Science & News from the Rhode Island Natural History Survey

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How Many Species Live in Rhode Island?

By DAVID W. GREGG and STEPHEN S. HALE

Introduction

How many species live in a particular place? This is a fundamental question in understanding our biosphere, as well as its functions, condition, and trends. Number of species is one measure of biodiversity (which can also include genetic, ecosystem, and habitat diversity); biodiversity is essential for support of life on Earth. But the number of species is also a tricky question and the answer depends on many variables. Nevertheless, we *Homo sapiens* are prone to curiosity and seem to have a strong urge to compile species lists. As we are the only one of the several million species on the planet capable of doing the counting, we would be remiss not to do so. We intend this article to be a recognition and honoring of life in Rhode Island in all its diversity.

All life on Earth evolved from a common ancestor that lived around 4 billion years ago. Most recent estimates of Earth's total number of extant species range from 5 to 11 million; some are much higher. Of those, around 1.7–2.0 million species have been formally described and recorded (Chapman 2009, Mora et al. 2011, Larsen et al. 2017).

Another good reason to monitor the number of species is that currently we are in the sixth mass extinction event (the first human-caused one) and are seeing the largest loss of species since the end of the dinosaurs; a million more species currently are threatened with extinction (Wilson 2016, Brondizio et al. 2019). In fall 2023, the US Fish & Wildlife Service declared that 21 species (birds, mussels, and a bat) on the US threatened and endangered list have joined the dodo in extinction. Animals that lived in Rhode Island until recently include a mussel, 2 tiger beetles, 2 butterflies, 3 moths, 2 sturgeon, a rattlesnake, and 7 birds (Enser 2006). Currently, there are 562 species on the Rhode Island rare species lists—148 animals and 414 plants (Enser 2006, RINHS 2016).

Rhode Island's species composition is largely determined by the state's geographical position in the larger context of ecoregions defined by Olson and Dinerstein (2002) and Bailey (1995). Much of the state lies in the Southern New England Coastal Plains and Hills Level IV ecoregion, the Narragansett Bay area in the Narragansett/Bristol Lowland ecoregion, and the southern coast in the Long Island Sound Coastal ecoregion (USEPA 2023). These three ecoregions include parts of eastern Massachusetts and Connecticut. Marine waters off southern New England lie in the Virginian Biogeographic Province.

Methods and Results

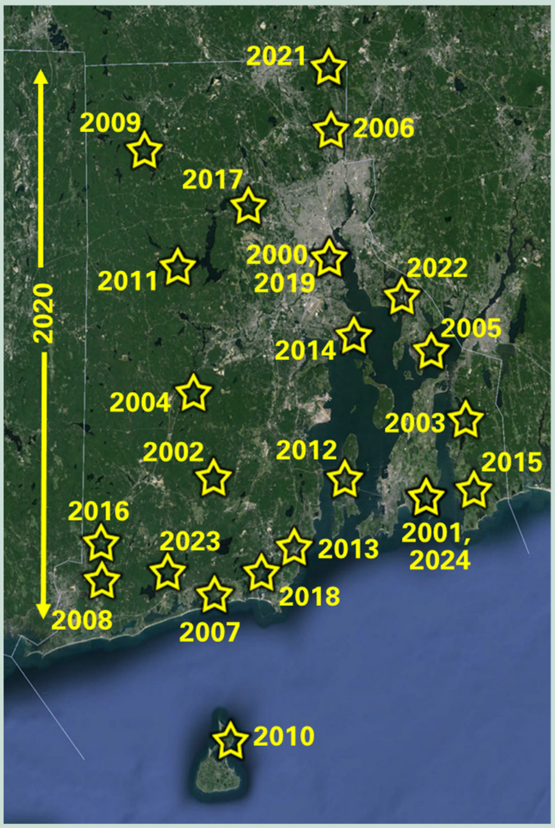
It is not easy to answer the seemingly straightforward question of how many species occur in Rhode Island. But we took inspiration from the state motto "Hope." We approached this task by counting species that have actually been recorded in the state. We (or the taxonomic experts we consulted) also made some estimates by looking at the distribution or range of species known from the northeastern US and extrapolating to Rhode Island, for instance by assuming species present in similar ecoregions of neighboring Massachusetts and Connecticut are also present in Rhode Island. Either way, this still omits a very large number of species from little-studied taxa (e.g., Bacteria, Archaea, protists) and another very large number that have not yet been discovered, formally described, and given a binomial scientific name by anyone anywhere.

In This Issue:

RHODE ISLAND NATURAL HISTORY SURVEY
Providing Ecosystem Science and Information

Rhode Island BioBlitz

During 24 annual Rhode Island BioBlitzes organized by the Natural History Survey (see the map below), some 4,100 participants have made over 24,700 identifications, accounting for several thousand separate species. The BioBlitzes, spread around the state in different habitats (in everybody's back yards in 2020) and attracting and concentrating specialized taxonomic expertise, have documented some little-studied taxa not prominent enough to have made it into an atlas or a checklist (e.g., tiny invertebrate species found in forest-floor leaf litter).



The average Rhode Island BioBlitz finds over 1,000 species, and the total number of species found in all Rhode Island BioBlitzes is approximately 5.5% of the total likely to be found in the state. Eventually, if the BioBlitz thoroughly covered all habitats in the state and included experts and sampling in all groups of taxa, and was conducted throughout the year, the species accumulation curve would rise closer to the true total. The BioBlitz is not solely about getting to total species; it is also an educational and engagement event that brings together professional and amateur naturalists and interested citizens and exemplifies methods of discovering biodiversity.

Lilioceris lilii – Lily Leaf Beetle

We counted as many species as we could reasonably find that have been observed and recorded in the state from all habitats—forests, fields, ponds, rivers, wetlands, urban areas, and marine waters, including migratory species passing through. About two-thirds of the state is terrestrial and freshwater; the one-third that is marine inspired the state's nickname the "Ocean State." No survey is instantaneous, but this count with a few exceptions covers roughly the last 100 years. We did not include fossil records of species that once lived in the state. Garden, house, or agricultural plants were not counted; nor were domestic or zoo animals or disease organisms.

(continued on page 4)

President's Corner: Happy Anniversary

Lou Perrotti, President, Board of Directors

2024 marks the 30th anniversary of the Rhode Island Natural History Survey's founding! As we enter a new year, I am in awe when I reflect back on the partnerships, projects, progress, and successes that the Survey has created and completed over all those years. If you are reading this, chances are you have been part of that journey. Whether you are one of our 30-year members, or have only joined the Survey family recently—we are thankful for you! I am also filled with anticipation and confidence as I look to the future of the Survey that we will build together.

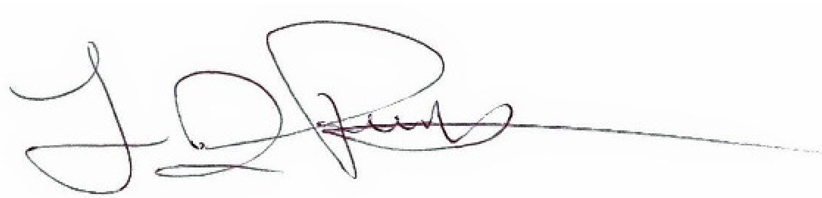
As a zoologist/conservation biologist with the Roger Williams Park Zoo, I was first drawn to the Survey almost two decades ago when I participated in my first Rhode Island BioBlitz—in 2006 at Cumberland Monastery, where it rained for the entire 24 hours! Since then I have worked to create and sustain a collaborative partnership between the Zoo and the Survey—which has included membership, encouraging staff participation in Survey events, joint education efforts, and the Zoo becoming a proud, annual sponsor of BioBlitz.

I was invited to join the Survey's Board of Directors in 2008. Serving on the Board—which is made up of many of Rhode Island's top conservationists, state and federal biologists, professors, scientists, and natural history champions—has been an inspiration and an honor. As president of the Survey's Board over the last three years, I have proudly watched as the organization persisted and thrived, despite the challenges of the COVID pandemic, and has come out stronger on the other side.

I can't talk about the success of the Survey without acknowledging the long-time dedication and professionalism of our core staff, David Gregg and Kira Stillwell. Their long tenures (20 years for each in August 2024) have provided organizational consistency; success in building and maintaining a portfolio of interesting projects; and programs that are relevant to our membership and instill confidence in our members, program partners, and funders.

All good things must come to an end, and so it goes with my 3-year presidential term. I want to thank my fellow members of the Board, both past and present, for their dedication and support of our mission, and the guidance, advice, and mentorship given to me over the years. I will remain on the Board, but am pleased to pass (in May) the president's torch to Sarah Gaines. Sarah joined the Board in 2017, bringing her expertise in earth science, natural and cultural heritage conservation, marine spatial planning, and international science policy. Sarah has over 15 years of experience working on balancing conservation and development concerns on a global level. Additionally, she is passionate about science communication—particularly through innovative collaborations between the arts and sciences. I am confident that Sarah's leadership is right for the Survey during this next exciting stage.

Lastly, a huge shout out and thank you to all of you who support the Survey through memberships, donations, and by attending our events. Together we keep the Rhode Island Natural History Survey connecting people knowledgeable about Rhode Island's animals, plants, and natural systems with each other, and with those who can use that knowledge for research, education, and conservation.



How Many Species? (continued from page 2)

For records from terrestrial and freshwater habitats, we primarily used sources (books, atlases, counts, checklists, surveys, and reports) available in the Natural History Survey's library and archive, in addition to communications with taxon experts. For marine species, we spoke with taxon experts and drew upon research papers and long-term surveys, such as the 64-year-long URI bottom-fish trawl (GSO 2022). Some sources are compilations of many other sources; for example, the number of marine benthic invertebrates observed was drawn from 109 different studies (Hale et al. 2018). We also looked at records in other databases and community data-collection projects such as GoBotany (gobotany.nativeplanttrust.org/), BugGuide (bugguide.net), and iNaturalist (iNaturalist.org), and checked with regional guides and taxonomic keys.

Geukensia demissa – Ribbed Mussel

The iNaturalist "Biodiversity of Rhode Island Project" as of January 2024 shows 7,977 species; about 62% of these have been verified. The website hosts over 100 projects for Rhode Island, including recent BioBlitzes as well as projects for fungi, plants, birds, bees, and others. Some of these that cover most of the state, time of year, and have good levels of effort may approach a good estimate of the true total; however, several are spotty.

Euphydryas phaeton – Baltimore Checkerspot

Prokaryotes (Bacteria, Archaea) have received little attention compared with many eukaryotes (such as vascular plants, birds, and fishes) and we did not include them because we couldn't come close to an accurate estimate. DNA samples of Narragansett Bay surface waters found at least 10,000 different types of bacterial organisms, encompassing different genetic variants as well as different species (Y. Zhang and B.D. Jenkins, URI, pers. comm.). Many microscopic eukaryote species have not been found in the state because of the practical limits of the methods used to sample their habitats. For example, marine benthic invertebrate sampling is typically done with a 0.5-mm mesh sieve and less frequently with a 0.3-mm sieve, losing all species of smaller sizes.

Agapostemon virescens – Bicolored Striped Sweat Bee

The numbers of species of some taxa are well known, birds for example. Given the spatial and temporal coverage, the intensity of effort, and Internet notices that send avid birders rushing to any sighting of an unusual bird, it is unlikely that many more bird species (other than climate refugees from the south) will be found in the state.

