THE MASSACHUSETTS CLIMATE ACTION TOOL

Inspiring local action to protect natural resources in a changing climate

Massachusetts Wildlife Climate Action Tool:

Inspiring local action to protect the Commonwealth's natural resources in a changing climate

Project of the Mass Climate Adaptation Partnership involving:

- MA Division of Fisheries and Wildlife
- UMass Amherst Center for Agriculture, Food and the Environment
- MA Cooperative Fish and Wildlife Research Unit
- DOI Northeast Climate Science Center

Diverse team of expert partners

Acknowledgments

This tool was developed by the Climate Action Tool Development Team:

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- Hector Galbraith, EcoSolutions
- Ambarish Karmalkar, DOI Northeast Climate Science Center, University of Massachusetts - Amherst
- Mikaela Heming, University of Massachusetts - Amherst
- David Paulson, Massachusetts Division of Fisheries and Wildlife

Objective

Make science accessible for people active locally and regionally by providing -

- Dynamic website tool platform that can be expanded
- Information about climate change impacts
- Vulnerabilities of various fish, wildlife, and habitats
- Adaptation actions that can be taken in the face of climate change

Photo Bill Byrne

Key Principles

- Research-based information vetted by scientists
- Promote adaptation actions that can be taken at a local level
- Acknowledge uncertainty
- A dynamic platform for information on climate change from diverse partners
- Use language suitable for target audiences

Target Audiences

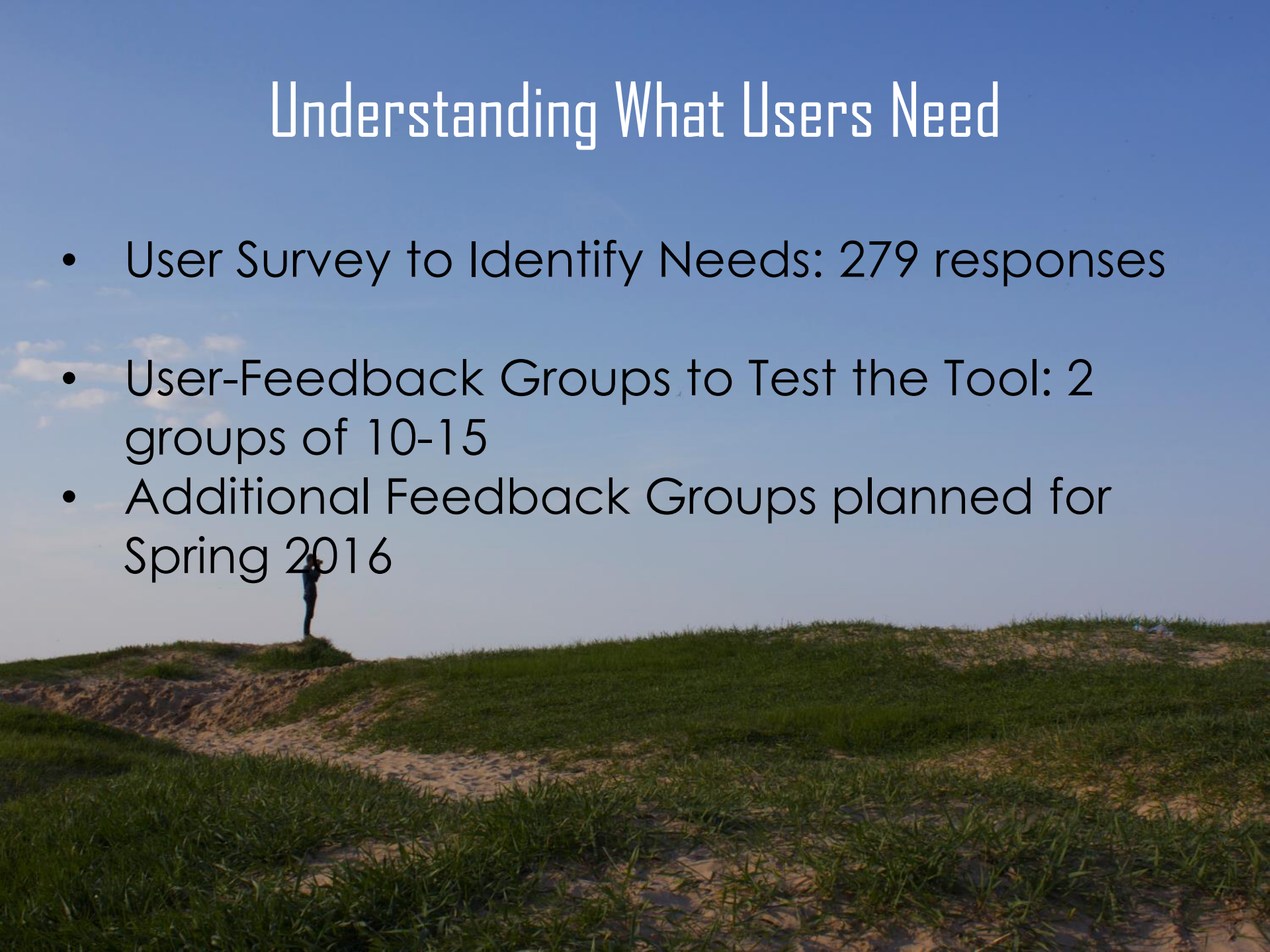
- Municipal government (conservation commissions, open space committees, departments of public works)
- Local conservation organizations (land trusts, watershed associations)
- Regional planning authorities (RPAs)
- Landowners and individual citizens looking to take action on climate change

