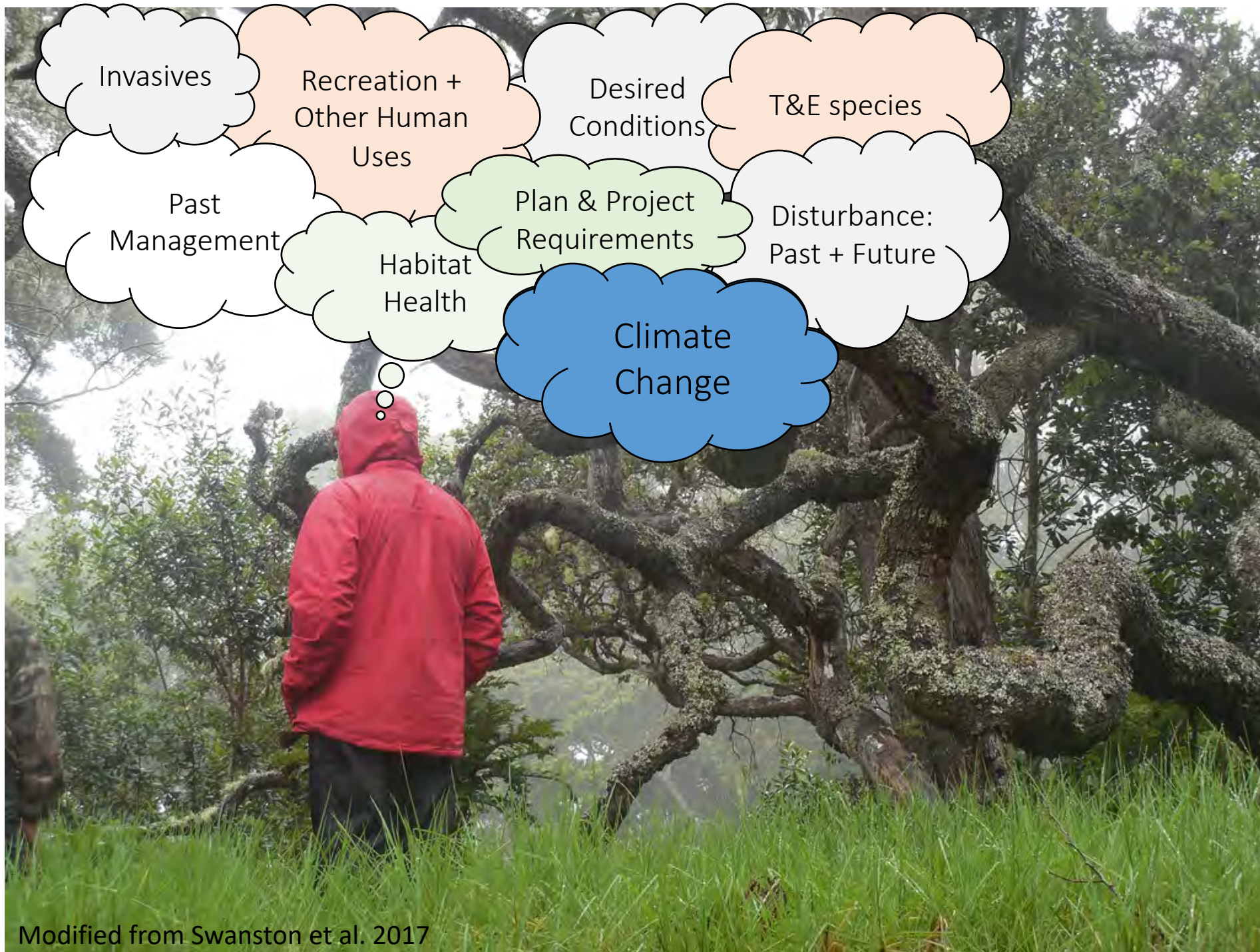