Sylvilagus floridanus – Eastern Cottontail

We found that at least 9,815 species of fungi, algae, plants, and animals have been recorded in Rhode Island and estimate that at least another 15,050 are likely to live in the state, for a total of 24,865 (Table 1). Fungi, vascular plants, insects, and marine benthic invertebrates had the most species. This version of Table 1 is organized partially by taxonomic group and partially by habitat; for future versions—after the launch of RINHS's BORIIS2 (Biota of Rhode Island Information System)—we will be better able to do it both ways.

If there are 24,865 species in Rhode Island and one accepts only the low estimate of 5 million for global species diversity, then the Rhode Island species represent 0.5% of the total. The 9,815 documented finds in Rhode Island are 0.7% of the 1.5 million described species worldwide (again

Pseudocolus fusiformis – Stinky Squid

taking the low estimate of global species). Among the vascular plants, the 1,700 vascular plants in Rhode Island are just 7% of the 24,184 species and hybrid species in the Biota of North America Project's Taxonomic Data Center (Kartesz 2015). That probably reflects Rhode Island's relatively small size and ecological homogeneity positioned within a region of higher ecological diversity.

Nymphaea odorata – American White Water Lily

Number of Species

Of course, hardly any species existed in the state when the Laurentide Ice Sheet covered Rhode Island lands and waters during the Pleistocene Epoch, which ended around 11,700 years ago. Probably some snow algae, insects, birds, and marine species were here. What we see now are largely species that had refuge south of New England and were able to re-populate the area when the ice receded north. And there are more recent arrivals from around the world; some introduced species have become naturalized and others have become invasive. Some species are rare, threatened, or endangered; others no longer exist in the state. Several species are expanding their ranges northward in response to global warming. Some exotic fishes brought to the state by Gulf Stream eddies only last for the warmer months and cannot survive the winters.

Aphenogaster picea – Pitch-black Collared Ant

Although 9,815 species may seem like a large number—and probably no one in the state has personally seen more than a tiny fraction of those—this number is undoubtedly an enormous undercount. This tallying of species is a work in progress. New sampling efforts, little-known taxa being studied, new species arriving, new species being discovered and described, new techniques such as environmental DNA, and improved databases will add to the list.

Platycryptus undatus – Tan Jumping Spider

Lack of consistent, broad-scale monitoring programs that would have a greater chance of encountering inconspicuous and rare species or species occupying uncommon habitats hampered our species count. Factors further clouding number-of-species estimates include: changes in taxonomic nomenclature including species name changes that put printed checklists out of date, disagreements among taxonomic lumpers and splitters, differences between morphological and genetic studies, advent of environmental DNA studies, declines in the number of trained taxonomic experts, errors in identification, and discovery of new species (e.g., globally about 2,500 new plants every year: Antonelli et al. 2023). Then there is the question of exactly what defines a species. Recent trends in systematics are de-emphasizing the species concept (Mallet 2008). Some biologists suggest viruses can be organized into species, others do not. We did not include them.

Leptuca pugilator – Atlantic Sand Fiddler Crab

The incompleteness of our list (Table 1) shows how little we know about the true biodiversity of Rhode Island and points out areas where more work is needed. Partly this is because certain taxa are not well understood anywhere, while partly this reflects a deficit of local knowledge. Certain taxa are hard to observe and harder to identify, and there are, therefore, few people in a position to carry out surveys here or anywhere else. This ignorance harms our efforts to preserve biodiversity (Wilson 2016). The Endangered Species Act (we celebrated its 50th anniversary last year) only protects known species. But countless species are yet unknown to science; many of these will disappear before we even knew they existed.

Lithobates clamitans – Green Frog

Table 1. Numbers of species in Rhode Island by taxonomic group; estimated numbers exclude those reported for the same category. The list of references can be found on the RINHS website at https://rinhs.org/wp-content/uploads/2024/03/GreggHale-Species-in-RI-Table-1-biblo.pdf

Taxonomic Group	Number of Species		Source(s)	Notes
	Reported	Estimated		
Fungi				
Lichens	322		1,7	Not including algal or other photosynthetic symbionts
Non-lichen fungi	1,700		1	
Protists, Algae				
Lakes phytoplankton	78		2	
Marine phytoplankton	200	1,050	3	1,000–1,500 estimated total, or 800–1,300 (midpoint = 1,050) in addition to the 200 recorded
Marine macroalgae (seaweeds)	197		4,5	Reference 5 is under revision, which will add more
Plants				
Mosses	341		6	
Vascular plants	1,699		8,9,10	Estimated 350 trees and shrubs included (GoBotany.org)
Animals				
Beetles	2,209		11	
Butterflies	118		12	
Dragonflies & damselflies	138		13	
Ants	90		16	
Bees	200		17	Adding new state records to Ascher's list
Other insects		11,650	14–22	Extrapolation
Spiders (Araneae)		750	23,24	Extrapolation
Ticks, mites, & kin (Acari)		1,000	25	Extrapolation
Terrestrial & freshwater mollusks		100	26,27	Extrapolation
Terrestrial & freshwater crustaceans		200	28	
Marine benthic invertebrates		300	29–34	Additional species from marine waters outside Narragansett Bay
Narragansett Bay	1,214		29	21 phyla; 320 annelids, 283 mollusks, 322 arthropods
Marine zooplankton	126		35–42	Crustaceans, cnidarians, ctenophores, tunicates, others; includes holoplankton only (spend most of life cycle in the water column)
Riverine benthic invertebrates	256		2	
Lake zooplankton	43		2	
Lake benthic invertebrates	25		2	
Amphibians	19		43,46	
Reptiles	28		44–46	Including 2 added by BioBlitz; 5 are marine
Fishes	300		48–51	70 freshwater; 230 marine
Birds	420		52,53	295 land and freshwater, 125 marine (some overlap)
Mammals	92		46,47,54	55 land and freshwater, 37 marine
Total species	**9,815**	**15,050**		**Grand total = 24,865**

As the smallest state in the US, Rhode Island would not be expected to have as much biodiversity as larger states. Connecticut and Massachusetts both have several more Level IV ecoregions compared to Rhode Island's three. In general, the greater the diversity of habitats in an area, the greater the number of species that will occur there (Nichols et al. 1998). The Great Smoky Mountains National Park, one of the most thoroughly inventoried areas in the US, had around 18,200 species (Wilson 2016). In comparison, our count of recorded species for Rhode Island, which is about 1.5 times larger and includes marine habitats, was around half that. Even with the differences in ecoregions and sizes, it is clear Rhode Island is a long way from being fully inventoried.

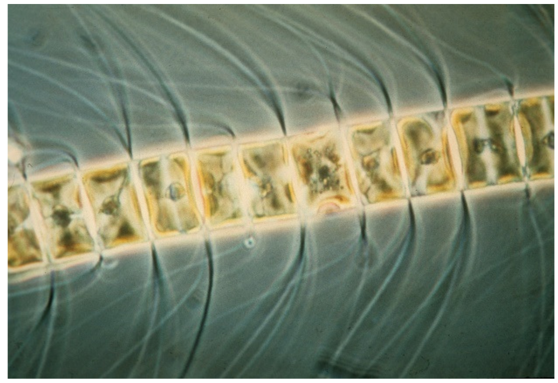
Conclusions

Despite the incompleteness of this compilation of species, there are good reasons for Rhode Islanders to be amazed and appreciative of the profuse species diversity we have around us. Knowing that close to 10,000 species have been found in the smallest state in the country is a celebration of the diversity of life in all of its sizes, shapes, colors, habitats, sounds, movements, behaviors, life cycles, and migrational patterns. This richness can be enjoyed by anyone in their own backyard or the great outdoors. In addition to us humans being the only species capable of counting other species, we also are the only species capable of saving many of those from extinction.

Thamnophis sirtalis – Eastern Garter Snake

This article is a first step of an ongoing project to document the biodiversity of Rhode Island. Next steps are to bring the BORIIS2 database online and make an effort to populate it with all species occurrence records that can be found, update taxonomic names to the currently accepted version, compile species checklists for those taxa with sufficient numbers and keep these up to date in the database, publish atlases where there is enough information to do so, investigate expanded use of crowd-sourced data and online reporting tools, and calculate which species might be expected to occur in Rhode Island because they exist in similar ecoregions in Connecticut, Massachusetts, or, given climate change, elsewhere to the south. Lastly, we invite anyone who finds omissions (of which there are many) or errors in our list (Table 1) to contact us.

Fuligo septica – Dog Vomit Slime Mold



Chaetoceros sp. – Marine Diatom (phytoplankton)*

Acknowledgments

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Thelypterus palustris – Eastern Marsh Fern
surrounded by *Sphagnum* sp. – Peat Moss

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All the photographs accompanying this article, or elsewhere in this issue without typical figure legends, come from our files or iNaturalist projects for our 2016–2023 BioBlitzes (with CC licenses), except for any marked (*) that come from NOAA photo archives (public domain). Photographers for the BioBlitz photos include (some are iNaturalist user names): birdersue, Jason Crowell, David Gregg, Melissa Guillet, jeegyar, Sally Johnson, Robert Kenney, littlehawkmoth, rilockguy, Noel Rowe, Dann Thoms, and many others whose photos we couldn't squeeze in.

Why Lyme Disease Is Such a Problem in Rhode Island: Geographical Ecology of a Tick-borne Pathogen

By HOWARD S. GINSBERG

Readers of the *Rhode Island Naturalist* tend to enjoy nature; they read about animals and plants, observe the critters, and enjoy time outdoors. So why are there all those ticks creeping through the forests of Rhode Island and why do they carry pathogens that can make us sick? Lyme disease is the major tick-borne illness in the state, but there are several others, and at least some of them are likely to increase in the future (Ginsberg et al. 2021a). Researchers have been studying the distributions of ticks and Lyme disease for decades, and the ecological reasons for the current distributions are becoming clearer. URI was involved in a large-scale study of this question involving several universities (led by Jean Tsao of Michigan State) and government researchers from the US Geological Survey and the Public Health Agency of Canada. I'd like to talk about some of the interesting natural history that underlies these distributions. First, it's important to talk about the regional landscape changes that have occurred over the past centuries. The answer to the Lyme disease question in Rhode Island requires a review of the ecological history of the northeastern United States, and the effects of human changes to the environment on the resident organisms, including the habitats and the vertebrates as well as the ticks.

Environmental History of the Northeast

The expansion of European colonists into the northeastern US resulted in dramatic changes to the environment. Forested areas were converted into farmland, substantially modifying the pre-colonial landscape (Spielman et al. 1993). Trees were felled for wood to build homes and for firewood. In addition, the abundant deer were shot for food. Acreages of farmland increased dramatically with colonization, and then, as the nation expanded and agriculture increased in the rich soils of the midwestern plains, farmland in the Northeast declined. The acreage of land used for farming in New York State, for example, peaked around 1880 (Vaughan 1929). Former farmland then became abandoned fields and later second-growth woodlands, dissected by roads and by towns and cities. The stone walls that had marked out farm fields are still widespread in northeastern forests. With the increased browse available in fragmented forests, the deer population, which had declined substantially during the 1800s, increased dramatically through the 1900s (Spielman et al. 1993).

