
AWCF NEWS

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Fungi for Management of Moose Ticks

Cheryl Frank Sullivan, Bruce Parker, and Margaret Skinner,
University of Vermont Entomology Research Laboratory

Funded by AWCF 2018

Project Rationale: Winter ticks, *Dermacentor albipictus*, aka the 'moose tick' cause physiological stress and mortality in moose across the southern portion of their North American range. Heavily infested, individual moose carry on average over 47,000 ticks. The winter tick is a one-host species producing one generation per year. In the spring, engorged and mated adult females drop from their host and lay eggs, then die. After hatching, the larvae remain protected at the soil level near where the egg mass was deposited and enter a brief resting phase during summer. Stimulated by shortening day-length, larvae ascend vegetation to quest for a host in the fall. A few hundred to several thousand attach to moose as their host brushes against vegetation. On host, larvae feed, then molt into nymphs that subsequently feed and grow



Winter tick adult female laying eggs in a protected fold in a leaf (above) and larval questing cluster (below). Photos by C.F. Sullivan



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Thank you!

into adults as winter progresses. During the tick's peak engorgement period (late March – April) the most dramatic effects occur when tick epizootics kill over 50% of 9-to 12-month-old moose calves.^{1,2}

Viable, sustainable management options targeting winter ticks have been elusive, but entomopathogenic fungi are promising biological control agents. *Metarhizium anisopliae* and *Beauveria bassiana* are the most widely studied species and have few effects on non-target organisms. They are found in soils worldwide. Most commercially available products contain one of these two species as their active ingredient. These fungi produce aerial conidia (spores) that cause infection when they come in contact with ticks. After a spore attaches to the tick cuticle (the hard outer layer), it germinates and penetrates this layer using enzymes and physical activity. The tick's interior becomes colonized from fungal hyphal growth, tearing apart organs and producing toxic metabolites. The fungi then reproduce within or on the cadaver, dispersing infective spores into the surrounding environment. Several isolates are commercially available, but only a few are registered for use against ticks. Met52® EC (an oil-based emulsifiable concentrate) contains *M. brunneum* (labelled as *M. anisopliae*, strain F52). This strain has also been formulated as a granular on grain matrix, Met 52® G. It is reported to provide up to nine months of pest suppression under the right environmental conditions. These products are promising biopesticides for use against the black-legged tick (*Ixodes scapularis*), but their effectiveness against winter ticks is unknown.³⁻⁷



Winter tick larva infected with sporulating *Metarhizium* fungus. Photo by C.F. Sullivan

The objective of this research was to determine the efficacy of fungal-based, biopesticide products to suppress the free-living (off-host) larval stages of winter ticks prior to questing. Winter ticks are susceptible to various species of fungi found throughout their habitats.^{8,9} The use of existing formulated entomopathogenic fungi as a possible management strategy against winter ticks warrants consideration. First, the life cycle of the ticks offers an opportunity to target the vulnerable, aggregating larval stage on the ground, the fungi's natural environment, prior to questing in the fall for a host. Second, the conditions in which ticks and fungi thrive (high humidity, non-desiccating conditions) are similar. Finally,

Conservation Book Report

by Daniel Leete, President

The Song of the Dodo, by
David Quammen, a
Touchstone Book published
by Simon & Schuster ©1996

Written and published more than two decades ago, this is an account of an eight year sojourn by the now-famous author David Quammen. The insights and resultant fears that Quammen frequently raised are now multiplied by a quarter of a century. His personal observations and scientific constructs about the extraordinary forms of evolution found on islands, and the dangers of extinction which can first be seen by studying islands, are now magnified. He didn't just write about islands, he personally investigated portions of the entire planet.

In my opinion, Mr. Quammen is "an ultimate naturalist." He traces the lives of other famous naturalists, such as Charles Darwin, Michael Soulé, and Alfred Russel Wallace. (Wallace's journey and subsequent findings almost eclipsed Darwin's famous discoveries regarding finches in the Galapagos Islands), and yes, Quammen explored there too. When David Quammen travels, he immerses himself in that particular setting. He has the capacity to observe anything and everything, and writes about it in a way such that you feel you are discovering right alongside him. It is thrilling!

enhancement of pathogens in natural environments provides a sustainable alternative to the use of broad-spectrum chemical pesticides.

Methods & Results Summary: Several lab-based bioassay experiments were conducted to test the pathogenicity of pure cultures of different commercial and experimental strains/isolates of entomopathogenic fungi on ticks in Petri dishes lined with filter paper. Then, tests were conducted using formulated commercial products containing *M. anisopliae* (= *M. brunneum*) strain F52. To obtain ticks for this research, adult female ticks were collected in April from deceased, radio-collared moose calves. They were then placed in individual containers for egg laying and larval hatching in the laboratory.

To obtain baseline information on fungal isolate effectiveness, larvae were exposed to fungus-treated surfaces where the filter paper received ten million spores/dish (a moderate test concentration within the range in commercially available products). Results showed there was significantly greater tick mortality when larvae were exposed to the commercial and experimental fungal isolates than from the controls, and mortality varied significantly among isolates.

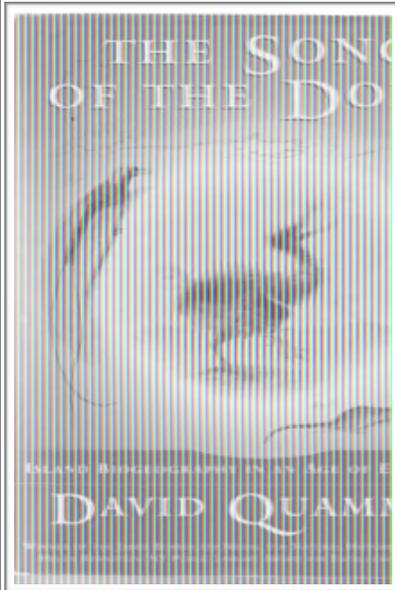
The commercially available *M. anisopliae* isolate caused significantly higher larval mortality than other isolates. Over 60% of tick mortality was observed after exposure to treated surfaces after 3 days with 100% mortality after 9 days. In contrast, an experimental isolate from a Vermont forest caused 89% larval mortality at three weeks. In general, *B. bassiana* isolates produced less overall mortality, ranging from 57-73% at three weeks. Since the active ingredients of the pure fungal isolates in the commercial products are effective at suppressing tick larvae, the efficacy of the biopesticides Met52®EC and Met52®G (granular) Novozymes Biologicals Inc. was directly assessed. Depending on the application method (broadcast vs. spray) and dosage, a similar level of mortality was observed.¹⁰⁻¹² We are currently investigating these products under more natural conditions.



