Using Scenarios to Prepare for Climate Change in Alaska National Park System Areas

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Introduction

Changing climatic conditions are rapidly impacting environmental, social, and economic conditions in and around national park system areas in Alaska. With over 50 million acres of parklands to administer, Alaska park managers need to better understand possible climate change trends to better manage arctic, subarctic, and coastal ecosystems, and human uses of these areas. National Park Service (NPS) managers have been exploring scenario planning as an alternative approach for science-based decision-making in the face of an uncertain future. Climate change scenarios will help prepare Alaska park managers for impending changes, so they can make informed decisions with the fewest regrets about future outcomes.

NPS and the University of Alaska, Fairbanks, Scenarios Network for Alaska Planning (UAF-SNAP) are collaborating on a three-year project to help Alaska NPS managers, adjacent landowners, and key stakeholders to develop plausible climate change scenarios for all NPS areas in Alaska. Final products will include climate change scenario planning exercises and reports for all the NPS units in Alaska, with efforts organized around each of four inventory and monitoring (I&M) networks.

Stage one in this project was a climate change scenarios training workshop with NPS contractor Global Business Network (GBN). Participants learned how to develop scenarios based on nested frameworks of critical uncertainties, and then fleshed out the beginnings of climate change scenarios for two pilot parks. Webinars were held to orient trainees to the scenario-building process, climate drivers, and climate effects. The training workshop was facilitated by Jonathan Star of GBN, and included key personnel with NPS parks and I&M networks in Alaska, NPS Climate Change Response Program staff, major adjacent area landowners, UAF-SNAP, and a few climate scientists.

The first climate scenarios workshop took place in Anchorage, Alaska, in late February, 2011, and addressed park areas in the South-West Alaska Network (SWAN), which includes Kenai Fjords National Park, Katmai National Park and Preserve, Lake Clark National Park and

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Preserve, Aniakchak National Monument and Preserve, and Alagnak Wild River. Members of a core team completed at least one GBN scenarios training course before leading the workshop. Participants included representatives from SWAN parks, NPS Anchorage office staff, UAF-SNAP personnel, plus key individuals from other agencies, businesses, and communities with a stake in this region. Thirty-four individuals contributed a wide range of perspectives and expertise to the inputs and outcomes of the workshop.

Workshop preparations

To orient participants, suggested reading included two books and a talking points paper: *Beyond Naturalness* (Cole and Yung 2010), *The Art of the Long View* (Schwartz 1996), and *Understanding the Science of Climate Change: Talking Points—Impacts to Alaska Maritime and Transitional Zones* (Jezierski, Loehman, and Schramm 2010). The NPS Alaska Regional Office made a small library of books available, which addressing climate change, scenarios processes, and climate change education and interpretation. Before the workshop in Anchorage, participants took part in three webinars. The webinars covered introduction to scenario planning, Southwest Alaska climate drivers, and Southwest Alaska climate change effects.

Workshop webinars, workshop results, and supporting documents are online (www.snap.uaf.edu/webshared/Nancy Fresco/NPS/). Other available online files included the following: an August 2010 training workshop summary; NPS maritime and transitional climate talking points paper; SNAP regional maps showing projected changes in temperature, precipitation, thaw date, freeze date, and season length; climate driver and effects tables; SNAP climate briefs for Katmai, Kenai Fjords, and Lake Clark; participant lists; workshop presentations.

Workshop summary

The workshop began with a plenary session on the fundamentals of scenario planning. Scenarios are defined as hypotheses about the future, rather than predictions. Scenarios are intended to be stories of divergent, yet plausible, relevant, and challenging futures that stretch thinking, and provide a tool to navigate change. Scenario development involves five steps: orient, explore, synthesize, act, and monitor (Figure 1).

