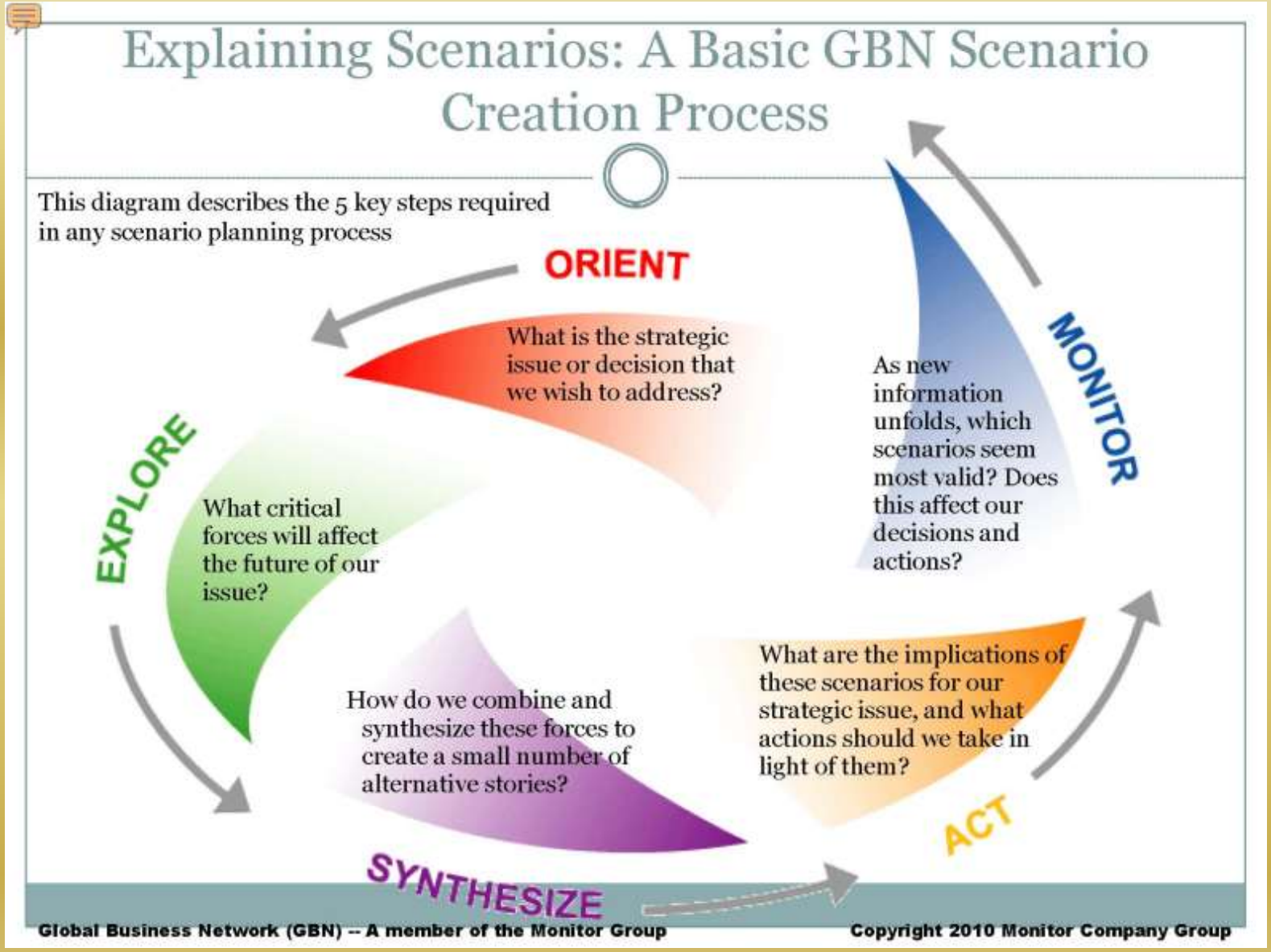
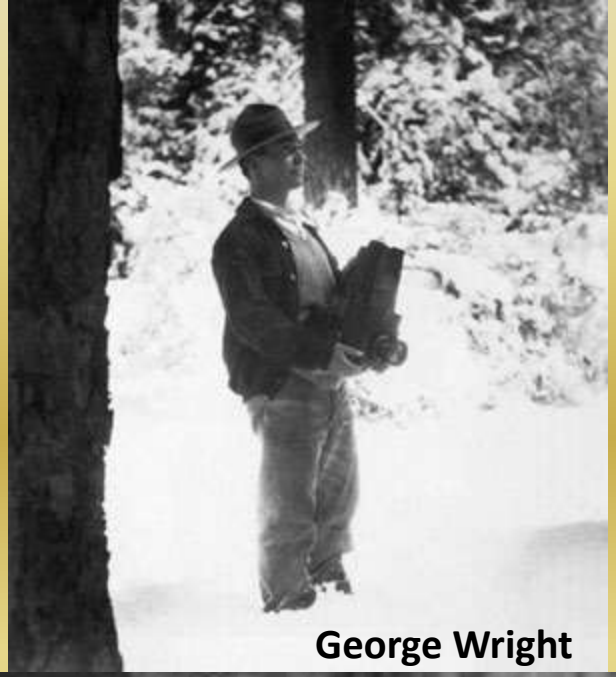
National Park Service

Explaining Scenarios: A Basic GBN Scenario Creation Process

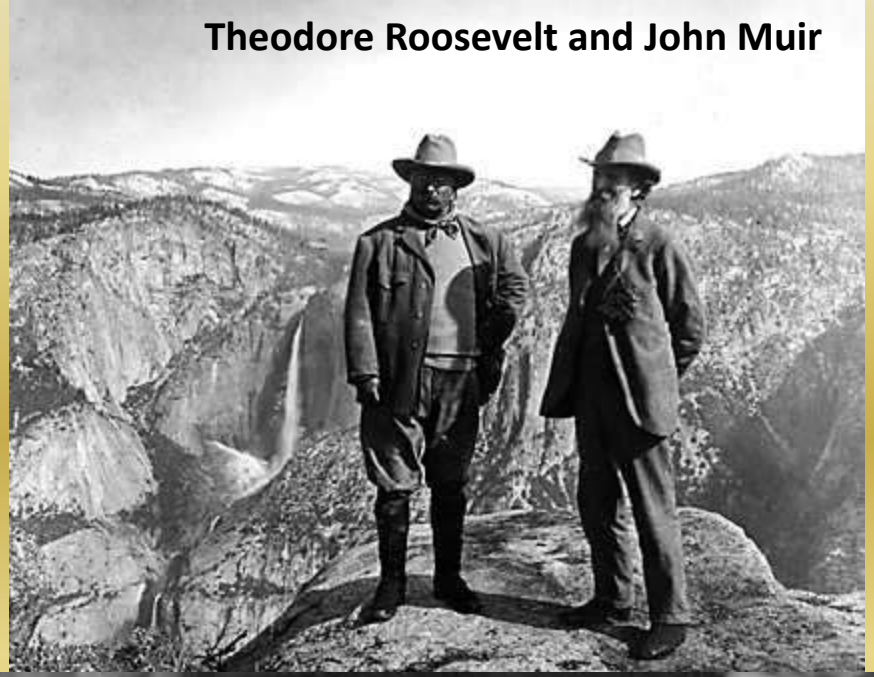


National Parks of Alaska

National Park Service



George Wright

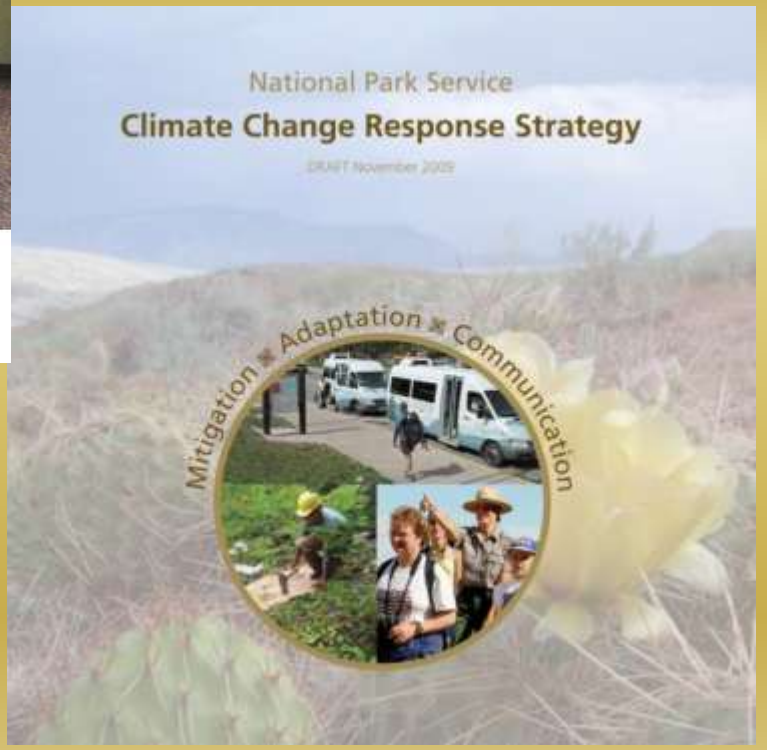


Theodore Roosevelt and John Muir

Stephen Mather and Horace Albright

2011 Alaska Leadership Council

Joel Hard, Tim Hudson, Ralph Moore, Jeanette Pomrenke, John Quinley, Mary McBurney, Deb Cooper, Susan Boudreau, Jeff Mow, Sue Masica, Vic Knox, Meg Jensen, Randy Larsen, Chuck Young, Elwood Lynn, Mark Vaughn, Paul Anderson, and Greg Dudgeon.

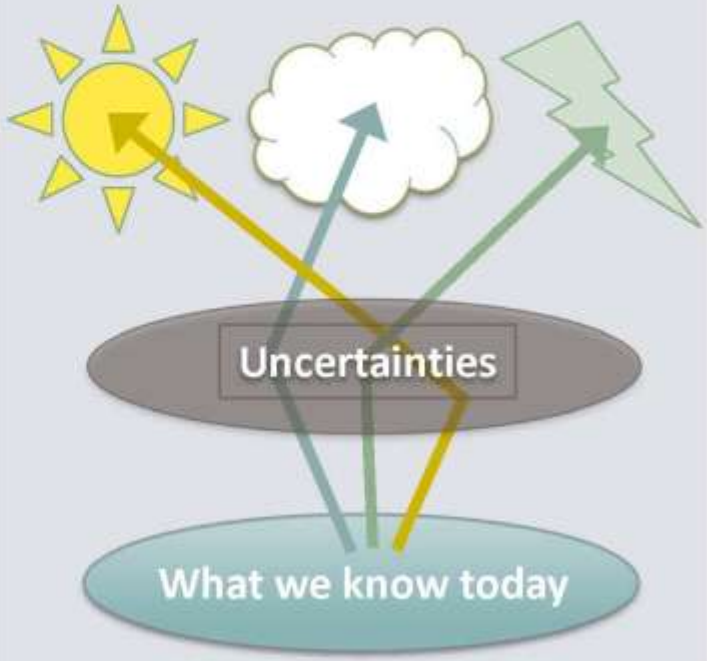


Scenario Planning vs. Forecasting

- *Scenarios overcome the tendency to predict, allowing us to see multiple possibilities for the future*

