

# NPS Science Working Group – Priority Goals and Actions to Respond to Rapid Climate Changes

**DRAFT – November 2008**

The Climate Change Science Working Group (SWG) is one of six working groups designed to help the NPS build the capacity to cope with this challenge. This document is based on the proceedings of the Science Working Group, and it does not include the considerable materials available from other Working Groups, which include Resource Stewardship and Communications Working Groups. All material should be considered as DRAFT, subject to change and revision.

## **Goal 1: Identify NPS Science Information Needs Relative to Climate Change**

**Outcome:** NPS clearly articulates and communicates the information needed by managers, scientists, and interpreters to identify changes, effects and needs resulting from climate change.

## **Goal 2. Facilitate Research and Monitoring to Fill Information Gaps and Serve as a Foundation for Science-Informed Management**

**Outcome:** NPS successfully utilizes both internal programs, such as Research Learning Centers, Cooperative Ecosystem Study Units, Inventory and Monitoring Networks, and external partners to generate new information and products that empower resource managers to protect resources and respond to ecosystem-level changes.

### **List of objectives for Goals 1 and 2.**

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High priority objectives and actions identified by the NPS Climate Change Response Program Science Working Group. These objectives and tasks address effects of rapid climate change (rather than gradual natural change), and there is an implicit understanding that many evaluations must consider effects at annual to multi-decadal time scales, and at local to regional spatial scales.

Actions	Scale**
<b>Objective 1: Characterize historical patterns and develop future projections of climate-related physical attributes with potential to dramatically impact parks.</b>	
<p>Characterize historical climate observations at regional scales; project future climates under a range of probable scenarios; and identify those areas most likely to experience substantial change.</p> <ul style="list-style-type: none"> <li>Identify appropriate climate attributes (temperature, precipitation, frost and thaw dates, growing season length, degree days, etc.) that are relevant and important to natural (biological, ecological, and physical) and cultural resources, infrastructure, and other constructed assets.</li> <li>Determine how to evaluate and express trends, directions, magnitudes, and rates of change (average, minimum, maximum, and extreme values; changes in frequency, etc.)</li> <li>Address the scale at which particular resources are likely to be affected and the scale of required management actions.</li> </ul>	Local to regional
<p>Characterize freshwater hydrological variables and processes likely to be affected by climate change.</p> <ul style="list-style-type: none"> <li>Snow and glacier accumulation and melt, permafrost thaw, surface flow patterns, flooding regimes, etc.</li> <li>Soil moisture, winter and summer storage, runoff, and evapo-transpiration</li> </ul>	Regional
<p>Consider magnitude and rate of change in C dynamics (CO<sub>2</sub> &amp; CH<sub>4</sub>) resulting from projected changes in permafrost.</p>	Regional
<p>Characterize projected changes in sea level and ocean chemistry and their consequent effects on resources at local to oceanic scales.</p> <ul style="list-style-type: none"> <li>Characterize rate and extent of sea level rise relative to ground level in coastal and marine parks. Include consideration of isostatic rebound, tectonic uplift, and subsidence where appropriate.</li> <li>Forecast probable future impacts over time, due to inundation of low-elevation lands, loss of land surface, coastal erosion, storm surges, saltwater intrusion in coastal aquifers.</li> <li>Consider potential effects of seawater chemical changes on ocean systems and park resources.</li> </ul>	Local to very broad.
<p>Describe and evaluate forecasted and likely effects of rapid climate change on severe weather and ecological disturbances such as flooding, landslides, erosion, fire, wind damage and blow downs.</p>	Regional
<p>Assess potential for contaminants from contaminated landscapes, vulnerable infrastructure, other installations, and waste sites to be redistributed by erosion, flooding, fire, and ice/permafrost thaw resulting from climate change.</p>	
<b>Objective 2: Identify the most vulnerable biological and ecological resources.</b>	
<p>Develop and implement a process to evaluate the vulnerability of ecological resources, including species, communities, and ecosystems, to climate changes.</p> <ul style="list-style-type: none"> <li>Identify attributes of resources that make them susceptible to climate-related changes.</li> <li>Identify species, communities, and natural systems most at risk.</li> </ul>	Local National to local
<p>Evaluate likely changes in the dynamics of natural biological processes such as phenology, competition, predation, herbivory, and specific diseases.</p>	Regional to national
<p>Evaluate likely changes in rates of spread of selected exotic and/or invasive plants, animals, and diseases as a result of climate change, stressed native species, vacated ecological niches, fire, etc.</p> <ul style="list-style-type: none"> <li>Develop a more comprehensive understanding of the interaction of climate change, fire, and invasive species and the resulting changes at scales from species to landscapes.</li> </ul>	Regional
<p>Determine historic and probable future trends in the intensity, timing, return frequency and severity of wildland fires and length of fire season, as a result of climate change.</p>	Regional

