



Adaptation Strategies and Approaches



Foresters and forest owners will respond to climate change in different ways, based on their judgment of the associated risks and opportunities. A range of adaptation actions can be taken, which can be selected based on management objectives.

The Earth's climate is changing. Many trends have been tracked, some reaching back tens of thousands of years. Trees and forests are sensitive to a range of environmental conditions, including the climate. In addition to climate, there are other factors to which forests respond, such as human activities and management, biological relationships, and invasive pests. All of this creates a dynamic within which forests grow and change.

While there is no doubt among the scientific community that the climate is changing, the ecological response of Michigan's forests is more uncertain (see other bulletins in this series).

Foresters and forest owners will naturally have different perspectives on how to judge climate change risks and opportunities.

Table 1. Forest Adaptation Strategies and Approaches¹

Strategy 1: Sustain Fundamental Ecological Functions

- 1a. Maintain or restore soil quality and nutrient cycling.
- 1b. Maintain or restore hydrology.
- 1c. Maintain or restore riparian areas.

Strategy 2: Reduce the Impact of Existing Biological Stressors

- 2a. Maintain or improve the ability of forests to resist pests and pathogens.
- 2b. Prevent the introduction and establishment of invasive plant species and remove existing invasives.
- 2c. Manage herbivory to protect or promote regeneration.

Strategy 3: Protect Forests from Severe Fire and Wind Disturbance

- 3a. Alter forest structure or composition to reduce risks or severity of fire.
- 3b. Establish fuel breaks to slow the spread of catastrophic fire.
- 3c. Alter forest structure to reduce severity of extent of wind and ice damage.

Strategy 4: Maintain or Create Refugia

- 4a. Prioritize and protect existing populations on unique sites.
- 4b. Prioritize and protect sensitive or at-risk species or communities.
- 4c. Establish artificial reserves for at-risk and displaced species.

Strategy 5: Maintain and Enhance Species and Structural Diversity

- 5a. Promote diverse age classes.
- 5b. Maintain and restore diversity of native tree species.
- 5c. Retain biological legacies.
- 5d. Restore fire to fire-adapted ecosystems.
- 5e. Establish reserves to protect ecosystem diversity.

Strategy 6: Increase Ecosystem Redundancy Across the Landscape

- 6a. Manage habitats over a range of sites and conditions.
- 6b. Expand the boundaries of reserves to increase diversity.

They will also have different institutional constraints when it comes to taking action. Even so, it is prudent for foresters to consider what they can do in order to help forests adapt to climate change. In many cases, preparing for climate change offers "win-win" opportunities because many adaptation actions are already fundamental practices of good forestry. Also, many adaptation actions can address forest stressors that foresters are already used to considering, such as drought and forest pests.

Swanston & Janowiak (2012) articulate a series of forest management strategies and approaches in light of a changing climate (Table 1).¹ These planning categories are intended to be couched within a framework of adaptation choices (Figure 1) and followed-up by a series of site-specific tactics, or management practices. The following set of strategies and approaches can generate ideas and drive the selection of on-the-ground practices. This list is proposed as a "menu" of possible actions – the idea is to pick and choose the approaches that are most suitable to a particular management goal and forest type. Not all items on the menu will work together, although they can be applied in various combinations across a landscape or project area. Also, foresters may generate additional ideas that can be added to the menu.

Strategy 7: Promote Landscape Connectivity

- 7a. Use landscape-level planning and partnerships to reduce fragmentation and enhance connectivity.
- 7b. Establish and expand reserves and reserve networks to link habitats and protect key communities.
- 7c. Maintain and create habitat corridors through reforestation or restoration.

Strategy 8: Enhance Genetic Diversity

- 8a. Use seeds, germplasm, and other genetic material from across a greater geographic range.
- 8b. Favor existing genotypes that are adapted to future conditions.
- 8c. Increase diversity of nursery stock to provide those species or genotypes likely to succeed.

Strategy 9: Facilitate Community Adjustments Through Species Transitions

- 9a. Anticipate and respond to species decline.
- 9b. Favor or restore native species that are expected to be better adapted to future conditions.
- 9c. Manage for species and genotypes with wide moisture and temperature tolerances.
- 9d. Emphasize drought and heat tolerant species and populations.
- 9e. Guide species composition at early stages of stand development.
- 9f. Protect future-adapted regeneration from herbivory.
- 9g. Establish or encourage new mixes of native species.
- 9h. Identify and move species to sites that may provide future habitat.

Strategy 10: Plan for and Respond to Disturbance

- 10a. Prepare for more frequent and more severe disturbances.
- 10b. Prepare to realign management of significantly altered ecosystems to meet expected future environmental conditions.
- 10c. Promptly re-vegetate sites after disturbance.
- 10d. Allow for areas of natural regeneration after disturbance.
- 10e. Maintain seed or nursery stock of desired species of use following severe disturbance.



To better understand how each of the approaches in Table 1 might be relevant to risks associated with climate change, review the “Vulnerability Assessments” that have been prepared for Michigan’s Northern Lower Peninsula / Eastern Upper Peninsula (Handler et al. 2014)² or Northern Wisconsin / Western Upper Peninsula of Michigan (Janowiak et al. 2014).³ For example, measures to protect against severe weather become even more important when the frequency and severity of these events are expected to increase.