Phase 1 – what's currently included

- Initial focus on fish, wildlife, habitats
- Spatial data (map viewer)
- MA climate change projections and implications
- Climate and other stressors to be addressed for us to adapt to climate change
- Vulnerability assessments
- On-the-ground adaptation actions
- Expandable site design to accommodate additional content

Understanding What Users Need

- User Survey to Identify Needs: 279 responses
- User-Feedback Groups to Test the Tool: 2 groups of 10-15
- Additional Feedback Groups planned for Spring 2016



Massachussetts Wildlife

CLIMATE ACTION TOOL

Select your topic of interest to learn how climate change is affecting your community's fish, wildlife, and other natural resources. Use the tool to explore and plan climate change adaptation actions.

I'm interested in...

- LEARNING ABOUT CLIMATE CHANGE
- FISH & WILDLIFE
- FOREST RESOURCES
- WETLAND & AQUATIC RESOURCES
- PROTECTING LAND
- MANAGING MY LAND
- ROADS & OTHER INFRASTRUCTURE
- IMPROVING POLICY, LAWS & REGULATIONS
- LAND USE PLANNING
- STARTING WITH TOWN OR WATERSHED

MassWildlife Massachusetts Division of Fisheries & Wildlife | NE CSC Northeast Climate Science Center | The Center for Agriculture, Food and the Environment | UMASS AMHERST

Massachussetts Wildlife
CLIMATE ACTION TOOL

QUICK START | ABOUT US | USER GUIDE | CONTACT & FEEDBACK

- LEARNING ABOUT CLIMATE CHANGE
- FISH & WILDLIFE
- FOREST RESOURCES
- WETLAND & AQUATIC RESOURCES
- PROTECTING LAND
- MANAGING MY LAND
- ROADS & OTHER INFRASTRUCTURE
- IMPROVING POLICY, LAWS, & REGULATIONS
- LAND USE PLANNING

- STARTING WITH TOWN OR WATERSHED

Select your topic of interest to learn how climate change is affecting [illegible] her natural resources. Use the tool to explore and plan clim[illegible]

I'm interested in…

- LEARNING ABOUT CLIMATE CHANGE
- FISH & WILDLI[illegible]
- [illegible]RESOURCES
- WETLAND & AQUATIC RESOURCES
- PROTECTING LAND
- MANAGING MY LAND
- ROADS & OTHER INFRASTRUCTURE
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NE CSC Northeast Climate Science Center
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Learning about Climate Change

Overall Trends in Climate Change | Uncertainty | Emission and Climate Scenarios | Climate Models | Interpreting Outputs | Projections Used | Other Resources | References

Overall Trends in Climate Change

The climate is changing rapidly in Massachusetts in ways that have already impacted fish, wildlife, and their habitats. These impacts will continue as climate change increases over the coming decades.

