

**The Climate Project Screening Tool Report
for the Massachusetts Division of Fisheries and Wildlife's
Central District**



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Introduction

As the influence of climate change increases, it is important to consider how adaptation techniques can be integrated into current natural resource management to reduce vulnerabilities to wildlife and their habitats over time. Climate change adaptation in the near term is essential because, owing to inherent time lags in climate impacts, the effects of increased atmospheric greenhouse gases will be felt for decades even if effective mitigation begins immediately (Melillo et al. 2014). However, climate science is a particularly challenging field given the level of technical expertise required, its high degree of uncertainty, and the lack of knowledge of climate change impacts at biologically relevant scales. Thus, climate change adaptation, although understood to be important to resource management, has not been explicitly incorporated into most wildlife management plans or actions.

Some decision-support tools have been developed to aid climate change planning and preparedness in response to the needs of resource managers (Climate Change Resource Center 2017). One such decision-support tool is the Climate Project Screening Tool (CPST) (Morelli et al. 2012), developed initially to aid national forests in the early stages of incorporating climate concerns into operational work and recently modified to aid fish and wildlife management in Massachusetts.

The CPST is a platform that natural resource managers can readily use to assess the potential impacts of climate change on projects and management goals. The CPST is a review and assessment tool that allows managers to explicitly and methodically consider current and impending projects and priorities through the lens of climate change. It provides space to assess whether a specific goal or project is appropriate in light of future climate trends. Through the

CPST process, some projects might be deemed inappropriate as originally designed and be recommended for comprehensive redesign or removal from activity lists.

The CPST is a broad tool that can be modified to accommodate many different working groups and management goals. For the Massachusetts Division of Fisheries and Wildlife (MassWildlife), the tool was modified to focus on projects within the Wildlife Management Areas (WMAs) owned by the agency. Within MassWildlife, there are 5 Districts (Central, Western, Connecticut Valley, Southeast, and Northeast), all with their own - and occasionally overlapping - WMAs for which they are responsible. Information about many of the WMAs, including key target species, can be found on the [Mass Wildlife Lands Viewer](#), although this information was not available at the time of these discussions.

This report focuses on the results of meeting with the Central District's Management team where the CPST was used to facilitate a discussion of climate change activities on select WMAs in the District. This report provides specific responses to the discussion and process questions as well as general findings and useful resources. Not all WMAs were discussed during the 3-hour meeting. Those not discussed can be analyzed using this Climate Project Screening Tool at a future date.

Methods

Overview of the CPST

The CPST is a table where the first column lists specific project or management activities of interest. Next, the tool provides a summary of climate change impacts relevant to the specific management activity, poses useful discussion and process questions, and provides space for response and record-keeping. Each management activity section concludes with a question of

whether to continue with the specific activity or not, and if so, if any portion of the activity should be modified.

CPST Column Descriptions

(See Figure 1 for the CPST layout and specific responses by managers at the meeting)

Project activities of focus for the discussion

- An important first step is to identify the appropriate scale at which relevant activities will be evaluated. To this end, all management activity categories were identified from the Federal Aid report produced by MassWildlife. District managers were asked to fill out a spreadsheet identifying which activities were being considered or actively done on each WMA. This process allowed the CPST to be tailored to each District and provided a coherent and efficient structure for the meeting.

General climate change trends and local impacts

- Information about projected climate and ecosystem responses can be gathered from many sources and summarized for key indicators of relevance to the local environment. The scientific literature (including a report done specifically for the northeastern states, see Useful Resources) and experts at the Department of Interior Northeast Climate Science Center were the primary sources for local climate data for this report. The purpose of this summary is to give managers a broad sense of anticipated and ongoing changes in climate and related ecological responses throughout their District. The local impacts focus on effects at a scale that is relevant to project design and highlight appropriate changes to the project.

Key questions for managers

- The purpose of this column is to facilitate thinking about the potential impacts of climate change on a specific project type. The questions used to guide the discussion were originally developed through meetings with US Forest Service resource specialists and then modified with MassWildlife staff. Additionally, information on some project activities was gathered from the MassWildlife website. After the questions were used in the first meeting (with the Central District), modifications were made to enhance relevance in future meetings.