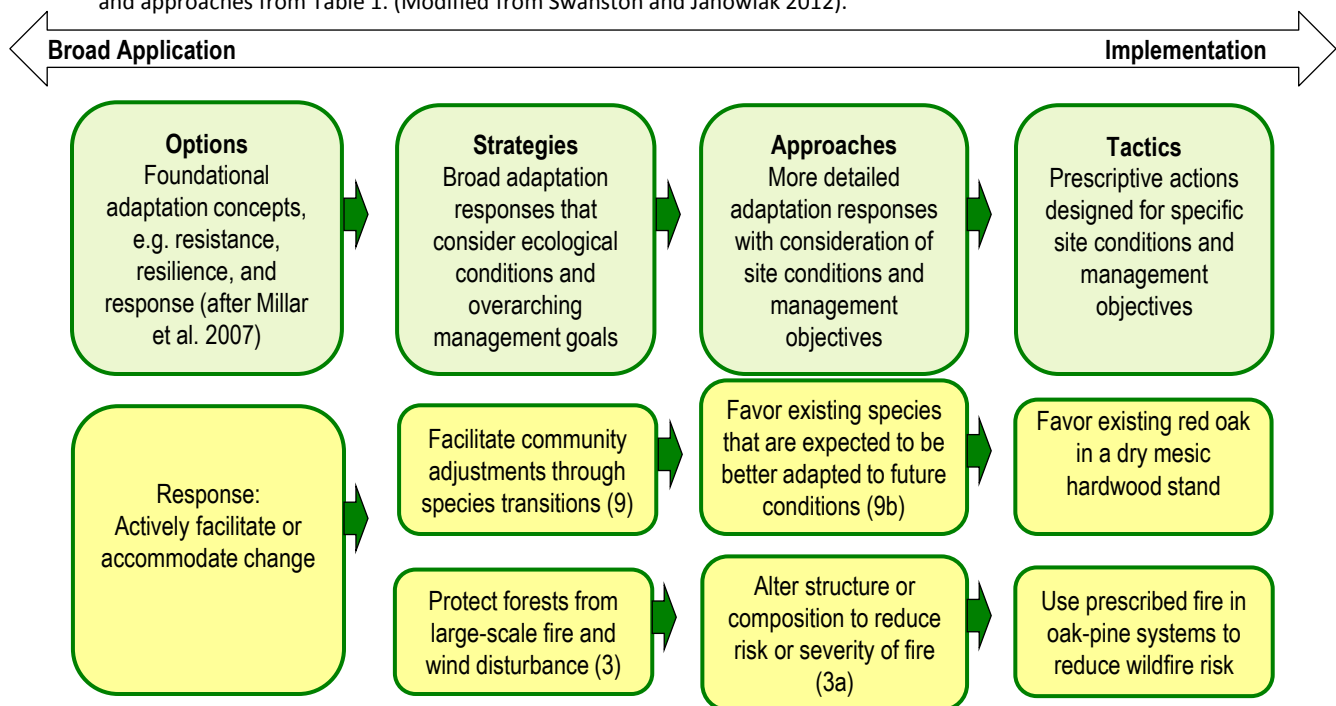
Swanston & Janowiak (2012) also provide a workbook process to help foresters and landowners consider climate change. This workbook process starts with identifying management objectives, and includes separate steps for considering climate change risks and opportunities and

selecting adaptation actions from the menu that will help achieve management objectives.

Implementing drastic adaptation actions, such as long-distance assisted migration, may be warranted only in limited situations. However, managing forests to increase basic ecological strengths (such as forest resilience, species diversity, and tree vigor) is good forestry under any circumstances.

Monitoring forest conditions over the long-term will be essential to adapting management to meet future challenges, not only from climate change, but also the wide array of socio-economic-cultural trends that are currently underway (e.g. parcelization, exotic pests, loss of forest industry, emerging technologies, etc.).

Figure 1. A continuum of adaptation actions is available to address needs at appropriate scales and levels of management (top). The lower boxes provide examples of each level of action. Numbers in parentheses refer to adaptation strategies and approaches from Table 1. (Modified from Swanston and Janowiak 2012).



1: Swanston, C.W. and M.K. Janowiak (editors). 2012. Forest Adaptation Resources: Climate Change Tools and Approaches for Land Managers. GTR-NRS-87. www.treesearch.fs.fed.us/pubs/40543
 2: Handler et al. 2014. Michigan Forest Ecosystem Vulnerability Assessment and Synthesis. GTR-NRS-129. www.nrs.fs.fed.us/pubs/45688
 3: Janowiak et al. 2014. Northern Wisconsin and western Upper Peninsula Ecosystem Vulnerability Assessment and Synthesis. GTR-NRS-136. www.forestadaptation.org/WI-MI-FEVAS.

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This bulletin is part of a series about climate change and forests. More detailed information about forest adaptation and climate change can be found in Handler (2014) and Swanston & Janowiak (2012). Three additional Michigan State University bulletins provide climate background “Climate Basics” – E3151, “Greenhouse Gas Basics” – E3148, and “Frequently Asked Questions About Climate Change” – E3150.