Massachusetts Wildlife

No. 1, 2017

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State
Wildlife
Action
Plan

Special Issue

Endangered Species Need Your Help!

Did you know that over 400 plants and animals are imperiled in Massachusetts and protected by the Massachusetts Endangered Species Act (MESA)? MassWildlife's Natural Heritage & Endangered Species Program (NHESP) focuses on the conservation of these rare native species and their habitats. By working together with citizens throughout the Commonwealth, we can ensure that these plants and animals have a future in Massachusetts—and they will be here for future generations as part of our natural heritage.

With hundreds of listed species and thousands of square miles of habitat to monitor, protect, restore, and manage, NHESP depends largely on grants and contributions to fund its staff and balance its budget. Citizen contributions to the Natural Heritage & Endangered Species Fund—whether through the state income tax check-off or direct contributions—are critical to our endangered species recovery efforts.

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From managing globally rare plants such as Sandplain Gerardia and New England Boneset on Cape Cod, to federally endangered Bog Turtle populations in the Berkshires, and many species in between, your contribution makes a difference.

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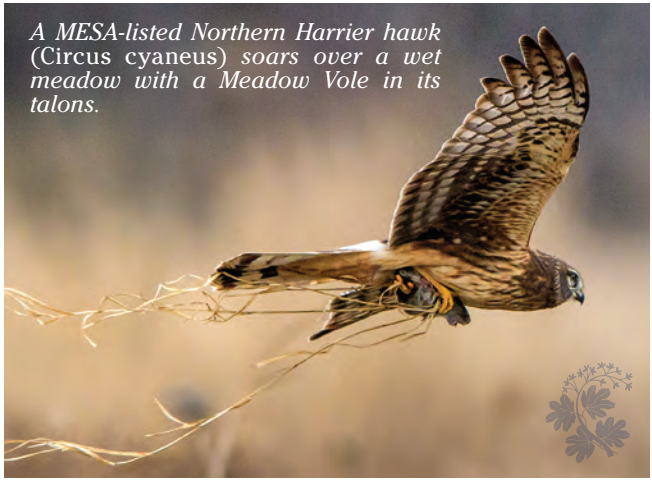

A MESA-listed Northern Harrier hawk (Circus cyaneus) *soars over a wet meadow with a Meadow Vole in its talons.*

Photo © Bill Byrne

MASSWILDLIFE

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MASSACHUSETTS WILDLIFE

Vol. 67 No. 1

FEATURES

On the Cover: Leaving her nest on Webster Lake, a Bald Eagle (*Haliaeetus leucocephalus*) resumes her shared duty of providing fish for two active chicks. The Bald Eagle (MESA-listed) is one of 570 Species of Greatest Conservation Need listed in the SWAP. Photo © Bill Byrne

Editorial

State Wildlife Action Plan

The Green River in Alford is one of 1,300 Coldwater Fish Resources in Massachusetts that provide critical habitat for a myriad of aquatic and terrestrial SWAP-listed species.

This special issue of *Massachusetts Wildlife* is devoted to the recently approved State Wildlife Action Plan (SWAP). The SWAP represents both a vision and road map for protecting and maintaining the Commonwealth's wildlife and fisheries diversity into the next decade. The SWAP identifies wildlife and plant Species of Greatest Conservation Need and includes recommendations on the steps necessary to manage and conserve these species and their habitats. Active habitat management, such as mowing, forestry, and prescribed fire, is a key component of the SWAP. As the lead agency, MassWildlife developed the plan with a broad range of conservation partners. The substance and scope of the SWAP is a testament to the commitment and collective vision of MassWildlife's professional staff and our partners.

The SWAP can play a key role in our future as a functioning, vigorous society. Many times and in many ways conservationists have developed tortured rationalizations for society's investment in fisheries, wildlife and land protection. The SWAP should be embraced as an integral planning document that addresses our "green infrastructure" alongside transportation and infrastructure planning, housing, economic development and public health.

Open space protection and healthy wildlife populations are not just an added value to our society but rather should be viewed as essential to a healthy lifestyle for people—now and into the future. A growing body of medical evidence supports this connection. Moderate exposure to nature results in significant health benefits, such as reduced stress, lowered blood pressure and improved mental health, all of which can prevent disease. Nature is a free prescription for what ails us.

In the not-too-distant future, getting outdoors may not be a choice but a doctor's orders. For example,

the Appalachian Mountain Club and Massachusetts General Hospital have developed a program called Outdoors Rx® that gives healthcare professionals resources to prescribe regular outdoor activity. Exposure to nature and outdoor activity can improve both physical and emotional health. The significant investment the Commonwealth has made in land protection is part of a free prescription for a healthier and happier public. The SWAP is the comprehensive guide to how we should manage our fish and wildlife to ensure healthy and balanced natural resources to be enjoyed by all.

Addressing the many SWAP management dilemmas will challenge the capacity and resources of MassWildlife, which has been supported by a funding model that relies almost exclusively on the sale of hunting and fishing licenses and the federal Wildlife & Sport Fish Restoration Program that draw funding from a tax on sporting arms and ammunition and fishing equipment. This funding cannot support the level of effort necessary to fully implement the SWAP. MassWildlife currently receives only modest support from the General Fund; in fact, the contribution of the public for endangered species protection is about 2.2 cents for every citizen of the Commonwealth!

Fortunately, a new national initiative may provide the resources to state fisheries and wildlife agencies to fully implement their State Wildlife Action Plans. A Blue Ribbon Panel on Sustaining America's Diverse Fish and Wildlife Resources, recently renamed the Alliance for America's Fish and Wildlife, reimagines a 21st century model of funding conservation that will bridge the funding gap between game and nongame species. Under the leadership of the co-chairs—Bass Pro Shops founder John L. Morris and former Wyoming governor Dave Freudenthal—the Alliance's panelists represent the outdoor-recreation retail and manufacturing sector, the energy industry, conservation organizations, sportsmen's groups and the Association of Fish and Wildlife Agencies (fishwildlife.org). The panelists worked together over the course of a year to produce recommendations and Congressional policy options on the most sustainable and equitable model to fund conservation of the full array of fish and wildlife species. The preferred option would redirect $1.3 billion annually from existing revenue from the development of energy and mineral resources on federal lands and waters for the management and protection of Species of Greatest Conservation Need. This initiative would be a game-changer for state wildlife agencies. Under the current recommendation, MassWildlife would be eligible for $19 million annually for implementation of the SWAP.

Our political leaders in Massachusetts have had the foresight to invest in the protection of lands benefiting wildlife, habitats, and the public. The next step will be to manage this green infrastructure to benefit the SWAP species; hopefully the Alliance's initiative will provide the means.

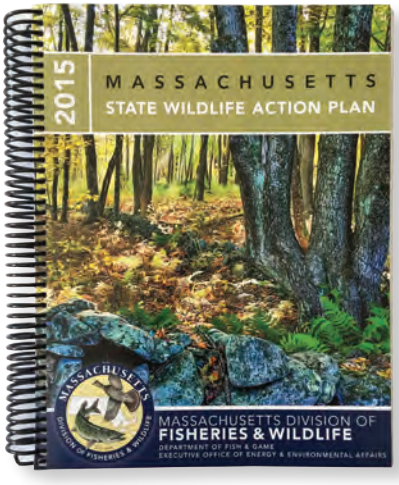
Jack Buckley, *Director*

What is the SWAP?

by
Lynn Harper

This special issue of *Massachusetts Wildlife* is focused on a single topic, one that is important to everyone concerned with the conservation of biodiversity in Massachusetts. The Massachusetts State Wildlife Action Plan (SWAP) was recently approved by the U.S. Fish and Wildlife Service; this issue introduces our readers to the SWAP and a few of the topics it covers.

In 2001, the U.S. Congress established the State Wildlife Grant Program to provide federal funds to help states conserve their species "of greatest conservation need." In order to qualify for these funds, at least every 10 years each state must produce a SWAP addressing conservation of the species the state fish and wildlife agency deems to be of greatest conservation need, while also covering the full array of wildlife and wildlife-related issues.



mass.gov/dfw/swap

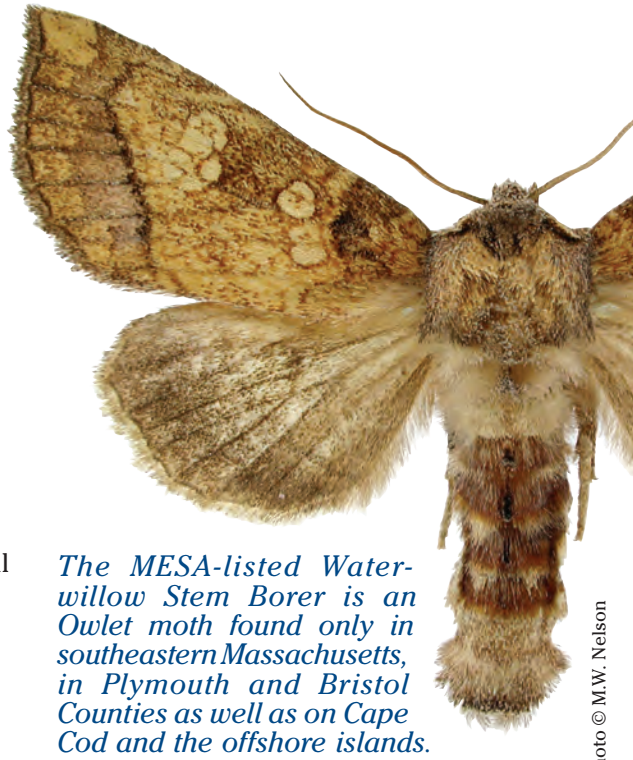
An essential element of biodiversity protection in Massachusetts is the fact that many conservation-minded organizations, agencies, and individuals work together as a conservation community to conserve our diverse and precious landscape. Federal and state government agencies, local and regional non-profits, colleges and universities, Native American tribes, and municipalities: all of us coordinate and collaborate toward this shared goal. While the Massachusetts Division of Fisheries and Wildlife (MassWildlife) was charged with writing this plan, this is not MassWildlife's plan alone; this is everyone's SWAP and all were invited to participate in producing it.

In 2005, MassWildlife submitted a SWAP covering 262 animal species. The current SWAP is greatly expanded, covering 172 vertebrates, 115 invertebrates, and 283 plants—a total of 570 species. While Congress required the states to include only animals of greatest conservation need, not plants, we have chosen to include plants in this update, as we recognize that both plants and animals are essential components of biodiversity in Massachusetts.

Of the 570 species of greatest conservation need (SGCN), the majority, 427 species, are listed under the Massachusetts Endangered Species Act (MESA). Another species, the Red Knot—a shorebird—has been added to the federal Endangered Species list and will be proposed for listing in Massachusetts under MESA. The remaining 142 SGCN include, among others, most coldwater fishes, many early successional birds, and several disappearing orchids.

These 570 SWAP-listed species were assigned into one or more of 24 habitats, because species using the same habitat often suffer from the same threats and need the same conservation actions. These SWAP habitats range from very large to very small. Here are the 24 habitat types, organized more or less from large to small:

- Connecticut and Merrimack Mainstems
- Large and Mid-sized Rivers
- Marine and Estuarine Habitats
- Transition Hardwoods-White Pine Upland Forest
- Northern Hardwoods-Spruce-Fir Upland Forest
- Central Hardwoods-White Pine Upland Forest
- Pitch Pine-Oak Upland Forest
- Large Unfragmented Landscape Mosaics
- Small Streams
- Shrub Swamps
- Forested Swamps
- Lakes and Ponds
- Salt Marsh
- Coastal Dunes, Beaches, and Small Islands
- Grasslands
- Young Forests and Shrublands
- Riparian Forest
- Vernal Pools
- Coastal Plain Ponds
- Springs, Caves, and Mines
- Peatlands and Associated Habitats
- Marshes and Wet Meadows
- Rocky Coastlines
- Rock Cliffs, Ridgetops, Talus Slopes, and Similar Habitats



The MESA-listed Water-willow Stem Borer is an Owlet moth found only in southeastern Massachusetts, in Plymouth and Bristol Counties as well as on Cape Cod and the offshore islands. It occurs nowhere else on Earth.

