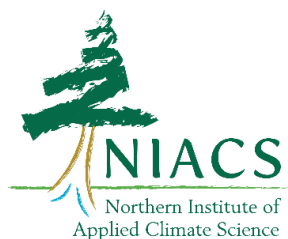




United States Department of Agriculture  
Northern Forests Climate Hub

# The Adaptation Workbook and Wildlife Adaptation Menu: Structured flexibility for management decisions



**MIDWEST**  
Climate Adaptation  
Science Center

# Acknowledging Barriers



## Climate change science is not being used

- Mismatches in scale & scope of science
- Science doesn't reflect the needs of managers



## Managers feel overwhelmed and isolated

- Managers faced with huge volume of research
- Individual attempts at adaptation are not communicated
- Climate change can be an intimidating topic



## There's not a shared understanding of "success"

- Best practices haven't been established
- One-size-fits-all prescriptions are non-starters

# Northern Institute of Applied Climate Science

Climate

Carbon

The Northern Institute of Applied Climate Science (NIACS) develops synthesis products, fosters communication, pursues science, and provides technical assistance in climate change adaptation and carbon management.

**Multi-institutional collaborative chartered by USDA Forest Service, universities, non-profit organizations, and a tribal commission**





## ***Project Goals:***

- Synthesize peer-reviewed recommendations for wildlife management under climate change
- Organize climate adaptation actions for wildlife at a scale and resolution that can inform on-the-ground management
- Demonstrate how this resource can help managers!

# Adaptation Menus of Strategies and Approaches

A “menu” of **possible adaptation actions** that allows you to decide what is ***most relevant for a particular location and set of conditions.***

*Brunch Classics*

|  |    |  |    |
|--|----|--|----|
| Lemon Ricotta Pancakes<br>Whipped Mascarpone Maple, Berries                          | 15 | AJ's Omelet<br>Fontal Cheese, Spinach, Mushrooms                             | 14 |
| Cornflake Crusted French Toast<br>Berries, Maple Syrup                               | 15 | Eggs Florentine<br>Spicy Capicola, House-Made Cheddar Biscuit, Spinach       | 15 |
| Bacon, Egg & Cheese<br>Bacon, Two Eggs, Taleggio Cheese, Cabbage                     | 14 | Porchetta Hash<br>Poached Egg, Calabrian Chili Hollandaise                   | 16 |
| Avocado Toast<br>Poached Eggs, Tomatoes, Chili Flakes, Sea Salt                      | 15 | Chia Pudding<br>Chia Seeds, Toasted Coconut, Banana, Strawberry              | 14 |
| Chicken Parmigiana<br>Spicy Marinara, Fresh Mozzarella                               | 22 | Farmhouse Breakfast<br>Two Eggs, House-Made Cheddar Biscuit, Chicken Sausage | 14 |
| Squid Ink fettuccine Vongole<br>Little Neck Clams, Garlic, White Wine, Butter, Chili | 22 | Chicken Kale Caesar<br>Chicken, Kale, Croutons                               | 16 |

*Create Your Own Pasta*

|  |    |   |    |
|--|----|---|----|
| <i>shapes</i>  |    | <i>glazes</i>   |    |
| Rigatoni<br>Semolina, All-Purpose Flour, Olive Oil                     | 14 | Marinara<br>San Marzano tomatoes, Garlic, White Wine, Basil, Chili          |    |
| Cavatelli<br>All-Purpose Flour, Durum Flour, Eggs, Ricotta             | 15 | Arrabiata<br>All-Purpose Flour, Durum Flour, Eggs, Ricotta                  | +1 |
| Tagliatelle<br>All-Purpose Flour, Durum Flour, Eggs                    | 15 | Broken Meatball<br>House Tomato Sauce with the Addition of Broken Meatballs | +4 |
| Gluten-Free Rigatoni<br>Gluten-Free All-Purpose Flour, Olive Oil, Eggs | 16 | Sunday Sauce<br>House Tomato Sauce with Short Rib, Sausage, Veal            | +4 |
| Spaghetti<br>Semolina, Durum Flour, Olive Oil                          | 15 | Roasted Garlic Pecorino<br>Semolina, Durum Flour, Olive Oil                 | +2 |
| Four Cheese Herb Ravioli<br>Fontal, Ricotta, Parmesan, Pecorino        | 18 | Carbonara<br>Pancetta, Eggs, Peas, Pecorino                                 | +3 |

*Sides*

|                        |    |
|------------------------|----|
| Pecorino Truffle Fries | 8  |
| Potato Hash            | 6  |
| Bacon                  | 6  |
| Turkey Sausage         | 6  |
| Field Greens           | 7  |
| Two Eggs Any Style     | 6  |
| Beignets               | 8  |
| Baked Goods            | 10 |

*Brunch Cocktails*

|  |       |
|--|-------|
| Bloody Mary<br>Vodka, Spiced Fresh DOP Tomato Juice, Horseradish           | 10/45 |
| Coitreau Spritz<br>Coitreau Spritz, Aperol, Crème de Peche, Sparkling Wine | 12/55 |
| Green Side<br>Ryka Vodka, Green Juice, Lemon                               | 12/55 |
| Morning Derby<br>Bourbon, Grapefruit, Ginger, Carrot Juice                 | 12/55 |
| Sangria<br>Red Wine, Fresh Fruit, Pisco, Crème de Peche                    | 10/45 |
| Firing Squad<br>Milagros Tequila, Coitreau, Fresh Lime, Grenadine          | 12/55 |
| Tall Mimosa<br>Ryka Vodka, Coitreau, Jake's Mimosa Juice, Sparkling Wine   | 12/55 |

# Why Menus Work

- Consistent “hierarchy” of general and specific ideas
- Connecting broad ideas to specific actions
- Document the **intent** of adaptation actions.
- Boost creativity!