Actions	Scale**
<p>Evaluate likely changes in patterns and fire-related attributes of vegetation and fire and post-fire disturbances (e.g., erosion) at the landscape scale level, including:</p> <ul style="list-style-type: none"> <li>fuel profiles (e.g., ground, surface, ladder and crown fuels), properties (e.g., moisture content, volatile organic chemicals, ignitability), and consequent effects on fire propagation or suppression.</li> <li>forest disease and insect infestations</li> </ul>	Regional
<p>Evaluate current and probable future landcover trends, to determine the potential for large scale changes to wildlife and fisheries habitat quality and quantity in susceptible ecosystems (i.e., tundra, coniferous and deciduous forests, semi-arid and desert lands, etc.) as a result of changing temperature, soil moisture, fire frequency, etc.</p>	Local to regional
<p>Evaluate redistribution of water resources, which may include changes to streamflow, spring discharge, aquifer storage, wetlands, and evapo-transpiration, increasing flow variability (i.e., change in timing and duration of high and low flows), water quality impairment, and changing risk of unmet water demands, floods, and drought.</p>	Local to regional
<b>Objective 3: Identify the most vulnerable cultural resources.</b>	
<p>Develop a process to evaluate the vulnerability of cultural resources to climate change.</p> <ul style="list-style-type: none"> <li>Characterize ways that cultural resources are affected by climate attributes including, erosion, fire, thaw, and decay.</li> <li>Identify areas, time periods, and environments where the distribution and attributes of cultural resources makes them most vulnerable.</li> <li>Identify attributes that confer protection or vulnerability to climate attributes.</li> </ul>	National
<p>Identify where the risk (magnitude and extent of damages) to cultural resources is greatest.</p> <ul style="list-style-type: none"> <li>Incorporate the value (uniqueness, etc) of the resource, physical traits, etc. in addition to likelihood of physical damage.</li> </ul>	Local
<p>Identify and evaluate scales at which climate change will impact particular types of cultural resources.</p>	Regional?
<p>Identify similarities and differences between impacts to natural and cultural resources relevant to planning, management, and emergency response.</p> <ul style="list-style-type: none"> <li>Consider timing, scale, and severity of impacts</li> </ul>	Regional?
<p>Evaluate potential for changes in visitor behaviors to impact cultural resources.</p> <ul style="list-style-type: none"> <li>Consider changes in visitation related to specific environments (high elevation, shorelines, etc.) to temperature changes; modified traffic patterns in response to seasonal variation; changing demands for public consumption of subsistence resources (game, fish, shellfish, timber, driftwood, peat, graze, etc).</li> </ul>	Local to regional
<b>Objective 4: Identify social, economic, and cultural effects of rapid climate change.</b>	
<p>Identify how climate change affects the seasonality, availability and quality of warm-weather and cold-weather outdoor recreation opportunities.</p> <ul style="list-style-type: none"> <li>Consider temperature, frequency of severe weather, visibility, smoke, etc.</li> </ul>	Local to national
<p>Determine how changes in the length of peak-, shoulder-, and off-seasons could affect parks visitation.</p>	Local to national
<p>Identify how changing climate patterns could affect subsistence/consumptive activities of human populations in or near national parklands where these are permitted uses.</p>	Local to national
<p>Identify how climate-related impacts to natural resources and cultural resources are likely to affect visitor experiences.</p>	Local to national
<p>Consider how park visitation could be affected by changes to population growth, demographics, technological adaptation, and travel patterns as a result of climate change.</p>	Local to national
<p>Estimate potential impacts of climate change on the quality of life and economics of gateway communities.</p>	Local to national
<p>Consider potential for expanded range, seasonality, and severity of specific zoonotic diseases capable of infecting residents, employees and visitors (e.g., Lyme, plague, hantavirus, West</p>	

