



2019-20
RESEARCH &
MANAGEMENT
REPORT

**Reptile, Amphibian, and Invertebrate
Conservation & Management**

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2019-20 RESEARCH & MANAGEMENT REPORT

Maine Department of Inland Fisheries and Wildlife protects and manages Maine’s fish and wildlife and their habitats, promotes Maine’s outdoor heritage, and safely connects people with nature through responsible recreation, sport, and science.

Reptile, Amphibian, and Invertebrate Conservation & Management

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Compiled and edited by Diana Harper and Lauren McPherson

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The Department of Inland Fisheries and Wildlife receives Federal funds from the U.S. Department of the Interior.

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REPTILE, AMPHIBIAN, AND INVERTEBRATE CONSERVATION AND MANAGEMENT

Program Overview

Maine is home to 18 species of frogs and salamanders (amphibians), 18 species of turtles and snakes (reptiles), and over 15,000 species of terrestrial and freshwater invertebrates, from beetles and butterflies to mayflies and mussels. The Reptile, Amphibian and Invertebrate (RAI) Group is challenged with coordinating research and conservation priorities for this diverse suite of organisms, more than 100 of which are currently state listed as Endangered, Threatened, or Special Concern.

Some rare invertebrates, such as the Katahdin arctic butterfly and Roaring Brook mayfly, are state or regional endemics – found nowhere else in the world but in Maine or a small area of the Northeast. Other species, including the cobblestone tiger beetle and the short-tailed swallowtail butterfly, have only recently been discovered in Maine by our biologists. The RAI Group works to ensure that these and many other lesser known, but ecologically important, species remain a part of Maine’s rich ecosystem.

The RAI Group is one of the Department’s few units devoted entirely to nongame and endangered species work, and is therefore dependent on dedicated, non-General Fund sources of revenue, such as the Loon License Plate and Chickadee Check-off. Thank you for your support of both these critical funding sources, thus helping our Department meet its legislative mandate “to conserve, by according such protection as is necessary..., all species of fish or wildlife found in the State, as well as the ecosystems upon which they depend” (107th Maine Legislature, 1975).



Black Racer photo by Derek Yorks



Wood Turtle photo by Derek Yorks



Black Swallowtail photo by Kent McFarland



MEET THE REPTILE, AMPHIBIAN, AND INVERTEBRATE GROUP



Phillip deMaynadier, Ph.D., Wildlife Biologist and Group Leader

Phillip supervises RAI Group activities and serves as one of the Department’s lead biologists on issues related to reptile, amphibian, and invertebrate conservation and endangered and nongame policy. Some of his recent projects include: participation on the lead team for Maine’s 2015 State Wildlife Action Plan; coordination of MDIFW’s program for protecting high-value vernal pools; co-coordination of state butterfly, dragonfly, amphibian, and reptile atlas efforts; and advising landowners and land trusts on rare and endangered species management practices. Phillip is also a Graduate Faculty member at the University of Maine’s Department of Wildlife, Fisheries, and Conservation Biology.



Beth Swartz, Wildlife Biologist

Beth is the Department’s lead biologist on a wide range of invertebrate taxa. Her recent efforts have been devoted to assessment and conservation of Clayton’s copper butterfly, brook floater and other freshwater mussels, rare mayflies, and bumble bees. Beth is currently coordinating a statewide atlas effort for bumble bees and targeted surveys for the rusty patched bumble bee, which was federally listed as an Endangered species in 2017. Beth also helps coordinate the Department’s vernal pool conservation efforts and plays a lead role in environmental review of large energy project proposals statewide.



Derek Yorks, Wildlife Biologist

Derek is the Department’s lead biologist on reptile and amphibian issues, coordinating research and conservation efforts on several priority rare species. Derek is currently assessing the distribution, status, and management needs of Maine’s black racers as well as Blanding’s, spotted, and wood turtles, and is coordinating Maine’s efforts with those of several working groups on these species across the Northeast. Derek is also studying and helping to develop recommendations for how to mitigate the impacts of roadways on Maine’s reptiles and amphibians.

SEASONAL STAFF AND PROFESSIONAL COOPERATORS

The RAI Group could not address such a diverse suite of taxa without the expert assistance of the following professionals in 2019-2020:

Dr. Samantha Alger
Dr. Catherine Bevier
Kalyn Bickerman-Martens
Paul M. Brunelle
Dr. Steve Burian
Dr. Ron Butler
John Calhoun
Dr. Matthew Chatfield
Charlene Donahue

Dr. Frank Drummond
Sarah Haggerty
Dr. Michael Kinnison
John Klymko
Megan Leach
Gregory LeClair
Dr. Cynthia Loftin
Derek Moore
Ethan Nedeau

Trevor Persons
Paul Powers
Bryan Pfeiffer
Dr. Leif Richardson
Marcia Siebenmann
Lisa St. Hilaire
Dr. Herb Wilson
Mark Ward

AMPHIBIANS AND REPTILES

By eastern U.S. standards, Maine is a large and climatically diverse state. Thus, while North American reptiles and amphibians (herpetofauna) are richest and most diverse at southern latitudes, Maine's relatively moderate southern and coastal climate permits many species to reach their northeastern range limit here. Only one species, the mink frog, reaches the southern edge of its range in Maine (and northern New Hampshire and Vermont).

Maine provides some of the most extensive and intact remaining habitat for the 36 known herpetofauna species it hosts. Of our 18 amphibians and 18 reptiles, one is extirpated (timber rattlesnake) and two introduced (mudpuppy salamander and red-eared slider turtle). Several are of regional and national conservation concern, and ~33% are listed as Species of Greatest Conservation Need (SGCN) in Maine's 2015 State Wildlife Action Plan. Some of MDIFW's recent survey, research, and conservation projects directed at these and other priority herpetofauna are highlighted below.



Partners in Amphibian and Reptile Conservation (PARC)

Derek Yorks and Phillip deMaynadier

MDIFW continues to cooperate with Partners in Amphibian and Reptile Conservation (PARC). Modeled partly after the successful Partners in Flight (PIF) bird conservation program, PARC forges partnerships between diverse public and private organizations to stem worldwide amphibian and reptile population declines.

MDIFW regularly attends PARC's northeastern chapter meetings, including the most recent 2019 annual meeting in Galloway, NJ (the 2020 meeting was cancelled due to Covid-19). Some of Northeast PARC's projects to date include: drafting model state herpetofauna regulations; compiling a list of regional species of conservation concern;

publishing management recommendations for important habitats; developing fact sheets on emerging amphibian and reptile diseases; designing guidelines for identifying Priority Amphibian and Reptile Conservation Areas (PARCAs); developing best management practices for turtle road crossing structures; and coordinating northeastern working groups for priority species such as the wood turtle, Blanding's turtle, and spotted turtle, and for priority habitats like vernal pools.

For more information on this or other national PARC conservation efforts, visit the PARC website at parcplace.org

This work is supported by the federal State Wildlife Grants program and state revenues from the Loon Conservation Plate and Chickadee Check-off Funds.

Maine Amphibian and Reptile Atlas Project (MARAP)

Derek Yorks and Phillip deMaynadier

From 1984-1988, MDIFW, in cooperation with Maine Audubon and the University of Maine, conducted the Maine Amphibian and Reptile Atlas Project (MARAP). Over a four-year period, 250+ volunteers across the state recorded roughly 1,200 amphibian and reptile observations. This initiative culminated in the 1992 publication of the book, *The Amphibians and Reptiles of Maine*, the first edition of which sold out within two years.

2ND EDITION (1999)

By 1998, considerable new data on the state's amphibians and reptiles had been compiled, and there was increasing demand for updated information. Editors Malcolm Hunter, Jr., Aram Calhoun, and Mark McCollough revised a second edition, incorporating information from 1,300 new records into updated range maps and species narratives, and added color photographs and a CD of the calls of Maine's frogs and toads. You can order the updated 1999 edition of *The Amphibians and Reptiles of Maine* for \$19.95 from MDIFW's Information Center (207-287-8000) or from our online store at mefishwildlife.com.

CONTINUING DATA COLLECTION

Since the publication of the most recent atlas, MDIFW has continued to collect data and maintain a comprehensive database on the distribution of Maine's 35 extant amphibian and reptile species (33 native and two exotic). As of spring 2020, our 1,700+ volunteers had logged nearly 14,000 records, nearly all having been carefully vetted and digitally curated by Trevor Persons, a consulting herpetologist.

INSIGHTS

The MARAP project has continuously improved our understanding of Maine's reptile and amphibian biogeography. For example, we now know that reptile species richness sharply decreases northward, while amphibian richness is fairly even across the state. MARAP findings have also helped to inform specific species' conservation

status assessments (e.g., Endangered, Threatened, Special Concern, SGCN), survey and research priorities, and on the ground conservation efforts.