Moose infested with winter tick.
Photo by NPS

Book Report Continued:

I like to learn, especially about all things natural. It is difficult to turn a page in this book without having learned something, and there are 700 pages to relish his research and observations. Even the glossary is educational. For example, there is Frank Preston's



independent research which he attributes to the "Arrhenius equation" which originally stemmed from studies of island biogeography: $S=cA^z$. **S** = number of species, **A** = size of an area, **c** is a constant specific to different taxonomic groups, and **z** indicates the degree to which the number of species on a landscape decreases with fewer landscapes.

Quammen takes this equation far beyond islands. In part because of Quammen's efforts, today this equation is applied to situations where there is a significant decrease in population numbers of certain vulnerable species. The

General Conclusions: These results demonstrate the effectiveness of commercially available *M. anisopliae* products containing strain F52 as formulated and applied under label rates for the management of larval winter ticks. Fungal-based biopesticides have potential for incorporation into an integrated tick management program in localized areas of optimal habitat where moose are known to congregate and be prone to winter tick recruitment. Entomopathogenic fungi require specific environmental conditions (temperature and humidity), ample spore contact with a host, and applications timed appropriately to a susceptible life stage for their use to be effective. These products are currently labeled for use against ticks in residential landscape settings: field efficacy trials are needed to investigate their use in natural settings. The development and testing of fungal biopesticides for tick management should continue until products become more widely available and existing guidelines for current products are expanded.

Acknowledgments: We thank the American Wildlife Conservation Foundation and U.S. Fish & Wildlife Service Wildlife & Sport Fish Restoration Program, and Wildlife Restoration Grants for providing funding for this work. We are also grateful for the assistance of personnel and graduate students from the Vermont Cooperative Fish and Wildlife Research Unit, Rubenstein School of Environment and Natural Resources, and the Vermont Fish & Wildlife Department for obtaining ticks for this study. The use of trade or corporation names does not constitute an official endorsement by the University of Vermont or supporting agencies.

About the Author:

Cheryl Frank Sullivan is a Ph.D. candidate studying the biological control of ticks. She holds a B.S. in environmental science and conservation biology and a M.S. in biological control. At the lab, she specializes in the integrated pest management (IPM) of arthropod pests. She conducts applied lab and field research on the use of IPM as alternatives to chemical pesticides to manage pests in agricultural and



Cheryl sampling for ticks in a northern Vermont forest

Book Report Continued:

“Arrhenius equation” helps scientists understand exactly what is happening (and why) in any particular landscape and explains the loss of diversity as the total area of natural landscapes declines and becomes more fragmented each year.

Why read this book? It’s educational, fun and fascinating! You get to visit some amazing places all over the globe. You see things and events through the eyes of an expert naturalist. As you read, the pages add up to give you an understanding of important lessons about species conservation that our species has yet to understand (or do something about). This is an important book: one of my top 10 books to read and re-read, and David Quammen continues to write. He was featured on PBS this year providing his insights into environmental situations that cause concern. He has also acquired even more renown as his prescient work “Spillover” on the science, history, and human impacts of emerging diseases (especially viral diseases) is yet again realized with the deadly corona virus pandemic.

If there is something written by David Quammen, I will read it, and suggest that you do too!
davidquammen.com

forest settings. In her spare time, she is an avid outdoorswoman and equestrian. For more information please contact her at (802) 656-5434 or cfrank@uvm.edu.

Supporting Information:

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Nature Sleuth

by Daniel Leete, President

In the previous edition of the AWCF Newsletter, you were shown the following photo:



Could you guess what the artifacts are? Answer: seed cases of European water chestnut (*Trapa natans*), not to be confused with the Chinese version which can be purchased in some food stores in tin cans. Other names for this plant are "horned water chestnut and water caltrop". This is an invasive species which has been taking over lakes, ponds, and slow-moving rivers on the east coast since the late 1800s. This plant can be found as far north as the Hudson Bay, and as far south as the Carolinas. Experiments are showing that the plant may be controlled by a certain type of insect. You do not want to step on the seed pods: it is painful! Thanks go to Rob Williams from PRISM/TNC for identification assistance.

Here comes the next item for you to identify: It is approximately 3" long, and in the dried state is hollow inside. Hint: Atlantic seaboard. Good luck!



Tracking the Phantoms - A Wisconsin Red-shouldered Hawk Telemetry Study Update

Gene Jacobs, Raptor Services, LLC research consulting; John Jacobs, Curator of Science, Neville Public Museum of Brown County (retired); and Matthew Hanneman, M.S. Candidate, University of Wisconsin-Stevens Point.

Funded by AWCF 2018

Some cultures believe that when animals cross your path, they are bringing a message to share with you. The Cherokee believe that red-shouldered and red-tailed hawks are messengers of vision, and that when you see one of these elegant raptors, whatever you are thinking about at that moment, is happening around you or that it will come true (springwolf.com).



