Moving towards a strategic approach to on-the-ground adaptation to rapid climate change on the Kenai National Wildlife Refuge, Alaska

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Kenai National Wildlife Refuge
REFUGE PURPOSES

1980 ANILCA

➢ conserve fish & wildlife populations and habitats in their natural diversity including but not limited to….

fish and wildlife = any member of the animal kingdom including without limitation any mammal, fish, bird, amphibian, reptile, mollusk, crustacean, arthropod or other invertebrate…
 OTHER REFUGE PURPOSES

1964 Wilderness Act
- secure an enduring resource of wilderness
- protect and preserve wilderness character
- leave them unimpaired for future use as wilderness

1997 Refuge Improvement Act
- ensure biological integrity, diversity and environmental health
The Kenai has gotten warmer and drier in the last 4 decades.
Measured rates of climate change impacts on the Kenai Peninsula

- wetlands (6–11% per decade since 1951)
- glaciers (5% surface area, 21 m elevation since 1950)
+ SB beetle outbreaks (triggered by 2 consecutive warm summers)
Δ wildfire (spring, grass)
+ treeline (10 m per decade since 1951)
- available water (60% loss since 1968)
Δ species distributions, phenology
Changing fire regime?  
2005 fire season

![Graph showing intervals between fires for different types of trees and intervals between outbreaks.](image)
Woody shrub encroachment into Sphagnum peatlands
Conversion of beetle-killed white/Lutz spruce forests to *Calamagrostis savannah*
Changing migration window
- eBird records for the Kenai Peninsula in 2007-12

- 13 new species in last 5 years
- Earlier arrival records for 33 species
- Later departure records for 38 species

- Eurasian-collared dove
- Heerman’s gull
- Jack snipe
- Lesser black-backed gull
- Long-billed murrelet
- Northern Mockingbird
- Redwing
- Spotted towhee
- Turkey vulture
- Western Kingbird
- Western meadowlark
- Willow flycatcher
- Wilson’s phalarope
American marten colonized western Kenai Peninsula ~2002

Alpine rest sites

Lowland rest sites

Baltensperger, 2009, Behavior and distribution of American marten in relation to snow and forest cover on the Kenai Peninsula, AK, MS thesis, Colorado State University
Harvested species likely to diminish in abundance on the Kenai Peninsula
Which is right?

Variations on climate envelope modeling

forecasting the Kenai Peninsula’s landscape through 2100
Which is right?

Variations on modeling approaches

ALFRESCO

forest matrix

climate envelope

forecasting the Kenai Peninsula’s landscape through 2100
Instead of choosing one model over another… consider looking for signal convergence

✓ Refugia identified at different scales and resolution (biome vs vegetation type) to ensure population sources and stepping stones for dispersal/migration

✓ Dynamic (transitional) areas identified where ecological risk exists, but so do opportunities for facilitating adaptation

✓ Encourage the framing of hypotheses for focused I&M, research and pilot studies

✓ Improve understanding (adaptive) through iterative modeling and different modeling approaches

Magness & Morton 2013
We have choices!

(1) **Retrospective** adaption = managing towards historical conditions

(2) **Prospective** adaptation = managing towards future conditions

(3) **Do nothing**

Magness et al. 2011
DECREASING UNCERTAINTY BUT INCREASING ECOLOGICAL RISK

RELATIVE EFFORT

TIME

Lower 48 model

Historic Climate

Future Climate

PROSPECTIVE

RETROSPECTIVE
DECREASING UNCERTAINTY BUT INCREASING ECOLOGICAL RISK

Future Climate

Historic Climate

Alaska model
Land designation/acquisition
Seed banks, living vouchers
Fire management
Invasives management
Silvicultural practices
Translocation
GMOs

DECREASING UNCERTAINTY BUT INCREASING ECOLOGICAL RISK

Future Climate

PROSPECTIVE

Kenai NWR model
Prioritizing land acquisition:
Using thermal imagery to identify cold seeps in warming non-glacial streams
DECREASING UNCERTAINTY BUT INCREASING ECOLOGICAL RISK

Future Climate

Kenai NWR model

Land designation/acquisition
Seed banks, living vouchers
Fire management
Invasives management
Silvicultural practices
Translocation
GMOs

TIME
Same climate forecast but potentially different outcomes...

Boreal Transitional

We have choices!
Mountain hemlock
(lowland population)
Shore pine
(non-serotinous lodgepole)
Alaska cedar
Sitka spruce
Lutz spruce (sitka X white)
Pacific silver fir

Future Forests If global temperatures rise, can forests still flourish in their current ranges? Some scientists think not, so British Columbia—with assistance from the U.S. Forest Service—is now testing the climate tolerance of 15 common and commercially valuable tree species in non-native habitats. The aim: to identify ones that can be moved into areas expected to be more hospitable in the future.

Called assisted migration, the controversial approach presumes “evolution can’t keep up with the rate of climate change, so it needs some help,” says project head Greg O’Neill. Detractors of the increasingly studied forestry practice cite the risks of altering ecosystems.

British Columbia has already extended the legal range in which timber companies can plant western larch seedlings. Other species, including Douglas fir and lodgepole pine, are being tested at sites spanning 1,700 miles, from Canada’s Yukon to California. These will be monitored for 30 years to evaluate their survival. “One day we could rely on Washington’s seed, Washington on Oregon’s, and so on,” says O’Neill. “It’s a problem that knows no geographic boundaries.” —Luna Shyr

Common garden experiments
Ongoing efforts to move towards on-the-ground adaptation....

- populate regional geospatial data-sharing hub (Southcentral Alaska Science Catalog)
- seek congruence in hierarchal models and competing spatial models
- validate model forecasts with empirical data (data mining, focused I&M, pilot studies)
- develop management (e.g., silvicultural) models of habitat-species/assemblages
- continue developing LTEMP, specifically capacity to monitor multi-species (assemblage) occupancy and application of DNA barcodes
- complete regional climate vulnerability assessment with Chugach National Forest, Kenai National Wildlife Refuge, Kenai Fjords National Park and UAA
- MOU among federal land managers to collaborate on adaptation?
Kenai Fjords National Park
Maintain unimpaired the scenic and environmental integrity of the Harding icefield...to protect seals, sea lions, other marine mammals...and to maintain their hauling and breeding areas in their natural state, free of human activity which is disruptive to their natural processes...

Chugach National Forest
Vegetation results from natural processes. Selected locations will be altered by management activities...to restore degraded conditions. Fish and wildlife will continue to flourish in their current abundance with stable populations and abundant habitat.

Kenai National Wildlife Refuge
conserve fish & wildlife populations and habitats in their natural diversity...

Kenai Fjords National Park
Maintain unimpaired the scenic and environmental integrity of the Harding icefield...to protect seals, sea lions, other marine mammals...and to maintain their hauling and breeding areas in their natural state, free of human activity which is disruptive to their natural processes...
Competing mandates among Federal agencies... create an opportunity to build resiliency.
Questions????