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The Rhode Island Natural History Survey and Stewardship of the Napatree Point Conservation Area

By JANICE M. SASSI and PETER V. AUGUST

Introduction

The Napatree Point Conservation Area (NPCA) is a 35-ha (86-acre) nature preserve that extends into Little Narragansett Bay from Watch Hill, Rhode Island. Napatree is largely owned by the Watch Hill Fire District (WHFD) and The Watch Hill Conservancy (WHC); the town of Westerly and the state of Rhode Island also own small parcels. WHC was granted a conservation easement over Fire District properties on Napatree and is responsible for their stewardship.

The habitats on Napatree are among the greatest in need of conservation in the state—Maritime Shrubland, Maritime Herbaceous Dune, Saltmarsh, and a small lagoon (RIDEM 2015). Rhode Island's largest patch of eelgrass (*Zostera marina*) occurs between Napatree and Sandy Point in Little Narragansett Bay (August et al. 2020a). The National Audubon Society has declared Napatree a Globally Important Bird Area in recognition of its importance to shorebirds and as a stopover site for migrants. Napatree is included in the US Fish and Wildlife Service's John H. Chafee Coastal Barrier Resources System. The Rhode Island Coastal Resources Management Council (CRMC) has designated the marine environment south and west of Napatree an Area Designated for Conservation because of its importance as winter habitat for sea ducks. The list of rare and endangered species that occur on Napatree is long and includes the iconic piping plover (*Charadrius melodus*), least tern (*Sternula antillarum*), American oystercatcher (*Haematopus palliates*), and osprey (*Pandion haliaetus*). The URI Coastal Institute has recognized NPCA as a Climate Response Demonstration Site, one of three in Rhode Island. The demonstration sites showcase creative, effective land management to enhance resilience to climate change impacts.

Stewardship of Napatree is challenging. It is heavily used by visitors. On a hot summer day 900 people can line the 1.8-km (1.1-mile) beach and 400 boats may be anchored off its bayside shore (August et al. 2020b). The herbaceous dune habitats are fragile and vegetation is easily trampled. The ground nesting piping plovers and least terns, as well as flocks of feeding and resting shorebirds, are easily disturbed by walkers or dogs (Mayo et al. 2015). Providing visitors an enjoyable and informative destination is an important element of the NPCA mission (Sassi 2020). Doing so, while protecting the ecological integrity of Napatree, is a priority for WHC.

Establishing a Stewardship Road Map

2005 ecological inventory

The Rhode Island Natural History Survey (RINHS or "the Survey") has provided critical guidance to Napatree managers for over 15 years. In 2004, RINHS was commissioned by Chaplin B. Barnes and Grant G. Simmons III of WHC and the WHFD Park Commission to conduct an ecological

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Providing Ecosystem Science and Information reconnaissance of NPCA and to provide stewardship recommendations. Under the guidance of Kristen Puryear, the Survey completed a thorough ecological inventory of Napatree in 2005. The 57-page report included lists of the fauna and flora observed during the study (Puryear 2005). The key management issues that were identified were invasive plant control and animal management. Specific management recommendations were related to preventing bird disturbance by dogs, reducing dog waste on the beach and public paths, and dune erosion from people trampling vegetation. They also included many actions that should be undertaken; for example, trash removal from the beach and continued inventory and monitoring. The report was well-received by the Conservancy and helped establish a baseline condition and identify priority management issues that needed to be addressed. In 2011, Julia Brownlee Royster, staff scientist for Napatree, developed a management plan for the NPCA based, in part, on the recommendations in the RINHS report (Royster and Barry 2011).

2010 ecological inventory

In 2010, WHC and WHFD once again engaged the Survey in a second ecological assessment of NPCA. This study, led by Jane Buxton, included a team of expert land stewards and conservation biologists. The review panel again identified plant trampling on dunes, invasive species management, and disturbance to birds by dogs and walkers as key management challenges (Buxton 2010) and very specific stewardship actions were recommended. In the prologue, RINHS Executive Director David Gregg made a strong argument for engaging visitors and educating them of the ecological importance and sensitivity of the site. The Napatree Investigators youth education program (co-taught by RINHS board member Hugh Markey) was acknowledged to be a successful means of building public support for NPCA and teaching the next generation of citizens the importance of coastal ecosystems (Brown et al. 2020). Finally, the report closed with a strong recommendation to establish an ongoing monitoring program of the condition of Napatree and development of a well-managed database to permanently archive this information.

A Message from the Editors

The deadline for submission of articles for the Spring 2022 issue of *Rhode Island Naturalist* is 31 January 2022. Submit your articles or send queries and comments to RINaturalist@rinhs.org. You can find a link to our author guidelines on the Survey website.

Implementing a Stewardship, Management, and Monitoring Program

Stewardship of Napatree

The two studies by RINHS established a solid foundation for the stewardship of Napatree. The 2005 and 2010 reports gave rise to the first comprehensive management plan for Napatree (Royster and Barry 2011). Immediately after the 2010 study, a team of science advisors was formed to recommend stewardship and monitoring initiatives to the Napatree Manager and to advise on how to implement the recommendations offered in the 2010 RINHS assessment. Survey scientists and board members—Keith Killingbeck, Peter Paton, Jon Boothroyd, Hope Leeson, Howard Ginsberg, and Peter August—were on the initial science advisor team. When Jon Boothroyd passed on, he was replaced by RINHS board member Bryan Oakley. These individuals still actively counsel the Napatree Manager on stewardship issues.

The recommendation to reduce dune trampling was heeded. Through a system of conspicuous trail markers, the number of trails on Napatree has been reduced from 64 paths spanning 3.9 km (2.4 miles) in 2012 to 8 approved paths (0.5 km, 0.3 miles) in 2016. This has reclaimed 0.6 ha (1.5 acres) of herbaceous dune habitat (August et al. 2020c).

WHC has partnered with RINHS on an aggressive program of plant restoration on closed trails and invasive plant management on Napatree. Hope Leeson (RINHS botanist) has been the chief restoration ecologist on a number of projects funded by CRMC and the URI Costal Institute. Over the past 7 years, 2,600 plants of 20 species have been planted on Napatree. Species have been chosen based on their suitability for Napatree environmental conditions and the value they provide pollinators and migratory species (Leeson et al. 2020).

The Youth Conservation League (YCL), sponsored in part by RINHS and the Rhode Island Conservation Stewardship Collaborative, has been commissioned on two occasions to help with plant restoration and invasive plant control (Fig. 1). The YCL consists of teams of high school students who spend the summer doing conservation land management (Cote et al. 2020). This activity follows the 2010 recommendation to use environmental educational opportunities as a means to train the next generation of land stewards.

A specific recommendation of the 2010 assessment was to establish a comprehensive digital data repository of relevant information for the NPCA. This has been accomplished;

(continued on page 4)

President's Corner: Changing of the Guard

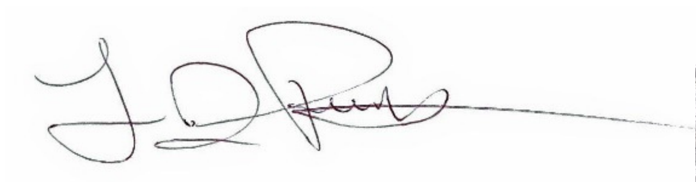
Lou Perrotti, President,
Board of Directors

I would like to start out by saying that I am a born and raised Rhode Islander who has had a passion for wildlife and wild places as far back as I can remember. I've been especially fascinated by amphibians and reptiles since I was a boy, thankfully a boy with a very patient mother. I always dreamed I would someday be in the position to make a difference for native wildlife and help inspire the next generation in doing so. As Director of Conservation Programs for the Roger Williams Park Zoo I have achieved this dream, as the lead on projects helping save some of the Earth's most threatened and endangered species (many of which are native here in Rhode Island!) and so sharing many great experiences with colleagues around the globe. While doing this work I have met many amazing and equally passionate people including the staff and board of the Rhode Island Natural History Survey.

My connection to the Survey began many moons ago when I attended my first BioBlitz. From that point on, I was hooked. I quickly fell in love with the Survey's mission, special events, and programs, as well as the people who make up our membership and broad circle of friends. The Survey has become an extended family of sorts for me—a family of dedicated naturalists (both amateur and professional), of dear friends, and of collaborating colleagues. These connections led to my joining the Survey's Board of Directors, with the goal of doing my part to support our mission. I am proud and honored to have served on the Survey board for over a decade and am excited to serve as its President for the next three years. I am humbled when I look back at the conservation heroes, biologists, and dedicated naturalists that founded and have led the Survey since the beginning—building it into what it is today. There are some big shoes to fill!

I am excited about our upcoming line-up of programs. We started back to in-person programs during mid-summer, so the first ones will have already happened by the time you read this. I was really looking forward to our signature events—the BioBlitz in Cumberland and the restoration science conference. We've had to postpone the conference to spring because of COVID-19 concerns, but the outdoor BioBlitz in October is on. Check the last page of this bulletin for more information, and watch for our email newsletters to keep up-to-date on what is coming up.

I look forward to the next three years working with the staff and board of the Survey to continue offering our members a broad host of exciting programs, connecting people to our natural world and to each other, and providing opportunities and information that will drive conservation action.