Red-shouldered hawk fitted with GPS transmitter. Photo by Jacobs

Brothers John and Gene Jacobs, now joined by graduate student Matthew Hanneman, have been studying the mature hardwood forest-dwelling red-shouldered hawk (*Buteo lineatus lineatus*) to determine the breeding range, nest site fidelity, breeding habitat use, migration timing and routes, wintering areas and wintering habitat use of hawks that breed in Wisconsin. In the north central states, the red-shouldered hawk is widely distributed but uncommon: it is state-listed as threatened in Wisconsin, Michigan, and Missouri; a species of special concern in Indiana and Minnesota; a species of special interest in Ohio; and state-endangered in Illinois.

Prior to 1900, red-shouldered hawks were one of the most common hawks but dramatic changes in land cover and intensified agricultural practices (including pesticides) over the last century were significant causes of its decline and rare status today. The large, contiguous hardwood forest tracts the species depends upon are becoming smaller and more fragmented, resulting in habitat that is more suitable to competitors such as the red-tailed hawk (*Buteo jamaicensis*).

Letting Nature Do Its Work

Larry E. Ely, UNH Cooperative Extension New Hampshire Coverts Project Cooperator

Many residents enjoy living in a forested landscape where they can live close to the natural environment. Suburban house lots often contain manicured lawns surrounded by woodland, or are adjacent to tracts of forestland.

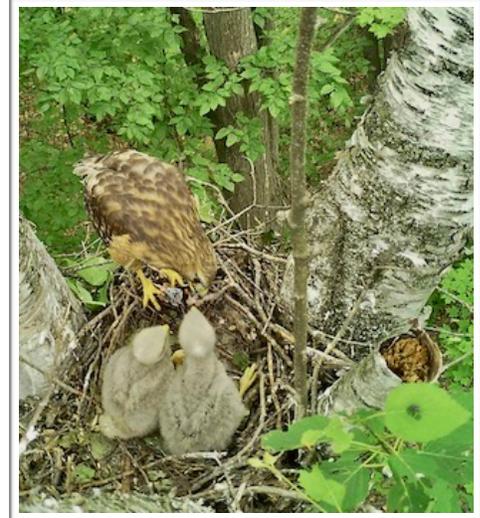
Despite this closeness to the natural world, we often try to tame and domesticate nature around us. I am reminded of this tendency when I see piles of brush and limbs stacked on the roadside after each spring cleanup, or rows of bagged leaves in the fall, all bound for municipal composting facilities.

I live part of the year in New Hampshire, which prohibited the disposal of leaf and yard waste in landfills or incinerators in 1993, and many towns created municipal composting facilities to comply with that law. As a result, many residents bag leaves and stack brush for recycling at the municipal facility. Yet it seems foolish to spend tax dollars to haul these valuable natural resources from our land.



The red-shouldered hawk is one of 26 North American raptors that are resident to medium-distance migrants: birds in the Northeast and northern Midwest migrate south for the winter, while birds in central and southern states don't tend to migrate. In Wisconsin, some data show that young red-shouldered hawks may return to within 15 miles of their natal site.

Unfortunately, more than 50% of juveniles do not survive their first year, with significant losses due to predation by fishers, raccoons, and Great Horned owls.



Female red-shouldered hawk feeding two chicks about 14-17 days old in the Chequamegon-Nicolet National Forest. Photo by Jacobs



Gene Jacobs approaching red-shouldered hawk nest. Photo by Hanneman

With the support of AWCF, the Northeastern Wisconsin Audubon Society, and other donors, the red-shouldered hawk Telemetry Project began in 2018 using innovative technology to better understand the biology and behavior of these rare hawks. Adult red-shouldered hawks were captured on their breeding grounds during the March-August breeding season, and equipped with a solar-powered GPS recording transmitter (logger). Summer activities and areas are being monitored and geospatial locations downloaded and mapped. These transmitters are small enough to be used on red-shouldered hawks although problems have been encountered. Low voltage levels and feathers on the backs of hawks were covering loggers making recharging batteries through solar panels difficult; however, these issues have been corrected by increasing voltage

Letting Nature Do Its Work *continued*

Since the last glacier receded some 12,000 years ago, the soils in New Hampshire have been constantly replenished with nutrients and energy. The slow, ongoing natural processes that build soil will continue as long as we don't interfere.

Pennsylvania State University Professor Richard Yahner has estimated that as much as two tons of leaf litter per acre can accumulate in a mature forest during a single season. Fortunately, naturally occurring bacteria and fungi, along with a large number of other organisms, decompose the material and return nutrients to the soil.

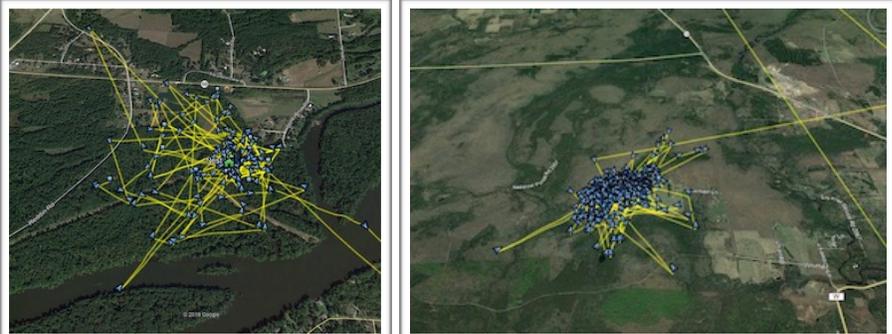
Someone walking through a deciduous forest for the first time and observing the deep carpet of fall leaves might think the forest would eventually be buried under the accumulation. From experience, we know the mass of



leaves will have mostly disappeared by mid-summer. Nature's recyclers will have finished their work and returned the nutrients to the soil vital to the growth of all plants in the forest.

levels and replacing transmitters with enclosed antennas. To ensure a good fit, loggers were "fit-tested" on captive hawks before putting them on wild hawks.

Breeding Range: In 2018 and 2019, loggers were attached to 5 hawks each year, (4 males and 6 females), during the summer breeding season. Only a single adult at any nest site was captured and fitted with a data logger to minimize interference on the nesting pair. Sufficient data was downloaded to accurately determine the breeding range for all of the red-shouldered hawks.