Actions	Scale**
Nile, malaria, etc.) as a result of climate change	
<b>Objective 5: Evaluate status of monitoring climate and park resources at risk</b>	Local to regional
Identify basic climate-related parameters that should be monitored by standard methods for trend analyses across all networks and partner agencies.	
Assess all current natural resource monitoring within or near parks that is relevant to evaluating and communicating effects of rapid climate change. <ul style="list-style-type: none"> <li>• Include vital signs monitoring, ground-water well, climate stations, stream gauges, and the full range of monitoring and long-term ecological research conducted by other agencies and institutions.</li> </ul>	Local
Assess current monitoring of cultural resources and evaluate the adequacy of current efforts.	Local
Assess current socioeconomic monitoring and evaluate the adequacy of current efforts.	Local
Identify key areas where current and proposed monitoring is inadequate and where there are opportunities for improvement and partnerships.	Local
<b>Objective 6: Evaluate the scientific basis of resource management, mitigation and adaptation strategies under climate change</b>	Local to regional
Evaluate consequences of climate changes on forest fire management options <ul style="list-style-type: none"> <li>• Consider impacts on carbon dynamics, including emissions and sequestration</li> <li>• Consider effects of natural and prescribed fires on T&amp;E and invasive species and cultural resources.</li> <li>• Consider how shifting phenology and water dynamics affect fire management options.</li> </ul>	Forest type to regional
Identify and evaluate physical, biological and ecological effects of current options for C sequestration in parks, and the likely quantitative influence of these options on cumulative atmospheric CO <sub>2</sub> levels over short to long terms.	Regional
Evaluate options to mitigate habitat loss and fragmentation, and to facilitate natural migration and range shifts of species that are expected to be severely affected by climate change. <ul style="list-style-type: none"> <li>• Evaluate major scientific issues associated with assisted colonization or migration, and approaches for evaluating ecological consequences of any such proposals.</li> <li>• Evaluate the potential of private lands conservation and large-scale corridor approaches to assist with mitigation and adaptation.</li> </ul>	National.
Identify and evaluate strategies to reduce or mitigate the effects of current stressors that are likely to exacerbate or contribute to deleterious effects of rapid climate change on park ecosystems.	Regional
Evaluate management strategies for addressing fuel hazards arising from forest pest insect outbreaks. <ul style="list-style-type: none"> <li>• Mountain pine beetles, etc.</li> <li>• Evaluate effects on fuel hazards and mitigation via pre-outbreak treatments.</li> </ul>	Local to regional
Evaluate consequences of federal wildland fire management policy on management of wildland fires under different climate change and carbon sequestration scenarios.	Local to national

**Actions**

**Objective 2.1 Advance opportunities to provide downscaled global and regional climate change model results**

Work across agencies and organizations to leverage relevant CC research at the landscape scale.

Develop a “prototype” project in one region of the US (e.g. Greater Yellowstone) to demonstrate how to “downscale” climate change models and demonstrate utility of downscaled results.

Identify links between global change factors and target attributes, and the relevant scales for addressing these links. Do not limit to various NPS “networks.”

Identify and evaluate geospatial models that identify relationships between focal resources/areas and stressors for incorporating more global change factors.

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## Actions

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Provide downscaled projections of CC models to all parks of interest (Univ. Alaska is doing this at 2-4 km).

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### Objective 2.2 Conduct vulnerability assessments and promote their development with appropriate partners.

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Promote assessments at appropriate, management-relevant scales.

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Coordinate with national-scale NGO's and federal land managers to develop a multi-scale national risk map for both species and ecosystems on both public and private lands.

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Request that the USGS-BRD focus on climate vulnerability assessments as part of the research and park assistance projects under USGS-BRD Research funding call and Park-Oriented Biological Studies (POBS) funding call.

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Incorporate global change factors into existing assessment frameworks.

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Evaluate the potential for incorporating global change factors into classification systems.

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### Objective 2.3 Promote development of predictive models to support proactive management

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Address the questions: What changes are likely on NPS lands? How could private lands conservation or different management alternatives on federal lands assist with the risk assessments in Objective 2.2?

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Identify models that incorporate global change factors and target attributes identified in Goal 1.

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Build on the ecosystem-based climate workshops funded by the DOI revolving fund and CESUs.

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### Objective 2.4 Enable opportunities to enhance monitoring of select climate change indicators.

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Develop formal plan to partner with the National Phenological Network (USA-NPN) to develop citizen-science, interpretative, and formal phenology programs in parks.

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Work with USGS-WRD to maintain and extend the long term stream monitoring network sites in NPS units.

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Promote cooperation with NOAA to modernize existing climate stations, infill gaps, and streamline data processing and management.

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Establish agreement with NOAA for ingest, management, access, and reporting of climate data from parks.

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Engage with NEON to include parks in environmental monitoring programs.

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Promote climate change related water quality monitoring a major focus area in the USGS-NPS Water Quality Partnership program – with projects in parks being selected annually.

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### Objective 2.5 Promote and enhance park-based long-term climate change research.

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Identify characteristics of most suitable parks or other protected/reference areas for establishing baselines.

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Identify opportunities to extend ecosystem assessments across international borders, into Canada and Mexico.

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Identify parks that host critical 'indicator' species or high numbers (e.g. 'hotspots') of species considered at risk via the process developed under SWG goal 1.

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Evaluate potential for using parks as refugia and/or actions that increase resilience to climate change.

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Identify locations where climate change will likely isolate species and habitats.

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Identify parks that support rare species that will likely be threatened by climate change.

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\*\* Scale refers to the lengths of time and space that are most relevant to a evaluating a task, to collecting data or conducting a research project, and /or to the application of the information. For example, one could, *a-priori*, identify a suite of characteristics used to identify species, or groups of species, that are likely to be most at risk from climate change. These criteria (e.g., high geographical and ecological specificity) could be used to evaluate risk for species anywhere. Thus the development of criteria and a process for assessing risk could an probably should be done at a very broad scale – nationally to globally. But identifying which species are actually at risk in a specific park is usually focused on a local issue – which species are at risk in a specific location? E.g., a species could be at risk in a particular park, but not at regional or broader scales.