# Adaptation Menu Development

- Lit review and synthesis
- Binning, organization
- Testing with managers
- Publication



# Adaptation Menu

## Published:

- Forestry
- Urban Forestry
- Forested Watersheds
- Tribal Perspectives
- Agriculture
- Forest Carbon Management
- Outdoor Recreation
- Non-Forested Wetlands
- Inland Glacial Lake Fisheries
- Wildlife Management
- Fire-Adapted Ecosystems
- Great Lakes Coastal Ecosystems

## In Preparation:

- Grasslands
- Ocean Coastal Ecosystems

## Menu of Adaptation Strategies and Approaches

*Developed for forests*

### Strategy 1: Sustain fundamental ecological functions.

- 1.1. Reduce impacts to soils and nutrient cycling.
- 1.2. Maintain or restore hydrology.
- 1.3. Maintain or restore riparian areas.
- 1.4. Reduce competition for moisture, nutrients, and light.
- 1.5. Restore or maintain fire in fire-adapted ecosystems.

### Strategy 2: Reduce the impact of biological stressors.

- 2.1. Maintain or improve the ability of forests to resist pests and pathogens.
- 2.2. Prevent the introduction and establishment of invasive plant species and remove existing invasive species.
- 2.3. Manage herbivory to promote regeneration of desired species.

### Strategy 3: Reduce the risk and long-term impacts of severe disturbances.

- 3.1. Alter forest structure or composition to reduce risk or severity of wildfire.
- 3.2. Establish fuelbreaks to slow the spread of catastrophic fire.
- 3.3. Alter forest structure to reduce severity or extent of wind and ice damage.
- 3.4. Promptly revegetate sites after disturbance.

### Strategy 4: Maintain or create refugia.

- 4.1. Prioritize and maintain unique sites.
- 4.2. Prioritize and maintain sensitive or at-risk species or communities.
- 4.3. Establish artificial reserves for at-risk and displaced species.

### Strategy 5: Maintain and enhance species and structural diversity.

- 5.1. Promote diverse age classes.
- 5.2. Maintain and restore diversity of native species.
- 5.3. Retain biological legacies.
- 5.4. Establish reserves to maintain ecosystem diversity.

### Strategy 6: Increase ecosystem redundancy across the landscape.

- 6.1. Manage habitats over a range of sites and conditions.
- 6.2. Expand the boundaries of reserves to increase diversity.

### Strategy 7: Promote landscape connectivity.

- 7.1. Reduce landscape fragmentation.
- 7.2. Maintain and create habitat corridors through reforestation or restoration.

### Strategy 8: Maintain and enhance genetic diversity.

- 8.1. Use seeds, germplasm, and other genetic material from across a greater geographic range.
- 8.2. Favor existing genotypes that are better adapted to future conditions.

### Strategy 9: Facilitate community adjustments through species transitions.

- 9.1. Favor or restore native species that are expected to be adapted to future conditions.
- 9.2. Establish or encourage new mixes of native species.
- 9.3. Guide changes in species composition at early stages of stand development.
- 9.4. Protect future-adapted seedlings and saplings.
- 9.5. Disfavor species that are distinctly maladapted.
- 9.6. Manage for species and genotypes with wide moisture and temperature tolerances.
- 9.7. Introduce species that are expected to be adapted to future conditions.
- 9.8. Move at-risk species to locations that are expected to provide habitat.

### Strategy 10: Realign ecosystems after disturbance.

- 10.1. Promptly revegetate sites after disturbance.
- 10.2. Allow for areas of natural regeneration to test for future-adapted species.
- 10.3. Realign significantly disrupted ecosystems to meet expected future conditions.



To be used in the Adaptation Workbook decision-support framework -- Swanston et al. 2016. Forest Adaptation Resources: climate change tools and approaches for land managers, 2nd edition <http://www.treearch.fs.fed.us/pubs/52760> **More information can be found at** [www.forestadaptation.org/strategies](http://www.forestadaptation.org/strategies)

Adaptation menus available at: [www.forestadaptation.org/strategies](http://www.forestadaptation.org/strategies)

# Adaptation Workbook

- Flexible 5-step workbook designed for a variety of landowners with diverse goals
- Works at project level
- Centers around manager's expertise, and judgement
- Creates **clear rationale** for actions by connecting them to **broader adaptation ideas**
- **Does not make recommendations**
- **Includes:**
  - Adaptation workbook
  - Adaptation strategies for different resource areas (menus)