The implications of these changes for tick populations are clear. White-tailed deer, *Odocoileus virginianus*, is the major host species for the adult stage of the blacklegged tick or deer tick, *Ixodes scapularis.* Deer are not competent reservoirs for the Lyme spirochete, *Borrelia burgdorferi*, which cannot survive in deer blood (reservoir competence is the ability of a host to maintain infection with a pathogen and to transmit it to uninfected vectors when they bite). The average engorged female *I. scapularis*, however, lays nearly 1,400 eggs on the ground (Ginsberg et al. 2017a), so just a few deer at a site can result in an enormous tick population. Infection with Lyme spirochetes is acquired by the larval ticks, which hatch from the eggs and become active in midsummer—when they feed on host animals (including competent reservoir species such as mice and voles) from which they often pick up the spirochetes. The ticks then overwinter and emerge as infected nymphs (the second immature stage) the following spring. Nymphal infection rates range from below 10% to over 40% at different sites. Nymphal blacklegged ticks are the primary vectors of Lyme disease spirochetes to humans in the eastern and central US (Fish 1993). In Rhode Island, nymphs are active starting in late May, peak in June and into July (most people are infected during these months), and then decline in numbers into August.

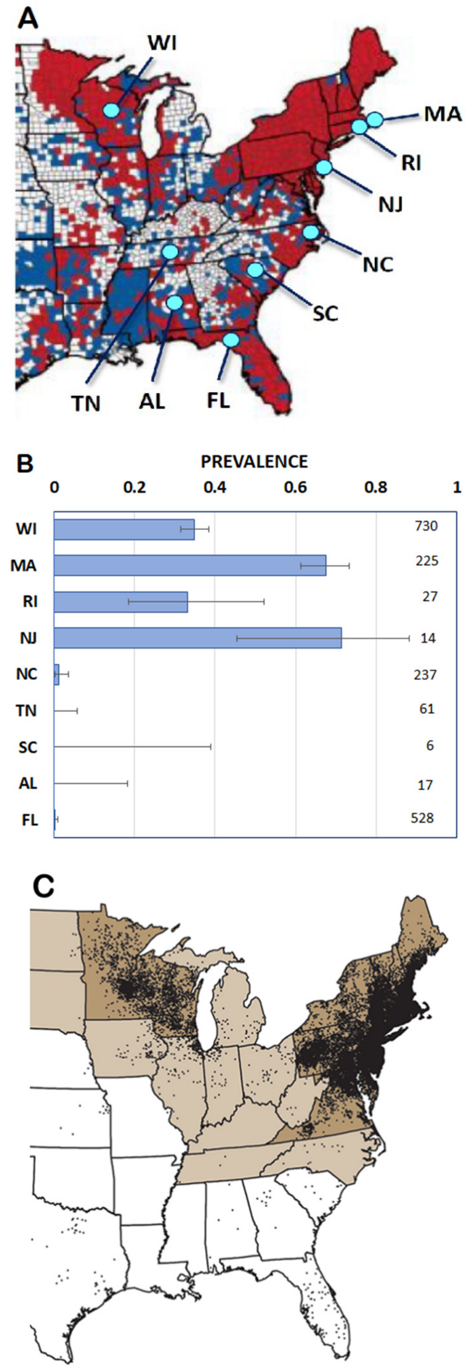

Figure 1. Distributions of blacklegged ticks, Lyme spirochetes, and human cases of Lyme disease. A) Distribution of *I. scapularis* (CDC data, Eisen et al. 2016), with study sites, B) Infection prevalence of adult black-legged ticks with Lyme spirochetes at study sites, C) Human cases of Lyme disease, states with highest rates darkest, neighbor states in lighter color (CDC data, Schwartz et al. 2017). (Modified from Ginsberg et al. 2021b).

Geographical Patterns in Tick Behavior

Blacklegged tick populations are now extensive throughout the eastern and central US (Fig. 1a). However, tick distribution is clearly not the only factor influencing the distribution of Lyme disease, because tick infection rates and human cases are concentrated in the northeastern and north-central states, and are relatively uncommon in the South (Figs. 1b, 1c). One hint about what might be responsible is a phenomenon related to the tick-collection method, long known among tick researchers. The standard method of sampling ticks, dragging a light-colored fabric (typically flannel or corduroy) along the ground and checking frequently for ticks, is very effective at collecting all stages of blacklegged ticks in the North and adults in the South, but collects very few larvae or nymphs in the southern states. We do know from collections from hosts and from adult samples that the ticks are present in the South. Diuk-Wasser et al. (2012) sampled nymphs using drag cloths at 304 sites throughout the eastern and central US and collected blacklegged ticks primarily in the northeastern and north-central U.S. (where human cases of Lyme disease are most common), but not in the South. Presumably, this was related to some north-south difference in tick host-seeking (questing) behavior that resulted in fewer nymphs collected in the South.

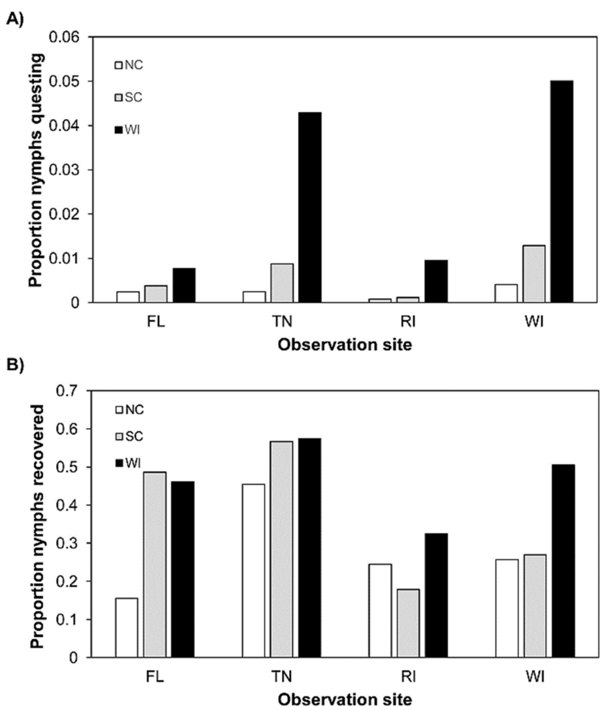

Figure 2. Questing behavior of northern and southern ticks: A) Proportions of northern nymphs (from WI) and southern nymphs (from NC and SC) questing above the leaf litter in "tick garden" experiments, B) Proportions of ticks recovered alive at end of experiment. (From Arsnoe et al. 2015, by permission).

Arsnoe et al. (2015) set up field experiments to assess differences in questing behavior between northern and southern blacklegged tick nymphs. She built arenas ("tick gardens") with soil, leaf litter, and vertical wooden dowels, surrounded by aluminum flashing with Tanglefoot to contain the ticks, and then performed timed observations of questing behavior. Ticks from lab colonies that originated from Wisconsin (northern ticks) and from North Carolina and South Carolina (southern ticks) were placed in these arenas at northern sites (Wisconsin and Rhode Island) and southern sites (Tennessee and Florida) to assess questing behavior. The results were clear (Fig. 2); at both northern and southern sites, the northern ticks frequently climbed on top of the leaf litter and on the dowels to seek hosts, while the southern ticks did not. This explains, in part, why Lyme disease is so much more common in the North than in the South. When you walk through the woods in Rhode Island, you are walking right through tick habitat. The ticks are questing on top of the leaf litter and on twigs near the ground; they get on your shoes or pants and climb up to find a place to attach. In contrast, when you walk through the woods in the South you are essentially walking on top of the tick habitat; they are predominantly seeking hosts down in the leaf litter below the surface. So you are far less likely to encounter a tick. Indeed, tick specimens found biting humans at military bases around the eastern US included large proportions of blacklegged ticks at the northern bases, but primarily other tick species in the South (Stromdahl and Hickling 2012). Arsnoe et al. (2019) followed up by testing blacklegged ticks from 15 sites scattered around the eastern US, and found that the propensity of the ticks to quest above the leaf litter was correlated with the incidence of Lyme disease (based on CDC and US Census data) in the county from which the ticks originated. This geographical pattern in tick questing behavior clearly contributes to the geographical pattern in human disease.

The next question, of course, is why ticks behave differently in northern compared to southern regions. Obvious differences between the North and South include climate and the mixture of vertebrate host species that are available to ticks. We looked at possible climatic effects at URI by maintaining ticks in the lab under northern and southern conditions. We hypothesized that ticks from northern sites would do better under northern conditions and ticks from southern sites would do better under southern conditions, but that was not the result. In our trials, ticks always lived longer under northern conditions, regardless of the site of origin (Ginsberg et al. 2014). Now this could simply result from the fact that ticks are ectothermic, so they lived faster and died younger under the warmer southern conditions, so we experimented with the effects of relative humidity (RH), in relation to temperature, on tick survival. Remember that nymphal ticks dwell primarily in the leaf litter, which is a moist environment in both North and South, but they venture above the leaf litter only occasionally to seek hosts. Arsnoe et al. (2015) estimated that these ticks spend only about

3.5% of their time above the leaf litter. When above the leaf litter, they face lower relative humidity levels, potentially affecting survival. We tested larval ticks from Rhode Island under northern and southern temperature conditions at varying levels of relative humidity, and the results were revealing (Ginsberg et al. 2017b). At near 95% RH virtually all of the ticks survived for the duration of the experiment (1,104 hours). At roughly 85% RH there was mortality, with considerable variability among larvae from different mothers, but survival did not differ between northern and southern temperatures. At lower humidity (approximately 75% RH), the ticks died quickly, and they always died faster under southern temperatures than under northern conditions. This result suggests the hypothesis that the higher temperatures in the South pose a desiccation stress on ticks above the leaf litter surface, possibly serving as a selective factor so that southern ticks evolved to remain down in the leaf litter when they seek hosts.

Tick-Host Relationships

The vertebrate hosts for ticks are also potentially important, and these differ along a latitudinal gradient. Biodiversity of mammals and lizards increases as you go south, possibly diluting the effects of important northern tick hosts (such as mice) at southern sites (Ostfeld and Keesing 2000). Furthermore, ticks are found increasingly on lizards at some southern sites (Apperson et al. 1993). These effects might influence tick questing behavior, but they might also affect tick infection with Lyme spirochetes. Rodents, the major tick hosts in the North, tend to be excellent reservoirs for the Lyme spirochete, while lizards generally are not. Infected white-footed mice can pass the spirochete to >75% of the uninfected larvae that attach to them (Donahue et al. 1987), as can meadow voles (Markowski et al. 1998). In contrast, studies of tick infection from infected skinks range from 0.005% (Moody 2013) to 24% (Levin et al. 1996), and for fence lizards there was no transmission (Rulison et al. 2014). When tick hosts are divided into categories based on size, taxonomic group, and known degrees of reservoir competence, a clear geographical pattern emerges of tick distribution on hosts (Ginsberg et al. 2021b). In the North, larvae and nymphs attach predominantly to small mammals like mice and voles; in the South they attach primarily to skinks, even at sites where mice are abundant (Fig. 3). The reason behind this pattern is not known. Tick attachment primarily to lizards (which are poor Lyme reservoirs) in the South largely explains why infection rates of blacklegged ticks (Fig. 1b) are so much lower at southern than at northern sites. Tick density also contributes at some sites; tick numbers at the Tennessee site, for example, were apparently too low to maintain a transmission cycle.