Photo © M.W. Nelson

In this issue, we focus on five of the SWAP habitats to give readers an idea of the life histories of and threats to the species in each habitat, as well as some of the conservation actions we and our partners are taking to conserve the habitat and its species.

In the first SWAP, in 2005, land protection was the highest priority conservation action. In the current SWAP, land protection is still a top priority. However, the SWAP emphasizes the need to redouble our habitat management efforts. Over 25% of Massachusetts is now protected from further development, but it does no good to protect a calcareous wetland full of rare plants if invasive phragmites overwhelms the native rarities. The pitch pine-scrub oak barrens of southeastern Massachusetts and Montague Plains have long been targets for land protection, but that globally rare habitat disappears without fire or equivalent disturbance across its landscape. Thus, the focus is increasingly on managing the land we have all protected, by removing exotic invasives, recreating grasslands, young forests and shrublands, re-establishing natural flows in rivers and streams, and imitating the effects of wild fires with prescribed burns, selective cutting, and ground scarification.

We hope you enjoy this special issue and that you plan to join us and the many other conservation organizations across the Commonwealth in conserving these species of greatest conservation need for the future.

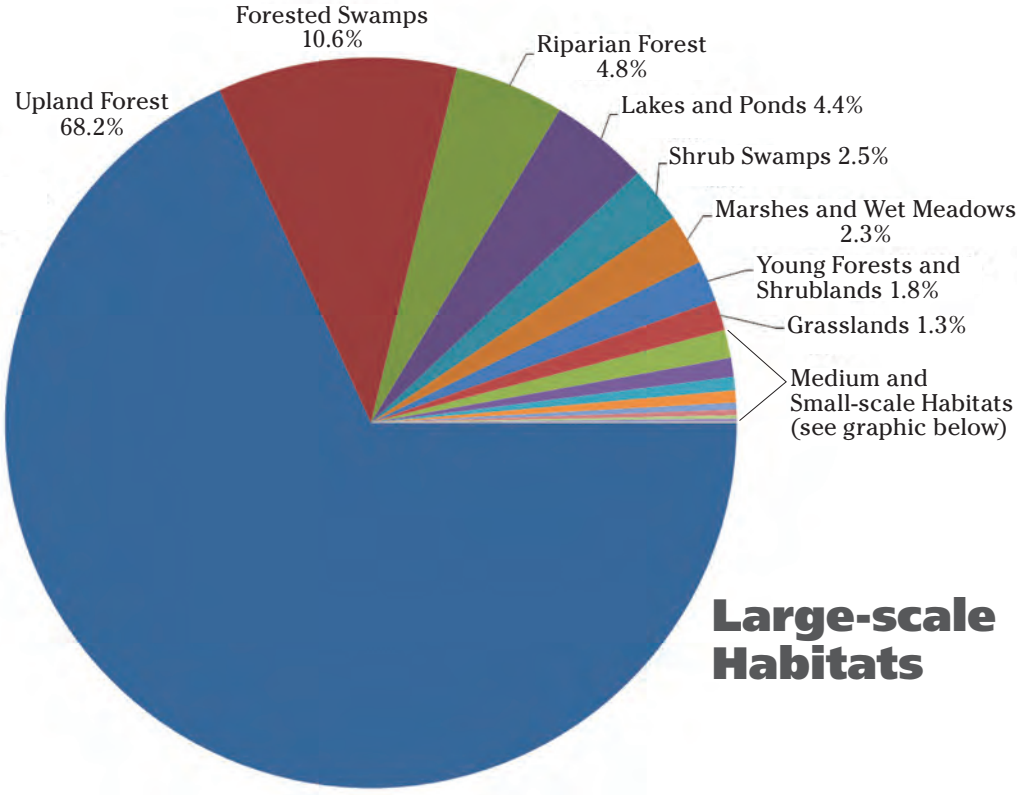
The complete Massachusetts State Wildlife Action Plan is not available in print, but it can be downloaded by chapter at: mass.gov/dfw/swap.

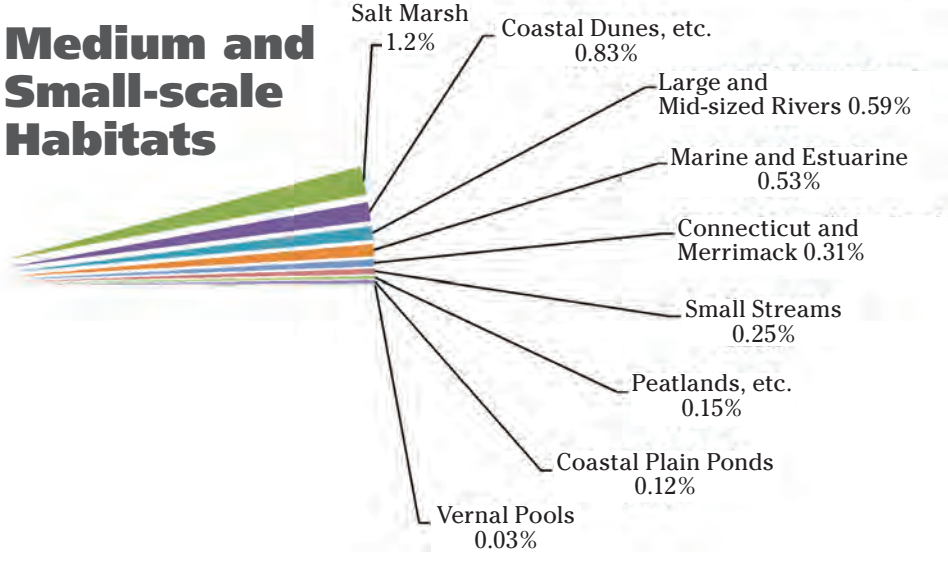
About the Author

Lynn Harper is the Habitat Protection Specialist for MassWildlife's Natural Heritage & Endangered Species Program.

SWAP Habitats

Percentage of Massachusetts acreage by habitat type





Photos © Jennifer Garrett (orchid), Bill Byrne (salamander)

Photos © Chris Buelow (beetle), Bill Byrne (kestrel)

The diversity of SWAP species in Massachusetts, from the Blue-spotted Salamander, to the American Kestrel, Hentz's Redbelly Tiger Beetle, and Yellow Lady's-slipper, reflects the diversity of habitats that stretch from the coastal salt marshes to the Berkshire Hills.

Photo © Bill Byrne

Small Streams

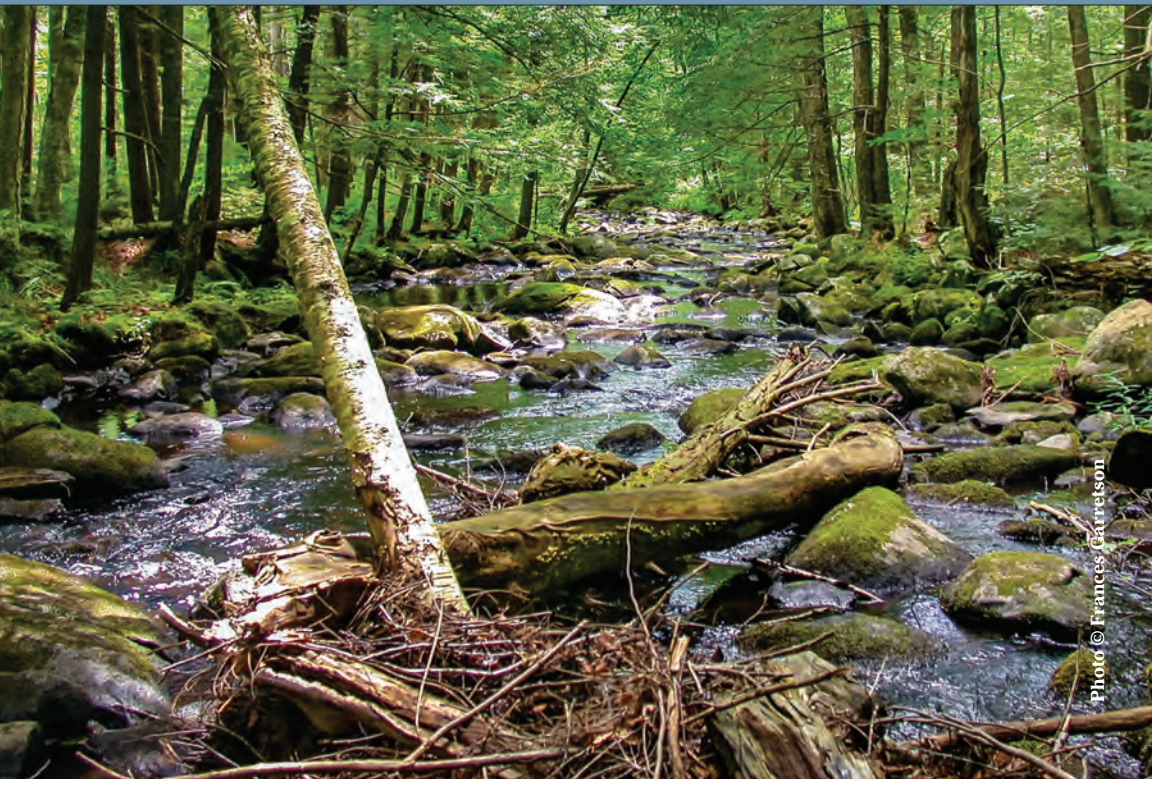


Photo © Frances Carretson

by
Peter Hazelton, Adam Kautza
& Rebecca Quiñones

Conservation of small streams is one of the most important ways that water quality and aquatic habitat can be protected throughout the state. These headwater streams are the sources of lakes, larger rivers and estuaries and are where fresh water, and the nutrients and sediments carried by rivers, are first set into motion. These streams provide important habitat for our wildlife, and are enjoyed by hikers, anglers and nature enthusiasts from the Berkshires to the Cape.

Small streams are typically less than 30 feet across and normally do not support as many fish and other aquatic species as the larger rivers they feed; however, some very important fauna and flora are found only in these ecosystems. Small streams and stream communities are defined by the geography and terrestrial habitats through which they flow. They can range from steep-sloped streams with stepped pools and cascades, to slow moving creeks in marshes and swamps.

Some small streams are charged with groundwater while others are warm water habitats harboring a different group of plants and animals. Despite these temperature differences, small streams are often cooler than the rivers into which they flow. This dependency means that small streams suffer the biggest impacts of drought and water withdrawal from surface or groundwater sources. Small streams are particularly at risk from changes to the water cycle and increased surface water temperatures.

Climate Change and Coldwater Streams

Coldwater streams are increasingly threatened by increases in temperature and shifts in precipitation resulting from climate change. In the Northeast, annual mean air temperatures since 1970 have risen by 1.5°F, but seasonal winter temperatures have risen by more than 4°F. Rising air temperatures mean that more precipitation is falling as rain rather than snow even in midwinter. More rain and warmer temperatures have shifted peak flows by up to two weeks earlier in spring and resulted in longer, more frequent droughts in summer and fall. Changes in seasonal timing and magnitude of stream flows—the water volume and velocity in a stream—can alter the structure and function of these sensitive habitats, and interrupt the biological cycles of the organisms that live within them.