In step one, *orient*, participants considered strategic issues or decisions that we wish to address: "How can NPS managers best preserve the natural and cultural resources and values within their jurisdiction in the face of climate change?" and, "How will climate change affect the landscapes within which management units are placed, over the next 50 to 100 years?"

In step two, *explore*, participants discussed critical forces that could affect the future of our issue. Critical forces, climate drivers in this case, have unusually high impact and unusually high uncertainty. In other words, what changes in climate are most important, most uncertain, and most likely to drive major change in park conditions and NPS management? Participants divided into two focus groups, coastal and riverine, to select critical climate drivers and develop scenarios. The groups used those drivers to develop potential scenario matrices (Figure 2; Table 1). From these matrices each group selected one matrix to develop further and build narratives for the future. In the next stage of the workshop, each group nested their original matrix within a higher level socio-political matrix representing varying degrees of public concern and varying degrees of institutional involvement with climate change (Figure 3).

In step three, *synthesize*, participants created narratives from bullet-point scenarios. With sixteen (or more) choices available, each group selected 3 -4 nested scenarios to turn into narratives and planning tools. They focused on scenarios that were *relevant, divergent, plausible, and challenging*. From each scenario they identified implications or "effects," which were pulled from existing effects tables and talking points papers. Each group outlined future actions appropriate