Response narrative

- The response narrative in the fourth column is the centerpiece of the CPST, where managers or facilitators record their answers to the questions and thus their thinking about the interaction between climate change and the project. Users are encouraged to identify and document sources for their answers.

Continue with project?

- The last column is where the user concludes whether to proceed with, modify, or cancel the project given the response narrative. It is intended as a recommendation regarding whether or not climate change impacts are likely to be: 1) insignificant enough to proceed as originally designed, 2) substantial enough to require modification to the proposed activities, or 3) whether the project cannot be adequately modified given relevant climate change effects and thus should be withdrawn. Selection and documentation of one of the three recommendations can then become part of a public report on how resource managers considered climate change prior to project implementation.

Table 1. Climate Project Screening Tool with responses from the Central District

Project Activity	Climate Change Trends and Local Impacts (for more information: climateactiontool.org)	Key Questions for Managers	Response Narrative (please complete)	Continue with Project?
Stream Restoration & Culvert Removal	<p>Trends – Reduced snowpack, thus earlier winter-spring peak flows; wetter springs with more flooding; longer, drier summers, though with heavier rainfall events and thus increased risk of flooding, exacerbated by decreased imperviousness from drier soils</p> <p>Local Impacts – Vegetation and wildlife species movement; reduced water storage in soils; changed hydrologic regimes</p>	<ul style="list-style-type: none"> Will the hydrologic system change from perennial to intermittent over time: e.g., what is the future range of flow? 	Lackey Pond: <ul style="list-style-type: none"> DFW can modify the dam release/retain water. 	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes, with modification:
		<ul style="list-style-type: none"> Can this area (or project) withstand extreme weather events? Events more extreme than those currently experienced? 	Lackey Pond: <ul style="list-style-type: none"> Perhaps? In 2016 Irene and drought occurred and the project was unharmed. For more extreme events, maybe, but release valve is controlled by Office of Dam Safety 	
		<ul style="list-style-type: none"> Are current plant/wildlife species viable in the future given changes in water temperatures? 	<ul style="list-style-type: none"> Currently managing generally as a wetland and specifically for wood ducks. Wood ducks will be fine given future projected changes. If wood duck boxes will continue, they can be adjusted to consider lack of frozen water in winter and changes in water level (raise wood duck boxes) 	
		<ul style="list-style-type: none"> Is the restoration area vulnerable to increased fire events and/or erosion? 	<ul style="list-style-type: none"> no Lackey Pond: <ul style="list-style-type: none"> No, the area has very little upland. 	
		<ul style="list-style-type: none"> Is this culvert a barrier to species tracking climate change? 	Thayer Pond: <ul style="list-style-type: none"> not at this time. Not a great producer of wood ducks/breeding Lackey Pond:	

			<ul style="list-style-type: none"> dam is newly renovated. Not coming out/going to be removed any time soon. Barrier to some species? 	
Vegetation Control – mowing, hand cutting, herbicide	<p>Trends – Increased fuel buildup and risk of wildfire; increased interannual variability in precipitation, leading to fuels build up and causing additional forest stress; increased stress to forests during periodic multi-year droughts;</p> <p>Local Impacts – Densification of vegetation; increased invasive aquatic, plant, and forest pests; earlier and longer growing season</p>	<ul style="list-style-type: none"> Will the activity be sufficient to control invasives that grow larger and more abundantly? 	<ul style="list-style-type: none"> uncertain, current activities include spraying and mowing. Calendar updates for optimal times to do such activities are needed 	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes, with modification:
		<ul style="list-style-type: none"> Does the project area include anticipated future vulnerable areas (i.e. higher elevation sites, riparian areas, soil types or ecosystems not previously recorded as invaded)? 	<ul style="list-style-type: none"> no, none known currently 	
		<ul style="list-style-type: none"> Will the treatment season need to be adjusted for the earlier growing season? 	<ul style="list-style-type: none"> yes, adjustments need to be made given arrival and departure of birds nesting in the open areas. Climate change will benefit the need to mow because machinery operates better in cooler weather and reduction of snow allows mowing to occur in the winter. 	
		<ul style="list-style-type: none"> Will additional invasives require more work hours to control? 	<ul style="list-style-type: none"> yes 	
Reforestation/ Restoration	<p>Trends – Increased stress to trees during periodic summer droughts; reduced snowpack; increased invasive insects and disease</p> <p>Local Impacts – Increased risk of tree mortality; changes</p>	<ul style="list-style-type: none"> Will local conditions change enough to alter the desired species composition? 	<p>Birch Hill, Muddy Brook:</p> <ul style="list-style-type: none"> Pine barren restoration plans. 	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes, with modification:

	in local species composition; species range shifts			
		<ul style="list-style-type: none"> Does tree planting density and spacing address anticipated water availability and mortality rates? 		
		<ul style="list-style-type: none"> Are there certain species or genetic pools of native species that are well suited for anticipated vulnerabilities? 		
Forest Thinning	<p>Trends – Increased fuel buildup and potential risk of wildfire; increased interannual variability in precipitation, leading to fuels build up and causing additional forest stress; increased stress to forests during periodic multi-year droughts; increased water temperatures in rivers and streams and lower water levels in late summer; decrease in water quality from increased sedimentation and warmer waters</p> <p>Local Impacts – Increased risk for erratic fire behavior; decreased window of opportunity for prescribed fire conditions; flashier, drier fuels; decreased water storage in soils</p>	<ul style="list-style-type: none"> Will the projected density of the stand after it has been thinned be able to withstand stressors? Does the spacing between trees need to increase? 	<ul style="list-style-type: none"> literature supports both trees closer together and trees farther apart when thinned. Healthier forest is a thinned forest/managed forest is the consensus. Spacing is not predicted to negatively impact the site <p>Phillipston:</p> <ul style="list-style-type: none"> So far invasives have not moved into thinned sites but they are being monitored. 	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes, with modification:
		<ul style="list-style-type: none"> Should stands be thinned at a more frequent interval to reduce forest stress or for changed growth patterns? 	<ul style="list-style-type: none"> another thinning should probably happen when time allows 	
		<ul style="list-style-type: none"> Does the project area include anticipated future vulnerable areas (i.e. higher elevation sites, or riparian areas, refugia)? 	<ul style="list-style-type: none"> Yes, Phillipston WMA is not seeing invasives threaten the newly thinned forest. 	
		<ul style="list-style-type: none"> Will the season of harvesting need to change given the reduced snow pack and extreme flood events to reduce ground disturbance? Will it need to change given shortening and less reliable winters? 	<ul style="list-style-type: none"> Yes, reduced snowpack and warmer winters make it more difficult to enter the forest with heavy machinery to conduct treatments 	

<p>Aquatic and Wildlife Species Restoration</p>	<p>Trends – Loss of seed and other germplasm sources as a result of population extirpation events; increased water temperatures in rivers and streams and lower water levels in late summer; reduced snowpack; longer, drier summers, decreased water quality as a result of increased watershed erosion; general shifts in temperature ranges; chance of fire; increased insect and disease</p> <p>Local Impacts – Historical availability of food and water sources may be altered geographically and temporally; suitable range of habitat may alter with changing forest stand structure (wildfire, species extirpation)</p>	<p>Terrestrial</p> <ul style="list-style-type: none"> • Are the plant/wildlife species viable in the future given changes in food and water availability, as well as the range of future habitat? 	<p>Muddy Brook</p> <ul style="list-style-type: none"> • Moose, turkeys, deer, and pheasant are moving into the area. Habitat has been improved/created to encourage the presence of moth through the planting of New Jersey Tea, and building black racer hibernacula 	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes, with modification:
		<ul style="list-style-type: none"> • What is the future range of habitat for the target species? 	<ul style="list-style-type: none"> • Species are of concern and thus habitat is being improved/created to encourage their presence. 	
		<ul style="list-style-type: none"> • How will breeding, young, and forage seasons be altered with the changing habitat and climate? Will hunting seasons need to be altered? 	<ul style="list-style-type: none"> • While hunting seasons may need to be altered it is difficult since those decisions are also made with regards to other concerns than specifically species timing • Modifications in stocking have been made due to increased water temperature • Mowing times have been adjusted and/or considered given timing of nesting birds 	