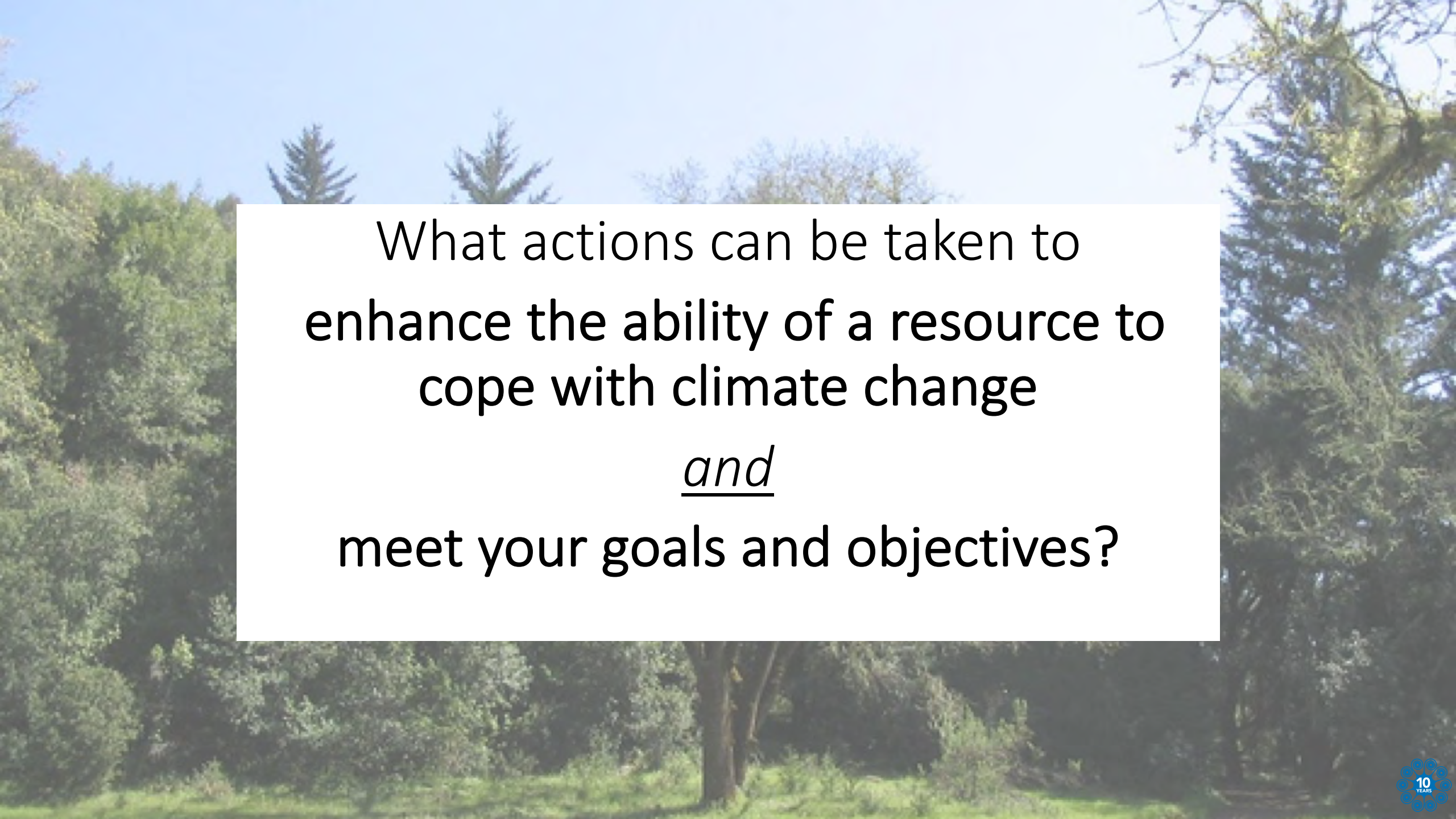


