NPS Climate Change Scenario Planning (CCSP) Workshop
Northwest Alaska Parks: Cape Krusenstern and Bering Land Bridge

Anchorage, Alaska

19-21 April 2011

Note that this is a draft report. Comments and suggestions are very welcome.

Executive Summary:

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 in order 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 NPS Alaska park managers for impending changes to make informed decisions with least regrets for future outcomes.

NPS and the University of Alaska's Scenarios Network for Alaska Planning (UAF-SNAP) are collaborating on a three-year project that will help Alaska NPS managers, cooperating personnel, 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 the four inventory and monitoring (I&M) networks.

The first stage in this project was a climate change scenarios training workshop with NPS contractor Global Business Network (GBN) at which 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, as described below. The workshop was facilitated and led by Jonathan Star of GBN. In February 2011, NPS, SNAP, and key stakeholders used the scenarios planning process to assess possible futures and management actions for parks in the Southwest Alaska Network (SWAN).

Northwest Alaska was the second NPS regions to be examined in its own scenarios workshop. The workshop was based on the framework introduced by GBN, and led by a core team who had gone through at least one training and one prior workshop. Due to scheduling limitations, this effort did not include all the parks in the Arctic Network, but instead focused on two: Cape Krusenstern (CAKR) and Bering Land Bridge (BELA). Participants included representatives from the parks in question, NPS staff from the Anchorage office, SNAP personnel, and key individuals from other agencies, businesses, and communities with a stake in this region. These individuals contributed a wide range of perspectives and expertise to the inputs and outcomes of the workshop.

General findings included predictions of changes in species and their assemblies both onshore and offshore, disappearance or changes to subsistence resources, loss of cultural resources, risks to infrastructure, and changes in development pressure. Participants agreed that most or all potential

scenarios pointed toward a need to revisit park mandates; improve integration of traditional knowledge into science, planning and management; coordinate communication and partnerships with other public and private entities; tune the planning processes to add more flexibility and more long-range adaptive planning to conserve limited funds; and develop good outreach tools for diverse audiences. They further suggested the need for immediate data recovery from archaeological sites; seamless data collection and sharing; interdisciplinary coordination with feedback loops and partnering; a robust I &M program focused on critical resources and habitat; increased monitoring of ecosystems; science outreach and education to multiple audiences; and research proposals for projects that address research needs identified through climate change scenario planning.

Pre-workshop webinars:

Prior to the in-person workshop in Anchorage, participants took part in three webinars, held weekly. The webinars covered the following:

Webinar 1: Introduction to scenarios planning, led by Nancy Fresco of SNAP

Webinar 2: Northwest Alaska climate drivers (see Appendix B), led by Nancy Fresco

Webinar 3: Northwest Alaska climate change effects (Appendix C) led by Bob Winfree, NPS, with input from the group

Further information and shared files:

For further detail about the workshop described in this document, see the summary PowerPoint "Northwest AK Climate Scenarios" available on line at http://www.snap.uaf.edu/webshared/Nancy%20Fresco/NPS/ in the folder "Workshop Documents Western Arctic." Other files available at the above site include:

- *All three webinars, as pdf files*
- *A summary of the August workshop*
- *All documents from the SWAN webinars and workshops*
- *NPS Boreal and Arctic climate talking points paper*
- *SNAP regional maps showing projected changes in temperature, precipitation, thaw date, freeze date, and season length*
- *Climate drivers tables for the northwest Arctic*
- *Climate effects tables for the northwest Arctic, including participant input and comments*
- *SNAP climate briefs for Bering Land Bridge and Cape Krustenstern*
- *Participant list*
- *Workshop presentations, as pdf files*

Other documents will be added to this site as they are produced.

Workshop Summary:

The workshop began with a plenary session on the fundamentals of scenario planning. Scenarios were defined as hypotheses about the future, rather than predictions. Scenarios are intended to be stories of divergent yet plausible, relevant, and challenging paths that stretch thinking and provide a tool to navigate change. Scenarios development involves five steps: orient, explore, synthesize, act, monitor (Figure 1). In the first step, **orient**, participants considered the questions "What is the strategic issue or decision that we wish to address?" and more specifically, "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 effects impact the landscapes within which management units are placed over the next 50 to 100 years?" In the second step, **explore**, participants discussed what critical forces will affect the future of our issue. Critical forces – in this case, climate drivers -- generally 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 NP management?

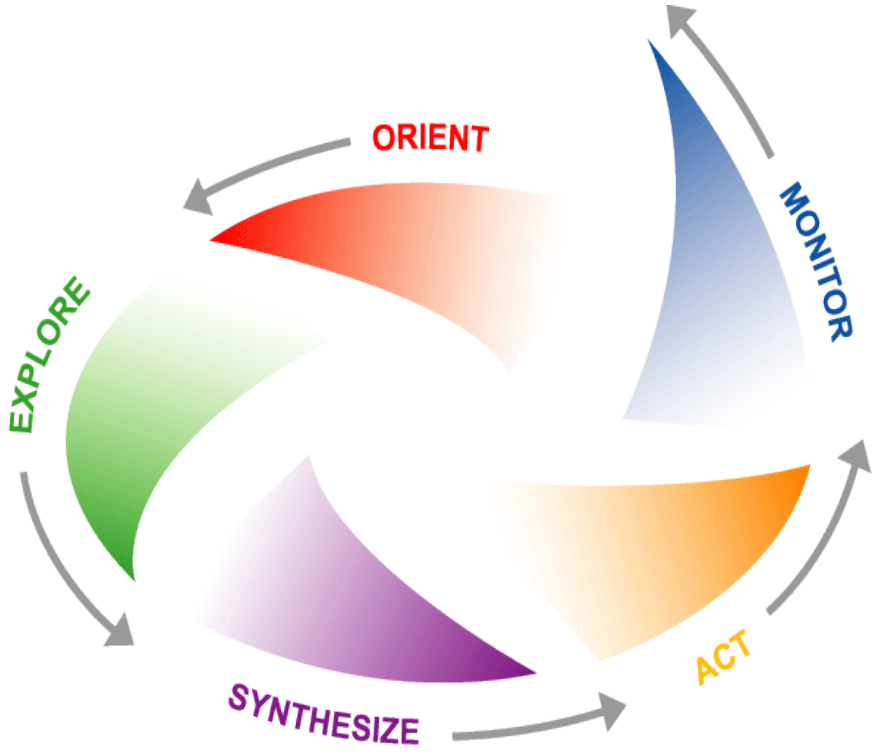

Figure 1. This diagram, provided by GBN, shows the stages in the scenarios building process.

Participants broke into two focus groups to select these critical forces and to develop scenarios, one for each park. Each group first considered potential critical uncertainties with regard to future climate. The groups used those drivers to develop potential scenarios matrices (Figure 2). From these matrices each group selected one matrix to further develop and build narratives for the future.

In the second 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). This secondary framework was slightly altered from the framework presented by GBN, which focused more on high-level government responses. The third stage in scenarios building, **synthesize**, asked participants to turn bullet-point scenarios into stories. With sixteen (or more) choices available, each group needed to select only 3-4 to turn into narratives and planning tools. To do this, each group focused on scenarios that were *Relevant, Divergent, Plausible, and Challenging*. They explored each of these, identifying implications or "effects," which were pulled from the effects tables (see Appendix C) and Talking Points papers created prior to the workshop. Each group outlined future actions appropriate to the selected scenarios. Ultimately, each group took the first step towards the fourth scenarios-building stage, **act**, by drafting a list of suggested management decisions from their findings.