There is still much to learn about the distribution and ecology of Maine's herpetofauna, and you can help! Members of the public can share photo observations in two ways:

1. Submit a MARAP reporting form, available on MDIFW's website in the Species Information section, or
2. Use the popular iNaturalist app. Within the platform, just look for the project entitled Maine Amphibian and Reptile Atlas Project. All amphibian and reptile observations added to iNaturalist within Maine are automatically added to this project.

This work is supported by the federal State Wildlife Grants program, state revenues from the Loon Conservation Plate and Chickadee Check-off Funds, and volunteer assistance.

How can you help?

Please submit observations of any of the four state-listed reptiles below as soon as possible to: derek.yorks@maine.gov or (207) 941-4475



Eastern box turtle (Endangered) photo by Derek Yorks



Blanding's Turtle (Endangered) photo by Derek Yorks



Black Racer (Threatened) photo by Derek Yorks



Spotted Turtle (Threatened) photo by Derek Yorks

Blanding's and Spotted Turtles

Derek Yorks

For over 25 years, MDIFW has researched the distribution and status of Blanding's (Endangered) and spotted (Threatened) turtles in Maine.

Blanding's turtles are seven to 10 inches long with a yellow throat and light-colored flecking on a helmet-shaped shell. They are found primarily in York county and areas south and southwest of Portland.

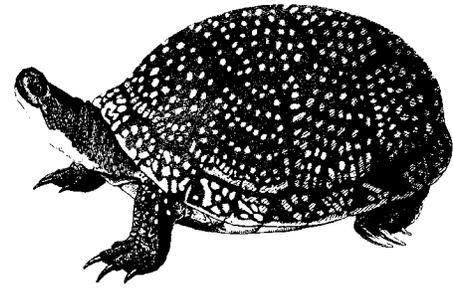
Spotted turtles are five to six inches long with yellow spots on the head, tail, and legs and a slightly domed, yellow-spotted black shell. They are found in southern Maine and the mid-coast area east to Penobscot Bay.

Both species are semi-aquatic, preferring small, shallow wetlands including swamps, marshes, and vernal pools. Undeveloped upland forests, fields, and other habitats surrounding these wetlands provide habitat for nesting, aestivating (a period of summer inactivity), and migration movements between seasonally occupied wetlands.

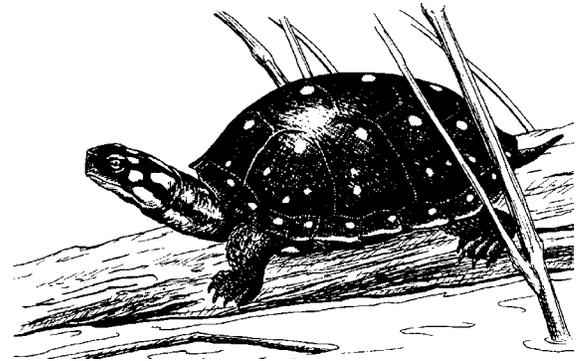
SURVIVAL CHALLENGES

Despite the attention these turtle species have received, habitat loss and fragmentation continue to threaten them in Maine. And as human population and development expands in southern and coastal areas, road mortality becomes an ever-increasing threat. The turtle's shell has provided sufficient protection from predators for millions of years but, unfortunately, is no match for a car tire.

Both Blanding's and spotted turtles are long-lived animals that take a minimum of seven (Spotted) to 14 (Blanding's) years to reach reproductive age. This delayed maturity, coupled with low hatching success, places increased importance on adult survivorship. Like most turtle species, Blanding's and spotted turtles have evolved a life history strategy dependent upon on a slow but steady reproductive output paired with long adult lifespans. Recent population analyses of Blanding's turtles indicate that as little as 2 to 3% additive annual mortality of adults is unsustainable, leading ultimately to local population extinction. In other words, losing just a few breeding adult turtles in a population each year to roadkill or other causes such as illegal collection may be these species' greatest threat.



Blanding's Turtle drawing by Abigail Rorer



Spotted Turtle drawing by Mark McCollough

CONSERVATION EFFORTS

MDIFW is currently involved in five conservation projects benefiting Blanding's and spotted turtles in Maine:

1. Conservation of Blanding's Turtle in the Northeast:

MDIFW and partner agencies in four other northeastern states were awarded a U.S. Fish and Wildlife Service Competitive State Wildlife Grant to implement collaborative conservation measures for Blanding's turtles.

This is the second such award these states have been jointly given for Blanding's turtle conservation, and our renewed effort focuses on implementing on-the-ground conservation actions and standardized population assessments that we identified in the 2014 Conservation Plan for Blanding's turtles in the northeastern United States.

These next steps toward maintaining and enhancing functional Blanding's turtle populations include improving and monitoring the use of nesting habitat, working to reduce road mortality, studying the population and demographics at priority sites, and reaching out to landowners and land trusts hosting high-value populations.

In 2019, Maine biologists concluded field work under this grant with intensive trapping studies at two Blanding's turtle sites, adding to the three sampled in 2017/2018, and we continued to analyze data and plan conservation actions with our project partners throughout 2020.



Blanding's Turtle photo by Derek Yorks

2. Cautionary Road Signage Project (Turtle Xing):

A cooperative study by the University of Maine and MDIFW identified high-density, rare turtle areas with road-crossing hotspots. With the assistance of the Maine Department of Transportation (MDOT), The Nature Conservancy, and local towns, we installed signs in strategic locations warning motorists to watch for rare turtles on the roadway. The signs are permanent, but they fold closed so that they may be deployed seasonally, coinciding with the spring and summer period when overland turtle movements are greatest. This reduces sign fatigue by local commuters, increasing the signs' impact. This project was one of the first of its kind among northeastern states and is now in its 15th year.

3. Maine Turtle Roadkill Survey:

In 2010, we partnered with Maine Audubon and MDOT to launch Wildlife Road Watch, a volunteer initiative to report wildlife-road interactions (both alive and dead). In 2014, we began monitoring for road mortality at previously documented Blanding's and spotted turtle crossing and roadkill sites and potentially important road-crossing sites identified in a predictive GIS model.

We expanded this effort in 2018 as the *Maine Turtle Roadkill Survey* – a partnership between MDIFW and Maine Audubon to refine the predictive model, improve survey methods, and enlist citizen scientist volunteers to collect data at roadways where turtles are at risk.

Data generated from these efforts will help us plan future wildlife roadkill mitigation efforts such as additional signage areas, critter crossings, exclusionary fencing, and public outreach.

For more information on the program, visit inaturalist.org/projects/maine-turtle-roadkill-survey or maineaudubon.org/projects/road-watch/maine-turtle-roadkill-survey.

4. Improving Nesting Habitat at Priority Blanding's Turtle Sites:

MDIFW, in partnership with local land

trusts, private landowners, and the U.S. Forest Service, is working to monitor, manage, and in some cases create or enhance nesting habitat at several of Maine's most promising Blanding's turtle sites.

Biologists are using time-lapse cameras at nesting areas to document nesting females and gather data that will help them effectively manage this critical resource. Most nesting sites were created by human disturbance and, without ongoing periodic managed disturbance, these bare gravel, sand, or soil areas are eventually overcome with vegetation.

This habitat-focused effort will improve long-term viability of regionally important Blanding's turtle populations in Maine. In addition to reducing the need for nesting females to travel outside core or interior areas of sites, management of nesting areas may serve to enhance nest success and hatchling survival by directing females away from marginal nesting habitats like backyards, active gravel pits, roadsides, and agricultural lands, where eggs and hatchlings are more susceptible to human-caused disturbance and human-subsidized predators, such as raccoons and skunks.

5. Conservation and management of the Spotted Turtle in the Eastern U.S.:

In 2017, MDIFW, and eight other eastern states, was awarded a U.S. Fish and Wildlife Service Competitive State Wildlife Grant to assess spotted turtle populations and develop an adaptive conservation plan. The State-Threatened spotted turtle reaches the northeastern terminus of its range in the Atlantic Coastal Plain of Maine and is identified as a Species of Greatest Conservation Need (SGCN) in all 21 states in which it occurs. While at the outset of this grant the spotted turtle's distribution in York County was well understood, seemingly isolated populations had also been recently confirmed in another four counties as far as central and mid-coast Maine.

Under this grant, MDIFW broadened its spotted turtle population assessments in 2020, making a special effort to gather baseline data at sites supporting this species throughout its statewide range. We also focused considerable sampling effort on poorly understood areas outside of York county, which helped us to identify new spotted turtle populations ranging from seemingly small to rather substantial and of statewide importance.

This work is supported by the federal State Wildlife Grants program, the Maine Department of Transportation, The Nature Conservancy, the Maine Outdoor Heritage Fund, state revenues from the Loon Conservation Plate and Chickadee Check-off Funds, and volunteer assistance.