Nesting Structures – Development and Maintenance	<p>Trends – Reduced snowpack; earlier green-up; longer, drier summers, general shifts in temperature ranges; increased insect and disease</p> <p>Local Impacts – Historical availability of food and water sources may be altered geographically and temporally; suitable range of habitat may alter with changing forest stand structure and temperature and precipitation regimes</p>	<ul style="list-style-type: none"> Are the plant/wildlife species viable in the future given changes in food and water availability, as well as the range of future habitat? 	<ul style="list-style-type: none"> Yes, most nesting structures were designed for wood ducks which over the last 10 years have become more abundant. Wood ducks are predicted to continue to persist. 	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes, with modification:
		<ul style="list-style-type: none"> Are target species arriving earlier? 	<ul style="list-style-type: none"> Species of migratory grassland-nesting birds are arriving earlier 	
		<ul style="list-style-type: none"> Are target species using different habitats? 	<ul style="list-style-type: none"> Yes, over the last 10 years wood ducks been very successful at finding and utilizing habitat other than the next boxes 	
		<ul style="list-style-type: none"> Will the future habitat of the focus species still consist of the current location? 	<ul style="list-style-type: none"> Yes 	
Maintenance and Construction: Roads and Trails, Dams, Bridges, Parking Lots, Blinds, Signs, Boundary Markers, Gates/Access Management	<p>Trends – Increased interannual variability in precipitation; more extreme flood and other weather events; decreased water quality as result of increased watershed erosion and sediment flow; increased likelihood of severe flood; increased risk of fire</p> <p>Local Impacts – Changed hydrologic regimes; soil disturbance due to increased runoff and movement of waterways; likelihood of road washouts and closures increase; storm events exacerbate sedimentation and erosion from burned areas</p>	<ul style="list-style-type: none"> Given that hydrologic regimes are changing, are your crossings designed and engineered to withstand the predicted changes? 	<ul style="list-style-type: none"> Dams/culverts in place are working well 	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes, with modification:
		<ul style="list-style-type: none"> Is the project located at the right location to reduce watershed erosion and sediment flow or other impacts? 	<ul style="list-style-type: none"> Yes 	
		<ul style="list-style-type: none"> Will current road structures/surface treatments be able to withstand the more severe flood events (and possible erosion) predicted in the future? 	<p>Merrill Pond:</p> <ul style="list-style-type: none"> Such issues are being considered <p>Thayer Pond:</p> <ul style="list-style-type: none"> Currently draining and moving water well but could have difficulty with flooding in the future 	

		<ul style="list-style-type: none"> How is the surrounding topography and vegetation being considered regarding future climate trends? 	<ul style="list-style-type: none"> The surrounding topography is not being directly considered. Lackey Pond: Site is very resilient and holding up well in current conditions 	
Public Access Management	<p>Trends – Increased interannual variability in precipitation; more extreme flood and other weather events; decreased water quality as result of increased watershed erosion and sediment flow and warmer waters; increased likelihood of severe flood; increased risk of fire</p> <p>Local Impacts – Changed hydrologic regimes; soil disturbance due to increased runoff and movement of waterways; likelihood of road washouts and closures increase; storm events exacerbate sedimentation and erosion from burned areas; suitable range of habitat may alter with changing temperatures, precipitation, and forest stand structure (wildfire, species extirpation)</p>	<ul style="list-style-type: none"> Is current infrastructure resilient given increased extreme events (floods and potentially hurricanes)? Will flooding, drought, and other extreme weather events make it more difficult to manage public access? Will more personnel hours be needed to manage public access given future climate trends? For hunting, have shifts in target species distribution, vulnerability, and phenology (timing of reproduction, migration) been considered? 	<ul style="list-style-type: none"> yes Flooding of sites may make it more difficult for public access during select times of the year Uncertain but probably yes Yes, have been considered and are still being considered. Currently trout stocking is being affected by water temperature and the date had to be adjusted. 	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes, with modification:
Fruit Trees – Prune and Release	<p>Trends – Increased stress to trees during periodic summer droughts; reduced snowpack; increased invasive insects and disease</p>	<ul style="list-style-type: none"> Will local conditions change enough to alter the desired species composition? 	<ul style="list-style-type: none"> Species of cultivated trees are not being planted. Phillipston: Some low bush blueberries 	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes, with modification:

	<p>Local Impacts – Increased risk of tree mortality; changes in local species composition; geographic movement of species</p>		<p>have been planted into recently-thinned forest understory as a native planting that benefits wildlife. They are anticipated to survive for their normal life span.</p>	
		<ul style="list-style-type: none"> • Will new trees be planted if old ones die or perform goals poorly given future climate trends? 	<ul style="list-style-type: none"> • No, grafted/commercial strains of fruit trees will not be planted if others die. The current ones are maintained as mast for species but there isn't enough time to really keep up with release and pruning as is. 	
		<ul style="list-style-type: none"> • Will present uses of the fruit trees persist under new climate models? 	<ul style="list-style-type: none"> • Yes, probably through the end of their naturally productive timeline 	
		<ul style="list-style-type: none"> • Are there certain species or genetic pools of native species that are well suited for anticipated vulnerabilities? 	<ul style="list-style-type: none"> • Yes, potentially a new strain of chestnut will be available for planting in the future 	
<p>Agricultural License Agreements</p>	<p>Trends – Increased interannual variability in precipitation; more extreme flood and other weather events; decreased water quality as result of increased watershed erosion and sediment flow; increased likelihood of severe flood; increased risk of fire</p> <p>Local Impacts – Changed hydrologic regimes; soil disturbance due to increased runoff and movement of waterways; likelihood of road washouts and closures increase;</p>	<ul style="list-style-type: none"> • In what ways do current policies regarding ag. license agreements consider future climate trends? 	<ul style="list-style-type: none"> • Leases dictate when farmers can harvest grass in order to protect breeding birds. • Dates and agreements may need to be re-considered soon in light of changes in fledging and migration patterns 	<p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes, with modification:</p>
		<ul style="list-style-type: none"> • Will climate change trends influence the level of involvement DFW has with lease holders and the properties? 	<ul style="list-style-type: none"> • It may, depending on what the lease holder wants to utilize the property for. • Hunters and lease holders can conflict on land use goals. Climate change may create more undesired interactions/conflicts 	

	<p>storm events exacerbate sedimentation and erosion from burned areas; suitable range of habitat may alter with changing temperatures, precipitation, and forest stand structure (wildfire, species extirpation)</p>	<ul style="list-style-type: none">• Should climate create a more favorable environment for agricultural land, will more properties be converted to agricultural land?	<ul style="list-style-type: none">• No, lease agreements are more of a burden than a benefit	
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Results

Overview

The facilitator team met at the Central District office in West Boylston, MA, with 3 Central District staff from MassWildlife: District Manager Bill Davis, Wildlife Biologist Mike Morelly, and Stewardship Biologist Scott Kemp. Meetings centered around management activities that were identified for a given WMA. The purpose of this design was to encourage the discussion of multiple WMAs when thinking about a specific management activity as well as to ensure that each type of management activity occurring within the District was discussed at least once.

Conversation flowed from specific questions in the CPST to a broader discussion of issues related to climate change to other issues faced by the District, and then back to the tool questions in a cyclical pattern until all questions in the management activity section were asked. An interesting secondary result of this meeting was that other management issues were identified, such as bigger picture questions about the continued utility of wood duck boxes. This secondary result was an unintended but beneficial outcome of considering climate change impacts on Agency lands. Many of the comments, activities, and concerns faced by one District were echoed at other Districts as well. These similarities and overlaps are included in this report (see Table 2).

The CPST allows Districts to document that they are thinking about climate change when making management decisions, whether they then choose to modify current activities or not. Deciding that continuing with the current activities, or lack of activities, for now is sometimes the appropriate choice at the end of the process. The critical step is to take time to consider climate change - within daily activities and larger-scale plans.

Interesting Findings

- Perceptions around dams: dams cannot be altered or removed without permission of Office of Dam Safety. Additionally, should destruction downstream of the site occur as a result of dam removal, the District would be held responsible. This perception creates an unfortunate barrier to management.
- The Central District cannot access many reports and documents in the MassWildlife database because of the internet speed at the District office.
- Many of the activities and overall goals of the Central District WMAs are prescribed by larger management plans or regional goals developed at the Headquarters office in Westborough, MA by John Scanlon or habitat or wildlife experts. Without coordination and communication, this could create a gulf between plans and execution.

