a large range of visitor preferences.

Access to Orientation Information and Interpretation - Under Alternative D, the methods of providing information and interpretation activities described under Alternative A would continue to be used, and the levels of education, outreach and partnering activities would increase. There would also be increased opportunities for guided interpretive tours within the Island Discovery Zone and Recreation Zone. Increased staff levels would increase NPS presence in the park and provide more opportunities for interacting with visitors. However, due to the increase in number of visitors at Buck Island, the increase in NPS presence may not be perceptible by some visitors. Additional opportunities for education and outreach activities involving school groups, universities and other organizations outside of the park would also be explored such as interpretive activities at Christiansted National Historic Site or utilization of the proposed education center at Salt River Bay National Historical Park and Ecological Preserve. There would likely be a higher reliance on other NPS units to provide information due to the increased numbers of visitor expected under Alternative D. Enhanced educational, outreach, and partnering opportunities would provide visitors an understanding of the park purpose and resources and increase awareness of the sensitivity of park resources. The overall effect on visitor access to information and interpretive activities would be long- and short-term, moderate, and beneficial.

Cumulative Effects

The same past, on-going and future plans, projects, and activities affecting visitor use and experience described under Alternative A would be applicable to Alternative D. The cumulative effect of these plans, projects, and activities when combined with management actions under Alternative D result in cumulative effects that might be concurrently viewed as beneficial and adverse, depending on personal preference and expectations.

The effects of Alternative D have a major contribution to cumulative effects to visitor use and experience. When the effects are combined, the cumulative effects on visitor use and access would be long-term, minor, and adverse. The elimination of bow and stern anchoring influences the level of intensity of effect, compared to Alternative A. The cumulative effects on recreational opportunity would be long- and short-term, minor, and beneficial for the majority of visitors since there are opportunities that would satisfy a large range of visitor preferences. The cumulative effect on visitor access to information and interpretive activities would be long- and short-term, moderate, and beneficial, substantially due to the contribution of management actions proposed under Alternative D.

Conclusions

The effects of management actions proposed under Alternative D would range from long-term, minor, and adverse for visitors who value accessing the park via both anchoring and mooring and appreciate a more social experience, to long- and short-term, major, and adverse for visitors who prefer a substantially anchorless park, fewer vessels and therefore fewer visitors and appreciate a more natural park setting.

The overall effect on recreational opportunities would be long- and short-term, minor, and beneficial for the majority of visitors since there are opportunities for a wide variety of recreational use. The overall effect on visitor access to information and interpretive activities would be long- and short-term, moderate, and beneficial.

When the beneficial and adverse effects other past, on-going, and future pans, projects, and activities affecting visitor use and experience are combined with actions under Alternative D, the resulting cumulative effects would be heavily influenced by the management actions proposed under Alternative D. The cumulative effects on visitor use and access would be long-term, minor, and adverse. The elimination of bow and stern anchoring influences the level of intensity of effect, compared to Alternative A. The cumulative effects on recreational opportunity would be long- and short-term, minor, and beneficial for the majority of visitors since there are opportunities that would satisfy a large range of visitor preferences. The cumulative effect on visitor access to information and interpretive activities would be long- and short-term, moderate, and beneficial, substantially due to the contribution of management actions proposed under Alternative D.

PARK OPERATIONS

Regulations and Policies

The regulations and policies that guide NPS actions with respect to park operations are presented in the “Servicewide Mandates and Policies” Section of Chapter 1 and in Appendix B.

Methods

This impact topic refers to the ability of NPS staff to protect and preserve Buck Island Reef National Monument and provide opportunities for enjoyable visitor experiences while leaving park resources unimpaired for future generations, and the efficiency and effectiveness with which NPS staff are able to perform tasks. Issues related to park operations identified during public comment periods and planning workshops included: (1) the need for greater law enforcement presence and consistency in the enforcement of rules and regulations; (2) a desire for more education and interpretive programs;

and (3) the importance of interpretive training for concessioners. To address these issues, an assessment of the effects of projected park management actions on park operations was made using qualitative estimates, and the effects were compared to Alternative A. In addition, information on park operations was evaluated based on the professional judgment of NPS staff. The area analyzed for possible effects as well as cumulative effects includes the entire park.

Major assumptions used in the analysis of effects on park operations were that: (1) under Alternative A, the existing management programs would be extended into the future, and that few or no new programs for visitors would be planned and implemented; (2) increased visitor use and access to Buck Island could potentially translate to a greater strain on park staff (see also assumptions for assessing "Visitor Use and Experience" methods section of Chapter 4); (3) increased educational and interpretive programs and increased partnering and/or research initiatives would strain park operations without an increase in staffing; and (4) the type and number of visitor facilities (not including moorings) and corresponding maintenance would be similar under all the alternatives and is not a factor in the impact analysis.