Identifying Climate-Informed Management Options

Introduction to Adaptation and Examples from the Field

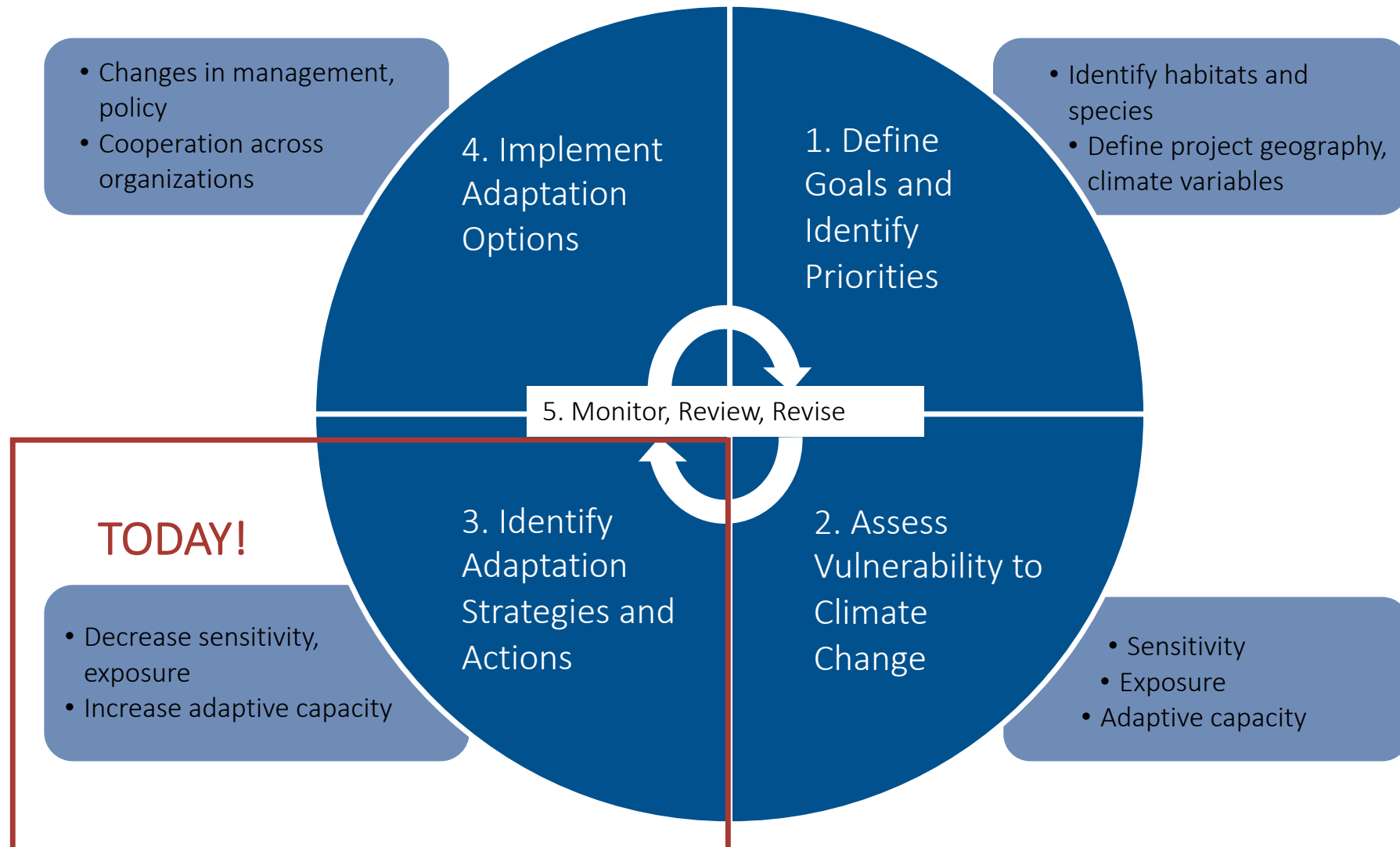


Modified from Swanston et al. 2017



What actions can be taken to
enhance the ability of a resource to
cope with climate change
and
meet your goals and objectives?

Climate Adaptation Framework



Defining Adaptation

Adaptation refers to adjustments in natural or human systems in response to changing climate conditions.

Adaptation is how we prepare for and respond to changes that we are already experiencing or are likely to experience.

Adaptation activities can build on sustainable management, conservation, and restoration of forests.



Adaptation Strategies & Actions

Adaptation strategies are more general responses that aim to reduce the negative effects or take advantage of the opportunities provided by climate change

Utilize fuelbreaks to slow the spread of high-intensity fire

Adaptation actions are more specific tactics that consider ecological and site conditions and context

Create and use roadside grazing corridors to reduce potential fuels (e.g., annual grasses)



