Executive Summary

The National Park Service has an agency-wide responsibility to address climate change impacts on vulnerable park resources. This handbook provides guidance for National Park Service (NPS) managers, partners, and other practitioners in exploring and implementing climate change adaptation strategies in estuarine and coastal areas, including the Great Lakes. This handbook captures the National Park Service's current understanding of a rapidly developing field as it relates to coastal parks; identifies tools and strategies; provides examples of approaches that the National Park Service as an agency and individual parks are using to address coastal vulnerabilities and climate change impacts; and provides policy and decision-making guidelines. Online resources will be updated to supplement this document and can be found at https://www.nps.gov/subjects/climatechange/coastalhandbook.htm.

The National Park Service protects natural resources, cultural resources, and facilities in over 120 parks that are vulnerable to changes in sea and lake levels, saltwater intrusion, ocean acidification, inundation during coastal storms, and the impacts of changing temperature and precipitation regimes. These parks compose a network of protected areas that are critical to maintaining threatened coastal resources and values and preserving coastal heritage. The National Park Service must prepare for and adapt to coastal climate change impacts in order to protect irreplaceable resources where possible, and to connect visitors to the resources and the potential impacts of climate change.

The nine chapters in the handbook expand upon the following take-home messages.

Introduction

- Climate change will continue to impact coastal resources and assets in the national parks at various rates. To address the current and anticipated impacts, parks can work proactively and cooperatively with others to implement adaptation strategies for resources at various levels of exposure and vulnerability. Adaptation is a process, not a single action.
- Adaptation includes a range of potential responses, including resisting change, accommodating change, and directing change towards a specific desired new future.
- Adaptation decisions should be made using the best available science; however, uncertainty should not prohibit adaptation action. There are numerous information systems and tools available to support climate change adaptation planning.
- Responding to climate change impacts on coastal parks is most effective when diverse adaptation strategies on a variety of temporal and spatial scales are considered.
- Vulnerability assessments can help prioritize among resources or better target an adaptation strategy.

Policy

- Park managers have substantial flexibility and discretion when selecting coastal adaptation strategies. Yet this flexibility and discretion are not unconstrained; various policy and guidance documents contain additional considerations that should be incorporated into park managers' decisions about adaptation alternatives.
- Park adaptation decisions must be well documented.

Planning

- Adaptation is most effective when it is intentionally and deliberately designed as a response to anticipated effects associated with climate change.
- Climate change adaptation is not a stand-alone plan, but should be addressed in ongoing, routine planning processes such as foundation documents, general management plans, resource stewardship strategies, and preparedness planning.
- Adaptation strategies may require a series of decisions and actions that will change over time.
- Preparing for natural disasters includes planning for uncertainty and allows for adaptation opportunities post-incident.

Natural Resources

- Parks can choose from a range of potential adaptation strategies developed for climate-sensitive ecosystems. Applying strategies to coastal systems is park- and resource-specific. There is not yet a clear way forward to know which adaptation options will be most effective, and implementation is an active research field. The scientific resources to support adaptation are varied and growing.
- Uncertainty or the lack of locally specific information should not stop adaptation action. Strategies that are able to incorporate additional information at later steps, such as adaptive management, are well suited to coastal climate adaptation challenges.
- Managing for change may require working at a larger landscape scale than a single park and, thus, working with partners.

- NPS policies to maintain natural processes are consistent with consideration of natural resource adaptation strategies because change is part of natural processes, and natural processes can be highly resilient. Yet climate change functions outside bounds of natural variability and thresholds will be exceeded. Strategies to manage for change, especially where natural systems are more vulnerable, or where thresholds can be anticipated, are a growing challenge.

Cultural Resources

- Cultural resources are unique and nonrenewable resources.
- The capacity of cultural resources to move or change is limited because they are in large part non-living and have strong ties to place, part of which can be ties to a dynamic coastal landscape.
- Cultural resource adaptation strategies can be applied to coastal systems.
- Managers need NPS-level guidance for adaptation of archeological and ethnographic resources to climate change. Upcoming reports and guidance for museum collections, cultural landscapes, and built environments will include coastal-relevant adaptation strategies.

Facility Management

- The National Park Service has the responsibility to invest wisely in facilities for the long term. Unquestionably, climate change and natural hazards pose a significant threat to our investment in current and future facilities.
- Vulnerability to climate change impacts needs to be understood at the asset level for parks to plan for these impacts. This includes an understanding of the risk of exposure and sensitivity of the asset to these impacts.
- Park asset management plans and five-year project plans should be evaluated to include elements of climate change vulnerability and coastal adaptation strategies.
- Climate Friendly Park workshops are opportunities to integrate climate change mitigation planning with coastal adaptation.

Communication and Education

- At the heart of the variety of products covered in this section lies communication itself. These products merely serve as the vehicle to provide audiences with effective communication of the efforts made in coastal adaptation. The communication of success stories, both with other parks and with partners, will help build support for the implementation of adaptation strategies.
- Support of local communities, parks, partners, stakeholders, and the general public is necessary for the effective implementation of any adaptation strategy. Many times the efficacy of adaptation programs relies on the cooperation of a variety of interested parties. Communication is necessary to include stakeholder involvement, which is crucial for planning and managing for change.

Protecting Infrastructure: Costs and Impacts

- Shoreline stabilization mechanisms can protect resources in place but are not long-term solutions and have trade-offs, including disruption of natural processes.
- Beach nourishment can be a costly short-term effort. There are ecological and physical consequences of dredging sand from other locations and placement of sediment on intertidal and nearshore habitats.
- The effectiveness of natural and nature-based features for shoreline protection is site-specific. Their suitability as a long-term alternative depends on ability to adapt to climate change, design, and compatibility with local conditions.
- Consider opportunities to redesign and relocate facilities, and to replace facilities with portable structures. Evaluate the maintenance costs and non-standard costs associated with these alternatives.

Lessons Learned from Hurricane Sandy

- Hurricane Sandy presented opportunities for adaptation and for testing adaptation elements in existing plans.
- Natural resources were found to be more resilient than many cultural resources and facilities.
- Historic structures have resilient design features. If buildings are well maintained, they may have a better chance of surviving a major storm.
- National seashores can provide other parks with good examples of preparation for and learning from experience about storm impacts on dynamic landscapes.
- After an event, there is an immediate and strong push to return park assets to pre-storm conditions, which can leave resources vulnerable to similar impacts in the future.
- Baseline monitoring and resource assessments are essential data to evaluate impacts and plan for recovery.
- Post-storm recovery is a critical opportunity to adapt to climate change.