Although increased staffing and funding are proposed under the action alternative, it should be noted that implementation of the approved plan would depend on future funding and servicewide priorities. Approval of a general management plan does not guarantee that funding and staffing needed to implement the plan would be forthcoming. Larger capital improvements may be phased over several years, and full implementation of the general management plan could be many years into the future.

Impact Threshold Definitions

Impact threshold definitions for park operations are as follows:

Negligible: Management actions would be at or below levels of detection and would not have an appreciable effect on park operations.

Minor: Management actions would affect operations in a way that would be difficult to measure. Impacts on the park staff workload would be short term, with little material effect on other on-going park programs. The change would be noticeable to staff but not to the public.

Moderate: Management actions would measurably affect operations. Park staff workloads and priorities would need to be rearranged to implement actions. The change would be readily apparent to park staff and possibly to the public.

Major: Management actions would measurably affect operations. Park staff workloads and priorities would be rearranged to implement actions. The effects would be substantial, widespread, and apparent to park staff and the public.

Duration: Long-term: Changes would be recognized for more than one year.
Short-term: Changes would be recognized for less than one year.

Impacts of Alternative A

Several factors have led to a greatly expanded workload for current park staff including: the 2001 boundary expansion from 880 to 19,015 acres; enforcement of the Proclamation (no extractive use, anchoring in deep sand only, etc); the listing of elkhorn and staghorn coral as threatened species; recent coral bleaching events requiring increased research and monitoring, impact, and recovery documentation efforts; reintroduction of the globally endangered St. Croix ground lizard, impact of the non-native invasive lionfish, climate change, and the associated need for increased enforcement, education, and interpretation. Additionally, without the creation of management zoning, park operations would become increasingly difficult to implement under current conditions resulting in less effective park management.

The levels of NPS ranger presence, activity, and enforcement would be expected to remain near or at existing conditions. NPS patrols at Buck Island and throughout the park are limited due to staffing constraints, and this condition would be expected to continue. Anchoring permits would be required for the designated anchoring area, with permit holders required to attend informational sessions to learn about park rules, regulations, and permit conditions. These sessions would need to be held on a routine basis, which would further increase staff workloads.

The current level of partnerships and cooperation with the territorial government, other agencies, and private organizations would continue; however, there is an ever increasing demand for park staff to partner with outside entities for response to coral bleaching events and coordination regarding protection of threatened and endangered species and other endeavors. Scientific research, coordination, and monitoring would become increasingly difficult with existing staffing levels. Demands for interpretation and activities would likely not be met, resulting in dissatisfaction from local organizations, educators, and visitors.

Concessioners would continue to operate under a similar or same number of concessions contracts, and the level of training for concessioners would remain the same. Some visitors have identified that more information is needed, and more interaction with NPS is needed. This condition would likely continue. Volunteer programs, such as the Youth Conservation Corps Program, would be expected to continue at current levels. Overall, Alternative A would have a long- and short-term, moderate adverse effects on park operations.

Cumulative Effects

Under all alternatives, increased development and tourism in the region would result in an increased demand for recreational activities, especially marine-based recreation and tourism, and a subsequent increase in visitor use. Increased visitor use would, in turn, result in increased pressure on the park to provide more educational and interpretive programs, more recreational opportunities, and increase the need for law enforcement. Since a greater number of visitors would be competing for a relatively fixed number of facilities and recreational opportunities, conflicts could arise, and increased law enforcement would be necessary to deter problems. Current staffing levels are not sufficient to adequately meet these demands. Development of territorial parks, such as St. Croix East End Marine Park and Salt River Bay National Historical Park and Ecological Preserve, could potentially buffer some of these increased demands, however.

Existing vessel use patterns and trends would be expected to continue which would create additional enforcement challenges to protect resources, particularly threatened and endangered species. Additional enforcement and research and monitoring is required to protect the threatened elkhorn and staghorn coral, which would place additional demands on existing park staff. There would therefore be an increased probability of resource damage or other adverse effects from the increased vessel use, including vessel damage from unauthorized anchoring and increased potential for disturbing park resources. This would adversely affect park operations.

The majority of NPS future studies and implementation plans outlined in Chapter 1 would benefit park operations in the long-term. In particular, development and implementation of a commercial services plan and a vessel management plan would greatly benefit routine park operations. A commercial services plan would identify the appropriate role of commercial operations in the park, and would assist the park to achieve the desired visitor experiences identified in this General Management Plan. The commercial services plan would also identify whether proposed concession facilities and services are necessary and appropriate, and would consider alternatives. A vessel management plan would provide a comprehensive tool for all aspects of management of vessels within park waters, including specific locations and appropriate type and use of all moorings and anchoring, and vessel operations. User capacity analyses and routine refinement of the indicators, standards, and

monitoring strategies that can be used to protect park resources while providing for quality experiences would also be beneficial.

While all the above mentioned planning efforts are needed to improve park operations and ensure resource protection and quality visitor experiences, formulation and implementation of these studies and plans would have short- to long-term adverse effects on staff workloads. Current staffing levels would not necessarily be sufficient to develop all the needed plans or to implement and enforce the recommendations of these planning efforts. When the beneficial and adverse effects of other past, on-going, and future plans, projects, and activities affecting park operations are combined with management actions under Alternative A, the resulting cumulative effects would be long- and short-term, moderate and adverse.