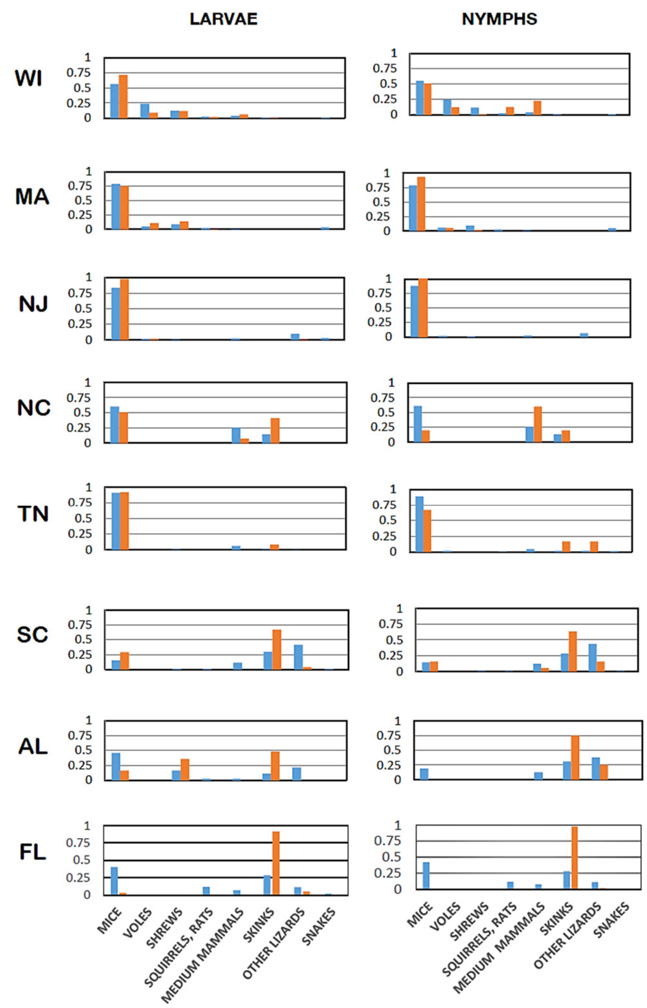

Figure 3. Infestation of *I. scapularis* tick larvae and nymphs on 8 different host types from 8 different states, arranged north to south. Blue bars indicate host availability—the relative proportion of each host type from all those sampled. Orange bars indicate infestation rate—the proportion of all ticks collected that came from each host type. (Figure from Ginsberg et al. 2021b, by permission).

Conclusions

The high incidence of human cases of Lyme disease in Rhode Island and other northeastern states compared to southern states therefore results primarily from two interesting quirks of tick ecology. Nymphal blacklegged ticks seek hosts above the leaf litter in the North and below the litter surface in the South (possibly related to climate), and ticks attach selectively to lizards, especially skinks, in the southern states. People walking through tick habitat are less likely to be bitten by a tick in the South than in the North, and if bitten, the tick is less likely to be infected. These results suggest questions about future trends in Lyme disease distribution, especially in view of climate change. Tick populations have been increasing in all directions in the last century, apparently from coastal refugia, and they might be expected to expand farther northward with climate change. Indeed, tick numbers and Lyme cases have been increasing in Canada (Ogden et al. 2013). However, the southern edge of the current range is more problematic. Will nymphal ticks in Virginia, Maryland, and Delaware start behaving more like southern ticks as the climate warms, and bite fewer humans? Will skink populations increase in these areas? We'll see. Rhode Island, on the other hand, is right in the middle of the current range of human cases (Fig. 1c), so Lyme disease will continue to be a problem here for the foreseeable future.

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Marine Mammals of Rhode Island: West Indian Manatee

By ROBERT D. KENNEY

Once again circumstances have conspired to change the order of installments in this series. I intended to include a humpback whale account this time, but we had another manatee show up in Rhode Island in the summer of 2023. This seemed like an opportune time to review the occurrences of manatees in our region. I did this once before (Kenney 2007) but at that point we had only 3 manatee visitors to our region; that number is now up to 8 and we should expect more as global warming continues.

The West Indian manatee (*Trichechus manatus*) is one of 4 extant species in the mammalian order Sirenia, collectively known as “sea cows” (Reynolds and Odell 1991). There are 3 manatees in the tropical Atlantic (*Trichechus* spp., family Trichechidae) and the dugong (*Dugong dugon*: Dugongidae) in the tropical Indo-Pacific. A fifth species, Steller’s sea cow (*Hydrodamalis gigas*), a sub-Arctic dugongid found only around the Commander Islands in the western Bering Sea, was both discovered and extirpated in the 18th Century.

Sirenians are the only herbivorous marine mammals. Although similar in form to other marine mammals, sirenians are not closely related to the Cetacea (whales and dolphins) or Pinnipedia (seals and their kin), but are most closely related to the elephants. West Indian manatees occur in warm subtropical and tropical waters, primarily in freshwater systems, estuaries, and shallow coastal waters. The species occurs in the southeastern US (primarily Florida), the Caribbean and the West Indies, and along the coasts of Central and South America from Mexico to northeastern Brazil.

Taxonomy and Status

West Indian manatees are divided into 2 subspecies: the Florida manatee *Trichechus manatus latirostris* and the Antillean manatee *T. m. manatus* (Caldwell and Caldwell 1985). The subspecies classification is not entirely consistent with the genetic evidence. Data from mitochondrial DNA analyses suggest three identifiable clusters—Florida and the West Indies, coastal Central and South America from Mexico to Colombia, and northeastern South America from Guyana to Brazil (Garcia-Rodriguez et al. 1998, Vianna et al. 2006). One gets the impression that resistance to changing a possibly outdated classification is at least partly due to bureaucratic inertia and/or convenience for the primary management agencies in the US.

West Indian manatees were classified as Endangered under the US Endangered Species Act, but in 2017 the classification was revised to Threatened. They are not included on the Rhode Island list of rare animals (Enser 2006), probably because they were treated as accidental visitors, and the state list is badly outdated. The species is classified as Vulnerable on the IUCN Red List, although both the Florida and Antillean subspecies are classified as Endangered (that assessment was last revised in 2008 and is noted as “needs updating”).

Mortality rates of manatees in Florida are relatively high, averaging 543 per year during 2014–2018 (USFWS 2023). About 22% of the mortality can be attributed as human-related, primarily collisions with watercraft but also including crushing in floodgates and canal locks, poaching, ingestion of persistent debris, and drowning or entanglement in fishing gear. Categories of natural mortalities include perinatal, cold stress, and biotoxins from “red tides.” Beginning in December 2020, large numbers of manatees died along the Atlantic coast of Florida—1,337 between 1 December 2020 and 31 December 2022. There were so many carcasses that only a subset could be fully necropsied; 88% of the necropsy findings indicated malnutrition. This Unusual Mortality Event is associated with phytoplankton blooms and die-off of seagrass in the Indian River Lagoon.

Figure 1. Female manatee suckling its calf. (photo by Galen Rathbun, USFWS, public domain, via Wikimedia Commons)

Description

Sirenians have more or less fusiform bodies, absence of hair except for well-developed vibrissae on the muzzle, no hind limbs, forelimbs modified into paddle-like flippers, and a horizontally flattened tail for swimming. West Indian manatees are large, rotund, docile, and slow-moving—ranging in length from 2.5 to 4.5 m (Jefferson et al. 1993, Wynne and Schwartz 1999). The body is tapered and somewhat streamlined, with a relatively small head and a large, rounded tail (Fig. 1). The skin is relatively smooth and uniformly gray or gray-brown, often with distinctive scars from boat collisions. The eyes are small and deep-set. The only teeth present, except for vestigial incisors that are resorbed soon after birth, are 5–7 molars in each upper and lower jaw, which are replaced from the rear and drop out at the front of the row when worn (Husar 1978). The forelimbs are relatively long and flexible, with blunt, rounded ends and elephant-like nails. The forelimbs are often used in feeding, in conjunction with the nearly prehensile upper lips, for manipulating vegetation into the mouth.

Natural History

Manatees feed on a wide variety of marine, estuarine, and aquatic vegetation, including seagrasses, algae, mangrove leaves and seedlings, floating aquatic plants, overhanging and streamside terrestrial plants, and even acorns (Reynolds and Odell 1991). Manatees typically spend 6–8 hours a day feeding. They are not deep divers, but are capable of remaining submerged for as long as 20 minutes. Manatees become sexually mature at 6–10 years old and about 2.7 m in length (Reynolds and Odell 1991). Gestation is believed to be about 12–13 months. Calves are born at about 1.2 m and 60 kg. Lactation lasts for about a year, although a calf may remain with its mother for another year. The nipples are axillary (i.e., located in the "armpits," Fig. 1). Intervals between births range from 2 to 5 years.

Manatees in the Northeast

There were no known manatee occurrences in or near Rhode Island prior to 1995 (e.g., Cronan and Brooks 1968). The total number of visitors is now up to at least 8. Many individuals can be identified by scars and other markings, but it is possible that more than one animal could have occurred in some years. The following accounts are based mainly on multiple media reports, which are not being cited in the interests of space.

1995. An adult male was the first manatee confirmed to occur in Rhode Island waters. He was captured in a Chesapeake tributary as winter approached in 1994, transported to Florida, equipped with a radio transmitter that could be tracked by satellite, and released—nicknamed "Chessie" for his rescue location. The following spring, he departed from Florida and headed north along the coast. Chessie did not make the expected left turn into Chesapeake Bay, but continued north past New Jersey into New York Harbor and then into Long Island Sound. He traveled the entire length of the Sound before finally reaching Point Judith on the 16th of August (Fig. 2, the orange symbol). Then he turned around and went back. He eventually lost the tag near New Haven, Connecticut, but was sighted in Virginia on 23 September and recognized back in his normal winter habitat in Florida in November.

1998. A manatee was seen in Montauk Harbor at the eastern end of Long Island for about a week in late July of 1998 (Fig. 2, purple).

2006. The third manatee to visit our area was first reported in Ocean City, Maryland on 11 July 2006. It was then seen in Delaware Bay on 14 July and at Barnegat Inlet, New Jersey on 22–23 July. Next it lingered for about a week in the Hudson River, from the 1st to the 8th of August, and was sighted off Manhattan and Harlem and more than 40 km upriver north of the Tappan Zee Bridge (where the media started calling it "Tappie") in Westchester County (Fig. 2, green). The next sighting was far to the east, in Quissett Harbor near Woods Hole, Massachusetts, on 17 August, before it turned around and started on the return trip. It was seen on the 19th in Westport, Massachusetts, and then caused a brief media furor in Rhode Island—drinking from a storm drain for the Channel 10 television cameras in a marina in Greenwich Bay on 20 August, and making brief appearances in Wickford Harbor on the 22nd and Bristol Harbor on the 27th or 28th.

2008. The fourth manatee visitor to southern New England was nicknamed "Dennis" for the harbor where he ended up (Fig. 2, yellow). It first was seen on 11 August off Crown Point on the South Kingstown side of Point Judith Pond and near Skip's Dock in Snug Harbor. The next report, on 21 August, came from a family fishing from a dock in Stony Brook Harbor on the north shore of Long Island. Then it laid low for almost a month, until the Massachusetts Division of Marine Fisheries reported on 19 September that a manatee had been seen for a couple of days under the Braga Bridge in Fall River. It showed up 5 days later on the 24th in a cove off Pleasant Bay in Harwich, Massachusetts—on the outside of Cape Cod. It apparently then went around the outer Cape, showing up on the 29th near the whale-watching boats in Provincetown Harbor. The next day it was seen in Sesuit Harbor in Dennis, in the southeast corner of Cape Cod Bay, where it remained until 11 October. On that day it was captured for relocation to Florida; however, it died in transit from cold stress.