Adaptation Strategies & Actions

Current/same actions

- Remove invasive plants from intact remnant habitats



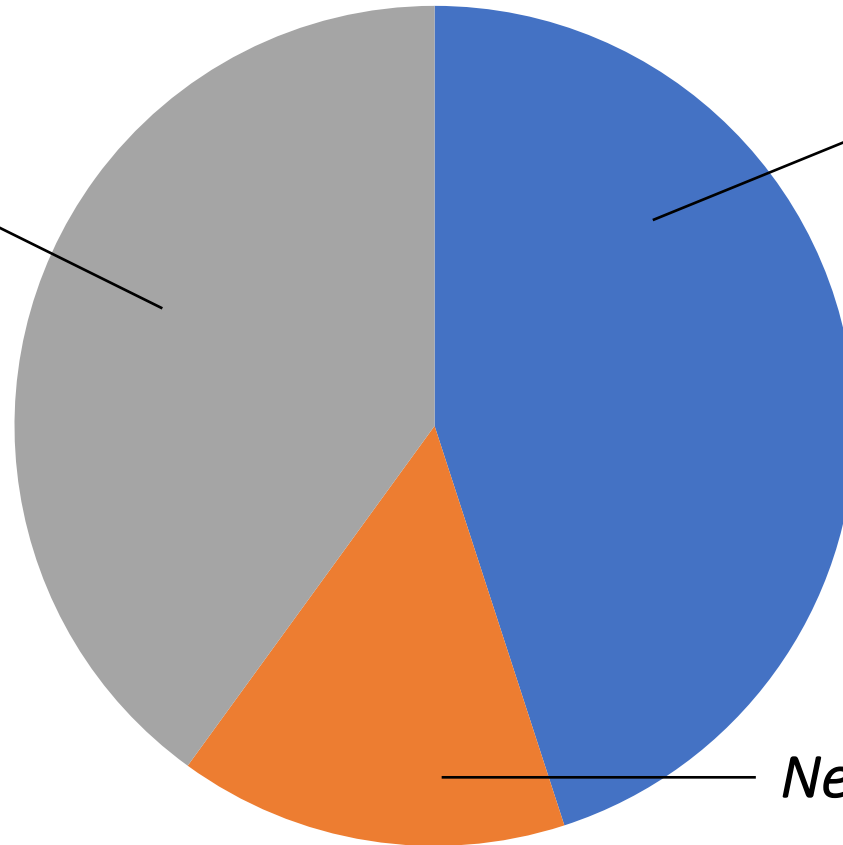
Modifications to actions

- Plant and seed with native species adapted to future conditions (e.g., drought-tolerant)



New/different actions

- Actively transition habitat to new ecological type (e.g., forest to shrubland)



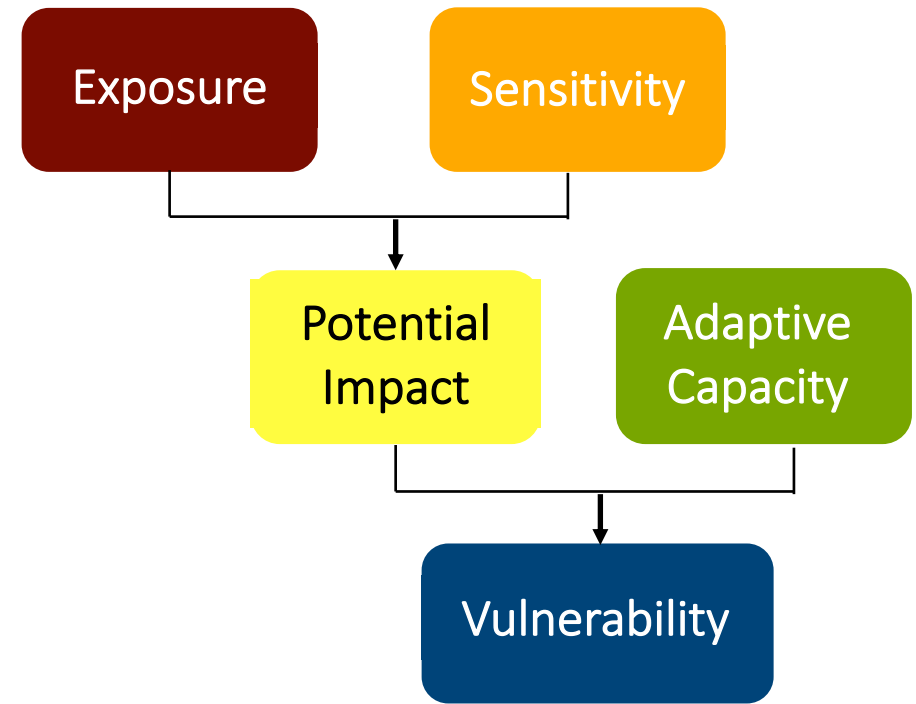
Applying Vulnerability Assessment Results in Adaptation Planning

$$\text{Vulnerability} = \text{Exposure} * \text{Sensitivity} - \text{Adaptive Capacity}$$

