

Adaptation Actions for

Resistance, Resilience, and Transformation

- Climate change is the defining challenge of our time with devastating impacts increasingly felt across the globe, including wildfires, droughts, and more frequent and intense storms.
- Because of this, it can feel overwhelming to know where to begin to address climate change, but we can use climate adaptation actions to face these impacts head on.
- Climate adaptation is preparing for and responding to climate change impacts. Adaptation actions can be categorized across a spectrum of **resistance, resilience, and transformation (RRT)**.
- Being strategic about how to respond will help us act quickly and effectively to ensure co-benefits for people and nature.
- Here we focus on examples of actions that include natural infrastructure or ecosystem components, such as:
 - creating wetlands to reduce downstream flooding,
 - planting trees to reduce extreme heat stress in cities, or
 - connecting habitat so wild-life can migrate in response to changing temperatures.
- Whether you are new to climate adaptation or a seasoned practitioner looking to better understand where your work fits into the bigger picture, this RRT categorization and toolkit serve to help you achieve your objectives in response to climate change.
- This resource is part of a RRT Toolkit that provides an overview of climate adaptation actions across a spectrum of categories, along with illustrative examples in different ecosystems. [Learn more here.](#)

Active transformation:

Mass ECAN members help plant floodplain forest tree species that are adapted to future climate conditions



What is resilience?

If you have been working on climate change in the last decade, you probably have heard the term “resilience”. Resilience, like ‘sustainability’ and other environmental buzzwords, has now become an umbrella or catch-all concept. But resilience traditionally refers to the ability to recover or bounce back from a disturbance or adverse event. In the context of climate adaptation, resilience is actually only one among a spectrum of options within a broader framework for enabling healthy natural and human communities to adapt. This spectrum ranges from preventing ecosystem changes (resistance) to promoting change (transformation), with resilience in between.

Researchers and practitioners can better match their work to long-term adaptation goals by understanding the differences among these categories. Reflecting on the full suite of adaptation options allows us to consider how our actions ultimately help the vulnerable communities or species we focus on.



Context is key.

Deciding among actions for resistance, resilience, or transformation requires both a clear understanding of the climate impacts affecting the system you are focusing on as well as clear management goals for what you want to accomplish. Here we share a four point scale of adaptation categories, adapted from Peterson St-Laurent et al. (2021), to illustrate the range of possibilities within the adaptation framework. These are designed as a gradient and projects often combine actions across the spectrum to meet their goals.

REFERENCES

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FORESTS

Here we illustrate climate adaptation project examples across the spectrum of Resistance, Resilience and Transformation in different ecosystems. See below for on-the-ground actions in southern New England forests.

RESIST CHANGE

Resistance

Actions designed to maintain current or desired species composition, ecosystem structure, or functions.

Example: Prioritize and maintain sensitive or at-risk species or communities

PROJECT:
Northern hardwood-conifer forest, October Mountain State Forest (MA DCR)

GOAL:
Retain current composition and increase structural diversity for wildlife

ACTION:
Encourage the retention and regeneration of at-risk species, such as spruce-fir, on favorable microsites to maintain them on-site for as long as possible

➤ [SEE PROJECT HERE](#)

Resilience

Actions that allow for some changes following a disturbance while enabling the system to return to a state similar to pre-disturbance.

Example: Maintain and restore diversity of native species

PROJECT:
Northern hardwood-red spruce forest, Notchview Reservation in MA (The Trustees)

GOAL:
Develop and maintain forest diversity to enable more rapid recovery from climate-related disturbances

ACTION:
Create early successional habitat in select areas to promote regeneration of shade intolerant species and establish new age classes of shade tolerant trees

➤ [SEE PROJECT HERE](#)



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Passive Transformation

Actions that allow a system to naturally transition to a new state characterized by new species, structure, or functions.