Unless greenhouse gases are significantly reduced or removed from the atmosphere, climate change in the Northeast will continue to increase temperatures year-round and further shift the type, timing, and quantity of precipitation. A greater portion (>60%) of coldwater habitat is likely to be lost in the Northeast than in the rest of the U.S. by 2100 because regional air temperatures are expected to rise at a faster rate. Regional mean annual temperatures are expected to increase 3.6°F over historical temperatures by 2040, 10–20 years before the rest of the globe. In Boston, more than 60 summer days are likely to exceed 90°F

A greater portion of coldwater habitat (>60%) is likely to be lost in the Northeast than in the rest of the U.S. by 2100 because regional air temperatures are expected to rise at a faster rate.

Photo © Leanda Fontaine-Gagnon

In Massachusetts, we are losing native Eastern Brook Trout (Salvelinus fontinalis) *habitat to increases in stream temperature, degraded water quality and habitat, and obstructions to fish movements. There are 1,200 streams with naturally reproducing Brook Trout populations throughout the state.*

by 2100. Changes in precipitation patterns are harder to predict but winters are expected to be slightly (10–30%) wetter, while the rest of the year will be slightly drier. Winter will likely be characterized by sporadic heavy rain interspersed by a few heavy snowfall events. Snow cover that lasted several weeks in winters past will only be seen a few days a year. Weather patterns in Massachusetts by 2100 will resemble that of present-day southeastern states like Virginia or South Carolina.

MassWildlife's Natural Resources Conservation Service Review Biologist Brent Powers surveys freshwater mussel species in Orange, Massachusetts.

Rises in stream temperatures and associated changes in precipitation are problematic for our coldwater fishes and invertebrates. The coldwater fishes include well-known native (e.g., Eastern Brook Trout) and introduced (e.g., Brown Trout, Rainbow Trout) sport fish species, as well as a number of other less well known fish found throughout Massachusetts coldwater habitats. Many of these fish are relatively common, like the Slimy Sculpin (*Cottus cognatus*), while others are some of Massachusetts' rarest fishes such as the Lake Chub (*Couesius plumbeus*) and Longnose Sucker (*Catostomus catostomus*). Other groups of freshwater organisms relying on coldwaters include common invertebrates like crayfishes, mayflies, and stoneflies, to increasingly rare freshwater mussels and dragonflies. In order to survive and successfully complete all stages of their life cycle, all coldwater fishes and many other aquatic creatures require year-round water temperatures generally less than 68–70°F.

Climate change presents a challenge to the conservation of coldwater streams. In Massachusetts, for example, climate change is likely to favor the spread of warmwater species—like Smallmouth Bass—while limiting the distribution of coldwater types such as Lake Chub. Because of the magnitude and longevity of climate change impacts, conservation of coldwater streams requires continued efforts in restoration and protection. These efforts will minimize and mitigate the local effects of climate change on small streams.

Meet Some Coldwater Creatures

Eastern Brook Trout

Many of our readers are licensed anglers and trout fans, spending countless enjoyable fall and spring days casting from the banks of their favorite stream, river or lake for the chance to catch a Brook, Brown, Rainbow, or hybrid Tiger Trout. Some people may be surprised to learn that the Eastern Brook Trout (*Salvelinus fontinalis*)—technically a char— is the only remaining native salmonid in Massachusetts. There are 1,200 streams with naturally reproducing Brook Trout populations throughout the state.

The Brook Trout range includes the northern Great Lakes states and Canadian provinces east to New England, and from the northern edges of Quebec and Labrador south to the State of Georgia along the Appalachian Mountains. Once more common in larger rivers throughout its range, native trout are now relegated to smaller coldwater streams because many large rivers no longer offer suitable water quality or temperatures to sustain trout year-round. While this phenomenon is more pronounced farther south, even in Massachusetts we are losing native trout habitat to increased stream temperature, degraded water quality and habitat, and obstructions to fish movement. Native Brook Trout populations have been significantly reduced or completely lost in over 60% of the watersheds in which MassWildlife has historic and current survey data. Still, there are suitable trout habitats located in nearly every watershed in the state including several streams with wild, naturally-reproducing Brook Trout in the greater Boston Metro Area.

Eastern Pearlshell

The Eastern Pearlshell (*Margaritifera margaritifera*) is one of Massachusetts' twelve native freshwater mussel species, and New England is near the southern edge of its range. As a filter feeder, the Eastern Pearlshell cleans the water by siphoning algae and bacteria from the water column, providing an important service to our streams and rivers. The mussel then transfers these nutrients to the stream bottom, where they are used by other invertebrates. This "benthic coupling" combined with structural habitat provided by the mussels' shells increases the abundance of aquatic insects—the primary food for Brook Trout and other stream fishes.

The Perfect Parasite

Beyond the services that the mussel provides, the Pearlshell and Brook Trout are uniquely linked in life history. During the youngest life stage of freshwater mussels—the glochidia or larval stage—they are largely benign, natural parasites on fish hosts. As little more than two microscopic shells, the glochidia attach to the gills of a trout and metamorphose into a small, clam-like juvenile mussel over the course of weeks to months. The trout gives the larval mussel important

Photo © Peter Hazelton

Native freshwater mussels, such as the Eastern Pearlshell (foreground) and Eastern Elliptio (background), play important roles in maintaining water quality statewide.

Habitat alterations such as increased turbidity, erosion, sedimentation, flow alterations, and pollution are major threats to the MESA-listed Lake Chub. They are visual feeders and increased turbidity can decrease their feeding efficiency. Erosion, sedimentation, and flow alterations can degrade clean, gravel spawning substrates that are required for proper egg development. Breeding males, like the one shown above, can develop vibrant patches of bright orange or red.

nutrients needed for transformation and a free ride to wherever it will detach and settle to the river bottom to begin its long life. Pearlshells are known to be among the longest living invertebrates. Mature Eastern Pearlshells in the Commonwealth have been aged at 30–70 years, but in Scandinavia these mussels have been found to be nearly 200 years old!

Although our understanding of its distribution is not complete, MassWildlife placed the Eastern Pearlshell on the State Wildlife Action Plan's (SWAP) Species of Greatest Conservation Need (SGCN) list because some populations are dominated by older, non-reproducing individuals. MassWildlife's Natural Heritage and Endangered Species Program has targeted survey efforts at Pearlshells in order to identify the most viable populations and determine conservation actions to protect them. By conserving and restoring Pearlshell habitat in small streams and the medium-sized rivers they feed into, MassWildlife may be able to prevent listing the Pearlshell on the Massachusetts Endangered Species List.

Lake Chub

The MESA-listed Lake Chub does not look very different from other minnows in Massachusetts with its brownish green back, a dark stripe extending the length of its body on its side, and silvery-white sides and underbelly. This common color pattern is thought to have evolved as camouflage to protect the fish from predators. Breeding males, like the one shown above, can develop patches of bright orange or red. Unlike many of our common minnows though, the Lake Chub requires a very specific habitat, is less common than it was 50 years ago, and is listed as Endangered under the Massachusetts Endangered Species Act.

Confined to the Westfield River and its tributaries, the Lake Chub's habitat in our state is very different from what its name implies. Here in Massachusetts, the Lake Chub is at the edge of its geographic range and behaves as a true coldwater specialist. The upper Westfield River basin is among the most protected and undeveloped watersheds in the Commonwealth, yet loss of habitat from warming stream temperatures may affect the very existence of the Lake Chub in decades to come.

Through continued surveying and monitoring of coldwater creatures like the Brook Trout, Pearlshell and Lake Chub, information on them will continue to grow. In addition, MassWildlife is currently taking part in research regarding the ability of SGCN and habitats to adapt to climate change. This information combined with our survey data, will help MassWildlife identify and prioritize restoration and protection activities.

Coldwater Fish Resources

MassWildlife has long appreciated the importance of protecting coldwater fishes and their habitats. Beginning in the 1940s, MassWildlife fisheries biologists began documenting water bodies that contained coldwater fishes. Early efforts began as a way to identify, monitor, and maintain popular coldwater trout fisheries. Fifty years later the agency began to develop an official list of Coldwater Fish Resources (CFR), mass.gov/dfw/cfr, with a broader goal of protecting these critical habitats for all coldwater fish species, regardless of their inherent recreational value. This list of waters would eventually become the basis for greater protection and conservation planning under existing Massachusetts environmental regulations.

Each year, MassWildlife biologists survey fish communities at an average of 135 locations throughout the state. They use this information for a variety of reasons, one of which is to determine if a stream or river is a CFR—CFRs are habitats, quite simply, where coldwater fish are found. Every effort is made to exclude fish that were stocked that year. Since almost all trout stocked by MassWildlife are greater than six inches, the presence of trout less than six inches usually means the stream is a CFR. Because MassWildlife does not stock any other coldwater species, the presence of any non-trout coldwater fish also indicates that the stream or river is a CFR.

CFRs represent a diversity of streams, from low lying, groundwater-dominated sea-run Brook Trout streams on Cape Cod and Martha's Vineyard to steep, boulder-strewn brooks found deep in the mountain gorges of western Massachusetts. CFRs cover approximately 35% of the estimated 11,000 miles of mapped streams in Massachusetts. With more waterbodies to be surveyed, there certainly will be more additions. Unsurprisingly, most of our CFRs are concentrated in the west. The Westfield and Deerfield watersheds are particularly notable for housing a concentration of high-quality, small-to-medium coldwater streams. However, there are CFRs located in nearly every watershed in the state including locations within the I-495 and I-95 corridors. Currently there are almost 1,300 CFRs statewide, which may seem like a lot of streams, but most are tiny, headwater brooks in which coldwater fishes are increasingly forced to seek out suitable water temperatures to survive.

MassWildlife fisheries biologists sample a small stream for native Eastern Brook Trout using a backpack electrofishing unit. The unit sends an electric current into the water which stuns fish, making them easier to collect for biological sampling. After a few moments, the fish revive and the biologists release them back into the water. This stream is one of 1,300 Coldwater Fish Resources in Massachusetts.

Photo © Bill Byrne

Protecting, Planning and Adapting for The Future

All small streams are afforded various levels of protection under Massachusetts laws and regulations, including the Massachusetts Rivers Protection Act, Surface Water Quality Standards, Stormwater Management Standards, and the Water Management Act. However, regulatory protection is not enough; proactive conservation actions are also necessary to protect our coldwater habitats. To that end, MassWildlife and other conservation partners are actively engaged in conservation planning and restoration efforts to conserve coldwater habitats and increase connectivity among them.

With changes in regional climate patterns, conservation of coldwater habitats is faced with new challenges. Climate change is one of many factors with the potential to degrade coldwater streams. A first step towards addressing climate adaptation is to evaluate the current status and potential vulnerability of habitats and species to climate change. MassWildlife recently completed collaborative vulnerability assessments of habitats and SGCN and much of this information was incorporated into the recently approved SWAP. Our assessments showed that coldwater streams and their associated species were identified as some of the most vulnerable to climate change.

Impacts from land use, including from existing infrastructure, often mimic climate change effects by increasing stream temperatures and altering stream flows. Dams, roads, and groundwater pumping, in particular, can magnify climate change effects. Habitat fragmentation and alteration by dams and road crossings, such as impassable and undersized culverts and reduced summer stream flows from groundwater pumping, are the major factors affecting native fish in small streams. The ability of coldwater species to adapt to climate change will largely depend on the protection and/or restoration of landscape characteristics that buffer against negative impacts on stream temperatures and flows.

Taking positive conservation actions on streams which foster climate adaptation will provide refuges for coldwater communities from harmful changing conditions. Helpful actions for these aquatic communities include protecting and restoring vegetation buffers around streams and promoting connectivity between habitats. These actions promote higher water quality by providing shade and slowing run-off of sediment and nutrients into streams. Removing dams and culverts, which function as barriers and impediments to stream flow, allows fish to move freely from unfavorable to favorable habitats as stream conditions change. Other useful actions alleviating impacts to stream flow and temperature include reconnecting streams to floodplains and restoring the dynamic, meandering nature of streams. By creating buffers and connecting habitats, the odds improve for the continued existence of our coldwater resources in changing habitat conditions.