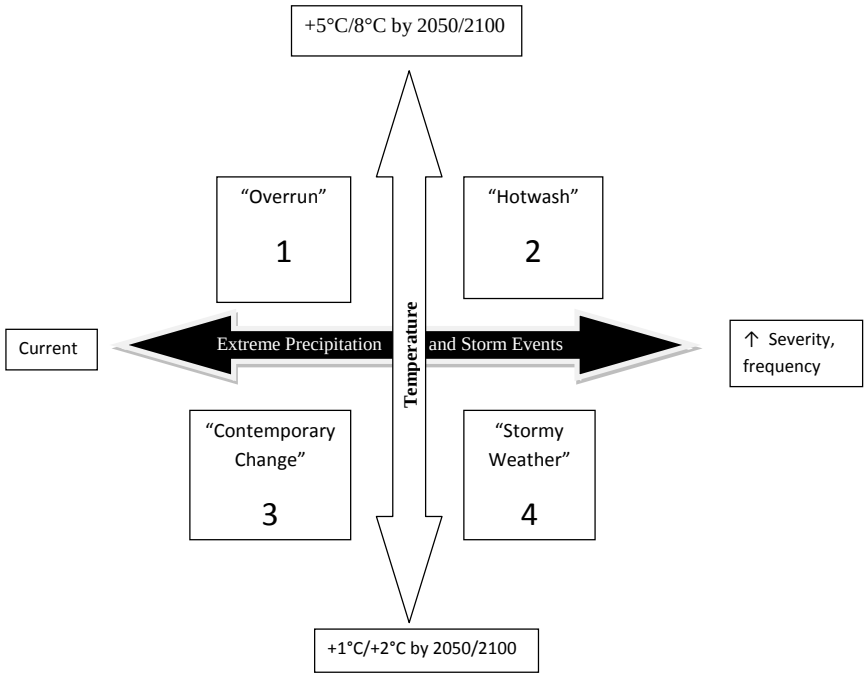

Figure 2. This is an example of a matrix produced by the BELA group.

The notes below summarize this process for both groups. The associated PowerPoint presenation focuses on the work of the BELA group.

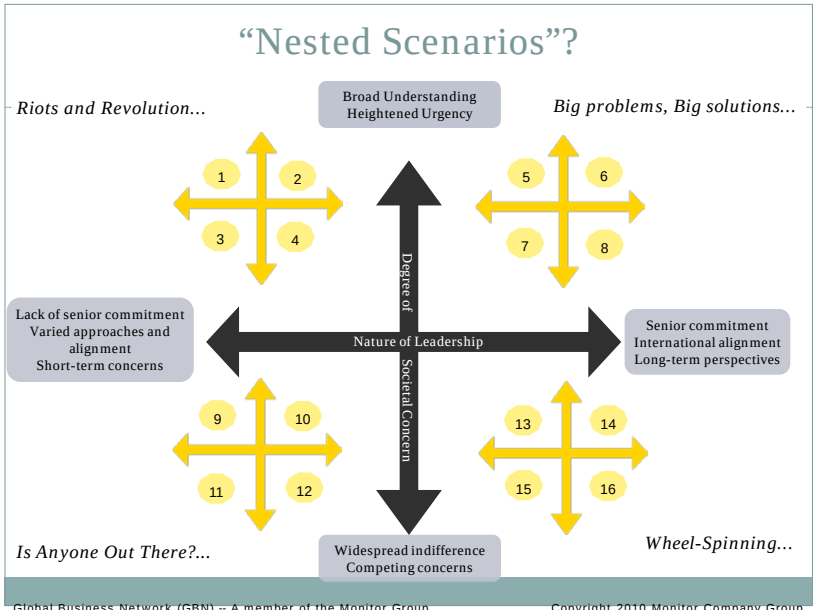

Figure 3. This high-level matrix provided by GBN was used to nest climate scenarios in a socio-political context.

Group: BELA

The group first assessed the relative importance and uncertainty of climate-related scenario drivers. These drivers had been presented and discussed during the pre-workshop webinars, and were reintroduced in workshop plenary sessions. For the purposes of scenario planning, the goal was to select the two drivers with the greatest importance (in order to maximize the relevance of resulting scenarios) and the greatest uncertainty (in order to maximize divergence).

Some discussion of uncertainty ensued. We clarified that there are really two distinct forms of uncertainty at work: threshold uncertainty, and uncertainty of degree. The former refers to the confidence we have regarding some type of change occurring, e.g. 95% (high certainty) vs only 50% (uncertain). The latter refers to the range within which that change might be expressed, e.g. temperature increase of 1-5 degrees. A broad range reflects higher uncertainty than a narrow one. Since both types of uncertainty yield the type of divergence we were seeking in our potential futures, both were taken into account.

Table 1. Rankings for scenarios drives for BELA. L,M,H = Low, Medium, High. Votes refer to how many group members preferred each driver, given three votes per person. Only two could ultimately be selected to create a matrix.

Temperature	M	H	4
Precipitation	M	H	
Relative humidity	M	L	
Length of growing season	M	M-H	3
Ocean acidification	H	H	1
Sea ice extent (decline)	M	H	7
Extreme weather events (severity and frequency)	H	H	4
Coastal permafrost degradation	H	H	3
PDO	H	H	1
Sea level rise	L	H	3
Change in hydrologic regime	H	M-H	2
Length of ice free season	M	H	
Freeze-up date	M-H	H	
Wind pattern shifts	L	M	
Snowpack	M	H	2
Fire	M-H	M	
Interior permafrost degradation	M	H	

Importance also has multiple dimensions. A driver can be important because it causes effect across a broad area (oceans, rivers, uplands); because it affects multiple sectors (tourism, subsistence, cultural sites) or because the potential effects in any one sector are catastrophic or profound. In selecting drivers we kept in mind not only the effects that we had already discussed in the 3rd webinar and in the workshop plenary, but also the purposes for which BELA was established: subsistence, geological resources, cultural resources/archaeological sites (up to 12K yrs old), beringeal migration; generic animal and plant conservation; and reindeer herding.

Finally, we discussed the relative merits of selecting a “high level” driver such as temperature or precipitation, versus a “derived” driver such as loss of sea ice, which is essentially one derivative of temperature increase. The group agreed that the benefit of lower-level drivers was that they allowed for a less diffuse focus that might yield scenarios that were easier to explain and define, and perhaps more relevant to stakeholder interests. However, this was likely to come at a cost to details, and might result in scenarios that were less challenging and less divergent. Ultimately, the group opted for fairly high-level drivers, and seen below.

Drivers selected to explore:

- Temperature: 1°C/2°C by 2050/2100 → 5°C/8°C by 2050/2100
- Extreme Weather Events (precip, storms): current conditions →increased frequency and intensity (5-8x increase)
- Sea Ice decline: current → none in Sept/ longer ice free season

Group decided to use:

- Temperature
- Extreme weather events

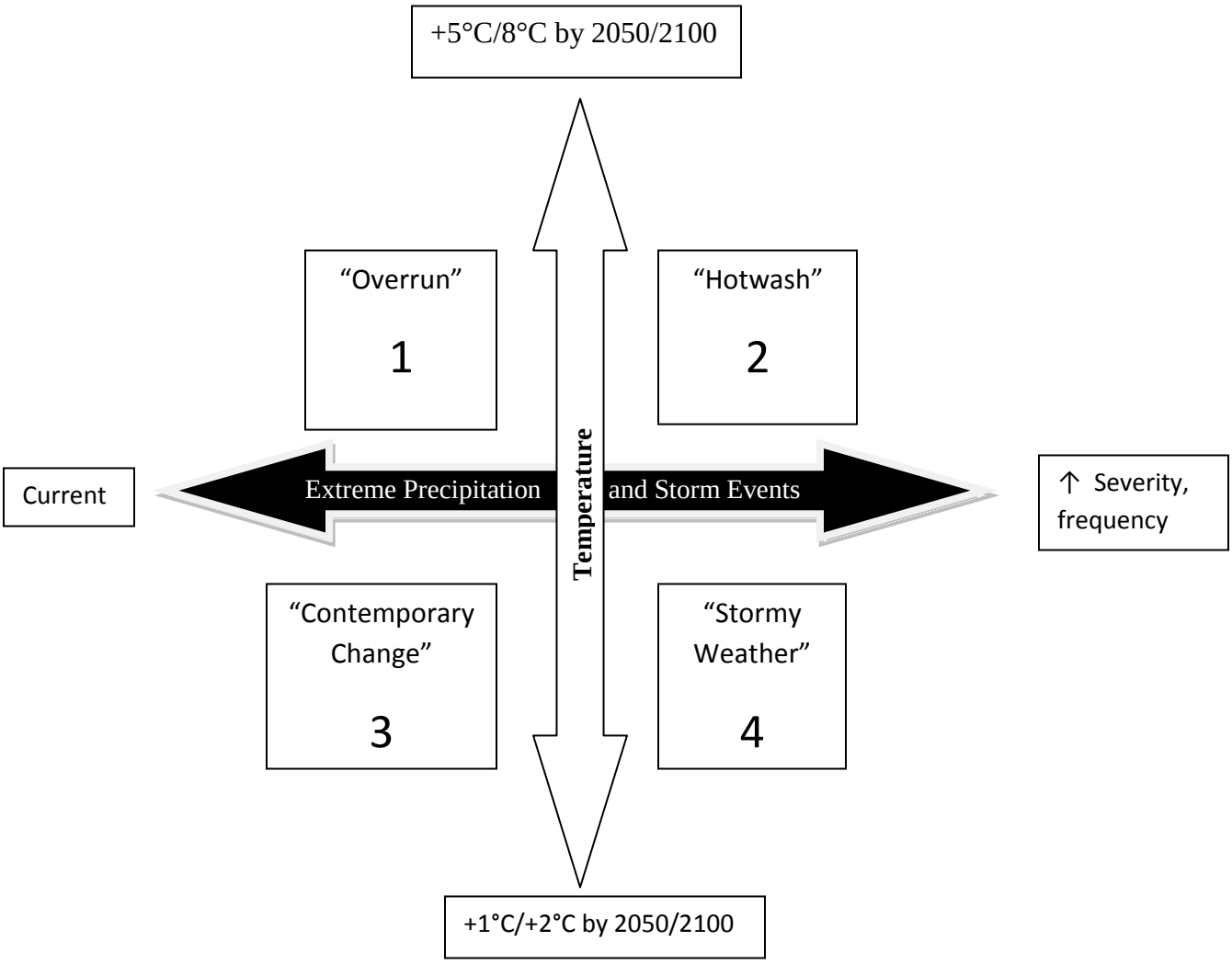

Figure 4. Primary matrix produced by the BELA group. Each quadrant represents a different combination of potential future temperature and storm/precip conditions. Details of each quadrant are described in the text.

“Overrun”

- Decreased ability to travel in winter
- Decrease marine mammals
- New marine species
- Infrastructure and habitat loss from permafrost loss
- Shrubification, lichen loss
- Boreal forest moves in
- Ocean development, ocean travel and tourism-oil and gas, mining, fisheries leading to increased risk for subsistence users/boats etc (but also more employment options).
- Increased risk of oil spills and associated losses of fish, wildlife, etc
- Marine noise and disturbance affect subsistence
- Loss of arctic endemic species, e.g. musk ox, tundra hares (beringeal relic species)
- Grasses and drought
- Aquatic invasives
- Terrestrial invasives
- Possible reduction in freight costs
- Potential for more research to support development
- More moose and beaver
- Potential change of fish habitat→spp. change.

1. “Hot Washed”

- ↑ coastal erosion
- ↑ rain on snow events
- ↑ travel danger
- ↑ sedimentation and river erosion
- ↓ marine mammals
- Migratory birds change
- Loss of archaeological resource on large scale
- ↑ fire
- More shrubification, lichen loss
- ↓ winter caribou range
- Infrastructure and habitat loss even more severe than other quadrants due to permafrost loss
- ↑ risk of village relocation/destruction
- Boreal forest moves in
- Ocean development, ocean travel and tourism-oil and gas, mining, fisheries leading to increased risk for subsistence users/boats etc (but also more employment options). (less tourism development due to storms).
- ↑ risk of oil spills and associated losses of fish, wildlife, etc

- Marine noise and disturbance affect subsistence
- Loss of arctic endemic species, e.g. musk ox, tundra hares (beringeal relic species)
- Aquatic invasives
- ↑ disease and insects
- Possible reduction in freight costs

2. "Contemporary Change"

- Continuation of current trends
- This does not mean there is no change. Just not as accelerated in other quadrants.
- Continued erosion at current rates
- More ESA listings, but less than in other quadrants.

3. "Stormy Weather"

- Less severe coastal erosion than #2
- Some loss of archeological resources
- More snowpack which would affect ungulates
- Changing wetland composition; return to sedgey beringean? (need to check on this)
- Flooding of airstrips

The group then nested the four scenarios above in the social/institutional matrix. While this theoretically produces 16 scenarios, we did not elaborate upon all of them. Instead, we first discussed the nature of the new matrix and the ramifications and plausibility of various combinations. Points of discussion included the question of whether the high engagement quadrant (upper right) is truly plausible, and whether the idea of public disinterest (lower half) is plausible in the context of extreme change, especially given the fact that local communities have been talking about and experiencing climate change for 30 years. We decided that all quadrants were plausible, if we assume that public disengagement might be the results of being overwhelmed, dispersing, and "giving up." We then voted on which three nested scenarios to pursue.

Votes for nested scenarios:

Overrun in Riots and Revolution- 8
HotWash in Is Anyone Out There?- 6
Overrun in Is Anyone Out There?- 5
Overrun in Big Problems Big Solutions-4
Contemporary Change in Big Problems Big Solutions-2
Stormy Weather in Big Problems Big Solutions-2

After further discussion, we decided to pursue the scenarios highlighted in Figure 5 in order to achieve the most challenging and divergent set of narratives. When we consulted with the CAKR group,

we further narrowed this to two scenarios, as described below, in order to avoid overlap, given that their selected climate drivers were very similar to those chosen in the BELA group.

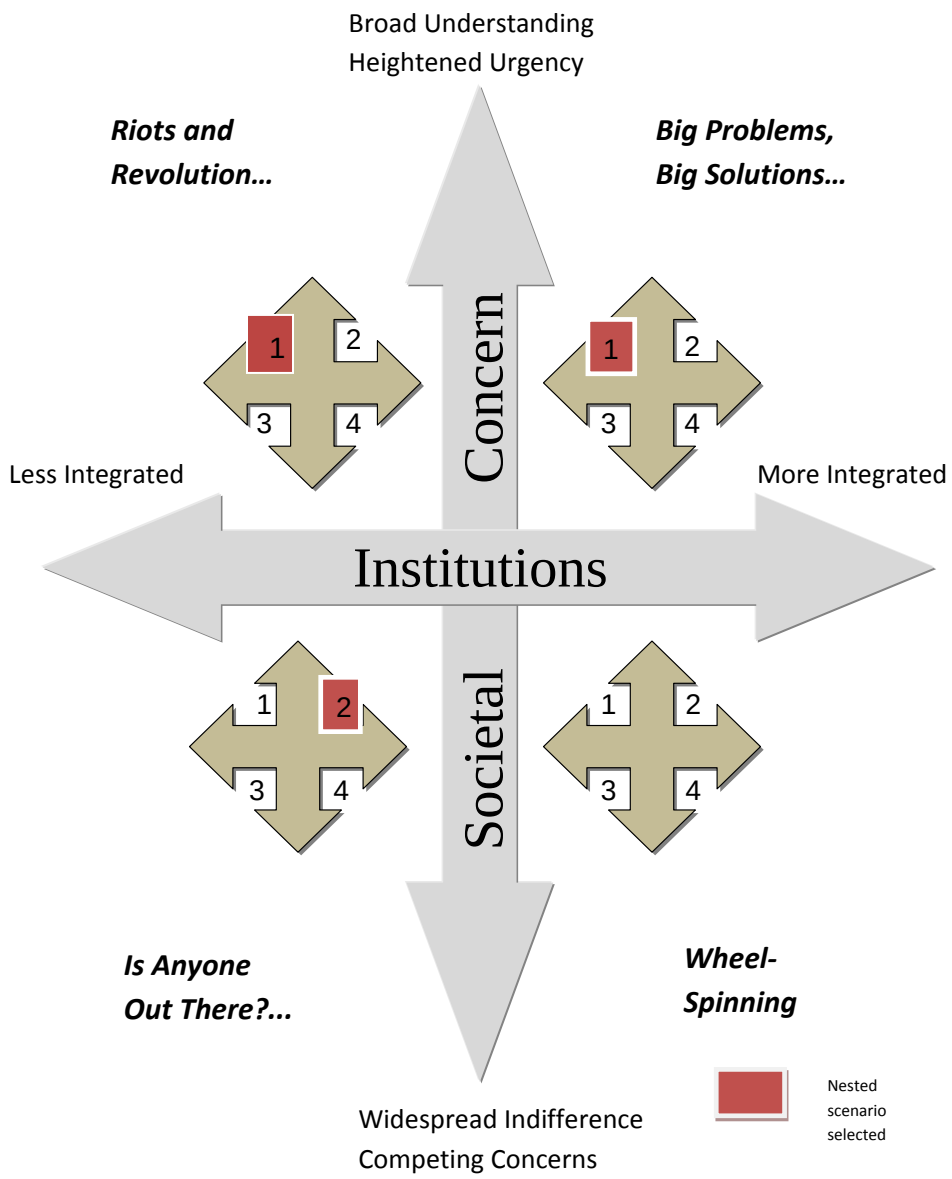

Figure 5. Nested matrices produced by the BELA group, showing the three scenarios initially selected. Two of these – "Hotwash" in "Is Anybody Out There?" and "Overrun" in "Big Problems Big Solutions" -- were fully fleshed out, and are described in the text below.

