Strategies for Coastal Park Adaptation to Climate Change

Rebecca Beavers and Courtney Schupp
Geologic Resources Division
National Park Service
14 November 2013
NPS is developing new tools to support park adaptation efforts

- Coastal Adaptation Strategies Handbook
- Climate Change Scenario Planning
NPS Coastal Parks Adaptation

*Actions Underway*

**Determine** where are we vulnerable

**Develop** strategies to increase resiliency

**Implement** actions for dynamic environments

**Prepare** plans in advance; expect surprises

**Collaborate** integrated strategies are stronger
105 Parks Vulnerable to Sea Level Rise
Over 11,000 Miles of Shoreline & 2.5 Million Water Acres
Park resources and responses vary

• Inventory and monitor resources
• Incorporate changes and forecasts into policy and planning
• Increase infrastructure resilience
• Interpret resources and enhance stewardship
At least 226 documented archaeological sites
  – Pictograph panels from nomadic hunter-gatherers (Archaic Period, 3000-4000 years ago)
  – American Indian Wars and railroad development (19th century)
Reservoir levels fluctuate in response to precipitation, storms, and agricultural water use
NPS has no management authority of the reservoir water, only the surrounding land
Changing water levels impact cultural resources

- **Low lake levels →**
  - Shoreline erosion (burial sites)
  - Increased visibility and looting
  - Human use impacts (campfires, cross-border law enforcement)

- **High lake levels →**
  - Silt accumulation in upper reaches of reservoir → reduced lake capacity → higher flash flood levels
  - Biological threats
    - Increase in mud-dauber wasp nests on Panther Cave pictographs, due to increased proximity of shoreline
    - Non-native clam (*Corbicula*) burrows into pristine archaeological sites
Response focuses on inventory and outreach

- Inventory archaeological sites when water is low
- Monitor resource conditions
- Salvage resources
- Assess and minimize human impacts
- Provide cultural resources orientation for law enforcement rangers
Northwest Alaska: Cape Krusenstern, Bering Land Bridge
Cultural resources are at risk in coastal Alaska

- Reduction in sea ice
  - Reduced protection against shoreline erosion
  - Increased marine traffic and oil development
  - Increased ocean exchange with lagoons
- Thawing permafrost
  - Accelerated shoreline erosion
  - Village relocation
Resource inventories are needed

- Lack of baseline information for sites at risk
  - Locations of cultural sites
  - Subsistence needs
  - Lagoonal water quality and characteristics
  - Difficulty in accessing remote sites

1950

2009
Alaska response focuses on data development

- Climate Change Scenario Planning
- Development of datasets related to climate change vulnerability
- Development of biological monitoring protocols
Drawing of Inupiat at time of European contact by Louis Choris, 1816, part of Otto Von Kotzebue’s crew
Inupiat Home

Thomas Makaiqtaq Barr’s home at Ublasaun

Photo of boy at entrance to house circa 1923
Salvage archeology

Intact tunnel entry to a house that had already been washed to sea
Island dynamics complicate management: Assateague Island National Seashore

- High vulnerability to sea-level rise and increased storm intensity
- Existing General Management Plan did not consider the significant climate change impacts on barrier island
- Many park neighbors were skeptical of future climate impacts, and resistant to management changes
- Three different agencies manage portions of Assateague Island
Management plan needs to address new challenges

- Facility sustainability and replacement
- Visitor access
- Response to natural processes (such as island breach)
- Balance of visitor use and wilderness values
- Cooperation with partner land management agencies
New projects and historic data inform development of management plan

- Climate Change Scenario Planning
- Scaled sea-level rise projections to management time frame
- Analysis of coastal change trends using long-term datasets
- Modeling climate change impacts (USGS partnership)
- Monitoring salt marsh hydrology and change (USGS partnership)
Outreach efforts target multiple audiences:

- **Park neighbors**
- **Visitors and stakeholders**
- **Employees and land management partners**
- Online education module
Sandy: NPS Response & Recovery