↓ *Exposure*

↓ *Sensitivity*

↑ *Adaptive capacity*



Applying Vulnerability Assessment Results in Adaptation Planning

↓ *Exposure*

- Protect resources and infrastructure from flood damage
- Plant riparian vegetation to shade streams
- Protect climate refugia



Applying Vulnerability Assessment Results in Adaptation Planning

↓ *Sensitivity*

- Actively plant drought-tolerant native species in an area projected to get drier
- Reduce invasive species that outcompete native species
- Reduce pollutants that increase sensitivity of a resource to climate stressors



Applying Vulnerability Assessment Results in Adaptation Planning

↑ *Adaptive capacity*

- Remove barriers to species movement/migration
- Adjust timing or route of access for recreation opportunities
- Develop genetic banks for species restoration



Adaptation Approaches

RESISTANCE/
RESILIENCE

ACCEPT/
NO ACTION

DIRECT/
RESPONSE

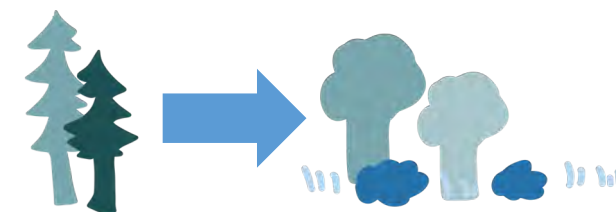
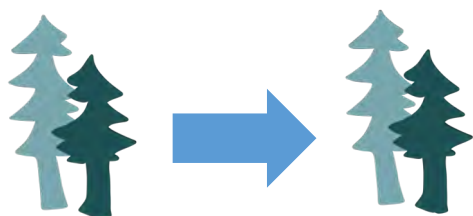


Managing for
Persistence

Managing for
Change

Still recognizable as same system

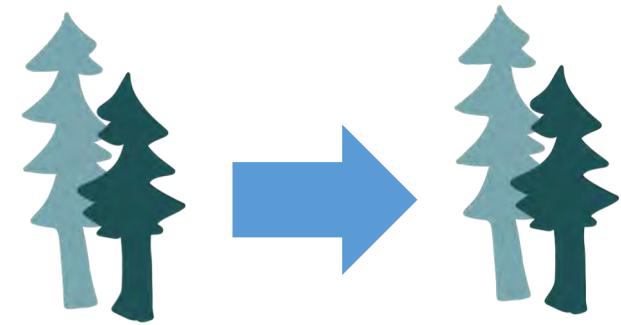
System fundamentally changed



Resistance

Strategies or actions that maintain current conditions by limiting change

- Near-term approach
- Resource and/or management-intensive



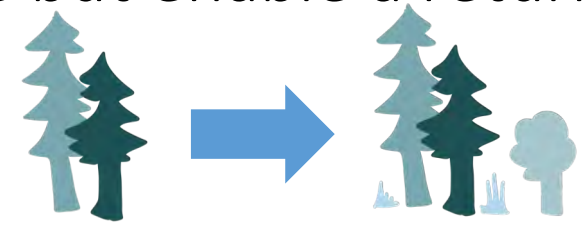
Examples:

- Preventing the spread of invasive species
- Expanding fencing and ungulate removal in areas more resilient to invasion
- Increasing fire prevention and fuel management efforts in most intact habitats

Resilience

Strategies or actions that accommodate some change but enable a return to a prior desired condition

- Near- to mid-term approach
- Management-intensive in the near-term; increasing resources needed to maintain desired condition



Examples:

- Promoting native genotypes and adapted genotypes of native species
- Increasing habitat heterogeneity
- Restoring hydrologic function (e.g., removing diversions)

Accept Change/No Action (aka “Let it go”)



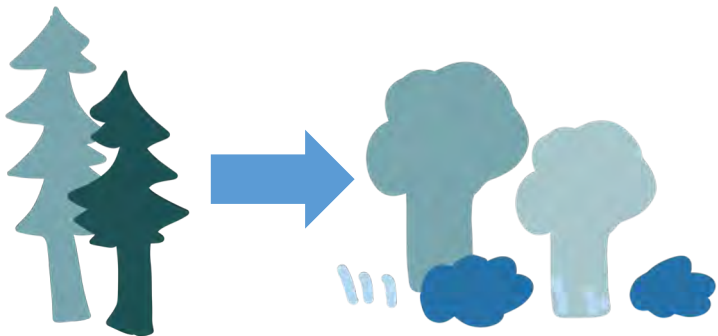
Examples:

- Allow newly arriving species to persist
- Allow transition from one habitat type to another (e.g., forest to shrubland or grassland) in response to changing climate conditions
- Monitor climate changes and impacts and resource conditions and trends

Direct/Response

Strategies or actions that intentionally facilitate or direct change and adaptively respond to new conditions

- Long-term approach
- Variable intensity (e.g., may require more resources up front, or gradual changes to put into practice)



Examples:

- Introducing species not historically present but better adapted to future climate conditions
- Proactively creating new places for habitat to migrate
- Accelerating the trajectory of change from one habitat type to another

Knowledge

Strategies or actions to gather information about climate changes, impacts, and/or management effectiveness

- Near- to long-term approach
- May be a precursor to implementing a Resistance, Resilience, or Response approach



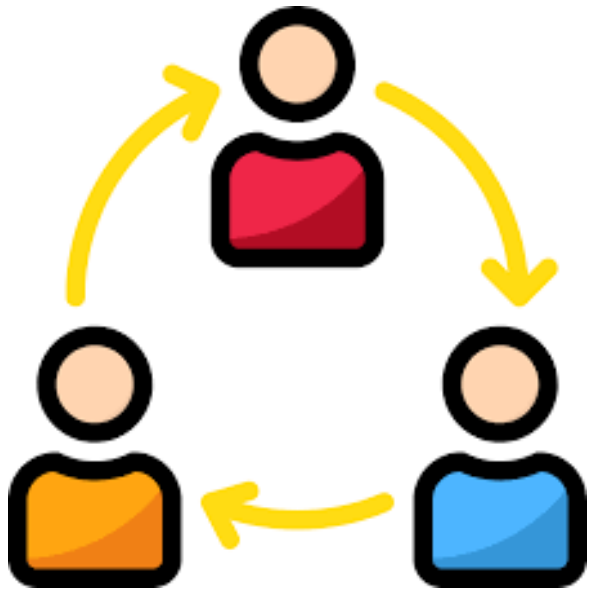
Examples:

- Identifying and monitoring rare species that are the most vulnerable to climate change
- Improving methods for native species propagation
- Monitoring the long-term effectiveness of rare species management and restoration

Collaboration

Strategies or actions that focus on coordinating management efforts and/or capacity across organizational, jurisdictional, or political boundaries

- Near- to long-term approach



Examples:

- Improving data sharing within and between agencies and organizations
- Identifying and/or developing cooperative management and land acquisition opportunities to proactively address habitat shifts due to climate change
- Building support for habitat conservation by conducting public education and outreach about climate risks and management responses

Putting It All Together: Approach, Strategy, Action



Approach

Strategy

Action

RESISTANCE

Prevent the spread of invasive species

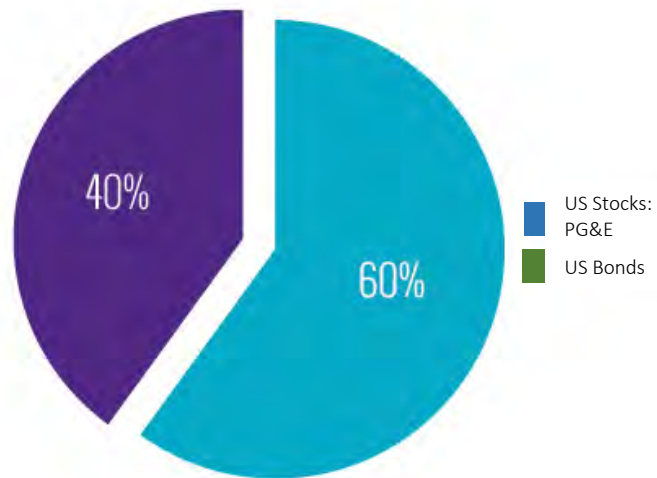
Remove invasive plants from intact remnant habitats (↓ sensitivity)

The Importance of Hedging Your Bets

OLD SCHOOL VS. NEW AGE (2003-2017)