Conclusions

Long- and short-term, moderate, adverse effects on park operations would occur under Alternative A largely due to a need for additional staff as a result of a workload that has been greatly expanded. When the beneficial and adverse effects of other on-going, and future plans, projects, and activities affecting park operations are combined with actions under Alternative A, the resulting cumulative effects would be long- and short-term, moderate, and adverse. The cumulative effect level of intensity is slightly less due to management actions proposed under Alternative A due to the benefits of future studies and implementation plans.

Impacts of Alternative B, the Preferred Alternative

The establishment of management zones under Alternative B and all other action alternatives provide effective means to improve park operations. Management zones would provide additional benefits for resource protection and visitor safety, which satisfies a large range of demands on park operations. This would aid park staff in decision-making, resource management, and enforcement.

Public and internal scoping identified a lack of enforcement staff and/or NPS presence (especially during weekends) under Alternative A, the no action alternative. Under Alternative B, approximately 6 additional full time staff, or equivalents, are proposed to help disperse the expanded workload (described under Alternative A). The increase in enforcement would help address this concern. In addition, it is estimated that Alternative B would accommodate slightly fewer vessels than Alternative A which would decrease management needs (72 versus 87 vessels, respectively).

Eventual elimination of the majority of anchoring under Alternative B would greatly reduce staff workloads by lessening the demands of the anchoring permit program and by greatly reducing anchoring-related enforcement and related resource management issues. These benefits to park operations would be slightly offset by the need for monitoring mooring use and routine maintenance of the proposed new moorings. In addition, creation of the Marine Hazard Zone would reduce the potential for vessel strandings/groundings and would limit interaction with sensitive resources which would also benefit resources and management efforts. However, more enforcement and visitor education would be required to convey the purpose of the Marine Hazard Zone as well as other management zones in the short-term to increase visitor awareness. Management zones would have overall long-term, major, beneficial effects.

Educational, interpretive, and volunteer programs and opportunities for partnering with local agencies and other organizations would continue and would have the potential to expand without straining park staff due to proposed increases to interpretive, enforcement, and resource management staff. In addition, increased levels of research and monitoring would be conducted to provide data necessary to determine the best management practices to avoid adverse effects to rare, threatened, or endangered species. Research and monitoring of the elkhorn and staghorn coral in the park and opportunities to partner with other research entities would increase, as would other research needed to determine what additional measures should be taken to help protect these threatened species, as

well as other natural and cultural resources in the park. Research in the park would also be aided by the addition of a maximum of eight resource management moorings. These moorings would provide consistent access for monitoring and other resource protection efforts, thereby increasing efficiency.

Successful implementation of Alternative B would be dependent on the hiring of additional staff, which is dependent on future funding and servicewide priorities. Overall, Alternative B would have a long- and short-term, major, beneficial effects on park operations.

Cumulative Effects

Under all the alternatives, including Alternative B, increased development and tourism in the region would likely result in an increased demand for recreational activities, especially marine-based recreation and tourism, and a subsequent increase in visitor use. Increased visitor use would, in turn, result in increased pressure on the park to provide more educational and interpretive programs as well as more recreational opportunities. Development of territorial parks, such as St. Croix East End Marine Park, could potentially buffer these increased demands, however. Increased staffing proposed under Alternative B would allow for additional cooperative efforts to address issues related to increased visitor use.

The same beneficial effects on park operations related to future NPS studies and implementation plans described under the cumulative effects section for Alternative A would be applicable to Alternative B. However, since additional staff are proposed for Alternative B, the short-term adverse effects described under Alternative A related to formulating and implementing these efforts would be of lesser magnitude. When the beneficial and adverse effects of other past, on-going, and future plans, projects, and activities affecting park operations are combined with actions under Alternative B, the resulting cumulative effects would be long- and short-term, major, and beneficial.

Conclusions

Long- and short-term, major, beneficial effects on park operations would occur under Alternative B due to the implementation of management zones, a proposed increase in staffing, and alleviation of management requirements resulting from the elimination of the majority of anchoring in the park. Cumulative effects on park operations would be long- and short-term, major, and beneficial.

Impacts of Alternative C

The establishment of management zones under Alternative C and all other action alternatives provide effective means to improve park operations. Management zones would provide additional benefits for resource protection and visitor safety, which satisfies a large range of demands on park operations. This would aid park staff in decision-making, resource management, and enforcement. Under Alternative C, approximately 8 additional full time staff, or equivalents, are proposed to help disperse the expanded workload (described under Alternative A). In addition, it is estimated that Alternative C would accommodate approximately 5 more vessels than Alternative A which would have similar management needs (92 versus 87 vessels, respectively).