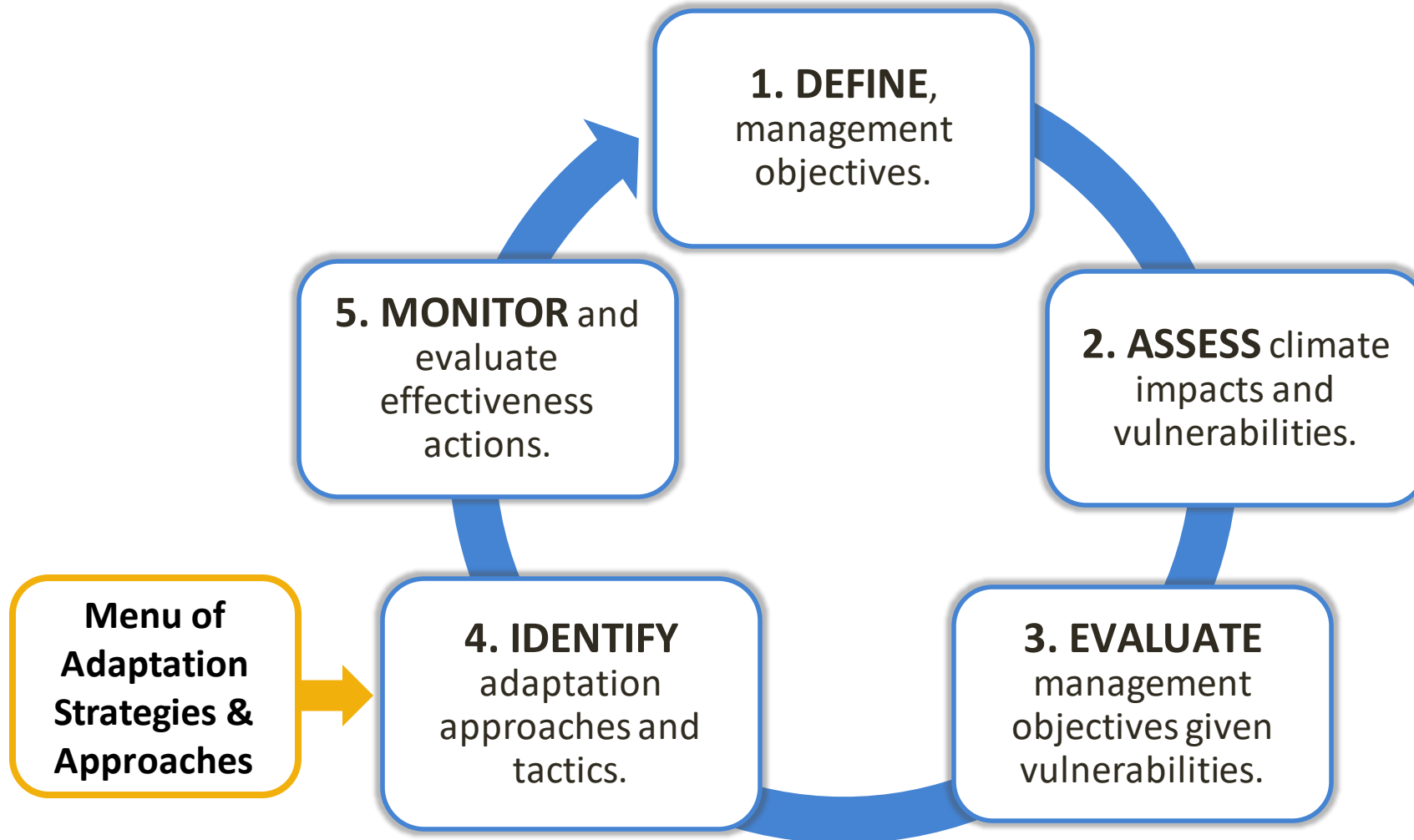


Swanston et al. 2016  
(2<sup>nd</sup> edition)



# Adaptation Workbook: Decision-support tool

A workbook process provides “**structured flexibility**”



# Adaptation Workbook

*Systematic and designed for transparency.*

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

# Adaptation Demonstrations

Real-world examples of climate-informed forest management.

More than 500 projects have used the **Adaptation Workbook** to consider climate change and identify adaptation actions.

More than 170 are described online



Adaptation case studies: [www.forestadaptation.org/demos](http://www.forestadaptation.org/demos)

# Wildlife Management Adaptation Menu

## *Target Audience:*

- Terrestrial wildlife managers
- Focus on **population management** as well as **habitat management** (2 halves of the menu)



# Wildlife Management Adaptation Menu

Literature search: climate change/global warming and wildlife/biodiversity

>2100 results



Exclude non-wildlife articles

>1300 results



Review for management recommendations

>500 articles

>2300 recommendations

# Literature Review Results



***Preparing wildlife for climate change: how far have we come?*** LeDee et al. 2020, JWM, <https://doi.org/10.1002/jwmg.21969>

| Recommendation   | Count       |
|--|-------------|
| Establish and enhance protected areas                                  | 596         |
| Maintain or create optimal cover                                       | 209         |
| Promote a 'wildlife-friendly' landscape matrix                         | 276         |
| Facilitate shifts in the geographic range of the species               | 124         |
| Reduce existing threats  | 119         |
| Prevent or limit human alteration of habitat                           | 115         |
| Maintain or restore water resources                                    | 107         |
| Maintain metapopulation processes                                      | 106         |
| Maintain a viable, socially acceptable population size                 | 93          |
| Sustain positive and reduce negative interspecific/biotic interactions | 93          |
| Other  | 72          |
| Maintain or mimic disturbance regimes                                  | 66          |
| Enhance genetic diversity  | 45          |
| Prevent or limit human disturbance                                     | 41          |
| Maintain or create adequate food sources                               | 35          |
| Take no action/laissez faire   | 30          |
| Maintain or enhance reproduction                                       | 26          |
| Prevent or control wildlife disease                                    | 26          |
| Plan for and reduce human-wildlife conflict                            | 24          |
| Maintain or enhance survival   | 14          |
| <b>Total</b>   | <b>2306</b> |

# Pilot Workshops

- Michigan, 2018
- Wisconsin, 2019
- Nebraska, 2019





# Wildlife Adaptation Menu: Strategies

## Populations

- 1) Maintain and enhance **genetic diversity**
- 2) Establish and maintain **connectivity** between populations
- 3) Facilitate **shifts in the geographic range** of the species in anticipation of future conditions
- 4) Manage interspecific and biotic **interactions**
- 5) Maintain a sustainable **population size** by managing reproduction, survival, and dispersal
- 6) Adjust **harvest regulations** to manipulate populations
- 7) Plan for and reduce human **disturbance** and human-wildlife **conflict**

## Habitat

- 8) Restore and maintain sources of **food, water, and cover** as components of habitat
- 9) Adjust management of food, water, and cover to align with expected **future conditions**
- 10) Establish and enhance **protected areas** or habitat reserves
- 11) Promote wildlife habitat conservation on lands **outside of protected areas**

## Xtra

- 12) Intentionally chose to **take no action**
- 13) Engage **human communities** in wildlife conservation

# Wildlife Adaptation Menu: Approaches and Tactics

## *Example Approaches and Tactics*

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

#### **3.1. Establish corridors and minimize barriers to movement to new suitable habitats**

*Tactic: Create highway crossing structures that span barriers to northward movement.*

*Tactic: Connect mature northern or boreal forest habitats that are oriented north-south across the landscape to facilitate northward migration of northern flying squirrels.*

#### **3.2. Prepare suitable habitat in anticipation of future introduction, reintroduction, or natural range shift of a species**

*Tactic: Provide technical assistance to enable private landowners to create grassland habitat for quail and other grassland birds.*

*Tactic: Identify and improve anticipated future stopover or wintering habitat for migratory birds.*