Warming is occurring in all seasons, with the greatest changes in winter, at higher latitudes, and potentially at higher elevations. Seasonal warming is extending the growing season, particularly with more frost free days occurring earlier in spring. Precipitation amounts are increasing, especially in winter. Warmer winters are also resulting in more precipitation falling as rain instead of snow, leading to reduced snowpacks - though stronger blizzards may lead to locally higher snowpacks in Massachusetts and New England. In the summer, heavier downpours combined with longer dry streaks are expected, increasing the risk of both droughts and floods. Sea level is also rising at a rapid rate along the Massachusetts coastline, leading to coastal flooding, which is compounded by increasingly intense coastal storms, such as hurricanes.

- Temperature changes
- Precipitation changes
- Changes in hydrology
- Changes in winter
- Sea level rise
- Storms and floods
- Change in timing of seasons

Climate changes over the past century can be explained through a combination of human and natural factors with the majority explained by

Climate Stressor Pages:

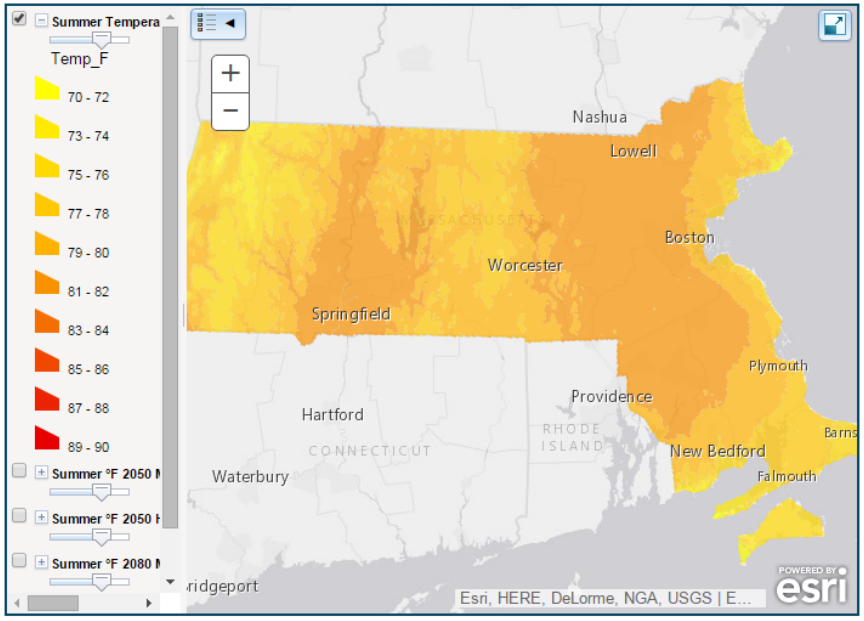
- Summary of historical and future trends
- Maps of current and projected conditions
- Additional graphics and resources
- Latest science synthesized by NECSC and partners

Stressors

Temperature changes

Annual and Seasonal Temperature Changes

The Earth's climate is warming. Global average annual temperatures have increased by 1.5° F since 1895, and the vast majority of this increase has occurred since 1980. The Northeast United States has experienced an increase in annual temperatures of 1.6°F over the last century. Warming has been occurring during all seasons, but has been greatest during winter (0.24°F/decade). Warming is also greatest at higher latitudes, elevations, and inland from the Atlantic coast.



Climate projections displayed in this map represent the average of the maximum air temperature (degrees F) for June, July, and August for the years 2010-2080...
Read More

