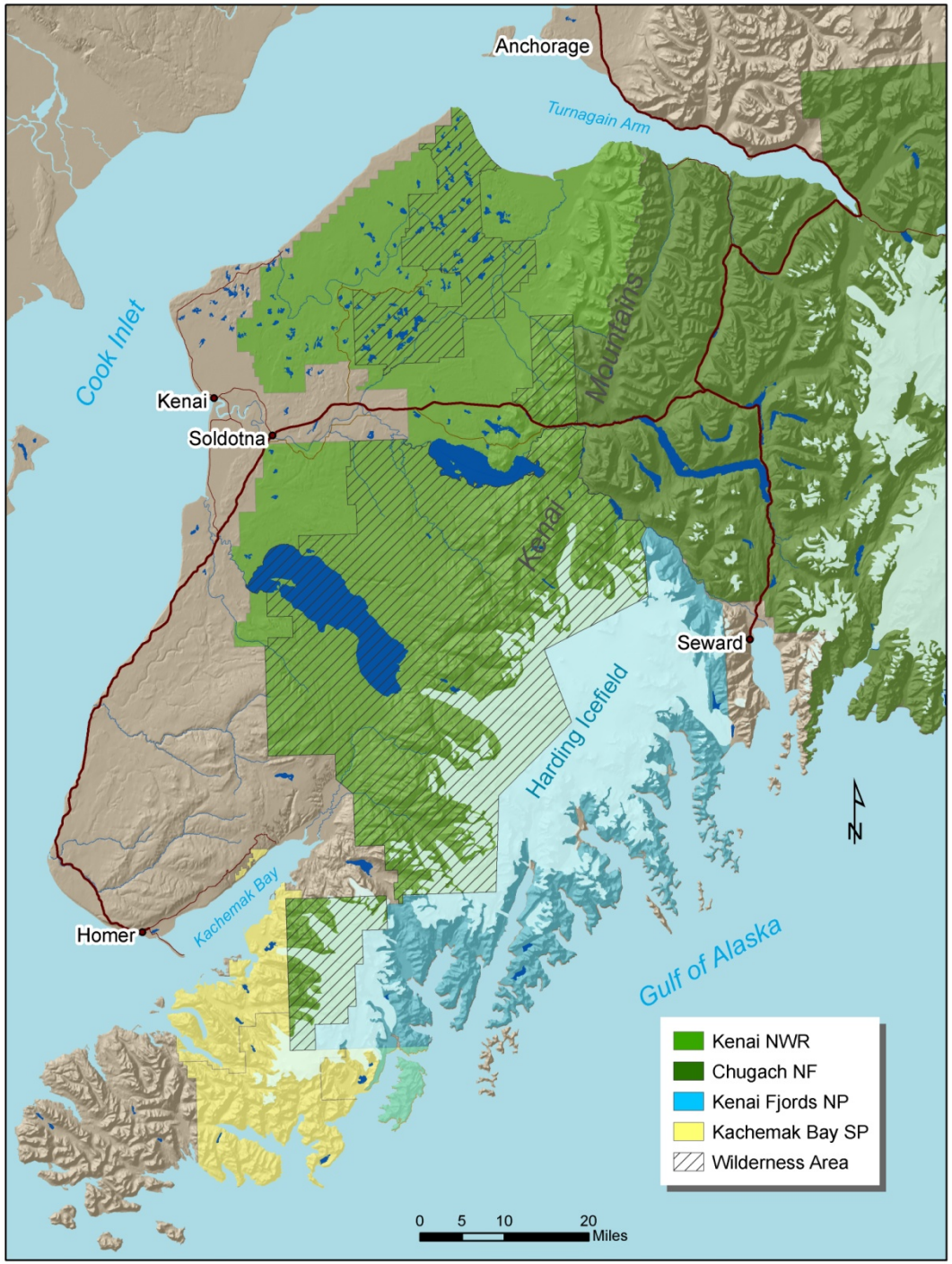
Moving towards a strategic approach to on-the-ground adaptation to rapid climate change on the Kenai National Wildlife Refuge, Alaska

John Morton, Dawn Magness, Elizabeth Bella
Kenai National Wildlife Refuge


Anchorage
Turnagain Arm
Cook Inlet
Kenai
Soldotna
Kenai Mountains
Seward
Harding Icefield
Kachemak Bay
Homer
Gulf of Alaska
N
Kenai NWR
Chugach NF
Kenai Fjords NP
Kachemak Bay SP
Wilderness Area
0 5 10 20
Miles