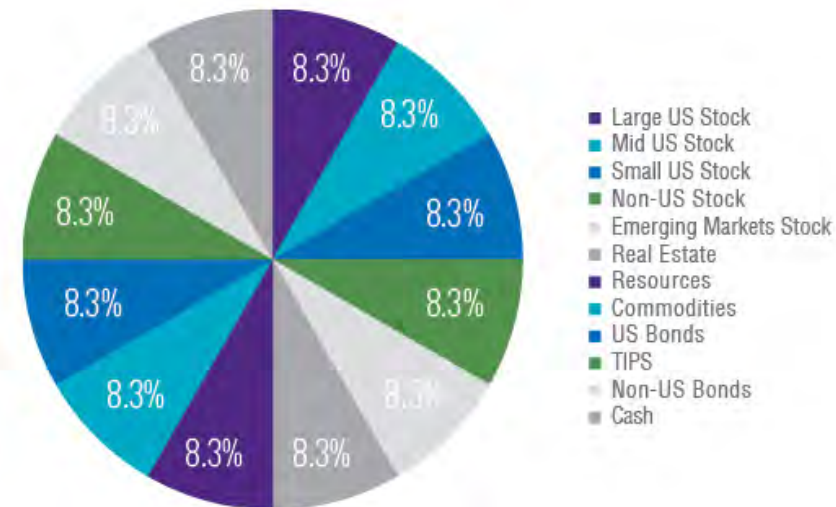
Old school balanced model

15- year annualized return = 8.01%



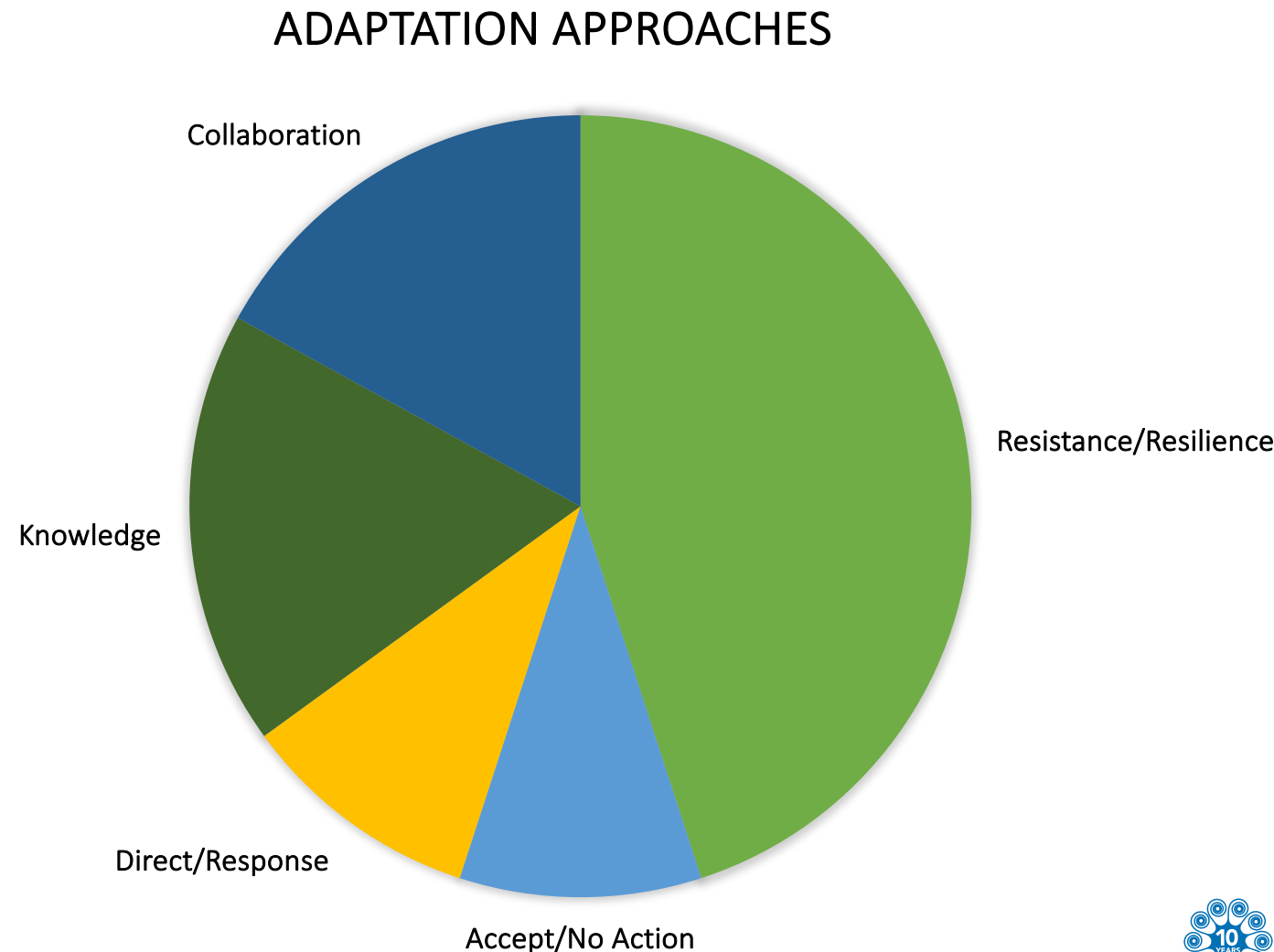
Modern balanced portfolio

15- year annualized return = 8.46%



The Importance of Hedging Your Bets

- Aim to identify a portfolio of approaches and timeframes
 - *even if you may only implement a couple of approaches in the near-term*
- Portfolio may shift over time



Examples?

UP NEXT!

Resistance/
Resilience

Accept/
No Action

Direct/
Response

Knowledge

Collaboration

Blackwater 2100: Climate Adaptation in Blackwater NWR

The Challenge

- Sea level rise is happening faster here than the rest of the Atlantic Coast, in part because the land has been sinking
- New tidal marsh is forming, but is not keeping pace with losses

Feasibility Analysis

- Evaluated site value and condition
- Selected primary and secondary tidal marsh migration “corridors”
 - *Those areas where sea level rise, land use and ownership patterns, future development plans, and bird presence indicate the greatest potential for high quality tidal marsh to relocate*



Blackwater 2100: Climate Adaptation in Blackwater NWR



Actions

- Improving current tidal marsh health and productivity: sediment enhancement and revegetation, controlling invasive plants (↓ sensitivity)
- Converting targeted transitional areas into tidal marsh: eliminate dead and dying trees, plant transitional species (↑ adaptive capacity)
- On adjacent private lands, facilitating tidal marsh migration by extending the head of a tidal creek (↑ adaptive capacity)