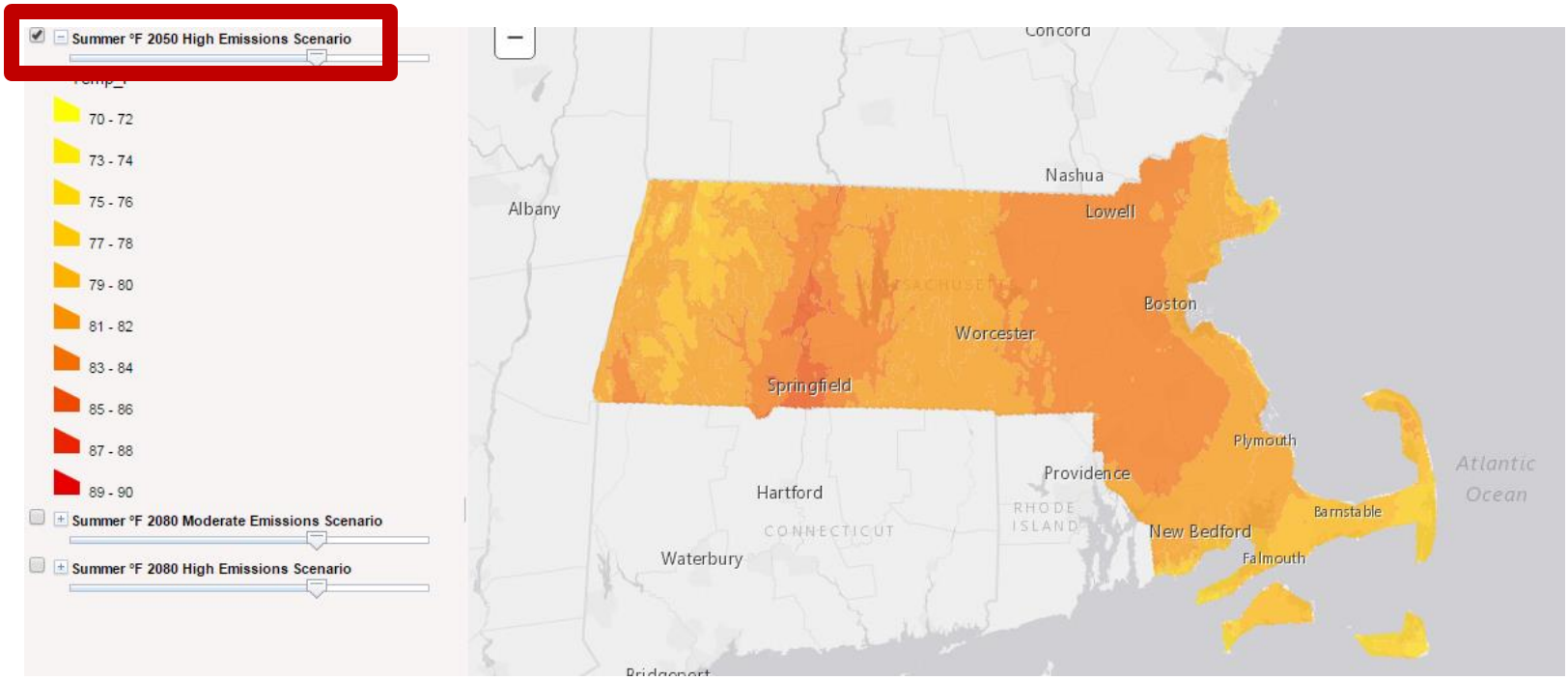
Future climate projections consistently show continued warming over the 21st century across Massachusetts and the entire New England region. All climate models agree that the warming trend will continue over the coming decades with high emission scenarios giving the greatest warming. However, for a given emissions scenario, the exact magnitude of warming varies slightly depending on the models used and their structure. Massachusetts is projected to see average temperature increases that exceed the global average, with potential warming of around 5°F annually by mid-century under a high emissions scenario. Model projections of future seasonal changes generally suggest winter will continue to show the greatest amounts of warming with increases up to 5°F by mid-century.