Breeding ranges of a female red-shouldered hawk in Wood County, 163 acres (left), and of a male red-shouldered hawk on the Nicolet National Forest, 290 acres (right)

Migration: Most red-shouldered hawks migrate from 100 to 700 miles south during late October through December. A working hypothesis in this study is that most adult hawks return to their same breeding territories in Wisconsin the following March. Migration and wintering data are downloaded to a mobile receiver base station when a hawk relocates to its home breeding territory. Data is still being collected and analyzed for the 2019-20 season, and combined with migration data on hawks from 2018-19:

- A female stayed close to home, migrating about 75 miles south from Lakewood to winter near Waupaca, Wisconsin.
- Another female showed that she remained near her breeding territory throughout the winter, traveling no more than 16 miles from her nest site.
- A third female left her breeding site near Stevens Point, Wisconsin on October 23, 2018 to winter in southern Illinois, near Waltonville. She traveled 428 miles in 27 days.
- A male left his nesting area north of Lakewood, Wisconsin on November 10, 2018 and arrived in northwestern Alabama on December 24, 2018, covering 760 miles in 45 days. In his second

Letting Nature Do Its Work continued

But it isn't only falling leaves that return nutrients and energy to the forest. Falling limbs, branches, twigs, and even whole trees add to the process. In his book, *The Trees in My Forest*, Bernd Heinrich summed up this dynamic process by writing: "The tree's decaying body releases the resources collected throughout its life, passing them back into the forest." All living things in the forest, not just plants, benefit from the recycled energy.

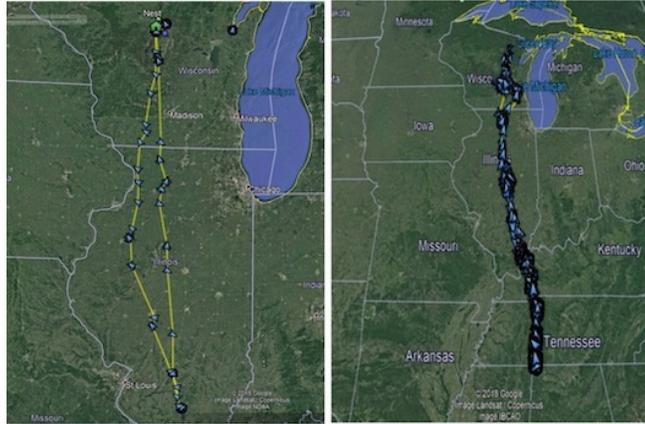
Leaf litter is important to many species of wildlife that inhabit the forest floor. Shrews and rufous-sided towhees search the leaf litter for invertebrates that are one of their primary food sources. Hollow logs on the forest floor are favorite den sites for seventeen species of mammals in New Hampshire. The coarse, woody debris is used as habitat by 30 percent of the state's mammal species, 45 percent of the amphibians, and 50 percent of the reptiles.

One of the amphibians, the Eastern newt in its "red eft" (juvenile) stage, lives in woodlands under rocks and logs on the forest floor for up to seven



Eastern newt. Photo by USGS

migration, he only migrated to western Kentucky. The difference between these two wintering locations is approximately 180 miles.



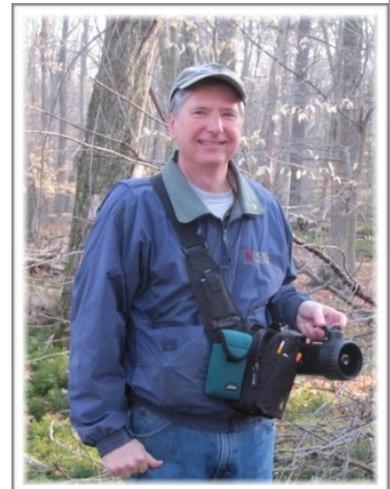
Migration routes of female red-shouldered hawk to southern Illinois (left) and migration route of male hawk to northern Alabama in 2018

In the summer of 2020, more transmitters are being deployed, hoping to collect more data to provide further insight into the migration of red-shouldered hawks in Wisconsin. This will also be the first summer collecting blood and feather samples to investigate mercury contamination.

This investigation is the first to attach solar-powered transmitters on red-shouldered hawks. Future plans are to expand the study to 25 hawks and gather data over 3-7 years. This research should provide important information on the biology and behavior of red-shouldered hawks in the northern part of its range, and aid biologists and land managers in developing strategies to conserve the species and their habitat.

About the Authors

Gene Jacobs is a raptor biologist and owner of Raptor Services, LLC research consulting. He has studied Wisconsin raptors for over 45 years and banded over 17,000 raptors along the way. He's passionate about sharing raptor education: he teaches Raptor Field Techniques Workshops and leads Saw-whet Owl banding field trips at the Linwood Springs Research Station. He has authored/coauthored 15 papers in peer-reviewed journals. Gene and his wife Lorraine have 2 sons and live in Stevens Point.



*Letting Nature Do Its Work
continued*

years before returning to water and transforming into an aquatic adult.

Downed logs and woody debris also provide habitat for insects and other invertebrates, as well as mosses, fungi, and lichens. The larger the log, the more value it offers to a wider range of species, but all woody debris on the forest floor has value to some species.

When we recognize the value of these natural resources, we might change how we view woodlands. We have become conditioned to looking at woodland around our homes as an extension of the lawn, to be kept neat and manicured. But nature is not tidy.

If the woods in and around your home landscape seem messy and you cannot let nature take its course, then go ahead and clean things up: break fallen branches into smaller pieces and spread them on the forest floor, limb fallen trees so they lie on the ground, and create brush piles in a corner of your property.



