Chapter 5. Climate Change and Conservation

There is a significant amount of work to be done in Ohio related to climate change, its impacts on species and habitats, and what can be done to mitigate these impacts. Since the 1970s, conservation threats/actions have largely focused on efforts to remediate habitat and water quality issues, deal with invasive species, and contain emerging diseases. Significant effort has been directed at improving land use practices and improving water quality. A more than substantial amount of time and money has been spent trying to prevent the introduction of invasive species, and contain the spread of those already here. Conservation practices have been developed to contain and/or eliminate diseases such as VHS and CWD. Recent efforts to work with the agricultural community to prevent harmful algal blooms have been significant. Climate change has certainly been on the conservation radar, but at this point lags behind the issues just mentioned in terms research and management plans.

For the duration of this 2015 SWAP, efforts related to climate change will focus primarily on data collection and planning. There is much to be done to integrate climate change issues into our strategic, tactical, and operational planning. This chapter will lay the groundwork for incorporating climate change into future conservation efforts using the SWAP to coordinate planning and implementation. The following discussion is adapted from Integrating Climate Change into the State Wildlife Action Plans (Staudinger et al., in review).

5.0 Regional Climate Changes

Climate change science indicates that the climate is changing in ways that will directly impact wildlife and their habitats. While species and habitats have had to adapt to and evolve with climate changes throughout history, evidence suggests that current changes are occurring at a more rapid rate than in the past. A summary of climate changes predicted and/or occurring in the Northeast and Midwest regions that are relevant to wildlife and ecosystems includes the following:

- Warming is occurring in every season, particularly in winter, at higher latitudes, at higher elevations, and inland (away from lake coasts)
- Precipitation amounts are increasing, particularly in winter, and as high-intensity events in summer
- Extreme heat events are increasing
- Snow is shifting to rain
- Atmospheric moisture is increasing
- Streamflow patterns may be intensifying with increases in precipitation
- Streams are warming
- Severe weather may become more common
- Floods are intensifying and occurring more often with heavier rainfall events, yet droughts are also on the rise
- Growing seasons are getting longer, with more growing degree days expected
- The Great Lakes are warming
- Winter maximum lake ice extent is shrinking
- Lake evaporation rates are increasing
- Lake effect snow events are likely to become more severe, and shift to rain, but occur less often

5.1 Regional Species and Habitats at Greatest Risk and Most Vulnerable to Climate Impacts

Climate change vulnerability is comprised of three separate but related components – exposure, sensitivity, and adaptive capacity. Exposure is a reflection of the type, degree, and duration of climate induced change. The degree to which the effects of that change are felt is related to the sensitivity of the object being acted upon. Adaptive capacity is a measure of object's ability to persist in the face of the change. Climate change vulnerability assessments targeting ecological systems can be focused at the

species, habitat, or ecosystem level. It is important to note that there are different interpretations, treatments, and approaches to assessing climate change vulnerability.

Climate change vulnerability studies for the Northeast and Midwest regions scored freshwater mussels, amphibians, and fish as either extremely or highly vulnerable, while the majority of birds and mammals received low vulnerability rankings. Similar studies focused on habitat vulnerability classified spruce-fir, lowland conifer, Appalachian northern hardwood forests, bogs, fens, and freshwater aquatic habitats as highly vulnerable to climate change.

Climate Change Vulnerability Assessments (CCVAs) have already been conducted for a number of species and habitats across the Northeast and Midwestern region. A synthesis of methods, information on the locations (e.g., States) where vulnerability assessments were conducted, lists of individual species and habitats and their respective vulnerability rankings, and comparisons of how vulnerability rankings were determined among studies is provided in Staudinger et al. (in review) .

5.2 Impacts of and Biological Responses to Climate Change

As discussed above, the Northeastern and Midwestern U.S. are experiencing, and will continue to experience increased air and water temperatures, changes in precipitation, and an increase in extreme weather events, including more extreme high and low temperatures, drought, and floods. These changes will subsequently result in impacts including changes in lake levels, hydrological flows, water quality, increased storms, beach and dune erosion, and ultimately shifts in vegetation and even ecosystems.

Climate changes will have cascading effects upon ecological systems. Predictions are that species' distributions will shift northward, upslope, and upstream, and the species that rely on them will either shift in response or adapt in place. These shifts will not happen at the same time, as species respond to different cues and at different paces. Shifts will be influenced by degree of habitat connectivity, as well as life history traits or genetic diversity that influence movement or adaptation. Changes in species abundance and distribution are more likely to occur at the edge of a species range than in its center. Increased disturbance related to climate change likely will exacerbate and/or work synergistically with many existing threats such as habitat loss and fragmentation, invasive species, altered fire regimes, water pollution, and wildlife diseases. This could in turn lead to more ecological disturbance resulting in community turnover, with changing species assemblages.

Biological responses to climate change will vary across taxa in the northeast and Midwest. Species that have broad distributions across the region are likely to be able to adapt to changing temperatures and precipitation. Other species that rely on habitats that are at the southern edge of their distribution may be forced to shift their range northward. Species with limited mobility will be the most highly impacted.