Napatree (continued from page 2)

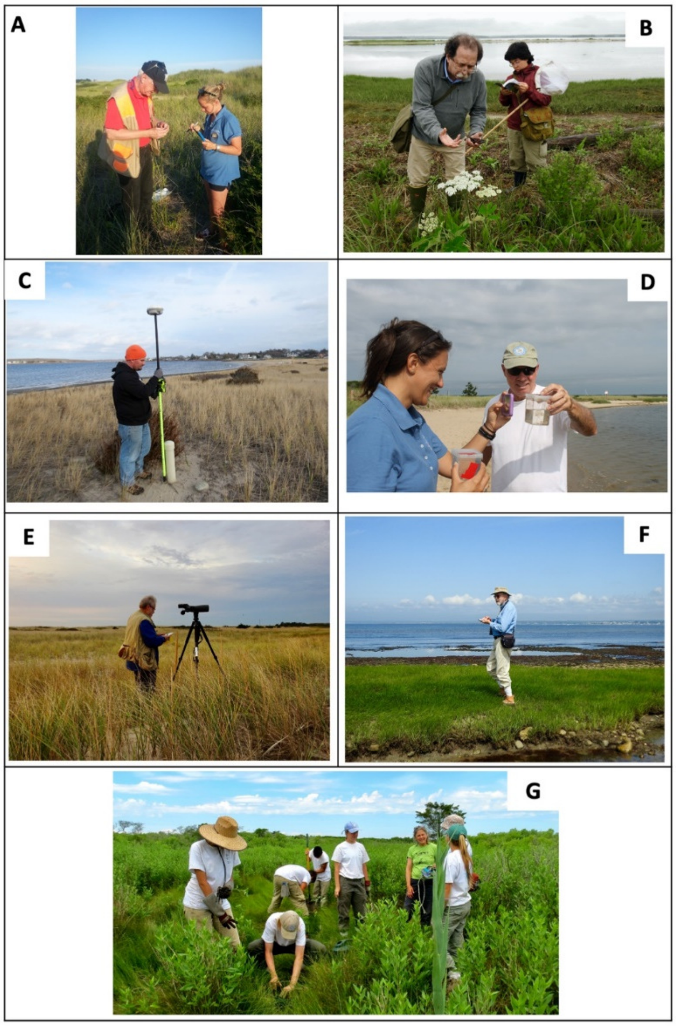


Figure 1. RINHS scientists in action on Napatree. A. Keith Killingbeck and Jessica Cressman-Greene monitoring shrub patch dynamics. B. Howard Ginsberg and Aya Rothwell conducting bee surveys. C. Bryan Oakley measuring dune height with GPS. D. Hugh Markey and Laura Craver-Rogers preparing materials for an Investigators class. E. Peter Paton monitoring shorebirds. F. Rey Larsen conducting a bird survey. G. Hope Leeson (in green) leading a YCL team in plant restoration. (Photos courtesy of The Watch Hill Conservancy)

the NPCA cloud-based database now contains over 100 Gb of GIS files, data tables, documents, photos, and videos for Napatree (August et al. 2020d). In addition, starting in 2013, we began publishing an annual State of Napatree report of monitoring data and project reports. They are available online from The Watch Hill Conservancy (Sassi 2020).

Inventory of the fauna, flora, and geology of Napatree

The Survey has played a significant role in collaborating with Conservancy scientists in inventorying the plants and animals of Napatree (Fig. 1, Table 1). Some examples, all of which are available for download, can be found in Sassi (2020).

Conclusions

The Napatree Point Conservation Area is an important ecological refuge and one of the most pristine coastal barrier systems in the region. Napatree is a public resource and is an extremely popular destination for visitors in all months of the year, and their density can be extremely high in the summer. Balancing the need to protect the plants, animals, and ecosystem processes of the site with providing the public access to Napatree is a challenge faced by Napatree stewards. The Rhode Island Natural History Survey has played a critical early role in developing management and stewardship plans for Napatree. Through ongoing research and monitoring by RINHS staff and Board members, the Survey continues to fill an important niche in the stewardship of Napatree.

Napatree is but one of many landscapes in Rhode Island that have benefitted from the work of RINHS. Through its work on invasive plant control, plant restoration, and maintenance of the rare species databases, many regions of the state benefit from the scientific leadership provided by the Rhode Island Natural History Survey.

Table 1. Rhode Island Natural History Survey officers, Board members, staff, and their students (*) participating in Napatree natural history studies, all of which can be downloaded from Sassi (2020).

Topic	RINHS-affiliated Investigators
Plants	Keith Killingbeck, Lisa Lofland Gould, Hope Leeson
Bees	Howard Ginsberg, Aya Rothwell*
Birds	Rey Larsen (2020 RINHS Distinguished Naturalist)
Shorebird Disturbance	Peter Paton, Tom Mayo*, Peter August
Moths	Mark Mello, Jamie Bogart (RINHS Godzala Grant recipients)
Shrubs	Keith Killingbeck, Jessica Cressman-Greene*
Mid-sized Mammals	Peter August
Physical Geography	Peter August
Geology	Bryan Oakley

Acknowledgements

The stewardship of the Napatree Point Conservation Area is supported by The Watch Hill Conservancy and the A.M. Roberts Charitable Foundation. The Watch Hill Fire District Park Commission provides essential logistic services for our work. The Rhode Island Coastal Resources Management Council and the URI Coastal Institute have provided generous grants to support many of the stewardship activities described here. David Gregg and Kira Stillwell have been key collaborators in all of the projects with the RINHS. Jocelyn Lahey provided helpful comments on the manuscript.

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***Janice Sassi** has been the Manager of the Napatree Point Conservation Area for over a decade and is responsible for the stewardship of Napatree. **Peter August** chairs the Napatree Science Advisors. He is Professor Emeritus of Natural Resources Science at URI and is the founding President of the Rhode Island Natural History Survey.*

Three "Ghosts": Three Very Rare Beetles (Coleoptera) of Rhode Island

By RAUL NASCIMENTO FERREIRA

Introduction

Beetles (Phylum Arthropoda, Class Insecta, Order Coleoptera) are among the most speciose of all living animals, with some 400,000 extant species. When asked if there was anything about the nature of the Creator that could be deduced from studying the natural world, British evolutionary biologist J.B.S. Haldane (1892–1964) was said to have quipped "an inordinate fondness for beetles." As one would expect from this, beetles are one of the most abundant and common components of the insect fauna of Rhode Island; Derek Sikes' checklist lists 2,209 species for the state (Sikes 2004). Some of those species are extremely rare, and some are believed to have been extirpated. Over the last three decades, three "ghost" beetles that were not known to currently occur within our state have been collected and identified: *Amara aulica* (Panzer, 1796)—a ground beetle that does not have a recognized common name; *Coccinella* *novemnotata* Herbst, 1793—the nine-spotted lady beetle; and *Lordithon niger* (Gravenhorst, 1802)—the black lordithon rove beetle. Two of them were species thought to be extinct in the state, and the third is an introduced species that was collected for the first time.

Since 2000 the Rhode Island Natural History Survey has conducted an annual BioBlitz at a different location within the state to document the biodiversity of fauna and flora at each site. I have been involved in the collecting and identification of Coleoptera at BioBlitz since 2007, when the 8th Rhode Island BioBlitz was held at the Trustom Pond National Wildlife Refuge in South Kingstown (1–2 June 2007). Since then, two ghost beetles have been collected at a BioBlitz—both at the 2014 BioBlitz at Rocky Point in Warwick. The third ghost species was collected in 1994 in Washington County (locality not disclosed) by Christopher Raithel (D.S. Sikes, University of Alaska Museum, pers. comm.). These occasional rare specimens demonstrate that the beetle fauna of Rhode Island is still poorly researched and that more effort needs to be put into mapping the real biodiversity of the insect population in all counties of the state. My hope with this article is to alert any naturalist, amateur or professional, to look out for these and other rare insect species. If you keep looking and have a basic understanding of their natural habitats, sooner or later you will be smiling with the discovery of your own ghosts.

Materials and Methods

In addition to my own collections, I reviewed the published documentation on Rhode Island beetles and communicated with colleagues to find existing records of beetles from the state. As part of the effort, I also visited various museum collections. Examination and confirmation of the identification of specimens was accomplished using a Wild M5 stereomicroscope. For specimen photographs, I used a Sony Cyber-shot DSC-W70 7.2-megapixel compact digital camera attached to the stereomicroscope.

Results and Discussion

Amara aulica (no common name)

Family Carabidae Latreille, 1802
Subfamily Harpalinae Bonelli, 1810
Tribe Zabrini Bonelli, 1810
Genus *Amara* Bonelli, 1810
Subgenus *Curtonotus* Stephens, 1827
Species *Amara aulica* (Panzer, 1796)

A. aulica, a native of the Palearctic region, was introduced to North America at Cape Breton, Nova Scotia in 1929 (Fall 1934). It is now known from Massachusetts, Maine, New Hampshire, and Rhode Island (Ferreira 2015).

Description. Body length 11–14 mm; dorsal surface glossy brownish black with a slight bronze hue; ventral surface paler (Fig. 1). Appendages of head, and often legs, reddish. Head large; pronotum (the section between the head and wings) with acute hind angles, smoothly curved sides, a distinct ridge on the lower edges. Elytra (the hard outer wings) short, widening behind middle; shoulder with blunt but evident tooth. Second segment of middle legs of males with two tubercles below a tooth (all other species of *Amara* with one).

Figure 1. *Amara aulica* (photo by R.N. Ferreira).

Natural history. Their typical habitat is on open, not-too-dry ground with meadow or weedy vegetation near ports and towns; also occurring in drift material along the shore. *Amara* species are predominantly herbivorous, with some species known to climb ripening grasses to feed on the seeds. Carabid larvae can be granivorous, omnivorous, or carnivorous, with their food preferences related to requirements for successful development. *A. aulica* larvae require seeds for development. Interspecific differences in larval food requirements facilitate the coexistence of closely related species, frequently sharing the same habitats. This species is more likely to live in close association with human habitation in America than in Europe. Hibernation normally occurs in the larval stage.

Specimens. Rhode Island, Kent County, Warwick, Rocky Point—collected during BioBlitz, 13–14 June 2014, 1 example (RNFC = R.N. Ferreira collection).