Nested Scenario 1: "Climate Kumbaya" (*Overrun* in *Big Problems, Big Solutions*)

<u>Implications</u>

Natural Resources

- Shrubification→ ↑moose, change subsistence uses, cascading effects on veg and natural environment
- Loss lichens→reduced caribou, reduced subsistence uses
- Fish spp. changes, change in commercial fisheries, change in historic resources/environmental integrity and wilderness
- ↑fire→ smoke, change in veg, permafrost, loss of historic building sites, increased employment
- Rain on snow events→ caribou and muskox reduced winter forage and population losses
- Change in sea ice results in change in sea mammal spp. and distribution
    - Change in subsistence practices
    - Ice spp. moving to land (polar bears, walrus)
- Invasive spp
    - ↓biodiversity
    - ↓endemic/iconic spp.
    - Change in ecosystem function
    - Alter subsistence patterns
    - Impacts to environmental integrity (wilderness values)
    - ↑in trammeling (due to management action)
- Drying of wetlands
    - Change in waterfowl and fish populations
    - Impact to yellow bill loon → ESA listing
    - Freshwater shortages
    - Change in nutrient transportation
    - Filter for contaminants
    - Decrease in insect populations and wood frogs
- Degradation of permafrost
    - Sedimentation
    - Altered aquatic habitat (change in spp.)
    - Drying of environment (changes transportation)
    - Loss of traditional landscape (changes the view)

Cultural Resources

- Dramatic loss of cultural and paleontological resources
- Loss of archaeological, paleontological, and ethnographic resources requires increased I & M for cultural resources (catalogue and preserve)
- Loss or degradation of other historic structure, e.g. cold war buildings, whale sites, due to permafrost and erosion

Facilities/Infrastructure

- Decreased ability to travel into park→↓ops for subsistence, recreation, village travel, and visitation
- Infrastructure loss (roads, buildings) cause reduced ability to access area and affect safety of residents and visitors
- Loss of permafrost causes road, gravel pad, facility damage (means rethinking construction types/areas)

Communications

- Rapid changes need education curriculum to increase awareness
- More and different types of visitation will put demands on park interpretation

Social/Economic/Subsistence

- ↑marine travel noise can disturb migration routes and subsistence
- ↑economic opportunities → environmental and subsistence impacts
- People will have to adapt to different species to eat (wildlife and plant, fish, sea weeds, etc.)
- Increased opportunity/requests for mineral and oil exploration and development

<u>Important Management Actions</u>

- Ensure that construction of facilities, roads, etc. consider future climate effects
- Increase outreach and education efforts (plan and implement)
- Increased need and change in current interagency collaboration for fishing and hunting regulations
- Increase inventory and monitoring of archaeological and paleontological sites (strategy, plan, funding)
- Work with other state/federal agencies to monitor resource development to ensure any development has benefits to the park (money, research)
- Model, collaborate and promote energy efficient techniques and practices
- Integrate traditional knowledge in meaningful way—serious!
- Establish and maintain long term relationships with partnered funding streams (sustain funding at local, regional, and national levels)
- Coordinate and collaborate with local, tribal, state agencies on creating a regional level plan that addresses climate change
- Incorporate climate change into all park planning efforts
- Develop fire management plans that address increase in fire and potential concerns over caribou winter habitat
- Rank park resources to facilitate extreme event response
- Consider park needs to facilitate increased visitation
- Streamline agreements process to facilitate effective collaborations
- Be a BIG player in LCC, ocean stewardship, shore zone, and other initiatives

Research and Information Needs

- Find and share specialized expertise in different disciplines
- Host periodic state of knowledge symposia and develop collaborate approach to identify and address info/research/management needs
- Work with Russian counterparts to collaborate on arctic issues (e.g. subsistence, conservation)
- Incorporate local knowledge into research/info needs and management actions
- Develop visitor/backcountry plans that address access and visitor facilities
- Use a "Hopkins" approach to research (interdisciplinary approach to climate change)
- Increase monitoring of impacts of fire on vegetation and wildlife habitat under changing climate.
- Increase wildlife monitoring
- Create detailed vegetation maps
- Monitor phenology of plants
- Increase coastal, lagoon, and fish research
- Add volume loss dimension to coastal erosion

Nested Scenario 2: "The Sign" (*Hot Washed* in *Is Anyone Out There*?)

Implications

Natural Resources

- Loss of biodiversity through ice decrease and heating of riverine systems; loss of marine mammal spp; loss of subsistence fish.
- Sea level rise → exacerbated damage from storm surges
- Sea ice season has receded and is now limited to about one month/year, limiting ability to hunt on ice and exacerbating erosion
- Migration patterns changing → indifferent harvest seasons, methods and take/limits
- Erosion of landing sites; impact to delivery of bulk cargo (e.g. fuel); rising cost of living
- Storms have been hammering the coast for 50+ years, causing massive erosion and communities washing away
- Shrubs and forest encroaching leading to more moose and beaver
- Inland permafrost degradation leading to damaged roads, new developable thawed lands

Cultural Resources

- Massive loss of archaeological sites due to erosion, irretrievable loss of cultural history and possible compromise of park mandate

Facilities/ Infrastructure

- Potentially greater need to accommodate cruise ships and road travel, but no funding and large erosion problems

Communication

- Less funding for interpretation and no strong forums for discussion due to community losses and funding cuts
- Great needs for communities near the park to communicate needs and get help

Social/Economic/Subsistence

- Decrease in subsistence harvests
  - loss of important nutrition and health impacts
  - loss of important social roles
  - increase in cost of living due to substitution of expensive imported food
  - huge increase in social problems due to relocation
    - alcoholism
    - drug use
    - domestic violence
- community evacuation leads to diaspora to cities and other communities
- Diaspora causes breakdown of sharing networks, cultural socialization, traditional roles
- institutional help and protections against damage to communities is missing, leading to more rapid erosion, destruction
- dissolution of community from storm surges → loss of traditional way of life
- damage to community infrastructure → rising cost of living

<u>Important Management Actions</u>

- Flexibility in access and use of park resources by affiliated communities, e.g. berry jam, carved driftwood, horns, etc
- Integrated response = one contact point for communities for delivering services from agencies
- Restructure NEPA to accommodate "collaborative learning" and "adaptive management" processes
- Increased coordination and consultation with stakeholders outside park boundaries
- Flexibility from federal subsistence board in changing seasons and bag limits to traditional Methods and mean, e.g. community quotas, new seasons as ice changes, new species
- Increased resources for development of cooperative management regimes
- Forward-thinking planning of development and infrastructure to avoid habitat impacts as habitats change
- Prioritized use of limited money for most effective community aid
- Increased integration of TEK in management regulations, policies, and enforcement

<u>Research and Information Needs</u>

- Eliminate stovepipe research funding
- Reward interdisciplinary research projects through funding, tenure, and recognition
- Organize research around management issues and require interdisciplinary proposals

- Good baseline info about species, water resources, permafrost and coastal stability, interdependence of resources, and trajectories of change
- Develop interdisciplinary regional studies plan
- More research on potential invasives and species shifts

Narratives

Please note that – like the rest of this draft report -- these narratives are NOT yet in their final form. They are still awaiting feedback from group members. Feel free to make comments, suggestions, and changes.