Conservation in Action; The Gulf Brook Culvert Connection

Massachusetts' interlaced network of roads with undersized culverts prevents aquatic species migration, blocks the transport of sediment, and creates higher water temperatures in what was once suitable coldwater habitat. The Gulf Brook Culvert Replacement Project is one example demonstrating how efficient, timely, and beneficial results can be achieved through a strong cooperative effort among committed constituents. Located in Pepperell, Gulf Brook is an important coldwater tributary to the Nissitissit River, a popular recreational coldwater fishery for both stocked and wild trout. In a region of the state with few high quality coldwater fisheries, the Nissitissit is also home to the Eastern Pearlshell and three other designated SGCN freshwater mussels. Two pipe culverts acting as barriers were replaced with an upgraded design which immediately opened up miles of critical spawning and nursery habitat for wild Eastern Brook Trout. These trout will eventually move downstream and supply

Photos © Todd Richards

Replacing a pipe culvert that acted as a barrier (left) with an upgraded design (right) immediately opened up miles of critical spawning and nursery habitat for wild Eastern Brook Trout in Gulf Brook, which is an important coldwater tributary of the Nissitissit River in Pepperell, Massachusetts.

the larger Nissitissit River with adults so prized by anglers. Culvert replacement, in addition to facilitating fish passage, remedied sediment transport and stream flow issues.

This project was successful due to a strong and diverse partnership. Technical expertise and funding were provided by MassWildlife, non-profit conservation organizations, the Greater Boston and Squannatissit Chapters of Trout Unlimited, and the Massachusetts Outdoor Heritage Foundation. The Pepperell Conservation Commission was a willing and cooperative partner, presiding over timely permitting and groundwork.

Powerful partnerships can facilitate positive conservation action for wildlife and habitats in need of conservation. MassWildlife has been and will continue to build and strengthen conservation partnerships with government agencies (e.g., MassDOT, Division of Ecological Restoration, Department of Conservation and Recreation, U.S. Fish & Wildlife Service, and municipalities), non-profit organizations, such as the Nature Conservancy, Connecticut River Watershed Council, Trout Unlimited, local land trusts as well as universities and other like-minded organizations. After all, the SWAP is a blueprint for all who care about our Commonwealth. Join the effort to take action for Massachusetts' wildlife, land, and waters!

About the Authors

Dr. Peter Hazelton is the Aquatic Ecologist for MassWildlife's Natural Heritage & Endangered Species Program; Dr. Adam Kautza is MassWildlife's Coldwater Fisheries Project Leader; and Dr. Rebecca Quiñones is MassWildlife's Rivers & Streams Project Leader and the Northeast Association of Fish and Wildlife Agency's representative to the Advisory Committee on Climate Change and Natural Resource Science.

Large Unfragmented Landscape Mosaics

by
Mike Jones

The Blanding's Turtle is the best example of a rare native animal that thrives in what are called Large Unfragmented Landscape Mosaics, one of the 24 habitats listed in the Massachusetts State Wildlife Action Plan (SWAP). In the SWAP, this type of habitat is called a Large Unfragmented Landscape Mosaic. Unlike all of the other SWAP habitats, this habitat is not defined solely on the basis of what it contains, but rather by what it *does not* contain. Think of Large Unfragmented Landscape Mosaics as huge areas where the footprints of human use are distant, where there are few or no roads, buildings, agricultural fields, or other development. The five SWAP-listed species most strongly associated with this habitat—Blanding's and Spotted Turtles, Black Bear, Moose, and Bobcat—all exhibit relatively large home ranges and varied upland and wetland habitats extending beyond habitat patches to landscape mosaics on a scale of kilometers. Though certainly not the only wildlife affected by intense human land use, these SWAP-listed species are the most representative of the interactions between people and other fauna living on this landscape.

The Blanding's Turtle is a lens through which to view this increasingly threatened SWAP habitat. Most Massachusetts residents have never seen a wild Blanding's Turtle, and even fewer have searched for them in the wetlands they inhabit. When seeing a Blanding's Turtle for the first time, many people view it as something unique and oddly out of place—extraordinary, even—compared to the extremely common Painted and Snapping Turtles. Though an adult Blanding's Turtle is much smaller than an adult Snapping Turtle, at over two pounds they appear massive and substantial, deliberate in their movements and clearly comfortable on land. In appearance, Blanding's Turtles stand out from Painted Turtles by their helmet-like, gray carapace and stunning yellow throat, which can be as bright as any other yellow found in nature.

Blanding's Turtles are swamp and marsh dwellers; they are most abundant

in areas where a wide range and diversity of wetland habitats occur together in a connected landscape with few busy roads. Here in Massachusetts, depending on the season, Blanding's Turtles are feeding, mating, and hydrating in deep vernal pools, flooded fields, emergent marshes, bogs, shrub swamps, beaver ponds, slow creeks and rivers, oxbows, and shrubby margins of larger lakes and reservoirs. Within these areas, they often bask for several hours per day on fallen logs, sedge tussocks, sphagnum hummocks, and exposed roots. These turtles are very wary and skittish. Approach too quickly and they will dive for deep cover, watching you as they drop into the water with surprising speed, and evading capture by swimming swiftly to a pre-determined (so it seems) hiding place. In order to truly observe them, you must either take up surveillance from an overlook above an open vernal pool or overcome any reluctance you may have to meandering and stumbling through deep swamps. In Massachusetts, the only hazards in these habitats are submerged beaver-chewed stumps, fallen logs, and tangles of shrubby vegetation.

Blanding's Turtles belong to a truly fascinating group of long-lived, semiaquatic turtles that evolutionarily diverged from the North American Box Turtles, the Spotted Turtle, and the Wood and Bog Turtles about 25 million years ago. Today, this group also contains the Western


Photo © Bill Byrne

(page 16) A female Blanding's Turtle; (above) former MassWildlife Herpetologist Lori Erb (left) and Wildlife Biologist Bridgett McAlice remove a Blanding's Turtle from a trap at Bolton Flats WMA to collect biological data; (below) prime habitat for the Blanding's Turtle in Worcester County.


Photo © Mike Jones

Black Bear, Moose, and Bobcat are three SWAP-listed mammals most strongly associated with Large Unfragmented Landscape Mosaics.

Pond Turtle, a versatile, aquatic turtle that formerly occurred from British Columbia to the northern coast ranges of Baja California, and the European Pond Turtle. Blanding's Turtle and nearly all of its close relatives share a number of life history traits that make them uniquely vulnerable to habitat fragmentation. For example, they become sexually mature only after about 15 to 20 years and produce low numbers of eggs, especially in northern areas where they lay only one clutch of eggs per year. In undeveloped ecosystems, these turtles' low reproduction rates are offset by extremely long lifespans of 60 to 90 years or more. In fact, this group of turtles comprises some of the longest-lived freshwater vertebrates in New England. More species in this turtle group, or subfamily, are found in Massachusetts and New York than anywhere else on the globe, emphasizing our regional role in their continued conservation.

Blanding's Turtle occurs over broad areas from Nebraska to Michigan, and in spotty pockets of suitable habitat from New York to Nova Scotia. In the western part of their vast range, Blanding's Turtles occur in prairie ecosystems including open, herbaceous wetlands such as the remote sandhills of northern Nebraska. Here the turtles live in shallow cattail-filled ponds. By contrast, in Massachusetts and much of New England, Blanding's Turtles prefer wetlands that are structurally complex—they seek out deeper channels that wind through thick clumps of Pickerelweed, Buttonbush, Highbush Blueberry, Winterberry, Leatherleaf, Sweet Gale, and Red Maple. Today, large and healthy populations of the elusive Blanding's Turtle persist in a handful of watersheds in eastern Massachusetts, where they tend to be isolated from one another by dense networks of human disturbance and development. Imagine an ideal swamp with a suitable mix of habitats. Now picture this swamp as an island, isolated from adjacent wetlands and nesting features by busy roads and human development. This particular swamp is unlikely to support healthy populations of Blanding's Turtles because the wide-ranging turtles, seeking new wetlands in different seasons, are likely to be killed on surrounding roads over time. Blanding's Turtles will accept a wide range of nesting sites: known nesting areas in Massachusetts include meadows, fields, pastures, yards, gar-

dens, bedrock outcrops, sand and gravel pits, abandoned rail beds, dirt roads, and roadsides. Nest-searching females may be found in yards and crossing roads from late May to early July—a very sensitive time window when they are most vulnerable to road mortality by cars, predation by small mammals, or human collection.

Landscape Size Matters

Even more so than most of our other native turtle species, Blanding's Turtles require unusually large landscapes: healthy populations are found primarily within unbroken landscapes larger than 500 acres. Although Blanding's Turtles clearly prefer a variety of shrub and herbaceous wetlands, the overall scale of this landscape is critically important to the turtles' long-term survival. The largest remaining turtle populations, and those that appear to be stable and recruiting or adding younger animals into the population, are found within large, lightly or undeveloped landscapes. This scenario allows individual turtles to seek out and congregate in undeveloped wetland mosaics and in any given year, each turtle can find and spend time in several distinct types of wetlands.

The Spotted Turtle (Clemmys guttata) *is another species that benefits from Large Unfragmented Landscape Mosaics, which have a diversity of habitats and few, if any, busy roads.*

Because Massachusetts is the third most densely populated state in the Union, with an average of 1.4 people per acre, the effects of human roads, homes, and towns extend far into the remaining relatively undeveloped landscape. By 2013, according to Mass Audubon's *Losing Ground*, approximately 22% of the land area had been developed, and roughly 25% had been protected as conservation land. More than 50% of the total land area (5 million acres) remains available for development or protection, and commercial and residential property rates are on the rise following the pronounced economic downturn that began in 2008.

One way to visualize Large Unfragmented Landscape Mosaics in the state is to use *BioMap2*, a special map created by MassWildlife's Natural Heritage and Endangered Species Program (NHESP) and the Massachusetts chapter of The Nature Conservancy. Within *BioMap2*, mapped Landscape Blocks show relatively intact landscapes that provide more natural ecosystem processes and natural disturbances, habitat for wide-ranging species, and a mosaic of natural land cover types. Landscape Blocks account for about 1.3 million acres and represent the most intact 36% of the total area of natural land cover in Massachusetts. The largest Landscape Block in the Commonwealth, not surprisingly, encompasses the Quabbin Reservoir area. Most of the other large Landscape Blocks are located west of the Connecticut River, with the exception of three large Landscape Blocks in Southeastern Massachusetts: areas centered on Myles Standish State Forest, Freetown State Forest, and the Massachusetts Military Reservation. Within and adjacent to the I-495 beltway, Landscape Blocks decrease dramatically in size and the area within the I-95 beltway is mostly devoid of any Landscape Blocks.

Turtle Conservation

For turtle conservationists, it is a very inconvenient fact that Blanding's Turtle is native only in eastern Massachusetts. The I-495 and I-95 beltways are where real

Regional partners from Nova Scotia to Minnesota gathered on October 3, 2016 at MassWildlife's Westborough Field Headquarters to discuss Blanding's Turtle conservation and management.

estate is the most expensive and the remaining buildable land is under the greatest development pressure. However, their habitat requirements and unusual life history make Blanding's Turtles an ideal focal species for ongoing conservation efforts by MassWildlife and its partners to identify and prioritize remaining lands for protection and management within this part of the state. Conservation partners across the state are directing their efforts towards the identification and protection of Large Unfragmented Landscape Mosaics. State-level initiatives, such as *BioMap2*, *Losing Ground*, and the North Atlantic Landscape Conservation Cooperative, provide a strategic basis for prioritizing parcels for acquisition and management. Many areas require coordinated land-protection efforts in order to secure a core area large enough to support Blanding's Turtles for multiple generations.

