Rehearsing the Future: Using scenarios to prepare for climate change in Southwest Alaska

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Introduction

Climate change is already impacting people, the environment, and the economy in Southwest Alaska. National Park Service (NPS) managers must plan in the face of an uncertain future.

Climate science can provide models of future conditions, such as temperature, precipitation, growing season length, ocean acidification, species shifts, and forest fires. However, the magnitude and effects of these changes are uncertain. *Scenario planning offers manages tools and techniques to plan for multiple possible futures.*

In February 2011, team leaders from NPS and the Scenarios Network for Alaska & Arctic Planning (SNAP) met with local park managers and staff, community members, and representatives from businesses, NGOs, and state and federal agencies. Together, they used climate models, scientific literature, and on-the-ground observations to create potential future scenarios and associated management recommendations for areas in and near Kenai Fjords National Park, Katmai National Park and Preserve, Lake Clark National Park and Preserve, Aniakchak National Monument and Preserve, and Alagnak Wild River.

What is SNAP?

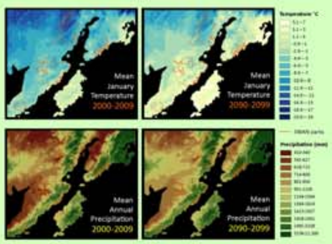
SNAP is a collaborative organization linking the University of Alaska, state, federal, and local agencies, and NGOs. Its mission is to provide timely access to management-relevant scenarios of future conditions in Alaska.

SNAP's models are based on Global Circulation Models used by the Intergovernmental Panel on Climate Change (IPCC). SNAP researchers selected the five models that perform best in the far north (Walsh et al. 2008) and scaled down outputs to 2km resolution using the Parameter-elevation Regressions on Independent Slopes Model (PRISM) climate mapping system (http://www.prism.oregonstate.edu/). PRISM incorporates point data, a digital elevation model, and expert knowledge of complex climatic extremes, including rain shadows, coastal effects and temperature inversions.

SNAP offers outputs from all five selected GCMs or a composite of the five; for each model, projections are available for three different greenhouse gas emission scenarios as defined by the IPCC: A2, A1B and B1.

SNAP services and products include:

- **Maps and projections** of future conditions, including monthly temperature and precipitation at 2km resolution for every year from 1900 (based on downscaled historical data) to 2100 (based on downscaled GCMs)
- **Data and maps** based on the above projections couples with additional information and models. Products include projections for thaw and freeze-up, season length, permafrost, fire, hydrology, and species shifts.
- **Objective interpretations** of projected scenarios and ramifications for management decisions
- **Explanations** of assumptions, methods, and uncertainty



SNAP climate projections are based on downscaled global climate model data
Details are available at www.snap.uaf.edu

Drivers in Southwest Park Units

Climate Variable	Projected Change by 2050	Projected Change by 2100	Confidence	Source
Temperature	+2°C ±1.5°C	+4°C ±2°C	>95% chance of increase	IPCC (2007); SNAP/UAF
Rain and snow (precipitation)	10%-20% increase, but possible decrease in winter snowfall due to warming	20%-40% increase, but possible decrease in winter snowfall due to warming	High uncertainty in timing of snowmelt	AMAP/SWIPA (2011); SNAP/UAF
Freeze-up date	5-10 days inland; freezeup may not regularly occur in coastal areas	10-20 days inland; freezeup may not regularly occur in coastal areas	>90%	SNAP/UAF
Length of ice-free season for rivers, lakes	7-10 days inland; freezeup may not regularly occur in coastal areas	14-21 days; freezeup may not regularly occur in coastal areas	>90%	IPCC (2007); SNAP/UAF
Length of growing season	increase of 10-20 days	increase of 20-40 days	>90%	IPCC (2007); SNAP/UAF
Sea level	3-24 inches higher	7-72 inches higher	>90% chance of increase	IPCC (2007)
Water availability (soil moisture during growing season, i.e. precip minus PET)	0%-20+% decrease	10%-40+% decrease	>66%; varies by region	SNAP/UAF; The Wilderness Society
Relative Humidity	0% ±10% increase or decrease	0% ±15% increase or decrease	50% = about as likely as not	SNAP/UAF
Wind Speed	2% to 4% increase	4% to 8% increase	>90% chance of increase	Abatzoglou and Brown (2011)
Pacific Decadal Oscillation (PDO)	Uncertain effect of atmospheric circulation anomalies on Alaska's climate	Uncertain effect of atmospheric circulation anomalies on Alaska's climate	High degree of natural variation	Hartmann and Wendler (2005)
Extreme Events: Temperature	3-6 times more warm events; 3-5 times fewer cold events	5-8.5 times more warm events; 8-12 times fewer cold events	>95%	Abatzoglou and Brown; Timlin and Walsh, 2007)
Extreme Events: Precipitation	change of -20% to +50%	change of -20% to +50%	Unknown	Abatzoglou and Brown (2011)
Extreme Events: Storms	Increase in frequency and intensity	Increase in frequency and intensity	>66%	Loehman (2009)

Selected Drivers: Coastal*

Scenario drivers	Uncertain	High Certainty	Important
Temperature	X		X
Precipitation	X		X
Freeze-up dat e		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		
Extreme Events (storms)		X	X

Additional drivers identified by the group:

- Ocean acidification
- Salinity (onshore/near shore)
- Aleutian Low
- Extreme Events (wind)
- Alaska coastal current

Selected drivers to explore:

- Ocean acidification
- Temperature
- Precipitation
- Extreme Events (storms)

**workshop participants divided into two groups to explore coastal and inland scenarios, then combined their results at the end of the event.*

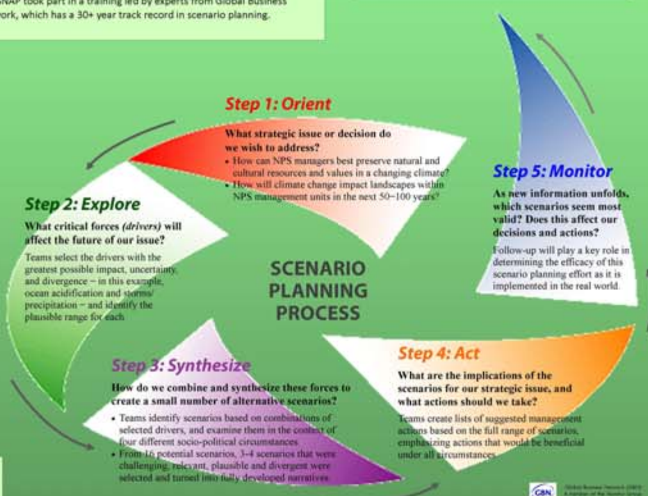
Scenario Planning

Unlike forecasts, which offer one possible outcome (often with an associated probability), scenarios address multiple plausible futures. Of course, three or four scenarios cannot encompass every possible future. However, a set of scenarios can provide a range of outcomes that are *plausible, divergent, challenging, and relevant.*

We all use scenarios planning in our daily lives – for example, when we bring extra cash or an umbrella along on a trip, even though we are not certain we will need these items. As in formal scenario planning, we tend to instinctively judge the likelihood (plausibility) and personal impact (relevance) of our mental "what if" scenarios. We are willing to contemplate a wider (divergent) range of possibilities when the stakes are high (challenging) – for example, we might allow extra time for traffic jams if we are going to a job interview, but not if we are going to meet a friend for coffee.

Scenarios planning has been successfully used by businesses and corporations. Before embarking on this project, team leaders from NPS and SNAP took part in a training led by experts from Global Business Network, which has a 30+ year track record in scenario planning.

Southwest Alaska Network Parks, Monuments, Preserves



Climate Scenario Framework — Coastal Group

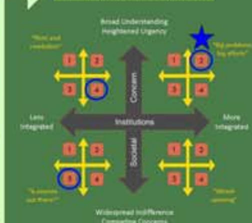
Climate Change Scenario Matrices: Two selected climate drivers

The matrix on the left shows the intersection of two climate drivers: 1) changes in storms and precipitation and 2) changes in ocean acidification, as each applies to coastal regions.

Each quadrant yields a set of future conditions that are plausible, challenging, relevant, and divergent.

The four resulting quadrants are then 'nested' in a social/institutional framework (on the right) to create 16 possibilities. These were narrowed down to 3 scenarios (circled in blue) that are relevant, divergent, challenging and pertinent.

Climate Change Scenario Matrices: Nested in socio-political matrices



★ Sample Scenario

Working groups created detailed lists of ***implications*** for each scenario, including this example for the "Acid Wash" scenario (#2 in matrix below) nested in the "Big problems big efforts" social framework:

Natural Resources
- benthic community decline & food web shift
- local extinction & mass redistribution
- coastal erosion
- extremely moist conditions
- unknown glacial dynamics

Cultural Resources
- flooding and wave action = loss of known historic sites
- loss of historic record (undiscovered sites)

Socioeconomic
- questions of prioritization, private vs. public aid
- livelihoods stressed, leading to industry shift (tourism, fishing)
- natural resource development—need for energy and jobs
- community relocation?

Facilities
- increased risk of flood/mudslide/erosion effects on structures
- access to roads and trails more frequently compromised
- potential effects on coastal communities and way of life
- private ecotourism accessibility (inholdings, lodges, docks, etc) compromised

Communication
- media/public involved at every step
- need for a highly evolved communication network
- potential misaligned message delivery

Subsistence
- Loss of fish, game, "revenue" (community asset)
- Shift in way of life
- Search for surrogates

Common "No Regrets" Management Actions

Working groups recommended management actions for each selected scenario; workshop participants then collaborated to identify the following actions that would be beneficial in all scenarios:

- Create seamless datasets
- Provide science outreach to multiple audiences
- Collaborate with researchers & monitoring programs to track changes in PDO and ocean acidification
- Model and promote energy efficient technologies
- Increase connections between research and monitoring
- Conduct coastal/marine ecosystem monitoring
- Create portable, flexible structures
- Cooperate with private/public entities and re-imagine how institutions can work together to solve common problems

Lake Clark National Park, Upper Kijik River | Photo by Jeff Shearer, NPS

Conclusions

NPS lands and surrounding areas represent crucial resources for local residents, important habitats for a wide range of species, and a national treasure for the American public. Change is already underway. The stakes are high.

As compared to traditional planning, scenario planning draws knowledge from a wider range of people, addresses a broader range of possibilities, has a stronger focus on "win-win" solutions, and offers greater opportunities for collaboration. However, the scenario planning process doesn't end with *"Synthesize"*. Next steps include:

- Discussion of how to turn plans into concrete actions
- Development of outreach tools and information, and dissemination to a broad audience
- Feedback from a wider audience
- Linkages with planning for other park networks

Sources

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