Mapping Maine's Wood Turtles

The wood turtle, listed as Special Concern, is one of Maine's rarest turtles. Medium sized (five-eight inches) with a distinct sculpted shell and orange coloration on its neck and legs, this long-lived species can survive for 58 years or more.

For much of the year, wood turtles are found in slow to moderate moving clear-water streams with a predominantly sand or gravel substrate. During late spring and summer, they use the surrounding uplands including forests, floodplains, meadows, and hayfields. From late fall to early spring, they hibernate underwater in sheltered areas of rivers, including deeper pool bottoms, under riverbanks, or under woody debris. No other Maine turtle species makes such extensive use of both aquatic and terrestrial habitats.

MDIFW verifies and tracks occurrences of this rare species and maps them for purposes of conservation planning, environmental reviews and inclusion in outreach efforts such as the Beginning with Habitat program. Wood turtles and many other species that the Department maps have long been represented by a simple buffer in the form of

a circle (often a ¼ mile in radius) around an occurrence point. We are increasingly engaging in a process to re-map species occurrences as “smart polygons” that are based upon detailed knowledge of the species' habitat use and typical home range extents (**Figure 1**).

We began this process for wood turtles in 2019, remapping their stream habitat using a protocol developed with MDIFW Habitat Group biologists. The new mapping protocol results in polygons which follow the linear stream feature up and downstream from stream-associated occurrences, buffered to include upland habitats out to 300 meters. We have excluded nonhabitat incursions, such as intensive development and aquatic features not typically used by wood turtles (e.g. impounded streams) from the maps. Smart polygons such as these, informed by species natural history, do a better job of directing Department and partner resources toward those areas of the landscape that are most meaningful for conservation.

This work is supported by the federal State Wildlife Grants program and state revenues from the Loon Conservation Plate and Chickadee Check-off Funds.

FIGURE 1. TRANSLATING RARE ANIMAL OBSERVATIONS INTO MEANINGFUL HABITAT POLYGONS USING SPECIES NATURAL HISTORY INFORMATION.



Maps by Becca Settele and Derek Yorks.

Northern Black Racers

Derek Yorks



Northern Black Racer photo by Derek Yorks

Black Racer Habitats in Maine

In northern New England, black racers are habitat specialists and are most commonly found in shrublands and sunny open woodlands with predominantly sandy soils. They are diet generalists that prey upon rodents, frogs, birds, and even other snakes. The northern black racer is found from southern Maine to northern Alabama, Georgia, and South Carolina. In many areas of its range, it is abundant and is one of the most commonly encountered snake species. Despite its prevalence elsewhere, Northern black racer is listed as a Species of Greatest Conservation Need (SGCN) in all six New England states. The black racer reaches its northern range limit in Maine where it is at risk of extirpation due to rarity, habitat loss, and habitat fragmentation. Currently, Maine racer populations appear to be restricted to interior York County and southern Oxford County, where there are only about 12 modern, documented sites.

Monitoring Black Racer Populations

In the spring of 2016, MDIFW biologists initiated a multi-year project seeking to confirm and document new or poorly known occurrences and to establish a monitoring program at sites where black racer populations occur. The project has since evolved to include a study examining the impacts of grid-scale solar development on one of Maine's largest racer populations. In the first three years of this effort (2016-2018), we tracked 25 individual racers using VHF radio transmitters. In 2017, we added a monitoring program that assesses populations with repeated transect surveys, and we continued these surveys in 2018. An analysis of the data we collected during this period estimated that populations at three of Maine's best-known Racer sites range from 29.1 (95% CI =17.4-70.5) to 182.1 (95% CI =124.3-297.9). This tells us that even Maine's very best sites support relatively small populations.

This work is supported by the federal State Wildlife Grants program and state revenues from the Loon Conservation Plate and Chickadee Check-off Funds.



Mudpuppy drawing by Abigail Rorer

The Introduced Mudpuppy

Phillip deMaynadier

The mudpuppy is Maine's largest and only non-native amphibian species. Entirely aquatic in all life stages, this giant salamander is found in lakes and streams throughout eastern North America, ranging from the Great Lakes region, south to the Gulf States, and approaching its native northeastern range in New York and Vermont.

Throughout much of its range, the mudpuppy is considered a species of conservation concern, but it is an introduced species in several New England states, including Rhode Island, Massachusetts, New Hampshire, and Maine. Accidentally introduced into the Belgrade Lakes, Kennebec County, in 1939, current documentation suggests the mudpuppy may have spread to 16 waterbodies (11 confirmed) across three major central Maine watersheds. This exotic salamander represents a potential management risk, where it could have negative interactions with economically important fisheries and several aquatic Species of Greatest Conservation Need (SGCN) identified in Maine's 2015 Wildlife Action Plan.

There is no clear evidence that the mudpuppy's introduction has negatively affected Maine's aquatic communities, but its ecological interactions as both predator and prey are also largely unstudied. Anecdotally, fishermen have expressed concerns that the mudpuppy interferes with fishing gear, is a possible fish larvae predator, and could be competing with game fish for food resources. Indeed, mudpuppies do have a broad diet that can include fish eggs, small fish, aquatic insects, mollusks, crayfish, and other amphibians. All of these taxa include constituent SGCN

species in Maine, some of which overlap the mudpuppy's potential range. More study is needed to assess the current range and ecological effects of mudpuppies in Maine's local aquatic communities.

MUDPUPPY STUDY

In the winter of 2017-2018, MDIFW and cooperators initiated a new study on the mudpuppy with the following objectives:

1. Document distribution and relative abundance using standardized field trapping techniques.
2. Conduct a diet analysis to understand potential impacts on lacustrine SGCN and aquatic ecosystems.
3. Update Mudpuppy records in the Maine Amphibian and Reptile Atlas Project database and prepare a distribution map for professional publication and public outreach.

eDNA SAMPLING

In addition to these direct objectives, this project will also inform novel mudpuppy environmental DNA (eDNA) detection protocols in development at the University of Maine (Dr. Michael Kinnison and Vaughn Holmes) by providing a confirmed baseline of occupied mudpuppy waterbodies and their relative abundance. eDNA consists of cellular DNA products shed from organisms into their environment, and has recently emerged as a sensitive and potentially cost-effective alternative to traditional survey methods for amphibians, fish, and other taxa. The challenge of mudpuppy detection and management presents an exciting opportunity to develop new techniques that combine eDNA sampling with traditional direct observation and trapping methods to determine and validate occupancy estimates for Maine's only exotic amphibian.

IMPROVED TRAPPING TECHNIQUE

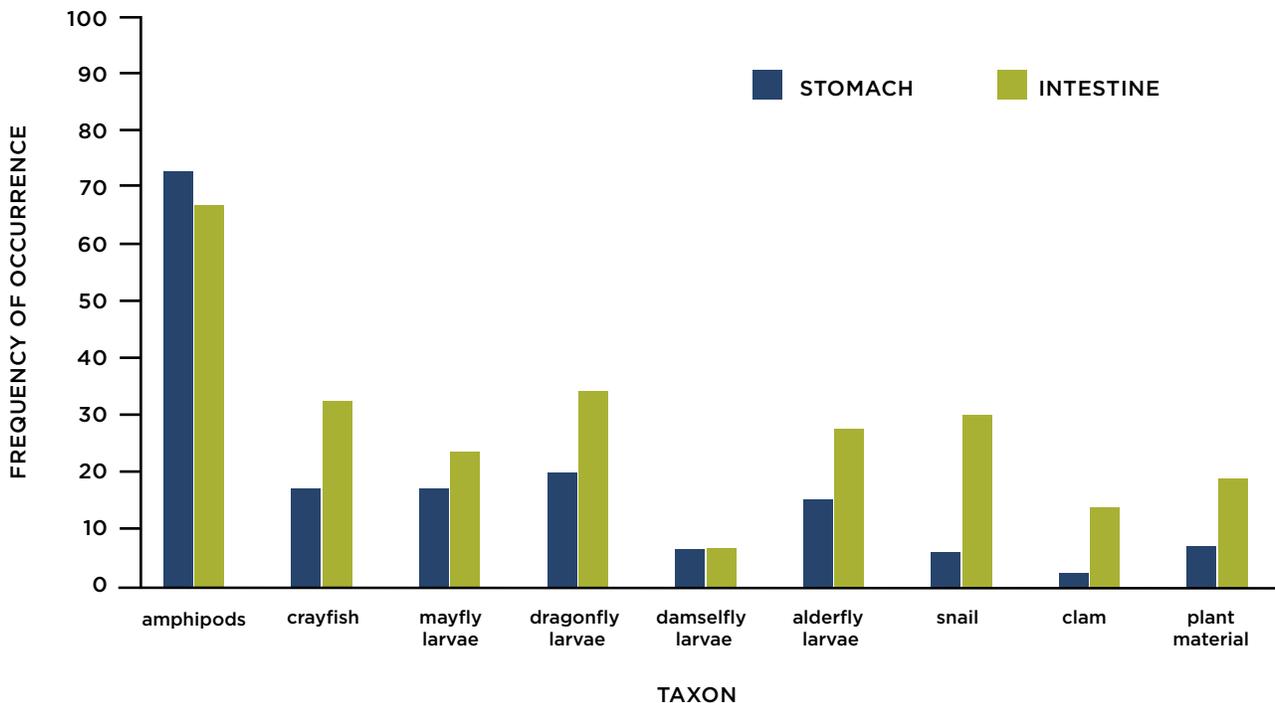
Following a review of mudpuppy biology and capture techniques, we developed a methodology to trap salamanders through the ice using modified, baited minnow traps. Our trapping method has been successful with a total of 356 mudpuppies captured during the winters of 2017, 2018, and 2019. Using this technique, we have confirmed mudpuppy presence in seven waterbodies including Salmon Lake (Belgrade/Oakland), North Pond (Smithfield/Rome), Long Pond (Livermore), Messalonskee Lake (Belgrade/Oakland), Togus Pond (Augusta), Long Pond (Belgrade/Mount Vernon), and Great Pond (Belgrade/Rome). Our capture rate of 0.488 animals per trap night compares favorably to those of other mudpuppy studies using similar methodology from within the species' native range, where capture rates range from 0.028 (Vermont) to 0.69 (Ontario). Notably, our capture rates on Long Pond (Belgrade/Mount Vernon) equaled 1.45 animals per trap night, a rate exceeding that of any reports from elsewhere in the species range.