White-throated sparrow on brush pile. Photo by choosenatives.org



John Jacobs has been passionate about hawks since his early twenties, and has studied them since 1971. With a Bachelor of Science degree from St. Norbert College and a Masters of Environmental Science from UW-Green Bay, he was the Curator of Science at the Neville Public Museum of Brown County for 32 years. Retiring in 2013 allowed him to turn his spring and summer research on red-shouldered hawks into a full-time commitment. He and his wife Mary have 2 sons and 3 grandchildren, and live in Green Bay.

Matthew Hanneman is a graduate student at the University of Wisconsin-Stevens Point (UWSP). During his undergraduate studies in wildlife ecology, he developed a passion for birds of prey, and after graduating in 2017, he followed that passion by working for organizations focused on raptors, including Linwood Springs Research Station, Mackinac Straits Raptor Watch, Hawk Ridge Bird Observatory, and the National Eagle Center. In the fall of 2019, he returned to UWSP to study red-shouldered hawks. Matthew intends to continue his education and earn a PhD, and become a professor at a university where he can teach, conduct research, and share his passion for birds of prey with future generations.



Guest Writer:
***Bird Surveys on the White Mountain
National Forest***
by Lesley Rowse

Do you remember the expression **canary in a coal mine**? It's an advanced warning of danger, a metaphor originating from the times when miners used to carry caged **canaries** while at work: if there were poisonous gases in the **mine**, the **canary** would die, signaling the miners to evacuate.

Bird counts and surveys monitor the status and trends of bird populations, but they are also our "canaries in a coal mine" as

Letting Nature Do Its Work continued

The piles provide tunneling space and cover for wildlife and are easy to build. Habitat Network offers ideas on how to locate and establish your own brush pile: <https://content.yardmap.org/learn/brushpiles/>.

Consider raking your leaves from lawns and spreading them directly into adjacent woodland, which is much less labor intensive than bagging them. If you don't have woods nearby, create a compost pile, simple or elaborate to match your ambition.

Reduce the size of your lawn by allowing surrounding woodland to expand into the yard and by using the fallen leaves to define the new border. Instead of a lawn that may require a significant addition of nutrients, pest controls and irrigation water, the natural woodland will maintain its own health with nutrients returned to the soil through natural processes.

Live with nature, don't fight it!

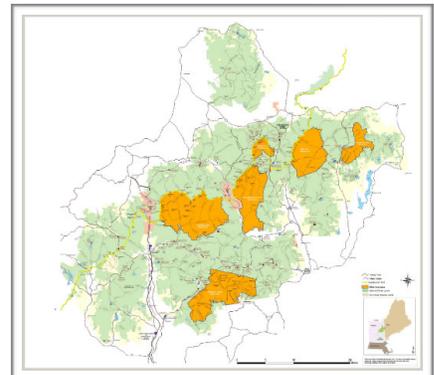


Native garden. Photo by earth911.com

fluctuations in bird populations may indicate or forecast shifts in pollution levels, climate change, habitat loss, timing of migrations, pesticide impacts, and more. Bird surveys and counts help alert communities to climate and environmental changes: large, rapid declines in bird populations point to environmental problems that need immediate attention. Further, data from counts and surveys are an important source for the range maps found in field guides: current range maps are benchmarks from which we can evaluate future changes in population ranges.

Annual events such as the Christmas Bird Count, Project FeederWatch, and the Great Backyard Bird Count are different bird census projects which have accumulated a massive amount of data about numbers of birds in different locations. The North American Breeding Bird Survey (BBS) is a multinational, long-term avian monitoring program designed to track the status and trends of continental bird populations, and is the largest single source for critical quantitative data to evaluate the status of North American bird species. Each year thousands of citizen scientists skilled in avian identification collect data on BBS routes throughout North America allowing us to better understand bird population changes. However, additional monitoring is needed to provide local land managers more specific information about species, critical habitats, and the effects of management activities.

In my nearly 30 years of work on the White Mountain National Forest (WMNF) in northern New Hampshire and western Maine, I conducted numerous, diverse surveys including large and small mammal, vernal pool, reptile, amphibian, bat, fish, butterflies, and more, but the Forest's longest and richest data set is from our annual bird counts. Birds have been counted and surveyed across the WMNF since 1992, and data is used to assess long term bird population trends across the Forest over a wide range of habitat types. They also allow comparisons of bird populations in areas where timber management occurs to areas where no timber management takes place, such as in wilderness and backcountry areas.



800,000 acre White Mountain National Forest Map by USFS

Low Elevation Surveys. In 1992, a series of transects were set up across the Forest in areas below 3000' elevation to monitor birds

Species Watch: Spotlight on the Rusty Patched Bumblebee

by Katherine W. Stuart

As you garden this year or stop at your local farmer's market, consider our pollinators and the trouble they are enduring. For example, the rusty patched bumblebee (*Bombus affinis*), once a common sight, is now on the brink of extinction. Several bumble bees (e.g., *Bombus terricola*, *Bombus pensylvanicus*, and especially *Bombus affinis*) have declined dramatically over their range. The rusty patched bumble bee once inhabited grasslands and tall grass prairies in the Eastern U.S. and upper Midwest, but remarkably little of our native grasslands remain. In the last few decades, the rusty patched bumble bee has disappeared from almost 90 percent of its historic range due to continued habitat loss, disease, climate change, and overuse of toxic pesticides. On March 21, 2017, the rusty patched bumble bee became the first bee species in the continental U.S. placed on the endangered species list.

The rusty patched bumble bee's annual life cycle begins in the early spring: solitary queens emerge and locate nesting sites, usually at or underground in abandoned rodent burrows, clumps of grass, or bird nests. They collect nectar and pollen from early spring blossoms and start laying eggs. Worker bees hatch from the early eggs and colonies expand as they gather food and protect the colony. Later in the summer, new queens and males start to hatch from eggs and the male bees disperse to find

in low elevation habitats. Each transect included 15 fixed points or stations. At each station, all birds seen or heard during a 10-minute period were identified and noted as either being within or outside a 50-meter radius circle around the surveyor. Each transect was surveyed three times from the last week in May through



Wood thrush. Photo by NPS

June. The survey replicate with the highest total number of observations was used for any given year. Initial results did not find differences in bird populations between wilderness areas and non-managed areas so the total number of transects was reduced. The low elevation surveys occurred annually from 1992 to 2002 and then every other year from 2004 to 2018.