- Forecast Planning
- One Future

- Scenario Planning
- Multiple Futures



Global Business Network (GBN) -- A member of the Monitor Group

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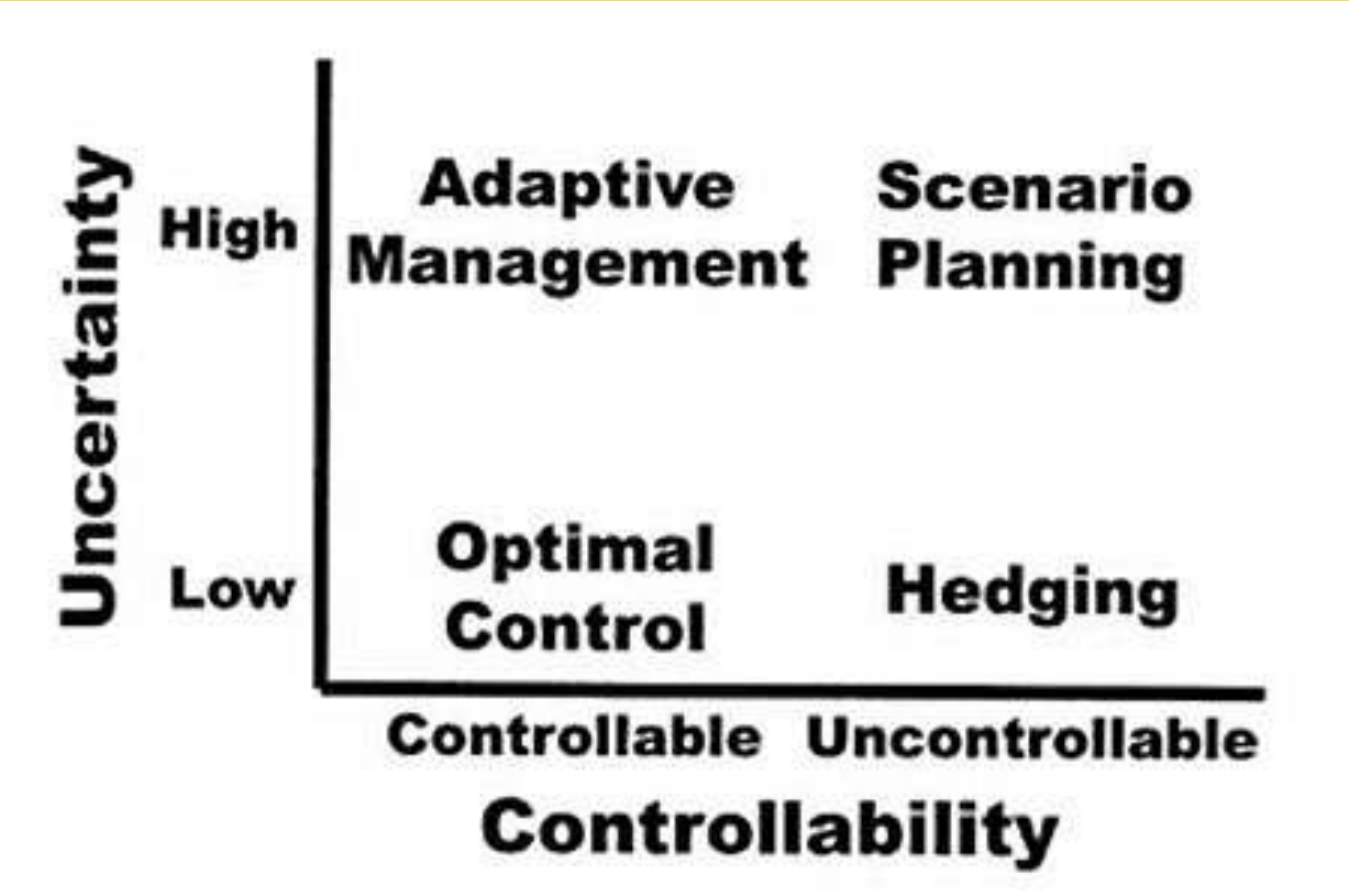

Uncertainty
High
Low
Adaptive Management
Scenario Planning
Optimal Control
Hedging
Controllable
Uncontrollable
Controllability

“Finally, the park system is going to scenario planning and seeing what places will be the most vulnerable and how to adapt. The new visitor center for the USS Arizona in Pearl Harbor is designed for a three-foot sea-level rise, as an example.”

Jon Jarvis, The Big Outside Blog, 12/21/2011

"We use scenario planning to rehearse the future to avoid the management surprises"

Generating a Broad Range of Options

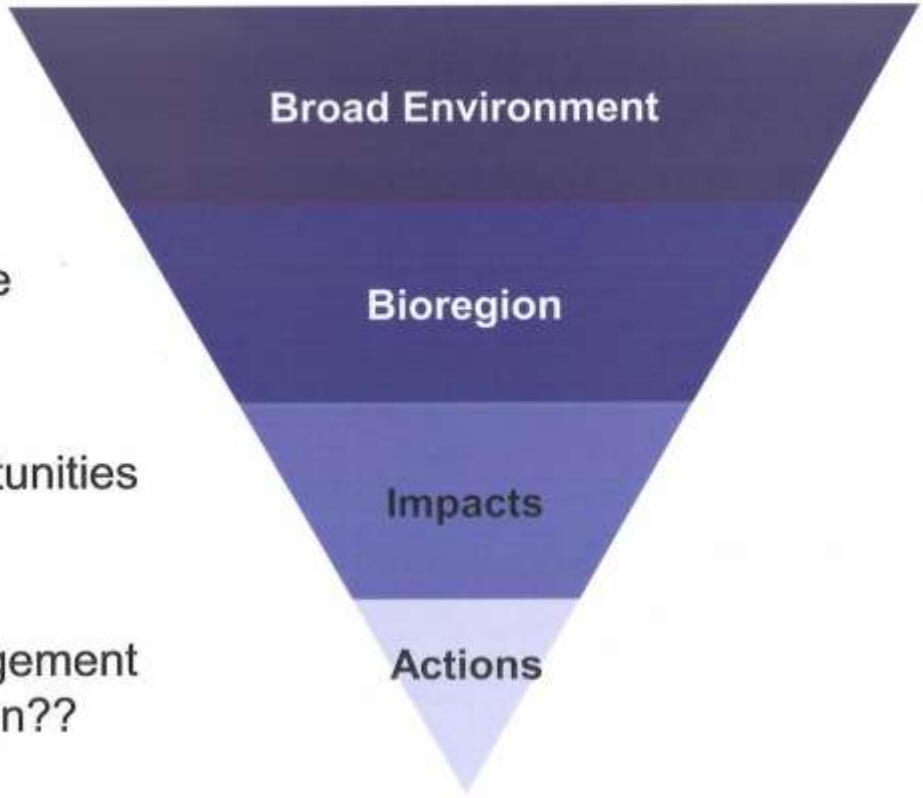
For each scenario . . .

What is this world like?

What effects does this have on the bioregion?

What pressures and opportunities will management face?

What could / should management do if faced with this situation??



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Implications and Options Differentiated

Implications		Options
The conditions under which you will need to operate		*The range of actions you will take in light of the conditions*
Challenges	→	Responses
Bottlenecks	→	Workarounds and fixes
Shortages	→	New supplies and suppliers
Emergent needs	→	Product or service offerings
Emergent capabilities	→	Specific investments, development activities

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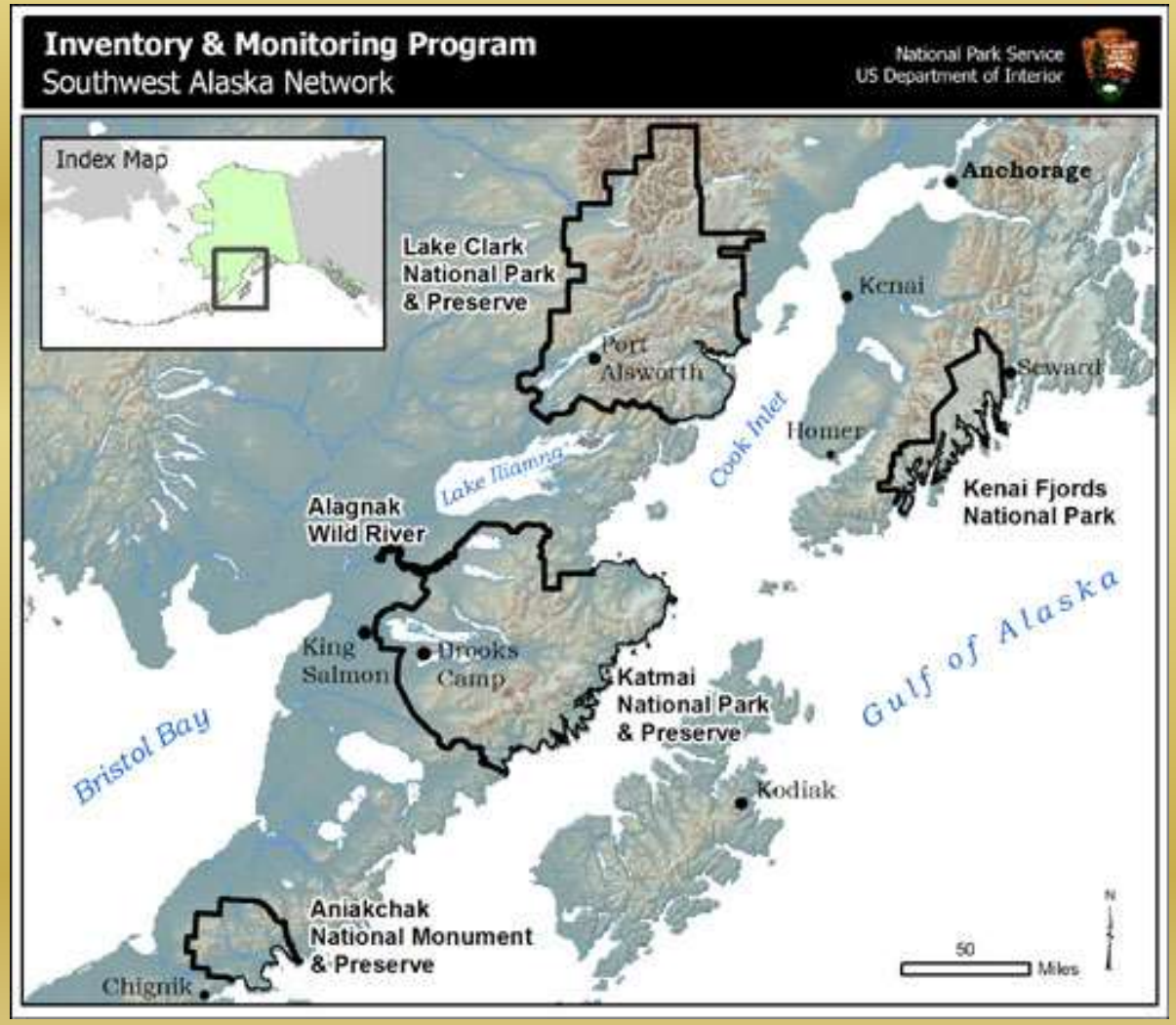
Southwest Alaska Network (SWAN)



SWAN Parks and Sites

Aniakchak

Lake Clark

Kenai Fjords

Katmai

Selected Drivers (Coastal)

Climate Drivers (or, "Scenario Drivers based on Climate")	Uncertain	High certainty	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)	
PDO	X		
Extreme Events (temperature)		X	
Extreme Events (precipitation)	X	X	
Extreme Events (storms)		X	X