Coccinella novemnotata (nine-spotted lady beetle)

Family Coccinellidae Latreille, 1807
Sub Family Coccinellinae Latreille, 1807
Tribe Coccinellini Latreille, 1807

Genus *Coccinella* Linnaeus, 1758
Species *Coccinella novemnotata* Herbst, 1793

The nine-spotted lady beetle (hereafter C9), a Nearctic native, was historically one of the most prevalent lady beetles in its range in the United States and southern Canada. Its range has been diminished in recent years, and it has become very difficult to find in the Northeast. In Rhode Island, Davis (1904) described this species as common, but I could not find any published reference for the state after that time. Neither Wheeler and Hoebeke (1995) nor Sikes (2003, 2004) cited any more recent specimens. A survey conducted by the US Department of Agriculture in 1993 in 13 northeastern states found no C9 (Harmon et al. 2007). I collected 13 specimens in Westerly, Rhode Island between 1973 and 1997 and one specimen at the Rocky Point BioBlitz in June 2014. I also collected one specimen in Pawcatuck, Connecticut on 16 June 2006. Also in 2006, a single specimen was found in Virginia by a brother and sister (ages 11 and 10), showing the real value of citizen science (Losey et al. 2007; see the accompanying box about the "Lost Ladybug Project"). The specimen collected at Rocky Point in 2014 was the first known after those two in 2006.

Description. Typically with nine spots, which gives the species its name (novem = nine in Latin), but spotless individuals can be confused with *C. californica* (California lady beetle). Red, oval shaped, 4.7–7.0 mm (Fig. 2). Head broad with a pale band between the eyes, anteriorly and posteriorly black. Pronotum with pale anterior and large black trapezoidal posterior that contacts the mid-dorsal spot. Elytra with 4 black spots each, a central common spot, and a black elytral suture. Sexes are alike.

Natural history. The eggs are usually orange-yellowish when viable but shrivel and turn brown in 2 to 3 days if not viable (Gordon 1985). The larvae hatch in 4 days and undergo 4 instars before pupating. They reach the 3rd instar in 3–4 days, and after 7 more days they spend 1 day in a pre-pupal stage when they stop eating and pupate. The adult emerges 4 days later and takes 1 day to harden (Gordon 1985). Adults mature in 2 to 4 days, then breed continuously for 22 to 25 days before overwintering. C9 is found on agricultural land and lives on various crops such as alfalfa, clover, corn, cotton, potatoes, and soybeans, but also occurs on a variety of other vegetation in woodland, grassland, and suburban habitats. It is a predator and active hunter of many species of aphids, spider mites, alfalfa weevils, nymphs of leaf hoppers, and lepidopteran eggs. It is also subject to predation and cannibalism in all life stages. C9 adults rely on visual and chemical cues to locate prey and mates. Their decline may be because of competition for prey with the introduced Palearctic *Coccinella septempunctata* (seven-spotted ladybug) and the shrinkage of agricultural land, although the two ladybugs successfully co-exist in the western US more than in the East (Evans 2017). *Harmonia axyridis* (Asian lady beetle), another introduced species, has not been implicated in the decline of C9. The braconid wasp *Perilitus coccinellae* is known to be a parasite of C9 adults (Hudon 1959).

Figure 2. *Coccinella novemnotata* (photo by R.N. Ferreira).

Specimens. Rhode Island, Washington County, Westerly—25 May 1973, 1 example; 21 April 1974, 1 example; 31 April 1974, 1 example; 13 June 1974, 2 examples; 3 July 1974, 1 example; 7 July 1974, 1 example; 30 June 1975, 1 example; 30 July 1975, 1 example; 14 July 1976, 3 examples; 25 May 1997, 1 example (all RNFC). Rhode Island, Kent County, Warwick, Rocky Point—collected during BioBlitz, 13–14 June 2014, 1 example (RNFC).

***Lordithon niger* (black lordithon rove beetle)**

Family Staphylinidae Latreille, 1802
Subfamily Tachyporinae Macleay, 1825
Tribe Mycetoporini Thompson, 1858
Genus *Lordithon* Thompson, 1859
Species *Lordithon niger* (Gravenhorst, 1802)

The US Fish and Wildlife Service classified *L. niger* as a species where "proposing to list as endangered or threatened is possibly appropriate, but for which persuasive data on biological vulnerability and threat are not currently available," concluding that "the species may possibly be extinct" (USFWS 1994). The list of states where the species was known to have occurred was Arkansas, Connecticut, District of Columbia, Georgia, Illinois, Kentucky, Michigan, Missouri. New York, North Carolina, Ohio, Pennsylvania, Texas, Virginia and West Virginia (USFWS 1994). A specimen was discovered by Christopher Raithel (RIDEM

The "Lost Ladybug Project"

The Lost Ladybug Project was begun in 2000 by Cornell entomology professor John Losey as a way to survey ladybug populations across New York State with 4-H Cooperative Extension Master Gardeners. It soon grew into a community science project focused on young students, and expanded beyond New York. It was a brother and sister (ages 10 and 11) who found a nine-spotted ladybug in Virginia in 2006—the first seen in the eastern U.S. in 14 years! Project volunteers have already submitted almost 300 photos of C9s among the nearly 40,000 ladybug photos uploaded by the end of August 2021.

Although the focus and mission remain bringing children into science, anyone in North America can participate by taking pictures of any ladybug encountered and uploading them to the website. The website also has a wide variety of educational materials to share—including lesson plans for teachers interested in bringing the project into their classrooms (and even their own coloring book).

www.lostladybug.org

Natural Heritage program biologist) in Rhode Island in 1994, both proving that the species was not extinct and extending the known range. Since then, on-going efforts suggest that this species may be more widespread than previous records indicate; iNaturalist shows records for Ontario, Quebec, Connecticut, Ohio, and North Carolina (https://www.inaturalist.org/taxa/205863-Lordithon-niger).

Description. Usually 6.0–13.2 mm long, head shorter, widest at base. Oval to moderately elongate, pointed abdomen often bordered by long hairs (Fig. 3). Body robust, shining black with a distinct metallic blue-greenish sheen. Males with last segment of forelegs thickened and a deeply divided last abdominal segment. Elytra glossy brownish black to black. Bases and tips of antennae, upper half of some abdominal segments near the rear, and legs and pronotum of some specimens reddish brown.

Natural history. L. niger lives in fleshy fungi, especially in the orders Polyporales and Hymenochaetales, where they feed on fly larvae and fungal spores. Expected habitat is secondary upland hardwood forest and mixed hardwood/pine forest, where the appropriate fungi live attached to standing dead hardwood trees such as beech and poplar. A variety of trapping methods can be used, including Lindgren funnel traps, malaise traps, UV light traps, flight interception traps, and common pitfall traps. Trapping is best done between June and October when the beetles are most active.

Figure 3. *Lordithon niger* (photo by Betsy Betros).

Specimens. Rhode Island, Washington County (no location specified for Natural Heritage data records)—20 June 1994, collected by C.J. Raithel (D.S. Sikes collection).

Conclusion

In the space of three decades, with relatively minimal effort, three "ghost" beetle species were identified in Rhode Island—two thought to be extinct, at least regionally, and one never before found in the state. Much more research needs to be done, in a well-planned and methodical manner, if we want to better understand the occurrence, abundance, distribution, and natural history of Rhode Island's insect fauna. Those seeking to collect and identify beetles and other insects will be most successful if they have a good understanding of the habitat-use patterns and life histories of their target species. Rarity of formerly abundant insect species, or their extinction, should be understood as a clear warning that humans and their activities are impacting our planet and all of its inhabitants, with the potential for serious consequences on ourselves in the long run.

Acknowledgments

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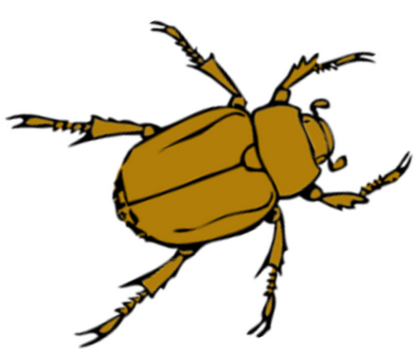
***Raul Ferreira** is a retired biologist and entomologist who graduated from the University of Coimbra, Portugal, and the Northwestern School of Taxidermy in Nebraska. His research has primarily focused on the Coleoptera, particularly on the Staphylinidae (rove beetles) of Portugal and the US, and all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



Marine Mammals of Rhode Island: North Atlantic Right Whale—Part 2

By ROBERT D. KENNEY

In the first part of this article on the North Atlantic right whale (*Eubalaena glacialis*; Kenney 2021)[1], I presented some basic information about the species, as well as details about current abundance and status. The species is one of the world's most critically endangered mammals, with an estimated abundance that declined from 482 in 2020 to only 368 in 2019. Human-caused mortality is the most important factor in the decline. The other primary factor has been a decline in the birth rate, which is covered below. There have also been substantial changes in distribution patterns, which are very likely linked to the changes in both birth and death rates, as well as to changes in prey and ocean temperatures.

Natural history

All right whales are migratory, moving annually between high-latitude feeding grounds and low-latitude calving grounds. Right whales historically were widespread in continental shelf waters from subtropical to cold regions on both sides of the North Atlantic, but were greatly reduced in number and range by centuries of whaling. Their original range extended from Florida and northwestern Africa north to the Gulf of Maine, Newfoundland, Labrador, Greenland, Iceland, the British Isles, and Norway. The remnant population in the western North Atlantic occurs primarily between northeastern Florida and the waters off the northeastern U.S. and Atlantic Canada. Their primary feeding grounds are in Cape Cod Bay (late winter–early spring), in the Great South Channel east of Cape Cod (late spring–early summer), in the Bay of Fundy and Roseway Basin near Nova Scotia (late summer–fall), and more recently in the Gulf of St. Lawrence (summer–fall). The winter calving ground is in coastal waters off Florida and Georgia. Other than the calving ground, habitat use during the winter is very poorly known and seems to be broadly dispersed, although some animals remain in the central Gulf of Maine and may be mating there. Animals are occasionally observed in distant areas including deeper waters beyond the shelf edge, Gulf of

[1]These articles are derived from species accounts prepared for the Rhode Island Ocean Special Area Management Plan (Kenney and Vigness-Raposa 2010), which should be consulted for fully detailed information and sources. See also Kenney (2020) for information about historical sources.

Figure 1. Aerial view of a right whale skim-feeding just below the surface, with the mouth wide open and showing the row of baleen plates suspended from the upper jaw (photo courtesy of Peter Duley, National Marine Fisheries Service, in the public domain).

Mexico, Greenland, Iceland, Norway, and southwestern Europe.