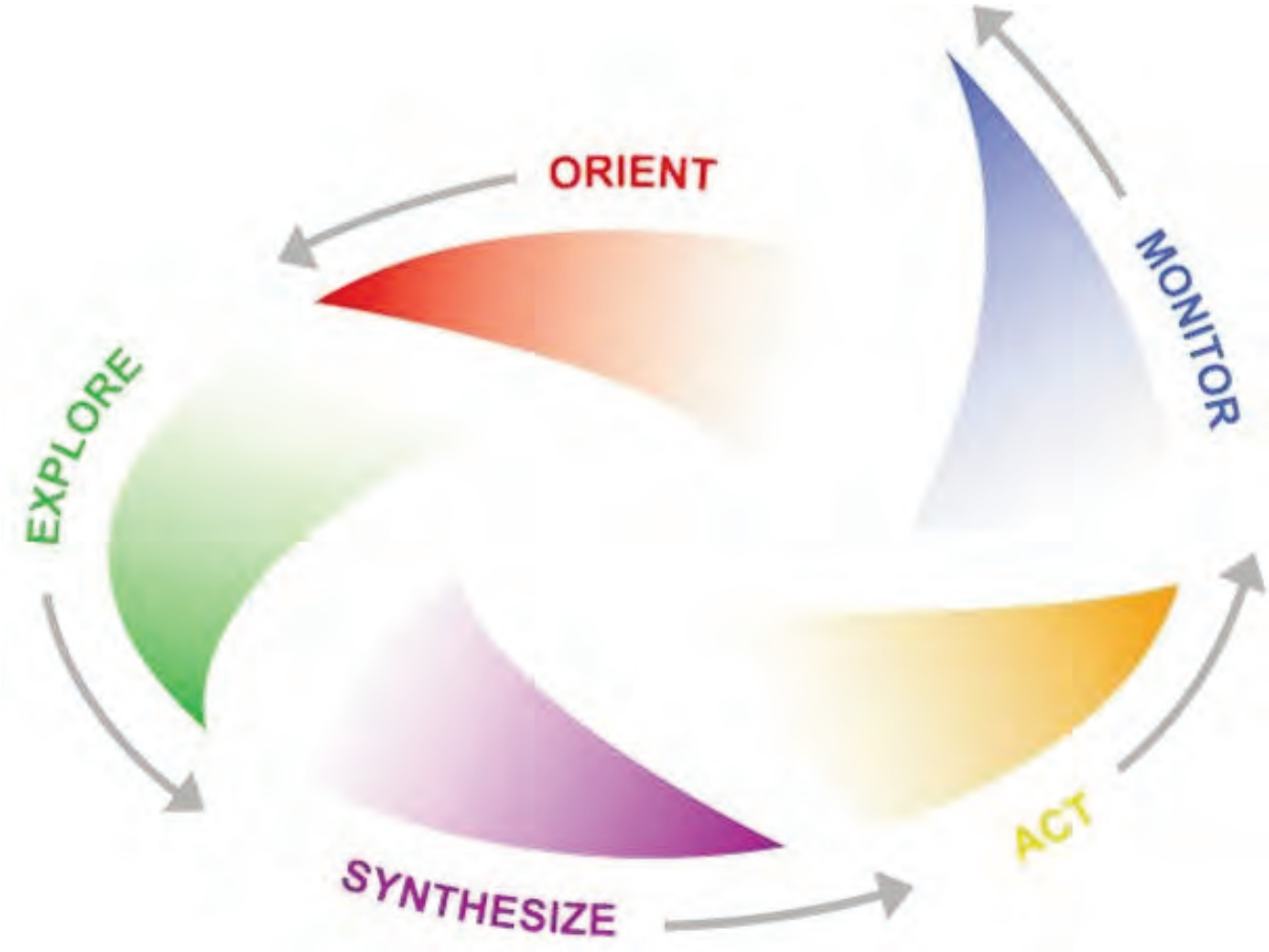

Figure 1. This diagram, provided by GBN, shows the stages in the scenarios building process.

to the selected scenarios as the first part in step four, *act*. The final step in the process is to *monitor* effects of actions over time, and then reorient.

This process is summarized for the riverine group, which was a focus of the associated George Wright Society presenation. The group explored "climate drivers" for the bioregion and added other critical drivers such as volcanic eruptions (local acidification), Pacific Decadal Oscillation (PDO)/Arctic Oscillation (AO)/jetstream changes, and variable stream flows. They selected from four climate drivers, precipitation (variability), temperature (variability), thaw days (more or fewer), and PDO (warm/cold phase shifts). They decided to use thaw days (more or fewer) and precipitation (low/high variation). PDO was included with thaw days, looking at the cold-phase PDO with fewer thaw days, and the warm phase PDO with more thaw days, to push extreme possibilities.

1. "Smokey" is the climate scenario from the upper left quadrant of Figure 2, and would result in the following environmental conditions: drought stressed vegetation; increase in disease/pests; longer growing season; maximum shrub expansion (less overland access); long-term reduction in stream flows; initially higher stream flows from seasonal glacial melt; reduction and loss of glaciers; increased fire on the landscape; 40% reduction in salmon fry due to smaller fry; less water access with warming, and less precipitation, so barge transport on Naknek Lake and Lake Clark is reduced; fewer biting insects; decreased waterfowl; exposure of cultural resources;