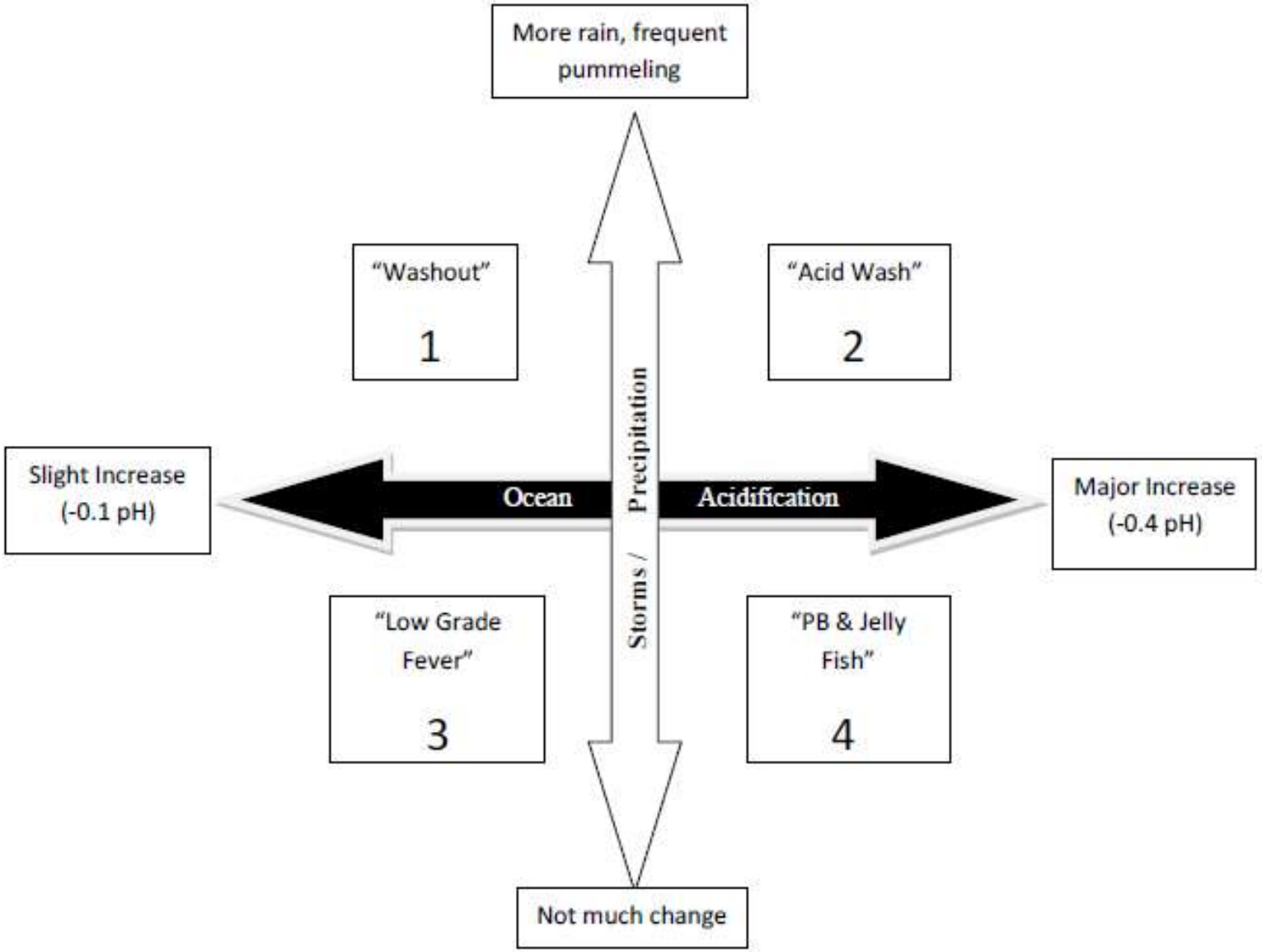
Additional drivers introduced by the group:

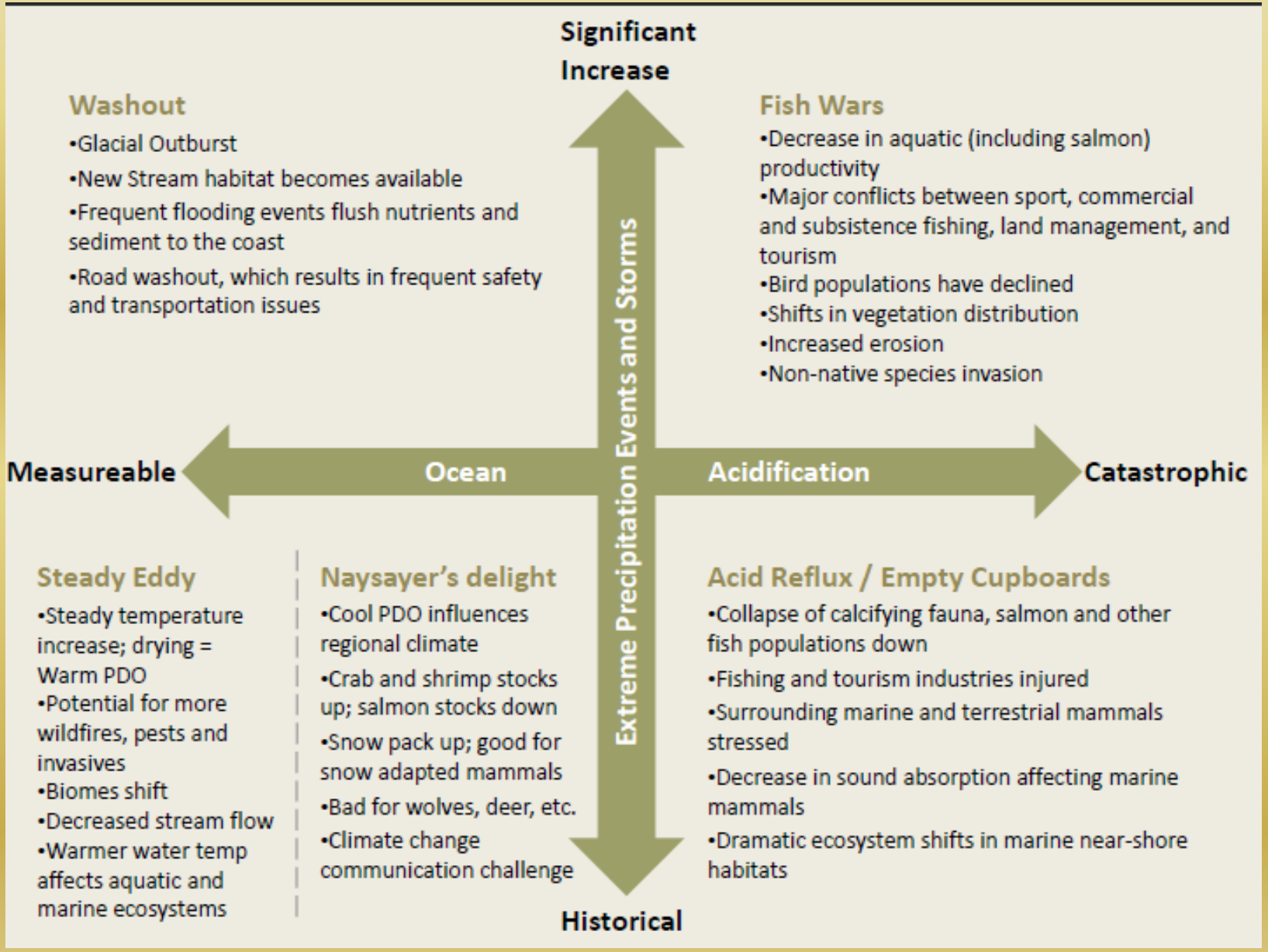
- **Ocean Acidification**
- **Salinity (onshore/near shore)**
- **Aleutian Low**
- **Extreme Event (wind)**
- **AK Coastal Current**

Selected drivers to explore:

Acidification:
Temperature:
Storms

Precip


More rain, frequent pummeling
"Washout"
1
"Acid Wash"
2
Slight Increase (-0.1 pH)
Ocean
Storms / Precipitation
Acidification
Major Increase (-0.4 pH)
"Low Grade Fever"
3
"PB & Jelly Fish"
4
Not much change


Significant Increase
Washout
•Glacial Outburst
•New Stream habitat becomes available
•Frequent flooding events flush nutrients and sediment to the coast
•Road washout, which results in frequent safety and transportation issues
Fish Wars
•Decrease in aquatic (including salmon) productivity
•Major conflicts between sport, commercial and subsistence fishing, land management, and tourism
•Bird populations have declined
•Shifts in vegetation distribution
•Increased erosion
•Non-native species invasion
Measureable
Ocean
Acidification
Catastrophic
Extreme Precipitation Events and Storms
Steady Eddy
•Steady temperature increase; drying = Warm PDO
•Potential for more wildfires, pests and invasives
•Biomes shift
•Decreased stream flow
•Warmer water temp affects aquatic and marine ecosystems
Naysayer's delight
•Cool PDO influences regional climate
•Crab and shrimp stocks up; salmon stocks down
•Snow pack up; good for snow adapted mammals
•Bad for wolves, deer, etc.
•Climate change communication challenge
Acid Reflux / Empty Cupboards
•Collapse of calcifying fauna, salmon and other fish populations down
•Fishing and tourism industries injured
•Surrounding marine and terrestrial mammals stressed
•Decrease in sound absorption affecting marine mammals
•Dramatic ecosystem shifts in marine near-shore habitats
Historical

Implications and Options Differentiated

Implications		Options
The conditions under which you will need to operate		*The range of actions you will take in light of the conditions*
Challenges	→	Responses
Bottlenecks	→	Workarounds and fixes
Shortages	→	New supplies and suppliers
Emergent needs	→	Product or service offerings
Emergent capabilities	→	Specific investments, development activities

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Implications Nested Scenario 2: Acid Wash/Big Problems, Big Efforts: "Acid Reflex"

Natural Resources

- benthic community decline , food web shift, local extinction, mass redistribution, coastal erosion, unknown glacial dynamics

Cultural Resources

- flooding and wave action , loss of known historic sites, loss of historic record (undiscovered sites)

Subsistence

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

Implications (continued)

Socioeconomic

- Questions of prioritization re: private vs. public aid , livelihoods stressed, leading to industry shift (tourism, fishing)

Facilities

- Increased risk of flood/mudslide/erosion effects on structures, access to roads and trails more frequently compromised, ….

Communication

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

Research and Information Needs

- Overall, more robust monitoring and research
- Acidification research
- Alternative energy/ alternative facilities research
- Exploratory husbandry
- Glacial monitoring
- Robust benthic, fish, seabird, mammal monitoring
- Mapping of cultural resources
- Coastal engineering

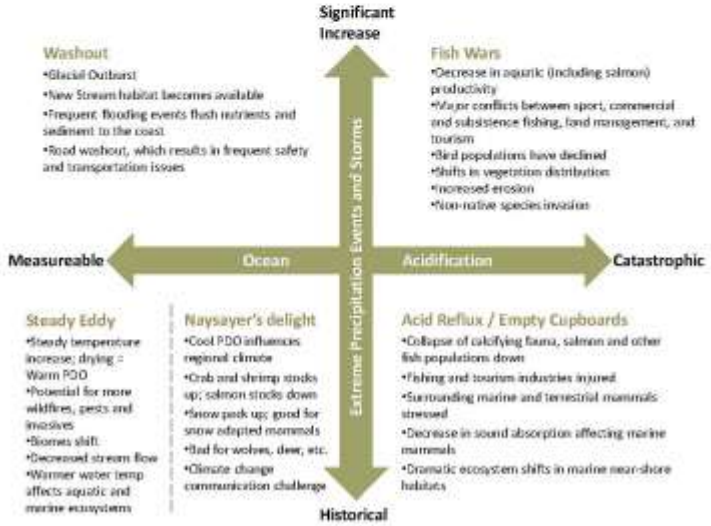
Important Management Actions

- Mission Statement evolution
- Removal of artificial barrier between research/monitoring/management loop
- Fostering public/private partnerships (e.g. ecosystem cooperatives/LCCs)
- Protecting and providing access to sacred cultural sites
- Comprehensive risk assessment for roads, bridges, trails, structures
- Temporary/portable facilities
- Species specific mitigation planning (economic driver species)
- Foster transitional community coping mechanisms
- Synchronize public/private education and outreach

Southwest Alaska Network

Background

Since 2006 the National Park Service (NPS) has been using scenario planning, a collaborative and strategic science-based decision support tool, to explore future impacts of global climate change, management policies and societal attitudes on national parks. The NPS has engaged several leaders in the field of scenario planning in this effort, most notably the Global Business Network, the University of Alaska's Scenarios Network for Alaska Planning, the University of Arizona's Office of Arid Lands Studies, the University of Montana National Center for Landscape Fire Analysis and the USGS Northern Prairie Wildlife Research Center. With the aid of these partners, the NPS has developed a unique approach to scenario planning, which employs quantitative as well as qualitative models of change to envision a variety of future social, political and environmental outcomes. By applying the process of scenario planning, NPS managers are able to evaluate the uncertainty and variability surrounding future environmental and sociopolitical conditions, and develop resource management strategies that will be effective across a wide range of potential outcomes.