Feeding by right whales is accomplished by "skimming"—simply swimming forward with the mouth open (Fig. 1). Water flows in through the opening at the front—below the rostrum, above and around the tongue, and between the two rows of baleen. Water then flows laterally through the baleen filter, straining prey organisms from the water and collecting them on the inside. Feeding can occur at or just below the surface where it can be observed easily, or more often at depth and out of sight. Typical feeding dives last for 10–20 minutes. Right whales feed strictly on zooplankton, with their principal prey being large, late-stage juveniles and adults of copepods in the genus *Calanus* (crustaceans approximately the size of a grain of rice). They can probably feed on any prey (of a size that can be filtered efficiently by the baleen), which does not swim strongly enough to escape, and which is concentrated into sufficiently dense patches to trigger feeding behavior. The sizes of predator and prey differ by a factor of 50 billion—equivalent to a human swimming with the mouth wide open and filtering bacteria from the water. Consequently, right whales can feed successfully only in areas where their prey are aggregated into extremely dense concentrations. Studies of their North Atlantic feeding grounds have shown that prey aggregations result from a combination of bottom topography, water column structure and stratification, currents, and prey behavior.

Female right whales give birth to single calves in winter; most births are in December–February, peaking in early January (Fig. 2). As with the abundance estimates, the catalog of identified whales is the primary tool for tracking reproduction. The gestation period is believed to be about a year, and most calves are probably weaned toward the end of their first year. Following weaning, the mother typically takes a year to "rest"—feeding and rebuilding blubber stores before mating the following winter. The result is a 3-year interval between calves under good conditions with adequate prey resources available. Calving intervals averaged 3–4 years in the 1980s, when the average number of calves per year was about 11 or 12, but intervals increased during the 1990s to over 5 years by 2000, then returned to a predominance of 3-year intervals by 2004–2005. The number of calves born each year increased to a record number (39) in 2009, but has been steadily declining

Figure 2. Aerial view of a right whale mother and calf off Georgia in 2008. The mother is catalog #1245 ("Slalom"). She was born in 1982, and had calves in 1996, 2001, 2005, 2008, and 2011, and was most recently seen in 2019. The calf was eventually cataloged as #3845 ("Mogul"), a male, and he also was most recently sighted in 2019. His father was identified by genetic profiling as #2530 ("Cotton"), who has not been seen since 2010 (photo courtesy of Clay George, Georgia Dept. of Natural Resources, used by permission).

since. For the first time ever, there were no calves observed in 2018, but there is a glimmer of hope with 18 calves seen in 2021. In addition, the annual average intervals between calves have increased to 5–10 years over the last decade. Environmentally driven variability in prey resources appears to underlie the marked variability in calving success.

Historical occurrence in Rhode Island

Glover Allen in 1916 reported three historical records from Rhode Island—all killed intentionally, two of which came to him in letters from Major Edgar Mearns.

- In February 1828, "a Right Whale forty-four feet long, and rated at about seventy barrels of oil, was killed in the waters off Providence, R.I., after having been seen for several days 'sporting in our river'."

- "1893.—Major E.A. Mearns furnishes me with a note of what was said to have been a Right Whale, about 50 feet in length, that was stranded on Ochre Point, Newport, R.I. The blubber had already been removed by one Mr. Church at Tiverton, where the whale had been killed. . . . The exact date is not available."
- "1894.—Major Mearns also sends me the record of a Right Whale that appeared off Beaver Tail, Conanicut Island, R.I., in this year. It finally was sighted off Fort Adams, where it was shot and killed (exact date unknown)."

There is also a specimen record from the Academy of Natural Sciences of Philadelphia (ANSP3227)—right whale skull fragments from Rhode Island from November 1857. The records from shore whaling for right whales along eastern Long Island clearly reflect what is known about the migratory pattern of the population. Most of the kills occurred in winter and early spring, from January through May with a peak in April, and included a high proportion of mothers and calves. The New York whalers were primarily targeting northbound animals during the spring migration.

Recent occurrence

Right whales have occurred off Rhode Island in all seasons of the year (Fig. 3). They are most common in late winter and spring, less common in summer, and relatively scarce in fall. Animals in this region are mainly migrating between winter calving grounds in the southeastern U.S. and feeding grounds in and around the Gulf of Maine. Howard Winn (a URI professor who died in 1995, and my PhD advisor) hypothesized that the southbound migration in fall was more diffuse and farther offshore than the spring migration. It appears that northward migrating right whales in late winter and spring travel along shore until reaching Cape Hatteras, North Carolina, after which they spread out more, with some continuing to follow the coast while others take a more direct route towards Massachusetts. Right whales off Rhode Island seem to show that pattern, with the majority relatively close to shore, but others more offshore and maybe on a migratory pathway between Cape Hatteras and the Great South Channel.

Feeding by right whales had been occasionally observed prior to 2012 in the Rhode Island region, but was thought to be an opportunistic response to relatively rare occurrences of appropriate prey patches. An aggregation of feeding right whales that persisted for about two weeks was seen just east of Block Island in April 1998. Similar aggregations occurred in April 2010 (98 whales sighted on the 20th) and April 2011. In October 2011, however, the New England Aquarium began a program of aerial surveys in the Wind Energy Areas off Rhode Island and Massachusetts. The surveys went through the summer of 2015, and resulted in many more right whale sightings than we expected (Leiter et al. 2017). That survey program resumed in 2017 and still continues. The area south of Cape Cod now appears to be a high-use feeding habitat for North Atlantic right whales—just one example of the substantial changes in distribution that have been occurring since 2010. At the same time, fewer whales were seen in the Great South Channel and more in Cape Cod Bay, the Bay of Fundy has been nearly abandoned in some years, and many more whales are moving even farther north to the Gulf of St. Lawrence in the summer. All of these changes are likely linked to climate change, warming ocean temperatures, and changes in the distribution of the whales' prey.

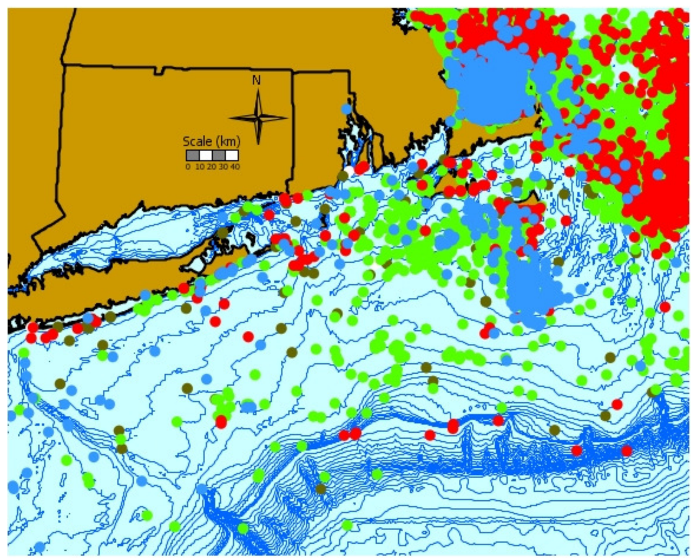


Figure 3. Seasonal distributions of North Atlantic right whales in Rhode Island and nearby waters, 1828–2019 (blue = winter; bright green = spring; red = summer; dark green = fall; white = unknown) (data courtesy of the North Atlantic Right Whale Consortium; principal sources during the 21st Century are the National Marine Fisheries Service and New England Aquarium).

In the Ocean SAMP report (Kenney and Vigness-Raposa 2010), we tallied six right whales stranded, floating dead, or seriously injured in or near Rhode Island in the 28 years between 1979 and 2006. But after a short respite, in the 8-year period of 2011–2018 there have been six more, for a total of 12 (Table 1).

The current situation for the North Atlantic right whale is dire. The number of animals surviving is decreasing at an alarming rate, because of both increasing mortality and decreasing reproduction. Entanglements in fishing gear and

Table 1. Strandings and other mortalities and serious injuries of North Atlantic right whales in the Rhode Island region since 1979 (M = male; F = female; U = unknown; COD = cause of death).

Date	Location	Sex	Age	Notes
Mar 1979	Wainscott, NY	U	U	Freshly dead, on the beach, tail severed by ship propeller
Jul 1995	Second Beach, Middletown, RI	M	2.5	10-m juvenile; multiple wraps of rope around one flipper deeply embedded into the bone; first seen entangled Dec 1993 at age 1 off Georgia; relatively benign entanglement tightened as the whale grew, leading to massive systemic infection
Jan 2000	15–18 km SE of Block Island, RI	F	3	Floating dead; could not be retrieved; COD never determined; entangling fishing gear or rope visible
Oct 2002	Nantucket, MA	F	1	On the beach; first seen entangled in probable lobster gear near Brier Island, Nova Scotia, in July; gear removed in Sep leaving severe lacerations, COD likely infection from the injuries
May 2005	39 km S of Martha's Vineyard, MA	U	U	Floating dead; never recovered; COD unknown
May 2006	56 km S of Block Island, RI	U	U	Floating dead; documented 3 days after first report by the Coast Guard; never recovered; COD unknown
Apr 2011	Off Martha's Vineyard, MA	M	8	Alive; line coming out both sides of the mouth and wrapped tightly over the back part of the head; last seen Nov 2011; believed to have died
Sep 2014	Off Nantucket, MA	U	U	Dead; anchored in place; multiple wraps of rope from head to tail
Aug 2017	Martha's Vineyard, MA	U	U	Dead on the beach; injuries from constricting wraps of rope around flippers and tail, although no rope remained on the carcass
Oct 2017	Nashawena Island, MA	U	U	Dead on the beach; evidence of severe entanglement and hemorrhage
Aug 2018	Martha's Vineyard, MA	M	3.5	Dead on the beach; evidence of multiple wraps of rope and associated hemorrhage
Dec 2018	50–60 km S of Nantucket, MA	M	16	Alive; sighted three times; no gear seen, but entanglement injuries visible; declining condition—very thin, gray skin, many visible lesions; seen once Feb 2019 in the same general location but not since

collisions with ships are killing whales. The birth rate is being impacted by changes in the food supply, which are linked to climate change and a warming ocean. Climate-linked changes in food drive changes in whale distribution, in turn influencing entanglement risk as the whales explore new habitat and spend more time moving from habitat to habitat. Increased entanglement also affects the birth rate. Research has shown that the energy cost of the added drag from a sub-lethal entanglement is equivalent to the cost of pregnancy, with the effect of lengthening the resting intervals between calves. Unfortunately, there is no short-term solution to problems caused by changing climate and warming oceans. But reducing mortalities from entanglement and collisions is well within the capabilities of 21st Century society, and is the only way we can avoid seeing the North Atlantic right whale becoming the first large whale species to go extinct during the modern era.