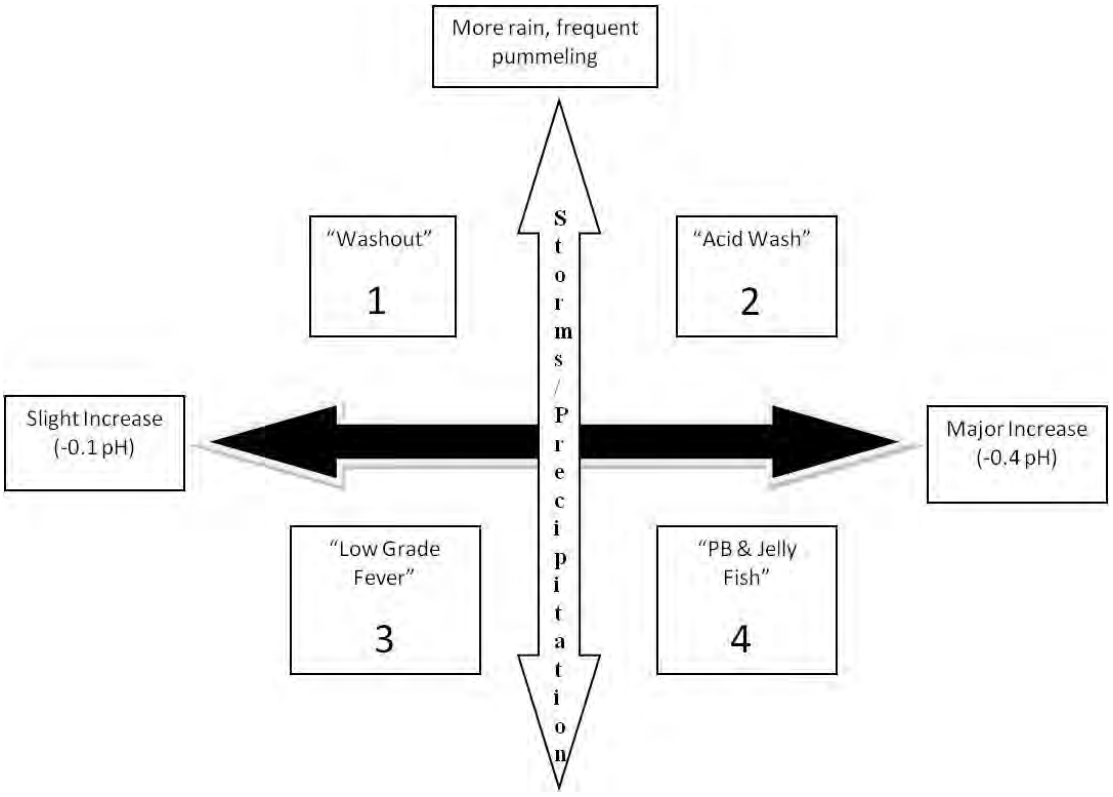

Figure 2. An example climate driver matrix produced by the riverine group.

Climate Drivers (or "Scenario Drivers Based on Climate")	UC	HC	Important
Temperature	X		X
Precipitation	X		X
Freeze-up		X	
Length of growing season		X	
Sea level	X		
Water availability	X		
Relative humidity	X		
Wind speed (separate from Aleutian Low)	X (duration)	X (increase)	
Pacific Decadal Oscillation (PDO)	X		
Extreme events (temperature)		X	
Extreme events (precipitation)	X	X	
Extreme events (storms)		X	X

Table 1. Climate drivers rated for certainty and importance by the riverine group.