#### **3.3. Move and release individuals into a population where conditions are now suitable and expected to improve**

*Tactic: Release wild turkeys from mid-Atlantic states into New England.*

*Tactic: Move eastern tiger salamanders from populations in south-central Minnesota to populations in north-central Minnesota, where conditions may be more suitable as the prairie-forest border shifts to the northeast.*

# Wildlife Adaptation Menu: Approaches and Tactics

## *Example Approaches and Tactics*

### **8. Restore and maintain sources of food, water, and cover as components of habitat**

#### **8.4. Manage and create suitable microhabitats and microclimates**

*Tactic: Protect and create vernal pools in mesic forests.*

*Tactic: Implement forest management actions that promote diverse canopy cover, light environments, and down woody habitat.*

#### **8.5. Enhance primary food sources for specialist climate-sensitive species**

*Tactic: Promote lupine species for Karner blue butterfly habitat*

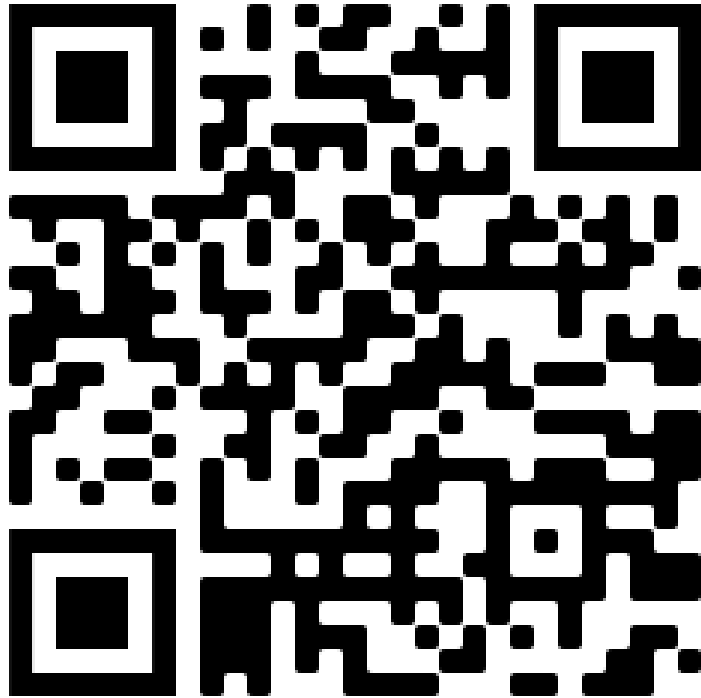
*Tactic: Promote milkweed along roadsides, utility corridors, and grasslands for monarch butterfly habitat.*

#### **8.7. Create or maintain replicated sources of food, water, and cover in a variety of locations across the landscape**

*Tactic: Manage for early-successional aspen forests in multiple locations adjacent to winter deer yards.*

*Tactic: Restore pothole wetlands and riparian oxbows in agricultural landscapes to provide redundant waterfowl habitats.*

# Wildlife Adaptation Menu



***A menu of climate change adaptation actions for terrestrial wildlife management.*** Handler et al. 2022, WSB, <https://doi.org/10.1002/wsb.1331>

May 2021 DRAFT – Submitted for publication

## Menu of Adaptation Strategies and Approaches

*Developed for wildlife management*

### Adaptation Strategies for **Population** Management

#### Strategy 1: Maintain and enhance genetic diversity.

##### Approaches

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

#### Strategy 2: Establish and maintain connectivity between populations.

##### Approaches

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

#### Strategy 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

#### Strategy 4: Manage interspecific and biotic interactions.

##### Approaches

- 4.1. Increase or protect existing biodiversity, for example species richness, functional diversity, and phylogenetic diversity
- 4.2. Detect and remove non-native invasive species
- 4.3. Manage predator populations
- 4.4. Restore historic trophic linkages
- 4.5. Maintain functional groups or keystone species that help sustain ecosystem functions
- 4.6. Reintroduce extirpated species or functional groups
- 4.7. Manage extant and emerging diseases

# Remember Last Month? (Dawn Magness)

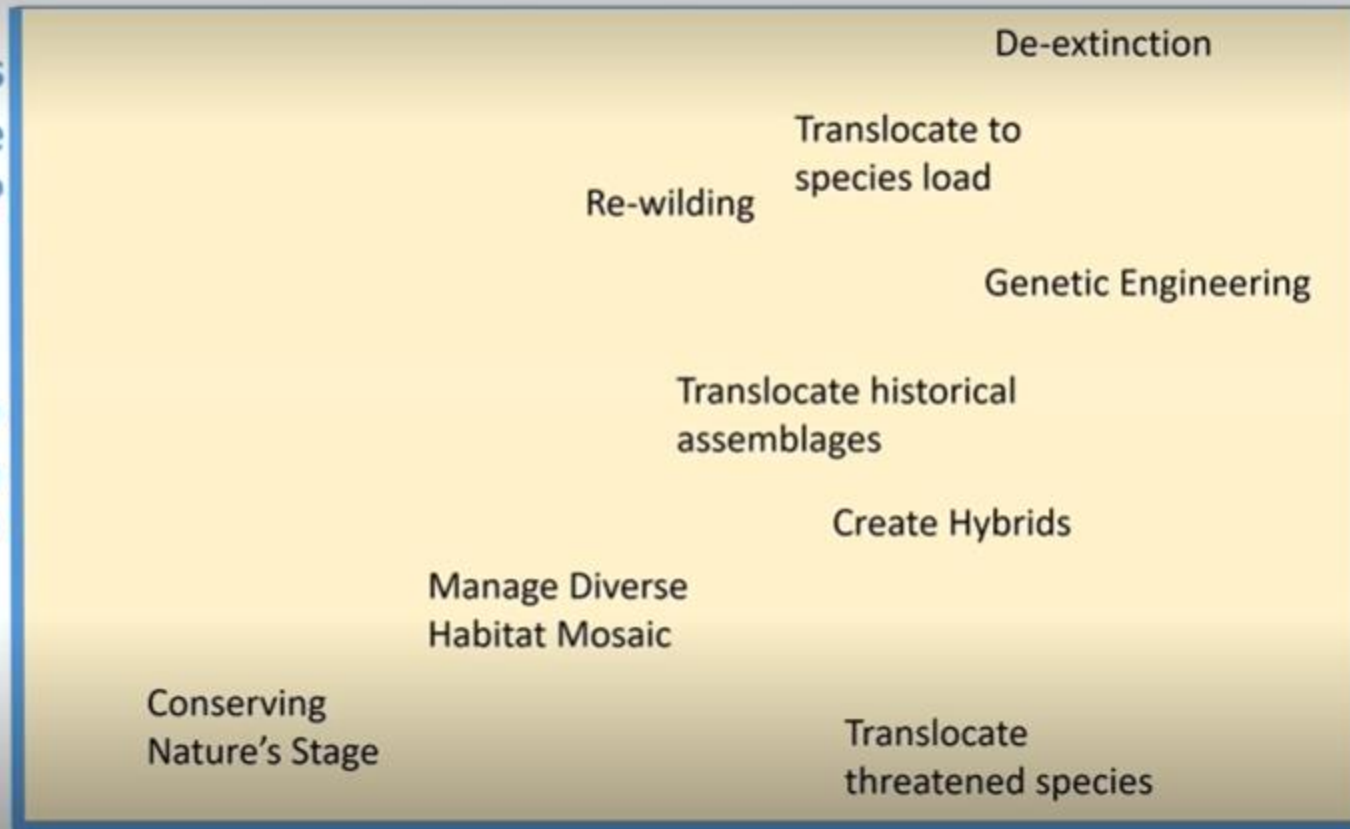
Actions to promote gains can be controversial and novel