2009. The manatee who visited in 2009 (Fig. 2, red) was already named "Ilya" by researchers in Florida. When he was young his companion was "Napoleon," and someone was a big fan of *The Man From U.N.C.L.E.* (For those too young to remember, that was a mid-1960s TV series about secret agents, and the heroes were Napoleon Solo and Illya Kuryakin.) Ilya was first spotted on 4 September in Point Judith Pond—close to where Dennis was seen the year before (and nearly invisible on the map under the blue symbol from 2023). Four days later he was seen off Sakonnet Harbor. On 12 September he showed up near the same marina in Sesuit Harbor where Dennis had been captured in 2008, and 4 days after that he was in Rock Harbor—a little farther east in Orleans. Nine days after that, on the 25th, he was spotted over 260 km west off Milford, Connecticut. Finally, on 16 October he was found hanging out in the warm-water outflow near an oil refinery in Linden, New Jersey—just off the Arthur Kill between New Jersey and Staten Island. Rescuers eventually managed to capture him and truck him back home to Florida.

2015. A manatee was sighted at the mouth of Crosswicks Creek in the Delaware River at Bordentown, New Jersey—just a little south of Trenton (and beyond the edge of Fig. 2).

2016. In August and September 2016, a manatee was seen repeatedly along the south side of Cape Cod between Chatham and Falmouth (Fig. 2, teal blue). Finally, as water temperatures cooled, on 22 September it was captured near Washburn Island and taken to Mystic Aquarium for treatment. It turned out to be a pregnant female, and of course it was named "Washburn." On 18 October it was flown to Florida on a US Coast Guard airplane.

2023. Our most recent manatee visitor showed up first in Quonochontaug Pond on 9 September (Fig. 2, dark blue). The difficulty of spelling "Quonochontaug" probably discouraged anyone from naming it. Three days later on the 12th it was in Point Judith Pond—the third one to show up in almost the same spot. Five days after that, on the 17th, it was seen in the Warren River in the northeastern corner of Narragansett Bay. Unfortunately, at the last sighting on 5 October it was seen floating dead between Hog Island and Prudence Island. The carcass was never recovered for a necropsy, and the presumption is that it died from cold stress.

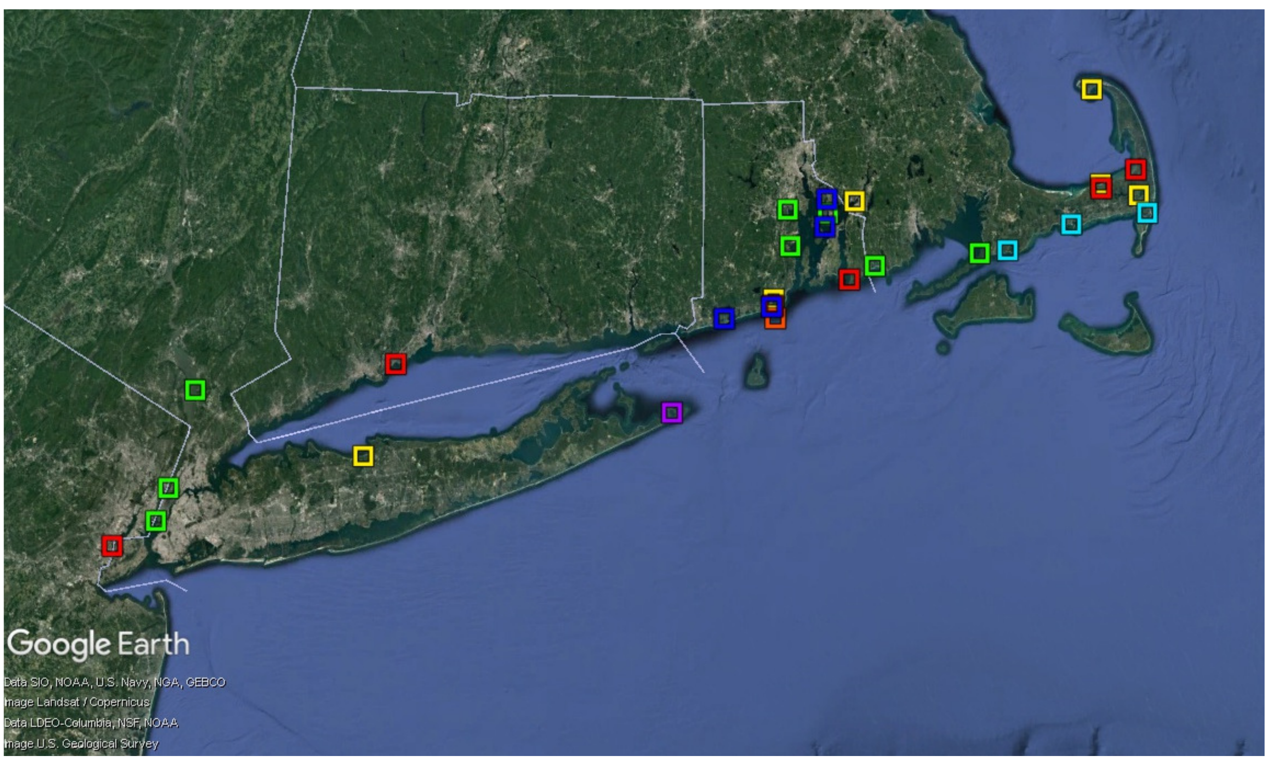

Figure 2. Sightings of West Indian manatees in southern New England, 1995–2023. Each year's records are a different color (see text for explanation of colors).

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Herbivorous Insects on Rhode Island Milkweeds

By RAUL N. FERREIRA

Milkweeds (*Asclepias* spp., in the order Gentianales and family Apocynaceae) are common and familiar wildflowers in Rhode Island. Eight milkweed species have been documented in our state (https://gobotany.nativeplanttrust.org/, Gould et al. 1998)—*A. amplexicaulis* (clasping milkweed), *A. exaltata* (poke milkweed), *A. incarnata* (swamp milkweed), *A. purpurascens* (purple milkweed), *A. quadrifolia* (four-leaved milkweed), *A. syriaca* (common milkweed), *A. tuberosa* (butterfly milkweed), and *A. verticillata* (whorled milkweed). The various milkweed species occur in a variety of habitats, such as sand (*A. amplexicaulis*); forests and woodlands (*A. exaltata*, *A. quadrifolia*); marshes (*A. incarnata*); and a wide variety of more open fields, including grasslands, farm fields, old fields, and waste places (*A. purpurascens*, *A. syriaca*, *A. tuberosa*, *A. verticillata*).

Asclepias syriaca – Common Milkweed

Many species of insects have been collected or reported from milkweed plants. Some are obligate milkweed herbivores, such as the milkweed ladybug beetle (*Brachyacantha ursina* Fabricius, 1787) or the caterpillars of monarch butterflies. Some are generalist herbivores or nectarivores, e.g., adult monarchs. Others may be predators feeding on other insects, and still others maybe just land on the milkweed for a short time.

I became curious about milkweeds around 1975 when I mistook their unusual pollen structures (pollinaria) attached to insects for a particular type of fungus that I was looking for. My interest in the mechanism of pollination in milkweeds soon expanded into other milkweed-insect relationships. I began collecting all the insects that I found on milkweed plants. Over time, by elimination I was able to identify those species that depend on milkweeds for development and survival, and which milkweed species are most preferred by each particular species of insects.

This study began in 1975. Collecting was done between early June and early October during daylight hours. One or two specimens of each species observed were collected as vouchers and deposited in the Raul N. Ferreira Collection.

After almost 5 decades of study, I decided to report my findings with the intention to trigger the interest and curiosity of young entomologists. This is a preliminary list based only on my own observations and collections, and should not be considered as complete. There are many other insects that are occasionally found on milkweeds and reported in the literature. Others have been reported for New England but not yet detected by me. Some of the species in my collections may need additional data to confirm if they are established in the area or are occasional vagrants. This introductory article features the monarch butterfly, which is likely the most familiar species to most people.

Order Lepidoptera

Family Nymphalidae Rafinesque, 1815

Subfamily Danaidae

Genus *Danaus* Kluk, 1802

***Danaus plexippus* (Linnaeus, 1758) (monarch butterfly)**

Description. An adult monarch butterfly is one of our most recognizable insects (Fig. 1). The adults are orange with black veins and borders and white spots. The wingspan is 7.0–10.0 cm. Females have thicker veins on the wings, while males have narrower veins and an enlarged spot (a sac containing pheromones) on one of the hindwing veins. The 1.2-mm eggs are cream to light green in color, and ovate with longitudinal ridges. The first instar (caterpillar) is pale green to gray-white with a black head and 2–6 mm long. The four subsequent instars have white, yellow, and black crosswise bands, with the fifth instars reaching 45–50 mm in length. The chrysalis is about 30 mm long, and is green with a black ridge around the dorsal side near the top and gold spots on the ridge and elsewhere.

Figure 1. Adult male *Danaus plexippus* (Linnaeus, 1758) (Photo by R. Ferreira)

Natural history. Adults feed on the nectar of milkweeds and many other plants. The eggs are laid singly on the underside of a younger leaf. The larvae (caterpillars) are obligate milkweed herbivores, feeding on the leaves of *A. syriaca* and *A. tuberosa*. They first appear in June, and become most common in August.

Literature Cited

Gould, L.L., R.W. Enser, R.E. Champlin, and I.H. Stuckey. 1998. *Vascular Flora of Rhode Island: A List of Native and Naturalized Plants.* The Biota of Rhode Island, vol. 1. Rhode Island Natural History Survey, Kingston, RI.

Raul Ferreira *is a retired biologist and entomologist who graduated from the University of Coimbra, Portugal, and the Northwestern School of Taxidermy in Nebraska. His research has primarily focused on the Coleoptera, particularly on the Staphylinidae (rove beetles) of Portugal and the US, and all beetle families of eastern Connecticut and Rhode Island. Email:* insectcatcher@comcast.net

Editors' note: *This is an abbreviated introduction to a longer article that includes 16 other species; the complete article will be published as Special Issue 4 of* Rhode Island Naturalist *on the Natural History Survey website.*

Executive Director's Journal: YouTube for COVID and Beyond

By DAVID W. GREGG

"Alright, Mr. DeMille, I'm ready for my close-up"

It was March 2020, four years ago this month, and the world was grinding to a halt. When the lockdown hit the Rhode Island Natural History Survey, my first thought was, "we're lucky, we don't have a public event scheduled until the annual meeting at the end of April . . . this disease has an incubation period of two weeks and the annual meeting was six weeks away, so everyone will just sit tight, we'll break the disease cycle, and we can get going again well before then." We'd definitely have this thing wrapped up by BioBlitz time in June. Of course it never occurred to anyone that we might have to cancel the science conference scheduled for November.

So home we went. We put a lot of new contacts into our cell phones and learned how to use Zoom. But that two-week incubation period would have been meaningful only if everyone actually followed directions, and as we know now, *that* did not happen. A few weeks later, in a technological tour-de-force, the Natural History Survey moved the annual meeting to Zoom, where we heard Ian Ives talk about Massachusetts Audubon's spadefoot toad restoration projects. The lockdown continued, though, and the BioBlitz date was approaching. Unless someone came up with a clever plan, and fast, we'd have to cancel, and we'd have the first year without a Rhode Island BioBlitz in two decades! That's when a kernel of a plan began to sprout.

