

WILDLIFE MANAGEMENT AND CLIMATE ADAPTATION WORKSHOP



Pre-Workshop Webinar:
Introduction to the Adaptation Workbook and
Climate Change Background

Climate Change Adaptation and Management for Terrestrial Wildlife

Project Goals

- Synthesize peer-reviewed recommendations for wildlife management under climate change
- Provide climate adaptation strategies for wildlife at a scale and resolution that can inform on-the-ground management

Olivia LeDee, Northeast Climate Adaptation Science Center

Benjamin Zuckerberg, University of Wisconsin-Madison

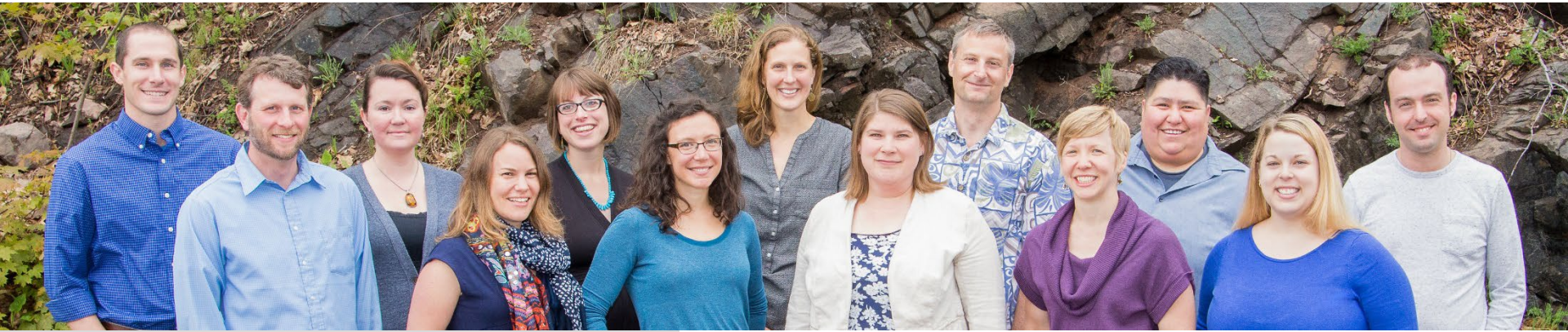
Chris Hoving, Michigan Department of Natural Resources

Stephen Handler, U.S. Forest Service and Northern Institute of Applied Climate Science

Chris Swanston, U.S. Forest Service and Northern Institute of Applied Climate Science



Northern Institute of Applied Climate Science



Chartered by USDA Forest Service, universities, non-profits, and tribal organizations:

- Practical information on **climate adaptation** and **carbon management**
- Adaptation resources
- Technical assistance



Two Key Questions

1. How might climate change affect the resources that I manage?
2. What management actions could help prepare for those effects?

Twin concepts for responding to climate change

- Mitigation = actions that reduce the human contribution to the greenhouse gas effect.



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- Adaptation = actions to prepare for and adjust to new conditions.



Adaptation Options

Resistance

Resilience

Transition



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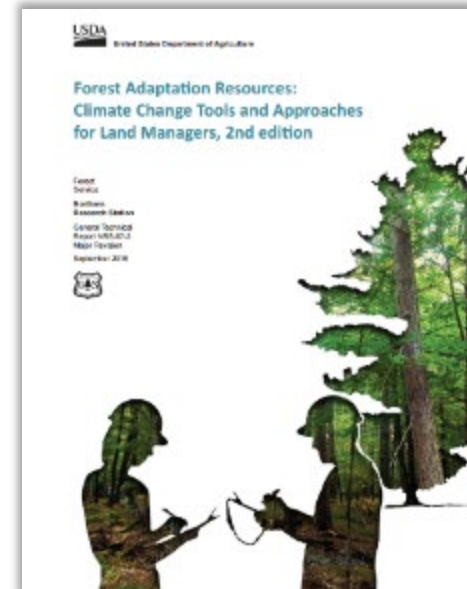


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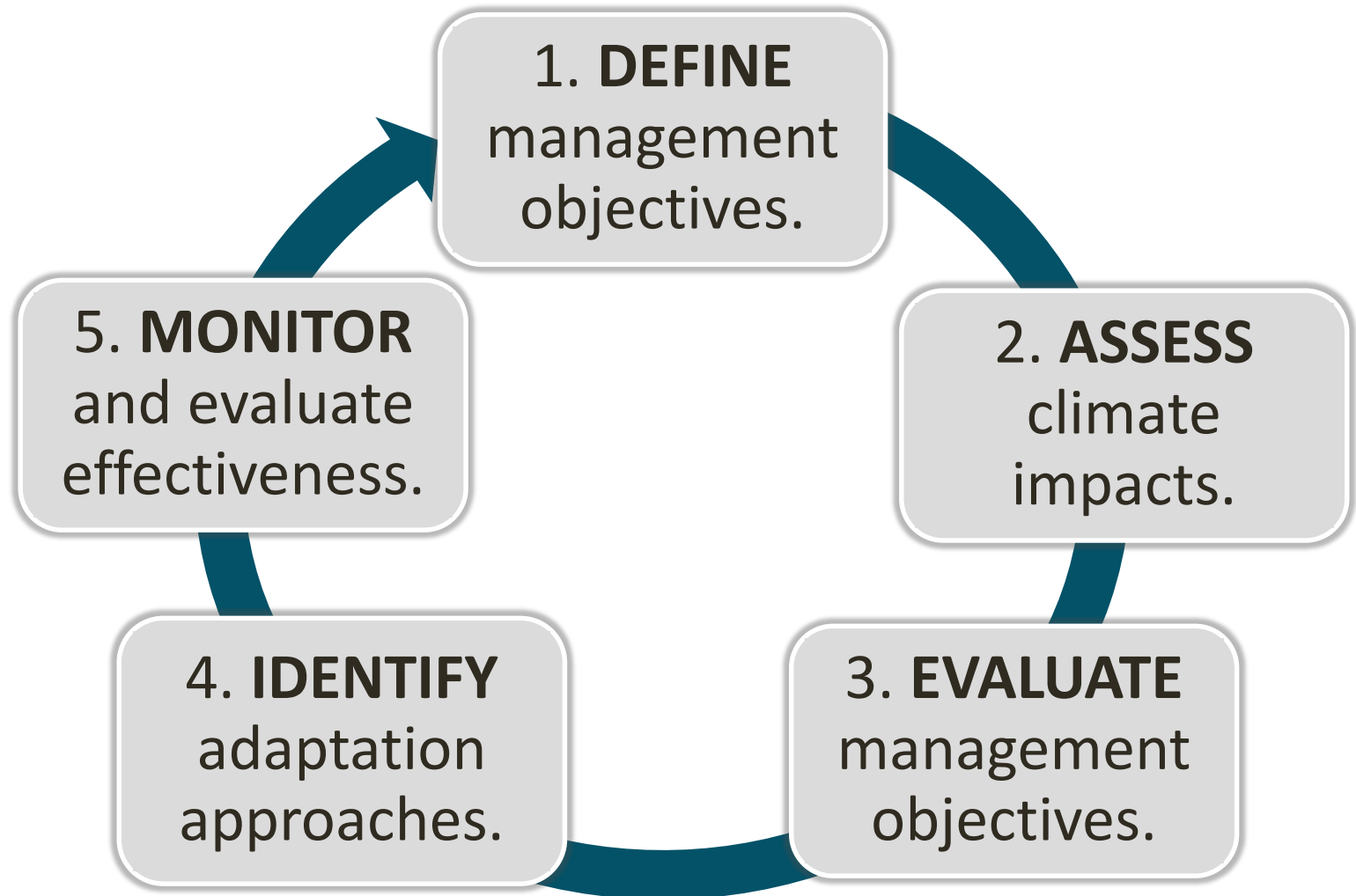
Forest Adaptation Resources

A flexible workbook and menu to address diverse needs

- Designed for a variety of land owners with diverse goals
- Does not make recommendations
- Menu of adaptation strategies and approaches for forest management
- New online version!



Adaptation Workbook



A systematic process...

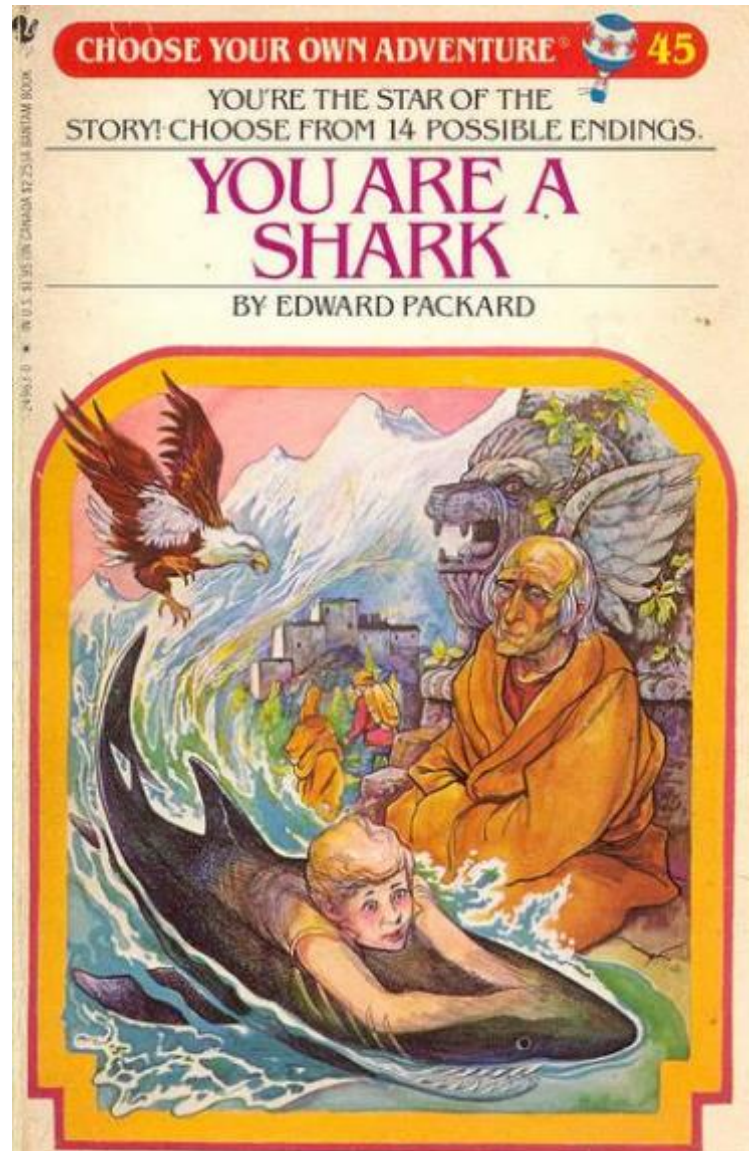
| Management Objectives | Challenges | Opportunities | Feasibility | Other Considerations | |
|------------------------------|-------------------|-----------------------|--------------------|--------------------------------|------------------------------|
| | | | | | |
| Adaptation Actions | | | Benefits | Drawbacks/ Barriers | Recommend Tactic? |
| Approach | Tactics | Time Frame | | | |
| | | | | | |

Intentional

- Explicitly consider and address climate change
- Sure we might get lucky...
- Intentionally assessing risk and vulnerabilities **makes our plans more robust!**



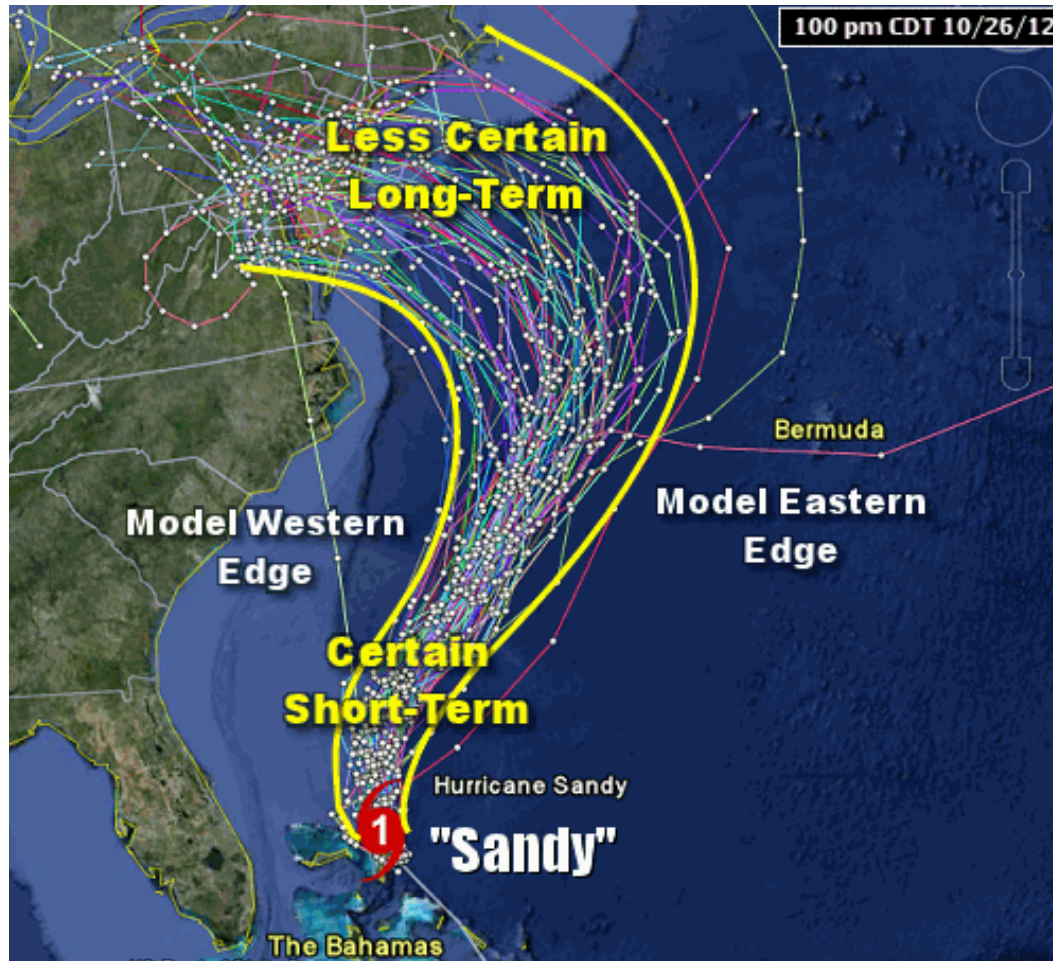
Flexible



An Uncertain Future

We Don't Need Certainty

- Instead: think about risk management!