Southwest Alaska Network Local Climate Drivers

The Southwest Alaska Network scenario workshop participants identified extreme precipitation events and storms and ocean acidification as the most critical and uncertain climate drivers that will affect conditions in the network over the next 50 to 100 years. These drivers were used to create a local climate change drivers matrix where impacts to park resources and infrastructure could be identified and elevated for additional consideration. Based on the local climate drivers matrix, four narrative scenarios were developed, which incorporate the potential impacts of climate change to park resources set in the context of varying future social and political situations.

Scenario #1 – NPS 911

"NPS 911" is a scenario where southwest Alaska is experiencing an increase in extreme storm and precipitation events. These events cause frequent flooding that flushes nutrients and sediment to the coast, increases erosion and encourages vegetation succession on land - which has allowed for invasive species encroachment in terrestrial ecosystems. Roads are prone to washout, resulting in safety and transportation issues. Increased water temperatures in lakes and streams stress salmon populations. This scenario offers a lack of senior commitment and governments are unable to articulate a coherent set of policies and approaches to climate change, resulting in growing public unease, and unstable systems and structures. Impacts and implications of this scenario may include cultural resources at risk of flooding and damage and emergency documentation of archeological sites would be necessary. This scenario would be characterized by an increase in the need of community support and assistance from the NPS. Facilities and infrastructure would likely suffer damage, and there would likely be an increase in travel risks and incidents. This scenario would present a challenge for interpretation and education in the form of reduced visitor satisfaction and heightened expectations of climate change response from the NPS.

Scenario #2 – Jellyfish Delight

"Jellyfish Delight" is a scenario where catastrophic increases in ocean acidification, coupled with extreme storm and precipitation events, have resulted in a decrease in aquatic (example: salmon) productivity. Major conflicts between sport, commercial, and subsistence fishing, land management, and tourism are common. Bird populations have declined due to decreased food availability and the loss of breeding habitat from flooding. However, broad societal understanding of climate change spurs coordinated action leading political leaders to initiate bold policies to mitigate the worst impacts of climate change, and adapt to the inevitabilities of climate change effects. Impacts and implication of this scenario would likely be characterized by severe stress to wildlife, especially aquatic wildlife. Coastal fish population could approach collapse, resulting in severe economic impacts and produce heated conflicts. Cultural resources, historic buildings, archaeological sites, facilities and roads could suffer flooding and erosion. It is likely that visitation would decline as a result of the reductions in charismatic species.

Scenario #3 – Baked Alaska

Baked Alaska is a scenario of relatively slow increase in ocean acidification, coupled with a historical trend of extreme storm and precipitation events. This scenario is characterized by strong commitment from leadership and the international community regarding climate change action. However, there are other concerns competing with climate change, and society remains largely indifferent to action.

There are few major changes in species composition and productivity along the coasts, although steady temperature increases have altered the terrestrial environment, causing increases in wildfires and pests, such as beetle kill, which continue to affect the landscape. Vegetation biomes have shifted, creating opportunities for the encroachment of invasive species. Stream volumes are decreasing, drying up many wetland and riparian areas, while rising water temperatures affect fish reproduction, and in turn, marine and terrestrial mammal populations.

Impacts and Implications: there would likely be an increase in fires, pests and stress to vegetation. Due to increases in temperature, there would likely be a small window of time to preserve snow bed archaeology relative to other scenarios. Summer tourism would likely increase with the longer visitation season and winter travel would be reduced with more open water.

Scenario #4 - "What Climate Change"

"What Climate Change" is a wild card scenario where winter temperatures are lower during a negative phase of the Pacific Decadal Oscillation, combined with a measurable level of ocean acidification. Impacts and Implications of this scenario would include climate change becoming a topic of little political or societal concern, as competing concerns and interests dominate public discourse. Southwest Alaska experiences a large marine shift as a result of the changes. Crab and shrimp stocks have increased, while salmon stocks have declined. This effect has caused brown bear declines. Snow pack may increase, resulting in ideal conditions for skiers, moose, and other mammals adapted to large snow cover. Wolves and their prey do not do as well in the deep snow. Potential for changes to the terrestrial ecosystems arise. Subsistence and commercial fishing is affected as more people compete for fewer fish. Interpretation and education would face significant challenges in communicating the implications of climate change to the public when climatic changes are not apparent, due to wetter, cooler weather.

"Best Practices" The following strategies, actions, and areas for further study were common to all four Southwest Alaska Network scenarios, and represent "best practices", as they will enable managers to better approach resource management regardless of how the future may unfold. Moreover, the indicators to monitor areas for further research represent milestones that could signal whether the future is evolving towards or away from one or more scenarios, allowing managers to adjust strategies and actions accordingly.

"Best Practices" Management Actions Common and Applicable to All Scenarios

Resiliency

- Make Climate Change an organizing principle for park priorities.
- Reduce stressors: control invasives, restore disturbed areas.
- Coordinate emphasis on inventory and monitoring of both social and natural systems.

Research and Study

- Safety and access changes.
- Role of natural variability.
- Park relevance with public and visitors under changing conditions.
- Consider park mandates and enabling legislation under changing conditions.

Capacity Building

- Enhanced communication technology.
- Promoting climate change literacy: global vs. local impacts and implications.
- Build true interagency cooperation and collaboration with stakeholders. Consider structuring a coordinating entity to deal with the impacts of climate change (include agency, state, tribal, NGO's).

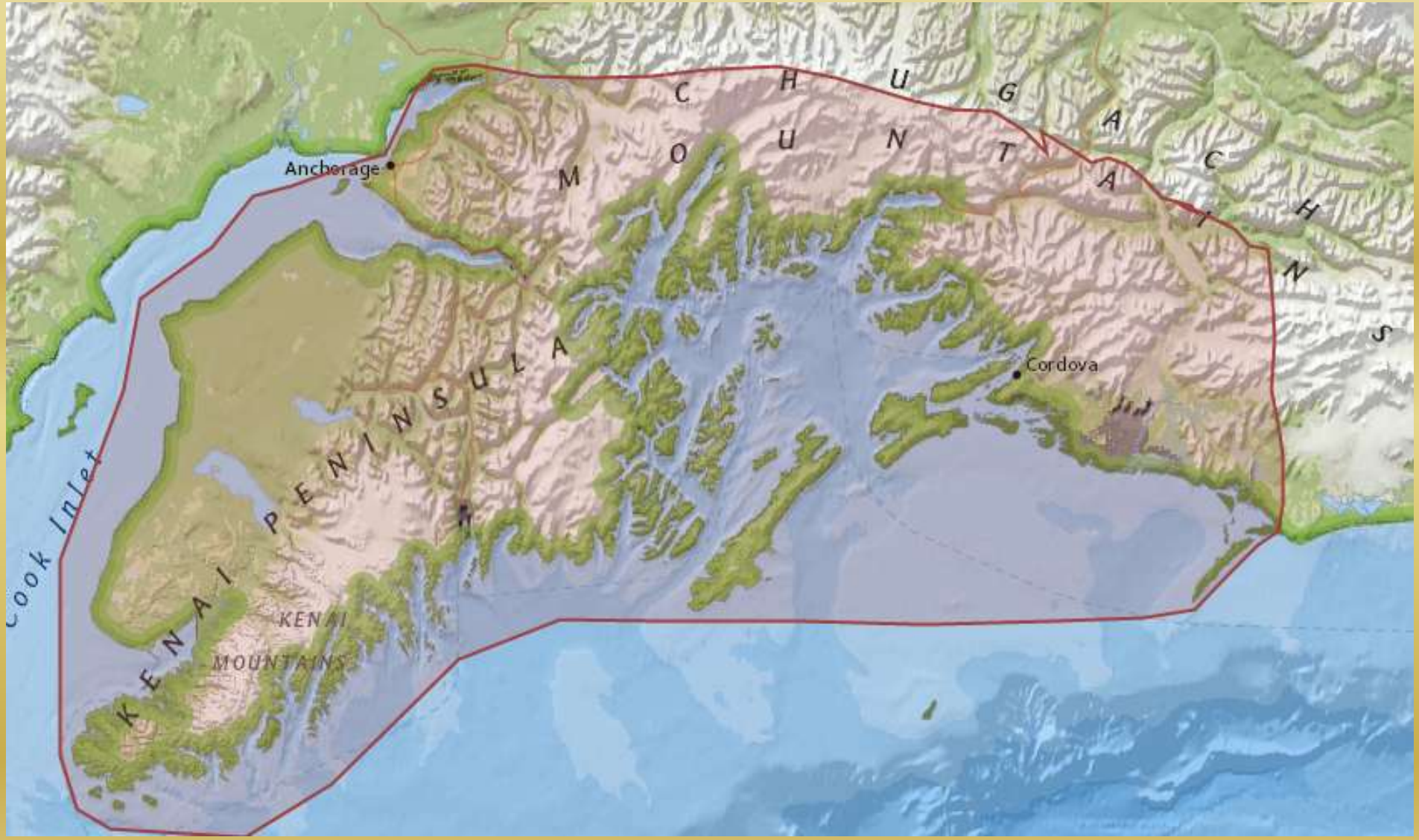
Indicators to Monitor

- Relative sea level rise
- Geomorphology
- Species changes
- Groundwater
- Landscape level changes
- Migration phenology