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Dr. Bob Kenney *is an Emeritus Marine Research Scientist at the URI Graduate School of Oceanography specializing in marine mammal ecology and conservation, a board member of RINHS and the North Atlantic Right Whale Consortium, and a co-editor of* Rhode Island Naturalist.

Executive Director's Journal
BioBlitzing Universal Orlando

By DAVID W. GREGG

During the difficult times of the past year and a half living with COVID-19, many people have sought solace, or preoccupation, in the great outdoors. Although the pandemic has been a calamity in many ways, at least this lesson on the importance of the natural world for our psychological, social, and physical health somewhat mitigates the disaster. Sometimes we need to be reminded about the importance of the animal and plant life surrounding and sustaining us. The ways and extent to which indifference to the natural world creeps up on us was brought dramatically home to me in 2017 when I experienced a juxtaposition of truly epic proportion.

The 2017 Rhode Island BioBlitz took place at Snake Den State Park and Farm in Johnston, nearly 900 acres in area with substantial blocks of forest, field, and stream, as well as bedrock ledges, vernal pools, and wetlands. At the end of 24 hours we had identified 1,119 species, including 376 vascular plants, 355 different insects, 106 vertebrates, and 181 fungi and lichens. Although we were not far from Providence, in one of the most densely populated states in the country, we were treated to a wealth of biodiversity.

The next Monday I packed my family onto an airplane and headed for Universal Orlando in Florida. My then 13-year old, Harry Potter-obsessed daughter was getting a trip to the Wizarding World of Harry Potter as a combo birthday-Christmas present. With BioBlitz fresh in my mind, I was looking forward to visiting Florida , where native subtropical biodiversity has been augmented by introductions of all sorts of seemingly fantastical, alien species. Maybe while the kids went on the rides, I could spot some interesting birds and butterflies (or an alligator!). Heck, on the heels of the weekend at Snake Den, wouldn't it be fun to BioBlitz Universal!

We arrived at our hotel too late to go into the amusement park so we decided to go on a boat ride through a meandering "river" that separates the park from the line-up of hotels. We got onto one of the ersatz African Queens that go around and around, and started to putt along. In my naiveté I thought, "this lake must have been carved out of some natural water body so there's bound to be some wildlife here!" Ha! It didn't take me long to realize that the banks were concrete and most of the bottom was actually sand-colored cement. Even the water was dyed blue and I couldn't detect a living thing in it. The only visible animals of any kind were a common gallinule and a great egret, both standing (perhaps wisely) out of the water.

Common gallinule (photo by D. W. Gregg).

Throughout the first day in the park, we didn't do much BioBlitzing, but I did manage to add one lizard—a brown anole (a non-native introduced from the West Indies)—to my paltry list, plus a house sparrow and a pigeon (both also non-natives). It was that evening that I really got going when we decided to go for a float in the lazy river that noodled around the hotel courtyard. Although it was a concrete trough full of chlorinated water, nonetheless as you floated along there were beds of landscaping just at eye level, and after a few laps I'd spotted a couple instances of invertebrate life crawling in the plantings: two different kinds of ant and two different kinds of millipede. As I headed back to our room, I found a snail crossing damp pavement from one flower bed to another. Two insects, two non-insect arthropods, and one mollusk!

As we entered the park on our second day, we were talking about my quixotic BioBlitz effort and speculating whether there was any hope of a mammal of any kind. As if on cue, there appeared a squirrel on a nearby lawn, our first mammal. But fittingly in a place where nature itself seemed abbreviated, it had only a stump of a tail. We later saw a rat near a dumpster, so I ended up with two mammals listed.

I found my first fish that afternoon in a stream that runs down Pteranodon Mountain in the Jurassic Park attraction. Just tiny minnows but a decent number of them. They must have been put there because I'm pretty sure this fiberglass construction doesn't connect to anything else watery.

There are two lagoons in the park itself, backdrops for attractions and a stage for fireworks and light shows, but as waterbodies—"something ain't right about 'em." One looked completely sterile although it was hard to tell because they'd dumped so much blue dye into it. I looked pretty carefully into the other one from the quay-side without luck and it was only as I was crossing the foot bridge from Harry Potter's London to the Simpson's Springfield that I spotted any life in it—seven very long but emaciated cichlid-ish fish floated beside the bridge staring hungrily up at me, strongly reminiscent of Blinky, the three-eyed fish that lived in the effluent of Mr. Burns's nuclear plant.

But what man-made lake surrounded by snack stands isn't chock full of ducks? We did, in fact, run into some ducks, really tatty-looking mongrel mallards, but they weren't in the water; they were wandering around the sidewalks like the rest of us. The nail in this aquatic coffin was driven home when I saw a cormorant flying by: he eyed the water, curved around a bit, then made one of those long, skimming landings. He wasn't in the pond 10 seconds; he ducked under the water once and hastily took off and flew away.

One of the "worlds" that Universal Orlando is divided into is Seuss Landing. It contains a One Fish, Two Fish, Red Fish, Blue Fish ride and a Cat-in-the-Hat ride, and (of course) the Green Eggs and Ham Cafe. The only thing scarcer than biodiversity here is a sense of irony—in the middle of a square mile of ponds that couldn't support a single Humming Fish and which cormorants shun, never mind Swomee Swans, is a playground vegetated with *fiberglass* Truffula trees. At least there was a black housefly in the garbage can at the cafe.

The Truffula tree forest (photo by Sam Gregg).

By the time we reached the Springfield section of the park, and its fiberglass Simpson family, I was getting pretty down on my BioBlitz idea. Maybe I could salvage something: Springfield is a relatively quiet, low-rise part of the park and even has some lawn and flower beds along the walkways. While the kids were occupied elsewhere, I looked around the side of a shed, where vegetation fell over the park wall, and there I found a small dragonfly sitting on a twig. I also found a third kind of ant, a trap-jaw ant introduced from the West Indies.

Trap-jaw ant, *Odontomachus ruginodis* (photo by D. W. Gregg).

In a flowerbed along one of the walkways I spotted one small green fly and, believe it or not, several honeybees! It made me think this was my chance; with a decent flowerbed you can always find myriad invertebrates if you just scrape aside some of the mulch. So I crouched down to see the wonders of the soil. But even the mulch was plastic, or chunks of rubber, spray painted brown. There wasn't a thing living in it.

Here is a list of all 27 animal species identified during 55 hours at Universal Orlando:

Invertebrates: a snail, 3 ants, 2 millipedes, a dragonfly, a flower fly, a house fly, a fruit fly, honeybees, a cricket, and a paper wasp.

Vertebrates: tilapia, small minnow, brown anole, mallard hybrid, house sparrow, great egret, grackle, crow, pigeon, common gallinule, rat, gray squirrel, . . . and *Homo sapiens*.

Admittedly, comparing the 27 species of animals found by one person in 3 days with a little help from the kids to some 500 animal species found at Snake Den in one day by teams of naturalists is not entirely fair. And Universal was designed to be an artificial fantasy land, not a state park. In 2017 Universal Orlando had 10 million visitors, so from a practical standpoint if you ran 10 million people over any piece of ground that wasn't made of concrete and rubber, you'd just end up with dirt or mud. And there are probably legitimate, mosquito-borne reasons to treat the water when you host that many people, clad in t-shirts and shorts, along the banks of stagnant lakes in a semi-tropical climate. You've attracted these millions of people with promises of diversion from an everyday life where you have to put on mosquito repellant if you want to be outdoors near water. Nevertheless, life is normally ebullient and spills out over even the largest asphalt and concrete surfaces, so it was an eerie feeling to not even see moths flying around the lights.

The way that Universal Orlando (or any other theme park of a similar size) came to be so suited to human desires but so foreign to nature is about a disconnection from humanity's experience of living on Earth, the same reason people were so surprised by the outbreak of biophilia during the COVID-19 pandemic. We set out to mitigate discomforts or dissatisfactions but in the process humans have become carried away by or overly enamored with our own success. But Mother Nature, including the occasional global pandemic, can be even more impressive—bigger, brighter, and louder—than the midway at any amusement park. We've nearly forgotten that, so we're surprised that we can see amazing things all around us in nature—e.g., more than a thousand species within a few miles of Providence. We still can relish that feeling of accomplishment that comes from sojourning with nature by foot, boat, or bike. And surviving hungry insects, dull water, and untidy forests.

The Newport Natural History Society, 1883–1940

By STEPHEN S. HALE

The late 1800s and early 1900s was the Golden Age of American natural history and Rhode Islanders joined in enthusiastically. Fueled by a keen interest of both professional and amateur biologists, natural history societies sprang up around Narragansett Bay. The Carnegie Institution's *Handbook of Learned Societies and Institutions of America* (Thompson 1908) listed four groups.

In Providence, the Providence Franklin Society (1821–1922) put on public lectures and field trips and began a collection of plants, insects, animals, and minerals. They published books on ferns and flowering plants and geology. The Rhode Island Field Naturalists' Club, founded in 1905, sponsored public lectures and field trips on topics such as seaweeds, shells, ferns, geology, and astronomy (Anonymous 1905). The club put together exhibits and workshops on seaweeds, shells, and mounting herbarium specimens. The Fall River Society of Natural History in 1919 hosted a meeting of the New England Federation of Natural History Societies (Emerton 1919). They prepared a large exhibit of local fauna and flora and sponsored excursions into the surrounding country for observation and collecting. But it was in Newport where the comings and goings of natural history societies got especially interesting.