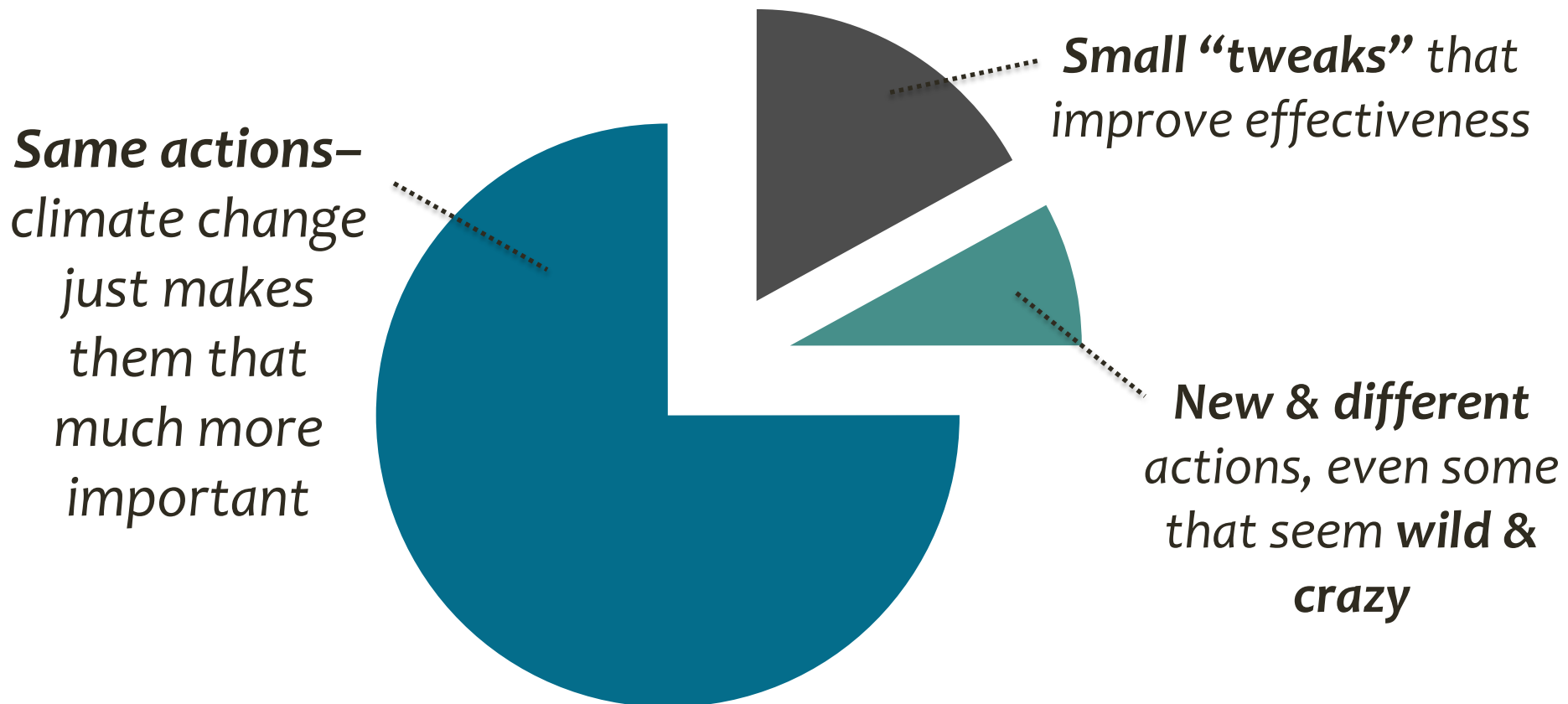
Regional to Site-Specific

- Research and assessments describe broad trends but local conditions and management make the difference.
- Local knowledge and experience is crucial!

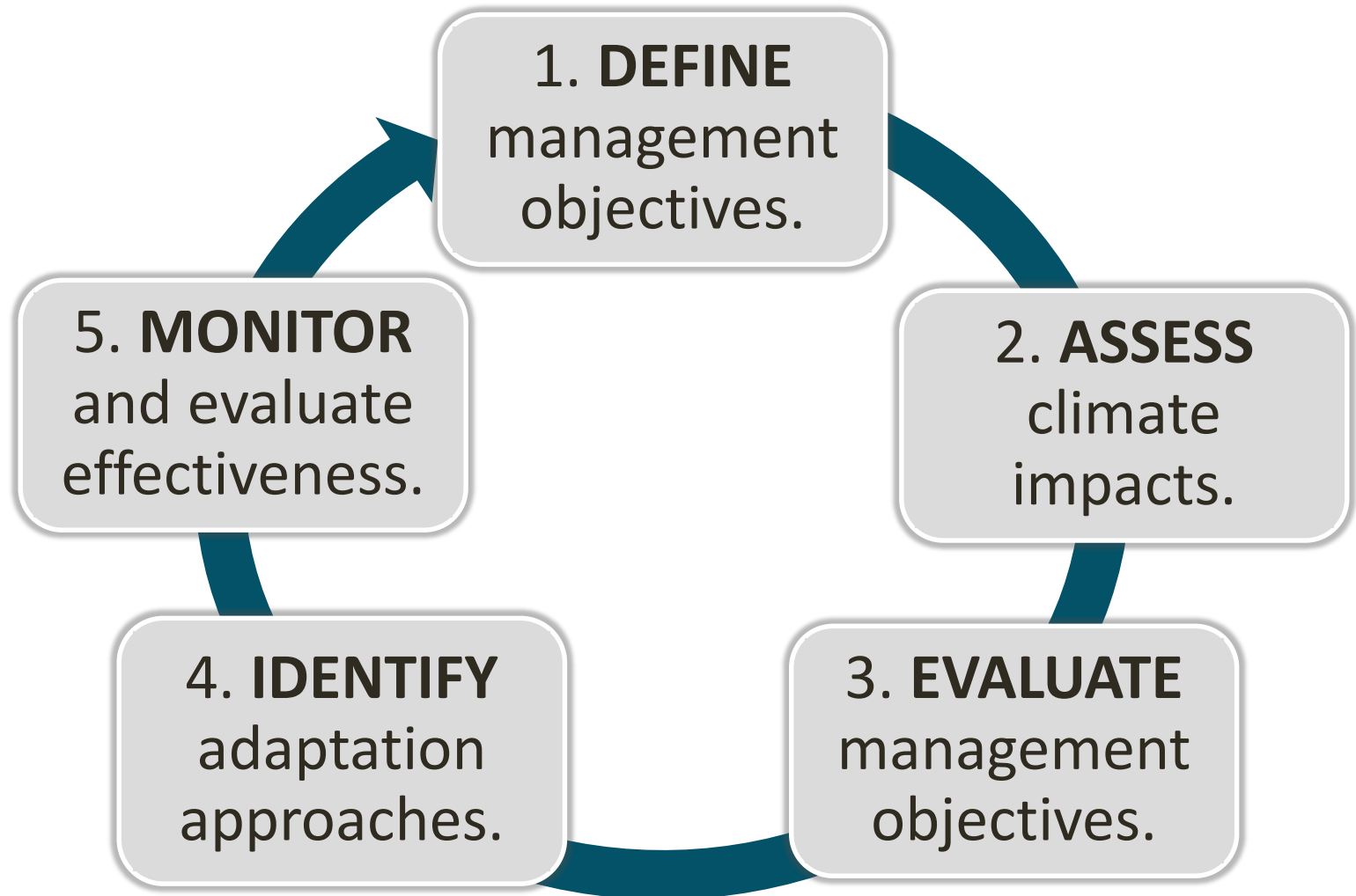


Adaptation

- Adaptation actions may not look that different from current management actions, especially in the near term.



Adaptation Workbook



Tentative project ideas

1. Wood Duck WMA (led by Russ Hamer, NGPC)
2. Nebraska Sand Hills/ Eastern red cedar mgmt (Greg Wright & Jeff Abegglen, USFS)
3. Indian Cave State Park (Gerry Steinhauer, NGPC)
4. Salt Creek Tiger Beetle (Shaun Dunn, NGPC)
5. Spring Creek Prairie Audubon Center (Meghan Sittler, Audubon Nebraska)
6. Sandhill crane populations (Andy Caven, Crane Trust)
7. Middle Niobrara BUL (Jen Corman, NGPC)
8. Row crop and wetland restoration (Nelson Winkel, TNC)

Step 1 Prep

Management Objectives should be SMART

Specific

Measurable

Achievable

Relevant

Time bound

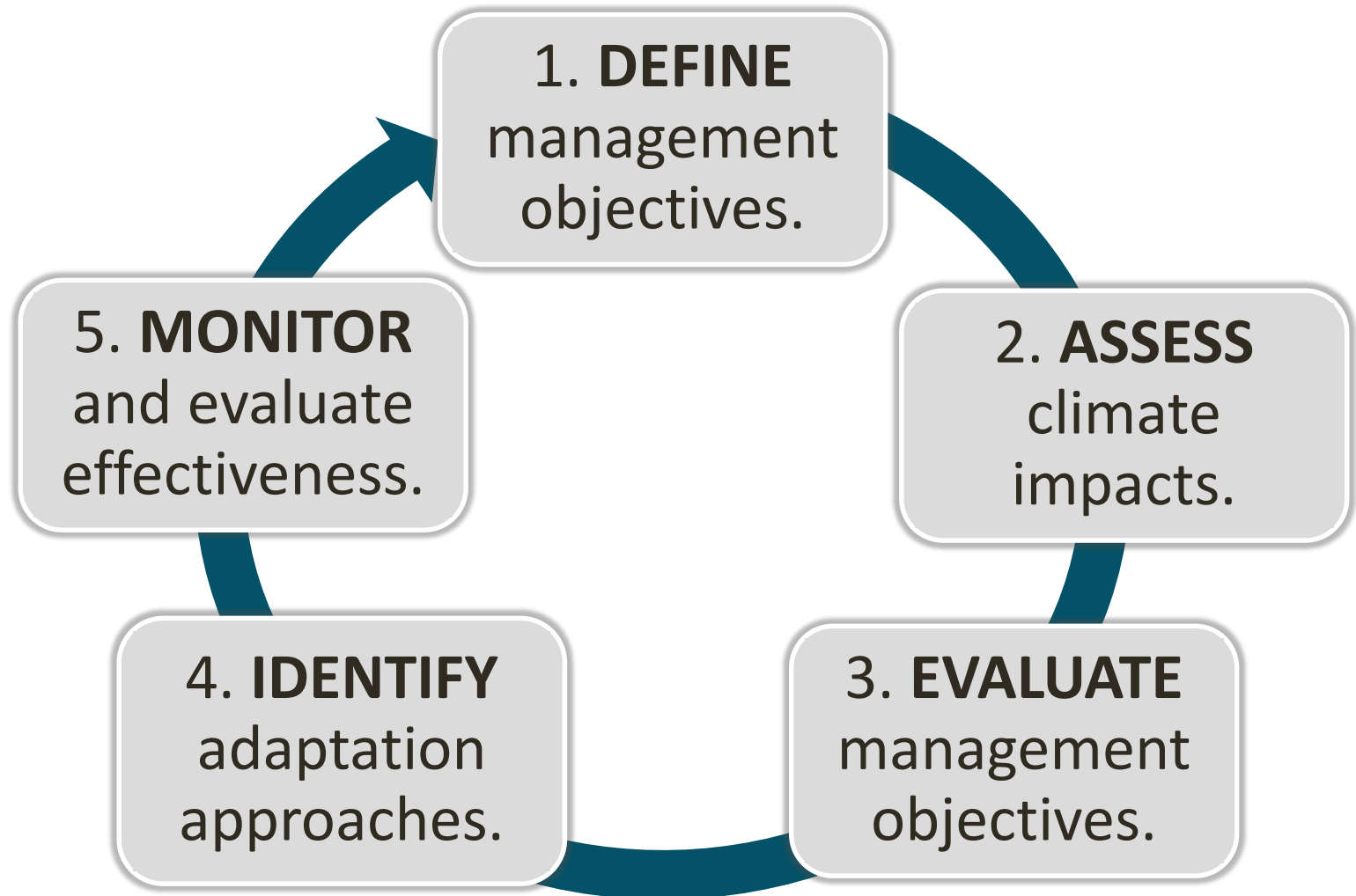
Emphasize your
goals related to
wildlife!

Step 1 Prep

Write down your key management goals and objectives for your project!

| Resource Areas | Goals | Objectives | Timeframe |
|---|--|---|-----------|
| Old field along river corridor | <ul style="list-style-type: none">Control exotic invasive speciesCreate forested river corridor for riparian wildlife species | <ul style="list-style-type: none">Monitor and spray roadsides to each summer. Focus on A, B, and C.Plant 10,000 bare root seedlings of X, Y, Z and protect with deer cages | 5 years |
| Northern Long-Eared Bat Habitat Improvement | <ul style="list-style-type: none">Increase forest structural diversityEncourage old forest characteristics | <ul style="list-style-type: none">Install 1-acre gaps in 20% of the stand, focusing on areas dominated by sugar mapleGirdle 2-4 large trees per acre. Leave all standing dead trees. | 10 years |

Adaptation Workbook



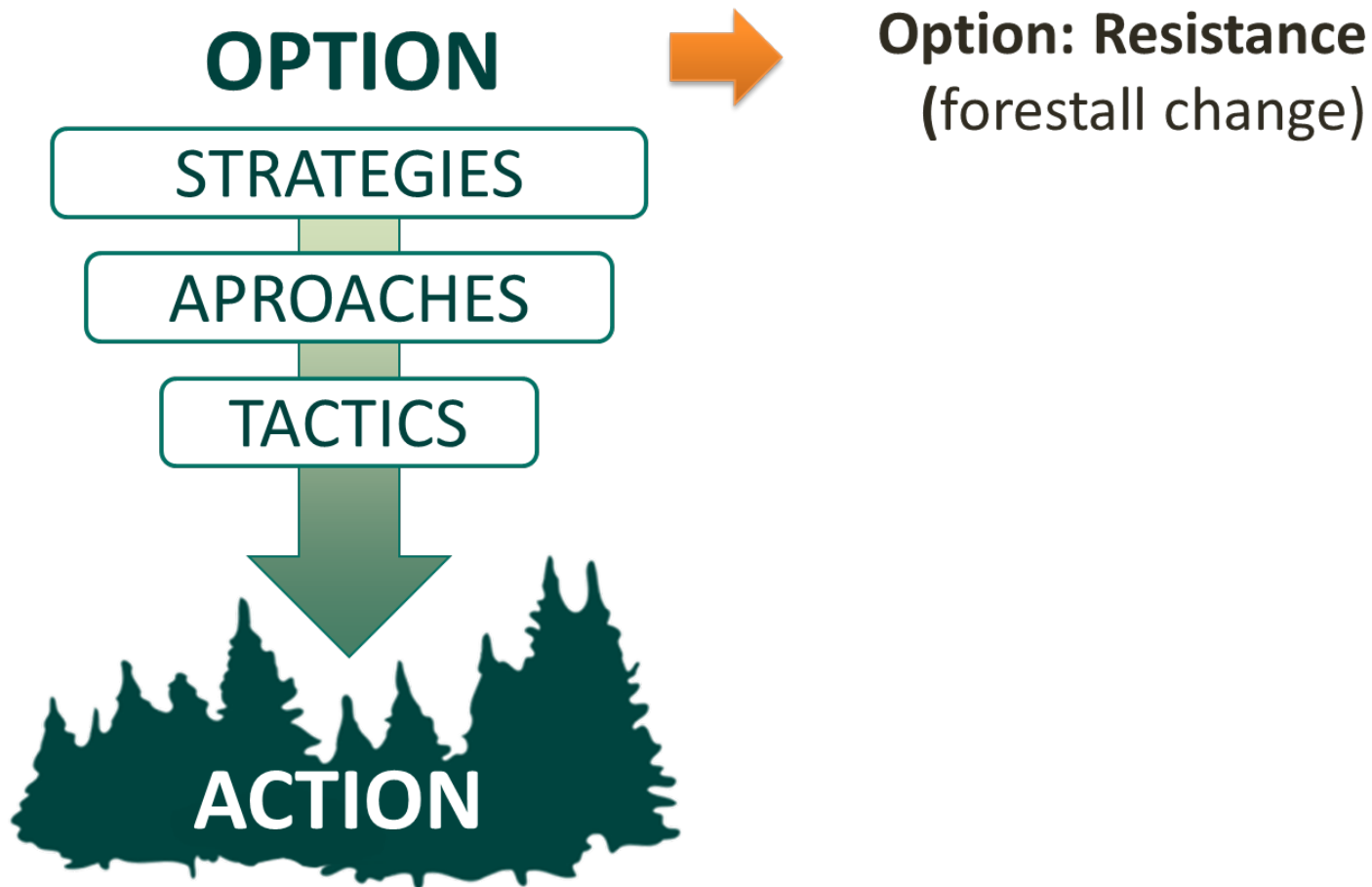
A “Menu” for Adaptation

The **Menu** helps you create **clear rationale** for your actions by connecting them to **broader adaptation ideas**.