Climate Change Response Program: www.nps.gov/climatechange

EXPERIENCE YOUR AMERICA™

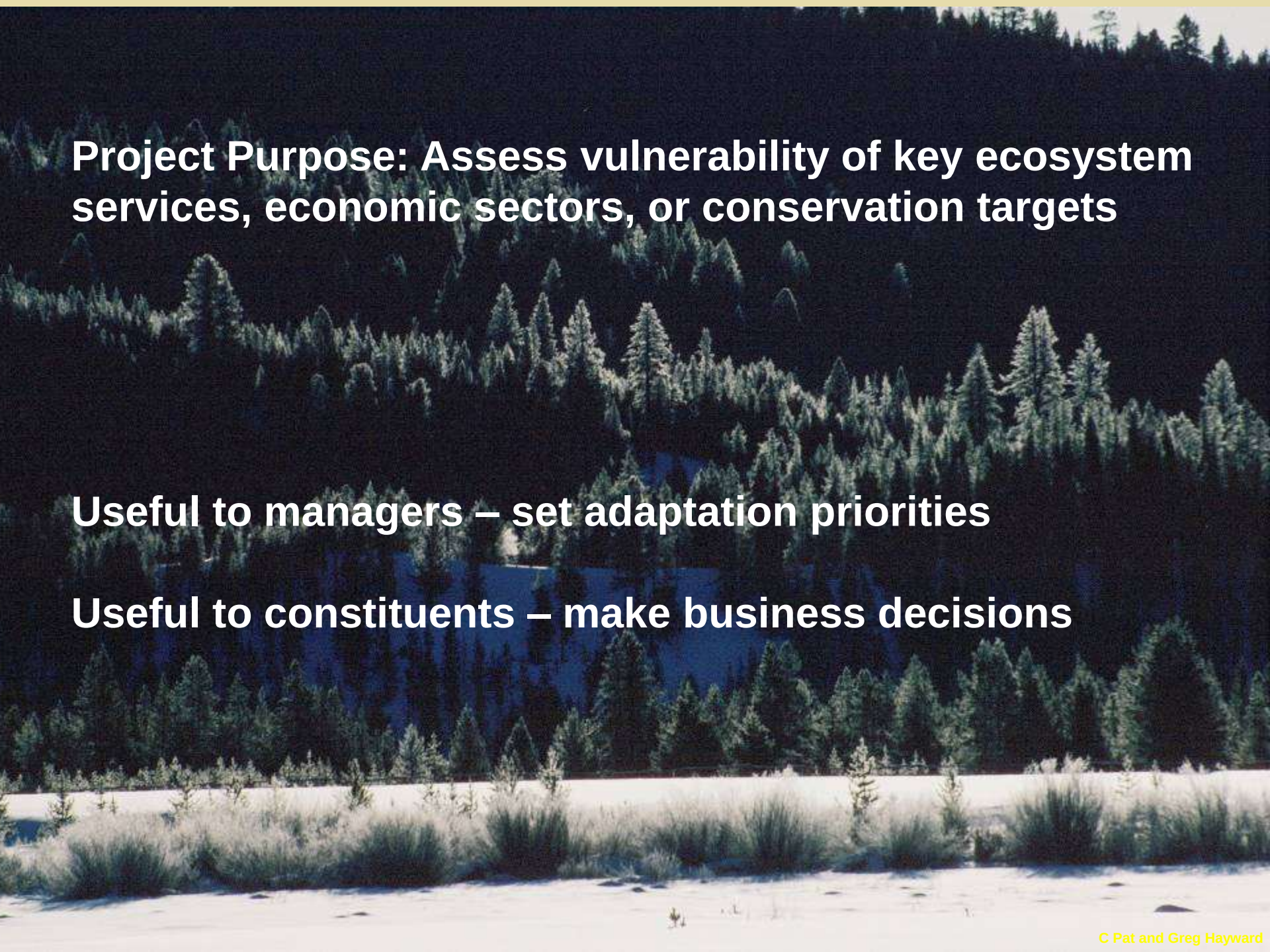
ROAD
CLOSED



National Park Service

Chugach - Kenai
Climate Vulnerability Assessment

University of Alaska, Anchorage
Chugach National Forest, State and Private Forestry
Kenai National Wildlife Refuge
Forest Service Research - PNW
Kenai Fjords National Park
USGS Climate Science Center



Project Purpose: Assess vulnerability of key ecosystem services, economic sectors, or conservation targets

Useful to managers – set adaptation priorities

Useful to constituents – make business decisions

C Pat and Greg Hayward

Five Emphasis Areas

Coasts and Sea-scapes Tourism, productive systems

Snow and Ice Snow sports, visuals, hydrology…

Culture and Infrastructure Integrating team using results from other teams.

Salmon A defining ecological service of the region

Vegetation and Species Integrate -- biome shift, tree species shifts, dominant ungulates, invasive species.

The Power of Place

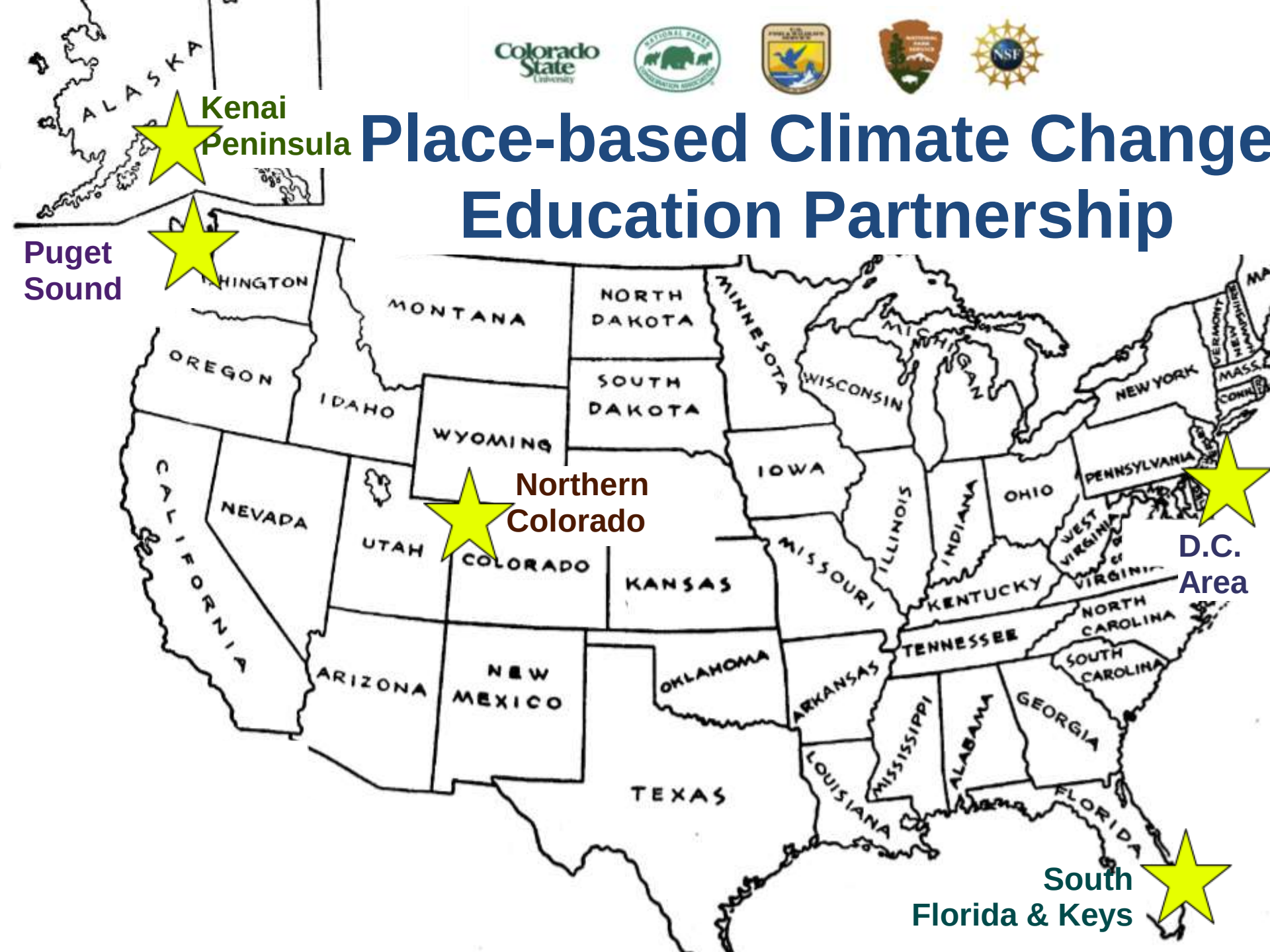
Kenai Fjords National Park

Kenai National Wildlife Refuge

National Park Service

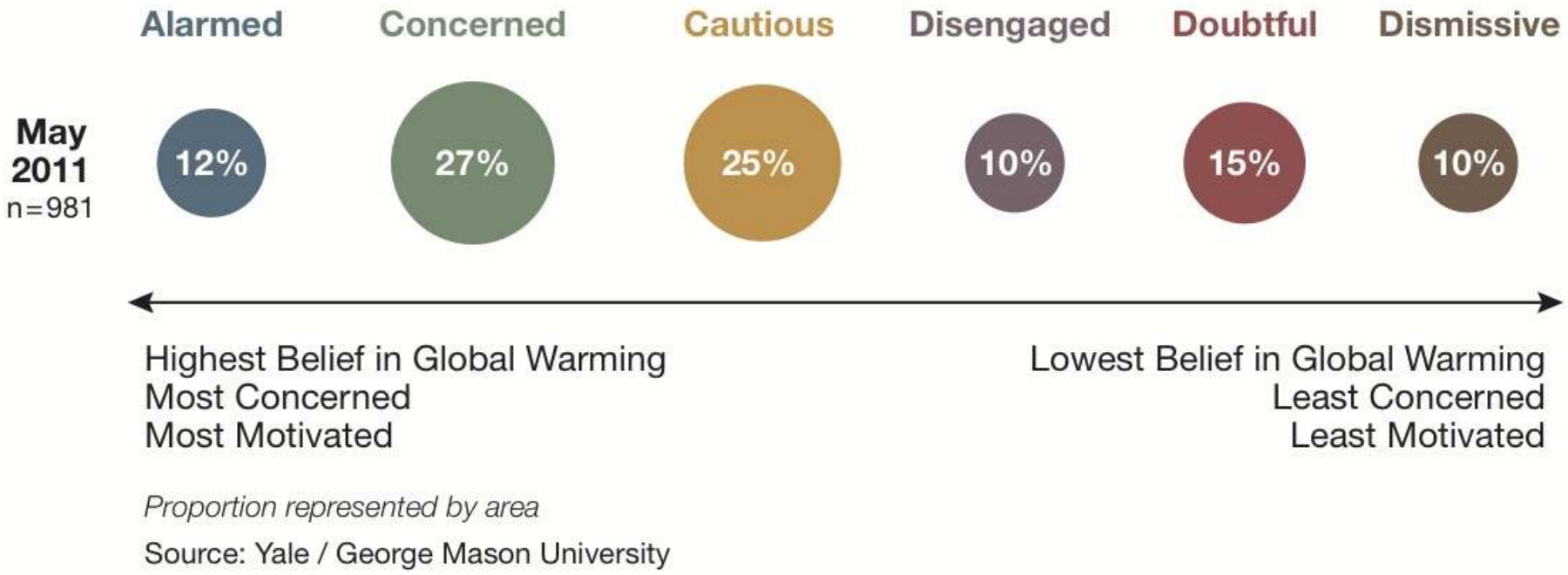
Changing the Conversation about Climate Change

Place-based Climate Change Education Partnership

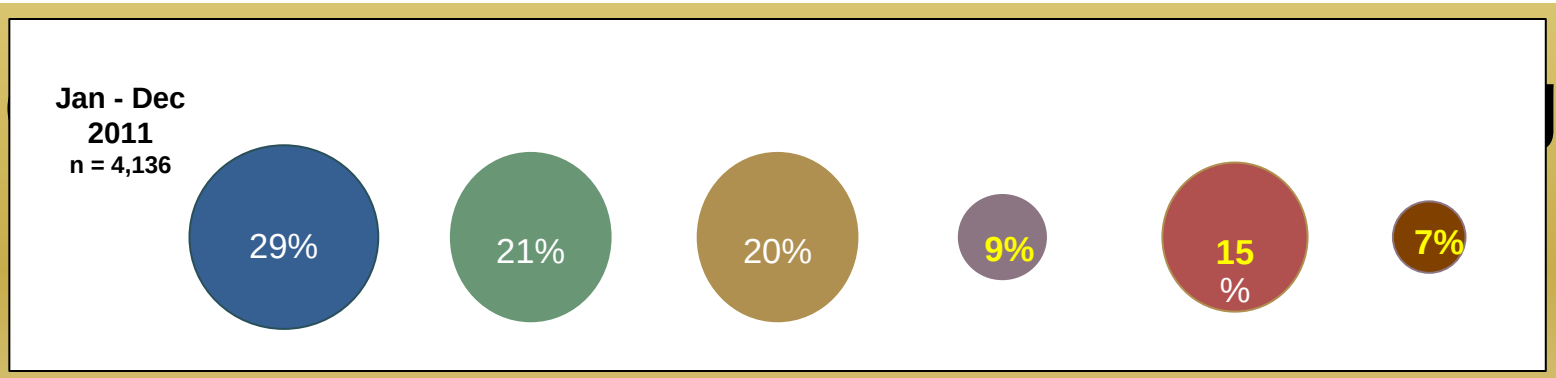


Project Objectives

- Discover *current activities* at each site
- Identify *barriers & opportunities* for collaborating and communicating about climate change
- Identify *issues & impacts* to be communicated
- Integrate ideas for place-based climate change education/engagement strategy!