Example: Promote landscape connectivity

PROJECT:
Diverse transition hardwood forest, Mount Philo State Park (VT ANR)

GOAL:
Conserve biological diversity, including rare plants and natural communities as climate conditions change, and allow species to naturally migrate

ACTION:
Maintain forested corridors to promote movement of plants and wildlife and allow shifts in species distributions as habitat conditions change

➤ [SEE PROJECT HERE](#)

DIRECT CHANGE

Active Transformation

Actions that facilitate or drive the transition of a system to a new state characterized by new species composition or functions with human assistance.

Example: Introduce species that are expected to be adapted to future conditions

PROJECT:
Central hardwood-pine forests on publicly-owned water supply lands in RI (Providence Water)

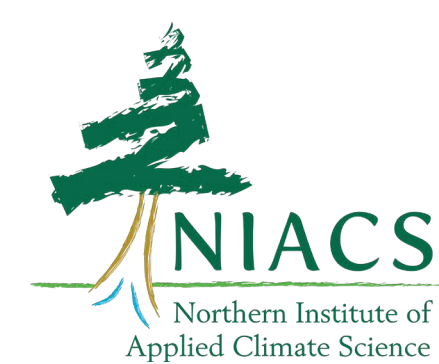
GOAL:
Ensure a mosaic of forest stands with trees of different species and ages, so the forest is resilient to future disturbances that could negatively impact water quality

ACTION:
Planting and seeding of trees that are expected to be better-adapted to future conditions, based on the USFS Climate Change Tree Atlas, such as black oak, sweetgum, and Virginia pine

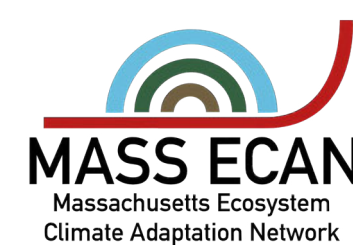
➤ [SEE PROJECT HERE](#)



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SALT MARSH

Here we illustrate climate adaptation project examples across the spectrum of Resistance, Resilience and Transformation in different ecosystems. See below for examples of on-the-ground projects actions taken in Massachusetts salt marshes.

RESIST CHANGE

Resistance

Actions designed to maintain current or desired species composition, ecosystem structure, or functions.

Example: Reduce salt marsh erosion

PROJECT:
Allen's Pond, Dartmouth, MA

GOAL:
Restore a more natural tidal hydrology of high marsh platform by reestablishing natural patterns of flooding and draining that have been disrupted by past human activity

ACTION:
Create shallow channels (runnelling) to reestablish a more natural hydrology that facilitates tidal flooding and drainage allowing for more vigorous growth of salt marsh vegetation

SEE PROJECT HERE



Resilience

Actions that allow for some changes following a disturbance while enabling the system to quickly return to the previous state.

Example: Maintain or restore coastal connectivity

PROJECT:
Kent's Island Creek Salt Marsh, Newbury, MA

GOAL:
Restore tidal flow and connectivity of the marsh allowing plants and animals to recover after disturbance

ACTION:
Replace a small, dilapidated bridge with a larger-span bridge that doesn't restrict tidal flow, and lower portions of the road to restore high marsh connectivity

SEE PROJECT HERE



Passive Transformation

Actions that allow a system to naturally transition to a new state characterized by new species, structure, or functions.

Example: Conserving upland areas to allow for natural marsh migration

PROJECT:
Parker River Watershed, Newbury, MA

GOAL:
Maintain land in undeveloped condition to allow natural wetland migration in response to sea level rise

ACTION:
Protect natural uplands adjacent to salt marshes from human intervention, such as hard infrastructure and development, to allow future marsh migration

DIRECT CHANGE

Active Transformation

Actions that facilitate or drive the transition of a system to a new state characterized by new species composition or functions with human assistance.