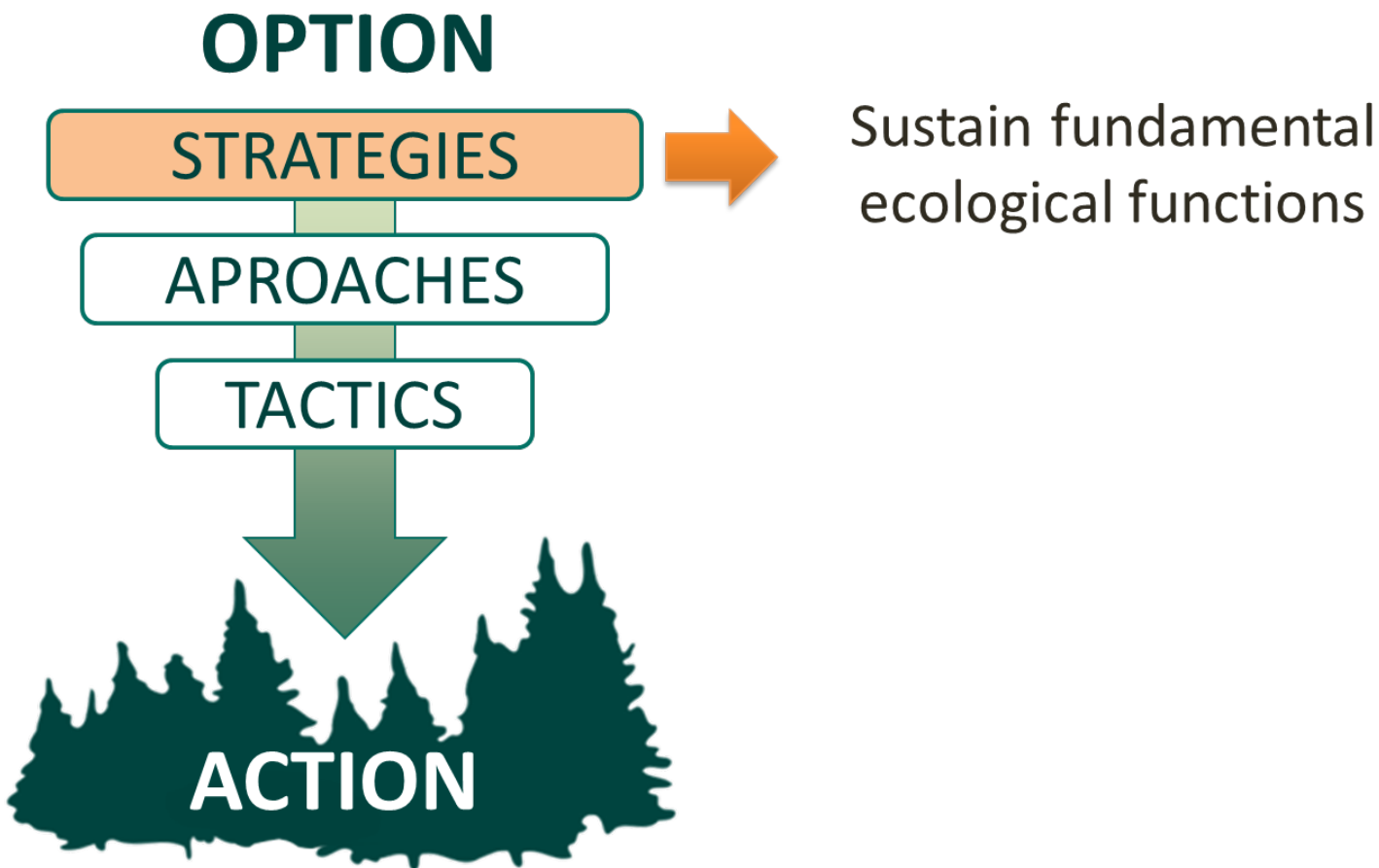
Adaptation Menus

1. *Connecting Broad Ideas to Specific Actions*



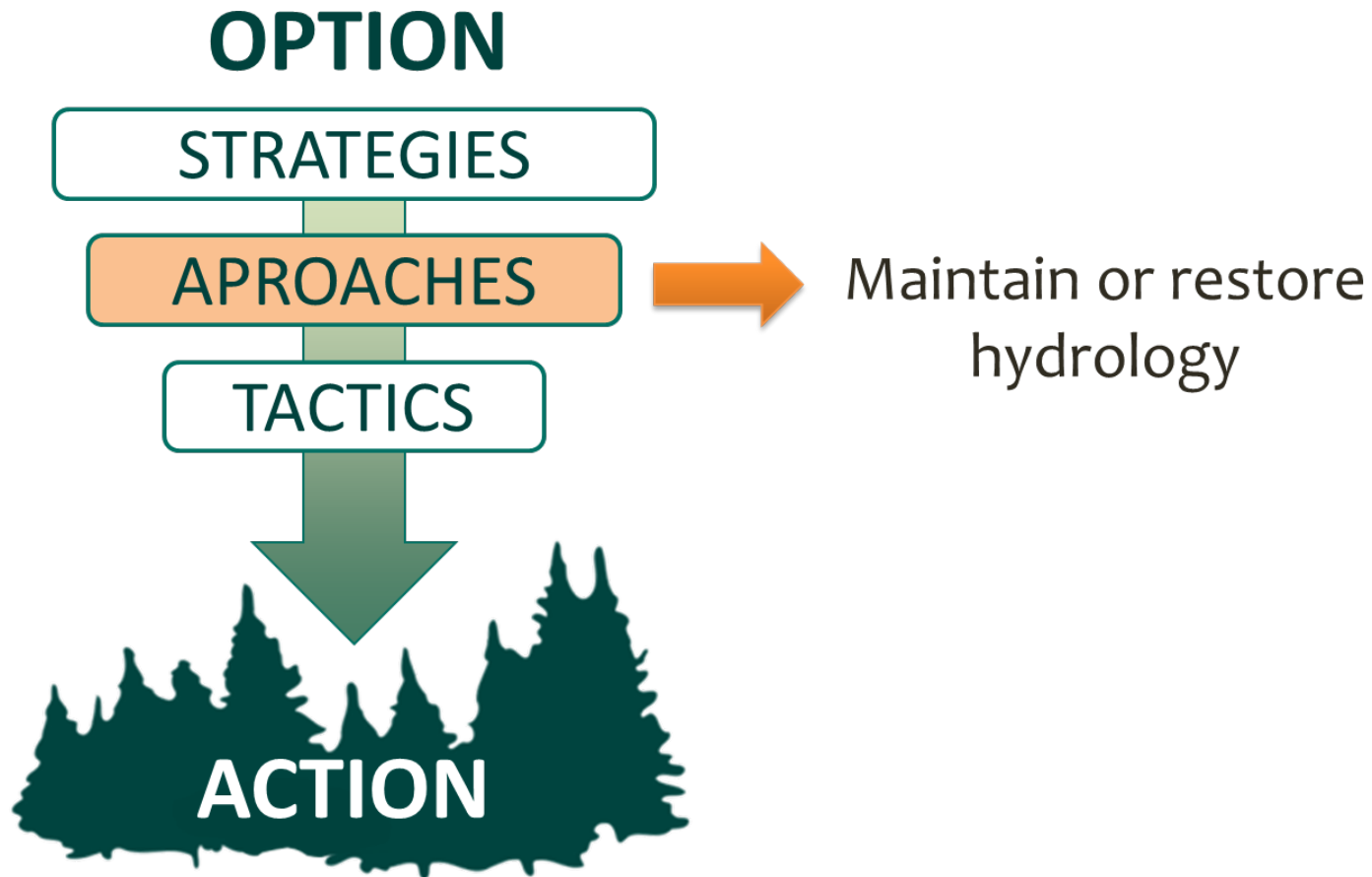
Adaptation Menus

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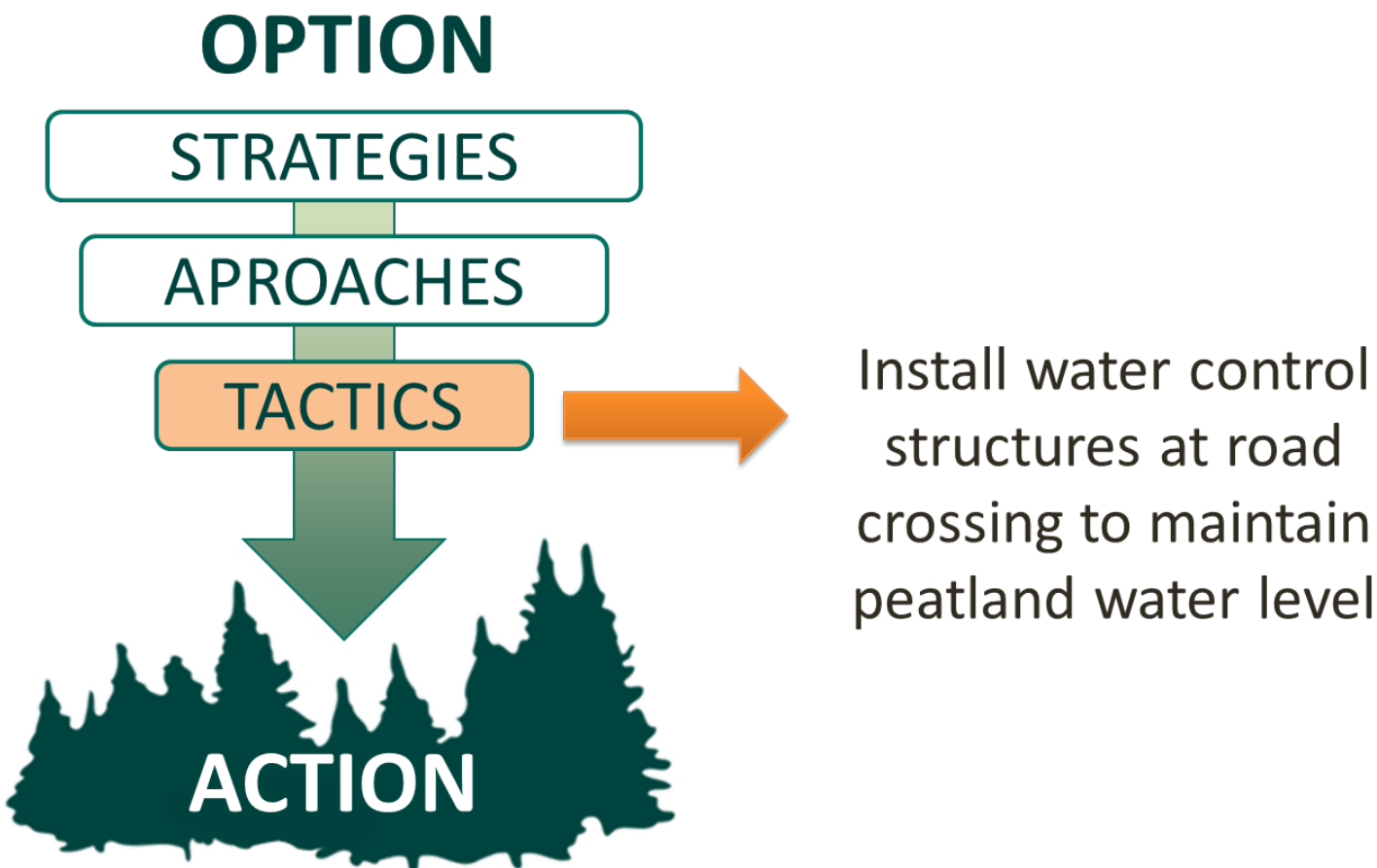
Adaptation Menus

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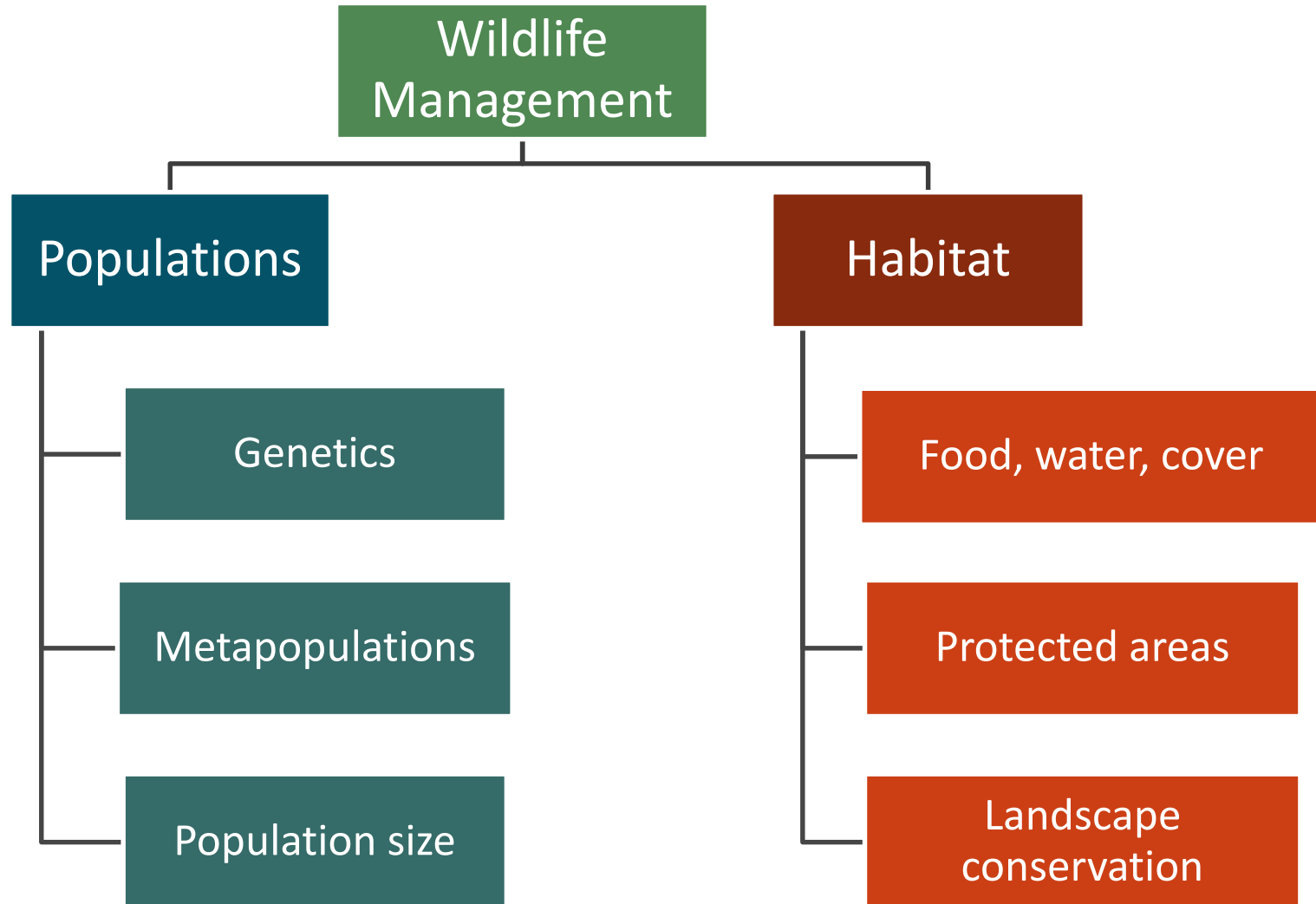


Adaptation Menu

1. *Connecting Broad Ideas to Specific Actions*



Wildlife Adaptation Menu



Wildlife Adaptation Menu

Populations

Strategy: Maintain a socially acceptable population size for harvestable species

Approach: Translocate individuals within the existing range to augment location populations

Approach: Increase reproduction and survival rates

Approach: Regulate hunting to increase or decrease population size

Approach: Control illegal harvest and prevent overexploitation

Approach: Implement nonlethal population control methods

Wildlife Adaptation Menu

February 2019 Draft

Wildlife Adaptation Menu

Adaptation Strategies for Population Management

1. Maintain and enhance genetic diversity

Approaches

- 1.1. Increase genetic exchange between populations
- 1.2. Protect genetic admixture (interbreeding) zones in order to facilitate adaptive genetic exchange
- 1.3. Limit genetic exchange to protect isolated populations
- 1.4. Protect trailing edge or leading edge populations
- 1.5. Protect populations in disturbed environments because they may contain adaptive traits
- 1.6. Protect areas of high phylogenetic or phenotypic diversity or endemism
- 1.7. Import individuals with climate-adaptive genetic traits (translocation)
- 1.8. Preserve genetic material (gene banks)
- 1.9. Restore genetic diversity in isolated or inbred populations (genetic rescue)