However, land protection alone is not enough. It is necessary to manage the land in a way that promotes Blanding's Turtle recovery. For example, though the land is protected, it may be necessary to actively address the needs of the turtle in the context of the activities on that property. Consider the following land management scenarios:

Nesting Habitat: Optimal Blanding's Turtle nesting habitat consists of stabilized and partially vegetated coarse sand or sand and gravel, located near clusters of suitable wetlands. Shallow, temporary pools can provide daytime cover for nest-searching females. Nesting areas within the core unfragmented habitats are an essential habitat component.

Forestry: Active forestry within high priority sites for Blanding's Turtle can pose a threat to populations. Forestry machinery can increase mortality, change hydrology of key wetlands, or provide vectors for invasive plant introductions. On the other hand, if carefully implemented, forestry activities can also be used to create nesting habitats.

Off-Road Recreation: Off-Highway Vehicle (OHV) trails can increase the risk of collection and mortality of turtles as they move overland between wetlands. These negative impacts can be alleviated through a combination of management techniques including: seasonal closures of OHV trails in and near sensitive wetland areas; seasonal or evening trail closures to protect nesting females where trails intercept nesting habitat; and trail relocation to avoid sensitive wetland complexes and to avoid separating suitable wetland and nesting habitats.

Turtle Partnerships

In the past decade, the northeastern wildlife agencies have significantly in-

creased their efforts to cooperate on Blanding's Turtle conservation. In fact, a team of scientists and land managers from southern Maine to western Pennsylvania are gearing up this spring to implement a regional conservation plan for Blanding's Turtle, with an emphasis on conserving and managing the most important remaining turtle habitats.

In 2004, representatives from five northeastern states formed the Northeast Blanding's Turtle Working Group to conserve populations of Blanding's. In 2007, the group first collaborated on the development of a regional population status assessment, and with State Wildlife Grant funds from the U.S. Fish and Wildlife Service, the group completed a Conservation Plan in 2014. Site-specific management plans were developed for the highest priority sites in Massachusetts, including portions of several Large Unfragmented Landscape Mosaics. The Working Group is now working with land managing agencies, organizations, landowners, and interested individuals to implement a regional turtle conservation strategy, placing heavy emphasis on the conservation of priority "turtle lands". The Working Group was recently awarded a second Competitive State Wildlife Grant to continue implementation of the Blanding's Turtle regional conservation plan. This regional, collaborative effort has served as a model for Wood Turtle and Spotted Turtle conservation efforts and could serve as a conservation model for other rare reptile and amphibians in the Northeast.

What You Can Do To Help

Support Conservation Efforts: Large Unfragmented Landscape Mosaics often straddle the borders of multiple towns. Non-governmental organizations and land trusts with a regional focus have identified many of the remaining large landscapes for conservation work. Rivers such as the Parker, Shawsheen, Ipswich, and Nashua have dedicated watershed groups that advocate for landscape connectivity. Land trusts are often keenly aware of the boundaries of large landscapes and are working within designated focal areas to conserve regional priorities. Within your own town, consider this question: what is the largest unfragmented block of habitat remaining? Does that change if you consider landscape blocks that incorporate part of an adjacent town?

Report Rare Species: Blanding's Turtles and Spotted Turtles are tracked through NHESP. Citizens can submit rare species observations through an electronic data portal, the Vernal Pool and Rare Species Reporting System. Black Bear, Moose, and Bobcat are tracked through formal surveys by MassWildlife, but you can report road-killed animals through the Linking Landscapes for Massachusetts Wildlife program at linkinglandscapes.info.

About the Author

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Young Forests and Shrublands

Photo © Bill Byrne

by
John Scanlon & Chris Buelow

A fundamental part of human nature is to cherish our special places, the places we go to find comfort or to revitalize our spirit. Many people don't like it when those special places are changed, and that inherent dislike of change tends to carry over when it comes to our natural environment. If I like a stand of trees because they are familiar and comforting (my child or grandchild saw their first deer in that stand of trees), I don't like it when a logging crew shows up to cut those trees down. Spare me the talk, you may say (even though you know it's true), about sustainable use of renewable wood products that support local jobs and help retain land in forest use—those trees were a constant, reliable part of my life, and now that constant condition has been disrupted.

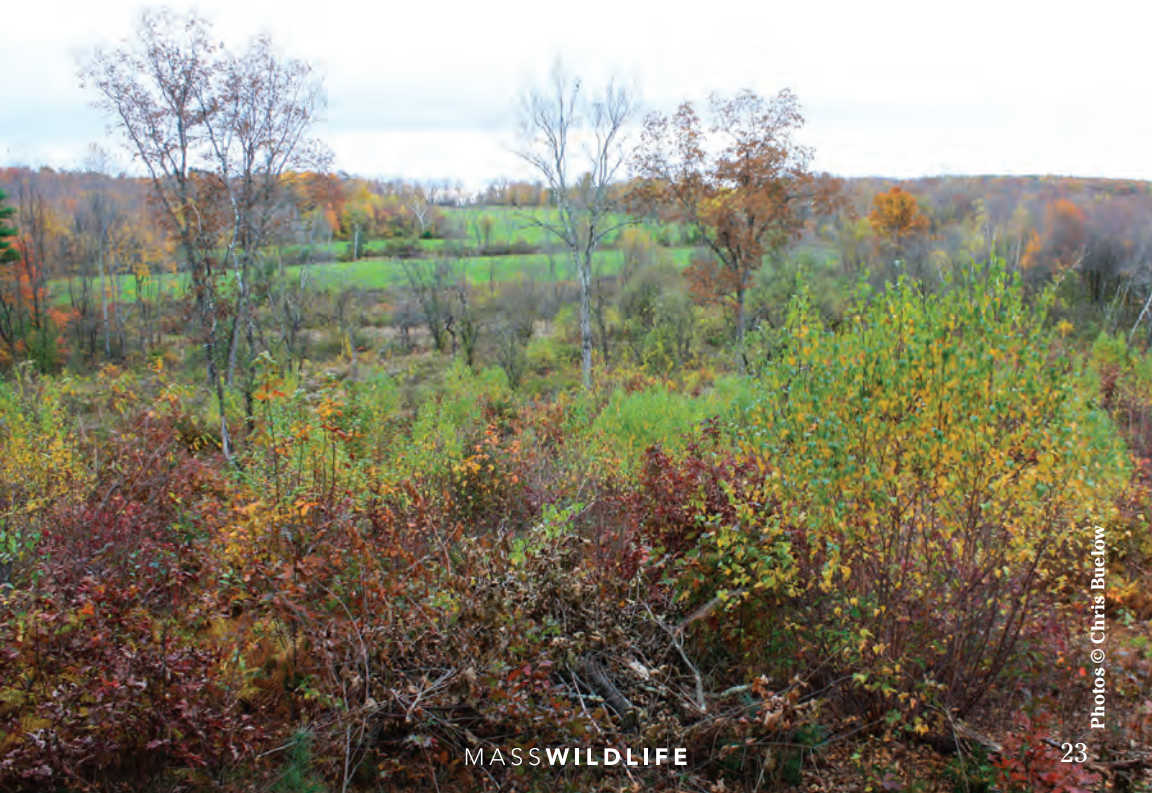
You can't blame someone for wanting conditions surrounding their favorite outdoor place to remain constant, but nevertheless, when it comes to natural systems, the only true constant is, in fact, change. When that change is incremental (a single tree within a larger forest dying from a lightning strike) we can handle it, but when extensive disturbance occurs (fire, flooding, or logging that disrupts the larger forest as a whole), we tend not to take it well.

Extensive disturbance can be natural (e.g., beaver flooding, ice scouring along rivers and streams during spring floods, wildfire, and wind), or human-caused (e.g., mowing or logging). The important relationship to understand is that numerous species of wildlife thrive in recently disturbed habitats, and entire plant communities that are locally and even globally imperiled depend on frequent disturbance to persist on the landscape. Human development tends to suppress or eliminate natural disturbance, and declines in wildlife diversity and plant community occurrence inevitably follow. As a society, we need to understand that

while our efforts to curtail natural disturbances like fire and flooding greatly enhance human health and safety, it also creates an obligation on our part to replace those disturbances elsewhere on the landscape in order to conserve the full diversity of our wildlife and plant communities. Active management that maintains a shifting mosaic of young forest and shrubland habitats across the landscape is critically important for meeting this conservation obligation.

Young forest habitat is dominated by seedling and sapling stage trees such as poplar, birch, cherry, oak, and pine, while shrubland habitat is composed of woody plants such as alder, blueberries, huckleberries, and scrub oak. Both young forest and shrubland habitats are characterized by high stem densities of 10,000–20,000 stems per acre. These thick, dense stands of saplings provide invaluable food and cover resources for a myriad of wildlife species, including game animals such as American Woodcock (*Scolopax minor*), Ruffed Grouse (*Bonasa umbellus*), New England Cottontail (*Sylvilagus transition-*

Ideal habitat for the SWAP-listed Ruffed Grouse (page 22), a prized upland game bird, is a matrix of regrowing young forest and shrublands habitat; (below) the East Quabbin Land Trust's Deer Park in Hardwick in 2011 after intensive habitat management designed to create 11 acres of shrublands and the same location in 2013. Active management is needed to ensure the appropriate percentage of this habitat persists across Massachusetts for both game and non-game wildlife.



Photos © Chris Buelow

The SWAP-listed New England Cottontail (Sylvilagus transitionalis) *is the only rabbit native to New England and the area east of the Hudson River in New York. A closely related species, the Eastern Cottontail* (Sylvilagus floridanus)*, expanded across much of the area following introductions around the turn of the 20th century. Unlike the Eastern Cottontail, New England Cottontails rely exclusively on young forests and shrublands.*

alis) and Eastern Cottontail (*Sylvilagus floridanus*), a wide range of songbirds, and a trove of specialized invertebrates including native pollinators and Lepidoptera (moths and butterflies). Species that key in on young forest and shrubland habitats have evolved strategies to deal with the ephemeral nature of their homes, most notably the ability to shift across the landscape as their disturbance-dependent habitats come and go over time.

Absent further disturbance, shrublands tend to be invaded by trees, and young forest will develop into mature, full-canopy forest over time through the natural process of succession. Each stage of succession provides critical habitats for a carousel of species that rely upon shifting gradients of plant communities and structures. Eastern Bluebirds (*Sialia sialis*) and American Woodcock may be among the first occupants of recently established young forest or shrubland habitat because they like some open spots of exposed soil. Bluebird abundance typically begins to decline in just 3–5 years, but even as bluebirds are declining, American Woodcock are hanging in, and Indigo Buntings (*Passerina cyanea*), Prairie Warblers (*Setophaga discolor*), Chestnut-sided Warblers (*Setophaga pensylvanica*), and cottontail rabbits are picking up. Within a few more years, the bluebirds and whips are gone and the buntings are declining, but Eastern Towhee (*Pipilo erythrophthalmus*) and Brown Thrasher (*Toxostoma rufum*) fill those open habitat niches. Soon enough, Ruffed Grouse and many species of forest songbirds (e.g., Wood Thrush, Black-and-white Warbler) will call this habitat home.

Over the arc of history, young forest and shrubland habitats in Massachusetts have waxed and waned due to major environmental and land-use trends, but it is clear that these habitats, and the specialized species that they support, have always played a key role in the composition of the region's biodiversity. Considering the importance of this role, and the current threats facing these species, MassWildlife has identified the conservation of the species associated with young forest and shrubland habitats,

as well as the restoration and management of these habitats themselves, to be a critical part of the agency's mission and work.

This is good news for naturalists and hunters of all persuasions. A person watching for a declining songbird like Brown Thrasher to add to their life-list, another person searching for a particular moth or butterfly, and yet another person hunting for the makings of their favorite American Woodcock or Ruffed Grouse recipe will all be fulfilled in these disturbance-dependent habitats.