The following is a summary of Kathrinne Duffy's article "From virtuous visions to rubbish and rats: A natural history society in Gilded Age Newport" (Duffy 2016). In Gilded Age Newport, beyond the sailing yachts and summer "cottages," an intellectual culture flourished. Thirteen natural history enthusiasts got together in 1883 to found the Newport Natural History Society (henceforth, the "Society"). The mission was to "Promote the study of natural science," focusing on the flora, fauna, and geology of Newport "for the purposes of public instruction and entertainment." Soon after founding, the Society had 71 members including doctors, professors, architects, military officers, politicians, clergymen, and merchants, "the leading scientific and cultivated men of Rhode Island" (Newport Natural History Society scrapbook, as cited by Duffy 2016). The eminent biologist Alexander Agassiz, curator of the Harvard Museum of Comparative Zoology, who had built a marine laboratory on the grounds of his summer estate at Castle Hill, was a Vice President.

The Society began collecting specimens, holding free lectures for the members and public, and publishing their research findings. Lectures were given on plants, spiders, insects, fishes, geology, and other topics. Being near the shore, collections of pressed seaweeds and marine mollusk shells were popular. By 1887, there were 160 members.

Some of the early leaders of the Society felt strongly that natural history was morally uplifting. Botanizers wrote that "The collection of specimens serves as a virtuous form of amusement, a pleasurable but work-like hobby demanding patience and discipline, resulting in self-improvement" (Keeney 1992, as cited by Duffy 2016). Some went further: Alexander Taylor felt that nature was a revelation of divine order and the Reverend Alpheus Hervey believed that the Society had a spiritual objective to "carry the mind beyond the creature to the Creator" (Hervey 1881, as cited by Duffy 2016).

One goal of the Society was to build a marine aquarium for public display. At a Society meeting, George King argued that an aquarium would be entertaining but also educational and uplifting. He said an aquarium would exert "a higher influence than that of gratifying gaping curiosity" and would be interesting enough to "incite even sluggish minds to beneficial activity." Spencer Baird, Secretary of the Smithsonian Institute and Director of the U.S. Fish Commission laboratory in Woods Hole, promised to donate the fish for the aquarium. The Society temporarily placed a few aquaria of marine life in the old Unitarian Church, whereupon the *Providence Telegram* newspaper waggishly noted that " . . . it will be no new thing for a Unitarian church to contain queer fish."

However, by 1886 the naturalists realized that they were not going to be able to raise enough funds for an aquarium. Even though Newport had many summer residents of great wealth, they were lukewarm about supporting a public aquarium. Apparently unmoved by the naturalists' morally uplifting thoughts, the cottagers opted to stick with their own summer social world. The naturalists turned their energies to their other goal—a museum. One of the founding members, T. Nelson Dale, felt that natural history museums were cathedrals for the scientific age and quoted the renowned naturalist Louis Agassiz (Alexander's father) who said the "great objective of our museums should be to exhibit the whole animal kingdom as a manifestation of the Supreme Intellect."

The naturalists opened their collection to public display in 1886 in the Newport Historical Society's quarters in the Seventh Day Baptist Meetinghouse (Fig. 1). In 1890, the naturalists moved their collection into a new wing they had added to the building; they owned the wing, but not the land. They originally intended to limit the museum collection to local geology, flora, and fauna but found it difficult to turn away exotic specimens from elsewhere.

Figure 1. Original home of the Newport Natural History Society, in the rear of the Seventh Day Baptist meeting house (visible on the right). Photo from the Newport Historical Society Collections, most likely taken by George H. Chase ca. 1900 (from Duffy 2016, by permission).

By the early 1900s, after a few good years of attendance, public interest in the museum dwindled. The museum became expensive to maintain, putting the society into debt. The prevailing Newport leisure culture and summer recreation that included "dancing, yachting, tennis, sea bathing" provided strong competition. The naturalists were dismayed by a trend of the general public toward "commercial entertainment and away from the morally uplifting observation of nature." They were troubled by the rising public taste for "other diversions and amusements" such as "Moving Pictures, and Vaudeville and Bridge Whist."

Trying to rally support, George King of the Society admonished that "Summer rest ought not to mean complete idleness." About the same time, natural history societies and museums around the country experienced the same crisis. Daniel Goldstein wrote that they typically had an initial surge in membership followed by a decline when they were no longer a novelty (Goldstein 2008). Further, the practice of science was changing from natural history societies to an increased focus on graduate education and laboratory research. Only a few of the larger, well-endowed natural history societies and museums in cities survived.

The Newport naturalists tried a new tactic, an appeal to youth. They held a competition for local students to collect specimens from the fields of botany, conchology, or entomology. Students had a certain amount of time to gather, identify, and preserve as many specimens as they could find. Prizes of natural history books and small amounts of cash would be awarded. According to the circular announcing the prizes, the naturalists felt the contests would provide "a recreation pleasurable and improving for some of the young people's leisure hours" (scrapbook of Newport Natural History Society 1904, as cited by Duffy 2016). Was this the first Rhode Island BioBlitz, albeit limited to a few taxa? In any case, it didn't generate much interest, although a few students made outstanding collections and were awarded their prizes.

Meetings and lectures continued but in 1906 the Society stopped publishing their Proceedings and by 1913, only 40 members were left, most of whom had not paid dues for years. The Society had not kept up with rent payments and had let their wing of the building fall into disrepair. The librarian of the Newport Historical Society complained of maintenance issues in the natural history wing of their building, stating that "The rats, etc. are getting beyond me." Soon thereafter the Newport Historical Society evicted the Natural History Society from the land beneath their museum and demolished the natural history wing. Nevertheless, the naturalists persevered, moving their museum collection to various community centers and churches. Finally, in 1940 the Society disbanded and donated the bulk of the museum collection to the local Cranston-Calvert School.

The Newport Natural History Society was a local manifestation of a broad general interest in the natural world in late-1800s America. Goldstein (2008) wrote that in the late 1800s, local and regional societies were the most widespread and accessible public scientific institutions in the country. He remarked that these local societies played a crucial role in the dissemination of scientific information and the nurturing of a scientifically literate population. They deepened public appreciation of and support for science. For the residents of Newport, the Newport Natural History Society educated the public about natural history at a time when other sources of information were scarce, stimulated curiosity about the natural world, and inspired a few young naturalists. Maybe it even improved their moral character!

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***Stephen Hale** is a retired Research Ecologist from the U.S. Environmental Protection Agency in Narragansett, a Board member of RINHS, and co-editor of* Rhode Island Naturalist.

Adult male yellow-rumped warbler, the most common species recorded in the Swan Point counts (photo by Chuck Homler, from Wikimedia Commons, licensed under the Creative Commons Attribution-Share Alike 3.0 Unported license).

Spring Warbler Migration at Swan Point Cemetery, Providence, Rhode Island: A 15-Year Analysis

By STEVEN E. REINERT, ROBERT M. BUSHNELL, STEPHEN W. DAVIS, and PETER CAPOBIANCO

The Partners in Flight Landbird Conservation Plan (Rich et al. 2004) underscores the dramatic declines of North American landbirds, adding that “Population monitoring is critical for all stages of conservation planning, including assessment of population status, identification of causal factors in population change, setting of population targets, and evaluating success of conservation action.” They also point out that more than half of the most vulnerable populations warrant improved monitoring. Toward addressing this information gap, we report on a 15-year monitoring effort of spring-migrant wood-warblers (Parulidae) conducted by RMB in Providence, Rhode Island, between 1986 and 2000. The study site, Swan Point Cemetery, is an urban forest fragment situated in the northeastern corner of the city. The site has long been heralded as one of the premier locations in the state for observing songbirds resting and feeding during spring-migration stopover periods, and especially as a haven for migratory wood-warblers (e.g., Bushnell 2001).

The area covered by RMB during his morning census walks is in the northwestern corner of the cemetery. Although mature deciduous forest dominated most of the census area, two tracts of more open areas covering approximately 0.4 ha (1 acre) provided early-successional and edge habitats that were used by migrating songbirds such as Blue-winged Warblers (*Vermivora cyanoptera*) and Indigo Buntings (*Passerina cyanea*). During the 15-year study period, however, those habitats succeeded to woody cover that closed in the open tracts and diminished habitat diversity.

From 1986 through 2000 RMB tallied warblers at Swan Point from late April through May. He conducted censuses in the early morning from 06:15 to 07:00, and tallied and recorded the numbers of each warbler species identified by sight or sound. The same route was followed on each census day during the 15-year period (see Figure 1 of the full version of this report—Reinert et al. 2021).

Warbler counts were conducted on 259 days during the study period, resulting in identification and tallying 4,290 warblers of 27 species ($\bar{x}$ = 16.6 birds per count, range = 0–108 birds per count; Tables 1 and 2). Our population-trends regression analyses detected no significant relationships of abundance and year for either the all-species-combined metric ($R^2 = 0.01$, $P = 0.75$), or for any of the eight dominant species individually. The relationship for Blackpoll Warbler (*Setophaga striata*) only approached significance ($R^2 = 0.44$, $P = 0.08$). Thus, no obvious trends of increasing or decreasing warbler numbers emerged over the 15-year study period. Migrating warblers arrived as early as 22 April (Table 2) and generally increased in numbers until a peak abundance period was reached between 10 and 19 May.

The data from this study present a perspective on the spring warbler migration at one location in Rhode Island in the late 20th century up through 2000. Although other analyses (e.g., Rich et al. 2004) highlight substantial decreases in the numbers of migrating songbirds throughout North America over several decades beginning in the late 1960s, our analysis of 15 years of spring-migration warbler counts—while demonstrating substantial year-to-year variation—did not exhibit such a diminishing trend as of the year 2000.

Female yellow-rumped warbler (photo by Dan Pancamo, from Wikimedia Commons, licensed under the Creative Commons Attribution-Share Alike 2.0 Generic license).