"Climate Kumbaya: Successfully Coping with Climate Change"
Abstract for the keynote speech at Beringea Climate Change Conference (given by BELA superintendant)

Changes in BELA and surrounding environs continue to be pronounced and dramatic. Because of our long term inventory and monitoring program, we have been able to document extensive changes to habitats which have affected fish and wildlife in the area. Some examples of these changes include loss of wetlands and increased drying, increased frequency and severity of fire, increased salinization of coastal areas, increased shrubification of tundra habitats, and dramatic changes to species composition of plants and animals. We are partnering with USFWS, NMFS and other agencies to document changes in distributions and movements of key wildlife species—e.g., walrus and ice seals are no longer very abundant in our area, and whales are changing migration patterns. Because of loss of marine mammal resources, subsistence hunters are shifting to terrestrial wildlife resources, especially caribou, moose and musk ox. Fortunately, the Federal Subsistence Board has proven to be nimble in responding to the needs of subsistence users, in large part because of the multi agency working groups that focus on NW caribou herd and musk ox. These sorts of wildlife working groups have allowed us to find streamlined solutions to our problems, but these issues are complex and ever-changing.

We had success in moving the village of Shishmaref by working with local agencies to provide a good location to suit the village's needs. This relocation had the potential to cause huge amounts of contention because of using parklands, but due to cooperation between agencies, local peoples, and funding agencies, it was a success. Shishmaref is a poster child for climate impact on coastal communities, and a spotlight shines on this area as an example of successful global climate change mitigation. We continue to experience extreme storm events and extensive coastal erosion, and this will continue. Our continued cooperation with Shishmaref emergency services has allowed us to provide safe travel and shelter for locals.

Economically, local communities continue to benefit from the new offshore ground fisheries for cod and pollock, but the bycatch issue that plagued the Bering Sea decades ago is something we are still struggling with. Economic spin-offs from oil and gas development and mining in the general area have

also increased economic opportunity, but at some costs to subsistence users and local values. The new Coast Guard station in Nome has been an economic boon and increased safety in the Bering Strait.

We've seen an increase in park visitation which has provided economic benefits but also created some additional challenges for park management. Pressure has arisen to finally put a road in to Nome which has increased the pressure on BELA to provide increased visitor services. We continue to try to find transport alternatives to Serpentine Hot Springs to allow for adequate visitation while keeping the springs' rustic feel. We are also working with the cruise industry to increase options for visitor experiences. Our cabins are being heated by geothermal or solar energy sources.

We have developed fire management options that rotate but still allow fires to occur on the landscape. These fire management options work to protect critical caribou winter habitat. However, stresses on caribou still continue due to climate change induced rain on ice events and habitat changes.

Due to the cultural resource challenge of the last few decades and an influx of funding, we have been better able to document, preserve, and protect archaeological and paleontological resources. We now have extensive and accurate cultural and ethnographic inventories for the area, which have contributed to a better understanding of Bering Land Bridge.

Despite some successes in dealing with climate change issues, climate change solutions are moving targets which continue to create new challenges and opportunities for BELA. These challenges include: wildlife management as wildlife population and subsistence patterns continue to change; partnership development and maintenance of critical levels of funding; a continued international presence across the Bering Strait with our Russian partners; and changing priorities and initiatives that compete for funding with climate change.

"The Sign"

A short skit set in the year 2060

A family is on a beach that used to be part of Bering Land Bridge National Park. The family is hunting for sea lions. The hunters have gone up to the haul-out. As they wait for the hunters to return, a young woman picks up an old faded sign with only a couple of letters left on it. "I wonder what this was?" she says to her grandmother. "Anyhow, it would make a good table. There's plenty of other driftwood for the fire."

The grandmother says, "Oh, that's the old park sign."

The young woman sets up the old sign as a table.

The old woman says, "I'm so glad my nephew came to hunt with us. It's been almost a year now since we lost his brother. That was so hard for him, and for all of us. His father was such a good provider, until he moved to Nome. The family kind of fell apart then, when the village was evacuated. That was really a shame. The storms got so bad, and we just couldn't get any help, not even rocks. There was no clean water anymore either. Folks were getting sick. Things got really bad. Even before the big storm, the village was cut off when the flooding washed out all the roads."

As they make the fire, the young woman says, "I sure hope the hunters get lucky. It's too bad our cousin in Nome didn't have the opportunity to harvest sea lions. He sure would have had fun, and he'd like the meat. I miss the taste of walrus, though, from when I was little."

The grandmother says, “Your cousin sure had a hard time in high school. I regret that he didn’t have the chance to learn the traditional skills his father had.”

Her granddaughter nods. “And he could have done a lot of moose hunting, now that there’s enough for everyone – but not this time of year, though, when they’re getting so buggy from this heat.”

The hunters return, triumphant, and are greeted and congratulated.

Later, as they sit and eat sea lion around the old park sign, they discuss past hunts.

An older man says, “It’s kind of scary these days, trying to get across rivers when the ice is so thin, even in the middle of winter.”

“It’s hard to get around,” agrees another. “And I miss being able to go out on the ice to fish.”

“That doesn’t worry me as much as those cruise ships. Seems like they don’t pay attention to small boats, and they make so much noise, and pollute the water. Sure doesn’t help the hunters.”

“I think the oil rigs are the worst. They say they’re not spilling anything, but I’ve seen slicks on the water.”

“Well, the government sure isn’t going to do anything about it.”

“We’ll just have to do the best we can with what’s left.”

They all fall silent and enjoy their meat.

As the meal ends, they toss the old sign onto the fire. The last letters of “Bering Land Bridge National Park” turn black and disappear.

Group: CAKR

The methods and procedures for the CAKR group were mostly identical to those described for the BELA group. However, some details were altered, based on the preferences and discussion of the group. For example, this group ranked drivers as either "important" or "highly certain" as shown in Table 2.

Inclusion of PDO allowed for a plausible "no change" scenario on the temperature axis, as compared to the BELA group, but otherwise these axes were remarkably similar to those selected for BELA. Since the two parks are relatively similar, this made it easy to combine the efforts of the groups.

Table 2. Rankings for scenarios drives for CAKR. "Level" refers to degree or range of uncertainty, while "HC" stands for "highly certain."

Driver	Level	HC	Important?
Temperature	+1 to +6	x	
Precipitation			
Wind Speed			
PDO	x	x	
Extreme Events: Temp			
Extreme Events: Precip			
Extreme Events: Storms	x	66%	
Sea Ice	Lg decrease		x
Snow	Inc amt, short season	x	x
Freeze-up date			
Ice free season			
River/stream temps			
Length of growing season			
Permafrost	x		
Sea level	x	x	x
Ocean Acidification	X	x	

Additional drivers introduced by the group:

Coastal Ocean Current
Icing events

Selected drivers to explore:

Sea Level Rise (3"-6')
Snow (10%-50%)
Sea Ice (20%40%- 70%)
Permafrost
Temperature/PDO

Group decided to use:

Extreme Storm Events (low/high) and Temperature/PDO (0*/6*)