Eventual elimination of the majority of anchoring under Alternative C would reduce staff workloads by lessening the demands of the anchoring permit program somewhat, and by reducing some anchoring-related enforcement and resource protection issues. These benefits to park operations would be slightly offset by the need for monitoring mooring use and routine maintenance of the proposed new moorings. However, Alternative C would be similar to Alternative A with regard to shoreline bow and stern anchoring at West Beach and park operation concerns regarding enforcement.

In addition, implementation of the Marine Hazard Zone would reduce the potential for vessel strandings/groundings and would limit interaction with sensitive resources which would also benefit resources and management efforts. However, more enforcement and visitor education would be

required to convey the purpose of the Marine Hazard Zone as well as other management zones in the short-term to increase visitor awareness. Management zones would have overall long-term, major, beneficial effects.

Educational, interpretive, and volunteer programs and opportunities for partnering with local agencies and other organizations would continue and would have the potential to expand without straining park staff due to proposed increases to interpretive, enforcement, and resource management staff. In addition, increased levels of research and monitoring would be conducted to provide data necessary to determine the best management practices to avoid adverse effects to rare, threatened, or endangered species. Research and monitoring of the elkhorn and staghorn coral in the park and opportunities to partner with other research entities would increase, as would other research needed to determine what additional measures should be taken to help protect these threatened species, and other resources in the park. Research in the park would also be aided by the addition of up to eight administrative moorings. These moorings would provide consistent access for monitoring and other resource protection efforts, thereby increasing efficiency.

Successful implementation of Alternative C would be dependent on the hiring of additional staff, which is dependent on future funding and servicewide priorities. Overall, Alternative C would have a long- and short-term, moderate, beneficial effects on park operations.

Cumulative Impacts

The same past, on-going and future plans, projects, and activities affecting park operations described under Alternative B are applicable to Alternative C. When combined with management actions proposed under Alternative C, the cumulative effects would be long- and short-term, moderate, and beneficial.

Conclusions

Long- and short-term, moderate, beneficial effects on park operations would occur under Alternative C due to proposed increase in staffing which would allow enforcement, research, partnering, and interpretive programs to continue and expand without straining park operations. Management efforts related to maintaining anchoring permits under Alternative C would be slightly less than Alternative A. When the beneficial and adverse effects of other on-going, and future plans, projects and activities affecting park operations are combined with actions under Alternative C, the resulting cumulative effects would be long- and short-term, moderate, and beneficial.

Impacts of Alternative D

The establishment of management zones under Alternative D and all other action alternatives provide effective means to improve park operations. Management zones would provide additional benefits for resource protection and visitor safety, which satisfies a large range of demands on park operations. This would aid park staff in decision-making, resource management, and enforcement. It is estimated that Alternative D would accommodate approximately 25 more vessels than Alternative A which would have increased management needs (112 versus 87 vessels, respectively).

Maintaining anchoring in the park in the 16 acre Anchoring Zone under Alternative C would require a staff workload similar to Alternative A to maintain the anchoring permit program, and address anchoring-related enforcement and resource protection issues. These park operations requirements would be slightly offset by the elimination of shoreline bow and stern anchoring. However, there would also be concurrent increased requirements for monitoring mooring use and routine maintenance of the proposed new moorings. Under Alternative D, approximately 9 additional full time staff, or equivalents, are proposed to help disperse the expanded workload (described under Alternative A). The increased demand on park operations from the increased number of vessels and

visitors in the park would be somewhat offset by the increase in staff, with short- and long-term, moderate adverse effects.

Implementation of the Marine Hazard Zone would reduce the potential for vessel strandings/groundings and would limit interaction with sensitive resources which would also benefit resources and management efforts. However, more enforcement and visitor education would be required to convey the purpose of the Marine Hazard Zone as well as other management zones in the short-term to increase visitor awareness. Management zones would have overall long-term, major, beneficial effects.

Educational, interpretive, and volunteer programs and opportunities for partnering with local agencies and other organizations would continue and would have the potential to expand without straining park staff due to proposed increases to interpretive, enforcement, and resource management staff. In addition, increased levels of research and monitoring would be conducted to provide data necessary to determine the best management practices to avoid adverse effects to rare, threatened, or endangered species. Research and monitoring of the elkhorn and staghorn coral in the park and opportunities to partner with other research entities would increase, as would other research needed to determine what additional measures should be taken to help protect these threatened species, and other resources in the park. Research in the park would also be aided by the addition of up to eight administrative moorings. These moorings would provide consistent access for monitoring and other resource protection efforts, thereby increasing efficiency.

Successful implementation of Alternative D would be dependent on the hiring of additional staff, which is dependent on future funding and servicewide priorities. Increased staff implementing management actions required to institute the desired conditions and use of management zones would result in long- and short-term, minor, adverse effects on park operations.

Cumulative Effects

The same past, on-going and future plans, projects, and activities affecting park operations described under Alternative A are applicable to Alternative D. When the beneficial and adverse effects of other on-going, and future plans, projects and activities affecting park operation are combined with management actions proposed under Alternative D, the cumulative effects would be long- and short-term, negligible, and adverse.