ALASKA


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

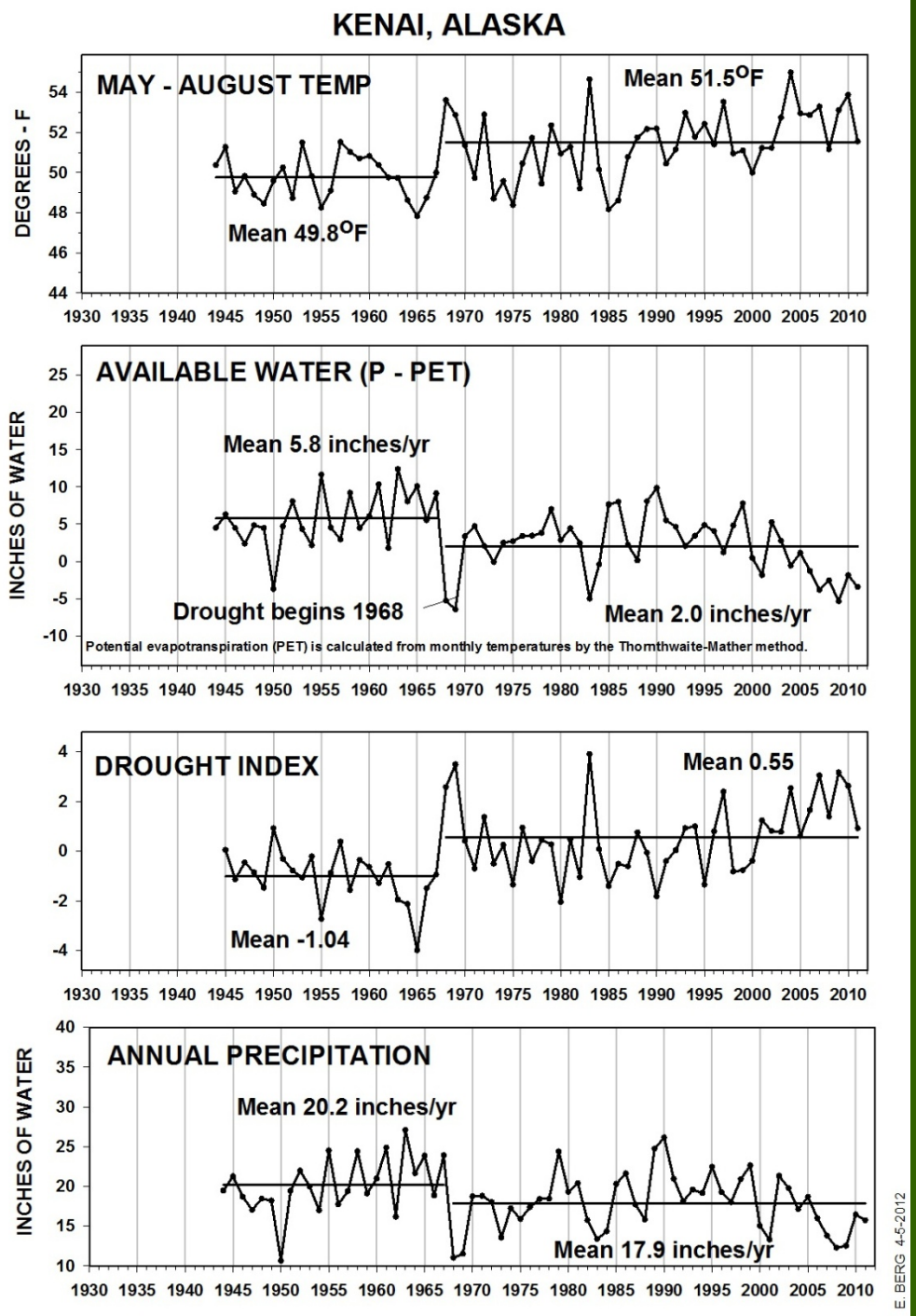
1964 Wilderness Act

- 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

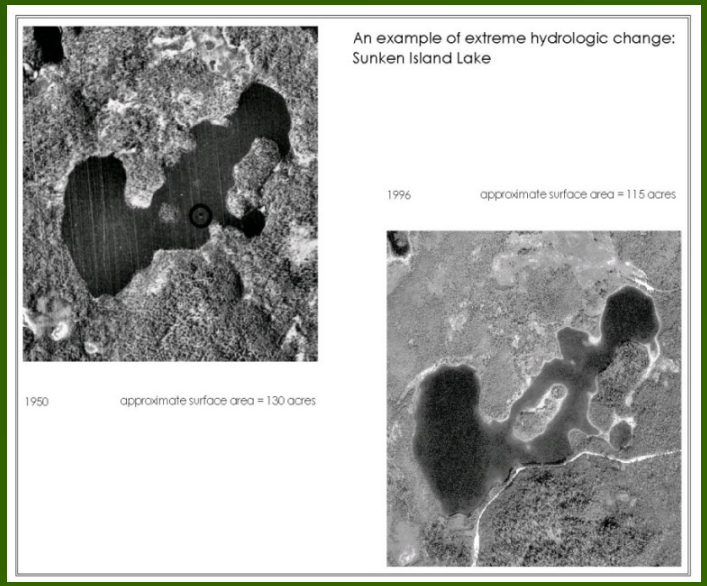

3230B
6/14/2004 9:36a



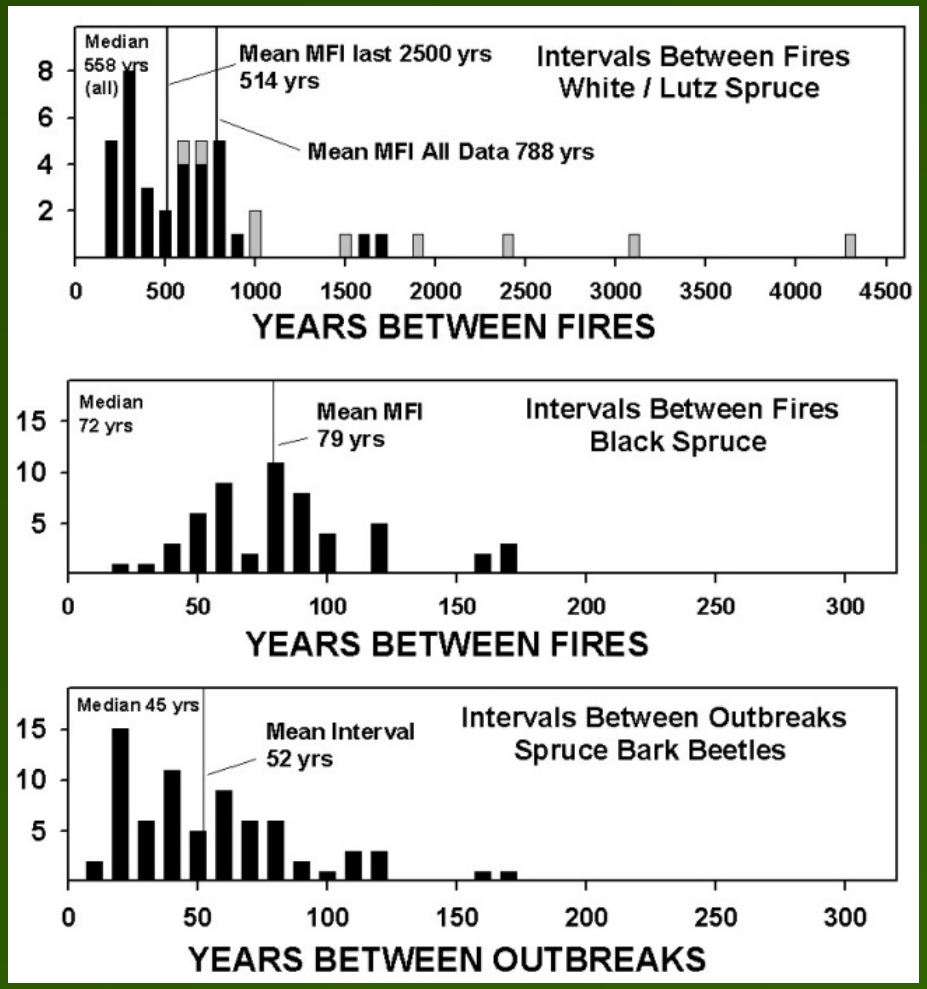
The Kenai has gotten warmer and drier in the last 4 decades