2. Maintain metapopulation processes

Approaches

- 2.1. Translocate individuals or populations to formerly occupied habitat within the existing range (reintroduction)
- 2.2. Identify and protect source populations
- 2.3. Establish and maintain connectivity between populations through corridors or stepping stones

3. Facilitate shifts in the geographic range of the species in anticipation of future conditions

Approaches

- 3.1. Establish corridors and minimize barriers to movement to new suitable habitats
- 3.2. Prepare suitable habitat in anticipation of future introduction, reintroduction, or natural range shift of a species
- 3.3. Move and release individuals into a population where conditions are now suitable and are expected to improve
- 3.4. Reintroduce species where climate is expected to remain suitable.
- 3.5. Conserve leading-edge populations (high altitude, northern, etc.)
- 3.6. Introduce species to new areas with suitable current and future climate

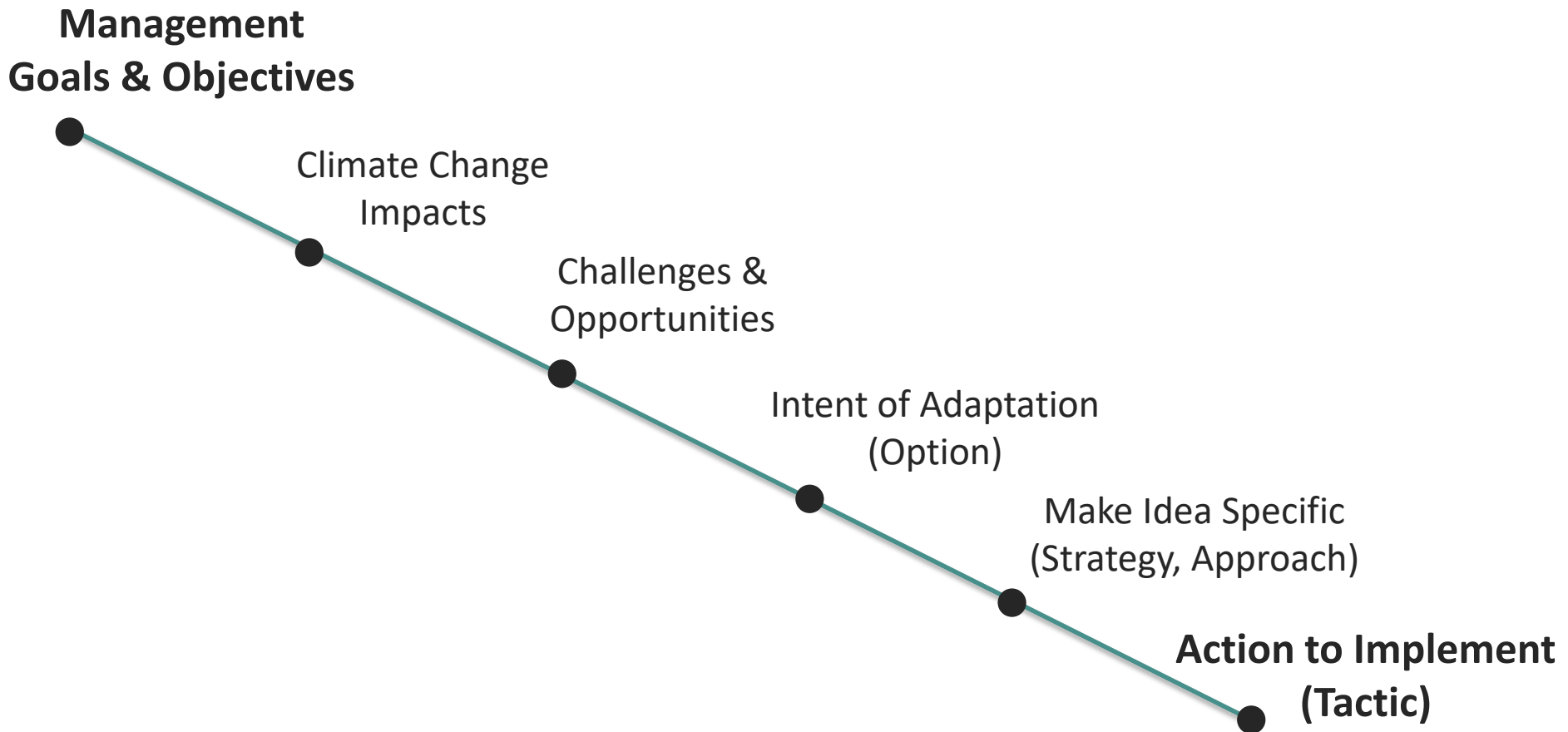
4. Sustain positive and reduce negative interspecific and biotic interactions

Approaches

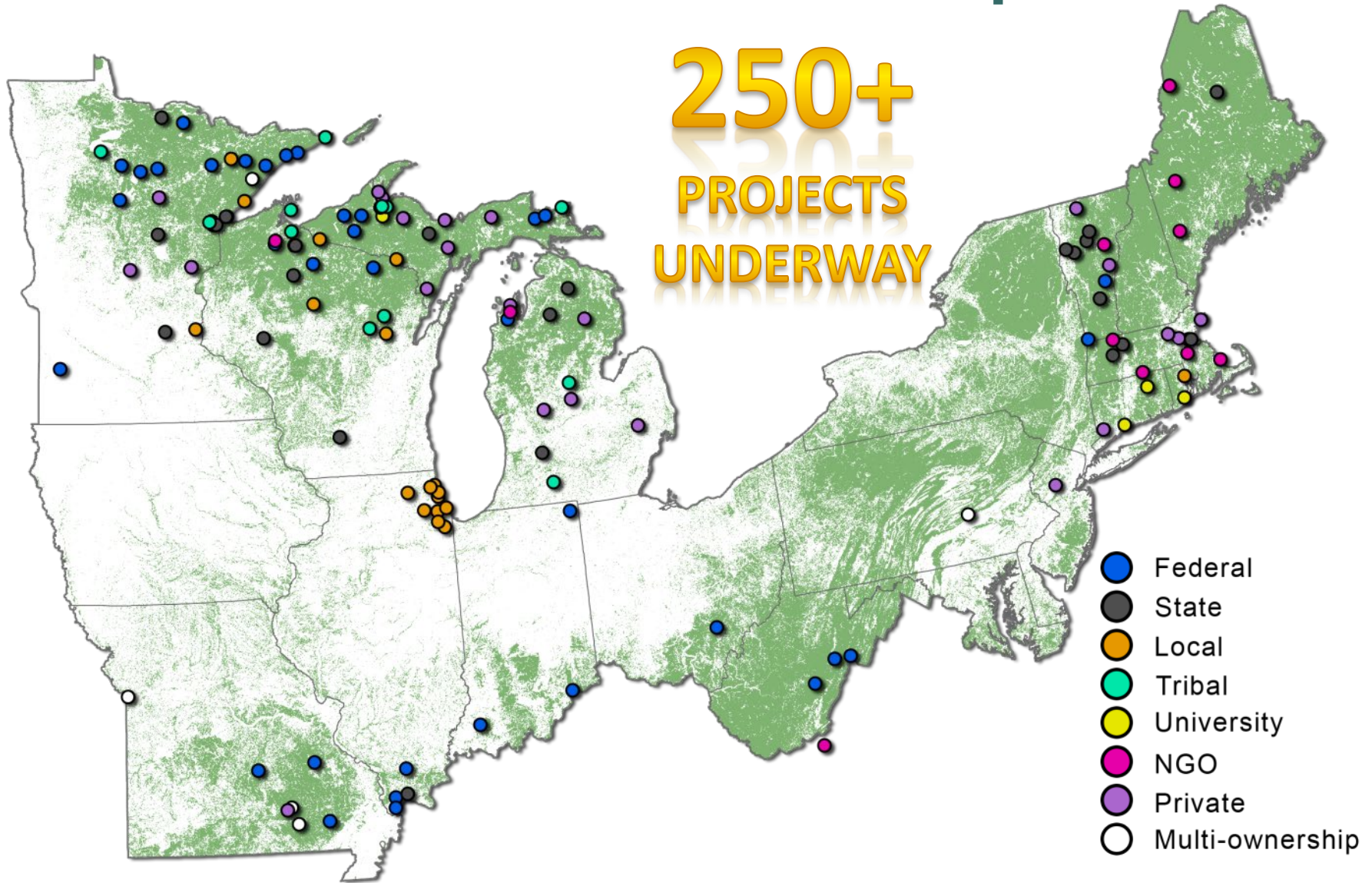
- 4.1. Increase or protect existing biodiversity.
- 4.2. Manage native competitor species to allow other species to persist or thrive
- 4.3. Detect and remove non-native invasive species

Connecting the Dots

- A clear train of thought shows *intentionality*



Real-world examples



Next steps!

- Get in touch with questions!
- **Project leaders: Send Step 1 worksheets to Stephen by June 5.**
- **Free agents:** Let me know what project interests you, or create your own!
- Skim through vulnerability assessments, climate data, or other resources (links coming)
- Gather information about your project area (maps, inventory data, mgmt. plans, etc.)

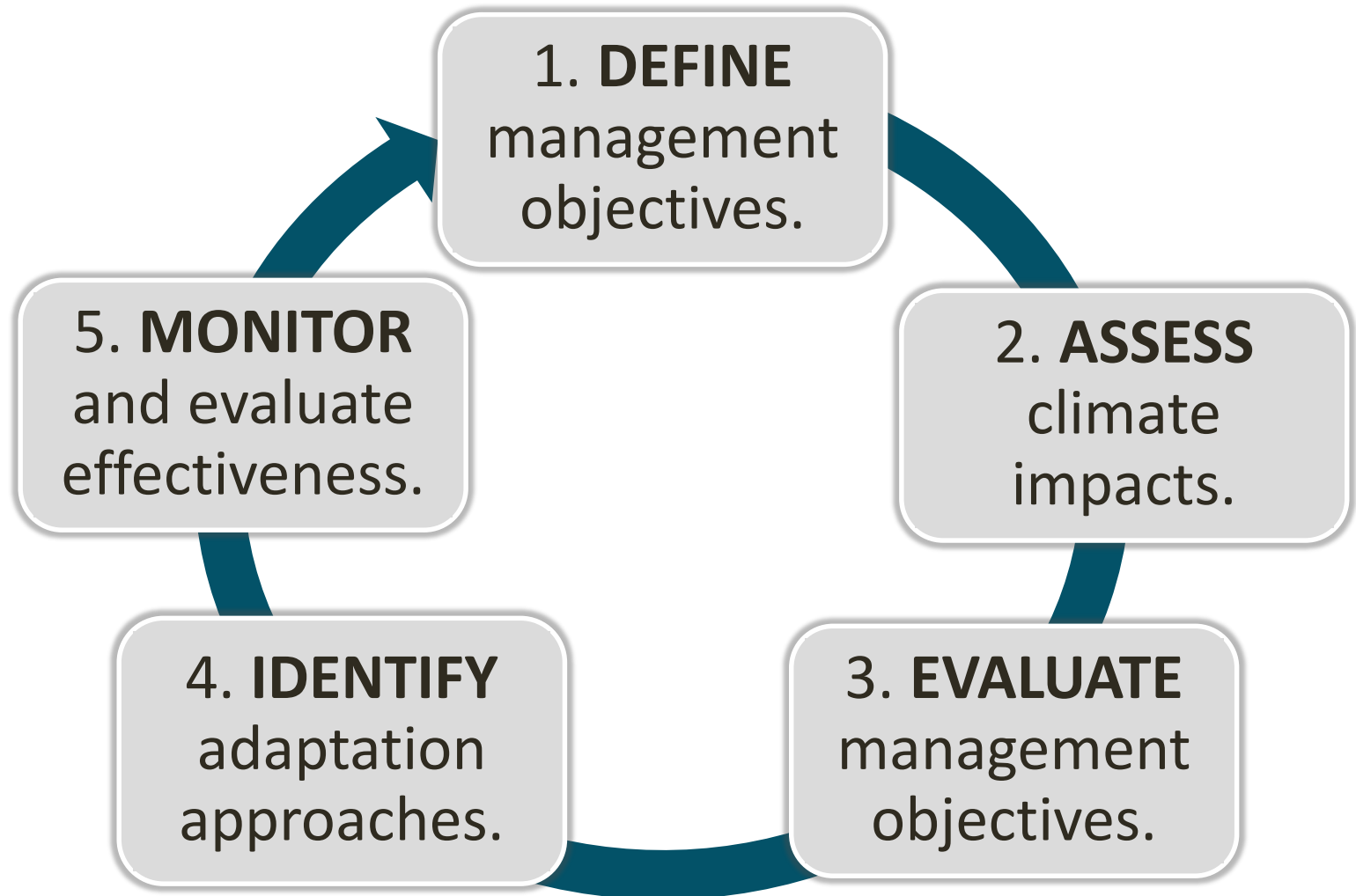
See you in Lincoln at 9am on the 11th!

Hardin Hall, Room 162

University of Nebraska-Lincoln East Campus

3310 Holdrege St., Lincoln, NE

Adaptation Workbook





NEBRASKA STATE
CLIMATE OFFICE

Climate Change and Implications for Nebraska

MARTHA SHULSKI, NEBRASKA STATE CLIMATOLOGIST | @MSHULSKI3
SCHOOL OF NATURAL RESOURCES, UNIVERSITY OF NEBRASKA LINCOLN

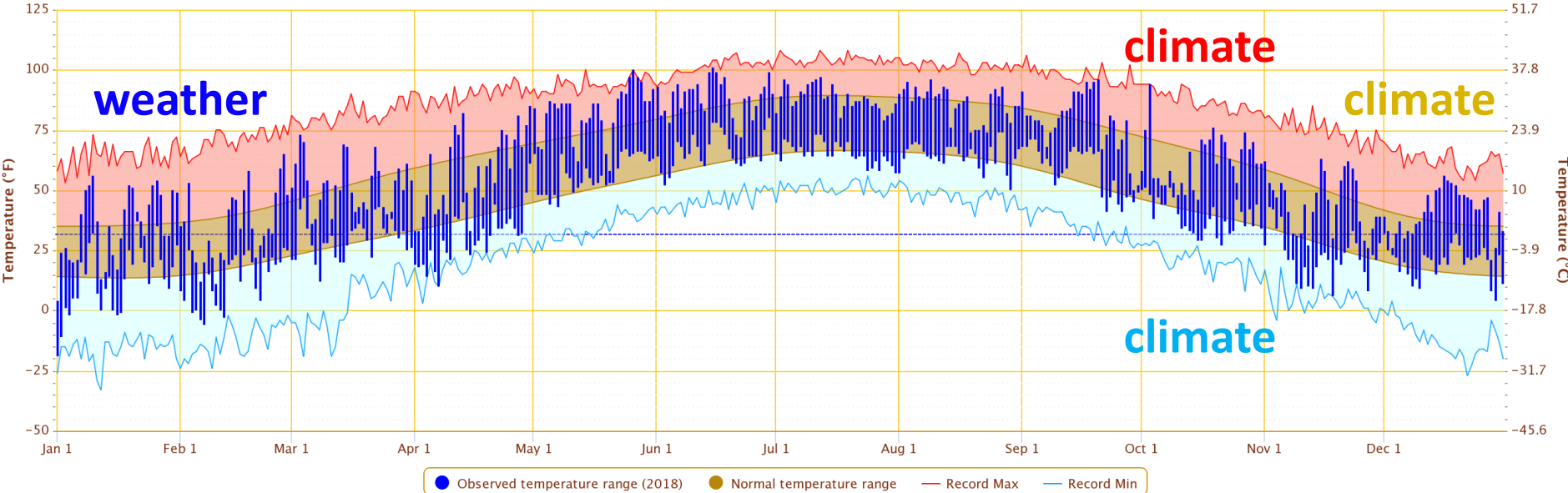
Main points

- **Weather and climate – they are related, but not the same**
- **Nebraska's climate past**
 - Warming by ~ 1.5 degrees F (nights warming more than days).
 - Rate of warming accelerating in recent decades.
 - Trend toward wetter (driven by Mar, May, Oct).
- **Nebraska's climate future**
 - Rate of warming will increase at an unprecedented rate.
 - Precipitation shift – wetter winter and spring, drier summer.
 - Increased variability and more extremes (heat, drought, heavy rain).