Conclusions

Increased staff implementing management actions required to institute the desired conditions and use of management zones under Alternative D would result in long- and short-term, minor, adverse effects on park operations. When the beneficial and adverse effects of other on-going, and future plans, projects and activities affecting park operation are combined with management actions proposed under Alternative D, the cumulative effects would be long- and short-term, negligible, and adverse.

PUBLIC HEALTH AND SAFETY

Regulations and Policies

Regulations and policies that guide NPS actions with respect to public health and safety are presented in the “Servicewide Mandates and Policies” Section of Chapter 1 and in Appendix B.

Methods

Issues related to public health and safety identified during public comment periods and planning workshops included: (1) boater safety and navigation hazards; (2) trip and fall hazards associated with shoreline bow and stern anchoring; (3) safe access to West Beach from vessels; (4) the desire for increased NPS ranger presence; and (5) hazards associated with marine life, terrestrial vegetation, and

harsh conditions. The effects of each alternative in relationship to these issues were estimated by qualitatively comparing the management actions under each alternative to effects of Alternative A. The primary sources of information used in this analysis included NPS policy documents, incident reports, and unpublished observations and insights from knowledgeable park staff. The area analyzed for possible effects on public health and safety includes the entire park; however, many of the identified health and safety issues predominate near West Beach, shallow reefs, the lagoon area, and the underwater and terrestrial trails. The cumulative impacts analysis also considers effects within the park boundary.

The assumptions used in this analysis were that: (1) under Alternatives A and C, hazards associated with shoreline bow and stern anchoring would be present (potential to trip on anchors, lines, or vessel propellers on West Beach); (2) the number of incidents of public health and safety concern is relative to the overall number of visitors and the number of vessels that may anchor and/or moor in the park under each alternative; and (3) when compared to Alternative A, adverse effects related to visitor health and safety would be minimized under the action alternatives due to proposed staffing increases.

Although increased staffing and funding are proposed under the action alternatives, it should be noted that implementation of the approved plan would depend on future funding and servicewide priorities. Approval of a general management plan does not guarantee that funding and staffing needed to implement the plan would be forthcoming. Implementation may be phased over several years, and full implementation of the general management plan could be many years into the future.

Impact Threshold Definitions

Impact threshold definitions for public health and safety are as follows:

Negligible: Public health and safety would not be affected; effects on employee and visitor health or safety would not be appreciable or measurable.

Minor: Effects on employee and/or visitor health and safety would be detectable; however, they would not produce an appreciable change in public health or safety.

Moderate: The effects would be readily apparent, and would result in significant, noticeable effects on employee and/or visitor health and safety on a local scale. Changes in rates or severity of injury or illness could be measured.

Major: The effects would be readily apparent, and would result in substantial, noticeable effects on staff and/or visitor health and safety on a regional scale, and could lead to staff or visitor mortality.

Duration: Long-term: Changes would be recognized for more than one year.
Short-term: Changes would be recognized for less than one year.

Impacts of Alternative A

Under Alternative A, existing levels of health and safety-related issues would be expected to continue into the future without change. There is currently no vessel size or access restriction in place in the park outside of the lagoon which increases the potential for vessel groundings and reef damage due to hazardous navigation conditions. Vessel groundings could result in personal injury. In addition, the trip and fall hazard associated with shoreline bow and stern anchoring would continue to exist under Alternative A. Providing vessels direct access to the beach, however, allows safer beach access for non-swimmers which was an expressed concern from visitors. Conversely, there would be no separation of vessels and swimmers near West Beach which could result in conflicts and potential safety hazards for swimmers.

The NPS would continue to close the beaches and anchoring area at Buck Island during storms, when stinging jellyfish are present, or during other hazardous conditions.

Public and internal scoping identified a lack of enforcement staff and/or NPS presence (especially during weekends) under current conditions. This lack of consistent NPS presence would be expected to continue into the future, resulting in an increase in the probable number of safety-related incidents. Staffing limitations also hinder expansion of education and interpretive programs which are instrumental in preventing incidents related to encounters with hazardous vegetation and certain marine life, the importance of adhering to marked trails due to hazards associated with steep and unstable slopes, poisonous/hazardous vegetation, and dehydration. As coastal and marine species continue to recover in the "no take" marine reserve, populations of predator species (such as sharks, barracudas and others) would also be expected to recover. The potential for incidents with sharks and other predators may occur. Without increased NPS presence at Buck Island, it would be difficult to provide onsite information regarding the hazards related to inappropriate fish feeding (fish feeding is prohibited) and inform visitors of the natural predator/prey relationships that exist in the park and how to avoid potential conflicts. The overall effect of Alternative A on public health and safety would be long- and short-term, minor, and adverse.