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



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

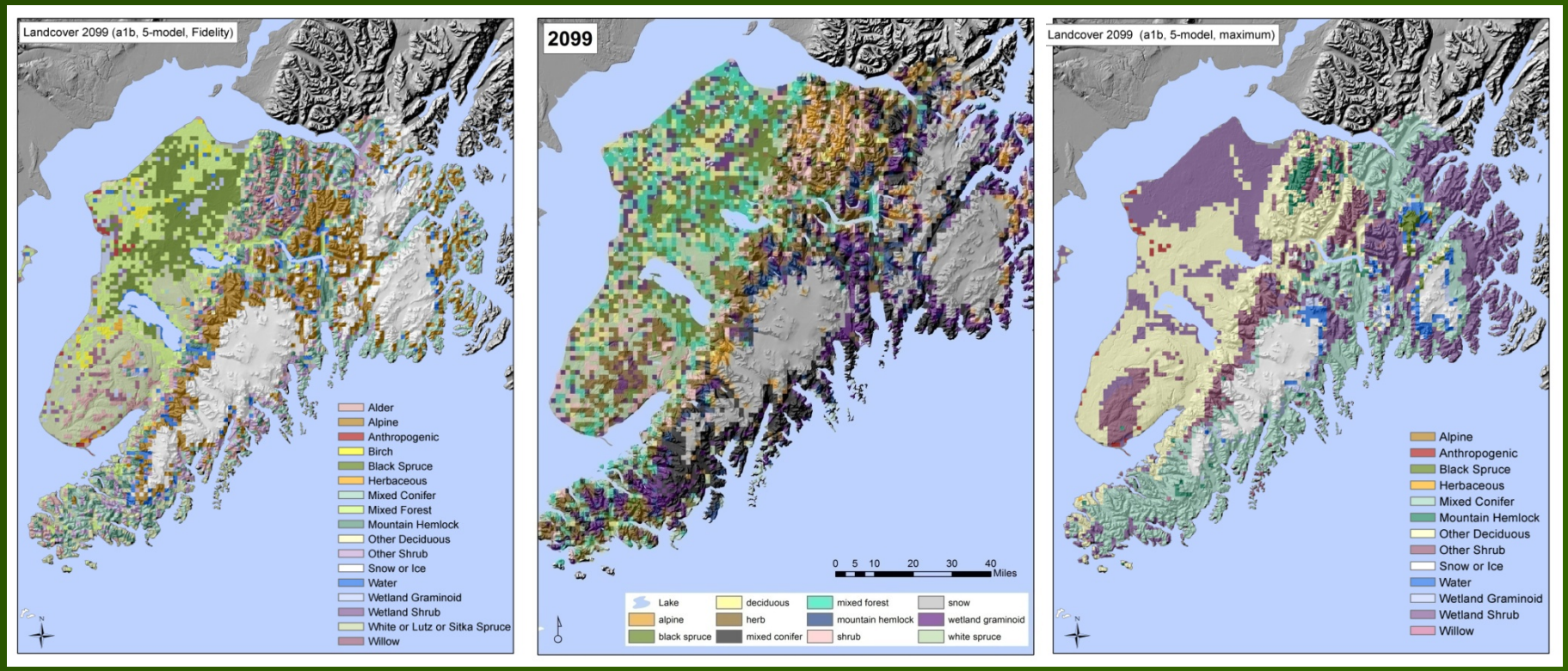
Lowland rest sites

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?

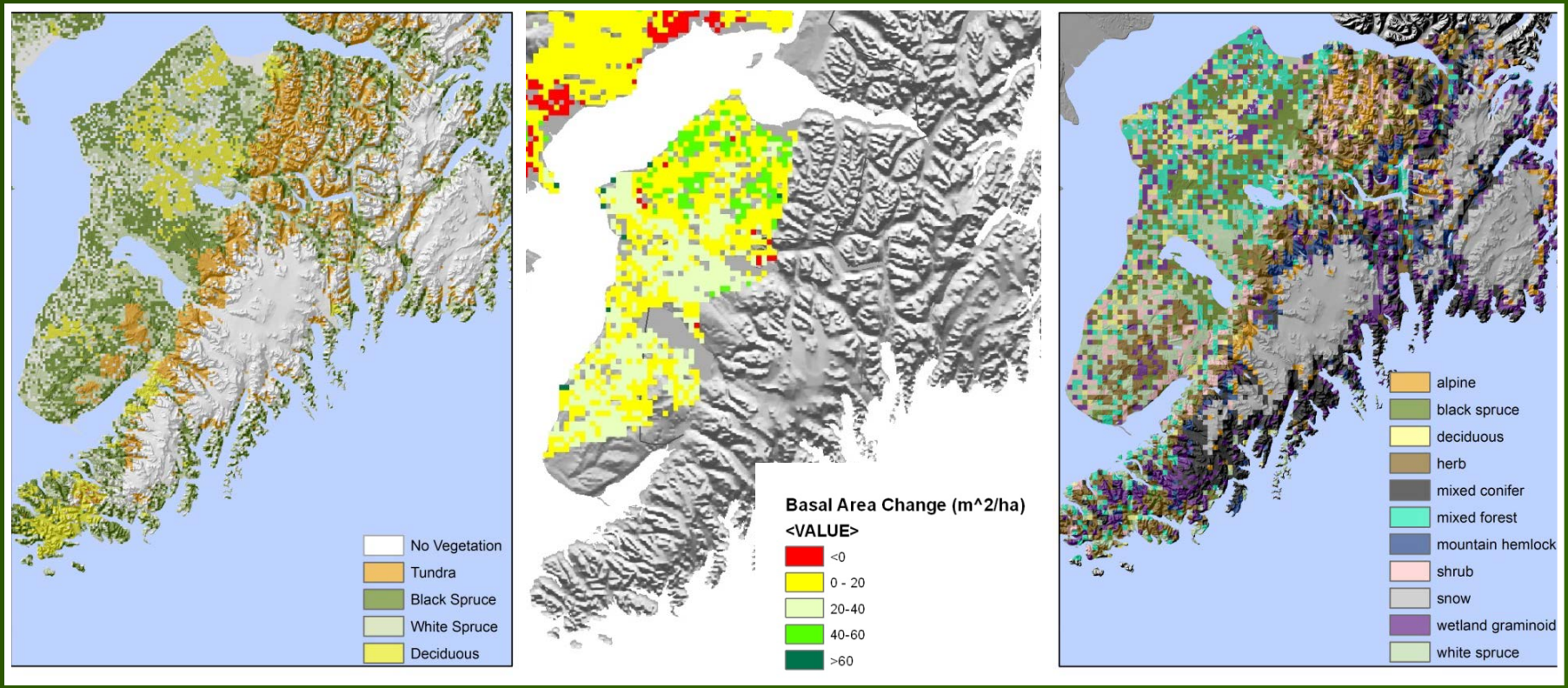
Variations on climate envelope modeling



Conservative ⟷ **Liberal**

Which is right?