Alarmed
Concerned
Cautious
Disengaged
Doubtful
Dismissive
May 2011 n=981
12%
27%
25%
10%
15%
10%
Highest Belief in Global Warming
Most Concerned
Most Motivated
Lowest Belief in Global Warming
Least Concerned
Least Motivated
Proportion represented by area
Source: Yale / George Mason University

Au

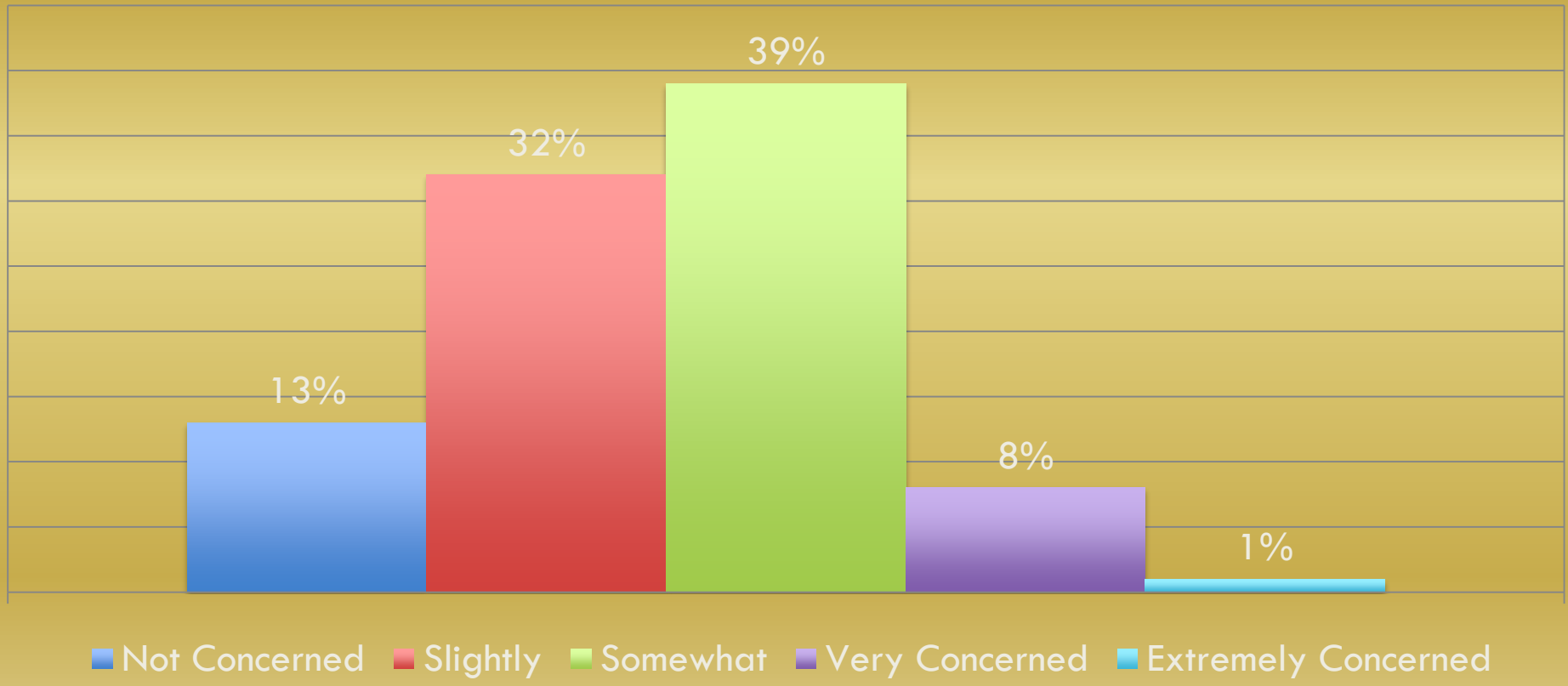

Jan - Dec 2011
n = 4,136
29%
21%
20%
9%
15 %
7%

ges

Audience Research Results

Staff & Visitor Surveys

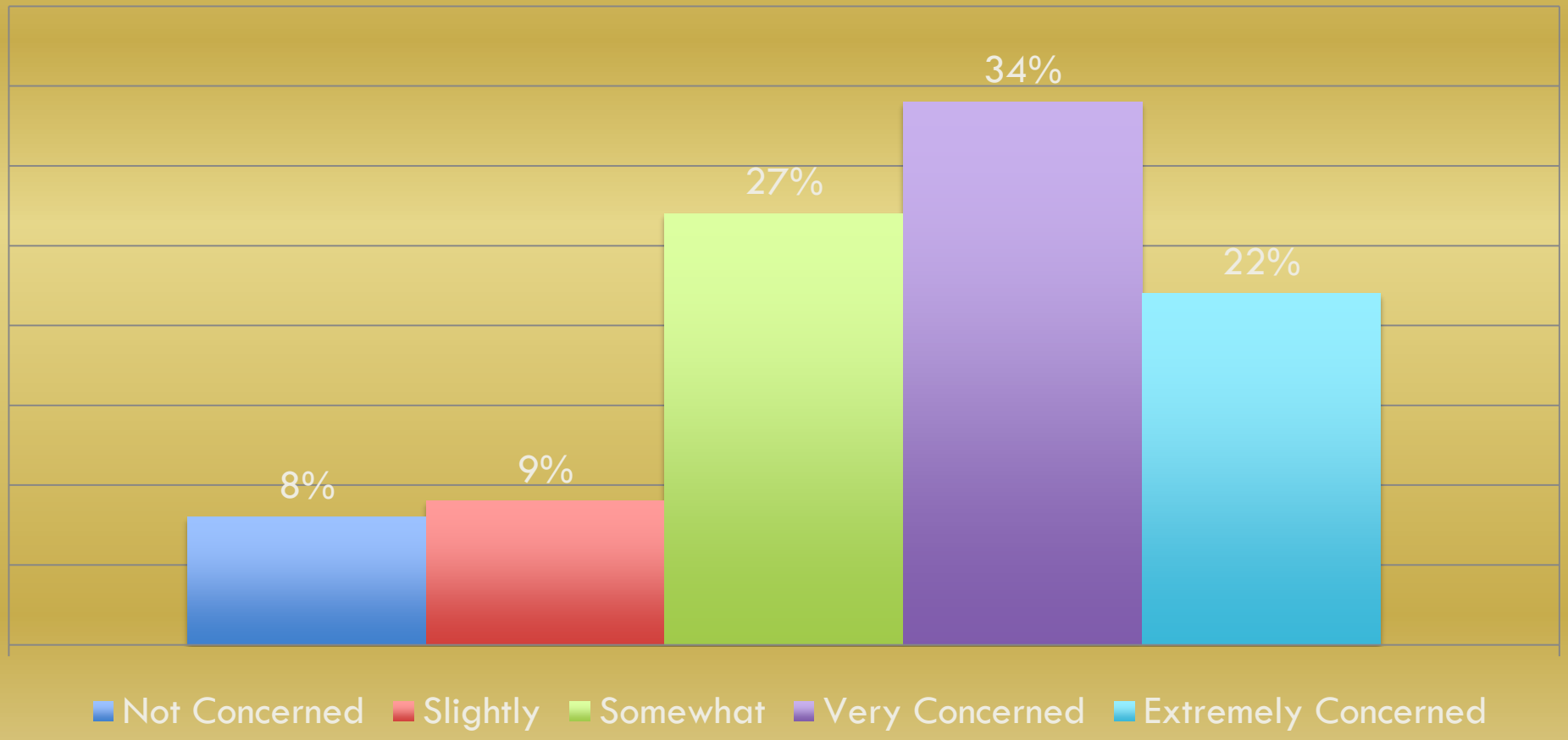
We asked the Staff: Are Your Visitors Concerned about Climate Change?



Audience Research Results

Staff & Visitor Surveys

Then we asked the Visitors: How Concerned are You about Climate Change?



Elements of the Kenai COP Project (Changing Landscapes)

Regional COP Coordinator (incl travel and admin support costs)

2-3 Interns to Support Project Needs

Developing Kenai Ranger Climate Change Hub

Scoping, Development and Evaluation of Training Modules for Agency and Partner (Guides, Visitor Services, Community) Staff

Scenario Planning Workshop for Kenai Peninsula Communities

Development of a Social Media Application for Sharing Climate Stories

Climate Education Programs for Youth Education

Kenai Climate Change Partnership

- Kenai Fjords National Park
- Kenai National Wildlife Refuge
- Chugach National Forest
- Kenai Watershed Forum
- Kenai Peninsula Borough??
- Kenai Communities??

Assateague Island National Seashore

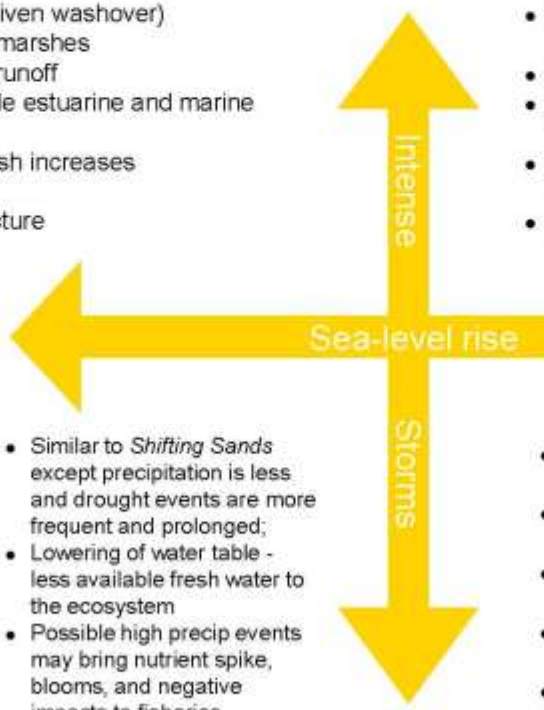
Established in 1965

…to preserve the outstanding Mid-Atlantic coastal resources and natural ecosystem conditions and processes upon which they depend while providing high quality resource-compatible recreational opportunities.

Climate Variable	General Change Expected	Confidence Level
Temperature	Increase, but not uniform	Virtually certain
Precipitation	Probable decrease in total annual precipitation	Low
Sea Level	Increase	Moderate
Drought	A modest increase in drought frequency in the warm season	Moderate
Snow cover	Increase in snow-free days; decreased snow accumulations	High
Length of growing season	Increase	High
Extreme Events: Temperature	Warm Events Increase / Cold Events Decrease	Moderate to high
Extreme Events: Precipitation	Possible decrease of frequency of heavy rain, but countered by rise in intensity.	Low to moderate
Extreme Events: Cold Season Storms	Increased intensity.	Low to moderate
Extreme Events: Warm Season Storms	Increased intensity; possible decrease in frequency	Low

ASIS Local Scenario Framework

Through conversations before and during the April workshop, the ASIS team identified the most important and most uncertain climate drivers that will affect conditions in the Park over the next 40 years. The decided upon uncertainties relating to the intensity of storms and the rate of sea-level rise. These were combined in the following matrix.