Resistance/
Resilience

Direct/
Response



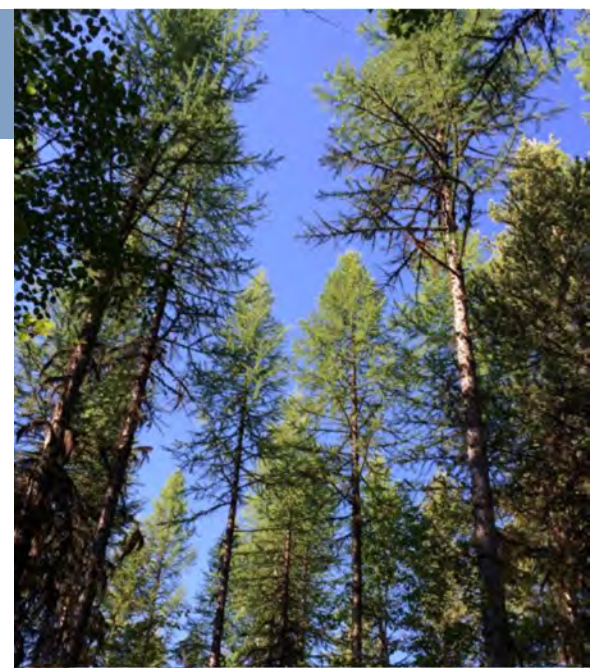
Adaptive Silviculture for Climate Change: Flathead NF

The Challenge: Western Larch Forests

- Occupies cool and moist, mid-elevation sites in the interior northwest
- Shade-intolerant
- Resilient to and dependent on disturbances (e.g., insect outbreaks, wildfire)
- Predicted to be one of the most vulnerable forest types to warming and drying climate

The Response: Adaptive Silviculture for Climate Change

- Experimental effort to cooperatively develop silvicultural strategies that mitigate the negative effects of future climate
- Highly collaborative
- Identify four types of treatments: No Action, Resistance, Resilience, Response
- Short- and long-term monitoring



Adaptive Silviculture for Climate Change: Flathead NF

Resistance

- Goal: even-aged with composition dominated by western larch
- Strategies: thin, uniform spacing of residual trees, favor western larch and quaking aspen

Resilience

- Goal: multi-aged with high structural and spatial heterogeneity, dominated by western larch and western white pine (disturbance-adapted)
- Strategies: create 2-4 acres openings, plant seed from higher and mid-elevations

Direct/Response

- Goals: two-aged with structural and spatial heterogeneity, composition dominated by western larch, western white pine, and ponderosa pine
- Strategies: irregular seed tree harvest, plant seed from higher and mid-elevations, introduce ponderosa pine