Example: Facilitate marsh migration by removing upland vegetation in favor of establishment of salt marsh plants

PROJECT:
This is an area of active research

GOAL:
Facilitate the movement of salt marsh species into upland areas in response to sea level rise

ACTION:
Removal of upland vegetation/trees and control of invasives in areas potentially suitable for marsh migration

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MASS ECAN
Massachusetts Ecosystem
Climate Adaptation Network



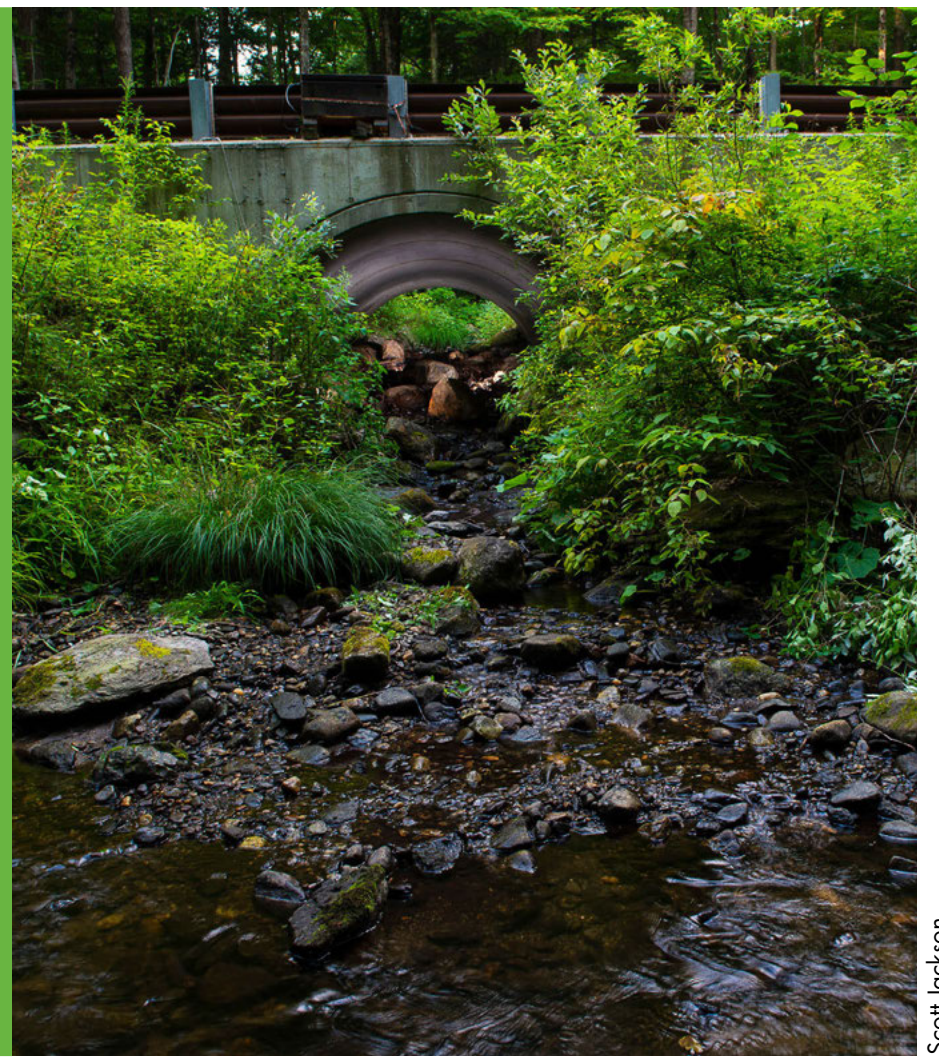
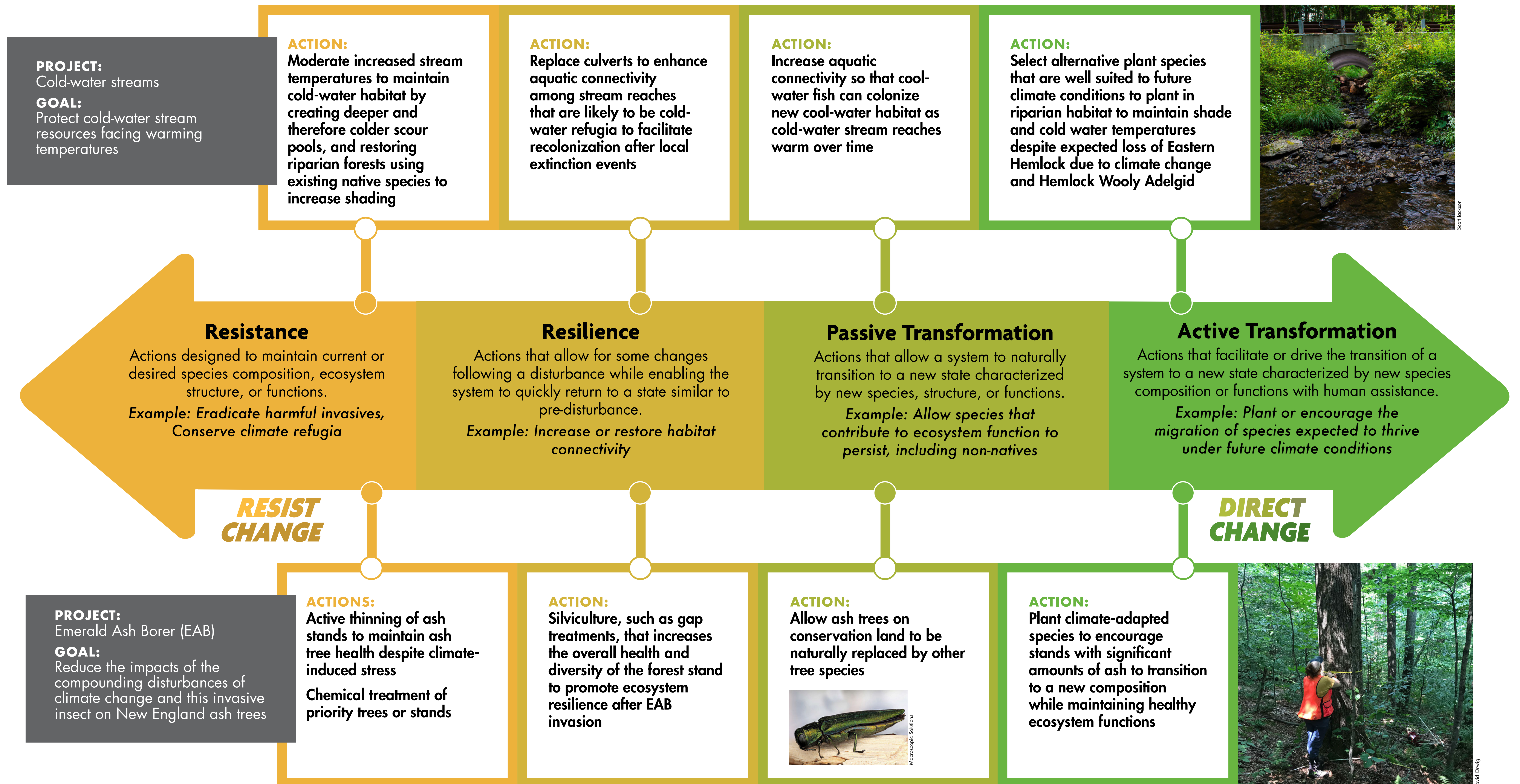
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INVASIVES & WATERSHEDS

Climate change and other stressors force difficult decisions and discussions as we consider which vulnerable systems or species to work to hold on to, to help transform or even to let go. The RRT framework can help us explore options for focal resources that we care about.

See below for two examples where actions are illustrated across RRT for the same target resource: a tree species facing forest stressors and coldwater streams facing warming temperatures.



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