GUT CONTENT EXAMINATIONS

A Colby College laboratory (Dr. Cathy Bevier) has dissected a total of 300 mudpuppies to examine digestive tract contents from both stomachs and intestines. This work is ongoing, but preliminary gut content identifications include remains from nine major taxa: crayfish (Decapoda), mayflies (Ephemeroptera), amphipods (Amphipoda), damselflies and dragonflies (Odonata), alderflies (Megaloptera), snails (Gastropoda), clams (Bivalvia), and plant matter (Figure 2). By far the most frequent food items were amphipods (scuds), occurring in 73% of mudpuppy stomachs and 67% of intestines. Incidental items included remains of a rubber fish lure, pebbles, fish lures, two worms, two crane fly larvae, and an unidentified beetle. The presence of fishhooks in the stomachs of three mudpuppies suggests interference with fishing gear.

This work is supported by the federal State Wildlife Grants program, state revenues from the Loon Conservation Plate and Chickadee Check-off Funds, Colby College, and the University of Maine Orono.

FIGURE 2. MUDPUPPIES DIGESTIVE TRACT CONTENTS





INVERTEBRATES

As they do globally, invertebrates dominate Maine’s biota, both in richness and biomass. In fact, Maine’s non-marine invertebrates are conservatively estimated to exceed 15,000 species, or nearly 98% of the state’s animal species diversity. Like many other states, Maine’s legal definition of “wildlife” (any species of the animal kingdom) includes vertebrates and invertebrates, thus challenging MDIFW and conservation partners with a tremendous breadth and volume of species to protect and manage. One of the ways MDIFW triages its limited staff and program resources toward invertebrate conservation and management is to focus on better-studied species and groups with well-documented patterns of decline or imperilment. Maine lists 132 non-marine invertebrates as Species of Greatest Conservation Need (SGCN) in the 2015 State Wildlife Action Plan, and some examples of recent survey, research, and conservation projects for these and other priority invertebrates are highlighted below.

Bumble Bees

Beth Swartz

Bumble bees are one of our most valuable pollinators of flowering plants. Many spring wildflowers, as well as important Maine crops like apples, blueberries, cranberries, and tomatoes, thrive on bumble bees’ early spring emergence and “buzz pollination” method. Unfortunately, over the past 25 years, several species of North American bumble bees have all but disappeared, and others have drastically declined throughout their ranges. On a global scale, habitat loss, pesticides, diseases and parasites introduced with commercially raised bumble bees, and intensive agricultural practices likely all play a role in bumble bee declines.

scientists from all over Maine to collect data on what species are present, where they occur, what habitats they use, and how abundant they are.

Over the course of the project’s six seasons, more than 300 volunteers were trained in a standardized survey protocol and provided field equipment. This enthusiastic and productive group of citizen scientists then went to work and, by the end of the final field season in 2020, conducted surveys at more than 2,500 sites statewide and contributed more than 27,000 new bumble bee records for Maine! Their data showed that 14 of the 17 species historically known to occur in Maine (Table 1) were still present, and that some species had decreased in relative abundance while others had increased.

The three previously documented species not found by MBBA volunteers are the rusty patched bumble bee, American bumble bee, and indiscriminate cuckoo bumble bee. All are known to have declined in other parts of their range and it is possible they are now extirpated from Maine. The rusty patched bumble bee has experienced a 90% decline in both numbers and distribution throughout its entire North American range, and in March of 2017 it became the first ever bumble bee to be protected by the U.S. Endangered Species Act. While the species has not been documented in Maine for more than a decade, we are still hopeful that a remnant population is out there somewhere.

TABLE 1. BUMBLE BEES OF MAINE.

COMMON NAME	SCIENTIFIC NAME
Rusty Patched Bumble Bee	<i>Bombus affinis</i>
Yellowbanded Bumble Bee	<i>Bombus terricola</i>
Brown-belted Bumble Bee	<i>Bombus griseocollis</i>
Red-belted Bumble Bee	<i>Bombus rufocinctus</i>
Ashton’s Cuckoo Bumble Bee	<i>Bombus ashtoni</i>
Lemon Cuckoo Bumble Bee	<i>Bombus citrinus</i>
Fernald’s Cuckoo Bumble Bee	<i>Bombus fernaldae</i>
Indiscriminate Cuckoo Bumble Bee	<i>Bombus insularis</i>
Two-spotted Bumble Bee	<i>Bombus bimaculatus</i>
Common Eastern Bumble Bee	<i>Bombus impatiens</i>
Confusing Bumble Bee	<i>Bombus perplexus</i>
Sanderson’s Bumble Bee	<i>Bombus sandersoni</i>
Tri-colored Bumble Bee	<i>Bombus ternarius</i>
Half-black Bumble Bee	<i>Bombus vagans</i>
Northern Amber Bumble Bee	<i>Bombus borealis</i>
Yellow Bumble Bee	<i>Bombus fervidus</i>
American Bumble Bee	<i>Bombus pensylvanicus</i>



The Maine Bumble Bee Atlas: Keeping Track of Native Pollinators

In 2015, MDIFW and the University of Maine initiated the Maine Bumble Bee Atlas (MBBA), a project to improve our understanding of the diversity, distribution, and conservation status of Maine’s bumble bee fauna. This multi-year statewide survey enlisted the help of volunteer citizen

An encouraging outcome of MBBA has been documentation of the apparent recovery of the yellowbanded bumble bee – a species that has experienced rangewide declines, including in Maine, but appears to be rebounding in northern New England. MBBA volunteers found this species every year of the project, in more than 170 townships across all corners of the state and in a wide diversity of habitats.

But perhaps the project's most exciting highlight came in 2017, when one of our volunteers discovered a population of Ashton's cuckoo bumble bee in northern Aroostook County. This species is one of the rarest bumble bees in North America and had not been documented in Maine since 1996. An obligate nest parasite of both the rusty patched bumble bee and the yellowbanded bumble bee, its decline likely followed the crash of these two species. The now rising numbers of yellowbanded bumble bees in Maine give hope that a few more occurrences of this rare species may be found.

For more information about the Maine Bumble Bee Atlas, visit the project website at mainebumblebeeatlas.umf.maine.edu. You can also follow the project on Facebook at facebook.com/MaineBumblebeeAtlas.

This work is supported by the federal State Wildlife Grants program, in-kind contributions from the University of Maine at Orono and Farmington, the Maine Outdoor Heritage Fund, state revenues from the Loon Conservation Plate and Chickadee Check-off Funds, and volunteer assistance from citizen scientists.

Rusty Patched Bumble Bee Surveys

The rusty patched bumble bee was once widely distributed across much of the eastern and upper mid-western U.S., but since the 1990s it has declined by nearly 90% range wide. Consequently, in 2017, it was afforded protection under the U.S. Endangered Species Act.

The rusty patched bumble bee historically occurred across most of the state, with records regularly reported from the late 1800s to the mid-1990s. But since then, only two observations have been documented, both in the mid-coast region: one individual photographed in a Rockport (Knox Co.) flower garden around 2005, and another collected from a commercial blueberry field in Stockton Springs (Waldo Co.) in 2009. In the multi-year (2015-2020) state-wide volunteer survey effort to document Maine's bumble bee diversity that generated over 27,000 new records, no rusty patched bumble bees were found.