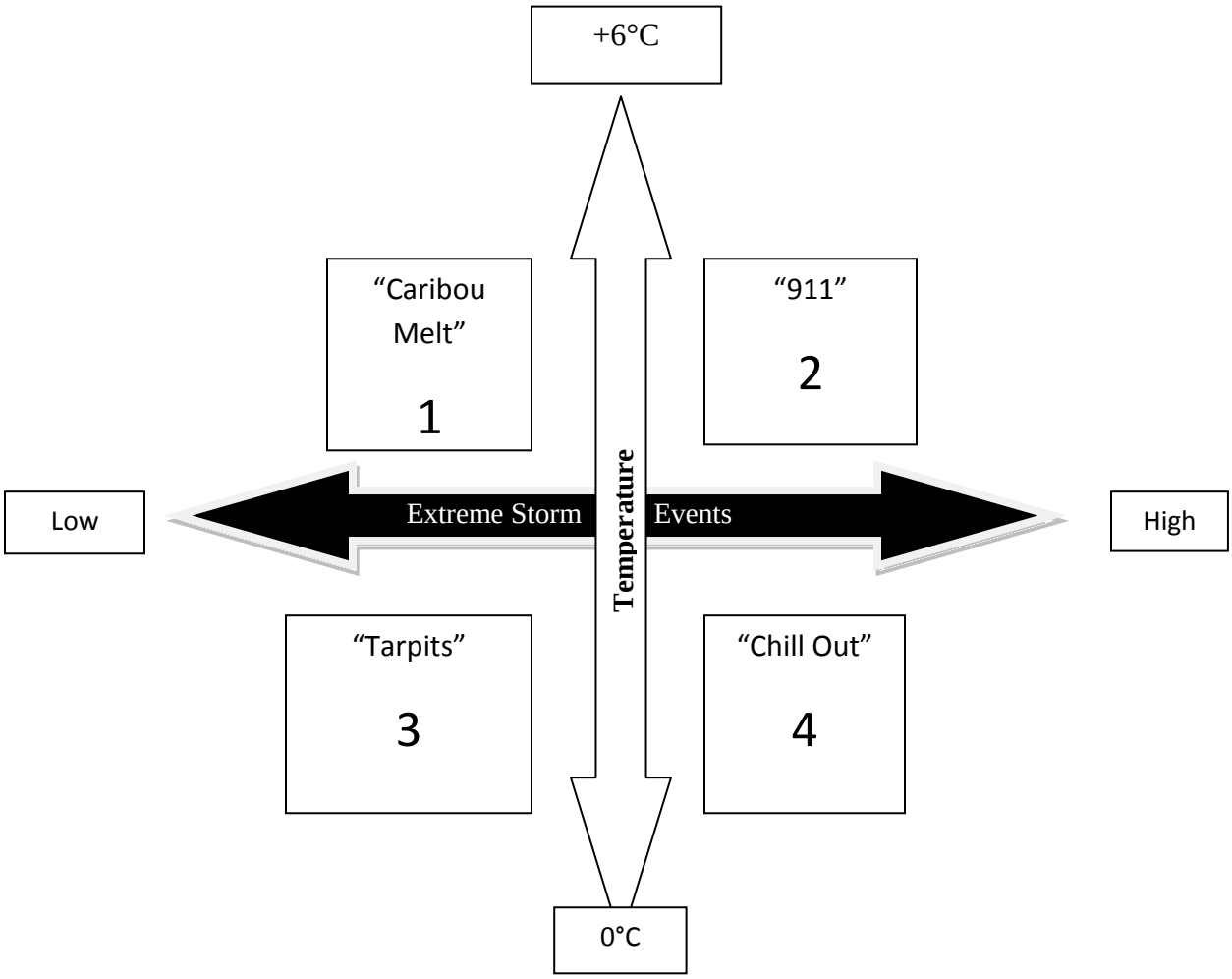

Figure 6. Primary matrix produced by the CAKR group. Each quadrant represents a different combination of potential future temperature (including PDO as a factor in order to maximize variability) and extreme storms events. Details of each quadrant are described in the text.

1. **Warm/Low: "Caribou Melt"**
   - increase marine shipping
   - polar bear population down or on landscape-level
   - drier landscape with vegetation shift to shrubs
   - increased moose hunting activities
   - increased summer erosion
   - increase risk to cultural resources
   - threat of invasive species
   - better caribou habitat
   - increased permafrost thaw

- community at risk
- salty lagoons
- increased fisheries
- increase mineral/energy development

2. **Warm/High: "911"**
    - Population wildlife decline
    - winter icing and wildlife stress
    - severe coastal erosion
    - increase spills
    - increased need for medical/emergency response
    - increased need for evacuation of coastal communities
    - increase in marine transportation
    - increase noise impacts
    - increased acidification
    - need for "hardened" infrastructure
    - increased fisheries
    - increased fires
    - TEK investment
    - change vegetation
    - increased dispersal of contaminates
    - decrease habitat for montane nesting shore birds

3. **Low/Low: "Tarpits"**
    - fewer extreme storms
    - moderate coastal erosion
    - favor status quo of existing management infrastructure
    - normal maintenance of infrastructure
    - similar patterns of transportation, tourism and development
    - moderate increase in shipping and offshore drilling
    - little to no change in subsistence resources and patterns
    - less marine hunting
    - more mammal hunting
    - slower effect on cultural resources/ gradual loss
    - shorter winter travel season

4. **Cool/High: "Chill Out"**
    - wildlife winter kill events
    - increased coastal erosion
    - winter travel hazards
    - increased impacts to cultural resources
    - increased spill risk
    - need for "hardened" infrastructure
    - increased energy costs and maintenance costs
    - increased dispersal of contaminants
    - decrease habitat for montane nesting shore birds

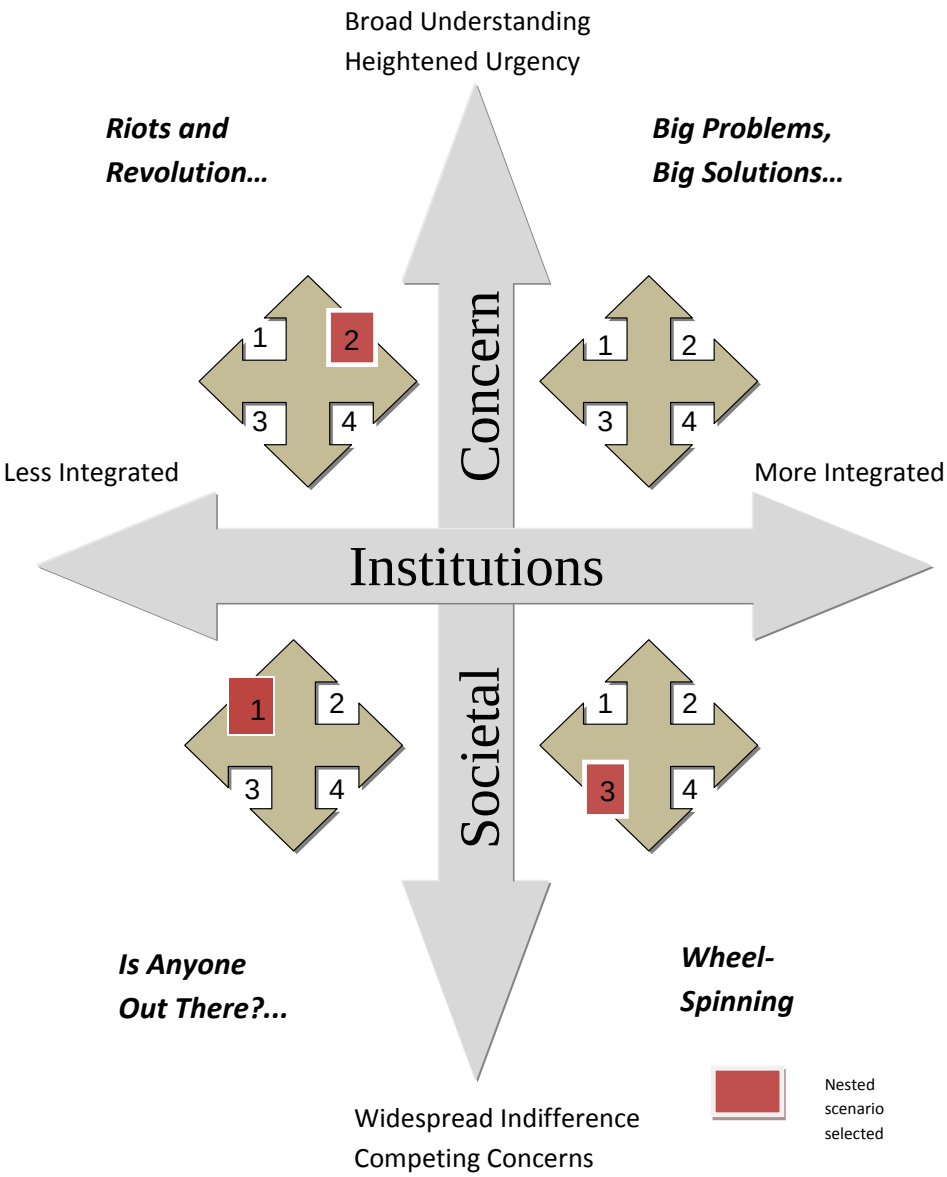

Figure 7. Nested matrices produced by the CAKR group, showing the two scenarios selected. This group briefly fleshed out all sixteen possibilities before voting to pursue the two below. The BELA scenarios were taken into account in the voting in order to maximize diversity.