There are many ways in which climate change can impact species and habitats, both directly and indirectly. From a species perspective, in general we know that as the effects of climate change manifest themselves:

- Habitat generalists will fare better than habitat specialists
- Food generalists will fare better than species with more specific dietary needs
- Tolerant species will fare better than species with narrow ranges of tolerance
- Species nearer the center of their range will fare better than edge of range species
- Mobile species will fare better than limited mobility or non-mobile species

Direct effects of climate change include the impact of changing temperature and precipitation regimes on species and habitats. Indirect effects are many and varied, and often complex. A list of some the most prominent and most discussed impacts in current scientific literature includes:

- Impacts of habitat changes on resident species
- Impacts of changing species assemblages on local habitat

- Range shifts that change species assemblages or put species proximate to each other that under normal circumstances are not – impact species through increased competition, predation, disease transmission, hybridization
- Predators may be affected by climate change impacts to prey abundance and distribution
- The concentrating effect of shrinking habitats can increase the vulnerability of species to predators and diseases
- Climate change may cause phenological mismatches where the timing of interactions between species, food, and habitat is thrown off because each is using a different cue (e.g., photoperiod vs temperature)
- Impacts of local land use/development on species as they attempt to react to climate change by shifting ranges or find local refugia (e.g., coastal habitat "squeeze" caused by water level rises combined with nearshore human development)
- Impacts to species that rely on other species for some part of their life cycle – hosts may be negatively affected by climate change
- Impacts to species caused by warmer winters allowing diseases and parasites to be more active

5.3 Adaptation Strategies and Actions in Response to Climate Change

Climate change adaptation is a relatively new and rapidly growing field focused on preparing for and responding to the current and future impacts of climate change. Climate change introduces high uncertainty to the decision making process as we are unable to exactly predict future climate conditions, how species and systems will respond to climate change and other stressors that act synergistically or cumulatively, as well as human response and behavior. Therefore managers must take action and make informed decisions that consider a range of possible futures.

The table below (modified from Butler et al. 2012 in Staudinger et al. (in review)) highlights different strategies and approaches being used across the region, and is intended to demonstrate the range of possible options for natural resource management under future global change.

Table 13. Ten broad strategies and approaches for climate change adaptation.

Strategy	**Approaches**
Sustain fundamental ecological functions	Maintain or restore habitat quality and nutrient cycling Maintain or restore hydrology Maintain or restore riparian, shoreline, or coastal areas
Reduce the impact of existing biological stressors	Maintain or improve the ability of habitats to resist pests and pathogens Prevent the introduction and establishment of invasive species and remove existing invasives Manage herbivory and other predation to protect or promote regeneration and growth of desired species

Protect habitats from severe fire and wind disturbance	Alter habitat structure or composition to reduce risk or severity of fire Establish fuelbreaks or other management actions to slow the spread of catastrophic fire and other events Alter habitat structure to reduce severity or extent of wind and ice damage
Maintain or create refugia	Prioritize and protect existing populations on unique and rare sites Prioritize and protect sensitive or at-risk species or communities Establish artificial reserves for at-risk and displaced species
Maintain and enhance species and structural diversity	Promote diverse age classes Maintain and restore native biodiversity Retain biological legacies Restore fire to fire-adapted ecosystems Establish reserves to protect ecosystem diversity
Increase ecosystem redundancy across the landscape	Manage habitats over a range of sites and conditions Expand the boundaries of reserves to increase diversity
Promote landscape connectivity	Use landscape-scale planning and partnerships to reduce fragmentation and enhance connectivity Establish and expand reserves and reserve networks to link habitats and protect key communities Maintain and create habitat corridors through reforestation and other restoration actions
Enhance genetic diversity	Use genetic material (e.g., seeds) from across a wide geographic range Favor existing genotypes that are better adapted to future conditions Increase diversity of early life stages to increase the likelihood of success of those species or genotypes

Facilitate community adjustments through species transitions	Anticipate and respond to species decline Favor or restore native species that are expected to be better adapted to future conditions Manage for species and genotypes with wide environmental (e.g., moisture and temperature) tolerances Guide species composition at early stages of development Protect future-adapted regeneration and population growth from predation Establish or encourage new mixes of native species Identify and move species to sites that are likely to provide future habitat
Plan for and respond to disturbance	Prepare for more frequent and more severe disturbances Prepare to realign management of significantly altered ecosystems to meet expected future environmental conditions Promptly restore sites after disturbance Allow for areas of natural regeneration after disturbance Maintain seed or nursery stock of desired species for use following severe disturbance Remove or prevent establishment of invasive species and other competitors following disturbance

While there is much work to be done regarding the integration of climate change into our strategic, tactical, and operational planning, there are many efforts underway or in the planning stages that address conservation threats related to climate change. Efforts to re-establish or enhance species populations (e.g., American burying beetle, Karner blue butterfly, lake sturgeon), protect and improve habitat (e.g., conservation easements, invasive species control, water quality improvements), or improve habitat connectivity (e.g., dam removals, connecting fragmented habitats) are all actions that can help mitigate the impacts of climate change. In this Action Plan, habitat specific conservation threats and actions related to climate change, and data gathering/analysis/planning are contained within each of the habitat sections in the Ohio's Habitats chapter.