There was a lot of buzz about video at the time: sea shanties on YouTube were a big pandemic craze! The Rhode Island Nature Video Festival has been a big hit. Even my teenage son was making (weird) videos and putting them on YouTube. The Survey had had a YouTube channel for a few years, but it was not very active. Could we make BioBlitz, the ultimate in-person event, into a virtual event *live* on YouTube?

Working with my son, I learned to use OBS Studio and loaded YouTube's ingest key into the software. Then, on the day in June when we should have been BioBlitzing Mercy Woods in Cumberland—instead we were holding a Backyard BioBlitz, where participants surveyed their own properties or neighborhoods. I was sitting in perfect COVID isolation in front of my laptop on a card table in the yard—talking live to 50 viewers. I blew the air horn to start the event like we always do. We had different volunteers monitoring counts reported via a Google Doc, on Facebook, or in iNaturalist. Then 24 hours later we went live again, and I blew the horn again. We were YouTubers, baby!

Over the next month, I did some research. YouTubers could make big money once they'd built up an audience. Could this be a new channel to reach a younger audience than Facebook, or a new line of support for the Survey? Only one way to find out: I decided as long as we were stuck in COVID isolation, the Survey would post a video a week, and we'd build up our subscriber base until we really hit the big time.

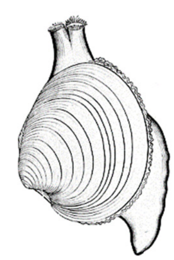
The strategy was simple—we'd post every Tuesday, calling it Natural History Tuesday. We'd keep a list of video ideas and ask people we knew who were working on interesting projects if we could video what they were doing. We recognized that we'd have to keep it simple. If every video was a mini-documentary, we would never be able to keep it up. We started out shooting everything on my Google Pixel 3a cell phone using just sound from the phone's onboard mic. Everything would be edited in the free version of DaVinci Resolve. One early lesson was about how hard it is to get good sound, so we asked the Conservation Stewardship Collaborative for some funds for a microphone and some other equipment, and that helped.

How far did we get? When we went live in 2020 for the Backyard BioBlitz we had posted 15 prior videos and had 18 subscribers. The first in the run of weekly videos was the channel trailer, which went up on October 6th, 2020, when we had 62 subscribers. We added 41 videos between then and June 2021, by which time we had 220 subscribers.

The first video was about a field trip to Cumberland with Charley Eiseman, an expert in leaf-mining insects. Some videos were more elaborate, such as the one about the day I spent on the Narrow River with Veronica Berounsky monitoring water quality. They needed to be alternated with simpler ones like *What is UP with that squirrel?,* which was just footage I shot in my backyard of a squirrel playing with a stick. We toured places with interesting natural history, such as Ell Pond or Jerimoth Hill, and visited local natural history institutions such as the Biomes Marine Biology Center and the URI Herbarium. We interviewed researchers about their work, for example Lynde Dodd's water chestnut experiments or Colleen Mouw's cytobot device.

We also started posting the recordings of the monthly meetings of the Rhode Island Woodland Partnership, informal gatherings of foresters, landowners, conservationists, and professionals concerned about the stewardship and long-term protection of Rhode Island's woodlands. Each monthly meeting features a theme, guest, or issue. When we first started posting them, I was not sure anyone would watch recordings of nearly 2-hour Zoom meetings, but viewership has been good and we've continued to do it.

One video made me a minor celebrity: *The Mystery of the Purloined Quahog*. This was a multi-disciplinary investigation into the natural history of a Rhode Island culinary icon, the "stuffie." In the course of production, my contact with the author of the history of Rhode Island shellfishing put me in touch with the author of the history of Rhode Island seafood, working shellfishermen, and the owner of the biggest local clam shack. The video ended up being shown as part of a statewide seafood festival, and I was made an honorary member of the "clam-oratti."



As the world woke back up again, we didn't have as much time for videos and the pace slowed down. Making even simple videos can be incredibly time-consuming, well over an hour per minute of footage for some. Nonetheless, we still managed to add another 50 videos over the next 3 years, bringing the total to 115, and doubled the subscriber count to 455.

What have been the Natural History Survey's most watched videos? The top five are instructive about what resonates with YouTube's audience. As much as I might wish it were one of the elaborately creative productions, the top video is literally scatological: it's *Coyote poop: there's a lot of meaning to scat*, which has been watched nearly 7,000 times. The second, third, and fifth are direct answers to questions people probably have, respectively: *How big are bobcats, anyway?*, *Winter invasive plant treatment: options for the homeowner*, and *How does a fish ladder work?* Number four just proves that clickbait works, it's *When sawflies attack!* and features a ridiculous thumbnail.

The Survey's channel has still not reached YouTube's subscriber or watch-hour thresholds for monetization, but 15 videos have more than 500 views. Some 75 have more than 100 views, and 100 is about typical for the audience at an in-person lecture. Many who find the Survey through YouTube are new, or wouldn't make it to an in-person event anyway, and become more deeply engaged with us through this virtual option. Even the act of making the videos has created contacts and spread awareness about the Survey. Altogether, there have been 50,000 views totaling over 3,500 hours. That's like one person watching 24/7 for 146 straight days. That's a *lot* of natural history.

If you'd like to learn more about what's going on in Rhode Island natural history, visit our YouTube channel: https://youtube.com/@rinaturalhistory

The Survey's Executive Director **David Gregg** *is coming up on his 20th anniversary in the position, and was a Board member for two years before that. He is also the number one fan of the Rhode Island BioBlitz.*

RINHS 2024 Awards

As part of its mission to advance public understanding of natural history and the role of naturalists in environmental conservation and management, the Rhode Island Natural History Survey has instituted three awards recognizing accomplishments of individuals from, or working in, Rhode Island. To see more about all our awards and find complete lists of past awardees, go to https://rinhs.org/events/awards/.

The **Distinguished Naturalist Award** is presented by the Survey to an individual who has made significant contributions to scientific knowledge of Rhode Island's organisms, geology, and ecosystems; is recognized as an outstanding teacher and educator about the natural world; and/or has significantly enhanced public awareness of the importance of understanding Rhode Island's ecosystems.

The **Founders' Award for Exceptional Service** celebrates the organization's heroes: individuals, groups, or organizations that have made extraordinary contributions—time, things, money, expertise, all of the above—that substantially advanced the Survey's longevity and mission. It is our newest award—created in 2020. Recipients of both the Distinguished Naturalist and Founders' Awards can be living or deceased, and are selected by the RINHS Board of Directors from lists of nominations made from people both within and outside of the Survey.

The **Golden Eye Award**, established in 2008, recognizes someone for making a notable natural historical observation and bringing it to the attention of the community—a "good catch." It could be a new species for Rhode Island, a rare or otherwise unusual species, an invasive species, or some other natural historical phenomenon. RINHS staff makes the nomination, and the award is voted on by the Board of Directors.

On November 18th, 2022, the Survey held an awards presentation in Avedisian Hall on the URI Kingston campus. We presented a Distinguished Naturalist Award to Peter Paton, a posthumous Distinguished Naturalist Award to Edna Lawrence, a Founders' Award to Carl Sawyer, and a Golden Eye Award to Silas Claypool. A video of the evening's presentations is on the Survey's YouTube channel at https://www.youtube.com/watch?v=3S1SoK3WOoeM. More about all four winners is in the following articles.

Call for Nominations: The 2024 nomination period is open for both the Distinguished Naturalist Award and the Founders' Award for Exceptional Service. Nominees can be living or deceased. Current members of the Board of Directors are not eligible, nor are members of the RINHS staff. To nominate someone, send a letter or email to the Survey office marked "Attention: Awards" or contact any member of the Board of Directors. In your correspondence please describe the ways in which your nominee excelled in the sort of contributions summarized above or provided in more detail on our website. Please include as much specific detail as possible, as we may not be personally familiar with your nominee's work. Past nominations are kept and reconsidered for up to five years, so if you've nominated someone unsuccessfully in the past, you are not required to re-nominate them. You may, however, wish to provide additional information on your nominee if you feel it would strengthen the nomination.

Peter Paton
RINHS Distinguished Naturalist 2023

By Peter V. August

It was a privilege to present the Rhode Island Natural History Survey's 2023 Distinguished Naturalist Award to my friend and colleague Dr. Peter Paton. Peter is a gifted scientist, a passionate teacher/mentor to graduate and undergraduate students, and as we discovered during his acceptance of the award back in November—an exceptional storyteller. He is most deserving of the Natural History Survey's highest honor.

Peter grew up in Colorado, and attended Lewis and Clark College in Portland, Oregon, where his first natural history class hooked him for life. He earned an MS from Colorado State University and a PhD from Utah State University, both in Wildlife Biology. He worked as a federal wildlife biologist and contract biologist for 10 years before joining the URI faculty in 1995. He has studied snowy plovers on the Great Salt Lake, the effects of timber harvesting on spotted owls and marbled murrelets at the Redwood Science Laboratory, egrets as an airstrike hazard in Hawaii, endangered birds on the Hawaiian islands, birds breeding in Denali National Park in Alaska, and terns on Great Gull Island in Long Island Sound. For the past 30 years he has helped to run the Kingston Wildlife Research Station, a collaboration between the Audubon Society and URI, and the longest-running bird-banding operation in North America (begun by Doug Kraus, 1998 RINHS Distinguished Naturalist).

I want to highlight Peter's professional accomplishments here in Rhode Island that earned him this recognition.

Scholarship. Peter is an exceptionally productive scientist. His primary areas of scholarship are the conservation of migratory shorebirds, movements and breeding of amphibians in vernal ponds, impacts of offshore wind turbines on migrating birds, and sea-duck ecology. His statistics tell the story:

- Peter was lead editor of *The Ecology of Block Island*, a book published by the Natural History Survey, and a co-author of the updated breeding bird atlas (see page 25).
- He has written 9 chapters in books.
- He has authored 92 peer-reviewed journal articles. I might note that almost every paper he has published over the past 23 years includes one or more of his students.
- As a Full Professor, Peter has secured over $12 million in grant funding from 15 different agencies.
- In 2003 he was awarded the College of the Environment and Life Sciences Research Excellence Award.

Mentoring. I was the department Chair in Natural Resources Science when Peter was hired. All new faculty get reviewed each year for their first 5–6 years, at which point a tenure decision is made. I clearly remember one of our conversations. Peter had a particularly stunning year with his research. I asked him what his goals for the next year were and he simply said "to be the best teacher I can be." Almost

30 years have passed since that conversation. Peter achieved his goal, and in a spectacular way.

- Peter's core courses are field ornithology, wetland wildlife management, and management of migratory birds. His student evaluation scores are a perfect 5 out of 5 almost every semester.
- As a Full Professor he has mentored 15 MS, MESM, and PhD graduate students. He has sat on scores of thesis and dissertation committees. Graduate students know Peter to be tough, but fair, and always constructive.
- He advises 25–40 undergraduate students each year.
- In 2015 he was awarded the College Teaching Excellence Award.
- Peter's natural history knowledge is epic, as is his contagious enthusiasm. One nominator wrote "His excitement for nature is infectious. Seeing him as enthusiastic about spotting his 10,000th yellow warbler, just as he was for his first, never fails to thrill his students!"

Service. Peter is exceedingly generous with his time. At URI, he has served two tours of duty as Department Chair and has done every service assignment there is on campus. He is a past President of the RI Natural History Survey, reviewer for many scientific journals, on the Editorial Board for *Northeastern Naturalist*, and advisor to CRMC and DEM. He is a Senior Fellow of the Coastal Institute and Science Advisor for the stewardship of the Napatree Point Conservation Area.