Scarlet tanager. Photo by NPS

Of the more than 130 bird species identified in the low elevation surveys, 39 species have enough data to provide estimates of population trends: a 5 percent or greater annual change in population was considered significant. A total of eleven species: Canada warbler, yellow-rumped warbler, wood thrush, veery, white-throated sparrow, dark-eyed junco, least flycatcher, common raven, scarlet tanager, common yellowthroat, and white-breasted nuthatch, had population shifts of at least 5 percent or greater. Unfortunately, all of these species show a declining population trend. These species occupy a wide range of habitats across the Forest, including both young forest and mature forests.

When compared with regional trend data from the BBS (1992-2010), half of the species that were declining on the Forest also showed regional declines including Canada warbler, wood thrush, veery, white-throated sparrow, dark-eyed junco, least flycatcher, and scarlet tanager. For these species, the data indicates a wider-range population decline possibly due to habitat effects outside of the WMNF. These data appear to coincide with other studies that show North American bird populations are declining due to loss of winter habitat, climate change, human encroachment and development into natural landscapes, and pesticides.

*Species Watch: Spotlight on the
Rusty Patched Bumblebee
continued*

newly hatching queens from other colonies. In the fall, the original queens, workers, and males all die. Only new queens go into diapause, a form of hibernation, and they overwinter in small holes just beneath or on the ground's surface, and the cycle starts anew in the spring. The rusty patched bee emerges early in spring and is one of the last bee species to go into hibernation. While female bumble bees can sting, they are generally quite docile and will sting only if they or their colony is threatened.



Rusty patched bumble bee on purple coneflower. Photo by USFWS

Rusty patched bumble bees are superior pollinators, instrumental to our food supplies and the healthy functioning of our ecosystems. They are a keystone species, necessary for native wildflower production and creating seeds and fruits that feed wildlife. They are among our most important pollinators for crops such as blueberries, cranberries, alfalfa, plums, apples, clover and tomatoes. Bumble bees are more successful pollinators than honey bees for some agricultural crops because of their facility to “buzz pollinate”, in which a bee grabs the pollen-producing structure of the flower in her jaws, and with

A comparative analysis of bird populations on WMNF areas where timber management does and does not occur showed some expected results. Timber harvest can result in increased habitat diversity, with some types of harvest increasing scrub shrub habitat while also maintaining mature habitats. Bird species associated with regenerating forests, including chestnut-sided warbler and common yellowthroat were prevalent in areas with recent timber harvest. Some birds associated with mature deciduous forests, such as the red-eyed vireo and scarlet tanager were common, likely because harvest is widely scattered in our timber management areas and mature deciduous habitat is also present. In areas of mature forest with no timber harvest, some habitat diversity is created by natural disturbance from wind, insects, or disease. Bird species associated with mature coniferous forests, including Swainson’s thrush and yellow-rumped warbler, were more prevalent in areas where no timber harvest occurred.



Bicknell's thrush. Photo by USFWS

High Elevation Surveys. In 1993, 572 points on 37 transects were established across the Forest above 3000 feet elevation to monitor birds in high elevation spruce/fir habitat. All birds seen or counted during a 5-minute period are recorded. High elevation points were surveyed annually from 1993 to 2000 and then every other year from 2003 to 2017. Bird species including Bicknell’s thrush, blackpoll warbler, boreal chickadee, yellow-bellied flycatcher, and spruce grouse are unique to higher elevation areas of the Forest.

Population trends for high elevation surveys were focused on Bicknell’s thrush as it is a species of concern on the Forest and across its range, which includes New York, Vermont, New Hampshire, and Maine, as well as some areas in eastern Canada. The WMNF supports both the largest block of Bicknell’s thrush habitat (26%) and the largest proportion of the total species population (31%) (Hill and Lloyd, 2017). Results of surveys show that while Bicknell’s thrush populations showed a decline between 1993 and 2000, their numbers seem to have stabilized since 2006. As Bicknell’s thrush is a migratory species, population trends can be influenced by outside factors such as habitat in wintering grounds. Examining population trends of other high elevation species over the same time period may

Species Watch: Spotlight on the Rusty Patched Bumblebee continued

strong in-flight vibrations, is able to dislodge tightly packed and otherwise inaccessible pollen from a flower's anther. Some plants, including tomatoes, peppers, and cranberries, require buzz pollination.

Bumble bees have the rare ability to thermoregulate and are able to fly in cooler temperatures and at lower light levels than many other bees. While the hairs provide some insulation, they are able to fly at cool temperatures due to a remarkable adaptation: they can uncouple their wing muscles so that the wings don't move, and use their muscles to shiver and elevate their thorax temperature until they can fly.

Intensive farming and urban sprawl are major threats that alter landscapes and habitat required by bumble bees. Livestock grazing by large domestic animals removes flowering food sources, alters the vegetation community, and disturbs nest sites.

Conversion of species-diverse grassland habitats to a few agricultural monocultures, and human housing development have also impacted bumble bee habitat. As natural habitats become increasingly fragmented, bumble bee populations shrink and inbreeding becomes more prevalent, leading to decreased genetic diversity and fitness, and increased threat of extinction.

What can you do to help the rusty patched bumble bee and other bumble bees?



Lesley conducting high elevation surveys on Caps Ridge on the WMNF. Photo by USFS

reveal whether non-local factors might contribute to population changes.

The WMNF Forest Plan uses five avian ecological indicator species to monitor high elevation spruce-fir habitats. In addition to Bicknell's thrush, these include blackpoll warbler, yellow-bellied flycatcher, boreal chickadee, and spruce grouse. Three are long-distance, neotropical migrants.