Variations on modeling approaches



ALFRESCO **forest matrix** **climate envelope**

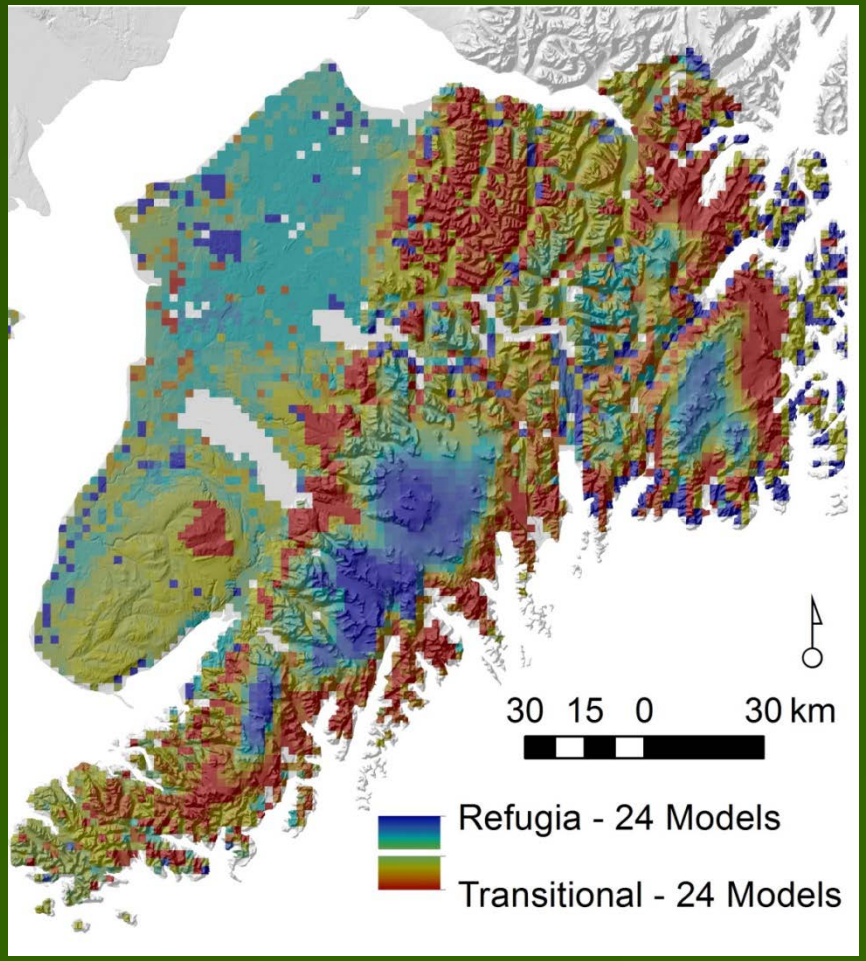
Instead of choosing one model over another… consider looking for signal convergence

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

✓Dynamic (transitional) areas identfied 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

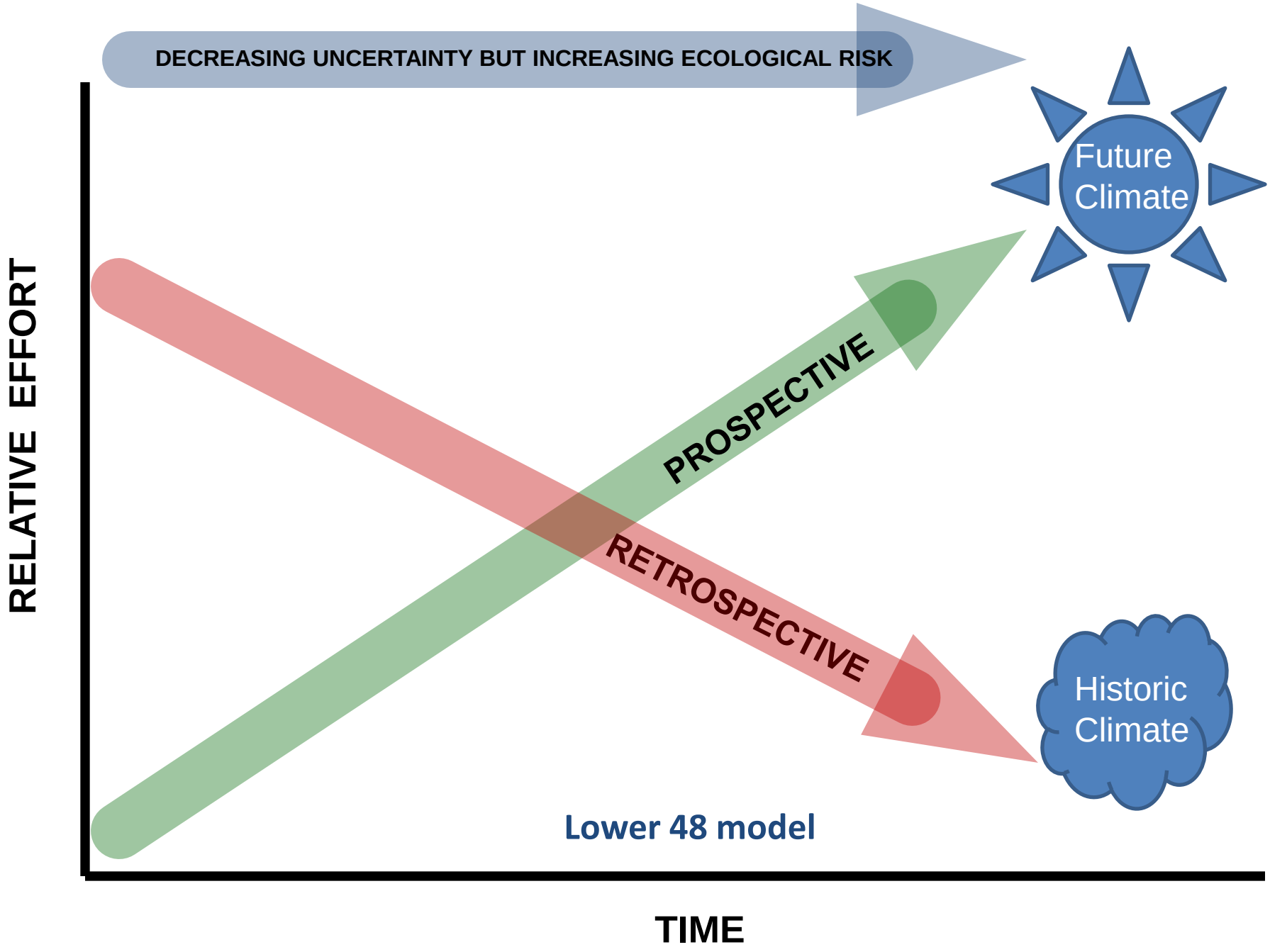
We have choices!