Nested Scenario 3: "Chronic Directional Change" (*Tarpits* in *Wheel Spinning)*

Implications

Natural Resources

- habitat degradation
- increased fire frequency and scale
- gradual loss of marine mammals
- change in species composition and distribution of fisheries
- increase in non-native species in disturbed areas
- pressure for intensive management
- increased contamination from resource development
- habitat fragmentation from roads
- degraded wilderness conditions

Cultural Resources

- gradual loss of cultural resources with coastal physical changes
- increased ravine erosion

Facilities/Infrastructure

- increased operational expense to maintain back country facilities
- future retrofitting park HQ as permafrost thaws
- employee housing improvements and relocation
- thaw lakes developing along the Red Dog haul road

Communications & Interpretation and Education

- pressure to relax regulations
- competing messages about intensive vs. adaptive
- park viewed as impediment to change
- ostracism for community meetings

Social/Economic/Community/Subsistence

- demoralized staff
- reduced productivity
- rapid employee turn over
- increased competition for program funding
- loss of marine subsistence
- increased terrestrial subsistence pressure
- civil disobedience (ORV, poaching, camps)
- greater public law enforcement conflicts

Important Management Actions

- Engage communities in scenario planning
- openness/encourage to co-management opportunities where appropriate
- engage staff in identifying solution and incentivize
- develop specialized expertise at appropriate level (park vs. region)
- expand community liaison program
- focus interpretation on communication, compelling/engaging messages
- cultivate park advocacy at all levels (local!!!)

- develop fire management plans for resource benefits
- advocate for conservation at interagency forums

Research and Information Needs

- monitor and research subsistence trends
- future habitat monitoring and modeling
- expanded village outreach and education
- establish a trend
- cooperative resolution to user conflict
- anticipate demand and conflict with increased community services
- prioritize exotic species based on success

Other

- ask if interpretation of park purpose is achievable
- co-locate fed/state/local employees (LCC)
- walk the talk of sustainability
- consider feasible renewable investment
- strengthen ties with NPCA and other NGO friends

Nested Scenario 4: "Katrina Comes to the Chukchi" (*911* in *Riots and Revolution*)

Implications

Natural Resources

- Habitat for migratory birds severely damaged
- Loss of iconic native species
- Widespread contamination from lead/zinc dust
- Loss of sea ice as habitat for marine mammals
- Natural biological process becomes increasingly more valuable in protected areas of CAKR

Cultural Resources:

- Archaeological resources damaged/lost

Facilities/Infrastructure

- Need for temporary and permanent housing
- Loss of infrastructure (NPS, communities)
- Communications systems severely damaged
- Waste disposal issues
- Port site destruction, fuel and lead/zinc contamination
- Oil rigs damaged by wave driven ice

Communications & Interpretation and Education

- Lost TEK from coastal communities
- No coordination in messaging

Social/Economic/Community/Subsistence

- Land base shortage for community

- Undeveloped quality degraded
- Clean drinking water needed
- Increase in community collaboration
- Increase reliance on terrestrial species for subsistence
- Loss of symbolic resources
- Increased community pressure for policy changes
- Transportation more difficult
- Economic drivers (mines, oil, tourism) → shut down months
- Temporary disruption of visitor opportunities
- Increased demand for access to information
- Decrease in NPS capacity to manage parks
- Increased noise
- Increase in hubbub, air traffic → decreased opportunities for solitude
- Increased need for coordination of responders
- Potential lack of public support to fund restoration

Important Management Actions

- Reaffirm park purpose, relevance, and objective for NR and CR –current GMP
- Robust consultation process
- Complete interagency strategic plans to address climate change and disasters
- Infrastructure that is appropriately designed for location and climate change
- Multiple media outreach to local, state, and national audience
- Decide in GMP to emphasize naturalness or to allow a certain level of manipulation

Research and Information Needs

- Conduct research and I&M for critical fish and wildlife habitat
- Seamless data collection and sharing
- Coordinate monitoring of coastal erosion
- Prioritize recovery of archaeological sites near coasts
- Archaeological triage

Other

- Complete oral histories and TEK recovery
- Interagency strategic planning

Narratives

Please note that – like the rest of this draft report -- these narratives are NOT yet in their final form. They are still awaiting feedback from group members. Feel free to make comments, suggestions, and changes.

"Katrina Comes to The Chukchi Sea"

Testimony to Congress
April 2030

Con Cerne, Superintendent of Western Arctic National Parklands:

Esteemed Senators:

Two months ago, a huge category four storm occurred in the Chukchi Sea with winds reaching 150 miles per hour and sea waves cresting to 30 feet. Open leads in sea ice enabled winds and waves to hurl large chunks of ice into oil platforms and fragile coasts with reduced permafrost depth. Oil platforms and fuel tanks in coastal areas were damaged and a large oil spill washed into lagoons surrounding Cape Krusenstern National Monument and Bering Land Bridge National Preserve. Coastal villages Shishmaref and Kivalina were devastated despite rock walls, and communications in the region, other than a few satellite phones, were down for weeks. Landing strips in these communities and hub communities were over-washed and were unusable for large aircraft. Extreme winds demolished large container storage buildings at the Red Dog Mine port facility, and lead and zinc concentrate were dispersed over the shrubby tundra.

Native organizations came to the rescue of surviving residents. They organized the relocation and distribution of food, and they were in charge of all on-site activities. The nearest federal emergency response unit was in the Aleutian Islands, and they were unable to get to the disaster area for weeks. Residents of damaged communities relocated to other towns, Red Dog Mine, and to refugee camps both outside and inside the parks, such as Serpentine Hot Springs. Park infrastructure in Kotzebue was destroyed, and NPS operations moved to Nome where minor damage occurred.

Local resident survivors were hired to help with cleanup response, but outsiders were also brought in to help with efforts. Once the storm abated, the affected area was declared a disaster and in a state of emergency. The National Guard was deployed via large helicopters. Because of other multiple, long-term crises and a monstrous deficit, federal disaster funding was depleted. International press interest was high, but it was difficult to accommodate reporters to the disaster zone, so there is little press coverage from the ground. Images are provided via Google Earth satellites and over flights.

Missionaries, Red Cross, and native grassroots groups arrived to help, but conflict arose due to the National Guard's need to control and contain the situation.

The extreme warming trend has already weakened subsistence resources and cultural traditions. Community members were already frustrated with the lack of agency response to conserve subsistence resources, but are now in a crisis mode. Cultural resources were exposed in coastal areas during the storm event, and it was alleged that cleanup crews looted resources.

Migratory birds are expected within a month, but the salt water and oil breach of the lagoons is not yet cleaned up. The remaining musk ox herds near Cape Krusenstern and Cape Espenberg were caught in the storm and extirpated.

Local residents question response time and government efforts. Local native leaders have requested funding to flow directly to communities because they were the ones best able to manage response efforts. Village and regional Native organizations are also requesting relaxation or removal of

all federal regulations regarding subsistence activities and assistance with firewood and other fuel sources. China, who has a strong economy, has sent messengers offering financial and logistical help in exchange for increased access to natural resources in the region.

I. M. Smooth, Senior Senator of Alaska:

Thank you Superintendent Cerne. Given our national financial situation and deteriorated conditions in Northwestern Alaska, what do you recommend Congress and the Administration do about this disaster at this time and to prepare better for the future?

Superintendent Con Cerne:

Thank you for the question Senator Smooth.

First, security of the local populations needs to be established. The Department of Homeland Security needs to step up its presence and work cooperatively with local governmental entities and Native organizations. Contaminated coasts and tundra need to be cleaned up as soon as possible. The National Park Service stands ready to help in any way it can.

Secondly, economic, natural, and cultural resources in the affected area need protection, especially with international presence and interest in the area. Rebuilt infrastructure in the area needs to take into account the extreme warming trends with reduced ice cover and increased storminess with storm surges. We need interagency strategic plans that address climate change and disasters such as this recent one that incorporate a robust consultation process with local communities, industry, and governmental entities in the region from national to local levels. Right now we need to clean oil from the most critical fish and wildlife habitat in the coastal lagoons before spring migrations bring threatened and endangered species and important subsistence resources back to these areas. We also need to conduct archeological triage for the affected coastal areas.