Climate Change Adaptation Techniques Already in Use

- Trout stocking dates have been modified according to the water and air temperatures rather than releasing on a specific calendar date.
- Mowing open grasslands in the winter is becoming more of a realistic possibility given that snowfall happens less frequently. Mowing in cooler temperatures is better for the mower engines because it mitigates overheating.

Using the Climate Action Tool

When faced with challenges to effective management as a result of climate change, the Massachusetts Wildlife Climate Action Tool (CAT, <https://climateactiontool.org>) can be particularly useful to District Managers. The CAT was developed in partnership by MassWildlife, the University of Massachusetts-Amherst, the Department of Interior's Northeast Climate Science Center, and the U.S. Geological Survey's Massachusetts Cooperative Fish and Wildlife Research Unit, so the information within is specifically geared towards the Commonwealth. The CAT includes information on climate impacts, vulnerability of species and

habitats, and adaptation actions that can be taken. It was developed using a literature review of the most recent scientific findings as well as new expert input.

District staff can use the CAT to find species-specific information that can be relevant to management goals. For example, the Central District has a goal to manage for wetland species at the Phillipston WMA by encouraging proper water flow, monitoring for invasives, and executing silvicultural prescriptions. If a manager was interested in knowing how to achieve that goal while being mindful of the effects climate change may have on their activities, they could look at the CAT website to find information on vulnerability, stressors, and adaptation strategies available.

A number of potential adaptation strategies and actions are included in the CAT that managers could refer to when considering forest management, coastal habitat restoration, or how to promote connectivity among WMAs. Please see Appendix 2: Additional Resources for examples. Since the CAT is a place to showcase existing expertise and practices, it could be modified to include some of the actions being undertaken by District staff as examples.

Next Steps

For the WMAs that were not discussed, the CPST can be used by District staff without facilitation for future projects and plans. A manager can complete it by him- or herself or with others on a team; we found great value in having multiple members of the staff present to share their input and often to spark and deepen the dialogue. This also creates buy-in for the implementation of actions. The versatility and simplicity of the CPST allows it to be useful in more than just a few select scenarios and times. A complete copy of the CPST developed for MassWildlife is available with this report.

Lastly, as its name indicates, the purpose of the CPST as a screening tool became apparent when the need for additional time to develop coherent climate change adaptation for

some management activities and WMAs was identified. For projects such as these, the Climate Adaptation Workbook (see Appendix 2) was mentioned, and the Workbook passed around. The in-depth nature of the Workbook appealed to attendees and there is interest in planning a training day at the Headquarters office, to learn how to use and implement it. The CPST could be considered a first step and its completion can facilitate and enhance the use of the Adaptation Workbook for projects that would benefit from more in-depth discussion and detailed planning

Conclusions

Using the CPST to facilitate a discussion of climate change impacts on current and planned management activities highlighted multiple results. In many cases, management professionals did not initially identify any ways in which they were modifying their work because of climate change and, in some cases, they did not readily identify ways climate change was affecting their work. However, upon further discussion, it became clear that observations of climate change and modification of activities were occurring, just not explicitly labeled as such. Through the course of the discussion, it also became clear that agency-wide policies on climate change would be helpful or, if already in existence, these could be communicated to Districts in a more comprehensive way. As such, it would be particularly important to have both District and Division Headquarters staff present at the meeting.

Overall, the CPST meetings provided a block of time for on-the-ground managers to pause in an otherwise busy schedule and directly consider climate change as it relates to their daily projects. The goal of these meetings was to facilitate this examination and encourage thoughtful planning for current and future management activities. In this way, work hours and

physical resources can be used most effectively to protect and manage Massachusetts' lands and wildlife resources in a changing climate.