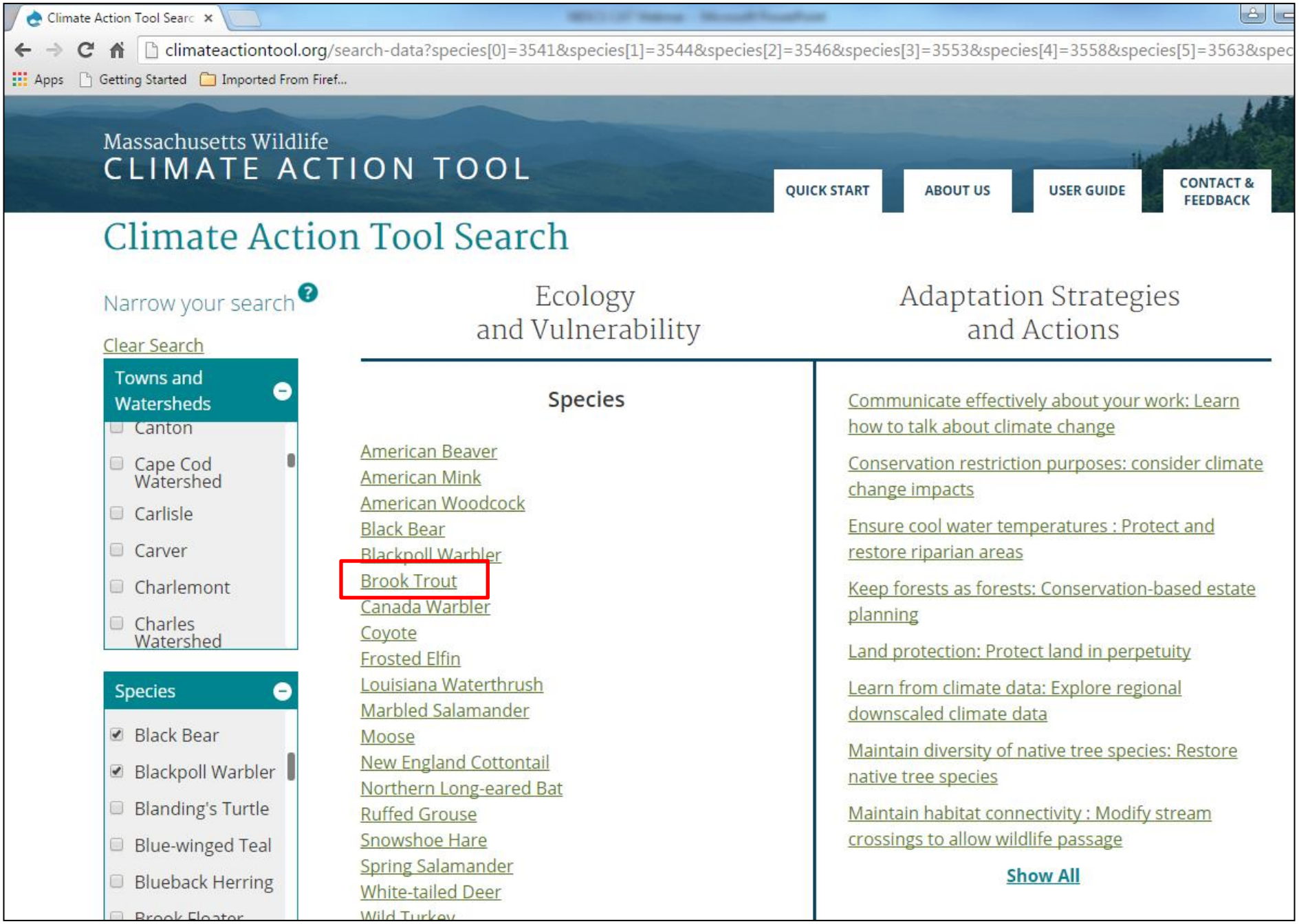
Extreme Temperature Events

Extreme temperatures in the form of heatwaves may become more frequent, more intense, and last longer. Extreme high temperature events are on the rise globally. Warmer night-time temperatures are driving this overall trend with fewer cold nights and more warm nights. However,

Climate Stressor Maps:

- Interactive layers
- Current conditions and future projections scaled to MA
- Low and high emission scenarios

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Apps
Getting Started
Imported From Firef...
Massachusetts Wildlife
CLIMATE ACTION TOOL
QUICK START
ABOUT US
USER GUIDE
CONTACT & FEEDBACK
Climate Action Tool Search
Narrow your search
Clear Search
Towns and Watersheds
Canton
Cape Cod Watershed
Carlisle
Carver
Charlemont
Charles Watershed
Species
Black Bear
Blackpoll Warbler
Blanding's Turtle
Blue-winged Teal
Blueback Herring
Brook Floater
Ecology and Vulnerability
Species
American Beaver
American Mink
American Woodcock
Black Bear
Blackpoll Warbler
Brook Trout
Canada Warbler
Coyote
Frosted Elfin
Louisiana Waterthrush
Marbled Salamander
Moose
New England Cottontail
Northern Long-eared Bat
Ruffed Grouse
Snowshoe Hare
Spring Salamander
White-tailed Deer
Wild Turkey
Adaptation Strategies and Actions
Communicate effectively about your work: Learn how to talk about climate change
Conservation restriction purposes: consider climate change impacts
Ensure cool water temperatures : Protect and restore riparian areas
Keep forests as forests: Conservation-based estate planning
Land protection: Protect land in perpetuity
Learn from climate data: Explore regional downscaled climate data
Maintain diversity of native tree species: Restore native tree species
Maintain habitat connectivity : Modify stream crossings to allow wildlife passage
Show All