In the long run the National Park Service needs to update its General Management Plans for affected area parks to consider climate change impacts and reaffirm park purposes, relevance, and objectives, including emphasis on naturalness but allowing for a certain level of manipulation to protect threatened and endangered resources, including important subsistence resources for local rural populations. We also need to complete oral histories of surviving local residents with traditional ecological and local knowledge before it is lost forever. We need to prioritize recovery of data from archeological sites near threatened coasts before they too are lost forever. We need to continue monitoring coast lines and critical fish and wildlife habitat because these areas are changing rapidly with the warming and increasingly stormy conditions. Information collected by local, state, federal, and international entities in the area need to be shared and seamless because not any one party can complete all of the work for any one species or resource.

Thank you for the opportunity to share our ideas with the Senate. I am certain the U.S. Coast Guard, Fish and Wildlife Service, Bureau of Land Management, EPA, State of Alaska, Northwest Arctic Borough, NANA, Bering Straits Native Corporation, Kawerak, Maniilaq, local tribes, and village corporations also have much to say along these lines. I certainly hope the Congress can steer some of its precious financial resources in our direction. This area is, after all, important to our national well-being and security with its strategic location along popular arctic shipping lanes, extraction from large mineral and oil and gas deposits, and priceless wildlife, archeological and subsistence resources.

I. M. Smooth, Senior Senator of Alaska:

Thank you Superintendent Cerne. Excellent ideas. Next up!

"Chronic Directional Change"

Briefing Statement
Revised: December 3, 2030

To: Superintendent, Western Arctic National Parklands
From: Staff Wildlife Biologist
Through: Chief of Natural and Subsistence Resources
Subject: Northern Seward Peninsula Caribou Herd Working Group (NSPCHWG) proposals

The NSPCHWG will meet next week to consider new proposals related to caribou herd protection and management. Several proposals have already been advanced to agency staff as informal suggestions, though not yet been formally submitted to the group for action. This briefing paper is to provide background on the issues, identify topics that we expect to be presented at the meeting, and to explain the basis for current agency positions on this issue.

Background: The NSPCH is one of several herds that collectively make up the remnants of the Western Arctic Caribou Herd (WACH), which splintered into several smaller populations over the last 20 years. The NSPCH currently numbers 35,000 animals, or about half of the total remnant WACH population. The WACHonce numbered about 500,000 animals. Most experts attribute the herd's breakup to habitat fragmentation, in part due to a long series of large-scale tundra fires that devastated much of the suitable winter caribou habitat, possibly confounded by traffic along a maze of new roads associated with mineral resource development. The herd has also experienced a combination of other pressures, such as a gradual long-term change in land cover vegetation, periodically severe losses as a result of rain on snow and icing events, and steadily increasing subsistence pressures as marine harvests declined with diminished sea ice. Most of the mineral resource development concerns working in the region have implemented voluntary bans on employee hunting in the vicinity of the mines and along haul roads. While widely supported, these actions have not been sufficient to reverse the long term declining trend in caribou numbers.

Pending Proposals: Several NSPCHWG members have recently fielded calls to discuss the proposals for consideration during the upcoming meeting, including a number of increasingly-intensive resource management approaches. The proposed actions are intended to improve caribou survival and condition and increase rural harvest success. The following ideas have been mentioned as possible proposals:

1. Predator removal
2. Phase out of state hunting permits for caribou and other subsistence species
3. Expanded enforcement of local subsistence preferences for hunting permits
4. Snow plowing to expose winter forage for caribou
5. Mechanical reversal of shrub and forest encroachment by chaining (dragging a length of heavy chain or cable between bulldozers moving in parallel)
6. Distribution of lichen propagules into recently burned or cleared areas
7. Seeding of burned areas with high nutrient annual forage plants (e.g. grains)
8. Fertilization to enhance herbaceous growth rates
9. Expanded use of calving pens to protect vulnerable caribou cows and calves from predators
10. Winter feeding of caribou herds along access roads. (Note: Winter feeding of caribou herds is apparently more feasible now due recent expansion of the road network. Program costs might

be recouped by collection and sale of shed antlers by local youth groups – perhaps junior rangers.)

11. Expanded reindeer ranching and range fencing

Biologist's Perspective: Biologists from multiple agencies have been monitoring caribou herd status and trends for more than three decades. Numerous studies document long-term habitat stress due to directional environmental change. Caribou are one of many species stressed by more than 50 years of cumulative climate change and developmental pressures. Review of long-term monitoring data by agency botanists, indicates shrub encroachment into former lichen range since at least the mid-1950's. Annual grasses and several exotic weed species have also expanded into burned tundra. Research indicates that shrubs, weeds, and annual grasses do not afford sufficient winter forage. Many areas still dominated by the lichen species necessary for optimal caribou nutrition are severely degraded and already over-grazed. The causative factors of widespread lichen decline are actively investigated, and there appear to be a number of contributing factors. Use of high-sulfur fuels (coal for energy production and diesel for transportation) remains problematic despite regulatory controls. Regional expansion of open pit mining has also complicated efforts at controlling fugitive dusts, including heavy metals. However, regional support for the economic benefits of mineral development and locally-produced fuels are strong and increasing.

There is strong scientific consensus that Alaska's temporary reprieve from the globally-severe temperature rise of the last 30 years is coming to an end. Indications are that the Pacific Decadal Oscillation has begun to shift from the extended cold phase that we've "enjoyed" for the last 20-30 years into a warm phase of uncertain magnitude and duration. If the coming decades are characterized by rapid temperature increases equal to or exceeding other polar areas, then Northwest Alaska can expect extensive and potentially rapid habitat conversion to species more tolerant of warm dry conditions and short fire return intervals.

Recommendation: Agency biologists strongly recommend allowing for continuity of ecological processes, biodiversity and evolution, while expanding interagency efforts to restore connectivity of migratory routes between fragmented habitats. Several range biologists have expressed concerns that short-term expansion of herd size by artificial means could eventually result in weaker stocks as the available winter range is further degraded. Natural predation to remove weaker individuals is an important selective pressure. Local resistance to this approach can be expected, as it will likely be perceived as another attempt by the agencies to stall needed actions by prioritizing intangible wilderness values over the immediate needs of community.

General Findings Based on all Four Selected Scenarios

Common Implications

- Natural Resources
    - Loss of biodiversity or unique arctic species
    - Shift of species
    - Invasive species
    - Habitat transformation (land, sea, and freshwater)
    - Changes to disturbance regimes
    - Increase in contamination of water and land
- Cultural Resources
    - Loss of archaeological and paleontological sites and associated history
- Facilities/Infrastructure
    - Contamination from new development and tourism already occurring
    - Risk to roads, communities, airstrips, telecoms infrastructure
    - Threat to park facilities, infrastructure vulnerable
    - Demand for new infrastructure for industry and tourism
- Communications
    - Need for effective collaborative communication across agencies and communities
    - Increased need to capture TEK
    - Inconsistent messages coming to and from park
- Social/Economic/Subsistence
    - Subsistence use patterns changing
    - Depletion on marine mammals and increasing pressure on terrestrial wildlife→increased conflict between terrestrial wildlife users
    - Loss of cultural traditions and norms
    - Pressure for more flexible regulations
    - Pressure for more industry and tourism

Common Management Actions

- Revisit park mandates
- Improved interagency collaboration and planning
- Improved integration of traditional knowledge into science, planning and management
- Increased flexibility in management, direction, principles
- Long range adaptive planning to conserve limited funds
- Develop good outreach tools for diverse audiences
- Find funding partners and make efforts to find such partners

Common Research and Information Needs

- Develop research proposals for projects that address research needs identified through CCSP
- Create and maintain coordinated seamless data collection and sharing
- Robust I &M program focused on critical resources and habitat
- Identify creative strategies to cross interdisciplinary boundaries
- Encourage interdisciplinary coordination with feedback loops and partnering
- Data recovery of archaeological/paleontological sites