Bicknell's thrush spend the winter on just four Caribbean islands, primarily Hispaniola. Blackpoll warblers and yellow-bellied flycatchers travel to northern South America and Central America, respectively. The boreal chickadee and spruce grouse are year-round residents that do not migrate.

Boreal chickadees and yellow-bellied flycatchers have stable population trends. Blackpoll warbler populations are more varied but seem to have an overall increasing trend. Spruce grouse are more difficult to detect, and not enough data has been collected to determine population trends for this species. Despite a seemingly downward trend for the Bicknell's thrush between 1993 and 2000, the population seems to have rebounded since 2006, with an overall stable trend. A similar pattern was documented by the Vermont Center for Ecostudies (2018) using citizen science data collected throughout the breeding range.

While high elevation bird populations seem to be stable, there is increasing concern that climate change could impact these species in the future as small changes in temperature could cause a reduction in high elevation spruce/fir habitat. A temperature increase of 1 degree C is predicted to reduce suitable habitat by more than 50% (Rodenhouse et al, 2007). In addition to climate change, threats to bird breeding areas include wind towers, communication towers, acid precipitation, ski area development, and more. It is quite possible that the tall peaks of the White Mountains may provide the last available habitat for these high elevation bird species in Northeastern U.S.

Final thoughts. The data collected in our long-term surveys allowed the WMNF to document the bird species that inhabit the Forest, and determine long-term population trends for 39 low elevation species and 5 high elevation species. The surveys provided data on how management practices can affect certain bird species, and are vital to understanding forest bird

*Species Watch: Spotlight on
the Rusty Patched Bumblebee
continued*

1. Plant a mix of flowers - rusty patched bumble bees are active from April through October so plant a mix of flowering trees, shrubs, and herbaceous natives to your area, so that something is always blooming. Include native species such as bee balm, milkweeds, hyssop, wild lupine, native grasses, and spring ephemerals, and well as later blooming plants like asters and goldenrods. Even small containers on patios can provide nectar and pollen for native bees.

2. Provide flowers in early spring - survival of bees rests on queens as they wake from winter diapause, look for nest sites, and start laying eggs. Help them start new colonies by including spring flowers and early flowering trees and shrubs such as nine bark and pussy willow.

3. Try not to mow and rake your entire yard - bumble bees and many other pollinators (bees, moths, and butterflies) need a safe place to build their nests and overwinter. During spring and summer, leave some areas unmowed. In the fall, leave some areas of your yard unraked and leave plant stems standing in your flower beds. Bumble bees nest under bunch grasses, piled stones, brush, and compost piles, in abandoned rodent holes, or other overgrown areas including where leaf litter, including evergreen needle duff, accumulates.

populations and making sound land management decisions for these species.

In our current federal budget environment, we conduct low elevation surveys in even years and high elevation surveys in odd years. An increasing concern is that it takes decades to gather enough information to be able to determine bird population trends and guide future management decisions.

It is increasingly difficult to keep long term surveys going. Factors including budgets and personnel decisions have resulted in a decline in overall bird survey efforts on the Forest over the years. Approximately half the original transects are now being surveyed. Fewer transects will increase the number of years it will take to determine population trends for many bird species. This information is vital to maintaining healthy bird communities on the Forest as well as providing data as part of regional and national assessments of bird populations.

Our bird populations are the canaries in our proverbial coal mine. The declining trends in numbers and diversity of our birds, plants, insects, and other animal populations are potent reminders of our changing environment.

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Lesley Rowse is a retired wildlife biologist. She received a Bachelor of Science degree in Wildlife Management from the University of Massachusetts and a Masters degree in Wildlife Ecology from the University of Florida. She worked as a District Wildlife Biologist for the White Mountain National Forest for 29 years. She has always been interested in birds and continues to volunteer, monitoring peregrine falcons, and participating in the Maine Bird Atlas project with her husband.



*Species Watch: Spotlight on the
Rusty Patched Bumblebee
continued*

4. Let flowering plants grow in your lawn - Pollinator-friendly lawns and yards contain small flowering plants such as dandelions, clover, self-heal, blanket flower, and creeping thyme.

5. Go pesticide-free or reduce your pesticide use - pesticides and especially insecticides harm pollinators. Herbicides reduce food sources by removing flowers from the landscape.

6. Be a citizen scientist - submit your photos and add to databases tracking bumble bee occurrences.

7. Be a bee spotter - in some states you can help by becoming a "bee spotter": BeeSpotter partners between citizen-scientists and the professional science community and educates the public about pollinators and engages them in data collection. The *University of Illinois* has a web-based data site for learning about honey and bumble bees, and is contributing to a nationwide effort to collect baseline information on population status.

8. Support increases of natural areas in your community.

9. Donate/join conservation organizations such as xerces.org, bumblebee.org, ipollinate.illinois.edu, fws.gov/pollinators, chicagowilderness.org, www.rustypatched.com,

President's Message

by Daniel Leete

I want to thank all of you for your commitment to the goals and mission of the AWCF. Our work is challenging and also important. The organization has many plans that have had to be placed on hold due to the pandemic, and yet we are pushing forward. Thank you for your time and energy.

I had the opportunity recently to have a lengthy conversation with a man in his mid 90's who is an ardent supporter of wildlife conservation. He is highly respected for speaking boldly about

his passions and feelings for natural resource issues. His wisdom about these times is precisely what I needed to hear. He told me that there had never been a period in his lifetime when people were not in discord about what to do about some social, political, economic, or environmental issue. He reminded me that we need bold thinkers, and passionate, hopeful people who understand what mature thinking, mature passion, and mature hope really are. He advised me to remember three things everyday, especially in turbulent times:

1. Allow yourself to be hopeful about what is happening on this planet without closing your eyes to what has to be changed or fixed. Find the right balance between these two ways of thinking, and catch yourself when you slide too far in one direction.
2. Be careful when you mix intellectual thinking with political thinking. At the same time, remember that any "fact" can, (and possibly should), be challenged.
3. Every day, stay cognizant of the fine line between passionate advocacy and the need to get your own way. Listen carefully for when your fervor turns people off, rather than pulls people in.