Weather vs. climate

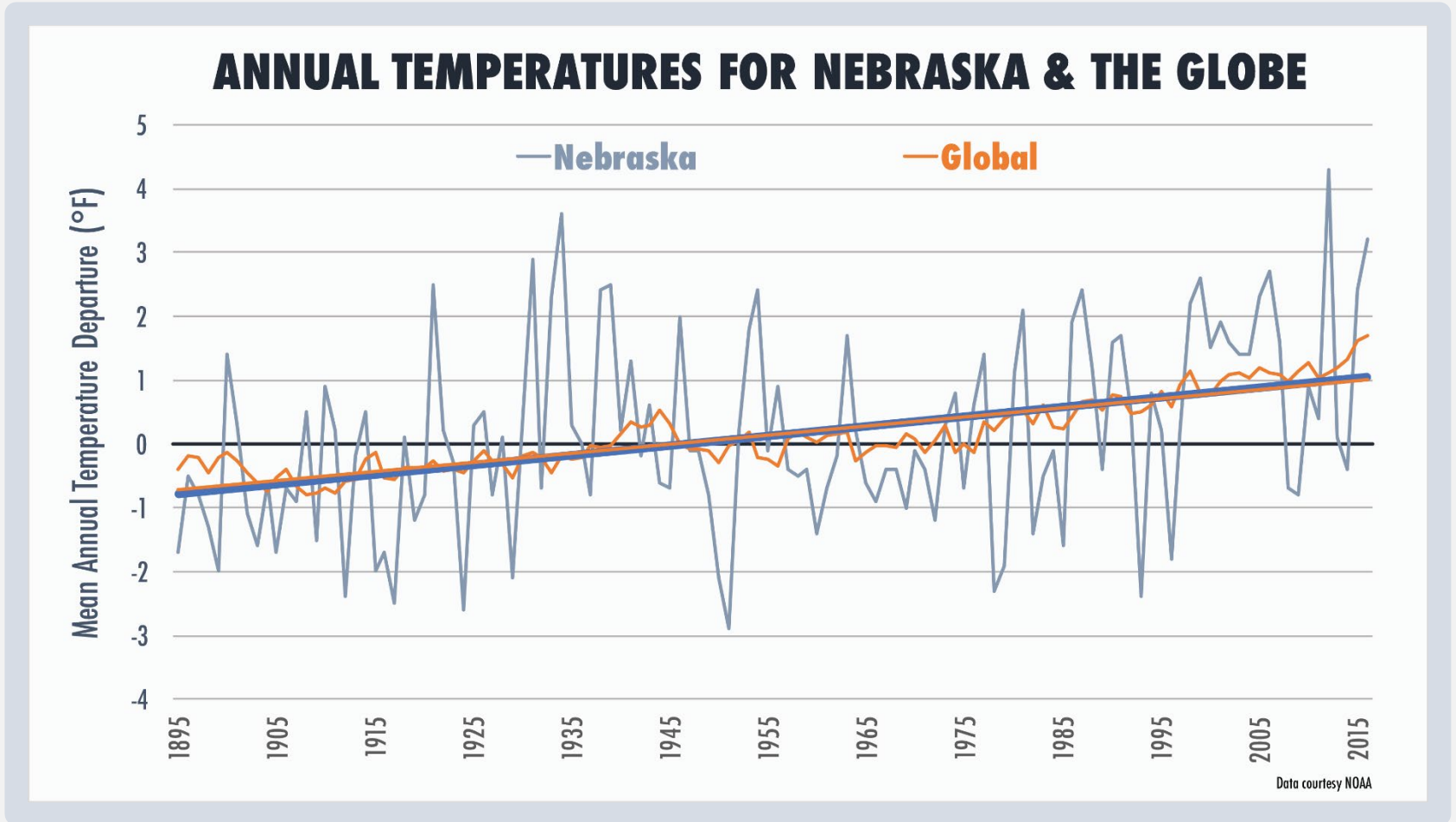
Daily Temperature Data - LINCOLN AIRPORT, NE

Period of Record - 1948-01-01 to 2019-05-27. Normals period: 1981-2010. Click and drag to zoom chart.



Powered by ACIS

Variability and change happen simultaneously

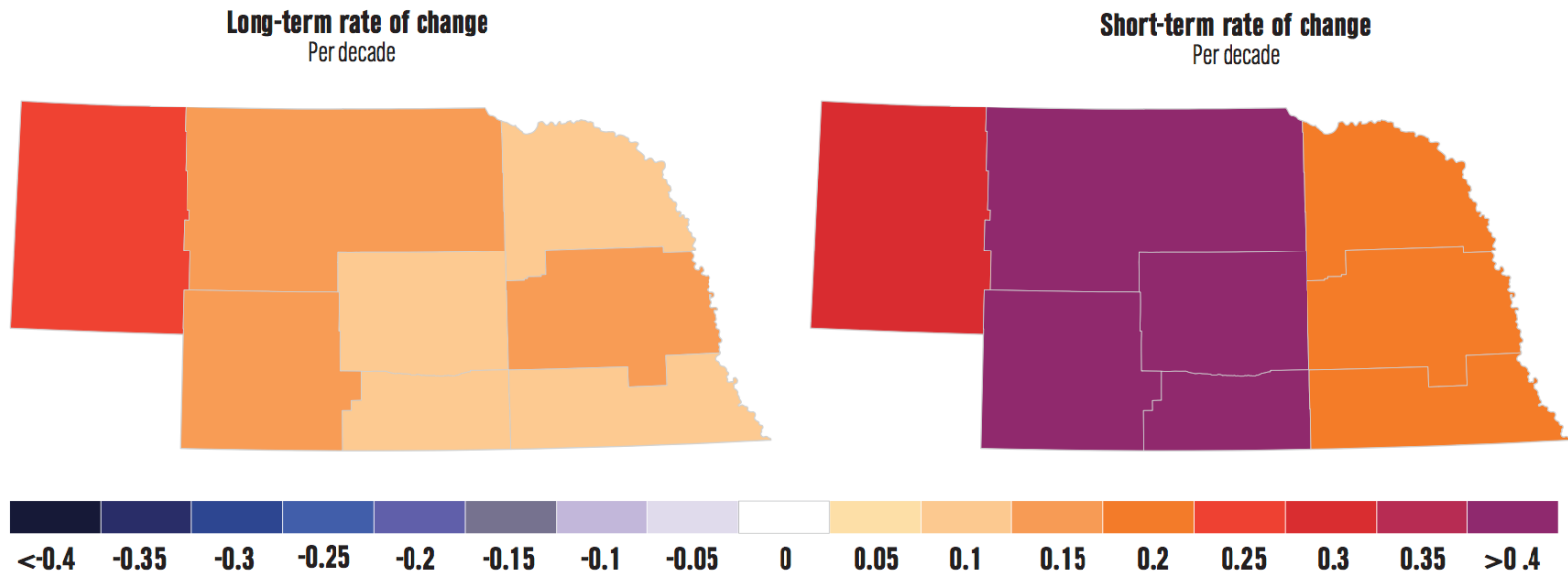


Nebraska's climate past

ANNUAL AVERAGE TEMPERATURE (°F)

NEBRASKA CLIMATE DIVISION TRENDS

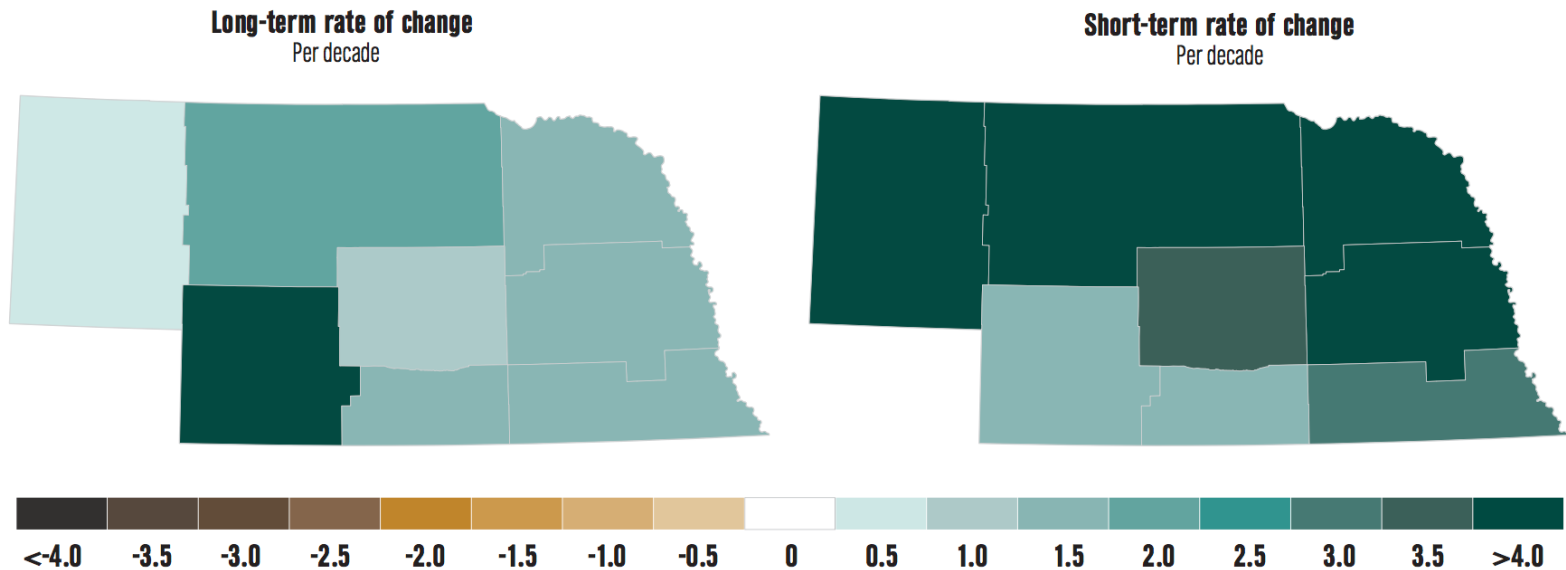
These maps show the climate trends over the long term and short term for the state's eight climate divisions based on industry-standard data from the National Centers for Environmental Information of the National Oceanic Atmospheric Administration. Long term trends use data collected between 1895 to 2016; short-term trends use data from 1987 to 2016.



Nebraska's climate past

ANNUAL PRECIPITATION (IN) NEBRASKA CLIMATE DIVISION TRENDS

These maps show the climate trends over the long term and short term for the state's eight climate divisions based on industry-standard data from the National Centers for Environmental Information of the National Oceanic Atmospheric Administration. Long term trends use data collected between 1895 to 2016; short-term trends use data from 1987 to 2016.



Nebraska's climate past

- Details of the trends matter. Timing and location are everything.

Monthly climate trend data for Nebraska

Per decade rate of change, Long (1895 – 2016), Short (1987 – 2016)

| | Avg Temperature | | Min Temperature | | Max Temperature | | Precipitation | |
|-----------|-----------------|-------|-----------------|-------|-----------------|-------|---------------|-------|
| | Long | Short | Long | Short | Long | Short | Long | Short |
| January | 0.24 | -0.10 | 0.27 | 0.30 | 0.20 | 0.20 | -0.03 | -0.10 |
| February | 0.42 | -0.80 | 0.48 | -0.60 | 0.36 | -0.90 | -0.07 | 0.07 |
| March | 0.38 | 1.30 | 0.38 | 0.70 | 0.37 | 0.40 | 0.31 | -0.35 |
| April | 0.08 | 0.20 | 0.11 | 0.60 | 0.04 | -0.20 | 0.15 | 0.66 |
| May | 0.05 | -0.60 | 0.10 | -0.70 | 0.00 | -0.60 | 0.39 | 0.09 |
| June | 0.12 | 0.20 | 0.15 | 0.30 | 0.09 | 0.10 | 0.16 | 0.33 |
| July | 0.06 | 0.60 | 0.16 | 0.60 | -0.04 | 0.70 | -0.06 | -0.39 |
| August | 0.05 | 0.30 | 0.16 | 0.30 | -0.05 | 0.40 | -0.04 | 0.11 |
| September | 0.03 | 0.80 | 0.08 | 0.80 | -0.02 | 0.80 | -0.04 | -0.08 |
| October | 0.07 | 0.70 | 0.15 | 1.20 | -0.01 | 0.30 | 0.31 | 0.31 |
| November | 0.15 | 1.30 | 0.23 | 0.50 | 0.08 | 2.10 | 0.17 | -0.15 |
| December | 0.17 | -0.40 | 0.18 | -0.40 | 0.15 | -0.30 | -0.03 | 0.18 |
| Annual | 0.10 | 0.30 | 0.20 | 0.30 | 0.10 | 0.40 | 0.12 | 0.67 |

Nebraska's climate future

Projected effects of Nebraska's changing climate.

Effect

Longer growing season
Warmer summers
More extreme hot days
Wetter spring
More extreme rain events
Higher cooling degree days
Lower heating degree days
More frequent large hail

Impact

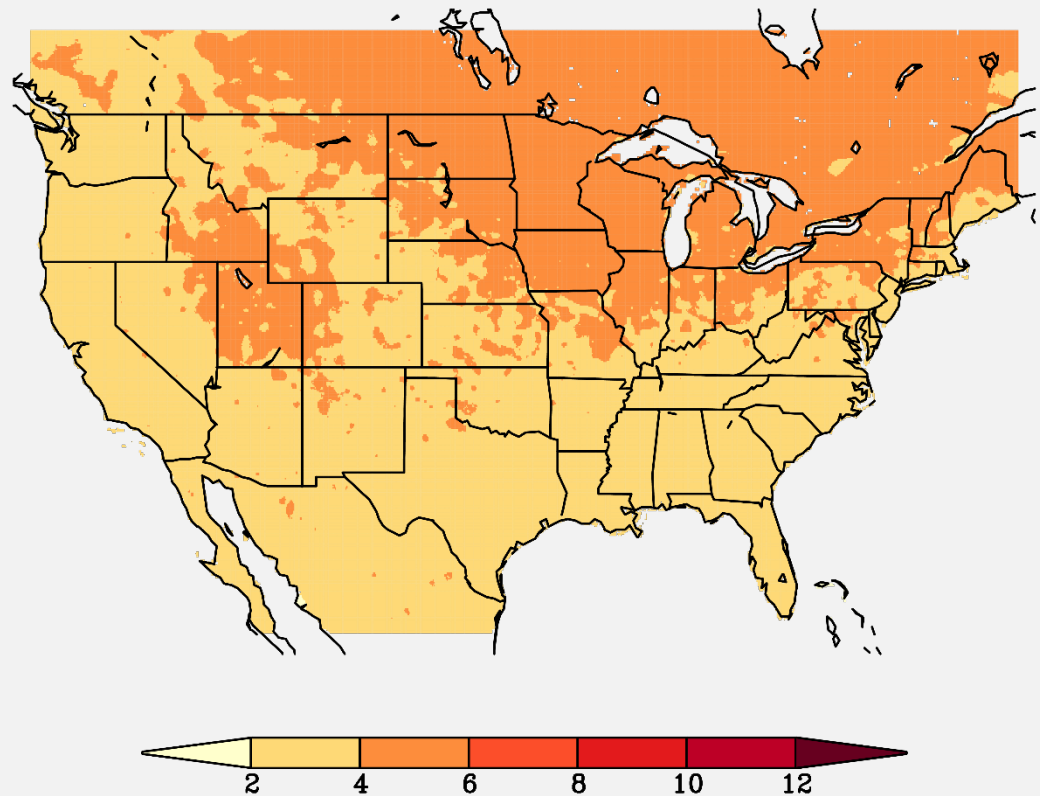
More evaporative demand
Increased water requirement
Crop, livestock stress
Decreased days for field work
Increased runoff/soil erosion
Shifting energy demands
Increased damage potential

Nebraska's climate future

- Temperatures expected to be 2 – 5°F warmer than what they are now.
- Rate of warming will continue to increase.