Moving Target

Intense storms, Increased frequency

- Episodic change (wave-driven washover)
- Higher productivity in the marshes
- Increased sediment from runoff
- Island size decreases while estuarine and marine area increases
- Dune erosion and overwash increases
- Simplified habitats
- High impacts on infrastructure

Sand Bar

- Fragmentation occurs through the formation of multiple inlets
- Greater potential for breaching
- System unable to keep up with pace of change – from island to sandbar
- Habitats simplify and become uniform – lower biodiversity
- Huge potential impacts to full range of communities (aquatic, terrestrial, salt marshes)

Low / Moderate

Significant

Shifting Sands

- Similar to today's dynamic environment, but with more intense pressure
- Expansion of complexity and stability of estuarine communities
- Lengthening of growing season
- Some lowering of the water table with impacts on flora and fauna
- Migration of species northwards
- Greater risk of vector-borne diseases

Parched

- Similar to *Shifting Sands* except precipitation is less and drought events are more frequent and prolonged;
- Lowering of water table - less available fresh water to the ecosystem
- Possible high precip events may bring nutrient spike, blooms, and negative impacts to fisheries.
- Increased risk of fire.

Status Quo, Decreased frequency

Drowning in Place

- Loss of land mass from sea level rise; island exists "further back"
- Individual storm events have big impact on resetting the landscape
- Recovery of system between extreme events is more likely
- Salt water inundation and intrusion into freshwater aquifer
- Shift in types of plants (tolerance for saline environs, higher temperature etc.)

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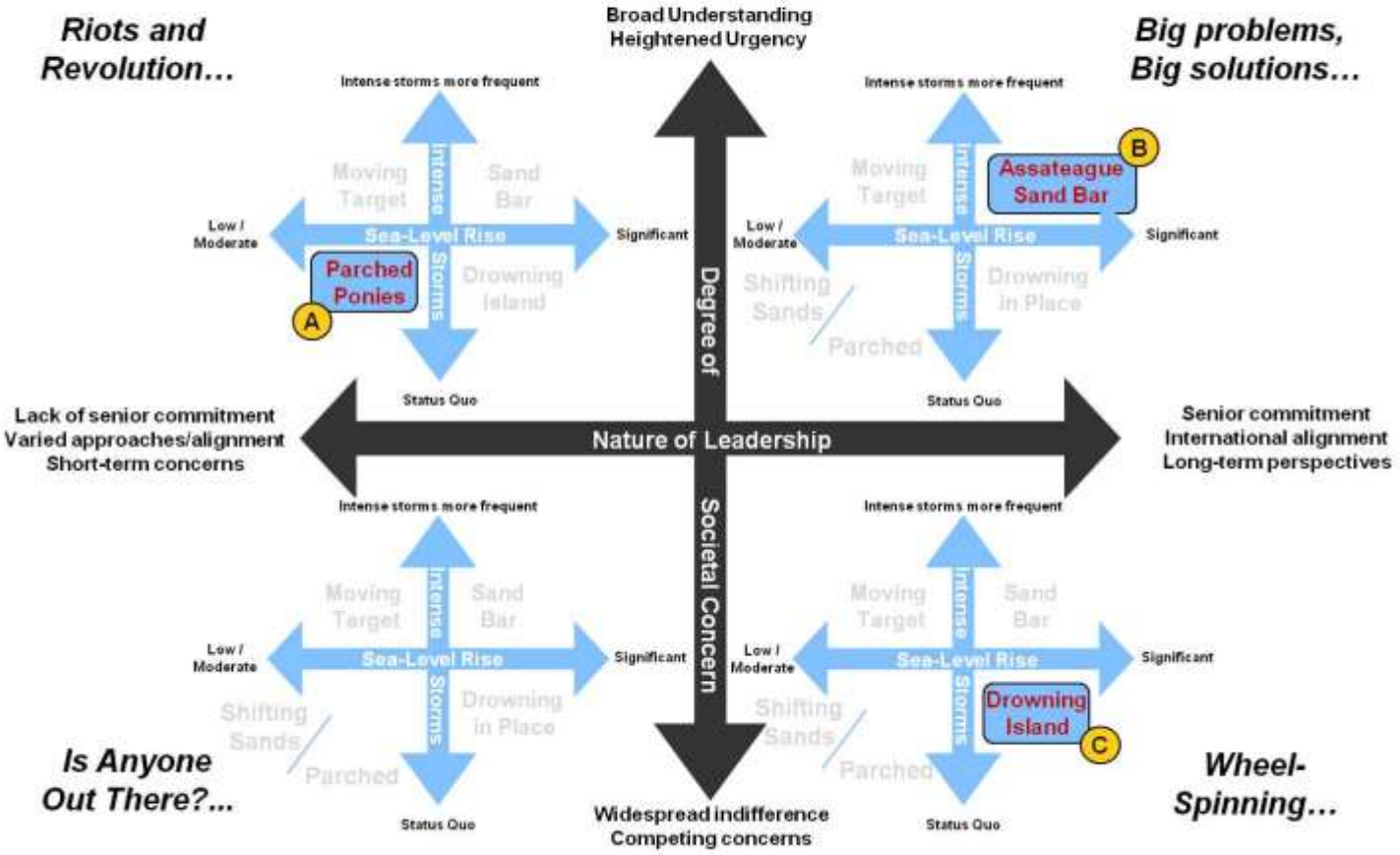
Case Study 1: ASIS Nested Scenarios

In the workshop, the ASIS team combined their local scenario framework with the high-level framework to create a set of "nested scenarios". They highlighted 3 nested scenarios (A, B, C) that seemed most important to consider further.



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Case Study 1: Assateague Nested Scenario (A): Parched Ponies

High-Level Scenario	Local Scenario
Riots and Revolution	Parched

"Parched Ponies" is a world in which societal concerns around climate change are heightened, yet there is little real leadership shown to address challenges at a global or national level. At the same time, ASIS experiences a storm intensity similar to today and low/moderate sea-level rises. Additionally, precipitation drops, creating drought events that are more frequent and prolonged.

- Lowering of the water table, leading to less available freshwater to the ecosystem
- The main impacts to the park under are migrating waterfowl, mammals, and declining or static shorebird habitat
- Resources changes include a smaller island, a shift from freshwater to brackish water (greater salinity), and more woody plant growth on beach areas.
- Possible high precipitation events may bring nutrient spike, blooms and negative impacts to fisheries.
- Impacts to plant and amphibian communities (especially those requiring freshwater and intolerant of warm water)
- Increased risk of fire
- Land use changes would require partnerships with other agencies, increased emphasis on coastal monitoring, an evaluation of the dune protection program, and greater land impact by ponies.
- Protection of resources would involve reprioritizing access needs and physically maintaining shorebird nesting habitat
- Monitoring capacity would need to be increased as would education and outreach.

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a member of the Monitor Group

Trish Kicklighter – Interview - 2011

- ASIS is on the front lines of CC
- We're one storm breach away from the tipping point at which the entire islands breaks up
- CC is overarching to all our planning
- What we have now is not what we'll have in 20-30 years
- What we do for future managers…

ASIS Management Actions

- Incorporate SP into ongoing GMP Process
- Rollout a Public Outreach Piece for SP
- Need to Monitor Groundwater – new protocol

- Two New Rules (No Regrets)
  - No more pavement on the island
  - Any new infrastructure on island must be portable

PLANNING CONSIDERATIONS FOR THE ALTERNATIVES

Natural Coastal Processes and Effects of Climate Change

Assateague Island is a barrier island that extends 37 miles along the coast of Maryland and Virginia and is part of a chain of barrier islands extending from Maine to Texas. Barrier islands like Assateague are highly dynamic places, in a state of constant change as currents and storms work to continuously reshape the land form and its habitats. Changing sea level and the availability of offshore sediments play vital roles in forming and maintaining these important coastal features.

Although long shore currents change course periodically throughout the year, sand is generally transported in a southerly direction along this part of the coast. On a seasonal basis, harsh winter weather pulls sand from dunes and upper beaches, depositing it into offshore sand bars and reducing beach width. This process is reversed during milder summer weather, as gentler wave action acts to restore the shoreline. Assateague is also moving westward as a result of sea-level rise and coastal storms through a process called "island rollover." During severe storm events, sand is eroded from the ocean beaches and carried across the island by flood waters and re-deposited in the marshes and bay, gradually adding land to the island's western margin. These events can also break through dunes, spilling sand in fanlike deposits or even carving new tidal inlets, such as the one that has separated Assateague and Ocean City since 1933.

Most global climate change scenarios indicate that barrier islands such as Assateague will become much more dynamic as a result of accelerating rates of sea level rise, and more intense and possibly more frequent storms. The formation of breaches and new inlets during storm events has occurred repeatedly on Assateague, is very likely to occur again, and may occur more frequently if rates of sea level rise continue to accelerate as predicted. Depending upon the location, future breaches or new inlets may render portions of the island largely inaccessible. Additionally, a more dynamic barrier island landform will

Assateague Island National Seashore Climate Change Projections

CLIMATE VARIABLE	RANGE OF CHANGE EXPECTED BY 2040	SIZE OF EXPECTED CHANGE COMPARED TO RECENT CHANGES	CONFIDENCE
Temperature	↑ 1.8 to 3.5 °F	Moderate to Large	High
Sea Level	↑ 3.5 to 9 inches	Large	Moderate
Precipitation	↑ 1-6% in cold half ↓ 3 to 7% in warm half	Small to Moderate	Low to moderate
Extreme Weather:	↑ storm intensity ↑ summer drought ↑ rainfall intensity	Small to Moderate	Low to moderate

Intergovernmental Panel on Climate Change, 2007.
Please visit our website for additional information on climate change projections at Assateague Island

Alternative 3

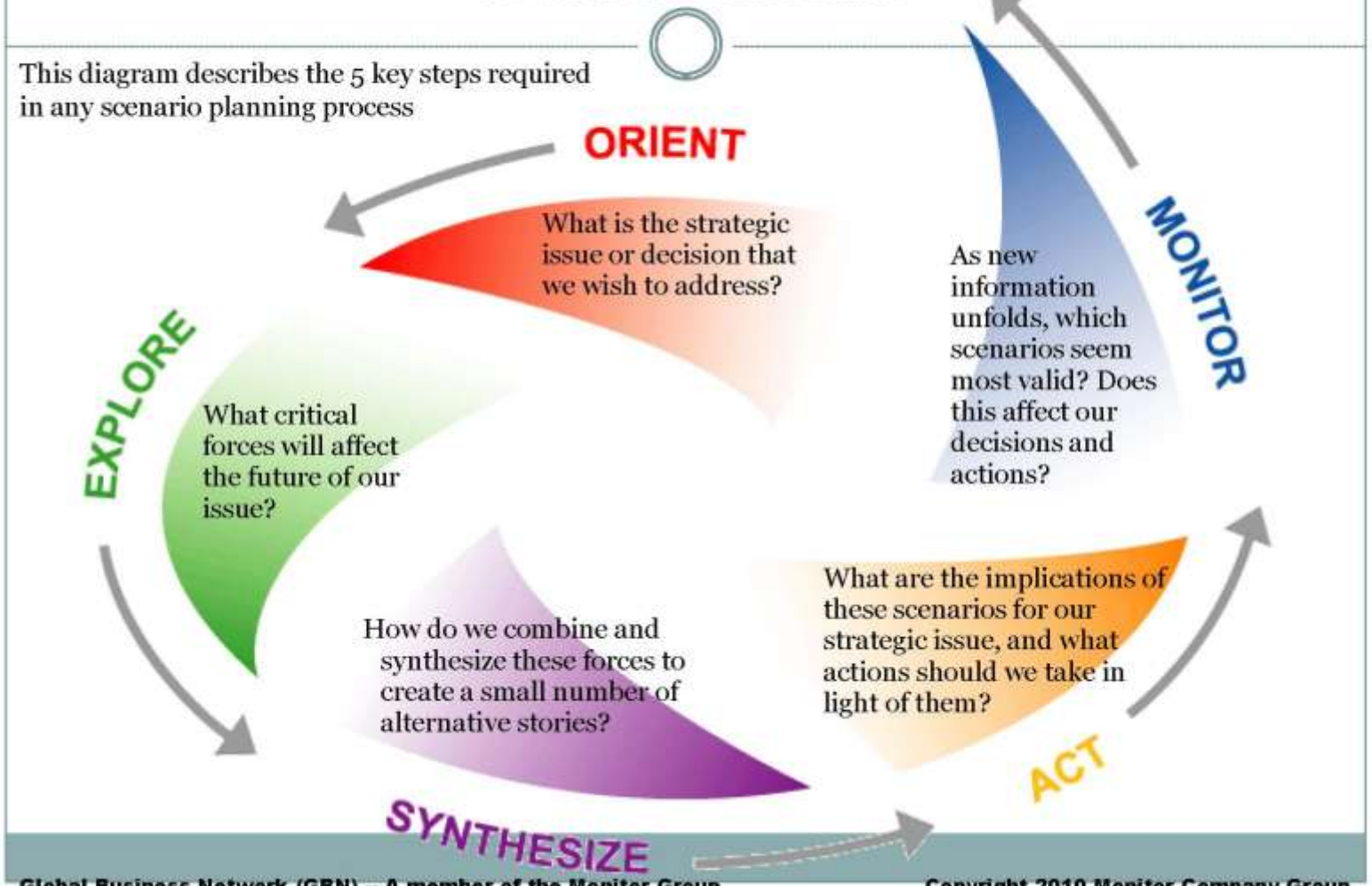
SUSTAINABLE RECREATION AND CLIMATE CHANGE ADAPTATION