I hope you have a few conversations this year with the people in your life who have lived long enough to gather hard-earned wisdom. The man I talked with has been a great mentor for me in many ways and I was glad to have the opportunity to talk with him again. Right after we spoke, I spent the afternoon slowly weeding my garden. It was a beautiful spring day in New York



CALENDAR OF EVENTS

July 8, 2020: (Online Event)

Colorado's Energy Future:
Making sure wildlife is
protected.

[https://rockies.audubon.org/
events/colorado's-energy-future](https://rockies.audubon.org/events/colorado's-energy-future)

July 9, 2020: (Webinar) ID Birds
by Sound with BirdNET.

[https://www.birds.cornell.edu/
home/event/webinar-id-birds-
by-sound-with-birdnet/](https://www.birds.cornell.edu/home/event/webinar-id-birds-by-sound-with-birdnet/)

July 9, 2020: (Online Event)

The Language of Birds: A
special presentation by Nathan
Pieplow. [https://](https://mitchelllake.audubon.org/events/language-birds)

[mitchelllake.audubon.org/
events/language-birds](https://mitchelllake.audubon.org/events/language-birds)

July 12, 2020: (Virtual) Lightning
Bugs ALIVE. Audubon

Nebraska. [https://](https://www.audubon.org/events/lightning-bugs-live)
[www.audubon.org/events/
lightning-bugs-live](https://www.audubon.org/events/lightning-bugs-live)

July 21, 2020: (Online Event)

Tiny fish play a big role in the
ocean ecosystem.

[https://ct.audubon.org/events/
tiny-fish-play-big-role-ocean-
ecosystem](https://ct.audubon.org/events/tiny-fish-play-big-role-ocean-ecosystem)

July 27-31, 2020: (Virtual
Conference) North American
Congress for Conservation
Biology. Crossing Boundaries:
Innovative Approaches to
Conservation.

[https://scbnorthamerica.org/
index.php/naccb-2020/](https://scbnorthamerica.org/index.php/naccb-2020/)

and therefore a day outside I did not want to miss. Here is what I pondered:



Yes, there are many species on my own property that cause me a lot of concern. No, I don't like the fact that someone had recently been fishing on the edge of my land without asking my permission. And yes, having to spend a half hour cleaning up this person's beer cans irritated me. However, our rhubarb is the best crop we have ever had.

My garden, which is much smaller this year, is doing really well. We have decided to eat most meals on our veranda this summer, and our simpler lifestyle during the pandemic has suited me. After talking with my older friend, I spent time taking in the good and seeing the positive, not just the worrisome. It was good to get more balanced in my thinking.

That same day I realized that most of us are deluged daily with articles, books, podcasts and newscasts that report facts, more facts, and more facts. Last night my wife commented that we are all becoming "fact fanatics". When we mix political thinking with non-political thinking, the facts can get dangerously muddled. Maybe I'll turn off the deluge and try a "facts fast" for a few days: it will probably do me good.

Right before bed I found myself talking with my wife about an issue with my grandson that I feel very passionate about. I had been hoping he would continue in the Scouts for the next ten years. My wife reminded me that I had been really mad when my son stopped taking his son to Scout meetings this past year. I caught myself, and asked myself: how would my annoyance serve my son or grandson?

It was good for me to question my thinking, and it forced me to observe and reflect on my mental habits. I encourage you to do the same.

I wish you well in the months to come. This pandemic, as well as the recent social and economic unrest and distress, has given us all a lot to think about. Hopefully we'll learn more about how to

CALENDAR OF EVENTS

continued

July 27-29, 2020: (Virtual) 2020 Annual Conference of the Soil & Water Conservation Society. Expanding horizons where conservation meets innovation. <https://www.swcs.org/events/conferences/2020-annual-conference>

Aug 3-6, 2020: (Virtual) 105th Annual Meeting of the Ecological Society of America: Harnessing the ecological data revolution. <https://www.esa.org/saltlake/>

Sep 28-Oct 2, 2020: (Virtual) The Wildlife Society Annual Conference. <https://twsconference.org>

Oct 6-8, 2020: (Virtual) Land Trust Alliance Rally 2020. The National Land Trust Conservation- Conference <https://alliancerally.org>

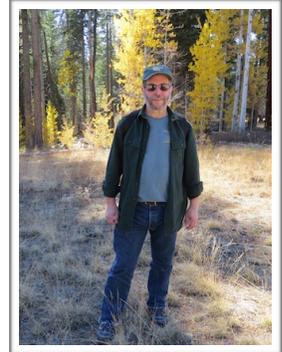


operate both successfully and unsuccessfully during times of great uncertainty. I look forward to working with many people again when we aren't looking over our shoulders for another round of Covid-19. Until then, I know good people with good intentions have lots to work on and share. Enjoy your summer.

Photographer's Corner: Jonathan Schwartz

Each newsletter, we like to highlight wildlife and landscape/habitat photography. If you or someone you know is interested, please forward my contact information. katiestuart33@gmail.com to them.

Nature photos on Instagram ([schwartz.jonathan](https://www.instagram.com/schwartz.jonathan)) and Facebook as Wilmot Flat Photos ([facebook.com/WilmotFlatPhotos/](https://www.facebook.com/WilmotFlatPhotos/))



Some years ago, I did my undergraduate work at Colgate University, which is how I met AWCF President Dan Leete. He showed up in my Conservation class one day in his blue DEC uniform and offered a chance to do volunteer work at the Rogers Education Center instead of the class research report. I jumped at that, and thus began a lifelong interest in teaching about nature. I did my graduate work at State University of NY-College of Environmental Science and Forestry and then became a high school science teacher in Connecticut while leading nature walks on weekends. I am now retired and somehow found myself living on a pond in Wilmot, NH.