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This is an abbreviated summary report; the complete article will be published as Special Issue 2 of Rhode Island Naturalist *on the Natural History Survey website.* ***Steve Reinert*** *has conducted bird research in coastal and wetland habitats of southeastern New England for over four decades; he is retired after a full-time career in medical research.* ***Bob Bushnell*** *is a lifelong environmental advocate, and a birder for over 50 years.* ***Steve Davis*** *is a retired family doctor who has been birding in Swan Point since the 1960s.* ***Peter Capobianco*** *started birding in Rhode Island when in his early teens, and now resides in nearby North Attleboro, Massachusetts.*

Table 1. Numbers of counts (N) and warblers detected, by census year.

Year	N	Total Birds	Warblers per Day		Species per Day	
			Mean (SD)	Range	Mean (SD)	Range
1986	24	422	17.6 (15.2)	2–53	6.3 (4.2)	1–15
1987	17	227	13.4 (12.8)	0–52	5.2 (3.9)	0–16
1988	16	154	9.6 (6.2)	0–23	4.6 (2.4)	0–8
1989	15	190	12.7 (11.9)	1–39	5.5 (3.6)	1–14
1990	17	480	28.2 (19.4)	3–68	9.9 (4.7)	2–15
1991	17	214	12.6 (10.7)	1–33	5.6 (3.1)	1–11
1992	18	196	10.9 (11.5)	0–44	4.4 (3.4)	0–11
1993	18	176	9.8 (9.5)	2–34	4.7 (3.2)	1–11
1994	18	343	19.1 (13.8)	3–46	7.3 (4.3)	1–14
1995	14	289	20.6 (15.1)	3–54	7.8 (4.8)	2–15
1996	17	490	28.8 (20.3)	0–64	8.1 (4.7)	0–15
1997	18	310	17.2 (11.7)	0–38	6.9 (4.4)	0–15
1998	16	56	3.5 (2.7)	0–10	2.4 (1.5)	0–6
1999	16	155	9.7 (12.7)	0–38	4.4 (5.0)	0–14
2000	18	588	32.7 (33.0)	2–108	6.0 (3.5)	1–12
Totals	**259**	**4,290**	**16.6**	**0–108**	**5.9 (3.8)**	**0–16**

Table 2. By-species statistics over 259 daily counts conducted during 15 census years, 1986–2000 (sort order by decreasing abundance). See Appendix A in the full report (Reinert et al. 2021) for the scientific names of all these warbler species.

Species	Total Tallied	Annual Mean Count (SD)[1]	Max Daily Count	Number of Days Seen	Percent of Days Seen	Earliest Arrival[2]	Latest Visit[2]	Migration Midpoint[3]
Yellow-rumped Warbler	1,297	4.88 (5.00)	106	142	55	22 Apr	25 May	9 May
Black-and-white Warbler	460	1.76 (0.81)	64	157	61	22 Apr	3 Jun	12 May
Northern Parula	380	1.46 (0.82)	52	136	53	25 Apr	26 May	14 May
American Redstart	312	1.21 (0.89)	58	111	43	6 May	3 Jun	18 May
Ovenbird	272	1.06 (0.45)	28	132	51	29 Apr	3 Jun	14 May
Magnolia Warbler	249	0.96 (0.57)	38	109	42	6 May	3 Jun	18 May
Blackpoll Warbler	235	0.90 (0.54)	35	87	34	7 May	3 Jun	22 May
Black-throated Green Warbler	199	0.75 (0.42)	31	104	40	28 Apr	28 May	14 May
Canada Warbler	134	0.52 (0.66)	46	58	22	9 May	29 May	—
Common Yellowthroat	115	0.45 (0.30)	19	79	31	6 May	30 May	—
Chestnut-sided Warbler	90	0.36 (0.34)	20	53	21	5 May	24 May	—
Tennessee Warbler	86	0.32 (0.49)	32	38	15	6 May	25 May	—
Black-throated Blue Warbler	76	0.30 (0.28)	18	54	21	4 May	22 May	—
Nashville Warbler	69	0.27 (0.18)	10	42	16	30 Apr	20 May	—
Yellow Warbler	66	0.26 (0.21)	13	50	19	2 May	28 May	—
Blackburnian Warbler	67	0.26 (0.20)	14	47	18	1 May	25 May	—
Bay-breasted Warbler	65	0.25 (0.25)	17	41	16	9 May	27 May	—
Blue-winged Warbler	38	0.15 (0.15)	8	29	11	1 May	23 May	—
Wilson's Warbler	20	0.07 (0.10)	6	17	7	11 May	27 May	—
Prairie Warbler	15	0.06 (0.07)	5	15	6	5 May	20 May	—
Palm Warbler	14	0.05 (0.07)	4	11	4	22 Apr	10 May	—
Pine Warbler	9	0.04 (0.10)	6	9	4	29 Apr	14 May	—
Kentucky Warbler	6	0.02 (0.04)	2	6	2	11 May	19 May	—
Cape May Warbler	5	0.02 (0.04)	2	4	2	9 May	15 May	—
Cerulean Warbler	4	0.01 (0.03)	2	4	2	11 May	21 May	—
Mourning Warbler	4	0.01 (0.02)	1	4	2	24 May	2 Jun	—
Worm-eating Warbler	3	0.01 (0.02)	1	3	1	8 May	23 May	—
Overall	**4,290**					**22 Apr**	**3 Jun**	**13 May**

[1]Average of 15 annual means of daily warbler counts. [2]Dates over 15 years, including dates outside the date-range formally analyzed in this study. [3]Average over 15 years, only for the 8 most abundant species and all species combined.

Field Notes:
The Rhode Island Summertime Green Frog Blues

By LIAM CORCORAN

On their nightly walks to the wetland in their Cumberland neighborhood, David and Amy Braz and their three-year-old daughter Allyson grew fond of watching the frogs they came across at the edge of the water. One evening last summer, a peculiar frog caught Allyson's eye. Upon closer inspection, they realized that unlike all the other frogs in the wetland that were various shades of green, this one was blue!

Rhode Island has a remarkable diversity of amphibians, home to 18 native species in only a 3,100-km^2 (1,200-mi^2) area. One of the most common species in the state is the green frog (*Lithobates clamitans*). Green frogs are widely distributed throughout Rhode Island, spending the majority of their lives in freshwater wetlands such as marshes, ponds,

The blue-colored green frog found by the Braz family in Cumberland, Rhode Island (photo by David Braz).

streams, and vernal pools. At first glance, green frogs are superficially similar to another common species, the bullfrog (*Lithobates catesbeianus*), but have one distinct characteristic that makes the two species easy to differentiate. Green frogs have two dorsolateral ridges that span the length of the back, while bullfrogs have a smooth back. Green frogs get their name from the green coloration that stretches from their head to their legs. Females have a white underside, while males have a white underside with a yellow throat. In late spring, the males wait in the water and make a distinct "*glunk*" call to attract females. The call is often compared to the plucking of a loose banjo string. When a female chooses a male to breed with, the pair go into amplexus, where the male grips the body of the female and fertilizes her eggs as she deposits them. Females lay between 1,000 and 7,000 eggs in a gelatinous mass that floats on the surface of the water or is attached to vegetation. The eggs take up to seven days to hatch, and the tadpoles will not metamorphose into frogs until the following spring. The average lifespan is six years. Adults are active in and around water bodies from spring to fall, and then overwinter in the mud of these wetlands through late fall and winter until they emerge again in the spring.

Most of the time, seeing this common species would not be anything out of the ordinary, but David and Allyson knew this must be a rare frog. Acting as model citizen herpetologists, they reported their observation to RIDEM's Division of Fish and Wildlife (RIDFW)—complete with photographs. Their observation turned out to be only the second blue-colored green frog in state records. Blue-colored frogs have been reported throughout New England, but they are exceedingly rare. Not much is known about how the trait is inherited, but the blue coloration has been observed in many species in the same family (Ranidae) including leopard frogs (*Lithobates pipiens*) and bullfrogs. Available data suggest that green frogs are the most common species to exhibit this trait.

Two researchers from Cornell University, Michael Berns and Lowell Uhler, conducted a study in 1966 on how common blue coloration was in frogs. They censused frog suppliers in the Midwest and had them record the number of blue frogs they found in their stock; they reported finding 69 blue frogs out of two million individuals (0.003%). The suppliers also reported that at one location they found 2 out of every 1,000 green frogs were blue, and at another 22 out of every 7,000 green frogs were blue. Berns and Uhler also sampled wetlands in Barre, Massachusetts, and Rochester, New York, where they found 15 and 4 blue green frogs, respectively. Based on these findings, it is clear that blue-colored green frogs are quite rare, and that the frequency of the phenomenon may vary from region to region.

The color of a frog's skin is determined by three types of skin cells, each contributing in their own way. Melanophores make the skin darker or lighter, iridophores reflect light, and xanthophores produce a yellow pigment. After Berns and Uhler's study was published, several other researchers postulated that the blue coloration was the result of lacking one of the three pigment cells located in the skin of the frogs. In 1970, Michael Berns and Shankar Narayan took these hypotheses and performed experiments on tissue

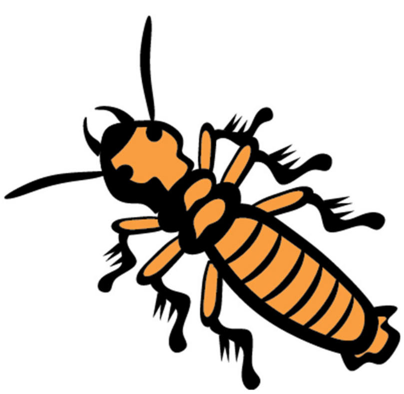
A blue-colored green frog from Foster, Rhode Island (photo by Marcia Chmys).

samples from green skin and blue skin. They found that the reduction or absence of carotenoids, found in the xanthophores, was the cause of the blue color. In an attempt to investigate the genetic component of blue coloration, the researchers tried to breed more blue-colored frogs, but found that breeding two blue individuals did not result in blue offspring. This finding did not rule out the role of genetics in blue pigmentation as a heritable trait, but it did allude to more complex genetics or possibly environmental influences as the cause.