- Incident Response (e.g., tree cutting, cleanup, hazard evaluation, project scoping)
- Hurricane Sandy Rebuilding Task Force (Interagency)
- NPS Rapid Review Team:
  - Park Planning Facilities and Lands
  - Cultural resources
  - Natural resources
  - Sustainability
  - Regional representative

Phase I Projects: Parks reopened Memorial Day – 4th of July
Phase II Projects: Park fully functional - Ongoing
Museum Emergency Response Team

Elis Island - Salvaging museum collections from Medical Exhibit
Salvaging, triage and air-drying artifacts from basement
GATE is a highly manipulated system: 36% of shoreline armored

- 2013: Published CEI Report & GIS files for 8 parks
  
  [Link: https://irma.nps.gov/App/Reference/Profile/2193512]
Cultural Resources

Gateway National Recreation Area

• Fort Tilden
Natural Resources

Fort Tilden
Shore Road, Exposed
Timbers and Bulkhead
Sandy Hook, NJ
Facility Impacts: Sandy
“For all projects, construction must account for ABFE plus one foot. For critical infrastructure, such as a power supply or water treatment operations, there is a strong recommendation from the Task Force for application of ABFE plus two feet. Some exceptions to this standard are temporary facilities, green infrastructure, and facilities that are essential to access beaches and other recreational assets that need to be within the flood zone for their purpose and are designed to be sacrificed in a flood event.”
“On April 4, 2013, HUD Secretary Shaun Donovan joined then DOT Secretary Ray LaHood to announce a minimum flood risk reduction standard that protects investments in Sandy-affected communities. This minimum flood risk standard addresses the increased flood risk that results from rising sea levels, more intense storms, increased urbanization in floodplains, and other factors. This standard, which is in line with standards that many State and local jurisdictions have adopted, requires all major rebuilding projects that rely on Sandy-related Federal funding to be elevated or otherwise flood-proofed according to the best available FEMA guidance plus one additional foot of freeboard. Where State or local building codes or standards already require minimum elevations, the higher of the competing minimums apply.”
ABFE +1’/+2’

- Hurricane Sandy Rebuilding Task Force
- Use latest data (ABFE to Best Available Flood Hazard Data) versus published FIRM
- Build above 100-year (1%) floodplain by at least 1’, 2’ for critical
- Goal is resiliency – minimize reinvestment costs
FEMA: FIRM vs ABFE vs BAFH
(Example - Ellis Island)

FIRM, ca 2006

ZONE A
(EL 9)
(All of both islands)

ZONE V
(EL 16)
(All of both islands)

ABFE, ca 2012

ZONE AE
(EL 12)

BAFH, ca 2013

ZONE VE
(EL 13)

ZONE VE
(EL 16)
Ellis Island
Miscellaneous Floor Elevations
(New?) Ideas

- Relocate primary electric and heating plants to central elevated site @ Statue of Liberty
- Adjust boardwalk railing spacing @ Sagamore Hill
- Condensers on platforms
- Great Kills docks (Design to float up w/out floating away)
Relocate Primary Electric and Heating Plants to Central Elevated Site, Statue of Liberty
Incinerator

Administration
FF=10.75’

Concessions
FF=12.05’

Pavillion (non-NPS)
Liberty Island
Concessions Building

- Boilers and Electrical Switchgear (including high voltage) in basement
- Water level was to the ceiling
Administration Building

- Primary Switchgear behind building at grade
- Heating Plant and building electric panels in basement
Liberty Island Incinerator Building

Mainly used for storage pre-Sandy
Choices for Resilience

- Elevate in each building
- Water proof equipment or basements
- Elevate in central location
Elevate in each building

- Administration Building – Possible but would require displacing sizable useful space
- Concession Building – One story building with floor just below design flood

NOT PRACTICAL
Waterproof Equipment or Basements

- Requires waterproofing basements and keeping them waterproof.
- Small breaches in waterproofing can exacerbate a flood by allowing water in – restricting its flow out.
- Buildings are historic.
- Waterproofing equipment is a challenge (boilers, electrical switchgear).