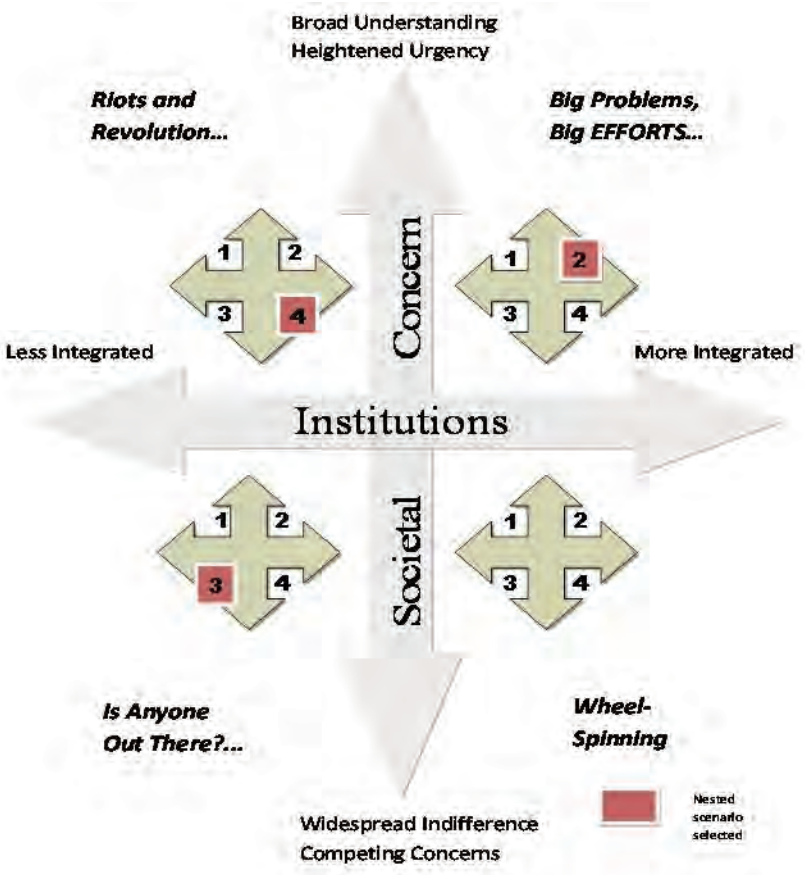

Figure 3. Matrix showing riverine climate scenarios nested in a social/institutional framework. Each quadrant yields four linked scenarios; three are selected in red. The details of these three are described in the text.

lowering of groundwater tables; more fugitive dust at Pebble Mine; increased competition for water; decreased subsistence travel over water and snow.

2. "Juneau /Helly Hansen" is the climate scenario from the upper right quadrant of Figure 2, and would result in the following environmental conditions: increased rain on snow events (increased flooding); thicker vegetation; increased erosion; increased lightning; increased evaporation (soil drying); more berries (good habitat for bear, moose, caribou); decreased area of alpine tundra; arrival of black bear; increased in waterfowl; increased impacts to park infrastructure; decreased backcountry use (due to rain and reduced flying days); increased hurricanes; decreased salmon production due to flooding; increased contamination due to runoff events; increased avalanches.

3. "Freeze-Dried" is the climate scenario from the lower left quadrant of Figure 2 and would result in the following environmental changes: permafrost persists; decreased productivity (plants and berries) impacts wildlife; overland access continues; competition for water resources intensifies between communities and mining; facilities and infrastructure are stable; slow retreat of tundra ponds; Dall sheep range extends; lichen ranges are stable and support caribou; high wind potential develops; and brown bear populations decrease.

4. "Tiny Ice Age" is the climate scenario from the lower right quadrant of Figure 2 and would result in the following environmental conditions: glaciers stabilize or enlarge; winter travel access remains viable; pests and diseases moderate; extreme weather events may impact salmon.

Nested scenarios

Each of the four climate scenarios described above were nested within a larger social/institutional framework (Figure 3). This framework explores how each story might play out in a world with greater or lesser degrees of societal concern and institutional commitment. We altered this framework slightly from that presented by GBN, where the horizontal axis is defined as "institutional" rather than "governmental" and would take place at a national, state, and local scales, rather than at national and international scales. Because sixteen scenarios present far too many possible futures for anyone to fully consider, the riverine group selected three scenarios highlighted in red, one of which is described below as an example. This example scenario includes future implications, important management actions, research and information needs, and a descriptive narrative to illustrate how the scenario could affect people and managers.

Nested scenario 3, "Freeze-Dried," is in a social context of riots and revolution. Future implications under this scenario resulted in numerous changes to natural, cultural, and subsistence resources, socioeconomics, and facilities. This scenario diverges from the others in that salmon resources could be severely decreased, vegetative growth would be limited, and significant economic and cost of living issues would occur.

Natural resource condition changes would result in less water in a cool dry temperature regime producing poor conditions for salmon reproduction, less snow, and large shifts in wildlife distributions and populations. Historical and archeological resources would not be seriously affected, but conflicts would result between subsistence, sport, and commercial user groups regarding access, seasons, and allocations for increasingly limited resources. Over-snow and river access would be reduced, making access for local area residents limited and difficult. Fewer locals would retain commercial fishing permits, and a higher cost of living, with increased fuel costs and governmental deficits, inflation, and less funding for land management, would impact rural communities. Coupled with the reduction in fish and wildlife resources for subsistence, local rural residents would move to urban and regional population hubs. Local cultures would suffer a loss of traditional ecological knowledge. The dry conditions would increase the risk and occurrence of wildland fires, but most facilities would not be severely damaged.