Lower emissions scenario (RCP 4.5)
2036-2065 compared to 1976-2005.

Change in daily mean temperature by mid 21st century, Deg F

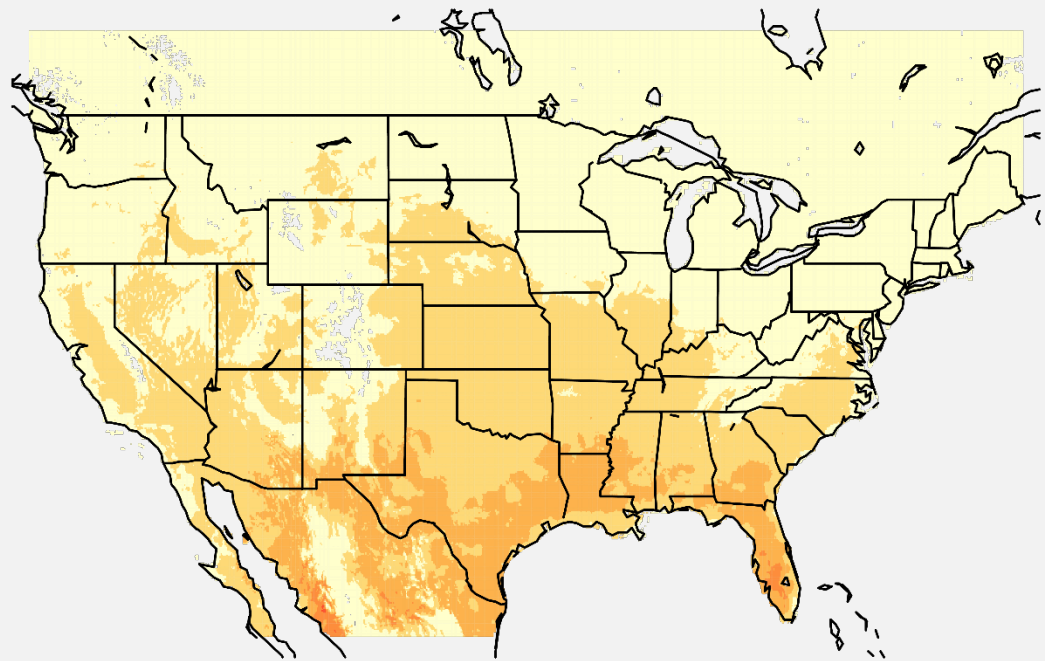


Nebraska's climate future

- Frequency of extreme warm days (above 95°F) will double.
- Frequency of extreme cold days will reduce by half.

Lower emissions scenario (RCP 4.5)
2036-2065 compared to 1976-2005.

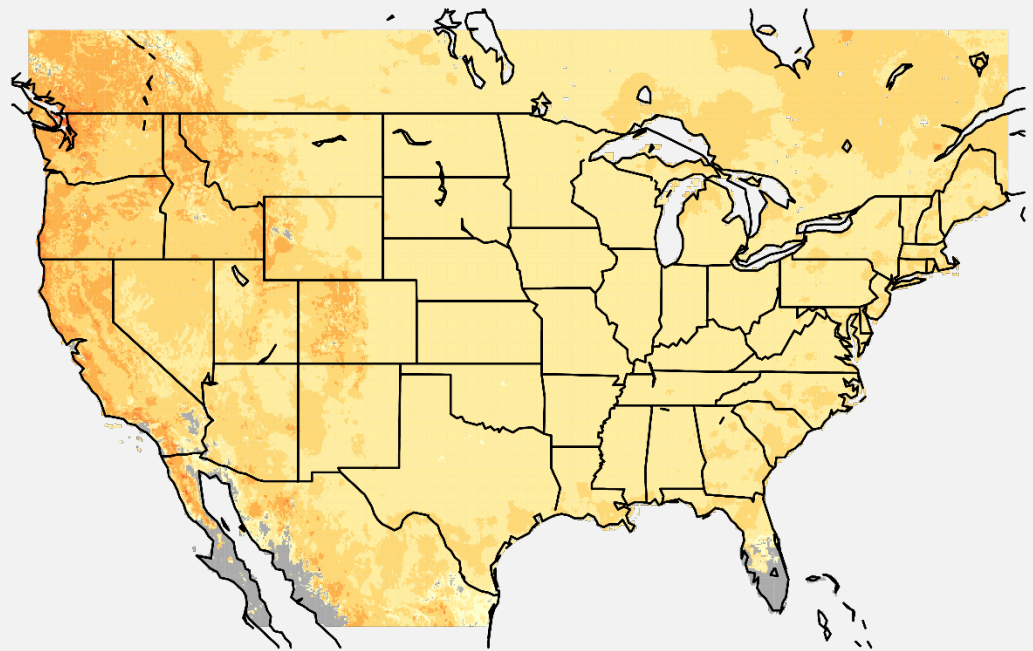
Change in annual #days Tmax > 95F by mid 21st century



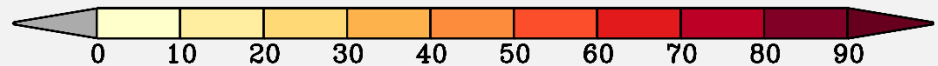
Nebraska's climate future

- Growing season will lengthen by several weeks.
- GDDs will increase by 25% (~ 1000 units).

Change in growing-season by mid 21st century, day



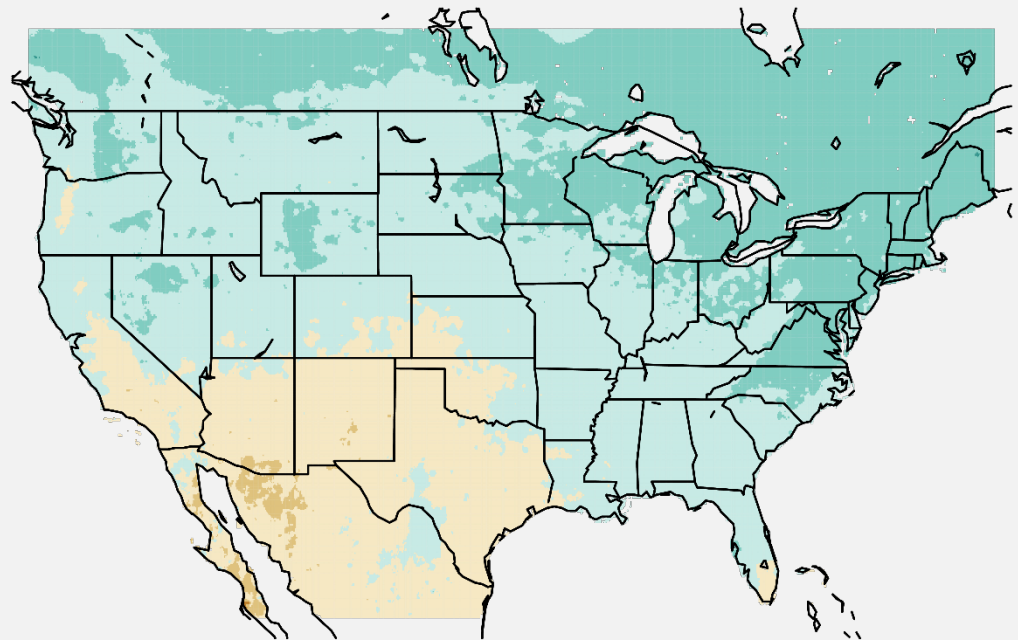
Lower emissions scenario (RCP 4.5)
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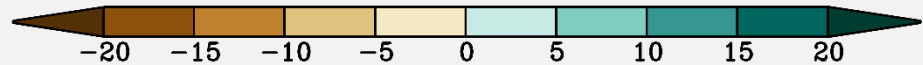
Nebraska's climate future

- We can expect the wetting trend to continue.
- Changes in timing and frequency of events will occur.

Change (%) in annual total precip by mid 21st century



Lower emissions scenario (RCP 4.5)
2036-2065 compared to 1976-2005.



Nebraska's climate future

Change (%) in annual #days > 1 inch by mid 21st century

- Seasonal precipitation shifts:

Winter, spring

Fall

Summer

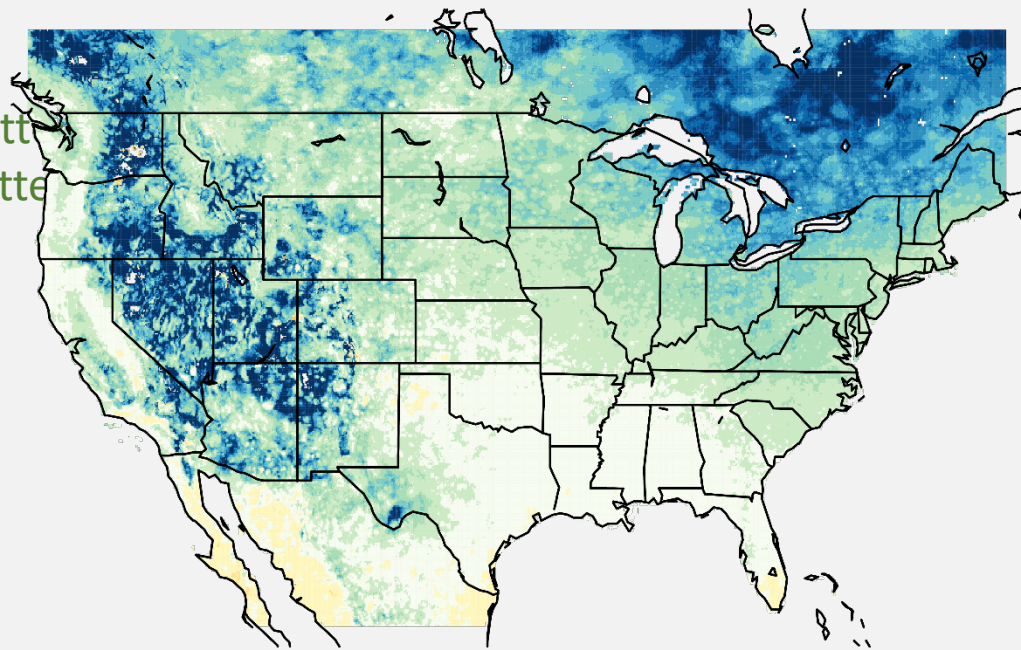
10% drier

20% wetter

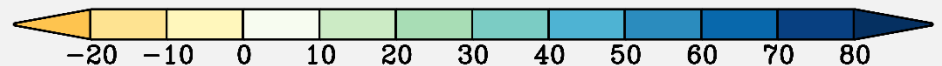
5% wetter

- More heavy rain events.

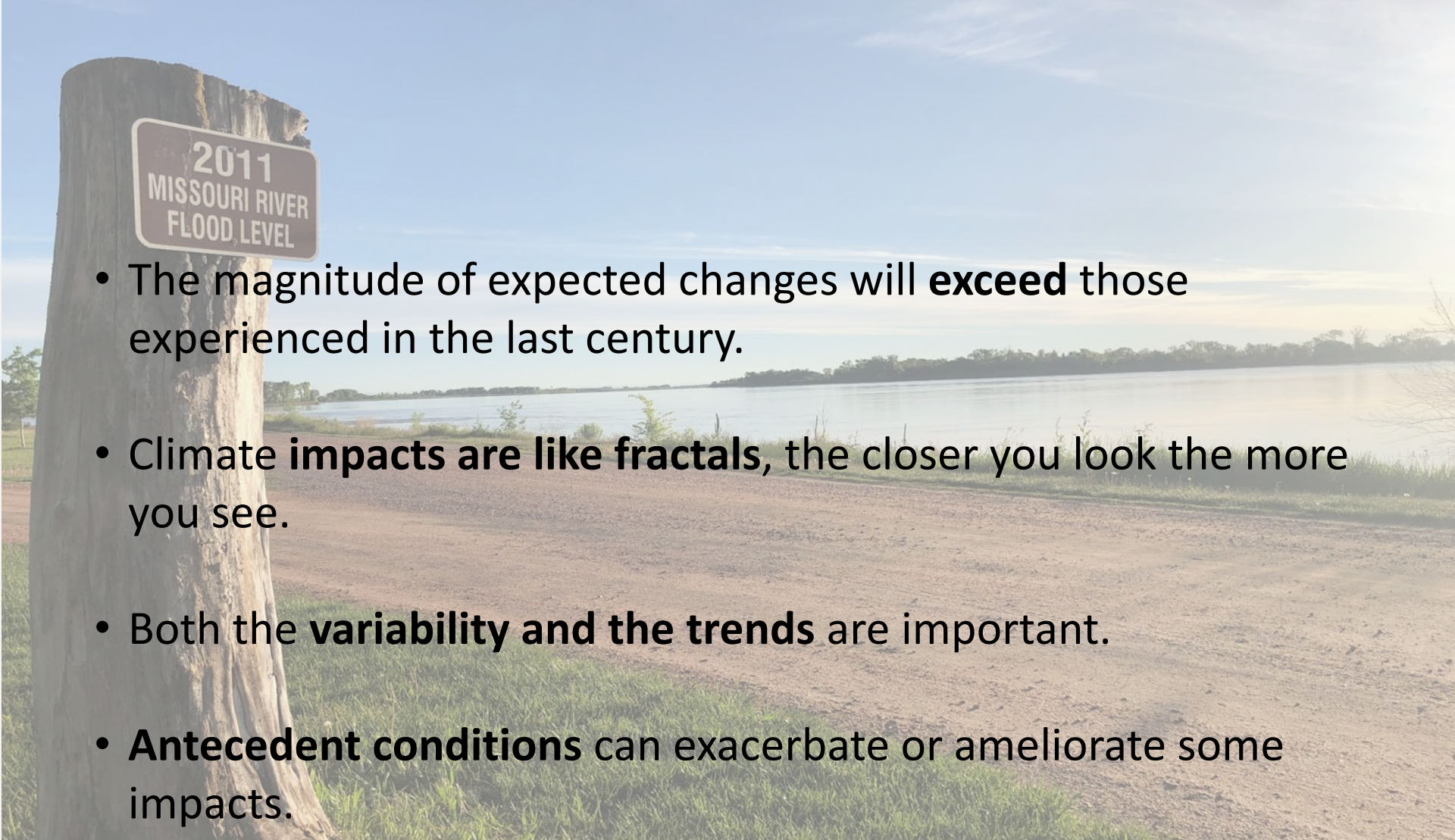
- Less mountain snowpack, earlier melt.



Lower emissions scenario (RCP 4.5)
2036-2065 compared to 1976-2005.



Nebraska's climate future

- 
- The magnitude of expected changes will **exceed** those experienced in the last century.
 - Climate **impacts are like fractals**, the closer you look the more you see.
 - Both the **variability and the trends** are important.
 - **Antecedent conditions** can exacerbate or ameliorate some impacts.