Cumulative Effects

Under all the alternatives, including Alternative A, cumulative effects on public health and safety would largely be controlled by park management actions and to a lesser extent by outside influences since effects on public health and safety are largely related to the number of visitors to Buck Island and park waters, natural hazards, and the level of NPS staffing presence. Other contributing factors to cumulative effects include working with partners (the territory, U.S. Coast Guard, and other federal agencies) to get digital boundaries of the park on charts and maps, which would aid in consistent enforcement practices, and to educate the public on hazardous navigational challenges, and other health and safety related issues. In addition, development of a vessel management plan would involve the public in identifying and addressing safety-related issues. Concessioners would benefit from a Concessions Management Plan that would clearly outline expectations and requirements for both the NPS and concessioners. Anchoring permit holders would continue to be provided with information regarding park rules and regulations as well as safety considerations.

As the "no take" marine reserve continues to allow for fish and other marine populations to recover, predator species (such as sharks, barracudas and others) would likely also increase in the park. This could present safety concerns to swimmers, snorkelers, and divers. The lack of increased education and outreach efforts or increased staff presence in the park under Alternative A would likely result in an increase in reported overall safety incidents.

When the beneficial and adverse effects of other past, on-going, and future plans, projects, and activities affecting public health and safety are combined with management actions under Alternative A, the resulting cumulative effects would be long- and short-term, minor, and adverse.

Conclusions

Long- and short-term, minor, adverse effects on public health and safety would occur under Alternative A due in part to the lack of consistent NPS staff presence. Adverse effects are also attributed to shoreline bow and stern anchoring and the lack of vessel size and access restrictions (outside of the lagoon). When the beneficial and adverse effects of other past, on-going, and future plans, projects, and activities affecting public health and safety are combined with management actions under Alternative A, the resulting cumulative effects would be long- and short-term, minor, and adverse.

Impacts of Alternative B, the Preferred Alternative

The establishment of management zones under Alternative B and all other action alternatives provide effective means to provide additional public health and safety measures. Management zones would provide additional benefits for resource protection and visitor safety.

Under Alternative B, vessels would not be allowed passage through the Marine Hazard Zone which would eliminate the potential for vessel groundings near shallow reefs within this zone. This would provide additional safety precautions for hazardous navigation conditions and avoid related personal injury. In addition, fall and trip hazards as well as hazards from vessel and propeller movement along and near shore associated with shoreline bow and stern anchoring would be eliminated under Alternative B. However, a potential safety hazard for those that do not swim or have limited swimming skills may be introduced in the form of accessing the beach from an offshore mooring as opposed to accessing the beach from a vessel anchored directly on the beach under Alternative A. This would be offset by use of beach access channels for dinghy use, or dropping passengers off at the pier. Access channels also provide safety for swimmers by eliminating swimming/vessel use conflicts.

The NPS would continue to close the beaches and anchoring area at Buck Island during storms, when stinging jellyfish are present, or during other hazardous conditions. In addition, providing 10 moorings west of the pier under Alternative B would provide a sheltered place for vessels during certain times of the year.

Increased park staff proposed under this alternative would provide consistent staff presence within the park providing visitors with park information, safety information, and enforcement of park mandates and policies resulting in long-term, beneficial effects. The potential for expansion of education and interpretive programs would also aid in informing visitors about hazards associated with poisonous vegetation, harmful marine life, and harsh island conditions. The overall result of Alternative B would be long- and short-term, minor, beneficial effects.

Cumulative Effects

The same past, on-going, and future plans, projects, and activities affecting public health and safety described under Alternative A are applicable to Alternative B. In addition, the additional staff proposed under Alternative B would aid in coordinated enforcement and education efforts between NPS, the territory, and other agencies. When the beneficial and adverse effects of other on-going, and future plans, projects and activities affecting public health and safety are combined with actions under Alternative B, the resulting cumulative effects would long- and short-term, minor and beneficial.

Conclusions

Long- and short-term, minor, beneficial effects on public health and safety would occur under Alternative B due to elimination of shoreline bow and stern anchoring, creation of the management zones, and a proposed increase in NPS staff and presence. When the beneficial and adverse effects of other on-going, and future plans, projects and activities affecting public health and safety are combined with actions under Alternative B, the resulting cumulative effects would be long- and short-term, minor and beneficial.

Impacts of Alternative C

The establishment of management zones under Alternative C and all other action alternatives provide effective means to provide additional public health and safety measures. Management zones would provide additional benefits for resource protection and visitor safety.

The same types of health and safety issues identified under Alternative A would be applicable to Alternative C (bow and stern anchoring is also proposed under Alternative C, and a similar number of visitors would be accommodated in the park as compared to Alternative A). Vessels would not be allowed passage through the Marine Hazard Zone which would eliminate the potential for vessel groundings near shallow reefs within this zone. This would provide additional safety precautions for hazardous navigation conditions and avoid related personal injury. The NPS would continue to close the beaches and anchoring area at Buck Island during storms, when stinging jellyfish are present, or

during other hazardous conditions. In addition, providing up to 10 moorings west of the pier under Alternative C would provide a sheltered place for vessels during certain times of the year.