Important management actions would include intensive management of fish and wildlife resources. Federal harvest preference for local rural residents would be triggered. Current and future critical habitats for fish and wildlife would be protected, including migration routes, breeding grounds, and ecosystem services. A more flexible process would be devised to adjust resource harvest to reflect rapidly changing conditions. Federal local-hire authority would be greatly enhanced. Long-term funding for managing invasive species would be secured. Future climate change scenario workshops would need to make a greater effort to include important stakeholders.

Research and information needs would include an intensified science outreach and education effort to multiple audiences. A higher understanding of Alaska protected areas in the global context would be presented. Funding for interdisciplinary studies would be acquired, and social scientists for the Landscape Conservation Cooperatives and climate science center in Alaska would be hired to balance the biologists. An ethnography program would be enhanced to capture cultural information before it is lost forever. Communication between the Alaska Landscape Conservation Cooperatives (LCC) would be enhanced, and the Bristol Bay area and its fisheries would be addressed under one LCC. Climate change models would be validated with I&M data.

As one example, the following narrative was created to synthesize this climate change scenario. An open letter to Senator Will Goforth, from the Alaska Peninsula Mayors Council, was envisioned, to be published by the Alaska Daily News, in July, 2030.

> Dear Senator Goforth,
>
> We the undersigned appreciate your many years of wise public service and support for Alaska's coastal communities. We are writing today to ask your help again in dealing with a crisis for which government agencies seem unable or unwilling to help our communities. You are well aware of the importance of community, place, and subsistence to rural Alaskans.
>
> While most people in our communities still live a subsistence lifestyle, it has become harder to subsist, and harder to maintain a viable community. After more than a decade of diminishing stream flows and sharply declining salmon returns, many local fishermen

have been forced to sell their salmon permits, their livelihood, and their family legacy to out-of-state businesses. After our fish processing plant closed, more people left to seek wage work elsewhere. We were devastated when school enrollments dropped below the minimums. Because schools have closed, there will soon be few younger people and families left in the community. With the prohibitively higher costs of fuel and electricity, we are thankful that some residents still have good paying jobs in government and community services. But the number of such positions has also declined with falling tax revenues. A few residents found jobs with new construction, wind farms, and mining operations on nearby state and corporation lands, but most good jobs seem to be filled by Outsiders.

Federal and state agencies have compounded the challenges faced by our communities. For example, with the loss of salmon, we have increasingly looked to hunters to provide for our aging residents. The decades-long drought, coupled with a history of water resources mismanagement, deforestation by wildland fires and mining impacts, and steadily increasing federal predator protection, has made it increasingly necessary for hunters to travel long distances to find harvestable wildlife. Agency regulators don't appreciate that the changed landscape and unrealistic hunting seasons make access by boat, foot, and snow machine unreliable. Now, those same agencies are working against our hunters, by denying use of ORVs for access to game on government lands. Senator, we need the agencies to work with our public, not against us, and we desperately need more good jobs in our rural communities before our young families all move away to hub communities and urban areas.

Today, we ask for your sponsorship of the "Salmon for our Children" bill, a program to fund construction and operation of an expanded network of government-funded community salmon hatcheries. We also ask for your support of a local-hire mandate, provisions for securing any necessary water rights from adjacent federal lands, and reasonable community access to federal lands by ORV in this bill.

Respectfully,
The Members of the Peninsula Mayors Council

In summary, park managers, park neighbors, and stakeholders can learn from the future by using the best available scientific information and climate projections to create plausible, divergent, relevant, and challenging future scenarios to prepare for uncertain future conditions in the face of climate change.

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