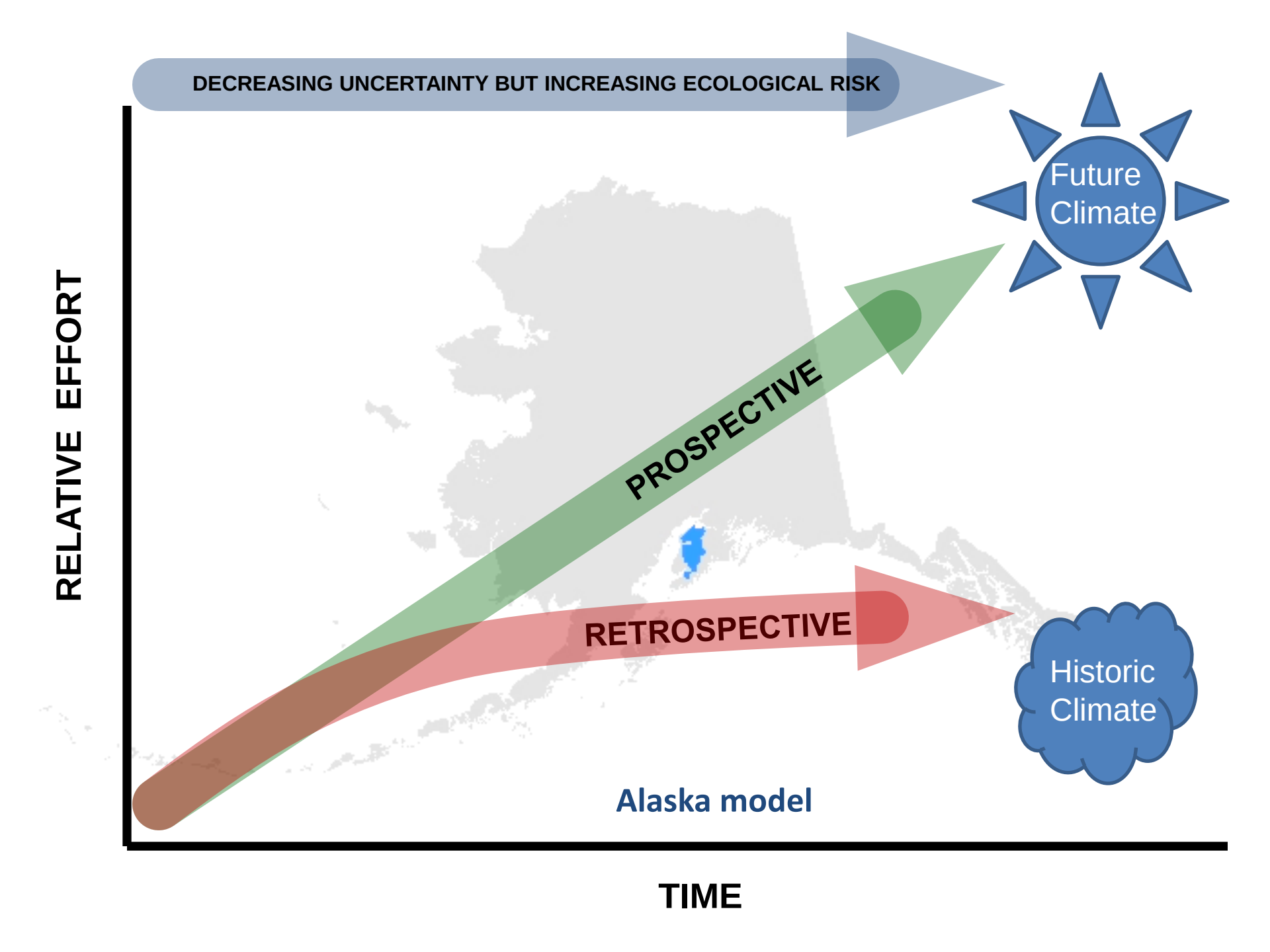
(1) **Retrospective** adaption = managing towards historical conditions

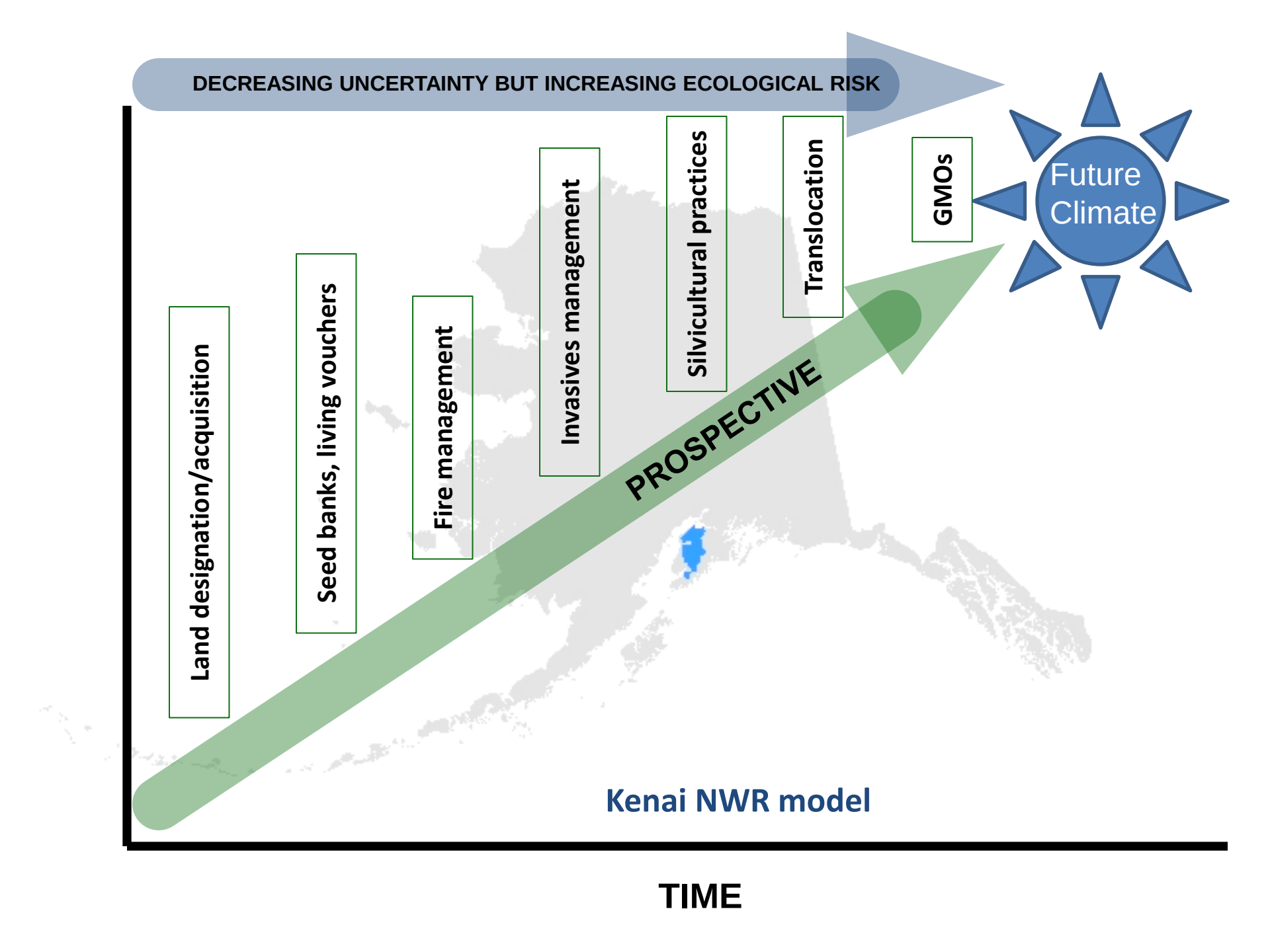
(2) **Prospective** adaptation = managing towards future conditions