View | Edit

Ecology and Vulnerability

Brook Trout

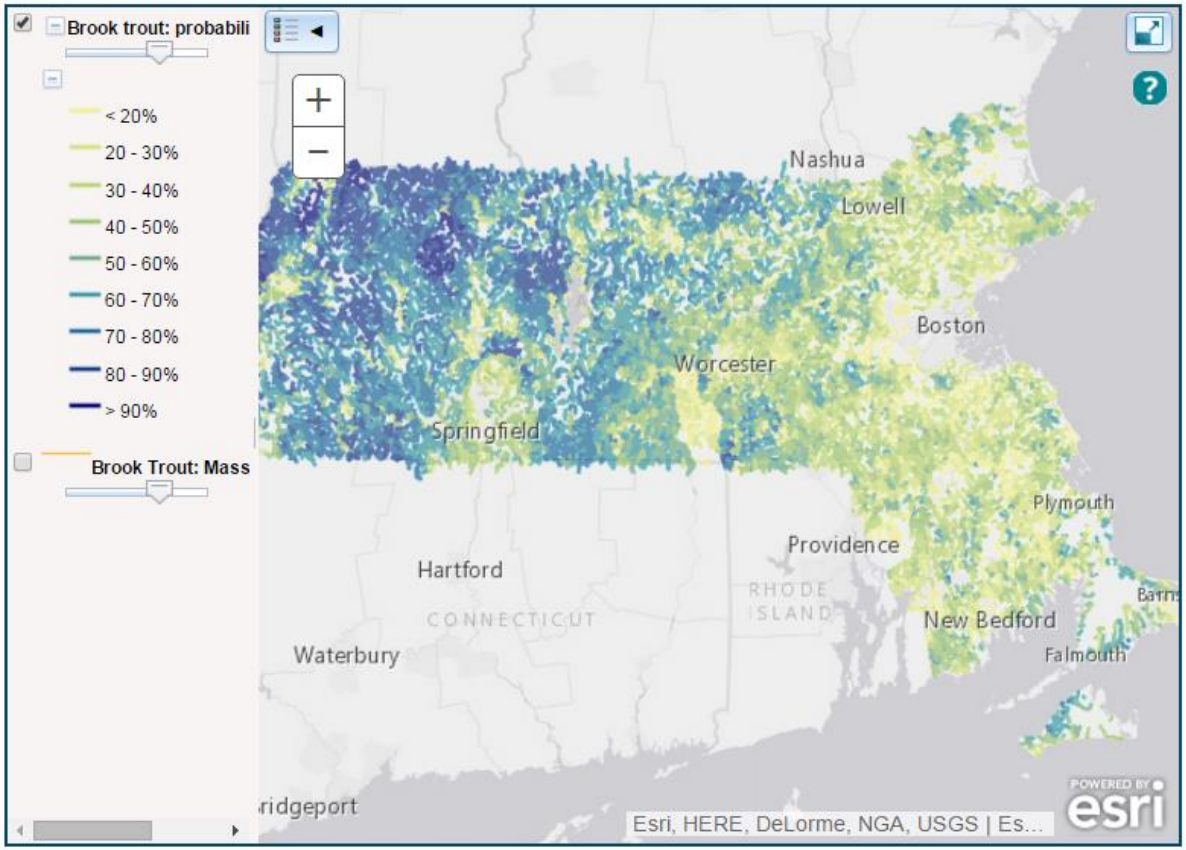
Photo credit: U.S. Forest Service

Scientific name:

Salvelinus fontinalis

Species stressors:

Aquatic connectivity loss (roads and dams)
Temperature changes
Changes in hydrology
Storms and floods
Change in timing of seasons
Invasive plants and animals
Pests and diseases



Brook trout probability of occurrence: The above map describes the current distribution of brook trout. Streams in blue are more likely to be inhabited by brook trout based on environmental...