To quote from one of Peter's letters of nomination: "Dr. Paton has to rank among the top professors at URI on most any metric you choose, and one of the most effective and dedicated naturalists in the state. His commitment to the profession of wildlife conservation, the university, his colleagues, his students, the citizens of Rhode Island, and most importantly, the science of natural history, is unrivaled."

***Peter August** is a Professor Emeritus in the URI Dept. of Natural Resources Science, and a founding member and first President of the RINHS Board of Directors.*

Edna W. Lawrence
RINHS Distinguished Naturalist 2023 (posthumous)

By Benedict Gagliardi

I was thrilled to present a 2023 Distinguished Naturalist Award in honor of Edna Lawrence. She was a woman whom I never met but whose influence, vision, and legacy (and photos) have surrounded me every day for the seven years that I've been working at the RISD Nature Lab. I was likewise happy for the opportunity to share a little bit more about her with those who might not have been familiar. The occasion was even sweeter because the event in November was only a few days away from what would have been her 125th birthday. It was great to have Edna's grandniece Jeannette de Beauvoir come all the way from Cape Cod to accept the award on her behalf.

Edna Winfred Lawrence, or "Miss Lawrence" as I learned from her students she preferred to be addressed, was the founder and now namesake of the Edna Lawrence Nature Lab at Rhode Island School of Design. She graduated from RISD in 1920 and after traveling the world—often alone by freightliner—collecting specimens and little treasures, she returned to join the RISD faculty in 1922. Nature Drawing is the class that we most associate with her at the Nature Lab, but she was quite skilled in many disciplines and also taught Cast Drawing, Life Drawing, Sketch and Action, Freehand and Mechanical, Perspective, Watercolor, Drawing and Painting for Architects, Foundation Drawing, Portrait Drawing, Still-Life Painting, and Museum Research.

"Miss Lawrence" (standing) with a class of students in the RISD Nature Lab in 1951

Throughout her first 15 years teaching at RISD she moved around using any classroom she could. In 1937 she was given the old library space in the Waterman Building, which she proceeded to fill with her own Natural History collection of about 1,300 specimens and cultural artifacts that she'd accumulated in her travels. This "Nature Laboratory," as she called it, was a completely unique concept—an interactive reference collection that gave art students hands-on access to natural history items. She wanted it to be a place where visitors could study specimens for what she referred to as "design content and inspirational value." The Nature Lab was her classroom, her unique domain, and sustaining it and growing it was a driving passion for her. So every summer after teaching she would add to her collection with specimens that she and her partner Bessie Stone gathered while traveling across the country and around the world.

Edna once explained, "I started this lab with things I picked up myself and then others began to give me things." Her collection grew to 25,000 specimens by the time she retired in the 1970s, and today the Nature Lab's collection is approaching 100,000 individual specimens. We often recite this quote from Edna from 1941 that elegantly summarizes what the Nature Lab's mission is: "The goal is to open students' eyes to the marvels and beauty in nature; of form, space, color, texture, design, and structure; and to help them realize the functions and reasons for nature's creations." That goal is something that she very much succeeded in accomplishing. In her 53 years of teaching at RISD she inspired countless students to understand and appreciate and be curious about nature, and instructed them also how to observe closely and patiently, and depict accurately and artfully.

Edna was a truly forward-thinking woman, and there isn't a day that goes by at the Nature Lab that we, the small staff of five or six people, don't stop to recognize and admire her ambition in launching a completely unique research facility and cross-disciplinary collaboration space. It breaks the rules of many similar places. It looks like a natural history museum, but we let you open the doors, take stuff out, touch specimens, and even check some out like library books—a freedom unheard of elsewhere.

Miss Lawrence may not have had a formal background in biology or life sciences (though she was a member of the Audubon Society and Rhode Island Field Naturalist), but as a keen-eyed artist, a specimen collector and preparator, and most importantly a tireless and impactful teacher who worked far outside the box—she has had a major impact on generations of RISD students. All those students who spent time in her lab went off into the art and design world with a deeper appreciation and understanding of the natural one.

I can speak on behalf of all the Nature Lab staff in expressing what a privilege it is to be the stewards of Edna's Lab and concept. We continue to grow the collection and use it in new ways. We've expanded our resources to include a state-of-the-art microscopy lab, and a bio-design maker space as well. I do sometimes stop and wonder what she would think of her legendary status at the Nature Lab—this place that she founded. How would she feel if she knew that some iteration of her name is the password on many of our computers, and that photos of her serve as profile images on our Flicker and iNaturalist accounts?

Just one last little tidbit . . . I'm trained in entomology and always striving to improve as a naturalist—a lifelong goal shared by many. However, I think it's crucially important to remember that we all enjoy different access and ability to experience nature. What might be mundane for some can be exceptional for others. So just a quick sort of thought experiment. In your mind imagine you're holding a cone from a fir tree. Imagine its shape, its lightness, its size, its dryness, and that delicate flicking sound when you run your finger down the scales. Now imagine a whelk shell. You can feel the heft of it in your hands. You can sense where its center of gravity is. Feel that smooth interior surface, the knobs and spiral of the apex, and the deep siphon canal at the opposite end. For most of us, these two examples are common natural artifacts, especially in Rhode Island. We've probably spent time handling these out of our own curiosity; we have tactile memories of the sensations of observing these things with our fingers. For others these simple experiences and the time to thoughtfully engage with these objects could be brand new and unforgettably impactful. That's what Edna Lawrence as an instructor, and her Nature Lab as a resource, have achieved so powerfully for so many. I think that a key characteristic of any great naturalist is inspiring the curiosity of others and for that I am so pleased to recognize Edna Lawrence as an RINHS Distinguished Naturalist.

Pinus strobus – Eastern White Pine

***Ben Gagliardi** is a biologist and collections manager at the Edna Lawrence Nature Lab at the Rhode Island School of Design in Providence, and a member of the RINHS Board of Directors.*

Silas Claypool
2023 Golden Eye Award

By DAVID W. GREGG

The 2023 Golden Eye recipient is Silas Claypool, who was only 10 years old when he discovered a mushroom that had never been seen in Rhode Island before. It was a bolete (a type of mushroom with pores under the cap rather than gills) called *Boletus billieae* (Billie's bolete). The species had been found previously in Massachusetts, New York, and New Jersey, and may be rare enough to be considered as a threatened species. Silas and his father Rick (who has needed to become something of a mushroom expert himself to keep up with his son) collected the specimens along the East Bay Bike Path near Brickyard Pond. They recognized that it was something different, shared photos on Facebook, and were given help on preserving specimens to share with experts from the Rhode Island Mycological Society and to be deposited in the Brown University Herbarium.

This award recognizes more than just lucky encounters in the field or voluminous natural historical knowledge. Anyone can be lucky, and even the most seasoned naturalist could be too hardened to notice something unexpected. The Golden Eye recognizes those who possess a fundamental quality that is surprisingly rare—curiosity. Curiosity is, first and foremost, an act of humility, admitting you don't know something, and it is also fundamentally about one's ability to recognize difference. We all walk through the environment daily seeing all kinds of natural phenomena—rock outcrops, cloud formations, river levels, and all kinds of living things . . . red maples, robins, red-winged blackbirds, June beetles, bittersweet. Whether we shelve these observations away without remark or we commence a sequence of events that leads to recognition of a marvelous discovery depends on our ability to compare these observations to expectations for that time, place, and circumstance. Only once you recognize that something isn't as you expect it to be, can you go further in your understanding.

Besides knowing what should be in a particular place and what's out of place, a Golden Eye winner also needs to be able and willing to reach out to others. If you are an active naturalist, you rely on others all the time. You probably developed your interest by working with mentors and you probably need help regularly with collecting and processing techniques, identification, or another task. If you can't figure out what you've found, you've got to find the right person to figure it out. It might require resourcefulness—maybe making an appointment at a university or a museum or somewhere else to go and show your discovery. Maybe you email the Natural History Survey. Finally, and very importantly, you have to be willing and able to communicate your discovery. We naturalists are all engaged in building up our collective understanding of the environment around us, and if you don't tell people what you have found, it's like you never found it.

Silas Claypool received this year's Golden Eye because he possesses a whole set of special characteristics. First, he had to see a mushroom and recognize that it's not the same as all the other mushrooms. He had a level of curiosity, a level of acuity, to see something and see difference. Second, he needed perseverance, because identifying mushrooms can be hard and he had to find the right resources. Third, he communicated about his discovery so now we can all share it with him!

Silas was presented with a plaque and a copy of the *Mycota of Rhode Island* book by Roger Goos (2005 RINHS Distinguished Naturalist), published by the Natural History Survey and with an illustration of a bolete stamped on the cover. Silas thanked the Rhode Island Mycological Society, its founder Deana Tempest Thomas, and Tracey Hall from Audubon who all "helped me on my journey to learn more about mushrooms and the mycological world."

thegraphicsfairy.com

***David Gregg** is the Executive Director of the Rhode Island Natural History Survey. Some details in this article came from the September 18th story by Bonnie Phillips in ecoRI News.*

Carl D. Sawyer
2023 Founders' Award for Exceptional Service

By KIRA STILLWELL

It was my great pleasure to present the 2023 Rhode Island Natural History Survey Founders' Award for Exceptional Service to Carl Sawyer at our celebration in November. Acknowledging Carl's earnest actions that evening brought honor to the intent of the Award.

Carl has been a member of the Survey since our founding in 1994. If you are doing the math in your head—yes, it is 30 years! During this time, he has been a consistent donor—responding to appeals and other asks for financial support, an active, engaged member, and stalwart supporter. I'm going to share with you my experience of Carl over the 19-plus years that I have been with the Survey and have known him.

Anyone who has attended even a few Survey events will have seen Carl—Annual Meetings, lectures, conferences, award celebrations, and of course, BioBlitzes. If you have met Carl, or are one of the many who call him a friend, you will have experienced his warmth and congeniality. Since our office moved to East Farm in 2015, we never know when Carl will wander in for a visit. Lucky us! It is always the high point of the day! He consistently takes the time to deliver his membership renewal, event registrations, etc. in person, and while visiting, never fails to ask if there is anything we need help with.

Carl was a Research Associate at URI's Agricultural Experiment Station for almost 40 years. Early on he was a colleague of botanist Dr. Irene Stuckey (the first RINHS Distinguished Naturalist in 1994). The story has it that Irene was the inspiration behind Carl's interest in native and naturalized plants. He was an accomplice on her roadside botany adventures—Carl the driver; Dr. Stuckey identifying plants along the side of the road. The rest of Carl's long-standing love of plants, both agricultural and native, is history. I'm sure many of you can tell that story far better than I can.

Since the Rhode Island BioBlitz in 2007, at Trustom Pond in South Kingstown (just a few miles from his home as the crow flies over the Matunuck Hills), Carl has been the Captain of the Plant Team. Due in part to his efforts, the task has evolved from reporting in the form of a long paper checklist to a computer-based list that includes regular updates to taxonomy. Carl spends time readying materials in advance of each year's BioBlitz, engaging with team members before they arrive, strategizing inventory coverage of all areas and habitats, and when possible conducting pre-event scouting. After the event he does QA & QC work on the vascular plant reporting list to ensure it is accurate and complete. For those of you not familiar with vascular plants at BioBlitz, the average species count is 322, so wrestling the list is no small feat!