Well established is the theory and methods?

Does this even make sense?

How do we do this?

Know how to do it



We can trust nature

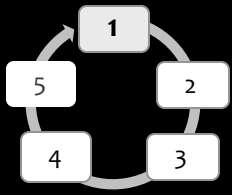
We must help Nature

What is the philosophy about the natural world?

# Wildlife Adaptation Menu: Application

- 3 pilot workshops (MI, WI, NE)
  - 1 online class (national)
  - ~120 participants, 50 projects
  - Forest Service project planning teams
- 
- Remember:
    - It's **not a checklist!**
    - Use it in conjunction with a structured planning process





**Step 1:** DEFINE area of interest, management goals and objectives, and time frames.

## Wildlife habitat and sustainable agriculture in the Central Platte River Valley

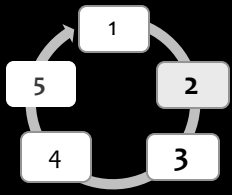


### Goals:

- Improve habitat for sandhill cranes and other wildlife
- Promote habitat-compatible agricultural practices

### Objectives:

- Increase meadow cover (<30%) and reduce woodland cover (>30%) within 800m of the river
- Increase average river channel width to <200m
- Improve soil fertility in agricultural fields
- Convert 40% of the row crop fields to crane-friendly crops such as wheat, barley, alfalfa, and corn