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CLIMATE CHANGE AND TERRESTRIAL WILDLIFE

Olivia LeDee

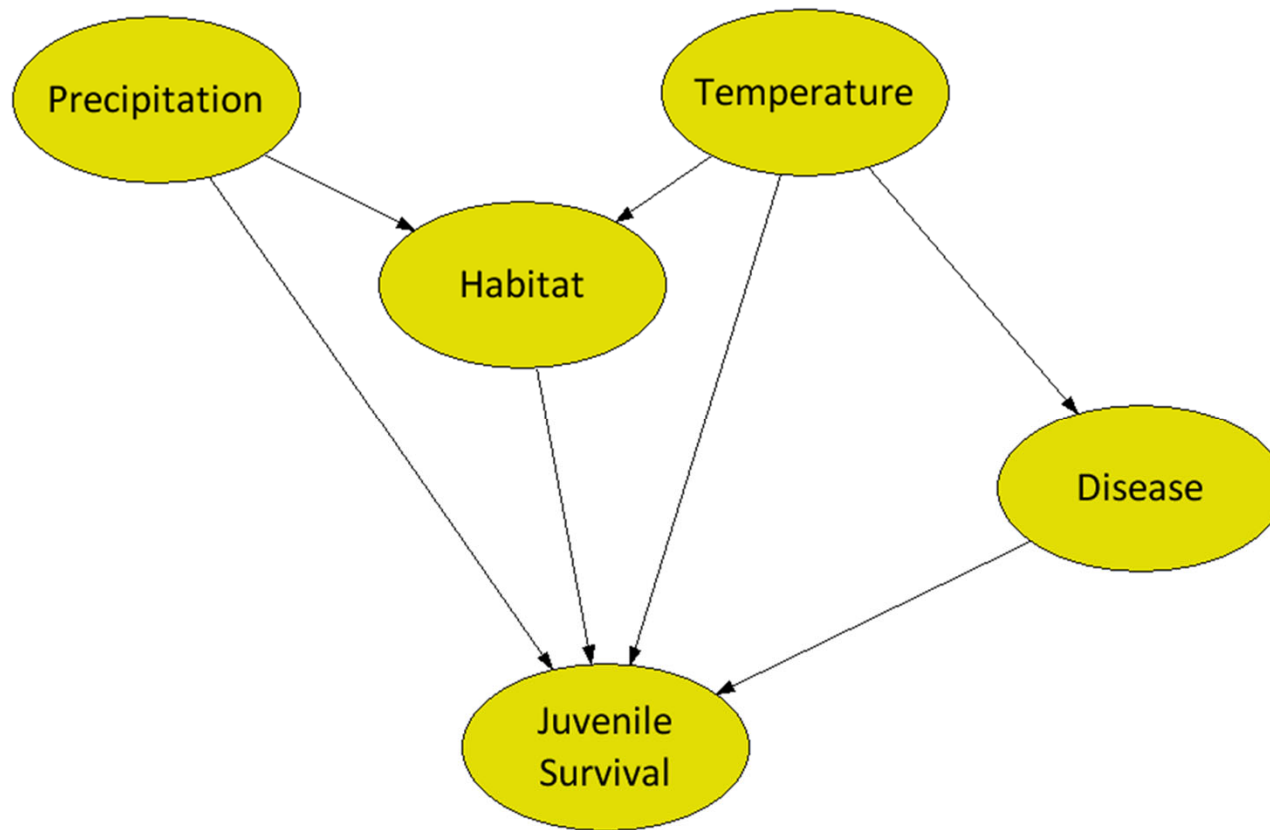
USGS Northeast Climate Adaptation Science Center

Pre-webinar, Nebraska Wildlife Workshop

5/29/2019



Direct and Indirect Effects



Direct Effects

Advance of
spring
conditions



Spatial shift
in climate
niche



Heat stress



Cold
exposure



Drought
stress



Flood stress



Indirect Effects

Altered interspecific interactions



Habitat change



Land-use change



Invasives



Pollution



Pest/Pathogen



Adaptive Capacity

“The ability of a species or population to cope with climatic changes”

- evolutionary adaptive capacity (i.e., the ability to evolve)
- dispersal ability
- phenotypic plasticity (e.g., behavioral adjustments)



European larger banded snails (*Cepaea nemoralis*), such as this one in Italy, with light colored shells are becoming more prevalent over time in the Netherlands.

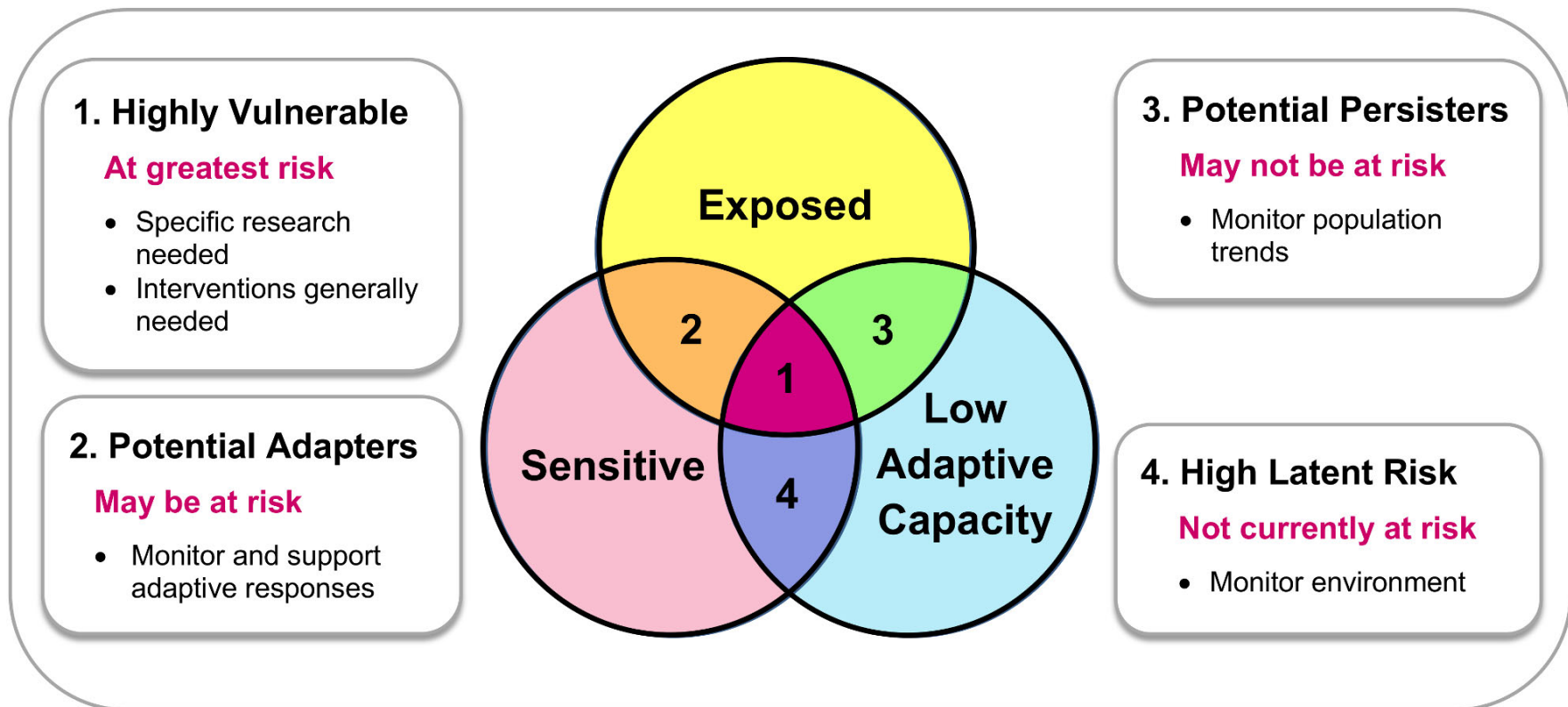
PHOTOGRAPH BY FRANCESCO TOMASINELLI, VISUALS UNLIMITED/CORBIS

How a Few Species Are Hacking Climate Change

Animals can be surprisingly adaptable—but can they change quickly enough?

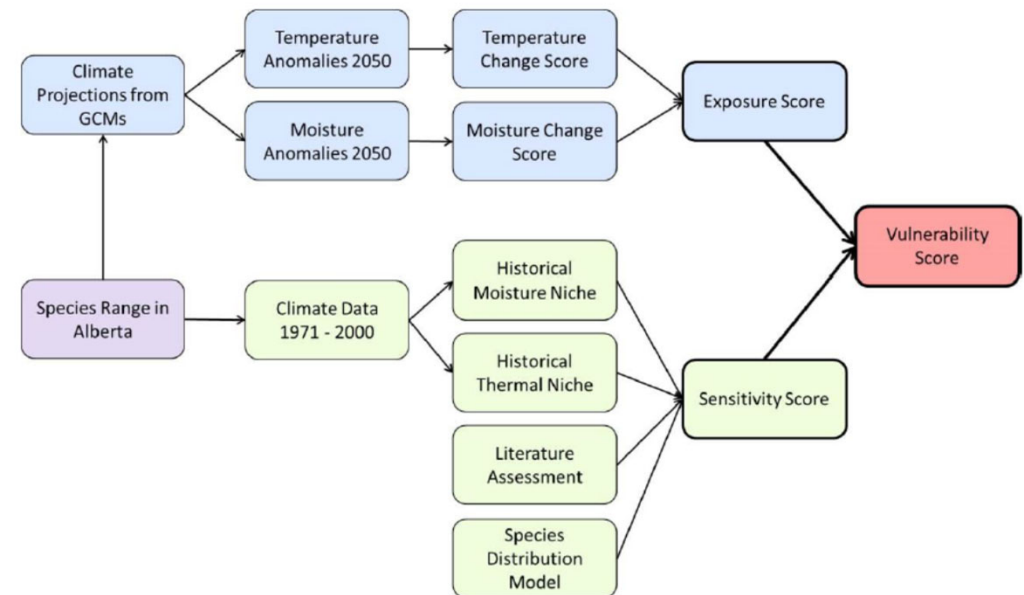
National Geographic

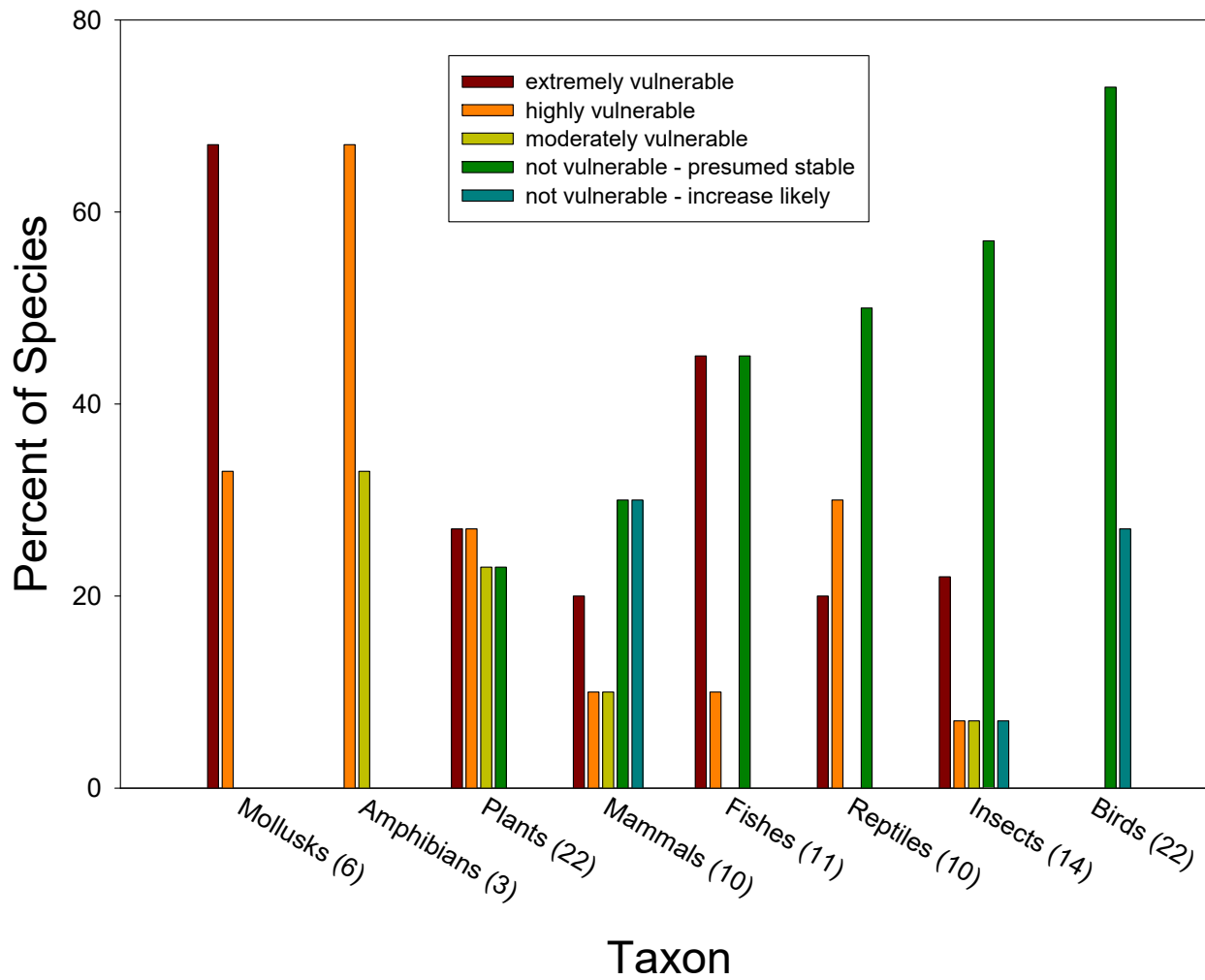
Vulnerability



Nature Serve Climate Change Vulnerability Index

- Trait-based
- Rapid, expert-based assessment
- Plants and animals
- Relative vulnerability
- Factors contributing to vulnerability
- 5 categories of vulnerability





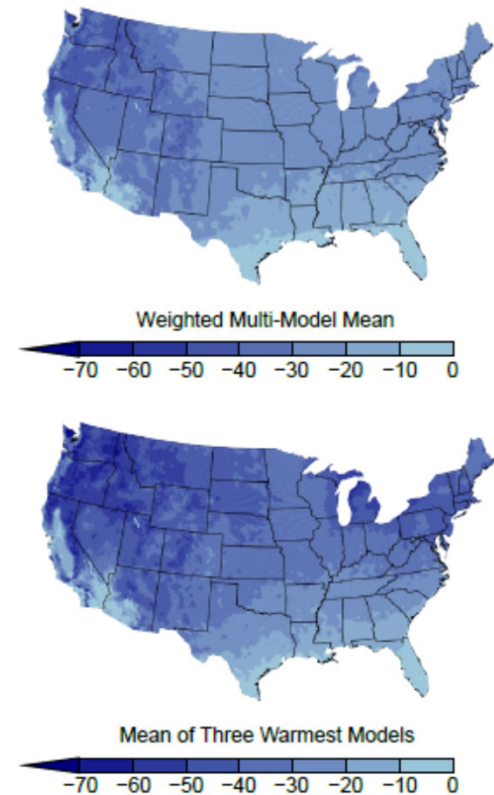


White-tailed Deer: Exposure

Severe winter as the “Grim Reaper”

- Winter Severity Index: Snow depth and extreme cold
- Foraging, movement, predation
- Number of days with a minimum temperature below freezing is projected to decrease 20–30 days (mid-century RCP 8.5) scenario
- Projections for reduced annual snowfall, with a transition to more winter precipitation as rain, faster snow melt, and a decrease in the number of days with a minimum snowpack of 1 cm by 5 (portions of IL and IN) to 60 (portions of WI and MI) days

Projected Change in Number of Days Below 32°F
Mid 21st Century, Higher Scenario (RCP8.5)