Every year since the 2014 BioBlitz at Rocky Point in Warwick (in the "old days" when we were on the 2nd floor of Ranger Hall—lugging gear down and up the stairs), Carl in his enormous bronze van has reliably provided transportation to and from each BioBlitz for most of the Survey's equipment and supplies. This predictable routine saves us precious time in pre-event planning and worry. Like a well-oiled machine, Carl arrives on the Thursday afternoon prior to BioBlitz and we load up! Van stuffed to the gills; Carl is one of the first to arrive at the BioBlitz site on Friday morning. Thirty hours later—after hours of set up, hours at the "Plantathletes" table, hours in the field botanizing, and only a few short hours sleeping—Carl (a volunteer, remember) helps heave everything back in the van and is the last to leave. Setting fatigue aside, he proceeds (along with David and me and occasionally other helpers) back to East Farm to unload. With never a complaint, Carl completes his task, and bids us goodbye with a warm and genuine smile. He never fails to share "attaboys" for a job well done, a reminder to enjoy the rest of the weekend, and thanks for our hard work.

Carl is invaluable as part of a team! His soft-spoken, good-natured, considerate, and humble disposition helps set the tone for all. A quiet and keen observer, Carl always offers up his dry sense of humor at just the right time. Not only is Carl a botanist, a leader, an equipment lugger, and a wonderful teammate; he is also handy! I would be remiss if I didn't call out his knowledge of tools and all things mechanical (particularly generators!) which has helped to keep us afloat at BioBlitz on more than one occasion.

Carl D. Sawyer is the quiet one, often at the edge of the periphery, who gets things done while others are just talking about what needs to be done.

***Kira Stillwell** is coming up on her 20th anniversary as the Survey's Program Coordinator.*

Book Review
Breeding Birds in Rhode Island

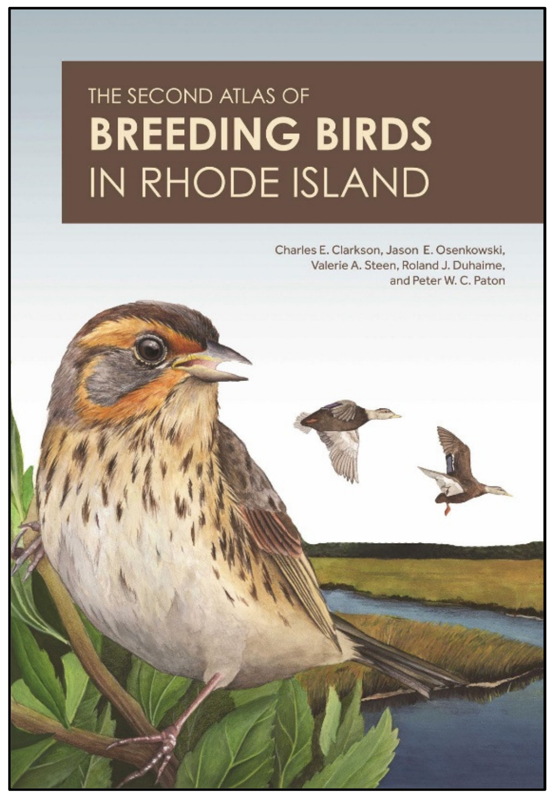
By ROBERT D. KENNEY

The Second Atlas of Breeding Birds in Rhode Island
By Charles E. Clarkson, Jason E. Osenkowski, Valerie A. Steen, Roland J. Duhaime, and Peter W.C. Paton
Rhode Island Department of Environmental Management, Division of Fish and Wildlife, West Kingston, RI; 2023. vii + 480 pp.
ISBN: 978-0-9834581-4-2.
Available from: https://dem.ri.gov/natural-resources-bureau/fish-wildlife/reports-publications/bird-atlas-2

The Second Atlas of Breeding Birds in Rhode Island (*Atlas 2* for short) is a significant upgrade from its predecessor (Enser 1992). The attractive, hard-cover book is printed in full color on quality, glossy paper. Both covers have beautiful illustrations by Emily Renaud—Saltmarsh Sparrow and American Black Ducks on the front (seen here) and a Pileated Woodpecker with two chicks peeking out of their nest hole on the back. There are excellent photos throughout the book.

As with *Atlas 1*, the meat of the book is comprised of the species accounts. Most readers will turn there first, with good reason, but first things first. The first six chapters include valuable information that will help the reader better understand the atlas and the ecological factors underlying breeding bird occurrence in Rhode Island: (1) Geography and climate; (2) Habitats and land cover; (3) Survey designs and field methods; (4) Analytical methods; (5) Coverage and results; and (6) Interpreting species accounts.

Chapter 7 (the last one) includes species accounts for 179 species. That total includes 157 species detected during both atlases, 7 species detected only during Atlas 1 and now considered as extirpated as breeders from the state (e.g., Northern Bobwhite, Upland Sandpiper), and 15 species recorded only during Atlas 2 ("colonizers," e.g., Bald Eagle, Common Raven). During Atlas 2, eight species were detected in all 165 blocks—American Crow, Black-capped Chickadee, American Robin, Gray Catbird, Yellow Warbler, Song Sparrow, Red-winged Blackbird, and Common Grackle. Note that a "detection" for atlas purposes must occur during the likely breeding period for a species (the "safe dates") to be counted as a "possible" breeder, with increasingly rigorous criteria to qualify as a "probable" or "confirmed" breeder. The Rhode Island bird checklist includes over 400 species, so the subset of breeding bird species includes less than half of the total.



Each species account is on two facing pages, so all the information is laid out in front of the reader. There is a color photo, the species name, and a status summary at the top left, and a header box with just the name at the top right, making it easy to leaf through in either direction to find a specific bird or group of species (e.g., ducks, sparrows). The major sections of text are Life History, Breeding Ecology and Migration Phenology, Distribution and Abundance, Conservation and Management, and Climate Vulnerability. Everything is thoroughly documented to the literature; there is a 50-page bibliography at the back.

I found two of the text sections to be most helpful. The amount of information provided under Life History for each species is astounding; I didn't keep track of the number of times I said to myself "I didn't know that." And I found the Distribution and Abundance section especially informative. There was a subsection on historical information, summarizing what was known about the species prior to Atlas 1, often back to the 19th Century, as well as comparative results from the Massachusetts and Connecticut atlases. That was followed by summaries and comparisons of Atlas 1 and Atlas 2.

Spinus tristis – American goldfinch

Then there are the graphics, for what would an atlas be without a lot of maps? Each species account included from as few as one to as many as five graphics:

- Breeding category map: this was the same concept as the *Atlas 1* maps, showing census blocks (the same 165 5 km X 5 km blocks used in Atlas 1) with detections of possible, probable, and confirmed breeding as small, medium, or large circles. The underlying map was color-coded (developed areas red, less-developed areas green, water bodies blue). This map was not included for species detected during Atlas 1 but not Atlas 2.
- Change map: the 165 blocks were color-coded by positive detections in any of the three breeding categories (yellow = only Atlas 1; green = only Atlas 2; blue = both atlases; white = not detected in either). This was the only graphic that was included for every one of the 179 species.
- Density map: for species with enough detection data, it was possible to develop quantitative models of distribution relative to habitat variables, to estimate densities (birds/km^2) across the state, and to map them by intensity of color. For those species, there also was an estimate of the minimum statewide abundance included in the Distribution and Abundance/Atlas 2 text.
- Probability of occurrence map: similar to the density map, but could be created with not quite as extensive data. Each point was color-coded by probability of occupancy from 0% (green) to 100% (red). To fully understand how the density and probability of occurrence maps were created, you'll need to read Chapter 4.
- Point detection map: simple dots showing detection locations in some cases where there were insufficient data for the preceding two map types. For a few species that call after dark—owls, nightjars, and woodcock—the point detection maps showed positive vs. negative detections from specialized transects driven along roads with evenly spaced listening stations.
- Waterbird colony site maps: for a few selected species.
- Trend graph: these show the change in abundance over the years from 1965 to 2017 with the two Atlas periods marked, based on regional (Massachusetts, Connecticut, and Rhode Island) breeding bird survey data.

In addition to the extensive bibliography, the back matter includes two appendices (the list of safe dates used, and a table of all the habitat coefficients used in the modeling work), and a species index.

The Second Atlas of Breeding Birds in Rhode Island would be a valuable addition to the library of anyone interested in birds—from casual observer to dedicated birder to professional ornithologist. I have only two complaints. One has to do with the sizes of the maps. The more information available, the more maps that need to be included, and so the smaller they need to be in order to stick with the two-pages-per-species design. It can be really difficult to see the details or read the numbers in the color scales. I especially had trouble seeing the difference between the positive and negative stations on the owl transect maps (my aging eyes are a contributing factor). I also found the quality and consistency of the copy editing to be somewhat disappointing, particularly given the length of time the book took to produce after data collection ended in 2019.

Literature Cited

Enser, R.W. 1992. *The Atlas of Breeding Birds in Rhode Island.* Rhode Island Department of Environmental Management, Providence, RI. vii + 206 pp

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The bulletin of the Rhode Island Natural History Survey, Inc. is published twice yearly

Our Mission

The Rhode Island Natural History Survey is an independent, member-supported non-profit, founded in 1994, that engages people knowledgeable about Rhode Island's animals, plants, and natural systems with each other and with those who can use that knowledge for research, education, and conservation.

For environmental conservation there are fewer resources than ever . . . but with zoonotic diseases, climate change, invasive species, and habitat loss all accelerating, the natural world isn't getting any less complicated. We need good science and we need everybody to work together to make the most of our combined knowledge and experience.

The Natural History Survey manages data documenting the state's species and natural communities, publishes books and articles, facilitates science projects that have diverse partners or complex funding, and hosts events bringing people together, including conferences and the annual Rhode Island BioBlitz. The Survey is not a state agency or university department: it is embodied in members and friends who make generous gifts of time, money, and expertise to do this important work.

Notices

Save the Date—30th Annual Meeting and Public Lecture: Saturday, May 11th, 3:00 pm, 170 Avedisian Hall (Pharmacy building), URI Kingston campus. Following the routine agenda of board elections, updates on projects (completed, underway, and planned) and finances, our Strategic Task Force will report on our planning work to position ourselves in the environmental non-profit sector for our next 30 years! Then we'll hear from Dr. Christen Wemmer, Scientist Emeritus from the Smithsonian National Zoological Park, who will share images, stories, and sage advice on the art of camera trap photography. Copies of his new book, *A Camera Trapper's Companion*, will be available for purchase and signing at the event.

BioBlitz 2024: Friday & Saturday, June 7th & 8th, Norman Bird Sanctuary, Middletown. This will be our 25th BioBlitz, and 2024 is the 30th anniversary of the Survey's founding. Orientation and registration will be happening in early May; watch the *News to Use* email newsletter for updates and announcements.

On our "rinaturalhistory" YouTube channel: In case you missed them, you can see two video celebrations of events from earlier this year. The 2024 Artists on Expeditions Exhibit gives you a front-row seat to a lot of nature-inspired art, some creative song-smithing, and a lesson about the North Atlantic marine ecosystem! You can also watch all 13 entries from February's 7th Annual Rhode Island Nature Video Festival.

Stay tuned for the fall: Natural History Week will be November 16th–24th; plans for activities are in the early stages. The 30th Anniversary Gala, with presentation of this year's Distinguished Naturalist, Founders', and Golden Eye Awards, will happen at the Quonset 'O' Club on Saturday evening, November 16th.

To Contact Us. . .

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