NOT PRACTICAL
Strategy: Liberty Island Incinerator Building w/ Mezzanine
Post- Sandy: Hundreds of facilities needed repairs
Fire Island National Seashore Breach

- In Wilderness 60 miles from Manhattan
- Breaches deposit sediment = platforms for future salt marsh
- Increased Island Width = more resilient to future storms
Oblique aerial photography and lidar-based measurements of beach elevation confirm prediction of barrier island inundation at western end of Fire Island, New York.
Increased vulnerability to coastal erosion during future storms

Pre-Sandy (2010) vulnerability
20% of Fire Island was likely to overwash during Hurricane Sandy.

Post-Sandy (2012) vulnerability
70% of Fire Island is likely to overwash during conditions similar to Sandy.
Sandy Lessons Learned

Low lying coastal areas are more vulnerable to inundation during future storms.

- Museum Collections
- Historic Structures
- Habitat
As sea level rise accelerates, funds for adaptation and recovery will flow to major metropolitan areas.

NPS and other federal land management agencies may have a difficult time competing for funds.

Initiating adaptation is important now.

Recovery from Hurricane Sandy is an excellent opportunity for an integrated, reasoned approach, using resilience, not “business as usual” strategies.

Sandy = Adaptation Opportunity
ADAPTATION TO SEA LEVEL RISE IN COASTAL PARKS

Goal: provide practical & actionable options for adaptation to long-term SLR & storm impacts in coastal parks

Focus: infrastructure, cultural resources, & natural resources

Deliverables: quantitative analysis of coastal park assets vulnerable to SLR, final report & workshop

- practical & detailed options for SLR adaptation
- divide assets into broad groups, discuss adaptation options for each, with examples

Quantitative Analysis: Analyze assets vulnerable to SLR from 41 coastal parks
Coastal Adaptation Strategy
Coastal Adaptation Strategy
Coastal Adaptation Strategy
Coastal Adaptation Strategy

Eco-Tents, Everglades (designed with local university partnership)
Coastal Adaptation Strategy

Maintaining visitor access and opportunities on vulnerable shorelines

- Parking lots made of crushed oyster shells
- Moveable bathhouses
The Cape Lookout N.S. Storm Recovery Plan

- Focus on Natural and Cultural Resources
- Includes Pre-Storm Preparedness and Phased Post-Storm Response Actions
- Works with Existing Hurricane Preparedness Plan
- Intended to Aid Incident Commanders and Teams
- Uses GPS Data, GIS and Photos to Guide Response Teams
- Discusses Long-Range Adaptation Efforts for Major Resources
Thank you

- Jack Johnson and Brenda Todd, Amistad National Recreation Area
- Trish Kicklighter and Ish Ennis, Assateague Island National Seashore
- Frank Hays, Western Arctic Parklands
- Tahzay Jones and Dael Devenport, Alaska Regional Office
- Mike Eissenberg, Denver Service Center
- Mark Christiano, Gateway National Recreation Area
- NPS Incident Management Teams for Sandy Response
- Patti Rafferty & Mary Foley, Northeast Region Office
- Rob Thieler, Cheryl Hapke, Hilary Stockdon, U S Geological Survey
- Rob Young, Western Carolina University
- Maria Caffrey, University of Colorado Boulder
- Eric Bardenhagen, Texas A& M University
Contact us for more information

- Rebecca_Beavers@nps.gov
- Courtney_Schupp@nps.gov

- Coastal Geology website:  
  http://www.nature.nps.gov/geology/coastal/index.cfm
- Oceans & Coastal Website:  
  http://www.nature.nps.gov/water/oceancoastal/index.cfm
- Climate Change Planning:  
  http://www1.nrintra.nps.gov/climatechange/planning.cfm