The remarkable observation of a blue-colored green frog in Rhode Island last summer was the result of wildlife enthusiasts exploring natural habitats right in their suburban neighborhood. Every year RIDFW receives many reports from people just like the Braz family about the wildlife that they come across in our state. In an attempt to harness this enthusiasm for science and conservation, they have developed and launched an app called Herp Observer, which can be downloaded from your phone's app store for free. Herp Observer allows anyone to submit observations directly from their phone of any amphibian or reptile that they come across anywhere in the state. If you would like to learn more about how to download and use Herp Observer, please access the URL below to read our instructions. RIDFW also welcomes reports of your amphibian and reptile observations by phone (401-789-0281) or by email (scott.buchanan@dem.ri.gov).

URL for instructions: http://www.dem.ri.gov/programs/bnatres/fishwild/pdf/herp-observer-fs.pdf

Liam Corcoran *graduated from URI with a BS in Wildlife Ecology and will be starting graduate school in the URI Department of Natural Resources Science in Fall 2021. He has been a seasonal herpetological bio-technician with the RIDEM Division of Fish and Wildlife for the last three years. A version of this article also appears in the Summer 2021 issue of* Wild Rhode Island*, the Division's quarterly publication.*



Book Review: Underbug

By KAREN JOHNSON

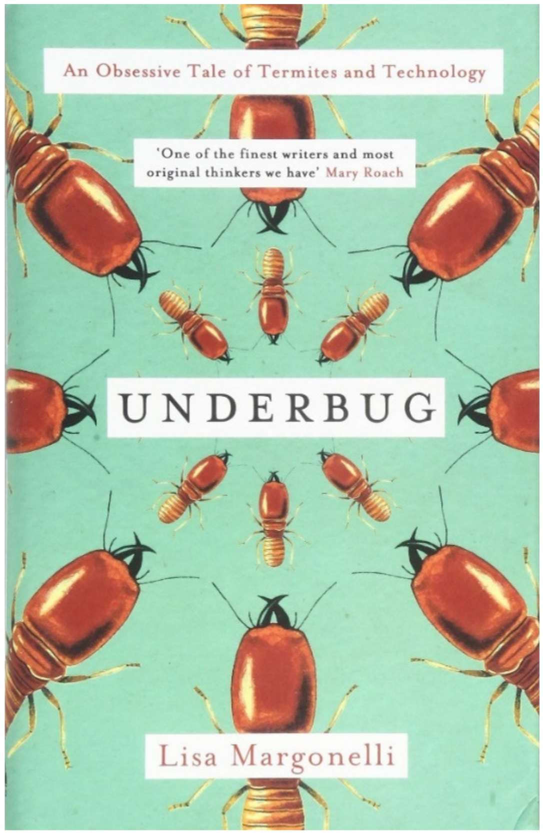
Underbug, An Obsessive Tale of Termites and Technology
by Lisa Margonelli
Scientific American / Farrar, Straus and Giroux, New York, NY; 2018. 320 pp.
ISBN: 978-0374282073

This is a story about how science gets done and about the people who do it. A plethora of topics are addressed in this book, including but not limited to nitrogen fertilizer, the RoboBee, drone warfare, racism, machine guns, CRISPR and, of course, termite life in the mound. Lisa Margonelli explores many events in history throughout this book. "Only twenty-eight out of twenty-eight hundred species are invasive pests, and Rudi [Scheffrahn] believes that the first destructive drywood termites traveled from Peru on Spanish ships in the 1500s. Not their fault."

Magonelli's writing style is straightforward and her references are colorful. "The termites are, in a sense, millions of Martha Stewarts; constantly remodeling." She writes briefly about growing up in Maine and she reminisces about watching her father skin muskrats. Her apartment in California is, ironically, eaten by termites. "This revelation was eerie, and the fact that I saw the termites in my walls is interesting rather than horrible showed me how deep into the bugs' world I'd gone." She can explain complex technology clearly, and she is not a scientist so she brings a refreshing perspective and detail to the time she spends watching the scientists work. "But as the years went on I realized I was actually watching the great global termite mound of science—a collection of equipment, ambitions, ideologies, grudges, blind spots, and insights—interacting and reshaping the way we think about life."

As Margonelli researched the book she admits that it took her to unexpected places. "I didn't realize I would become obsessed and spend many hours reading research papers. Or that I would cold call scientists until I had a collection of friendly roboticists, computer scientists, physiologists, ecologists, synthetic biologists, physicists, geneticists, and mathematical biologists who let me watch them work in places as far flung as California, Namibia, Massachusetts, and Australia."

One of the books she used in her research is Eugène Marais' *The Soul of the White Ant*. "One of the greatest storytellers



of the termites is the South African writer Eugène Marais, who spent many years peering into their mounds." She references it often throughout this book. She first describes the mounds of *Macrotermes* in Namibia and their fungus *Termitomyces* in detail. "Termite and *Termitomyces* fungus are so interrelated that it's hard to tell where the mushroom ends and the termite picks up, but within their codependence is some sort of frenemy-type rivalry."

She visits the roboticists who are studying how termites build and the geneticists who are gathering the DNA and the RNA. "Termite guts are a molecular treasure chest: 90% of the organisms in them are found nowhere else on Earth." When she goes to Harvard to see the TERMES robot that can build walls, she sees a display. "Kirstin [Petersen] pointed out three long glass panels displaying an old-style computer print-out, with perforated sprocket holes on the sides and rows of dot matrix printing. I assumed it was art, but she explained that it was a piece of the code written by Bill Gates, Paul Allen, and Monte Davidoff when Gates was a student at Harvard in 1975." She visited Harvard on 23 April 2014 when the Reverend Billy and the Church of Stop Shopping came to stop the development of the RoboBee.

Margonelli introduces the reader to many new technologies, which she can explain clearly. "Though I started with the assumption that I was watching scientists watch bugs, I came to understand that I had a ringside seat to a much larger, multidisciplinary argument about what life is, and what its relevant units are—genes, individuals, superorganisms, or metabolisms." She explores how data are gathered and is fascinated by the intricacies of benchwork. "John said that one year in graduate school he counted worms without talking to anyone all day long. He just looked in a microscope and hit a counter. His year of work turned into a single line in a large paper."

For a complete understanding of termites Margonelli had to go to Australia. "And once there, Australia gave me an education in seeing what was not visible—white ants, hollow trees, and promises kept as well as broken." She meets up with Phil Hugenholtz, who had started her on her termite quest in 2008. She is there to see *Mastotermes darwiniensis*, the only living member of its genus. And in its gut, lives the symbiotic protozoan *Mixotricha paradoxa*—remarkable for its multiple bacterial symbionts and for having only one known host. I found it very interesting to discover that I had seen a close relative of *Mixotricha* (*Trichomonas vaginalis*, in the same family) through the microscope many times during my career while evaluating Pap smears.

In Australia she meets Dieter Hinz, a horticulturalist. "Anyway, he was also crazy about termites. Over the next few hours he told me a strange tale about bugs, his initiation into an aboriginal clan, and how forest destroyed by bauxite mining came to be restored, complete with enough stringy-bark eucalyptus trees to keep the clan's ancestors happy."

This book was published in 2018 but she was writing it in 2010 when the Deepwater Horizon oil spill occurred. "In 2010 technology had seemed like a way to jump over politics, but it didn't anymore. Technology was a different kind of politics: sure, it might solve problems, but the questions of who chose the problems and who chose the technologies were big. My interest in oil was waning and my interest in people was rising. How did people use politics to build real hope—a shared future—out of confusion?"

I first heard about this book on "Maine Calling," a show on Maine Public Radio. It was promoted as "Underbug tells the fascinating story of the lowly termite—a bug that collectively outweighs human beings by 10 to 1 and consumes $40 billion worth of valuable stuff each year." You can listen here: https://www.mainepublic.org/show/maine-calling/2018-11-29/underbug-a-new-book-by-a-maine-author-about-the-role-of-termites-in-our-world

This book is packed with information. The writing style is delightful and the information is riveting. Margonelli tells a story that is a travelogue through science.

Karen Johnson *is a 2017 graduate of the Maine Master Naturalist program. She graduated from URI with a degree in Zoology in 1973, and worked for 39 years in Bangor, Maine as a cytotechnologist.*

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 connects 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

BioBlitz 2021: It's not too late to register for 22nd edition of the longest running BioBlitz in the world—Friday and Saturday, October 1 and 2, at the Mercy Woods Preserve in Cumberland, Rhode Island, hosted by the Cumberland Land Trust. We had planned it for June 2020, but the pandemic forced us to postpone in favor of a "Backyard BioBlitz." You *must* pre-register to participate, and the deadline is midnight on Tuesday, September 28th. Go to https://tinyurl.com/ribioblitz2021 to register and to the Survey's YouTube channel to watch the orientation video.

Conference: Our conference, "Ecological Restoration in Rhode Island: Successes & Challenges in a Changing World," has been postponed until sometime in the spring.

Natural History Week: November 14–20. We're planning a full week with lectures, field programs, and Distinguished Naturalist Awards.

Research Support Opportunity: Did you know the Henry & Theresa Godzala Research Fund at the Natural History Survey gives small grants for natural historical research in Rhode Island, including student research? Supporting the Godzala Fund helps conduct research, promote science, and educate a new generation of scientists. Donations to the Survey earmarked for the Godzala Research Fund, if made before December 10, will be matched by a generous donor (up to $1,000). Godzala grants in 2021 supported two graduate student projects: on the disappearance of certain bumblebee species from the state and the effect of light pollution on moths. To make a gift to the Godzala Research Fund, name the fund in your check memo, in the note field on the PayPal donation page, or contact David Gregg or Kira Stillwell at the office.

Save the Date: Tuesday, January 25, 2022, 5:00–7:30 PM, Annual Open House at the Survey offices, Building 14, URI East Farm.

To Contact Us. . .

Rhode Island Natural History Survey
P.O. Box 1858, Kingston, RI 02881
Tel: 401.874.5800
www.rinhs.org
info@rinhs.org

Visit us in person at Bldg. #14 on URI's East Farm
1 East Farm Road, Kingston, RI 02881

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