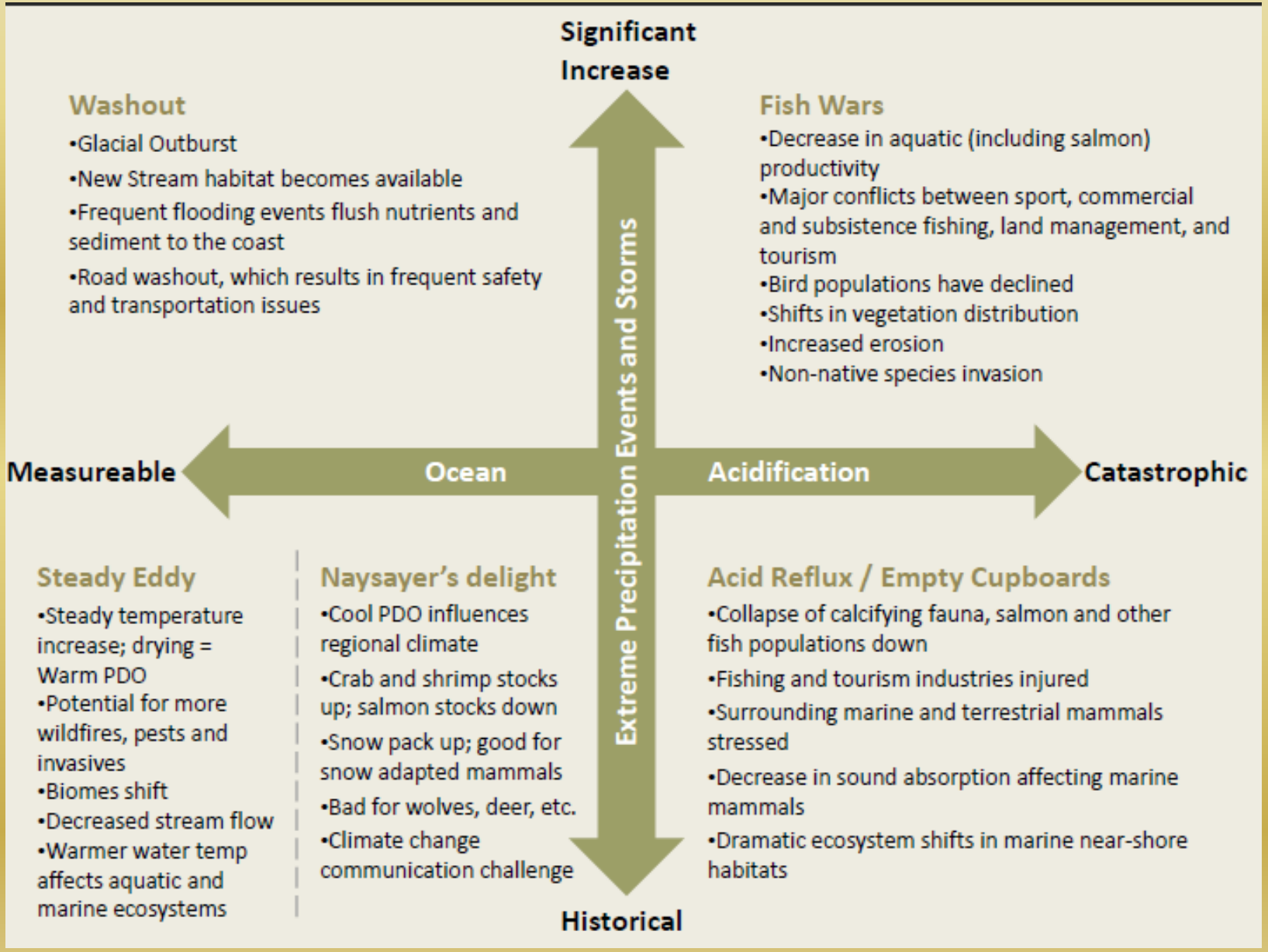
Climate change adaptation would play an increasingly important role in seashore management. Over time, the effects of natural coastal processes and climate change/sea level rise are expected to become the dominant force shaping the character of the Maryland developed visitor area. To minimize or avoid the damaging effects of natural coastal processes and climate change/sea level rise, visitor use infrastruc-

The NPS would continue to support beach oriented recreational activities in the Virginia developed visitor area through its agreement with the U.S. Fish and Wildlife Service.

Most recreational uses and activities in the Maryland portion of the seashore would be maintained on the island although, over time, the facilities and infrastructure

Explaining Scenarios: A Basic GBN Scenario Creation Process




Significant Increase
Washout
•Glacial Outburst
•New Stream habitat becomes available
•Frequent flooding events flush nutrients and sediment to the coast
•Road washout, which results in frequent safety and transportation issues
Fish Wars
•Decrease in aquatic (including salmon) productivity
•Major conflicts between sport, commercial and subsistence fishing, land management, and tourism
•Bird populations have declined
•Shifts in vegetation distribution
•Increased erosion
•Non-native species invasion
Measureable
Ocean
Acidification
Catastrophic
Extreme Precipitation Events and Storms
Steady Eddy
•Steady temperature increase; drying = Warm PDO
•Potential for more wildfires, pests and invasives
•Biomes shift
•Decreased stream flow
•Warmer water temp affects aquatic and marine ecosystems
Naysayer's delight
•Cool PDO influences regional climate
•Crab and shrimp stocks up; salmon stocks down
•Snow pack up; good for snow adapted mammals
•Bad for wolves, deer, etc.
•Climate change communication challenge
Acid Reflux / Empty Cupboards
•Collapse of calcifying fauna, salmon and other fish populations down
•Fishing and tourism industries injured
•Surrounding marine and terrestrial mammals stressed
•Decrease in sound absorption affecting marine mammals
•Dramatic ecosystem shifts in marine near-shore habitats
Historical

Implications and Options Differentiated

Implications		Options
The conditions under which you will need to operate		*The range of actions you will take in light of the conditions*
Challenges	→	Responses
Bottlenecks	→	Workarounds and fixes
Shortages	→	New supplies and suppliers
Emergent needs	→	Product or service offerings
Emergent capabilities	→	Specific investments, development activities

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“Best Practices” Management Actions Common and Applicable to All Scenarios

Resiliency

- Make Climate Change an organizing principle for park priorities.
- Reduce stressors: control invasives, restore disturbed areas.
- Coordinate emphasis on inventory and monitoring of both social and natural systems.

“Best Practices” Management Actions Common and Applicable to All Scenarios

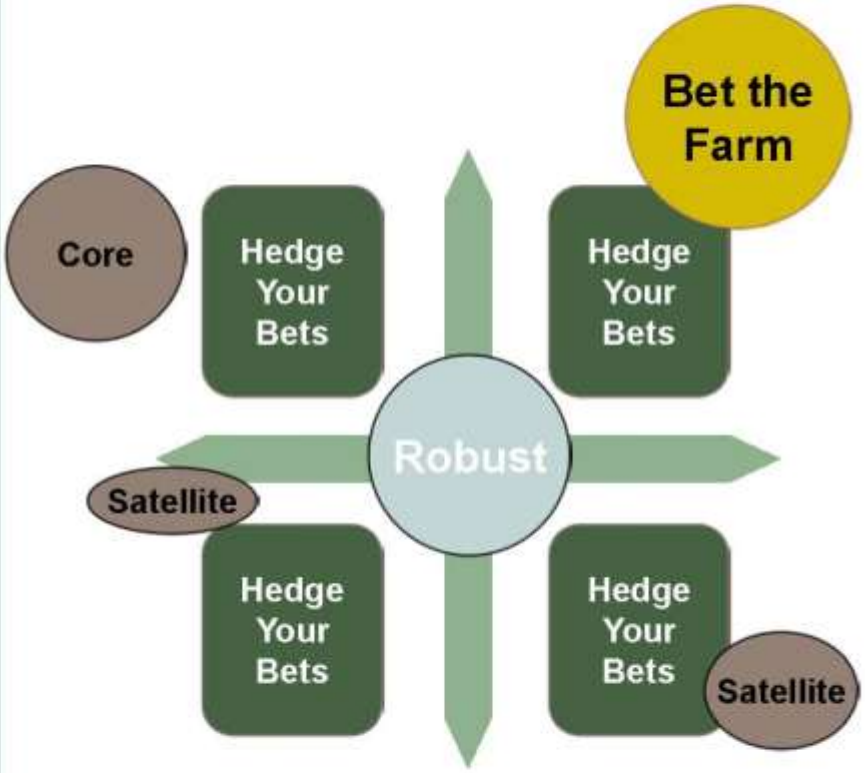
Research and Study

- Safety and access changes.
- Role of natural variability.
- Park relevance with public and visitors under changing conditions.
- Consider park mandates and enabling legislation under changing conditions.

“Best Practices” Management Actions Common and Applicable to All Scenarios

Capacity Building

- Enhanced communication technology.
- Promoting climate change literacy: global vs. local impacts and implications.
- Build true interagency cooperation and collaboration with stakeholders. Consider structuring a coordinating entity to deal with the impacts of climate change (include agency, state, tribal, NGO’s).



Robust: Pursue only those options that would work out well (or at least not hurt you too much) in any of the four scenarios

OR

Bet the Farm / Shaping: Make one clear bet that a certain future will happen — and then do everything you can to help make that scenario a reality

OR

Hedge Your Bets / Wait and See: Make several distinct bets of relatively equal size

OR

Core / Satellite: Place one major bet, with one or more small bets as a hedge against uncertainty, experiments, and real options

Questions?

“Best Practices” Management Actions Common and Applicable to All Scenarios

Indicators to Monitor

- Relative sea level rise
- Geomorphology
- Species changes
- Groundwater
- Landscape level changes
- Migration phenology

Climate Change Education Partnership (NSF – CSU, NPCA, NPS, FWS)

Kenai Peninsula Climate Change Education Partnership - (NPS, FWS, NPCA, USFS, KWF)