Rusty Patched Bumble Bee photo by Johanna James-Heinz

In 2019 and 2020, with funding from the U.S. Fish & Wildlife Service (USFWS), MDIFW conducted targeted surveys in the vicinity of the most recent Knox and Waldo County occurrences, as well as in adjacent Lincoln and Sagadahoc Counties and in areas of southwest Maine with hillier terrain. Using a combination of Maine Bumble Bee Atlas and USFWS survey methodologies for finding new populations of rusty patched bumble bee, biologists visited as many high-quality habitats as possible during the species' flight season. Across all study areas and through both field seasons, they conducted a total of 150 surveys at 119 sites. While 10 species of bumble bees were documented, unfortunately the rusty patched bumble bee was not observed.

MDIFW will continue looking for this extremely rare species in 2021. You can help by carefully observing the bumble bees you see and documenting any credible sightings with close-up, in focus photographs. You can submit your photos to iNaturalist (inaturalist.org), which MDIFW will monitor for confirmed reports. For more information on how to distinguish the rusty patched bumble bee from similar-looking, more common Maine bumble bees, please visit the Maine Bumble Bee Atlas website (mainebumblebeeatlas.umf.maine.edu) and read *Tips For Identifying the Rusty Patched Bumble Bee*.

This work is supported by the federal Endangered Species Section 6 grants program, state revenues from the Loon Conservation Plate and Chickadee Check-off Funds, and volunteer assistance from citizen scientists.

Dragonflies and Damselflies

Phillip deMaynadier

Insects in the Order Odonata, damselflies and dragonflies are conspicuous components of Maine’s wildlife diversity and valuable biological indicators of freshwater ecosystem integrity. Over 1/3 of the total North American Odonate fauna — 160 species — have been documented in Maine to date. In fact, northeastern North America is considered a regional hotspot for damselfly and dragonfly diversity, and several species of national and global conservation concern are found in Maine.

TAKING STOCK OF MAINE’S RARE BLUETS

From 2017 to 2019, a working group of experts from eight states (ME, NH, MA, CT, RI, NY, NJ, PA) was organized to better coordinate, on a regional level, the study and conservation of bluets (*Enallagma ssp*), which are some of the Northeast’s rarest endemic damselfies. As part of this project, MDIFW cooperated with Dr. Ron Butler from the University of Maine at Farmington to conduct standardized surveys of historical pond locations for the pine barrens bluet, scarlet bluet, and New England bluet, two of which are Species of Greatest Conservation Need (SGCN) in Maine’s Wildlife Action Plan.



New England Bluet photo by Bryan Pfeiffer

From 2018 to 2019, Dr. Butler’s team conducted 245 site visits to 116 ponds and lakes to document the status and habitat use of rare damselfly species. A final report was completed in 2020, and highlights from it include:

1. Scarlet and New England bluets are broadly distributed in Maine’s southern and central lakes from the New Hampshire to New Brunswick borders
2. Many historical New England Bluet populations cannot be reconfirmed, and the species is therefore recommended for Special Concern status.



Breeding Ringer Boghaunters photo by Terry Chick

3. There has been no confirmation of pine barrens bluet populations since 1995, suggesting potential species extirpation.

TRACKING THE ELUSIVE RINGED BOGHAUNTER DRAGONFLY

Listed as a state Threatened species and a Species of Greatest Conservation Need in Maine’s Wildlife Action Plan, the Ringed Boghaunter is globally rare and regionally restricted to the northeastern and upper midwestern U.S., where fewer than 60 populations have been documented. This species was a former candidate for federal listing and is considered “vulnerable” by the International Union for the Conservation of Nature.

The ringed boghaunter was first discovered in Maine in 1995 by MDIFW biologists, and extensive subsequent fieldwork (>715 field surveys of >315 wetlands) over nearly 25 years has only yielded nine confirmed breeding populations, all restricted to York and Oxford Counties. In some cases, boghaunter dragonflies share their habitat with Blanding’s turtles (State Endangered), spotted turtles (State Threatened), and ribbon snakes (State Special Concern). Significant in its own right, the ringed boghaunter is also an indicator of healthy pocket swamp and vernal pool ecosystems – habitats threatened by development in southern Maine. As with many other vulnerable elements of Maine’s biological diversity, identifying, characterizing, and mapping populations of the ringed boghaunter is an important first step toward forging proactive species conservation partnerships with landowners, land trusts, towns, and others.

This work is supported by the federal State Wildlife Grants program, a Northeastern Regional Conservation Needs grant, and state revenues from the Loon Conservation Plate and Chickadee Check-off Funds.

Butterflies

Phillip deMaynadier

With over 120 species and subspecies, butterflies are a colorful and conspicuous component of Maine's biological diversity. They also play important ecological roles, both as wildflower pollinators and as prey to larger species, from dragonflies to birds. Despite growing concern for butterflies and other pollinating insects generally, Maine has, until recently, only had a rudimentary knowledge of the group.

MAINE BUTTERFLY SURVEY

Launched in 2007, the Maine Butterfly Survey (MBS) is a statewide atlas effort designed to fill information gaps on distribution, flight seasons, and habitat relationships for one of the state's most popular insects. Following in the tradition of previously state-sponsored wildlife surveys, such as the Maine Amphibian and Reptile Atlas Project, data generated from the MBS is generated by both professional biologists and citizen scientists.

There is increasing public demand for information on the status of butterflies and other nongame wildlife in Maine. Of special note is the high proportion of state butterflies considered Extirpated, Endangered, Threatened, or Special Concern. Additionally, about 20% of the state's butterflies are currently recognized as Species of Greatest Conservation Need (SGCN) in Maine's 2015 Wildlife Action Plan because of perceived rarity and habitat specialization. Statewide survey effort could demonstrate that some of

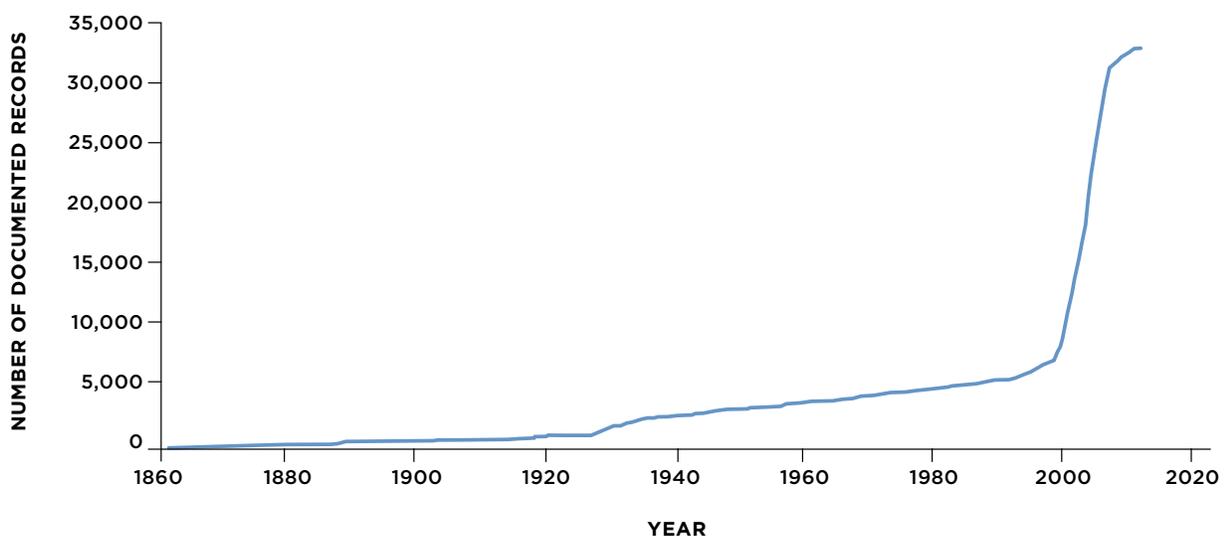


these species are more abundant than formerly believed, while others may merit increased conservation attention. By marshalling the efforts of volunteers and professionals, this multi-year butterfly atlas is designed to provide MDIFW and its conservation partners with a significant increase in knowledge on the status and trends of the state's butterfly fauna.

The volunteer atlas component of the MBS project was launched in 2007 and completed its 10th field season in 2016. From 2007 to 2014, more than 25,000 new records were contributed, representing a >270% increase in records over project baseline. Since then, we have limited new data submissions to unusual species and new county records.

Placed in the context of Maine's historical butterfly study over the past century (**Figure 3**), the MBS contributions are striking. Many of these records provide novel information to our understanding of butterfly distribution and abundance, including >240 new county records, 12 new state records, one new U.S. national record (Short-tailed Swallowtail), and dozens of newly recorded SGCN butterflies.