Historical Context

The majority of undeveloped, non-agricultural land in Massachusetts is currently in an even-aged forest condition that is dominated by 70–90 year old trees. However, in many ways the current forest-dominated condition of our landscape represents the historical exception rather than the rule. For millennia prior to European settlement, the Massachusetts landscape was a mosaic of vast old-growth forest interspersed with open habitat patches, both large and small, that pulsed across the landscape as a result of natural disturbance processes. Old-growth forest is typically uneven-aged (contains trees of all age classes), and to the surprise of most people, actually contains more young trees than old trees. Visually, we focus on the majestic ancient stems when we visit old-growth forest (usually there are only a few dozen such trees per acre), and tend not to notice the abundant seedling, sapling, and pole-sized trees (usually several hundred per acre).The replacement of our original uneven-aged, old-growth forest with today's even-aged, mid-successional forest, coupled with human constraint of natural disturbance process like flooding and fire, has fundamentally reduced available wildlife habitats across Massachusetts.

Present Day Opportunities

The goal, and challenge, of modern day land managers is to determine the appropriate level of open habitat in relation to other habitat types in the state, and then initiate management strategies that will stabilize, or even grow, populations of otherwise rapidly declining wildlife species. When thinking about the appropriate level of young forest and shrubland habitat on the landscape, finding a balance between the post-agricultural peak and the modern low is an essential task, and one that should be based on historical and scientific research.

Chestnut-sided Warbler (Setophaga pensylvanica) *nesting habitat includes young deciduous forests (<20 years post-disturbance). Historically, habitat for this SWAP-listed species was created naturally by strong storms, fire, and beaver activity. With natural disturbances minimized today, such habitat can be created through forestry practices.*

Based on published literature, MassWildlife has set landscape goals for 6–10% shrubland habitat and 10–15%

young forest habitat on state Wildlife Management Areas (WMA). These levels of open habitats should provide adequate resources to maintain viable populations of wildlife species that are currently experiencing long-term declines, and while we cannot know for certain if these levels are comparable to the late Pre-Contact Era when natural disturbances were still occurring unhindered on the landscape, what matters most is that these target levels will help conserve the full suite of biological diversity on our 21st century landscape.

Currently, 3% of MassWildlife lands are in shrubland and 4% are in young forest, for a total of 7% open, post-disturbance habitat. Statewide, the picture isn't any better—in fact, it's worse. MassWildlife has recently mapped SWAP habitats across the Commonwealth and found that only about 2% of all undeveloped lands occur as young forest or shrubland habitat. In the short-term, because there's such a paucity of young forest and shrubland habitat in the state, and because the restoration and maintenance of these habitats can require a fair amount of resources, it is highly unlikely that land managers will overcommit to early successional management and over-represent the habitat type in the state's greater habitat mosaic. Instead, the key consideration for identifying sites to be managed as young forest and shrubland habitat is to identify sites that are naturally conducive to support these open habitat types.

Heavy equipment on Wildlife Management Areas may at first seem counter to MassWildlife's conservation mission, but this type of management resets the landscape and allows for the growth of important young forest and shrubland habitat which supports many SWAP-listed species.

Proper site selection is critical, and MassWildlife has recently completed an extensive computer mapping analysis to identify the most appropriate places on WMAs to conduct management for young forest and shrubland habitats. This analysis factors in soil type, slope, land use history, and landscape setting to prioritize sites with stable, upland soils that are near or adjacent to other open habitat types. MassWildlife typically avoids management for young forest and shrubland habitats in tracts of high-quality, closed-canopy forests, as those communities are also important to landscape scale conservation.

Once a site is selected, there are three primary considerations that drive a young forest and shrubland restoration and maintenance project: 1) how will succession at the site be initially reset and to what stage; 2) how the site is to be maintained over time; and 3) what is the current and projected invasive species situation at the site. Other considerations can be more site specific, and can include rare species issues, wetland and permitting issues, and public outreach consideration, among others.

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Sportsmen's League Taking Action for Wildlife

Individual landowners, land trusts, sporting clubs and municipalities across the state are actively managing habitat for wildlife in need of conservation assistance, often adopting recommended actions from the SWAP. Because 80% of Massachusetts lands occupied by wildlife are in private hands, proud owners of woodlots, fields, or wetlands who want to assist wildlife in conservation need are encouraged to join the collective effort to take action for wildlife! The following habitat project is just one of many positive examples demonstrating how landowners working with natural resource professionals and leveraging various funding sources can make a difference for wildlife, habitat, and people.

The Worcester County League of Sportsmen Club (WCLSC) owns 100 acres of forested land, the Babbit Gribbons Area in New Braintree. In 2011, wanting to manage the property for wildlife, habitat, and recreation, WCLSC hired a Certified Forester, Jim DiMaio, who immediately went to work. His first actions involved completing a comprehensive inventory of the property's natural resources, establishing management objectives, and, funded by a Department of Conservation and Recreation grant, developing a Forest Stewardship plan. Other steps included locating, blazing, and painting land boundaries and preparing a timber sale. DiMaio also assisted WCLSC with enrolling their property in the Chapter 61 Program for forest taxation status, registering the League in DCR's Forest Stewardship Council "Green Certification" Program, and helped WCLSC secure a federal Natural Resource Conservation Service EQUIP Habitat Management Grant.

In 2016, fulfilling WCLSC's desire for both permanent land protection and public recreational access, MassWildlife acquired a conservation restriction on the property which abuts the agency's 535-acre Winimusset Wildlife Management Area. Now and into the future, WCLSC's sustainable management practices benefiting SWAP-listed species such as Ruffed Grouse, American Woodcock, Black Bear, and Chestnut-sided Warbler, as well as other upland game and non-game wildlife, will continue in coordination with MassWildlife's forestry staff.

WCLSC's Wildlife Habitat and Forest Stewardship Plan Actions:

- Decommissioned a crumbling, unsafe building foundation.
- Created three patches of young forest wildlife habitat totaling about 15 acres.
- Constructed grouse drumming logs and rabbit brush piles. (A few winters later, MassWildlife tracked a radio-collared Black Bear hibernating in one of the brush piles!)
- Thinned 70 acres of forest to allow for growth of the highest quality trees for the future.
- Treated densely growing invasive plants; Burning Bush, Multiflora Rose, Japanese Barberry, and Oriental Bittersweet.
- Built water bars on two abandoned roads alleviating significant erosion issues.

Coastal Plain Ponds

Photo © Bob Wernerehl

by
Karro Frost

On a crisp morning last November, I led a group of four scientists from MassWildlife and two Natural Resources Wardens from the Town of Plymouth to the north shore of Great South Pond in Plymouth. As the Plant Conservation Biologist for MassWildlife, I am charged with protecting rare plants in their native habitats and determining what is needed to improve their condition. We were there to remove non-native, invasive Gray Willow that invaded the habitat of several rare Coastal Plain Pond plants. It was well past the end of the growing season, so I was thrilled to be able to find and show my colleagues the rare plants occurring on this shore. We were richly rewarded and I was able to point out five rare plants, as well as two watch-listed plants, as we worked that day.

Great South Pond is a Coastal Plain Pond—a unique habitat. Coastal Plain Ponds are well described by their name. In Massachusetts, most occur on the sandy coastal outwash plain in the southeastern part of the state and on Cape Cod and the Islands. Examples with public access include: Myles Standish State Forest, Carver; Mary Dunn Ponds WMA, Hyannis; and Nickerson State Park, Brewster. A unique community of plants has developed to withstand the harsh growing conditions associated with these ponds. Coastal Plain Pondshores are nutrient-poor, and have widely variable moisture conditions as the shore is often flooded until mid-summer, then completely dries out in late summer and early autumn. Unlike typical lakes and ponds, most of the Coastal Plain Ponds have no inlet or outlet and are fed mostly by groundwater, with only a little input from rainfall. However, since European settlement of Massachusetts, some of our Coastal Plain Ponds have been connected to other wetlands or ponds, and in particular, used as reservoirs for cranberry bogs. Great South Pond, for example, is now connected to Little South Pond to the north by a concrete waterway.

In a typical year, groundwater and Coastal Plain Pond water levels rise due to autumn rain and winter snow. In spring, tree leaf-out increases transpiration, drawing on the groundwater and pond water, and the warmer temperatures increase evaporation from the pond surface. Coastal Plain Pond water levels recede, exposing the sandy shorelines. Depending on the year, more or less of the shoreline is exposed, providing habitat to a variety of species. In fall and winter, the ponds typically refill with water from rain and snow, restarting the cycle. The Coastal Plain Pond plants are adapted to this seasonal rise and fall either by withstanding the inundation of their basal leaves and stems, or by producing seed that will germinate only when the right conditions occur—exposed drying shore substrate.

Great South Pond is one of the few locations where the globally rare species New England Boneset (*Eupatorium novae-angliae*) occurs. This species' global distribution is limited to a few Coastal Plain Ponds in Massachusetts and Rhode Island, and was the primary reason we had come to work at Great South Pond. Gray Willow (*Salix cinerea*), an introduced willow from Europe and western Asia, was threatening to shade out the rare New England Boneset at this pond. Although New England Boneset was past bloom that sunny day in November, the distinctively toothed, opposite leaves of the plant were visible and we were able to avoid damaging any of these plants as we cut the willow stems and carefully painted each cut stump with a small amount of herbicide.

The annual fluctuating water levels around these ponds maintain these communities: the high water levels in the winter and spring kills many woody plants that cannot tolerate inundation of their seedlings or roots. The herbaceous plants have evolved to thrive under the conditions found in these ponds: sandy cobble to mucky substrate, acidic waters,

Photo © Jennifer Garrett

The globally rare Plymouth Gentian (page 28) and New England Boneset (above) are two of 40 plant and animal Species of Greatest Conservation Need that are specifically associated with Coastal Plain Ponds in Massachusetts.

naturally low nutrients and seasonally fluctuating water levels. Coastal Plain Pond plants can withstand the inundation of their leaves through the winter, or have seeds that tolerate the inundation until the next dry cycle. The annual drawdowns eliminate the fully aquatic species from becoming established on the shoreline. Many organisms that have evolved to thrive around Coastal Plain Ponds do not occur elsewhere in the state, or in the world. Although we saw five MESA-listed plants in November, there are 40 plant and animal Species of Greatest Conservation Need identified in the State Wildlife Action Plan (SWAP) that are specifically associated with Coastal Plain Ponds in Massachusetts.

A typical pondshore will often have zones of vegetation with more aquatic-tolerant species closer to or in the water, while species preferring drier substrate are on higher ground closer to the shrubs that typically ring these ponds. This characteristic is especially noticeable when the shore has a gradual slope, while the community may be abbreviated or non-existent if the shoreline drops off quickly to deep water. Typical zonation from high ground to inundated pond might consist of Oak and Pitch Pine, with a zone of Sweet Pepper-bush and Highbush Blueberry with Common Greenbrier at the upper edge of the water. The upper beach area provides habitat for many of the herbaceous and grass-like Coastal Plain Pond plants, including Golden Pert, Slender-leaved Flat-topped Goldenrod, Lance-leaf Violet, beak-rushes, Pondshore-rush and sundews. This is the zone where several globally rare but locally abundant plants occur, including Plymouth Gentian (*Sabatia kennedyana*), Pondshore Knotweed (*Persicaria puritanorum*), and Rose Coreopsis (*Coreopsis*

Photos © Bob Wernerehl

The MESA-listed Dwarf Bulrush (top) and Round-fruited Seedbox (bottom) eke out a precarious existence on the narrow margins of sandy pondshore between the high water line and the surrounding shrubs and forest.