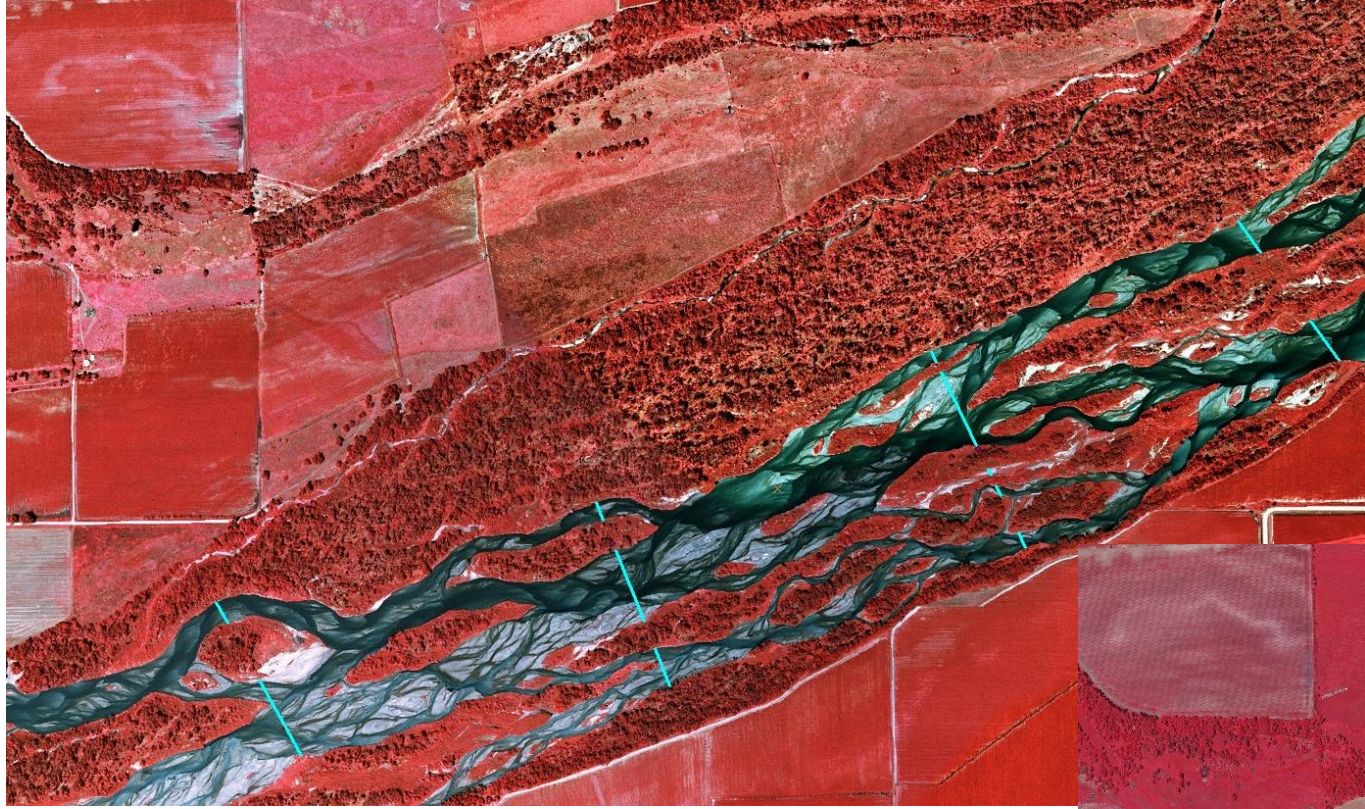


**Step 2:** ASSESS climate change impacts and vulnerabilities for the area of interest.

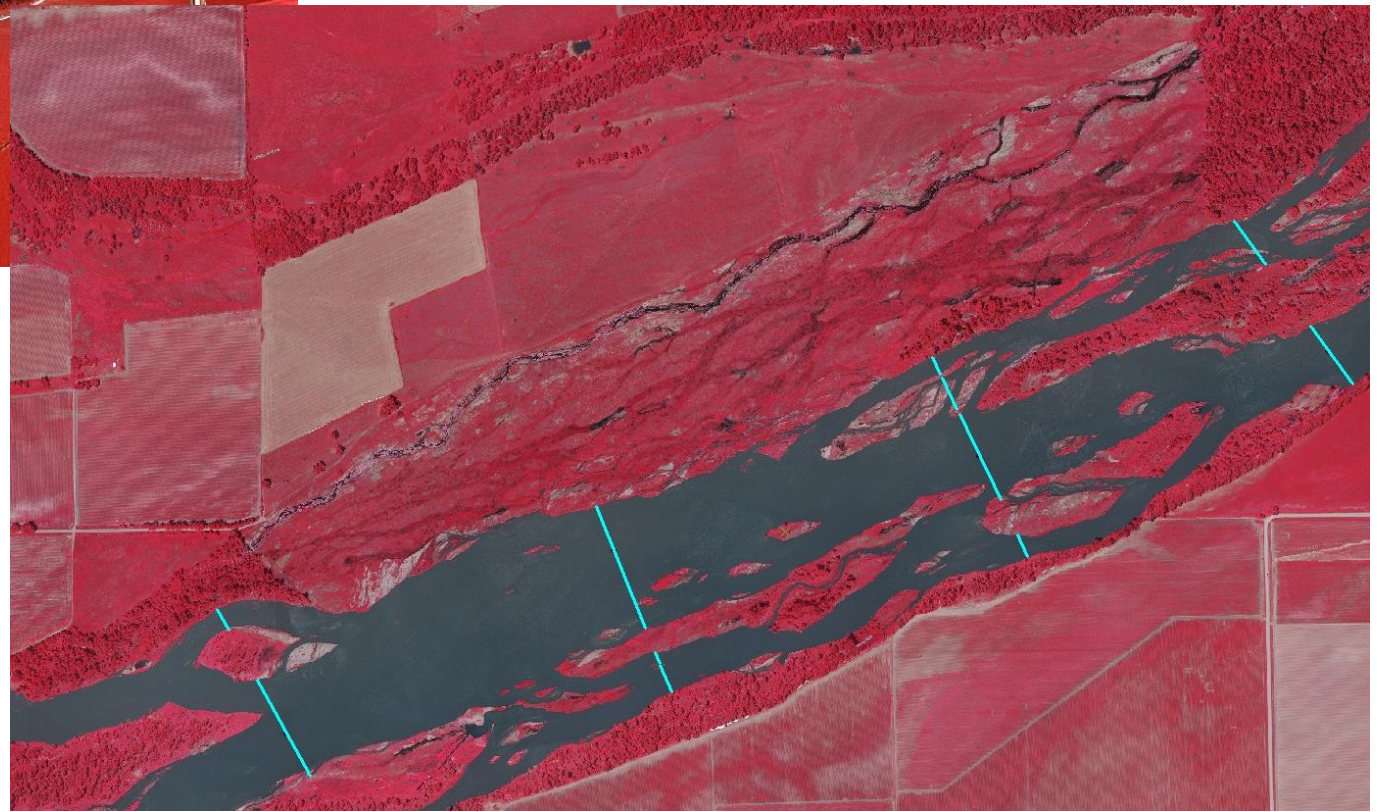


### Priority Climate Change Impacts

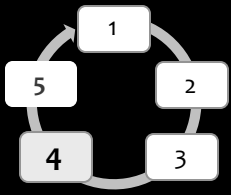
- Warmer winters leading to shifts in crane migration and overwintering patterns
- Reduced ice jams that help maintain the river's open, wide-braided character
- Increased pressures from insect pests and cool-season invasive plants
- Variable mountain snowpack and warmer winters = shifting timing of floods/scouring action
- More low-flow days in the summer leading to vegetation encroachment in the river channel