(3) **Do nothing**

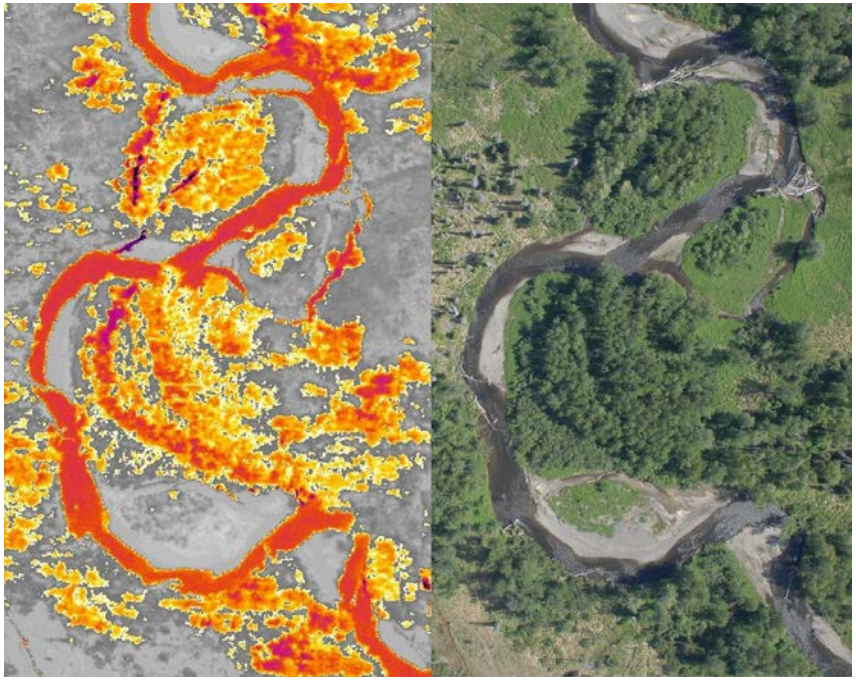
Magness et al. 2011

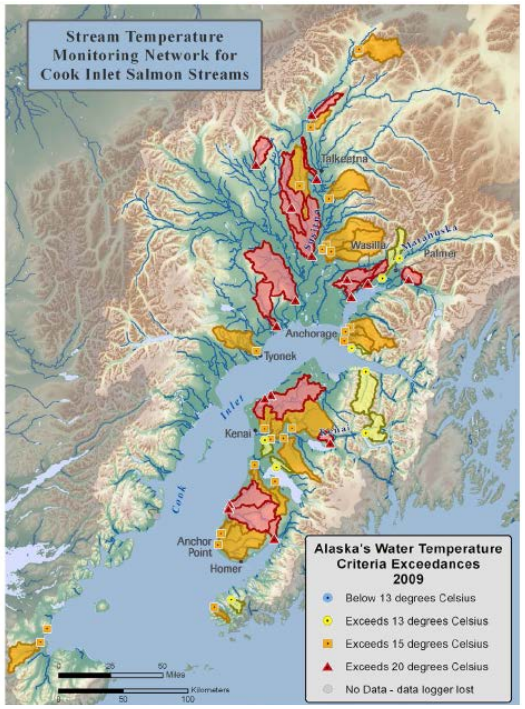

DECREASING UNCERTAINTY BUT INCREASING ECOLOGICAL RISK
Future Climate
RELATIVE EFFORT
PROSPECTIVE
RETROSPECTIVE
Historic Climate
Lower 48 model
TIME

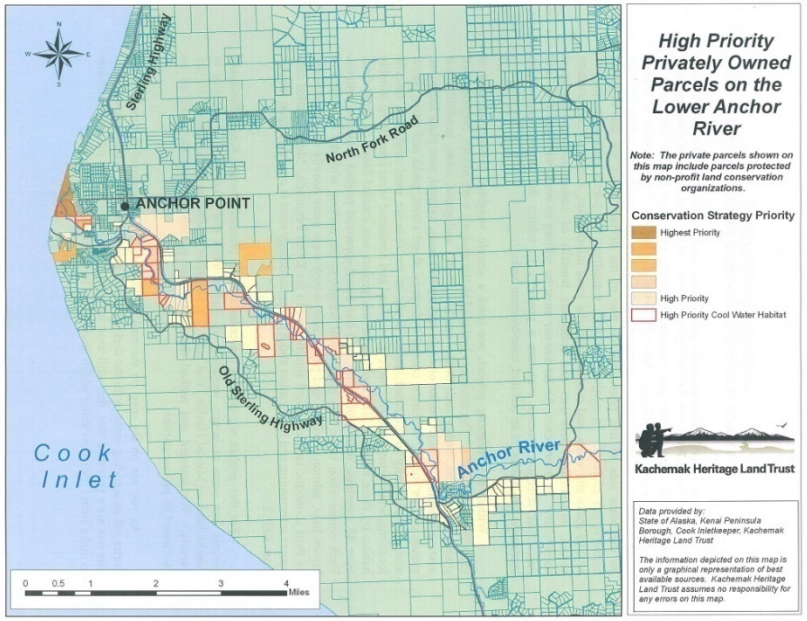

DECREASING UNCERTAINTY BUT INCREASING ECOLOGICAL RISK
Future Climate
PROSPECTIVE
RETROSPECTIVE
Historic Climate
RELATIVE EFFORT
TIME
Alaska model