A typical Coastal Plain pondshore with zones of vegetation. More aquatic tolerant species grow closer to or in the water, while species preferring drier conditions grow on higher ground closer to the shrubs that typically ring these ponds.

rosea). The semi-permanently inundated zone is slightly lower and provides habitat for Bayonet Rush, Water Lobelia and Pipewort as well as the globally rare Terete Arrowhead (*Sagittaria teres*). Classic pond species may be found rooted in areas most likely to retain water, such as Yellow Cow-lily and Floating Heart along with the rare plants, Subulate Bladderwort (*Utricularia subulata*) and Horned- and Bald-Sedges (*Rhynchospora* spp.) Not every pond has every zone, and even on ponds with a variety of zones, zone width and species composition may change year to year. Small ponds or shallow bays of larger ponds may not hold any water by late summer, and the area inundated by water earlier in the season will be completely carpeted with a variety of plants, or, depending on the year, have only one species dominating the depression.

As a botanist I find the plants to be interesting, but there are several other species that thrive in and rely on Coastal Plain Ponds. Coastal Plain Ponds are important habitat for several dragonflies and damselflies: over 45 odonate species are known to occur in this habitat and several are rare. As larvae, they live in the water among the aquatic vegetation, and climb onto emergent vegetation to undergo metamorphosis to adults. A mid-summer trip to a Coastal Plain Pond is a good time to see these flying jewels. Coastal Plain Ponds also provide important habitat for Painted, Musk, Spotted, and Snapping Turtles, as well as the federally Endangered Northern Red-Bellied Cooter (*Pseudemys rubriventris*). The exposed sandy pondshores provide habitat for turtle nests. Large Coastal Plain Ponds, such as Great South Pond, can be important for migrating waterfowl, such as Common and Hooded Mergansers, Goldeneye, and Bufflehead. When fish are present through introduction or hydrologic connectivity with other water bodies, freshwater mussels might also be present. These animals can be important in the nutrient cycling in Coastal Plain Ponds. Mussels likely to be present include the Eastern Lampmussel (*Lampsilis radiata*), Triangle Floater (*Alasmidonta undulata*), and Eastern Pondmussel

(*Ligumia nasuta*). The Tidewater Mucket mussel (*Leptodea ochracea*) might also be present. When fish are absent, the ponds might function as vernal pools. The smaller Coastal Plain Ponds which do not hold water every summer are most likely to provide this important habitat.

Massachusetts geology has led to the creation of many Coastal Plain Ponds, and this state has by far the largest number of Coastal Plain Ponds in New England. The current data on rare plants and animals that use Coastal Plain Ponds indicates over 300 ponds where these species might be found. While most Coastal Plain Ponds occur on the coast, including Cape Cod, the Islands, and Plymouth and Bristol counties, there are also inland variants. Last summer, I visited several Coastal Plain Ponds in the center of the City of Springfield. Several others occur in the Connecticut River valley.

There are several threats to this community. The primary threat is residential and commercial development around the ponds. The low-nutrient water quality within Coastal Plain Ponds can be damaged by discharge of high-nutrient runoff from roads and lawns and discharge to groundwater of septic waste. Homeowners may threaten the pondshore community by planting and mowing lawns to the edge of the water. Conversion of the surrounding landscape to impervious surfaces increases runoff of contaminants to both ground and surface water, including chloride in the groundwater as a result of road salt. This chemical has been slowly increasing over time and is toxic to many organisms at higher concentrations.

The use of Coastal Plain Ponds as recipients of irrigation runoff from cranberry bogs similarly contaminates the ponds and changes the natural fluctuation of water levels. The nutrients and pesticides can alter the species composition in ponds and on pondshores, and may encourage the excessive growth of algae or vascular plants.

Water withdrawal for municipal wells in the vicinity of these ponds threatens the natural water fluctuations to which this plant community is adapted. When water levels are drawn down too early in the season, it allows woody plants to expand into the open pondshore area, shading out the native plants.

Often with development comes an in-

crease in recreation on the pondshores. Most of the plants have withstood some level of activity on the pondshore, but all-terrain vehicle driving on pondshores is particularly damaging. It not only destroys the growth from the current year, but also the root systems within the sand.

Any change in hydrology to these systems as a result of climate change will impact them. New England may become wetter; thus, the pondshore communities may not have sufficient time to flower regularly and produce seed or the various zones may be compacted. We might experience more severe droughts like we did last year, in which the water levels in many Coastal Plain Ponds dropped and stayed low through much of the winter. Warmer temperatures warm the water in Coastal Plain Ponds faster, making the ponds inhospitable to some of the current species. Increases in severe weather events will increase runoff of pollutants from agricultural and urban areas into water bodies.

The Maryland Meadow Beauty (Rhexia mariana)*, shown here after flowering, is MESA-listed and is found on moist open Coastal Plain pondshores.*

In November, my colleagues and I were responding to another threat to this community, the introduction of exotic and invasive plants. Several have become problems in the Coastal Plain Ponds, including Gray Willow and Common Reed. Both Fanwort and Hydrilla are increasingly being detected in Massachusetts Coastal Plain Ponds.

The SWAP identifies Coastal Plain Ponds as a very high conservation priority due to the large number of co-occurring rare plants and animals, and the many threats Coastal Plain Ponds are facing. MassWildlife has a long history of working with partners to protect and manage Coastal Plain Ponds, including open space protection at particularly significant pond complexes, such as Cooks Pond and Hyannis Ponds Wildlife Management Areas. MassWildlife is working with a number of partners including the Department of Conservation and Recreation, the Town of Plymouth, Wildlands Trust, and others to protect this rare habitat's future by managing and controlling Gray Willow and Common Reed at priority Coastal Plain Ponds. In addition, we are continuing a successful long-term partnership with schools and other conservation organizations on head-starting Northern Red-Bellied Cooters for release back into the wild.

Coastal Plain Ponds are gems in our landscape and need our protection. In the long run, much of the Coastal Plain Pond stewardship will need to be led at the local level, by municipalities, local non-profit organizations, and private landowners. MassWildlife looks forward to providing technical support and other assistance. We encourage people to be involved with stewardship of their ponds and to learn to identify the rare plants and animals that occur here. We need local people to monitor them, and help us to protect them. By working together, we hope to make it possible for the next generation to take a walk in late summer and have the pleasant surprise of finding several rare plants still adorning the shoreline of their Coastal Plain Pond.

About the Author

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Pitch Pine-Oak Upland Forest

by
Michael W. Nelson & Chris Buelow

The term "Pitch Pine-Oak Forest" encompasses a suite of globally rare habitats that varies in structure from closed canopy forest, to open woodland, pitch pine-scrub oak "barrens," shrubland, savanna or "shrubby field," heathland, and sandplain grassland. These various habitats often grade into each other, forming a mosaic across the landscape. Pitch pine-oak habitats are found widely across Plymouth County, Cape Cod, and the offshore islands, where retreating glaciers left outwash plains of sandy soils. Though not as noticeable, these habitats are also found inland, typically on sandy soils left by drained glacial lakes, deposited by rivers, or on rocky uplands. Pitch pine-oak habitats consist of vegetation adapted to the dry, nutrient-poor soils where they occur, including Pitch Pine (*Pinus rigida*) and oak trees (*Quercus* spp.), shrubs such as Scrub Oak (*Quercus ilicifolia*), huckleberries (*Gaylussacia* spp.), lowbush blueberries (*Vaccinium* spp.), and grasses such as Little Bluestem (*Schizachyrium scoparium*).

In a particular place and time, the structural continuum from forest, woodland and barren to shrubland, savanna and grassland is a result of past disturbance. Many different types of "disturbances" occur in these habitats—some natural, some human-caused. Pitch pine-oak habitats are fire-prone, as dead leaves, pine needles, and wood decompose slowly and accumulate in the dry environment. Even the living vegetation of these habitats is flammable; including the sticky pitch pine resin, the waxy coating of pitch pine needles, and the papery leaves of scrub oak, huckleberry, and other heaths. Wildfire may result from a lightning strike or human carelessness, or historically through the intentional setting of fire by Native Americans and early farmers, or a prescribed burn may be conducted by fire professionals to reduce accumulated fuel (thereby decreasing the danger of wildfire), as well

as to maintain the habitat. In addition to maintaining a more open habitat structure, fire releases scarce nutrients into the soil, and stimulates growth, flowering, germination, and seedling establishment of the fire-adapted vegetation.

A variety of other disturbances help maintain the integrity of pitch pine-oak habitats by reducing excessive tree and shrub cover. Prominent among these are various human land use practices, in particular mechanical cutting, including logging (or other tree cutting), "brush-hogging," and mowing. Coastal savannas, heathlands, and grasslands such as those found on the offshore islands of Massachusetts are partly the result of livestock grazing, which was more widespread historically. Weather including strong winds, ice storms, and (along the coast) salt spray serve to thin and dwarf trees. Even severe insect irruptions, whether of introduced species like the Gypsy Moth (*Lymantria dispar*), or native species like the Yellow-headed Looper Moth (*Lambdina pellucidaria*), may kill and thin trees and shrubs.

Pitch pine-oak systems are inhabited by the greatest diversity of species, rare and common alike, when the habitat consists of a mosaic including patches of bare sand, openings dominated by lichens, grasses and heath, thickets of scrub oak, and pitch pine and oak trees in a complete range of canopy cover, from isolated trees grading to a closed canopy forest surrounding the barrens proper. Such a complex habitat structure results from disturbances varying in seasonality, frequency, and intensity. Following disturbance in such habitat, climate may maintain an open vegetation structure for a longer period of time than might be expected.

MESA-listed species such as the Imperial Moth (p. 34) and Eastern Spadefoot Toad (below) rely on pitch pine-oak forests to fulfill important phases of their life cycle.

Photo © Bill Byrne

Photo © M.W. Nelson

On sandplains with rapid radiational cooling due to a lack of sufficient canopy cover or soil moisture to prevent heat loss, the vegetation is exposed to late spring frosts that often result in dieback of sprouting leaves, as well as a cooler and shorter growing season, which reduces the overall growth rate. These feedback mechanisms between soil characteristics, vegetation structure, and frost damage slow the establishment of a forest canopy even in the absence of frequent disturbance. Within pitch pine-oak barrens, the effects of radiational cooling and frost are amplified in "frost pockets" (or "frost bottoms"), which are kettleholes and valleys in a sandplain into which cold night air sinks and is trapped. In barrens habitat in southeastern Massachusetts, a frost pocket microclimate often results in freezes well into the spring and frosts early in the fall, and rarely, even a frost in mid-summer on an unusually cool night.

No fewer than 50 species on the Massachusetts list of Endangered, Threatened, and Special Concern Species, including the New England Blazing Star (pictured above), are found in pitch pine-oak habitats.

No fewer than 50 species on the Massachusetts list of Endangered, Threatened, and Special Concern Species are found in pitch pine-oak habitats, particularly in open pitch pine-scrub oak barrens. Two dozen rare and endangered moths and butterflies are found only in pitch pine-scrub oak habitat. The caterpillars of these species feed only on a specific plant, often scrub oak or lowbush blueberry. The most conspicuous scrub oak feeder is the Barrens Buckmoth caterpillar (*Hemileuca maia*); the black and white moths can be seen flying on relatively warm and sunny days from late September through October. The nocturnal, but large and brightly-colored Imperial Moth (*Eacles imperialis*), see page 34, is even more spectacular; as a caterpillar, it feeds primarily on pitch pine. Another member of the sandplain insect community is the Barrens Tiger Beetle (*Cicindela patruela*), a ground-dwelling predator of ants and other small insects.