Increased park staff proposed under this alternative would provide consistent staff presence within the park providing visitors with park information, safety information, and enforcement of park mandates and policies resulting in long-term, beneficial effects. The potential for expansion of education and interpretive programs would also aid in informing visitors about hazards associated with poisonous vegetation, harmful marine life, and harsh island conditions.

Creation of management zones, a proposed increase in NPS staff presence, and the potential for expansion of education and interpretive programs under Alternative C would have beneficial effects on public health and safety for the same reasons described for Alternative B. The overall result would be long- and short-term, negligible, beneficial effects.

Cumulative Effects

The same past, on-going, and future plans, projects, and activities affecting public health and safety described under Alternative A are applicable to Alternative C. In addition, the additional staff proposed under Alternative C would aid in coordinated enforcement and education efforts between NPS, the territory, and other agencies. When the beneficial and adverse effects of other on-going, and future plans, projects and activities affecting public health and safety are combined with actions under Alternative C, the resulting cumulative effects would long- and short-term, negligible and beneficial.

Conclusions

Long- and short-term, negligible, beneficial effects would occur under Alternative C since effects on public health and safety would be similar to Alternative A, but less adverse due to the benefits of management zones, and a proposed increase in NPS staff presence and activity. When the beneficial and adverse effects of other on-going, and future plans, projects and activities affecting public health and safety are combined with actions under Alternative C, the resulting cumulative effects would long- and short-term, negligible and beneficial.

Impacts of Alternative D

The establishment of management zones under Alternative D and all other action alternatives provide effective means to provide additional public health and safety measures. Management zones would provide additional benefits for resource protection and visitor safety. However, due to the increased number of vessels mooring and anchoring in the park, and therefore more visitors (112 versus 87 vessels under Alternative A), there is an increased likelihood of increased incidents in the park. The types of incidents that may increase would include boating accidents or conflicts between vessel operations and swimming and snorkeling in the park. An increase in park staff (an addition of 9 full time equivalents) would help deter some incidents.

Under Alternative D (as is the case for all action alternatives), vessels would not be allowed passage through the Marine Hazard Zone which would eliminate the potential for vessel groundings near shallow reefs within this zone. This would provide additional safety precautions for hazardous navigation conditions and avoid related personal injury. In addition, trip hazards associated with shoreline bow and stern anchoring would be eliminated under Alternative D. However, a potential safety hazard for those that do not swim or have limited swimming skills may be introduced in the form of accessing the beach from an offshore mooring as opposed to accessing the beach from a vessel anchored directly on the beach under Alternative A. This would be offset by use of beach access channels for dinghy use, or dropping passengers off at the pier. Access channels also provide safety for swimmers by eliminating swimming/vessel use conflicts that may increase under Alternative D compared to A due to the increased number of vessels in this area off West Beach.

The NPS would continue to close the beaches and anchoring area at Buck Island during storms, when stinging jellyfish are present, or during other hazardous conditions. In addition, providing 10 moorings west of the pier under Alternative D would provide a sheltered place for vessels during certain times of the year.

Increased park staff proposed under this alternative would provide consistent staff presence within the park providing visitors with park information, safety information, and enforcement of park mandates and policies resulting in long-term, beneficial effects. The potential for expansion of education and interpretive programs would also aid in informing visitors about hazards associated with poisonous vegetation, harmful marine life, and harsh island conditions. The overall result of Alternative D would be long- and short-term, negligible, adverse effects.

Cumulative Effects

The same past, on-going, and future plans, projects, and activities affecting public health and safety described under Alternative A are applicable to Alternative D. In addition, the additional staff proposed under Alternative D would aid in coordinated enforcement and education efforts between NPS, the territory, and other agencies. When the beneficial and adverse effects of other on-going, and future plans, projects and activities affecting public health and safety are combined with actions under Alternative D, the resulting cumulative effects would long- and short-term, negligible and beneficial.

Conclusions

The overall result of Alternative D would be long- and short-term, negligible, adverse effects. An increased number of vessels and visitors would be expected under this alternative which may result in a higher potential for safety-related incidents, however the creation of management zones, and a proposed increase in NPS staff and presence would help deter adverse effects. When the beneficial and adverse effects of other on-going, and future plans, projects and activities affecting public health and safety are combined with actions under Alternative D, the resulting cumulative effects would long- and short-term, negligible and beneficial.

SUSTAINABILITY AND LONG-TERM MANAGEMENT

The National Environmental Policy Act (sec. 101 (b)) and the NPS Organic Act require an assessment of the potential for each alternative to produce long-term effects and the potential of foreclosing future options available to the NPS with regard to managing each park. An alternative is required to allow for sustainable development, which is defined as an action that meets the needs of the present without compromising the ability of future generations to meet their needs (*World Commission on Environment and Development* in NPS 2001). This section addresses the following three components of the sustainability assessment for the alternatives proposed in this general management plan: unavoidable adverse impacts, irreversible and irretrievable commitments of resources, and relationship of short-term uses and long-term productivity.