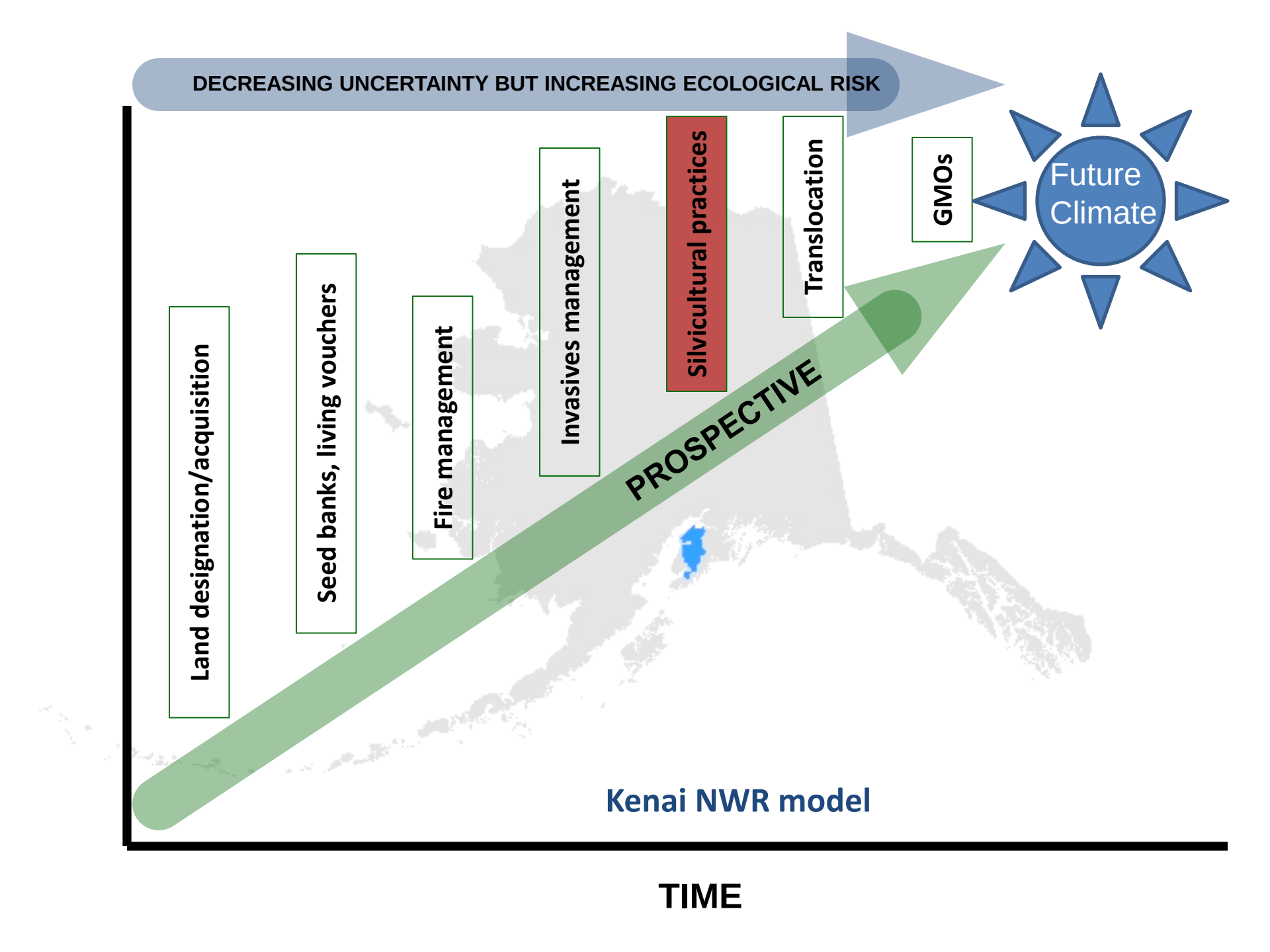

DECREASING UNCERTAINTY BUT INCREASING ECOLOGICAL RISK
Land designation/acquisition
Seed banks, living vouchers
Fire management
Invasives management
Silvicultural practices
Translocation
GMOs
Future Climate
PROSPECTIVE
Kenai NWR model
TIME

Prioritizing land acquisition:
Using thermal imagery to identify cold seeps in warming non-glacial streams







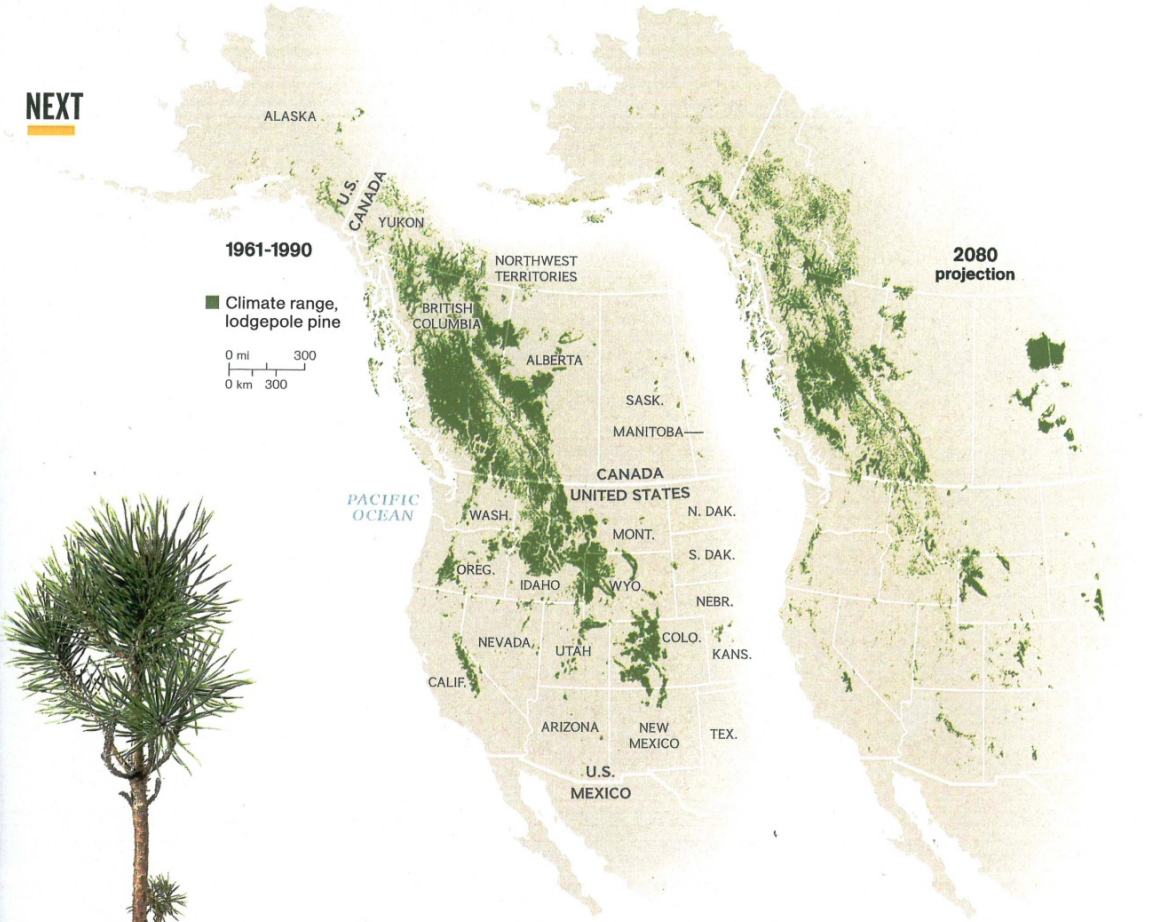

DECREASING UNCERTAINTY BUT INCREASING ECOLOGICAL RISK
Land designation/acquisition
Seed banks, living vouchers
Fire management
Invasives management
Silvicultural practices
Translocation
GMOs
Future Climate
PROSPECTIVE
Kenai NWR model
TIME

Same climate forecast but potentially different outcomes….

Boreal Transitional

We have choices!

NEXT



Maps showing historical and projected areas where climate suits certain trees help foresters pick species for assisted-migration planning. British Columbia is evaluating 15 kinds, including lodgepole pine (above).