FIGURE 3. CUMULATIVE MAINE BUTTERFLY RECORDS





Common Buckeye photo by Roger Rittmaster

Public outreach goals for the project met expectations, with more than 300 volunteers attending MBS training workshops at Colby College, over half of whom contributed photo and/or specimen voucher records. More than 10 media articles were published on the project and the website (mbs.umf.maine.edu) has attracted more than 30,000 hits.

In 2016, we began working with the Atlantic Canada Conservation Data Centre (ACCDC; John Klymko) to combine data from their recently completed Maritime Butterfly Atlas with that of the MBS project. Our ultimate goal is to produce a regionally integrated assessment and publication entitled *An Atlas of the Butterflies of Maine and the Maritime Provinces of Canada*.

Progress on this regional atlas is underway with collaboration from five institutions: MDIFW, ACCDC (J. Klymko), Colby College (H. Wilson), UMaine Farmington (R. Butler),



Canadian Tiger Swallowtail photo by Bryan Pfeiffer

and University of Florida (J. Calhoun). Slated for completion in the spring of 2021, the atlas is under contract for publication with Cornell University Press. We hope that this contribution will not only summarize the state of knowledge of butterflies in the Acadian region for scientists, but also introduce new members of the public to the fascinating world of butterflies, and other invertebrates.

In addition to the publication, other MBS project deliverables planned for completion in 2021 include: a finalized electronic database of over 38K records, an updated MBS website, revised state butterfly rarity ranks (NatureServe S-ranks and state ETSC status), and a curated reference collection at the Maine State Museum.

The work is supported by the federal State Wildlife Grants program, The Nature Conservancy, the Maine Outdoor Heritage Fund, state revenues from the Loon Conservation Plate and Chickadee Check-off Funds, and volunteer assistance.

Mayflies

Beth Swartz

Mayflies, or “shadflies” as they are often called, are a diverse group of insects with over 160 species found in Maine. Some species inhabit lakes and ponds, but most live in the flowing waters of streams and rivers. Belonging to the Order Ephemeroptera – named for the short lifespan of the winged adults – mayflies spend nearly their entire lives underwater, where they play a significant role in the food webs of aquatic ecosystems. The often-abundant nymphs are major algae consumers and plant material decomposers, and they provide a high-quality

food source for many stream predators. Anglers know that a good mayfly stream is likely a good trout and salmon stream, too – and the most popular flies tied by fly-fishers are modeled after the different life stages of the mayfly.



Roaring Brook mayfly photo by Don Chandler

MAYFLY CONSERVATION

Most, but not all, of Maine’s mayfly species are common and widespread. Of the rarer mayfly species, Maine lists two as Threatened, and both are identified as Priority 1 Species of Greatest Conservation Need (SGCN) in Maine’s 2015 Wildlife Action Plan.

The Roaring Brook mayfly is among the rarest insects in the world. For many years, it was only known from a single adult specimen collected on Mt. Katahdin in 1939, until MDIFW confirmed in 2003 that the species was still present there. Since then, MDIFW has surveyed more than 160 streams and documented a total of 15 where the mayfly occurs, all in the mountains of north central and western Maine (**Figure 4**).

Researchers outside of Maine have also collected specimens in recent years: one in the Green Mountains of Vermont and several in the White Mountains of New Hampshire. While we now know the Roaring Brook mayfly is not confined just to Mt. Katahdin, it does appear to be New England’s only endemic mayfly, restricted to cold, undisturbed, high-elevation streams of the northern Appalachian Mountain Range.

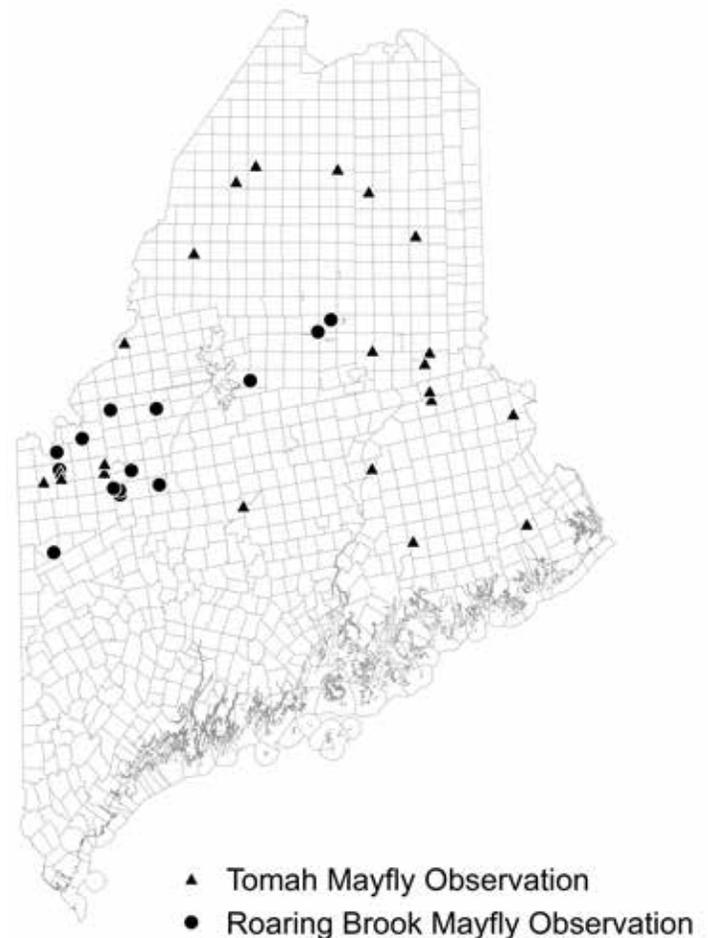
The Tomah mayfly, once thought to be extinct, was rediscovered in Tomah Stream (Washington County) in 1978 and has since been documented at 21 sites across northern, eastern, and central Maine (**Figure 4**) and at least one site in New York. Unlike other mayfly species, the Tomah mayfly is carnivorous as a nymph, preying largely upon other mayfly larvae. To complete its life cycle, this species depends on highly productive seasonally flooded sedge meadows along large streams or rivers. Although sedge meadows are not uncommon in Maine, the Tomah mayfly is only known to inhabit a limited number of sites.

In addition to the Roaring Brook and Tomah mayfly, 13 other Maine mayflies are considered Special Concern and SGCN. Many of them are only known from one or two sites, but comprehensive surveys have never been done. To help us plan such work for the future, the Department contracted mayfly expert Marcia Siebenmann to document

40 years of rare mayfly survey efforts and enter the data into a database. This database will help us track known occurrences and plan our search efforts for new populations of these uncommon insects.

This work is supported by the federal State Wildlife Grants program and state revenues from the Loon Conservation Plate and Chickadee Check-off Funds.

FIGURE 4. DISTRIBUTION OF ROARING BROOK MAYFLY AND TOMAH MAYFLY IN MAINE.



Map by Jason Czapiga and Beth Swartz

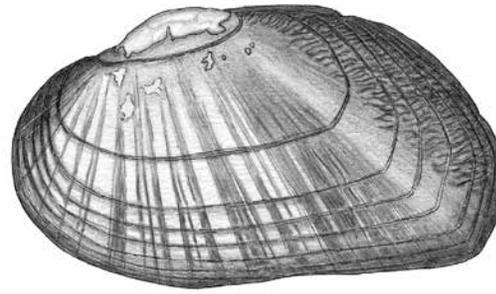
Brook Floater Surveys and Conservation

Beth Swartz

Maine is home to 10 species of freshwater mussels, three of which are listed as Threatened under the Maine Endangered Species Act (Table 2). One of those three, the brook floater, has been the focus of intensive survey efforts by MDIFW over the past decade. This species has declined throughout its Atlantic Coast range and is listed as Endangered or Threatened in nearly every state where it still occurs.

BROOK FLOATER HABITAT

One reason for the brook floater’s decline is its need for clean, relatively undeveloped, undammed riverine habitat with intact forested riparian buffers. While some of the state’s brook floater habitats have been degraded by human impacts, Maine’s many unspoiled rivers and streams still host the best remaining populations of this rare species throughout its entire range. Its stronghold lies in streams and rivers of the Penobscot River watershed, but it also occurs in the Pleasant River (Cumberland County), Sheepscot River, St. George River, lower Kennebec River watershed, and several Downeast rivers. Because Maine is so important to the conservation of this species, maintaining and protecting the quality of our stream and riverine habitats are essential to ensuring the brook floater remains a part of our natural heritage.



Brook Floater
drawing by
Ethan Nedeau

TABLE 2. FRESHWATER MUSSELS OF MAINE.