Unavoidable Adverse Impacts

The National Park Service defines adverse impacts as those that cannot be fully mitigated or avoided. Some negligible to moderate, adverse effects on natural and cultural resources would be essentially unavoidable (e.g., soil erosion, vegetation trampling, and wildlife disturbances); however, the majority of adverse effects may be mitigated or avoided. There are no major, adverse effects to cultural and natural resources identified that are associated with implementation of the management actions proposed under any of the alternatives (A, B, C, or D). Unavoidable adverse impacts to visitor experience would occur for those visitors that would prefer to maintain opportunities for bow and stern anchoring in the park.

Irreversible and Irretrievable Commitments of Resources

The National Environmental Policy Act and the NPS define irreversible effects as those effects that cannot be changed over the long term or are permanent (NPS 2006a). An effect to a resource is irreversible if the resource cannot be reclaimed, restored, or otherwise returned to its condition before the disturbance. Irretrievable commitments of resources are actions that result in the loss of resources but only for a limited period of time.

Alternative A

Under Alternative A, all current land-based facilities (picnic area, NPS grills, toilets, the pier), marine facilities (boundary and regulatory buoys and other moorings for SCUBA and the underwater trail), and the existing hiking trail on Buck Island would continue to be provided and maintained. However, no new facilities or construction are proposed. With the exception of consumption of fuels and raw materials for maintenance activities, no actions in this alternative would result in consumptions of nonrenewable natural resources or use of renewable resources that would preclude other uses for a period of time.

Alternatives B, C, and D

Maintenance of existing facilities, as described under Alternative A, would also occur under each of the action alternatives B, C and D. In addition, 63 additional new moorings and limited trail construction are proposed for Alternatives B, C, and D. Mooring installation and trail construction and maintenance would require limited resources; and a slightly greater consumption of fuels and raw materials would occur when compared to Alternative A. Additional staff are also proposed under these alternatives to provide a greater presence within the park and to conduct additional research, education, and outreach activities. Increased park operations would likely increase the need for additional fuels and materials, which would be irretrievable once committed. No actions under these alternatives would result in consumption of nonrenewable natural resources or use of renewable resources that would preclude other uses for a period of time.

Relationship of Short-term Uses and Long-term Productivity

The NPS must determine if the effects of alternatives involve trade-offs of the long-term productivity and sustainability of park resources for the immediate short-term use of those resources. The NPS also must also consider if the effects of the alternatives are sustainable over the long-term without causing future adverse environmental effects (NEPA Section 102(c)[IV]).

Alternative A

Buck Island Reef National Monument would continue to be used by visitors, and most areas would be protected in a natural state. NP S would continue to manage the park to provide appropriate recreational opportunities consistent with the preservation of cultural and natural resources in accordance with the Proclamation. As demand for visitor use and recreation in the park increases, the long-term protection and enjoyment of resources could be jeopardized under Alternative A since additional park staff, management zones, and programs are needed to ensure long-term resource protection. Several factors have led to a greatly expanded workload for current park staff including: the 2001 boundary expansion from 880 to 19,015 acres; enforcement of the Proclamation (no extractive use, anchoring in deep sand only, etc); the listing of elkhorn and staghorn coral as a threatened species; recent coral bleaching events requiring increased research and monitoring, impact, and recovery documentation efforts; reintroduction of globally endangered St. Croix ground lizard; threat of the non-native invasive lionfish; climate change; and the associated need for increased enforcement, education, and interpretation. Despite current management strategies to provide continued protection of cultural and natural resources, there would likely continue to be instances where resources are disturbed by visitors. These impacts would be avoidable only if visitor use were

not allowed in the park. Mitigation measures would be taken where possible to avoid and reduce these impacts. Partnering, education, and outreach would continue to occur on a limited basis dependent upon staffing and resource constraints, but current levels of these services are not adequate given the expanded workload for current park staff. No new facilities or trails would be provided under Alternative A. Boating, swimming, SCUBA diving at the SCUBA moorings, snorkeling, hiking, and picnicking would continue to provide visitor enjoyment and contribute to the overall visitor experience.

Alternatives B, C, and D

Under Alternatives B, C, and D, management actions would provide appropriate recreational opportunities consistent with the preservation of natural and cultural resources. Factors contributing to the expanded workload described under Alternative A would continue to exist; however, the addition of staff under the action alternatives would allow for the associated need for increased enforcement, education, and interpretation. An increased level of education, outreach and partnering programs as well as increased coordination with local agencies, organizations, and other cooperative initiatives for resource management would contribute to the long-term protection and preservation of resources. Although the potential for limited new facilities is proposed under Alternatives B, C, and D (limited new trails, signage and moorings), these short-term uses would be implemented using best management practices and required mitigative measures to ensure long-term productivity of park resources. Buck Island Reef National Monument would continue to be used by the public and the majority of the park would be protected in a natural state.

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