**1998**

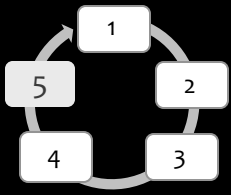


**2016**



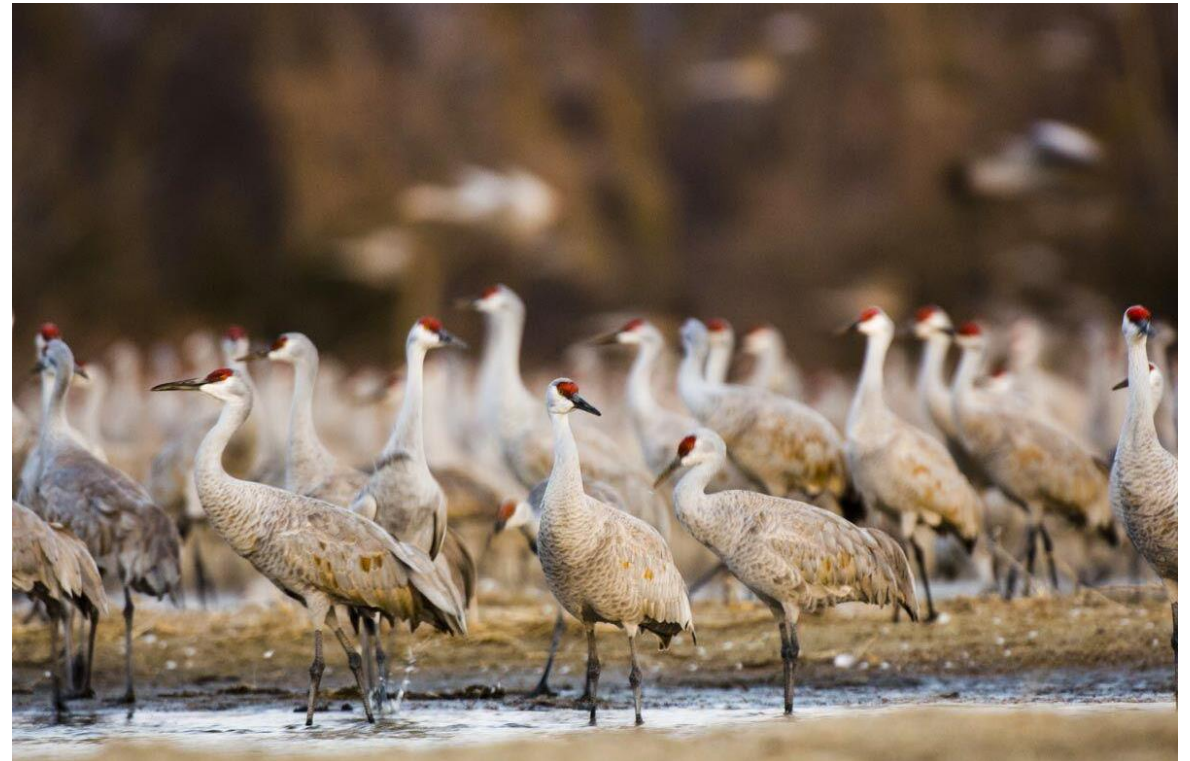
## Step 4: IDENTIFY and adaptation approaches and tactics for implementation.

| Option     | Approach (From Wildlife Menu)  | Tactic (Your specific actions)  |
|------------|--|---|
| Resistance | 11.5. Manage public or private agricultural land to provide compatible wildlife use  | <ul style="list-style-type: none"> <li>• Encourage no-till agriculture and cover crops in the Central Platte River watershed.</li> <li>• Promote “precision agriculture” techniques to reduce inputs of fuel, fertilizer, and water.</li> </ul> |
| Resilience | 8.8. Maintain or mimic natural disturbance regimes to enhance habitat quality  | <ul style="list-style-type: none"> <li>• Create disturbances at suitable seasons to boost floristic quality and biodiversity in meadows, such as grazing in the winter and prescribed fire in the summer as opposed to spring.</li> </ul>       |
| Transition | 8.1. Manage for plant species diversity and complexity<br>9.2. Create new sources of food, water, and cover in anticipation of future conditions<br>11.3. Manage private lands near and between protected lands (buffer zones) | <ul style="list-style-type: none"> <li>• Replace conventional row crops with native meadow species or alternative crops that may provide a greater variety of food sources over a longer seasonal timeframe.</li> </ul>                         |



## **Step 5:** MONITOR and evaluate effectiveness of implemented actions.

- Crane population trends
- Crane arrival and departure dates
- Acres of meadow vs. woodland in the project area
- Acres of wildlife-friendly agricultural practices being employed
- Fuel and fertilizer consumption trends for farmers engaging in these practices



# Piping Plover (Apostle Islands, WI)

## Goals:

- Support 10-20 piping plover nesting pairs on Long Island/ Chequamegon Point
- Maintain piping plover nesting and foraging habitat

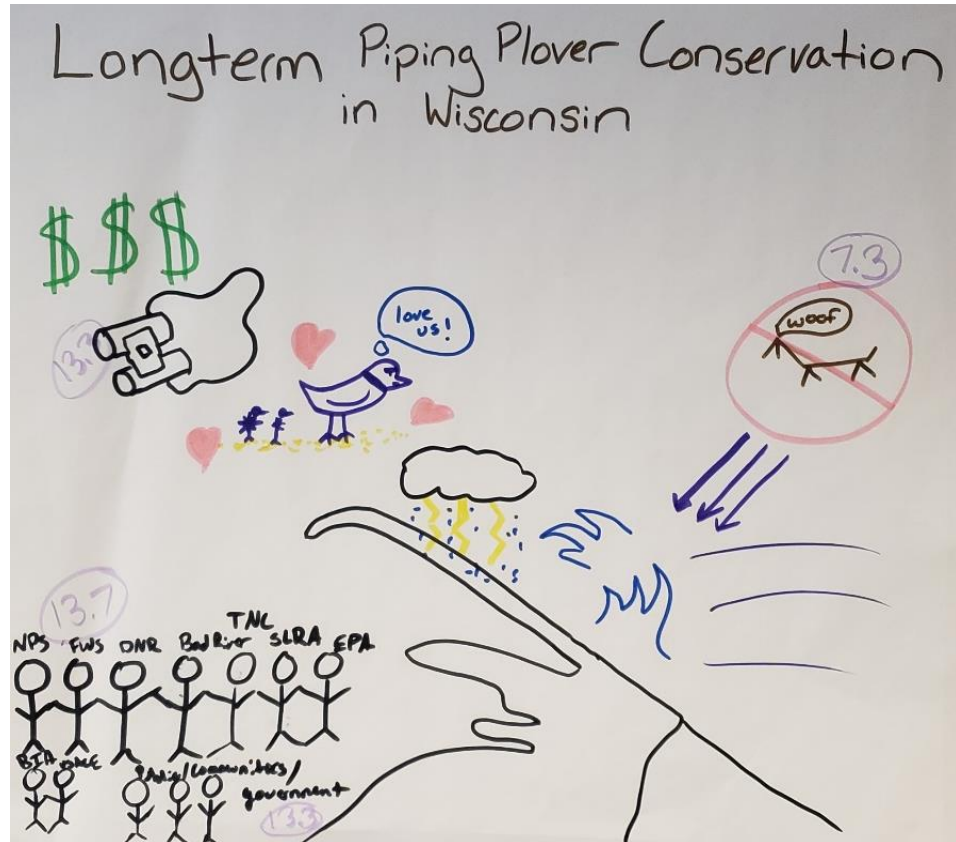


## Climate challenges:

- More beach disturbance due to stronger storms, larger waves, etc.
- Botulism, West Nile virus, tick diseases
- Changes in food webs and food availability