The total abundance of moths, both rare and common, is high in barrens and other pitch pine-oak habitats, and these moths are an important food source for predators. The Eastern Whip-poor-will (*Caprimulgus vociferus*) feeds on moths and other insects at night, catching them on the wing like a bat. Indeed, the abundance of moths attracts bats to these same habitats. This includes species that have declined as a result of the fungal disease "white-nose syndrome," such as the Northern Long-eared Bat (*Myotis septentrionalis*, Endangered). During the breeding season, songbirds including the Prairie Warbler (*Setophaga discolor*), Pine Warbler (*Setophaga pinus*), and many others rely on the abundance of caterpillars of moths and butterflies found in pitch pine-oak habitats to feed their young.

Finally, among the common and abundant kinds of plants of pitch pine-oak habitats, there are rarer plants adapted to dry soils and disturbance such as fire. One example is Broom Crowberry (*Corema conradii*), a low-growing evergreen shrub that looks like a clump of miniature pine trees and produces small, reddish-purple flowers in early spring. Another example is New England Blazing Star (*Liatris scariosa* var. *novae-angliae*), pictured above; a tall aster with brilliant purple flowers in late summer and early autumn.

Prescribed fire shapes pitch pine-oak communities by favoring fire-tolerant species while temporarily excluding fire-intolerant, generalist species. The Barrens Tiger Beetle (MESA-listed), Prairie Warbler (regionally rare), and Hognose Snake all benefit from this habitat management technique.

Photo © Chris Buelow

Photo © M.W. Nelson

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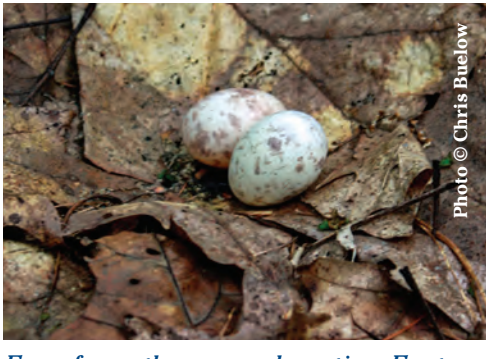
The Fire Cycle

One of the most basic threats to barrens communities and the specialized plants and animals they support is the natural process of habitat succession that occurs in the absence of periodic disturbance. For millennia, fire was the primary disturbance that maintained barrens habitats in the Northeast. Fire shapes a natural community by favoring fire-tolerant species while temporarily excluding fire-intolerant, generalist species. Fire-tolerant trees and plants such as Pitch Pine, Scrub Oak and lowbush blueberries will survive a fire, while generalist, fire-intolerant species such as White Pine (*Pinus strobus*), Red Maple (*Acer rubrum*) and cool season grasses will often be killed. Fire also burns off leaf litter, fallen woody debris, and even organic duff, creating an especially harsh, dry, low-nutrient environment where generalist plant species find it extremely difficult to grow and thrive. Organic matter in the form of leaf litter and woody debris will eventually begin to accumulate in all barrens systems, but when there are periodic fire events,

MassWildlife biologists Chris Buelow and Rebecca DiGirolomo conduct field research in pitch pine-oak habitat at Myles Standish State Forest.

this debris becomes fuel for the next fire event, continuing the cycle, and allowing the barrens community to persist indefinitely.

However, when the fire cycle is disrupted or suppressed, the structure and species composition of barrens communities will eventually shift from relatively open landscapes dominated by fire-tolerant species to communities dominated by densely growing generalist vegetation. Without periodic fire, organic matter builds in the soil, resulting in greater water retention and more nutrient-rich growing conditions that favor generalist plants. As these generalists begin to thrive, increased shade and continued accumulation of organic matter and moisture in the soil result in even better conditions. This not only accelerates their dominance in the system, but also creates conditions much less conducive to fire. In this scenario, the fast-growing generalist plants will soon overtop and outcompete the slow-growing, fire-tolerant species. Over time the system will no longer function as a barrens community—unless another major disturbance event, such as a fire or timber harvest, resets the system. This shift toward generalist communities is often referred to as mesification: a term that describes both the shift of soil characteristics from dry and nutrient-poor toward moist and nutrient-rich, as well as the shift of plant communities that favor dry, nutrient-poor conditions toward plant communities requiring less harsh growing conditions.



Eggs from the ground-nesting Eastern Whip-poor-will, a MESA-listed species, lie on leaf litter in a pitch pine-oak forest.

The integrity of many of our barrens communities in Massachusetts has declined greatly as a result of nearly 100 years of fire suppression. On the coastal plain, where conditions can be especially harsh, this shift toward mesification has been relatively slow, and most of our historic barrens are still easily recognizable and still support a dominance of barrens species. However, in the interior of the state, where even outwash soils support more organic material, mesification has occurred at a much faster rate, and many former barrens communities are now almost unrecognizable, often covered by a high canopy of White Pine. Fortunately, because barrens communities rely upon disturbance events to persist, they are incredibly resilient, and respond well to habitat restoration efforts such as targeted timber harvest and prescribed fire.

The Barrens Buckmoth, a MESA-listed species, inhabits very dry, open habitats with extensive scrub oak thickets, especially sandplain pitch pine-scrub oak barrens, as well as maritime shrublands. In Massachusetts, this moth is restricted to the southeast coastal plain, with one inland population in the Connecticut River Valley.

Timber Harvest

Because restoration in barrens habitats is often intended to overcome long disturbance-free periods, the initial management techniques used to restore these systems often appear extreme. Typically, one of the first actions in barrens restoration is a timber harvest to remove generalist trees and thin the forest canopy. At sites where the canopy has become closed, a timber harvest can result in removal of up to 80% of tree canopy cover. A timber harvest resets the system, effectively using the harvest as a proxy for a catastrophic fire, returning the canopy structure to a time when fire occurred regularly on the landscape. It is often easy to determine which trees to keep at a site because there will be a few large-crowned, open-grown oaks and Pitch Pines evenly spaced across the landscape: a clear indication of the site's pre-fire-suppressed condition. In order to ensure that the maximum amount of organic material is removed from the system, whole tree harvesting is the preferred method for barrens restoration. This wholesale removal of material is counter to the goals of a more traditional timber harvest, but in the case of barrens habitat it is important to prevent the build-up of organic material that leads to mesification and may interfere with future prescribed fire.

A site may appear bleak immediately following an initial timber harvest, but soon after, the natural resiliency of a barrens system will be on display. Because barrens species are disturbance-dependent, they can persist for long, disturbance-free periods of time. For example, when shaded, lowbush blueberries will shift energy away from producing stems and leaves, and instead store energy in a vast underground system of roots. When there is a return of favorable growing conditions, the plants will send forth a new set of dense stems to recolonize the area. Pennsylvania Sedge (*Carex pensylvanica*) will do the same, creating green carpets where pre-harvest conditions consisted of only bare ground. But perhaps most impressive is the reemergence of barrens

species that had appeared absent from a site for decades. These species rely upon their ability to persist in the seed bank between disturbance events. At a recent restoration site at Muddy Brook WMA in Hardwick, five barrens plants reemerged from the seed bank after the thinning of a 70-year-old canopy: Bird's Foot Violet (*Viola pedata*), Yellow Wild Indigo (*Baptisia tinctoria*), Blunt-leaved Milkweed (*Asclepias amplexicaulis*), Partridge-pea (*Chamaecrista fasciculata*), and New Jersey Tea (*Ceanothus americanus*). The resilient community that results from disturbance makes barrens restoration, even at highly degraded sites, a very successful and rewarding conservation action.

Habitat Management Follows Restoration

Following the initial restoration phase, habitat management transitions to a maintenance phase. The main goal is to reintroduce regular disturbance events, typically through a combination of mowing and prescribed fire. Mowing is conducted early when a few generalist species are still vigorous and there is not enough fuel debris to accommodate prescribed fire. In time (usually a few years), as repeated disturbance begins to favor more specialized barrens species, prescribed fire is applied as the community becomes more stable. Once a barrens community is reestablished at a site, how often fire should return depends on site-specific characteristics, but in general a sandplain grassland requires a fire interval of every 3–4 years, a heathland every 5–7 years, a pitch pine-scrub oak barren every 5–10 years, and many upland oak sites every 10–20 years.

The Pine Warbler (Setophaga pinus) *relies on the abundance of caterpillars of moths and butterflies found in pitch pine-oak habitats to feed their young.*

A Top Priority

MassWildlife considers pitch pine-scrub oak barrens a top conservation priority in the Commonwealth because these globally rare communities support a wealth of rare species, as well as game birds such as American Woodcock (*Scolopax minor*) and Ruffed Grouse (*Bonasa umbellus*). MassWildlife has initiated a major barrens restoration program, focusing on barrens management on Division lands and through partnerships at important coastal and inland sites. Major restoration projects have been initiated on MassWildlife lands including Frances Crane WMA in Falmouth, Montague Plains WMA in Montague, and Muddy Brook WMA in Hardwick. Working in collaboration with the Department of Conservation and Recreation (DCR-Parks), MassWildlife has also been restoring habitat in the Plymouth pine barrens and at Manuel Correllus State Forest on Martha's Vineyard. Other barrens habitat projects currently in planning include Herm Covey WMA in Belchertown and, in collaboration with the U.S. Army Corps of Engineers, Birch Hill WMA in Winchendon and Templeton. Another planned collaboration includes the Quabbin and Ware River Watersheds with DCR-Water Supply Protection. Each of these projects represents an important contribution to the state's and region's biodiversity; together, they comprise significant landscape-level conservation.

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Climate Change

by
John O'Leary

MassWildlife has always sought to use the best science available to inform its management decisions. How we address the emerging threat to the Commonwealth's biodiversity from climate change is no different. To meet this challenge, we find ourselves both using published scientific literature and breaking new scientific ground.

Since the first SWAP in 2005, MassWildlife has sought to understand how rising sea levels, increasing temperatures, and changes in the timing, type, and amount of precipitation will impact SWAP Species of Greatest Conservation Need (SGCN). One approach has been conducting Climate Change Vulnerability Assessments (CCVA) of the SGCN species and the habitats which support them.

The CCVA process measures a species' sensitivity and its capacity to adapt to change, and results in the development of conservation measures to ensure the long-term sustainability of the SGCN in a changing climate. These measures, which are presented in the Massachusetts Wildlife Climate Action Tool (MassCAT), climateactiontool.org, are drawn from assessments completed throughout the Northeast, as well as Midwest and Mid-Atlantic regions.

MassCAT presents a summary of CCVA results for individual species and habitats in four information categories: ranking (the predicted extent of climate change impact), confidence (which reflects the amount and quality of background information present), emission scenarios (based on expected changes in human population and technology), time period (projected impacts in the years 2050, 2080, or 2100), and location (the applicable geographic region considered).

MassCAT is a powerful tool designed to inform and inspire local action that was developed for local decision-makers, conservation practitioners, large landowners, and community leaders across the state.

While the scope and challenge of the projected effects of climate change seem overwhelming, you can take meaningful action by factoring climate change into daily individual and organizational decisions. Take advantage of the regional resources available to help you make those decisions. In addition to MassCAT and the SWAP, these resources provide information specific to climate change in Massachusetts and the New England/Northeast area:

- Massachusetts Climate Change Adaptation Report, mass.gov/eea.
- Northeast Climate Science Center, umass.edu/necsc.
- National Climate Change and Wildlife Science Center, https://nccwsc.usgs.gov.

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Photo © Bill Byrne

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In Deerfield, near the Connecticut River, the red sandstone conglomerate comprising North and South Sugarloaf Mountains, protected by the Department of Conservation and Recreation as the Mount Sugarloaf State Reservation, rises from the flat bottom of the Connecticut River valley. The rich bedrock of these low hills supports seven rare plants, including the only Massachusetts population of native Snowberry, an Endangered species. The steep cliffs are home to a Peregrine Falcon eyrie, one of the few natural nest sites in the state for these stunning raptors. Even a rare moth, the Orange Sallow Moth, lives in these hills; its caterpillars eat the unripe seeds of false foxglove plants, which are semi-parasitic on oak roots. Photo © Bill Byrne

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