Appendices

Appendix 1: WMAs Not Discussed

Ashby WMA	Nineteenth Hill WMA	Fish Brook WMA	Martha Deering WMA	Raccoon Hill WMA
Barre Falls WMA	Oakham WMA	Four Chimneys WMA	McKinstry Brook WMA	Richardson WMA
Bennett WMA	Palmer WMA	High Ridge WMA	Millers River WMA	Savage Hill WMA
Bolton Flats WMA	Popple Camp WMA	Hitchcock Mountain WMA	Mine Brook WMA	Scripture Hill WMA
Breakneck Brook WMA	Poutwater Pond WMA	Hubbardston WMA	Moose Brook WMA	Squannacook River WMA
Chockalog Swamp WMA	Prince River WMA	Hunting Hills WMA	Moose Hill WMA	Stone Bridge WMA
Clinton Bluff WMA	Quaboag WMA	Lawrence Brook WMA	Mt. Pisgah WMA	Sucker Brook WMA
Coy Hill WMA	Quacumquasit WMA	Leadmine WMA	Mulpus Brook WMA	Tully Mountain WMA
E. Kent Swift WMA	Quisset WMA	Long Pond WMA	Winchendon Springs WMA	Ware River WMA
Wayne F. MacCallum WMA	West Hill WMA	Whortleberry Hill WMA	Wolf Swamp WMA	Winimusset WMA

Appendix 2: Additional Resources

- Massachusetts Wildlife Climate Action Tool <http://climateactiontool.org> - For specific information on species and habitat vulnerability, climate trends in Massachusetts, and adaptation strategies and actions. Example pages below.
 - Species
 - Brook trout - <https://climateactiontool.org/species/brook-trout>
 - Moose - <https://climateactiontool.org/species/moose>
 - American Black duck - <https://climateactiontool.org/species/american-black-duck>
 - Habitats

- Vernal pools - <https://climateactiontool.org/ecogroup/freshwater-wetlands-vernal-pools>
- Spruce Fir forest - <https://climateactiontool.org/ecogroup/forest-spruce-fir>
- Coldwater fisheries streams - <https://climateactiontool.org/ecogroup/rivers-and-streams-coldwater-fisheries-resources-streams>
- Adaptation Actions
 - Culvert upgrades <https://climateactiontool.org/content/maintain-habitat-connectivity-retrofit-or-replace-culverts>
 - Riparian restoration for coldwater streams <https://climateactiontool.org/content/ensure-cool-water-temperatures-protect-and-restore-riparian-areas>
 - Promote species in the northern and middle edge of their range <https://climateactiontool.org/content/promote-drought-and-heat-tolerant-species-encourage-species-northern-and-middle-edge-range>
- Adaptation Workbook <https://adaptationworkbook.org> - A process to consider climate change impacts and design adaptation actions. Similar to this CPST, but for a deeper dive into climate change planning for a WMA.
- Vulnerability Assessment of MA Species of Greatest Conservation Need (2017) <https://necsc.umass.edu/projects/vulnerability-northeastern-wildlife-climate-change-using-decision-science-inform-manageme-0>
- North Atlantic Aquatic Connectivity Collaborative (NAACC) streamcontinuity.org – [Database](#) and background information on culvert assessment and prioritization.
- The Deerfield Stream Crossings Explorer SCE.ecosheds.org – Tool to locate and prioritize road-stream crossings. Include ecological data (aquatic connectivity from the NAACC, coldwater streams) and transportation vulnerability data (risk of failure and EMS delays) for Deerfield Watershed. Some of the data will be expanded to the entire state in the next few months.
- [Climate Change Resource Center](#) – Website run by the United States Forest Service containing general information about climate change. The website also has a section with specific tools that can be utilized when trying to make decisions in response to or monitor impacts of climate change. There is even a section which allows users to search for specific tools based on needs and geographic location.
- Northeast [Regional Invasive Species and Climate Change \(RISCC\) Management network](#) <http://people.umass.edu/risc> - Northeast Climate Science Center initiative to address the question “How can we manage for upcoming biological invasions in the light of climate change?”
- [Integrating Climate Change into Northeast and Midwest State Wildlife Action Plans](#) <https://necsc.umass.edu/projects/integrating-climate-change-state-wildlife-action-plans>
- Climate Change Tree Atlas and Bird Atlas <http://www.fs.fed.us/nrs/atlas/> - Includes current and possible future distributions for over 100 tree and bird species in the Eastern US.

Works Cited

- Climate Change Resource Center. 2017. United States Department of Agriculture – United States Forest Service. *Climate Change and Carbon Tools*. <https://www.fs.usda.gov/ccrc/tools>.
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