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*

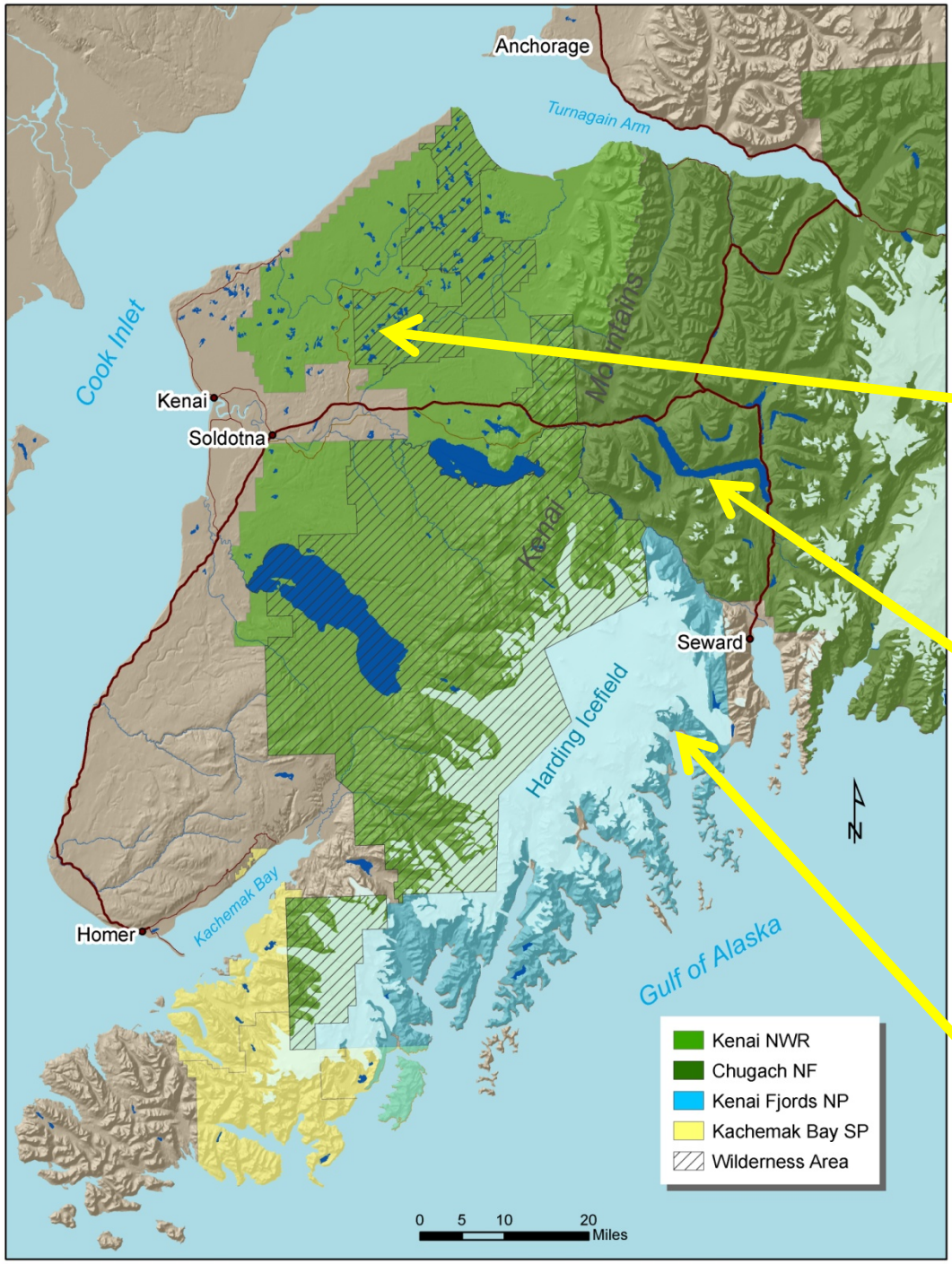
Common garden experiments

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

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?

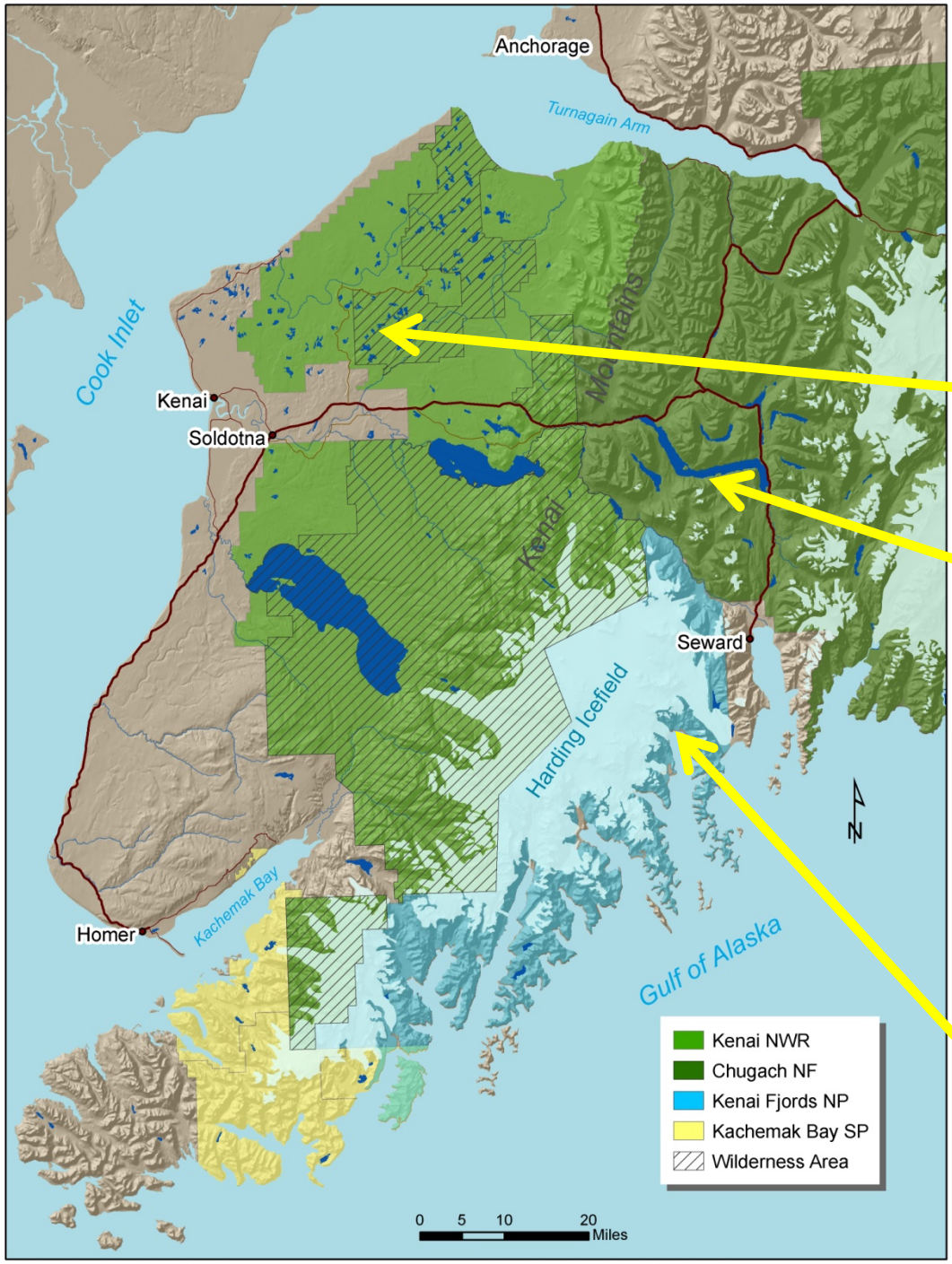
Competing mandates among Federal agencies…



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

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 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

Kenai National Wildlife Refuge
PROSPECTIVE

Chugach National Forest
RETROSPECTIVE

Kenai Fjords National Park
NO ACTION

Questions????