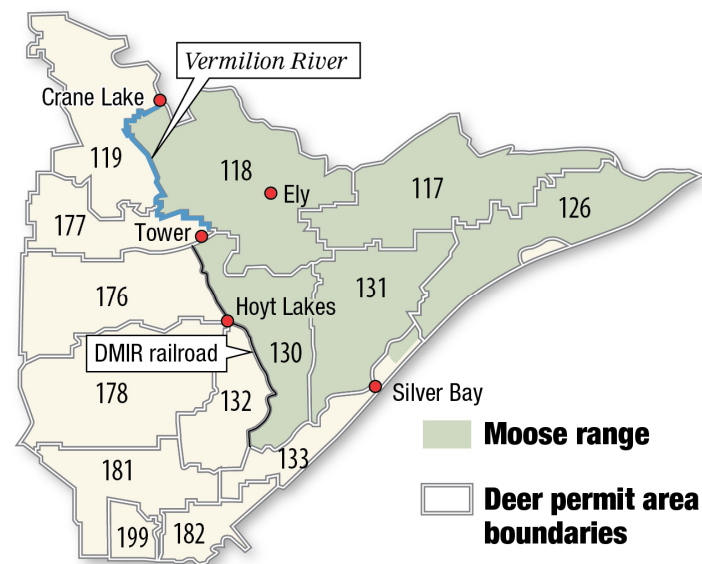


White-tailed Deer: Response

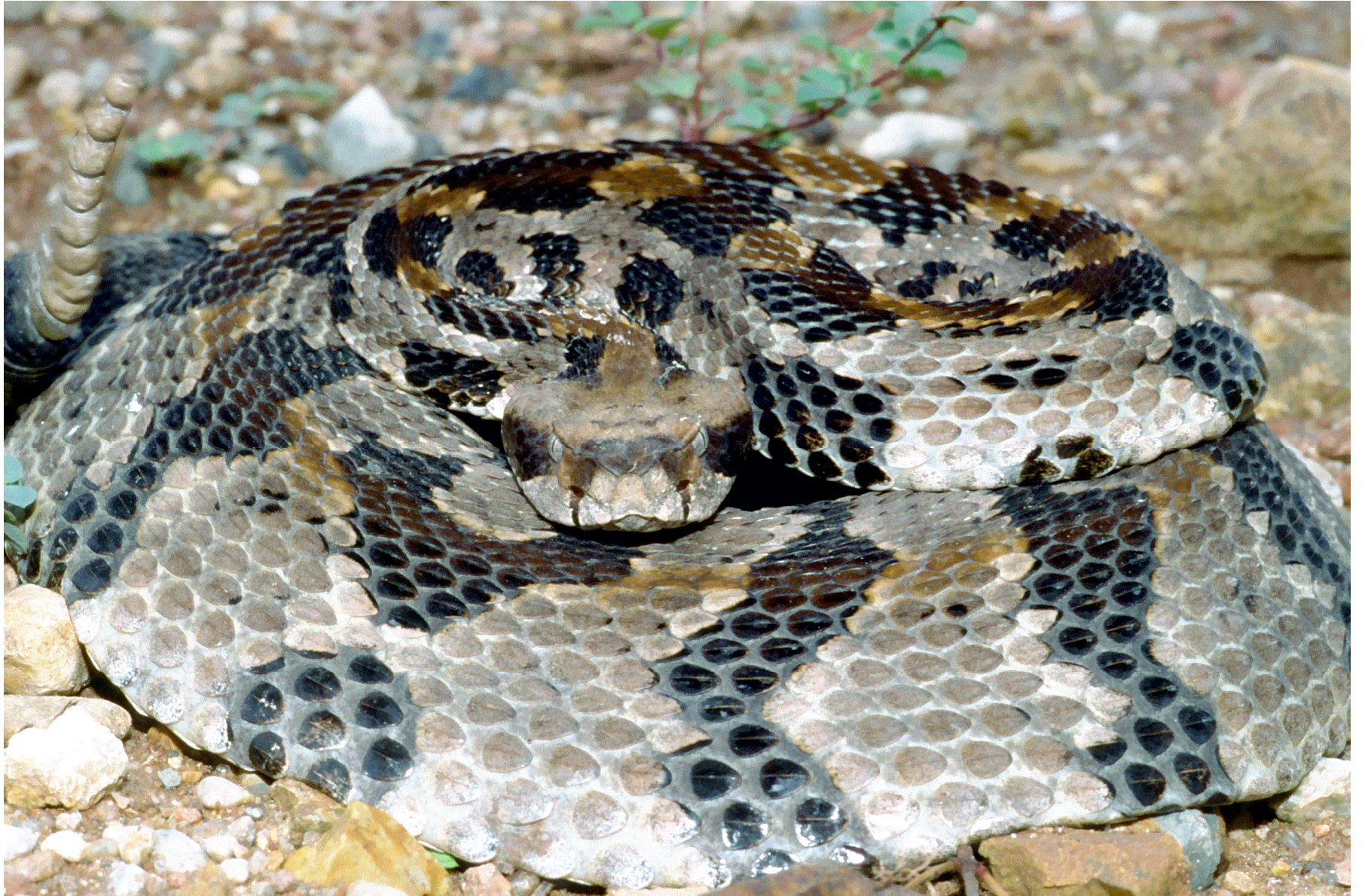
| Observed or projected physical changes | Potential effects on deer or their habitats |
|--|---|
| Increasing temperature or decreasing winter severity | Increased abundance and condition overwinter Habitat: increased oak abundance, leading to increased mast production and a higher carrying capacity |
| Increasing lake effect snow | Decreased or stable overwinter survival |
| Increased precipitation in spring | Increased fawn survival |
| Overall | Deer likely to expand range and increase in abundance |

White-tailed Deer: Management

- Increase harvest goals
- Spatial and temporal regulations
- Depredation management
- Limit food plots
- Forest management- bud caps, fencing



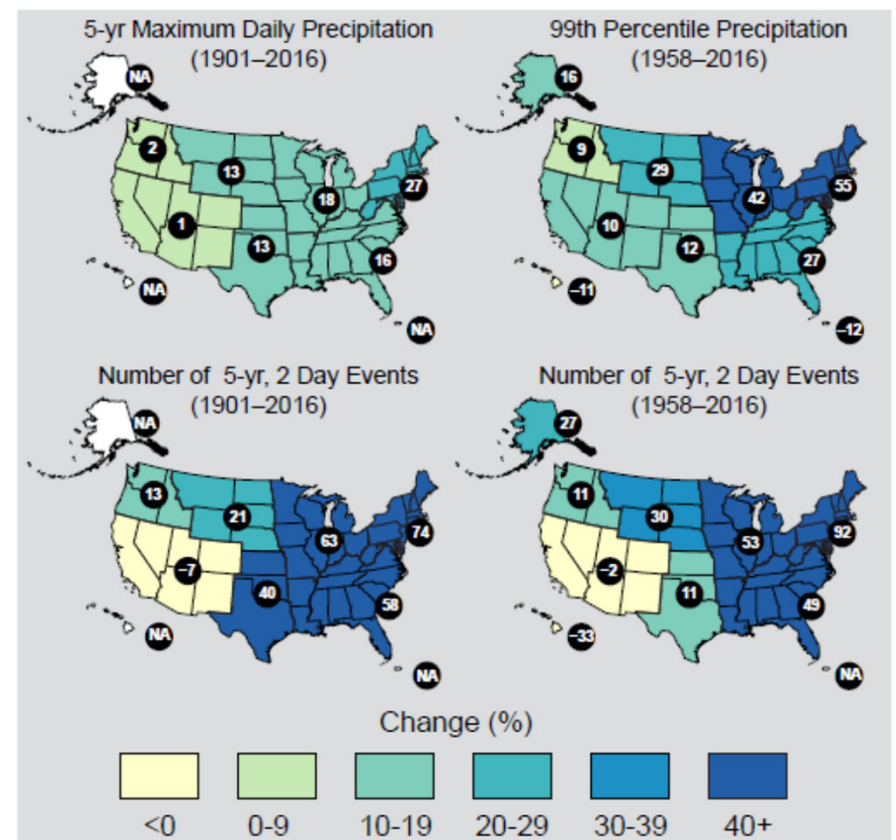
Duluth News Tribune



Timber Rattlesnake: Exposure

Extreme precipitation,
flooding, humidity

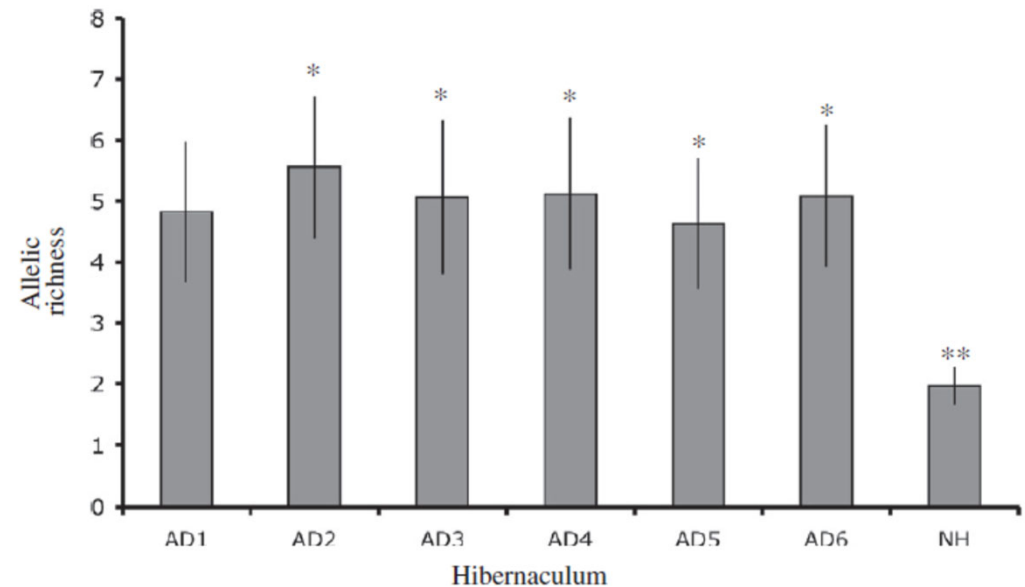
- Direct mortality
- Fungal disease



Timber Rattlesnake: Response

New England:

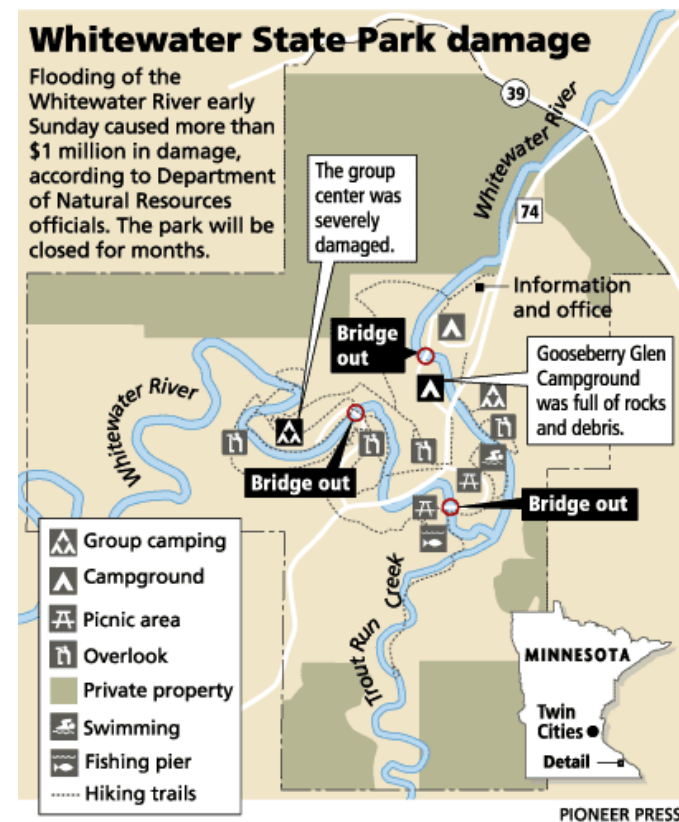
- Fungal outbreak during abnormally wet conditions
- Interacting effects of habitat fragmentation, inbreeding depression, and climate change
- Extinction vortex



Timber Rattlesnake: Response

Minnesota:

- 2007 extreme rainfall event
- Local extirpation



Timber Rattlesnake: Management

- Remove barriers to movement
- Translocate for genetic diversity
- Captive rearing
- Emphasize protection for multiple population





Henslow's Sparrow: Exposure

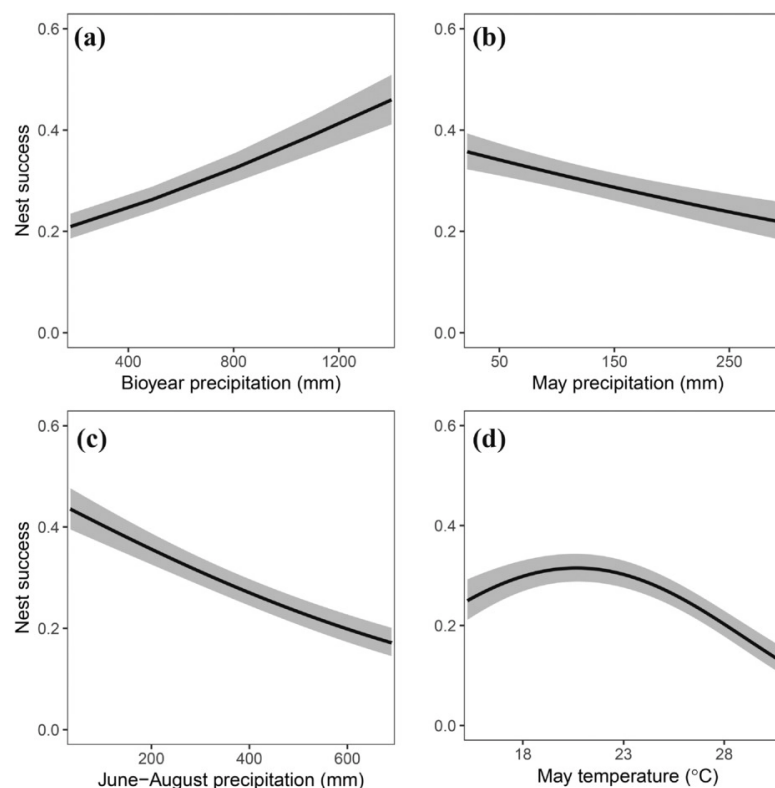
Grassland bird ranges are constrained by gradients in climate

Breeding season precipitation and temperature

- Nest success

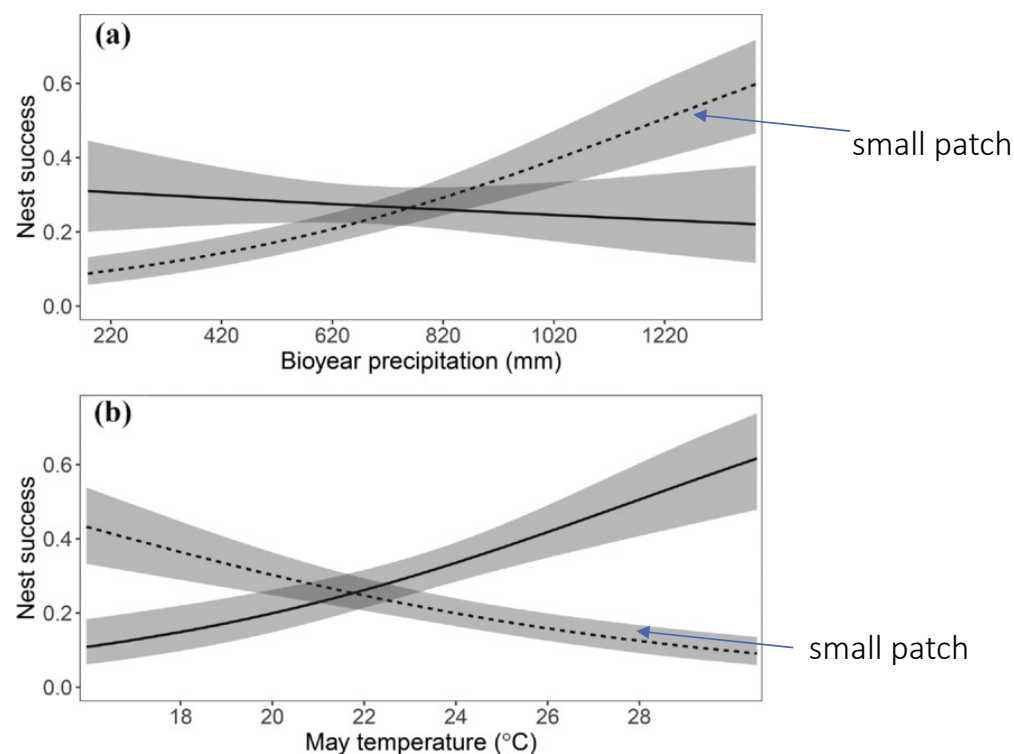
Growing season precipitation

- Vegetation



Henslow's Sparrow: Response

- Grassland patch size moderates the effects of precipitation and temperature
- Grassland primary productivity important
- Vulnerable in small fragments



Henslow's Sparrow: Management

- Increase patch size
- Invasive species removal
- Prescribed burns
- Work with private landowners