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Profile: Brook Trout ▾

Background

Brook trout are an economically important game species throughout their native range, which extends south in the Appalachians to Georgia[1] and north to the Atlantic drainages of Newfoundland, Labrador, and Quebec[2]. Brook trout in Massachusetts are found primarily in streams that have cold, highly oxygenated water[3]. They generally do not tolerate extended periods of water temperatures above 20°C/68°F[3], and the ideal temperature for growth and activity is between 12-19°C (53.6-66.2°F)[4]. Because of their requirements for clean, cold water, brook trout have experienced extensive reductions in distribution and abundance because of habitat degradation[1]. In Massachusetts, wild, reproducing populations of brook trout have been greatly reduced and the majority that remain are restricted to isolated headwater streams[5].

Climate Impacts

This species' need for cold water implies that there is great potential for climate change to impact brook trout populations. Indeed, modeling studies conducted in various parts of its range, including parts of Canada[6], and in the southern Appalachians[7], suggest large reductions in future distributions for brook trout. Studies commonly have found that in streams where temperatures exceed 20°C/68°F for extended periods, brook trout are either at low abundance, or are absent altogether[8,9,10]. Brook trout begin to experience significant mortality as water temperatures approach 25°C/77°F[11]. However, studies have observed physiological indicators of heat stress in temperatures as low as 21°C/70/68°F[12]. These sublethal temperatures are accompanied by decreased feeding, growth, and reproduction[13,14]. In one Adirondack Lake with marginal temperatures for brook trout, warm temperatures in some years resulted in complete failure to reproduce[13].

Some studies have found that different strains of brook trout have different degrees of thermal tolerance, suggesting some limited capacity to adapt to higher temperatures[15]. Under such conditions, trout seek out thermal refuges such as inflows from cold tributaries or groundwater inputs, where they will aggregate until overall temperatures are more favorable[16]. However, on a broad geographic scale, distribution is largely defined by temperature constraints[16,17], suggesting that adaptive capacity is limited. Additionally, brook trout are able to persist in surprisingly small, isolated populations above barriers in headwater streams[18] so there is potential that these trout could continue to remain in isolated pockets in areas where larger populations decline[19]. While brook trout will likely not disappear from Massachusetts, reductions in suitable habitat are expected.

References:

[1]Hudy, M., T.M. Thieling, N. Gillespie, and E.P. Smith. 2008. Distribution, status, and land use characteristics of subwatersheds within the native range of brook trout in the eastern United States. North American Journal of Fisheries Management **28**:1069-1085.

[2]Ficke, A.D., D.P. Peterson, and W.A. Janowsky. 2009. Brook trout (*Salvelinus fontinalis*): a technical conservation assessment. USDA Forest Service, Rocky Mountain Region. Available: <http://www.fs.fed.us/r2/projects/scp/assessments/brooktrout.pdf>. (Accessed on 20 May 2015).

[3]Hartel, K.E., D.B. Halliwell, and A.E. Launer. 2002. Inland Fishes of Massachusetts. Massachusetts Audubon Society, Lincoln, MA.

[4]Waco, K.E., and W.W. Taylor. 2010. The influence of groundwater withdrawal and land use changes on brook charr (*Salvelinus fontinalis*) thermal

Climate Change Vulnerability Assessment: Brook Trout (North Atlantic Coast)
Ranking: Moderately Vulnerable
Confidence: Moderate
Climate scenario: SRES A1B (Mid-range emissions scenario)
Location: North Atlantic Coast
Time period: 2050

This species was identified as moderately vulnerable to climate change because of the following factors:

- Anthropogenic (human-made) and natural barriers prevent dispersal or shifts in species' range
- Sensitive to changes in temperature
- Sensitive to changes in precipitation
- Has already experienced slight variations in annual precipitation (over the last 50 years)
- Slightly impacted by changes due to human response to climate change

The factors below decrease this species' vulnerability to climate change:

- Ability to move across the landscape and/or disperse relatively long distances

What is a Climate Change Vulnerability Assessment?

References

Sneddon, L. A., and G. Hammerson. 2014. Climate Change Vulnerability Assessments of Selected Species in the North Atlantic LCC Region. NatureServe, Arlington, VA. Available from: http://northatlanticlcc.org/projects/completing-northeast-regional-vulne...

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