# Piping Plover (Apostle Islands, WI)



## Select Actions:

- Remove eggs from the mouth of Bad River for **captive breeding**
- Identify **possible new habitat** along Bad River corridor
- **Close Long Island to dogs** during the breeding and rearing season
- Continue installing **nest enclosures** and psychological fencing
- Develop beach observation points for the public to provide **safe viewing opportunities**, including a live-action webcam for community engagement

# Thank you!

**Stephen Handler**

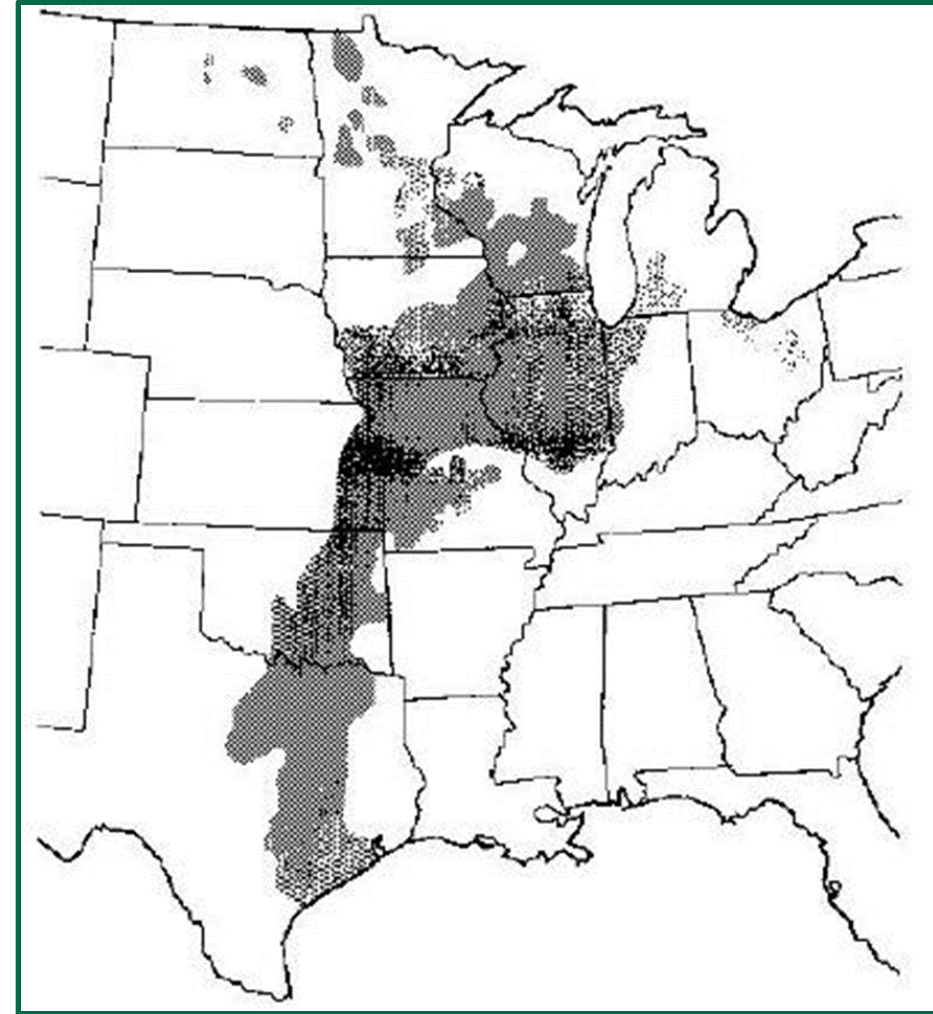
[stephen.handler@usda.gov](mailto:stephen.handler@usda.gov)

[www.ForestAdaptation.org](http://www.ForestAdaptation.org)

# Whitney Kroschel

## Agassiz National Wildlife Refuge

- **Project:** Oak Savanna Restoration and Management
  - **Location:** Northwest Minnesota
  - **Purpose:** Restore and effectively manage 3 units of oak savanna for native vegetation and wildlife
  - **Audience:** Refuge management, staff, and stakeholders
- 
- Located at the northern extent of oak savanna habitat
  - Goals: Restore tree density, encourage native cover and regen, implement prescribed fire, improve wildlife use



Extent of Midwestern oak savanna in the United States pre-settlement. From the 1993 Proceedings of the Midwest Oak Savanna Conferences, modified from Nuzzo (1986).

# Climate Change Impacts, Challenges, Opportunities

## Climate Change Effects

- Temperatures are projected to increase ~5-9 °F; more frequent extremes (drought, temps, precip); average annual precipitation will likely increase; longer growing season

## Climate Change Challenges

- Encroachment by undesirable woody species may become more aggressive
- Management could be more demanding, requiring more mowing, burning, grazing, etc.

## Climate Change Opportunities

- Oak regeneration may be positively affected by longer growing seasons and more precipitation
- Oak productivity may increase, producing more forage for wildlife

# Adaptation Actions

## Adaptation Strategies and Tactics

- Manage for plant species diversity and complexity
  - 25-50% canopy cover
  - Remove aspen, green ash, hazel
- Maintain or mimic disturbance regimes to enhance habitat quality
  - Prescribed fire
- Promote diverse age classes
- Maintain and restore diversity of native species
  - Encourage viburnums, juneberries, dogwoods, black cherry and choke cherry

## Combination of Standard and New Approaches

- New: formerly neglected, low-priority units. Today – high priority with intentions to establish a regular, long term management plan with monitoring criteria
- Business as usual: Will be implementing strategies used in similar oak savanna units, combining fire and mechanical methods to set back unwanted vegetation and encourage native species growth for the benefit of wildlife