COMMON NAME	SCIENTIFIC NAME	STATE LISTING
Eastern Pearlshell	<i>Margaritifera margaritifera</i>	
Eastern Elliptio	<i>Elliptio complanata</i>	
Triangle Floater	<i>Alasmidonta undulata</i>	
Brook Floater	<i>Alasmidonta varicosa</i>	THREATENED
Eastern Floater	<i>Pyganodon cataracta</i>	
Alewife Floater	<i>Anodonta implicata</i>	
Creeper	<i>Strophitus undulatus</i>	
Yellow Lampmussel	<i>Lampsilis cariosa</i>	THREATENED
Eastern Lampmussel	<i>Lampsilis radiata radiata</i>	
Tidewater Mucket	<i>Leptodea ochracea</i>	THREATENED



Brook Floater Habitat photo by Ethan Nedeau

BROOK FLOATER SURVEYS

Over the past decade, the Department has intensively surveyed all of the 34 streams and rivers where the brook floater has ever been documented in Maine. Many of these sites had not been visited for over 20 years, and little was known about the brook floater's status at each. To conduct the surveys, MDIFW contracted Ethan Nedeau (Biodrawiversity, LLC), a mussel biologist with extensive experience studying brook floaters in the Northeast, and his work has yielded some interesting results. At Maine's only southern brook floater occurrence, the Pleasant River in Cumberland County, erosion and sedimentation likely caused by adjacent land use and severe flooding have nearly extirpated the species. Where 125 individuals were found at one location in 2001, only three were found in the entire river in 2020.

At the other end of the state, far Downeast in the remote Dennys River, Ethan spent three days looking and only found one live animal. In the St. George River, where we've always presumed the population was healthy, Ethan found relatively good numbers, but they were all old animals with little evidence of reproduction.

Conversely, some sites like Kenduskeag Stream, West Branch Union River, and the Passadumkeag River were confirmed to host relatively large, healthy populations – with the East Branch Pleasant River (Piscataquis County) boasting what might be the best population in the brook floater's entire North American range, with perhaps thousands of animals present.

At each site he surveys, Ethan documents the numbers and density of brook floaters, as well as habitat use and potential threats. This information will help MDIFW plan



Brook Floater Long-term Monitoring by MDIFW

and prioritize conservation efforts and will contribute valuable data to a regional brook floater conservation status assessment that we are working on with 12 other northeastern states.

BROOK FLOATER RANGEWIDE CONSERVATION AND RESTORATION

In 2016, the U.S. Fish and Wildlife Service awarded MDIFW and several partnering states a Competitive State Wildlife Grant for a range-wide brook floater conservation and restoration effort. In 2017, the Brook Floater Working Group was formed and went to work developing rapid assessment and long-term monitoring protocols for states to use throughout the species' range. Surveys conducted using these protocols will provide comparable and comprehensive data about occupancy and the status of each population and will give us a standardized way to monitor trends over time.

In 2018, MDIFW implemented the long-term monitoring protocol at two sites: one in Wesserunsett Stream in Kennebec County and one in the East Branch Pleasant River in Piscataquis County. We marked individual brook floaters at each site with uniquely numbered tags, then measured them and put them back where we found them. We surveyed each site twice in 2018, 2019, and 2020, relocating and remeasuring marked animals and tagging any unmarked animals we found. The data collected during these and future visits will give us information about population size and trends, age structure, survival, and growth.

The Brook Floater Working Group is also coordinating an investigation of effective captive rearing techniques so that brook floaters can be re-introduced to former habitats. Because Maine has some large, healthy populations and we know where to find them, MDIFW has been able to provide gravid females to the propagation study. These animals will help researchers determine how best to care for and successfully raise brook floaters in captivity. We also will share data about Maine's brook floater habitats with other states, in hopes of supporting their conservation efforts. Because we host some of the best remaining populations and habitats throughout the species' range, Maine will play a key role in the brook floater's future conservation.

This work is supported by the federal State Wildlife Grants program and state revenues from the Loon Conservation Plate and Chickadee Check-off Funds.

Tiger Beetles

Tiger beetles are a large group of predatory beetles belonging to the subfamily Cicindelinae within the family Carabidae (ground beetles). They are known for their incredible running speed (relative to their size) and their aggressive predatory behaviors. They have large eyes, long legs, and prominent mandibles. Maine's 14 known tiger beetle species live in a variety of habitats, but most are associated with bare or sparsely vegetated ground that may be composed of sand, gravel, cobble, or mud depending upon the species. The larvae of Tiger Beetles are fierce predators in their own right, living in burrows where they lie in wait to ambush invertebrate prey that pass over them.

CONSERVING RARE TIGERS

Most of Maine's tiger beetle species are widespread and common in their respective habitats. However, Maine lists one as Endangered and two as Special Concern. The State Endangered cobblestone tiger beetle is identified as a Priority 1 Species of Greatest Conservation Need (SGCN) in Maine's 2015 Wildlife Action Plan and the Special Concern salt marsh tiger beetle and White Mountain tiger beetle are identified as Priority 2 SGCN.



Cobblestone Tiger Beetle photo by Jonathan Mays

The cobblestone tiger beetle is considered a 'Globally Imperiled' (G2) species by NatureServe and is deemed 'Critically Imperiled' (S1) in most jurisdictions throughout its range including New Brunswick, Maine, New Hampshire, Vermont, New York, Pennsylvania, New Jersey, West Virginia, Indiana, Kentucky, and Alabama. It is 'Presumed Extirpated' in Mississippi. The cobblestone tiger beetle (CTB) was first discovered in Maine in 2009.

This unique insect is rare primarily because it is a habitat specialist confined to sparsely vegetated cobble bars (usually associated with islands) in free-flowing rivers of a very specific hydrology. This distinct habitat is maintained by high flows in the early spring that produce the preferred cobble substrate and limit the build-up of organic sediments. Statewide surveys to document potential additional populations of the cobblestone tiger beetle were conducted in 2010 and more recently in 2020, but failed to locate the species anywhere other than its original site of discovery in Somerset County. MDIFW will continue to search for this endangered beetle, but it is quite possible that the future of the cobblestone tiger beetle in Maine depends on our efforts to conserve the habitat integrity of a single small watershed in Maine's western foothills.

This work is supported by the federal State Wildlife Grants program and state revenues from the Loon Conservation Plate and Chickadee Check-off Funds.

SPECIAL HABITATS FOR REPTILES, AMPHIBIANS, AND INVERTEBRATES

Per the Maine Legislature, it is the state's policy (and MDIFW's responsibility) to conserve and manage all species of inland fish and wildlife. We take this mandate seriously, but we're also aware of the challenge it presents, considering wildlife is further defined by the state to include thousands of species of native birds, mammals, fish, reptiles, amphibians, and invertebrates.

The Department uses a fine-scale, hands-on approach to the conservation and management of a relatively small number of these species, mainly those managed as harvestable fish and game and those endangered or threatened by extinction. However, the state does not have the capacity to manage all fish and wildlife resources on an individual species-by-species basis. Biologists recognize that a more efficient and lasting approach for sustaining the majority of wildlife requires working at coarser scales, by identifying and conserving diverse high-value habitats and natural communities. Doing so not only provides a safety net for our most vulnerable habitat-specialized species, but also helps maintain healthy populations of all Maine wildlife. Below, we highlight some especially valuable habitats for reptiles, amphibians, and nonmarine invertebrates.

Pollinator Habitat

Beth Swartz

Maine is home to a wide diversity of native insect pollinators, including many species of butterflies and moths (Lepidoptera), bees (Hymenoptera), beetles (Coleoptera), and flies (Diptera). The ecosystem service that these wild pollinators provide to natural communities and human societies is immeasurable. Without them, many wildflowers, shrubs, and trees, as well as fruits, vegetables, and other food crops, would not get fertilized, including important Maine crops like apples, blueberries, squash, and tomatoes.

POLLINATORS IN PERIL

Over the past few decades, several native Maine pollinators, including the monarch butterfly and rusty patched bumble bee, have experienced significant declines throughout their ranges. Factors including habitat loss, disease, pesticides, and competition from introduced species have put these and other insect pollinators in danger of extirpation.





Monarch butterfly photo by Bryan Pfeiffer

HOW YOU CAN HELP

We can all help reverse the decline by establishing and protecting pollinator habitats. Here are a few ways to do so:

Invite Summer Monarchs – Providing summer habitat for monarchs is as simple as allowing common milkweed, the sole host plant for their caterpillars and a valuable nectar source, to grow and flourish.

Create a Bumble Bee Haven – Bumble bees are habitat generalists, but they require an abundance of diverse flowering plants that bloom continuously from spring to fall.

Embrace Your Wild Side – Some of the best habitats for pollinators are “weedy” un-mowed fields and roadsides, which generally benefit from full sun and are rich in pollinator favorites like clovers, milkweeds, goldenrods, vetches, dogbanes, asters, thistles, fireweed, lupines, and raspberries. You can replicate this at home by allowing a portion of your lawn to grow tall until late fall, or by creating an unmowed border around the edge of your property. In the early spring, waiting two to three weeks between cuttings can allow clovers, violets, creeping ground-covers, and dandelions to bloom, providing pollinators with some of their first available nectar and pollen sources of the season.

Plant a Pollinator Garden – Many common garden plants are especially attractive to butterflies, bumble bees, and other insect pollinators. Examples of favorites that are easily grown in Maine include bee balm, butterflyweed, sunflower, coneflower, thyme, mint, rhododendron, blueberry, and rose, but there are many more from which to choose. Use native plant species as often as possible.

Avoid Chemical Herbicides and Pesticides – Herbicides kill many of the flowering plants that pollinators feed on, and insecticides can kill bees and other insect pollinators – either directly or by affecting their abilities to forage, reproduce, or care for their colonies. There are safer alternatives that can still help you manage plant diseases and insect pests around your home and garden. Use native plant species as often as possible and be sure to select nursery plants and seeds that have not been treated with pesticides.

For more information, visit the Xerces Society at [xerces.org/pollinator-conservation](https://www.xerces.org/pollinator-conservation).

Vernal Pools

Phillip deMaynadier

Vernal pools are small, forested wetlands that come in many shapes, sizes, and settings. In the spring, their depressions fill with water from snowmelt and rain, and by late summer, they become partly or completely dry.

Isolated from streams, these habitats provide wildlife with a rich, highly valuable fish-free food base fed by surrounding organic forest matter. They also provide a nearly predator-free haven for a diversity of specialized amphibians (salamanders, frogs, and toads) and aquatic invertebrates (over 500 species in New England) that lack the physical and chemical defenses to reproduce in more fishy environs. Some of Maine's better-known vernal pool indicator species, including spotted salamanders, blue-spotted salamanders, wood frogs, and fairy shrimp, breed almost exclusively in vernal pools.

Still, just as deer wintering areas and waterfowl and wading bird wetlands host more than just deer and ducks, vernal pools provide habitat for more than a few specialized frogs and salamanders. Over half of Maine's amphibian and reptile species frequent vernal pool habitats during their life cycles, as do more familiar species like black ducks, great blue herons, flycatchers, hawks, deer, moose, fox, mink, bats, and other small mammals. Some forest herbivores are drawn to vernal pools because they serve as spring oases, offering up the season's first herbaceous forage. And forest predators are attracted to vernal pools because of the abundance of amphibian prey on the surrounding forest floor. In some forests, the collective weight (or "biomass") of these unseen spring amphibian sentinels has been estimated to exceed that of all birds and mammals combined! Indeed, their sheer abundance and palatability has many biologists and sportsmen convinced that the terrestrial wanderings of pool-breeding frogs and salamanders play a powerful role in the local ecology of Maine's woodlands.

Additionally, among Maine's dozens of wetland community types, few host as many rare and endangered species as do vernal pools, which provide sustenance and shelter to the Blanding's turtle (Endangered), spotted turtle (Threatened), ribbon snake (Special Concern), ringed boghaunter dragonfly (Threatened), as well as rare plants including the featherfoil (Threatened) and sweet pepperbush (Special Concern). Some of these species could face extinction in Maine without the distribution of high-value vernal pools throughout their range.



Vernal Pool photo by Phillip deMaynadier

Additionally, among Maine's dozens of wetland community types, few host as many rare and endangered species as do vernal pools, which provide sustenance and shelter to the Blanding's turtle (endangered), spotted turtle (threatened), ribbon snake (special concern), ringed boghaunter dragonfly (threatened), and rare plants that include the featherfoil (threatened) and sweet pepperbush (special concern). Some of these species could face extinction in Maine without the distribution of high-value vernal pools throughout their range.

DEFINING AND PROTECTING SIGNIFICANT VERNAL POOLS

In 2006, MDIFW and the Maine Department of Environmental Protection (MDEP) developed a definition of Significant Vernal Pools — the most recent Significant Wildlife Habitat under the state's Natural Resource Protection Act (NRPA) — which was approved by the 120th Maine Legislature.

By definition, a vernal pool is considered significant if a State Endangered or Threatened species is present or there is evidence of exceptional breeding abundance by specialized amphibian indicator species.

In collaboration with MDEP, MDIFW has reviewed over 3,800 vernal pools to date, and approximately 25% of them have met standards for potential regulatory significance under NRPA. This use of science-based and legislatively approved criteria for defining a high value (significant) subset of Maine's vernal pools helps MDIFW biologists prioritize those with the greatest wildlife habitat values.

ONGOING EFFORTS AND HOW TO HELP

MDIFW and MDEP cooperate with the Maine Department of Conservation (DOC), municipalities, and landowners to conserve vernal pools. Workshops on vernal pool biology and conservation have been held throughout the state for landowners, land trusts, and land managers, and several publications are available offering voluntary techniques for protecting vernal pools and their wildlife. One such publication, *The Maine Citizen's Guide to Locating and Documenting Vernal Pools*, provides a comprehensive introduction to recognizing and monitoring vernal pools, including color photographs of the indicator species. Also available are two complementary guidebooks for protecting vernal pool habitat during timber management (*Forestry Habitat Management Guidelines for Vernal Pool Wildlife*) and development (*Conserving Pool-breeding Amphibians in Residential and Commercial Developments in the North-eastern United States*). All of the guides can be obtained by contacting the Maine Audubon Society at 207-781-2330.

Pitch Pine Woodlands and Barrens

Phillip deMaynadier

Pitch pine woodlands and barrens are lightly forested upland areas with dry, acidic, and often sandy soils. Pitch pine, red pine, scrub oak, blueberry, huckleberry, and/or bluestem grasses are commonly among the sparse vegetation of this unique natural community.

Once viewed as unproductive wastelands, Maine's few remaining pine woodlands and barrens are now recognized as areas of exceptional wildlife value, providing habitat for a variety of highly specialized plants and animals that feed on the specialized barrens vegetation. These unique habitats are especially rich in rare butterflies and moths, such as Edwards' hairstreak (Endangered), sleepy dusky-wing (Threatened), cobweb skipper (Special Concern), and barrens buck moth (Special Concern). Other rare species associated with Maine's barrens include black racers (Endangered), grasshopper sparrows (Endangered), upland sandpipers (Threatened), northern blazing star (Threatened), and many rare plants.



Pine Pitch Woodlands and Barrens photos by Derek Yorks

Dry woodlands and barrens often require periodic fire to prevent succession to a more common, closed-canopy white pine-oak ecosystem; however, fire is a natural disturbance that is now short-circuited by habitat fragmentation and active fire suppression. Both MDIFW and The Nature Conservancy make an effort to manage barren habitats that are in conservation ownership by implementing prescribed burns and mechanical harvesting as tools for conserving the ecosystem's unique vegetation structure and composition. It is estimated that over half of the state's original pine barren acreage has been lost to residential development, agriculture, and gravel mining, and what remains intact (mainly in the towns of Kennebunk, Wells, Waterboro, Sanford, Shapleigh, Hollis, and Fryeburg) is now tracked as a rare natural community by the Maine Natural Areas Program (MNAP, maine.gov/dacf/mnap).

Freshwater Marshes and Shrub Swamps

Derek Yorks

Freshwater marshes and shrub swamps are open, vegetated, shallow wetlands that contain water most of the time. They vary in size and appearance, but are all characterized as sun-soaked places with standing water, abundant vegetation, and high biological production. Many of Maine's amphibians, reptiles, and invertebrates depend on these wetlands for some or all of their life cycle.

WILDLIFE HUBS FOR MAYFLIES, MINK FROGS, AND EVEN MOOSE

Across Maine's forest-dominated landscape, marshes and shrub swamps serve as focal points for wide-ranging wildlife.

The mixture of lush herbaceous vegetation found above and below the water surface provides amphibians with shelter from predators, plus food in the form of invertebrate prey or the vegetation itself. Frogs, including leopard frogs (Special Concern), pickerel frogs, green frogs, bull frogs, mink frogs, gray tree frogs, and spring peepers breed and often live here year-round. Many reptile species, including spotted turtles (Threatened), Blanding's turtles (Endangered), painted turtles, ribbon snakes (Special Concern), garter snakes, and northern water snakes, thrive here too. And these habitats are also hugely important to several invertebrates, perhaps most conspicuously dragonflies and damselflies, as well as waterfowl, beaver, muskrat, and moose.



Shrub Swamp photo by Derek Yorks



Blanding's Turtle photo by Derek Yorks

CRITICAL HABITAT FOR BLANDING'S TURTLE

Thanks to a Competitive State Wildlife Grant (U.S. Fish and Wildlife Service), MDIFW has recently been able to conduct assessment and planning efforts focused on Blanding's turtles in Maine.

While Blanding's turtles are known to use a number and variety of wetlands, even in a single season, they are not found in just any wetland type. High-value marshes and shrub swamps are often at the core of their home ranges, generally serving as overwintering and late summer feeding areas.

As Maine biologists continue to collect and analyze data from this project, we expect to learn more about what specific characteristics of marshes and shrub swamps are critical for the survival of this species.